The Mines, Miners and Mining Interests of the United States in 1882

Compiled by William Ralston Balch.

MINES, NTERESTS

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THE Suc MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES IN 1882 before it reached the printer, and the warm praise lavished upon the plan of the work, revealed very clearly to the Compiler that the greatest success of his idea could be obtained only through an annual issue. It has been determined therefore to publish a volume yearly, and to make such issue *the* manual of American Mining Interests.

With this as the laudable objective point, the Publishers announce the issue of THE MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES IN

1883.

This volume it is earnestly intended shall be a compilation of the greatest value. Matters that in the volume for 1882 are passed over lightly, or not mentioned at all for want of time and public confidence, will receive next year the fullest expert attention. Strong efforts will be made to cover every known interest that the volume reaches. Our own statistics from every State and Territory will be at the reader's disposal. The ablest expert engineers have already been enlisted for its pages. The illustrations will be drawn for us. A series of magnificent original maps will adorn the pages, and no expense will be spared in order that the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES IN 1883 shall adequately represent its high aims.

The difficulty of obtaining reliable Mining statistics and the best mining information, will be readily overcome if our readers will co-operate with us, and furnish such information as they may possess. Criticisms upon the present volume will be thankfully received, and suggestions gladly adopted. We are satisfied that the Mining Interests of this country are in need of just such a publication as we have projected. To attain our highest ambition the co-operation of the public is necessary. Your sincere support is therefore solicited.

THE MINING INDUSTRIAL PUBLISHING BUREAU:

427 Walnut Street,

PHILADELPHIA.

THE

Mines, Miners and Mining Interests

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UNITED STATES

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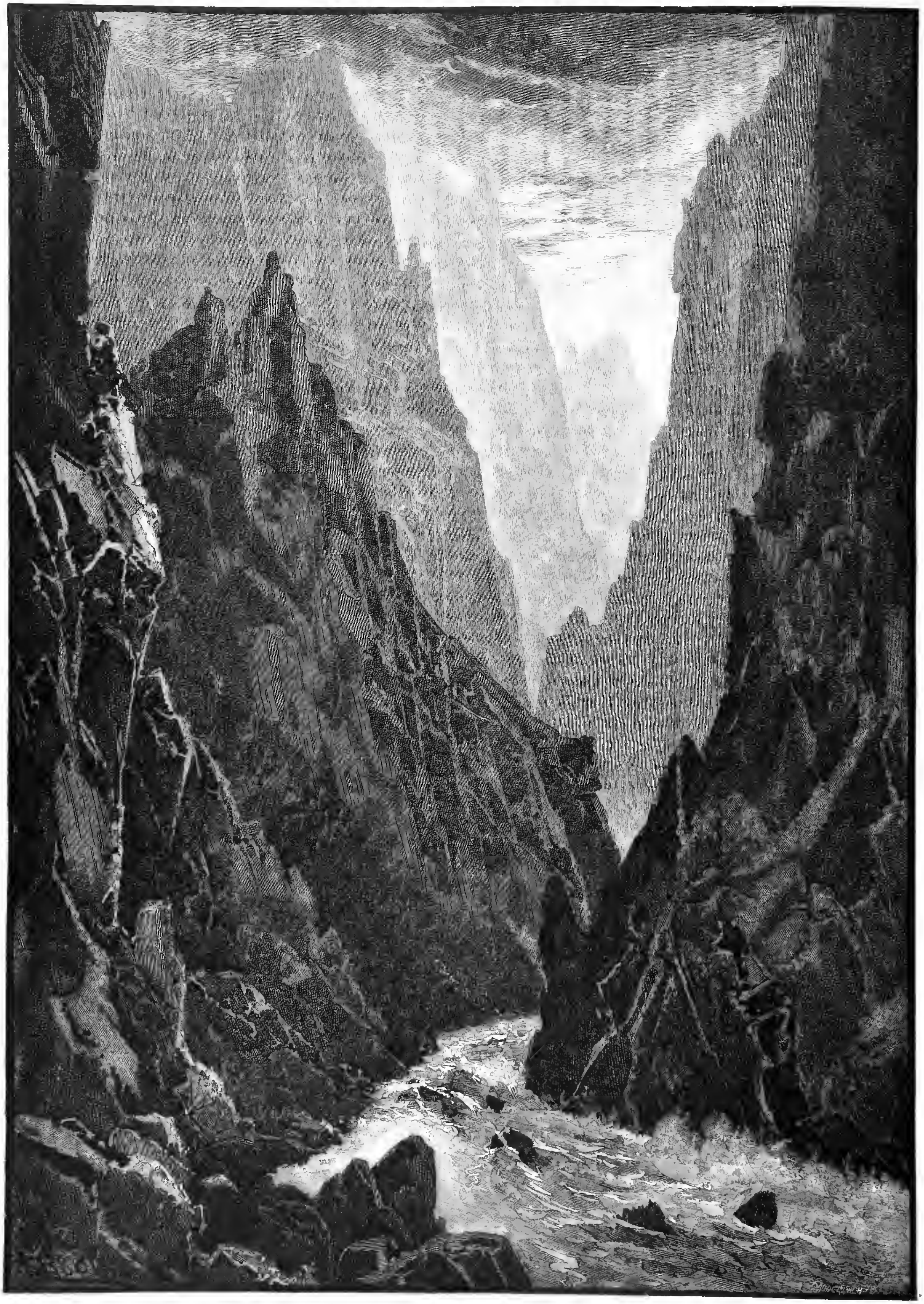
1882.



THE GRAND CAÑON OF THE COLORADO.

NO MAN WHO ENTERS THE GEOLOGICAL FIELD IN QUEST OF THE WONDERFUL, NEED PASS IN THE PURSUIT OF HIS OBJECT, FROM THE TRUE TO THE FICTITIOUS—HUGH MILLER

THE Mines, Miners and Mining Interests OF THE United States IN 1882

COMPILED BY

WILLIAM RALSTON BALCH

PHILADELPHIA
THE MINING INDUSTRIAL PUBLISHING BUREAU

THE COMPOSITION OF READING MATTER AND THE PRESS WORK UPON THIS VOLUME WAS DONE BY GRANT, FAIRES & RODGERS

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To

THOSE WHO HAVE AT HEART THE BEST INTERESTS OF THE

AMERICAN MINING INDUSTRY

THIS VOLUME

Is Sincerely Dedicated

BY

THE COMPILER.

PREFACE

THIS volume requires, I trust, neither apology nor special plea for its appearance. The mining industry of the United States has never yet possessed a publication that answered its need as a reference book or manual of our mining life. Government documents however valuable, State documents however worthy their purpose, are practically inaccessible to the general public. The careful collections of the Census Bureau, owing to the time consumed in preparation and printing and the parsimony of Congress, are sealed books to the multitude. The millions invested in mining stocks find chroniclers from week to week and can be collated for reference only after the most laborious search. With the exception of Coal, Iron and Steel, no annual furnishes anything of reference value upon our mining industries. What is being done by our excellent and hard-working Scientific Societies is frequently lost altogether or buried in their archives. The progress making in the technical studies at our schools and colleges reaches the people partially like the faint response of an echo. The cause of hygiene and the elevation of the mining classes is in the keeping of a very few. The records of invention and discovery rarely challenge interest beyond the circle of those immediately benefitted, because of the few open avenues through which to summon public attention. Many important treasure fields of our country lack development, because attention is not directed to them. The actual condition of the mining industry is nowhere reflected in such a way that the economic questions involved in its rise and fall can be studied with ease. The money problems that come so close home to us in questions of debt and taxation, have only occasional expounders to champion their cause with the people. The banker, the broker and the investor have no book to which they can appeal for the standing of the Mining Companies whose stocks and bonds they are solicited to purchase. The shares may form part of $100,000,000 of capitalization or they may be only constituent elements in $10,000. The promoter of a mining company has a long hunt before he can intelligently comply with the necessary legal forms. The lawyer called in to prosecute or defend a mining suit must endure hours of arduous study to collate the law points of his case. The iron master, the coal and copper operator, the mine owner who has risked his capital, wants yearly a thousand facts that bear with vital force upon his prosperity, and he knows not where to get them. The fluctuations of the markets, the discovery of new deposits of treasure, the opening of new depots of supply and distribution, the steady insinuations of trade in

Fresh fields and pastures new,

the product of rival countries abroad and rival States at home—all possess special interest for him, and yet, if he would know them, he must compile them. This volume is an earnest attempt to supply the wants that are thus suggested.

The value of most books is measured by the conveniences they afford for ascertaining facts. The maker of a good dictionary wins for his work a profounder circle of constant companions than the writer of a striking fiction. The dictionary maker gets little credit for originality and none for his labor, but the satisfaction remains to him that he has produced a volume that answers the necessities of the many. The Compiler of this volume claims no more credit for it than is deserved by its appearance and the selection and arrangement of its contents. It bears the finger marks of haste, a haste that was unavoidable; yet it evidences, I trust, an appreciable amount of thoroughness over a wide range of topic. The ground has been fairly gleaned in all parts of the world. In the arrangement of the book no effort was made to more than meet the requirements of hasty work. That system of parts and pages was adopted that most readily bent itself to the imperial dictation of the printer. All short-comings of this arrangement are covered by the elaborate thoroughness of the index. The Compiler hopes that in this way his work has been kept fairly symmetrical, and while it hardly approaches the high ideal set for it; still it proves if nothing more, the sincerity of his intention.

Whatever may be the sins of omission and commission—and I am aware that both have been committed—the pages of this volume are honest. They were prepared without bias, free from the shackles so often riveted upon an author by the greed of his publishers. No insidious considerations of gain have dictated the phraseology of a single line within the portions of this book subject to the Compiler's control. The opinions advanced by some of the authors brought together here may have been swayed by low ambitions. Of this I know not. But nothing has been allowed a place that to the Compiler was not honestly deserved, by its value for permanent record. The reading matter of Part XII, which precedes the Index, is matter furnished by the Publishers and is paid for as advertising. To the close of Part XI and for the Index, the Compiler is wholly responsible. Everything appropriated has been credited to its source; and no one deprived of any portion of his good name. Duplications in the matter will be noticed here and there, but these the Compiler has permitted rather than deprive any article of the symmetry given it by the author. Any other arrangement would have necessitated annoying references.

The Compiler believes this volume to be a timely publication. The clouds that obscure the gold and silver mining industry of this country cannot be allowed longer to intrude their shadows. No industry can thrive hedged about with fraud and deception. Mr. J. D. Whitney, in his volume "The Metallic Wealth of the United States," says:

"The facility with which the public allows itself to be deceived, in regard to everything connected with mining, is as remarkable, as the machinery by which the swindling speculation is organized and brought into successful operation is simple. The locality is selected, and visited by some very distinguished scientific geologist, who for a sufficient consideration will write a sufficiently flattering report, and demonstrate the absolute certainty of success. The value of the mine is fixed at an enormous sum, and divided into one or even two hundred thousand shares; the company is organized, and the stock brought into the market. Every means possible is then taken to inflate its value; fictitious sales of ore are announced; the most flattering reports are received from the mine, and published in all the newspapers; the President of the company, who, perhaps, had never seen a mine before in his life, and who may therefore be excused for mistaking iron for copper pyrites, or perhaps even for gold, visits the scene of action, and finds the surface literally 'covered with stacks of ore;' a series of dividends is announced as about to be paid, or perhaps, even, the ore or metal from a neighboring mine is purchased with a part of the capital paid in, and sold, and a dividend declared 'from the proceeds of the mine;' the whole machinery of fictitious sales of stock is put in motion, the stock rises, and the promoters of the enterprise benevolently allow the public to step in and share with them in the magnificent profits which are certain to accrue. As soon as a sufficient quantity of the stock has been thus disposed of, and the getters-up of the scheme have pocketed the proceeds of their skilful manœuvring, the natural results follow: the stock, no longer artificially kept up, begins to droop; one after another the deceptions which have been practiced become suspected; the unfortunate holders rush to dispose of their shares, but it is too late. The property which a few days before was quoted at hundreds of thousands can now hardly be given away; the unfortunate victims having nothing left as the tangible evidence of the brilliant dividends promised but the elegantly engraved stock certificates, and the equally valuable reports by which they were deluded. And yet the mine, thus made the object of speculation, and perhaps abandoned in disgust, may be really of value, and capable of being worked so as to pay a moderate profit on the capital actually and judiciously invested in its development. But the idea was given out in the beginning of the enterprise that it could be made profitable at once, and because this has not been the case, the holders of the stock lose all confidence, and refuse to furnish the capital, without which hardly any mine, however rich it may be, can be put into a condition in which it can for any length of time be worked with profit. The system which prevails in this country of chartered companies with a large number of shares, seems especially adapted to make the mining business, which contains so much of the lottery element of uncertainty in it, a mere object of stock speculations. The records of the last few years show almost without exception that companies with large fictitious capital, and an enormous number of shares, have been got up for the purpose of swindling the public, and not for *bona fide* mining purposes. It may be laid down as a universal rule, that the stockholders in a mining enterprise should be kept fully informed in regard to the expenditures and operations of the company. A frank and full publication is the only guarantee of sincerity and good faith. When these things are more generally understood, and the public refuses any longer to be victimized, we may expect to see a less noisy but far more effective development of our mineral resources than we have yet had."

This was written in 1853. And it is not a day old in 1882. What Mr. Whitney saw is a photograph of mining matters this year. The Compiler has knowledge of a mining company that was formed with a borrowed set of ore samples and false reports, and knows of the existence of a depot of geological specimens where samples of ores may be procured from any mine in the world, including those not yet discovered! And this state of affairs has come about largely because mine owners fail to recognize, what Francis Wayland puts so clearly:

"The case is the same with a copper, a silver, or a gold mine. The owner of the land at the time of the discovery becomes greatly enriched in consequence of this new product which may be derived from his property. But after this rise, when a new purchaser comes into possession, the *peculiarity* of the gain ceases. A rich gold mine will rent or will sell for more than a poor one, and its price, or its rent, will be in exact proportion to its productiveness; just as a farm, a mill privilege, or any other property. It is a somewhat remarkable fact, that mines of the precious metals are, in general, singularly unprofitable, after they have passed out of the hands of the original owners. It had grown into a proverb in South America, that if a man owned a copper mine he would grow rich, if he owned a silver mine he would gain nothing, but if he owned a gold mine he would certainly be ruined. The fact, however, may be easily accounted for. The imaginations of men are always strongly excited by the contemplation of the precious metals, and it is rare that anything but experience can teach them that they may buy gold too dear. Hence they do not compute the chances of profit in the production of gold as they do in any other case. But the production of gold is governed by as fixed laws as the production of wheat. Gold cannot, any more than wheat, be produced by an effort of the imagination. It is the result of labor, and skill, and expense. And if these be greater than the revenue, a man will as assuredly be ruined by producing gold as by conducting any other unprofitable business, his imagination to the contrary notwithstanding."

Such a state of affairs can be altered only by the dissemination of honest information, and the Compiler hopes this volume is therefore a timely step forward to the day of honest business-like mining.

No work such as this could have been brought to a conclusion without the incurring by the Compiler, of many debts of courtesy. Of these, I desire to acquit myself as far as may be possible, in a public acknowledgment. My sincere thanks are due, for services rendered, to

Hon. Edward McPherson, Clerk of the House of Representatives, Washington.
Hon. Horatio C. Burchard, Director of the Mint, Washington.
Hon. N. C. McFarland, Land Commissioner, Washington.
Mr. John W. Powell, Director U. S. Geological Survey, Washington.
Hon. Thomas Donaldson, Smithsonian Institute, Washington.
His Excellency Thomas J. Churchill, Governor of Arkansas.
His Excellency Albert G. Porter, Governor of Indiana.
His Excellency Thomas J. Jarvis, Governor of North Carolina.
His Excellency George C. Perkins, Governor of California.
His Excellency John H. Kinkead, Governor of Nevada.
His Excellency Shelby M. Cullum, Governor of Illinois.
His Excellency John P. St. John, Governor of Kansas.
His Excellency Charles Foster, Governor of Ohio.
Hon. Aaron K. Dunkel, Secretary of Internal Affairs for Pennsylvania.
Mr. Henry G. Hanks, State Mineralogist of California.
Mr. F. L. Bartlett, State Chemist of Maine.
Mr. George H. Cook, State Geologist of New Jersey.
Mr. W. C. Kerr, State Geologist of North Carolina.
Andrew Roy, State Inspector of Mines for Ohio.
Edward Gilpen, Inspector of Mines for Nova Scotia.
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Dr. Charles B. Dudley, Altoona.
Mr. James M. Swank, Secretary of the American Iron and Steel Association, Philadelphia.
Mr. P. W. Sheafer, M. E., Pottsville; and to others.

Thanking the reader for the attention that has carried him thus far in a preface, and trusting the faults of this compilation will be forgotten in its merits, the Compiler invites him to go farther—to the pages beyond—and fare much better.

WILLIAM RALSTON BALCH.

Philadelphia, Summer of 1882.

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I TAKE it for granted that every thoughtful, intelligent man would be glad, if he could, to be on the right side, believing that in the long run the right side will be the strong side.—J. A. Garfield.

PART I.

WHAT METALS ARE—FACTS FOR MINE OWNERS—HISTORICAL NOTICES AND MEMORANDA.

OVERMAN writing more than thirty years ago in his still interesting volume on "Practical Mineralogy" lamented the existing ignorance concerning those minerals most useful in the arts. To-day, with the mineral interests of the American continent, hundreds of millions of dollars more in value than in 1851, his lament is still true. Mine owners, the great body of capitalists who possess the earth's treasures know little more concerning their properties than is contained in the annual report of the mine superintendent or the monthly balance sheet from their ledger. In Part I. of The Mines, Miners and Mining Interests of the United States, this deficiency is in a measure supplied in articles that give in simple language primary information upon the subject of mines and minerals. To these are added several articles of a historical nature, containing valuable memoranda concerning the early days of mining and metal finding in this country, with some further information about metals and metallurgy among the ancients.

THE DISTRIBUTION OF MINERALS.

THE useful minerals are not distributed over the earth irregularly; there is a system in these distributions, the knowledge of which furnishes us with a rule by which we decide whether a particular kind of mineral may be expected to be found in a certain spot. The signs by which we judge whether a particular mineral is present at the place in question, are the general characteristics of the rock in that locality. The knowledge of the relation of particular minerals to the general character of rocks constitutes the science of Geology; and the knowledge of the character of minerals, that of Mineralogy. It is not our object to penetrate into the science of Geology; but it will be useful to give a general idea of the positions in which minerals are found, and of their relations to each other.

Granite.—The history of the formation of rocks has been divided into certain periods; and it is generally agreed that *granite* is the oldest of the rocks. For this reason it is called primitive rock. Granite is a close, compact rock, composed of fragments of other rock or stony matter. These are so firmly cemented together, that the whole forms but one solid mass, without the slightest indication of pores or fissures. The matter of which granite is composed is often found to be in the form of small crystals, seldom or never assuming the shape of round grains. It is found of all shades and colors, from a bright white to deep black, often in the same block. The crystals are, in many instances, not more than one-twelfth of an inch in diameter; but they are also found of the size of one inch, and even larger. If a certain color of the composing crystals predominates, the granitic rock appears to be of that color, either grey, reddish, greenish, or bluish; shades of yellow and crimson are also perceptible. Granite rock is particularly characterized by the absence of all stratification, or any indication of parallel joints; the rock is uniformly compact in all directions. It is of great hardness and strength, and of everlasting durability. It takes a fine polish; but, on account of its component matter scaling off in leaves, like mica,—which latter is sometimes found to be one of its elements,—it does not take or retain a solid surface.

Granite is not very extensively found in the United States. It occurs chiefly in the States of Maine, Massachusetts, New Hampshire, Connecticut, New York, along the Lakes, and sometimes in the Mississippi Valley. Granitic rock is frequently interspersed with more or less vertical crevices or veins, which are filled with matter foreign to the rock itself, and form lodes and veins of ores or other minerals. We may expect to find in these veins, ores of tin, iron, copper, lead, cobalt, silver, a few other metallic ores, and anthracite coal. We find also, in such veins, feldspar, kaolin, quartz, in beautiful crystals, plumbago, or black lead, garnets, heavy spar, calcareous spar, fluor-spar, and fragments of rock of various kinds. We cannot expect to find bituminous coal in granite; nor anthracite coal, except as a curiosity. We do not find gold, platinum, iridium, rhodium, and similar metals, nor sulphurous ores of tin, nickel, cobalt, or mercury; nor sulphur and sulphurets in such quantities as to justify their extraction.

Metamorphic Rock.—The rock of this formation, also called transition rock, is the second in age. To this class belong a great variety of minerals; as gneiss, mica-slate, clay-slate, limestone, and other minerals, in rocks covering tracks of great extent and at a great depth. The rock of this class is characterized by a partial and sometimes by a decided stratification. It does not exactly belong either to the compact or the stratified variety. Metamorphic rock, which often assumes the appearance of granite, pudding-stone, or stratified rock, is particularly distinguished by its close grain and strength from the rocks of the secondary formation, and by its stratification from granite and volcanic rocks. Transition rock covers the greater part of the New England States, New York, western New Jersey, eastern Pennsylvania, Maryland to the Alleghanies, middle Virginia, parts of North Carolina, South Carolina, Georgia, Alabama, Missouri, Arkansas, and all the States west of the Mississippi. In this rock, which is the most extensive in the United States, we find, and may expect to find, gold, in Virginia, North and South Carolina, Georgia, Alabama, New Mexico, California, Utah, and Oregon. We also find silver in this rock in Vermont, Virginia, the Carolinas, Georgia, Arkansas, New Mexico, and California. Platinum and the platinum metals are also found along with the gold. Lead is found in this rock in almost every State, particularly in Missouri and Arkansas. Iron also is found everywhere in this formation, and generally the best quality of iron ores. Besides these, there are found ores of zinc, antimony, arsenic, nickel, cobalt, tin, manganese, and in fact almost every kind of ore. In Pennsylvania, Virginia, and North Carolina, heavy deposits of plumbago are met with; and anthracite coal is almost exclusively found in this formation. It is the home of metallic sulphurets. It generally forms good building material, if not too hard to be worked. The sandstones of this period are exceedingly well qualified for building purposes, of which an example may be seen in the brown Connecticut sandstone, so extensively used for ornamental architecture. We find roofing-slate, and extensive tracts of limestone, in the rock, of this period, in New York, New Jersey, Virginia, Ohio, Missouri, Illinois, and other States. The limestone is generally magnesian: that is, it contains magnesia as well as lime. The mineral veins of this period run either parallel with the stratification, as the gold veins of the southern States do; or traverse the strata in more or less inclined angles; or form isolated elliptical masses or lodes, as the iron, zinc, and lead ores generally do. This rock formation is the most productive in useful minerals; and where a faint indication of something valuable is discovered, it is generally worth the trouble to follow and dig after it.

Stratified Rock.—The rock of this period, also called secondary formation, or coal formation, is decidedly stratified. We easily follow the various layers of minerals, which are distinctly parallel to each other. The layers or seams are sometimes almost horizontal, as is the case in the western coal basin. The inclination of the strata of the Pittsburgh coal veins is almost imperceptible. We can follow the same stratum for hundreds of miles, without its disappearing below ground, or running over the tops of the hills. In other places the strata are more or less inclined; the coal strata of Alleghany county, Maryland, form a canoe, sunk between two high ridges of mountains. In Illinois and Missouri we find the strata undulating, gently rising and falling. The rock of this period is the *coal-bearing* rock *par excellence.* We find here the richest and most extensive layers of mineral coal, all of the bituminous kind, or soft coal. The great western coal field covers western Pennsylvania, parts of Ohio, Illinois, western Virginia, Kentucky, Tennessee, Alabama, Indiana, Missouri, and other States. The Maryland coal formation is about forty miles long, and eight miles wide; the Pittsburgh field is over five hundred miles long, and from two hundred to three hundred miles wide. There are coal deposits of this kind in the transition rocks of eastern Virginia, North Carolina, California, Oregon, Nova Scotia, and Canada. In this formation we are to look chiefly for soft mineral coal, iron ore, limestone, and salt. It contains none of the precious metals, no lead, no copper, nor any metal except iron and manganese, the latter not available. There is no plumbago or anthracite, no heavy spar or fluor-spar. We can neither find nor expect to find anything useful but sandstone, (which, however, is an inferior building-stone,) fire-clay, limestone, iron ore, and salt in the form of brine, which is found from one hundred to one thousand feet below the surface. Coal is almost everywhere found where this kind of rock appears.

Tertiary Formation.—Stratified rock of a later period is frequently called tertiary formation. In this rock we find plenty of shells, and fossil remains of animals and plants. This rock is not rich in minerals. It often contains a species of mineral coal not much valued, and sprinklings of iron ore of no consequence. The only mineral of importance in this series is green sand or marl, which is extensively deposited in heavy beds all along the Atlantic coast, from New York to Florida. This marl, containing the elements for stimulating the growth of plants, is extensively used in New Jersey and Maryland, and to some extent in Virginia, for improving the land. This formation, extensive as it is, offers but little inducement to search for minerals; and those which are found are generally of an inferior quality. It affords no building material of any consequence, and the small beds of shelly limestone contained in it are not of much importance. In many instances, a fine quality of potter's clay is found in it; but this is generally of such a composition as to be too fusible for strong and fine ware. It frequently affords fine sand for ordinary glass.

Volcanic Rock.—The rocks belonging to this class are often found to be perfectly vitrified, and of a glassy appearance, as basalt and some kinds of lava. The first is found in columns, grouped together in isolated mountains, or imbedded in other volcanic rocks. The latter appears in compact masses, and is often very porous. To this class belongs a remarkable rock, called trap-rock. This is generally very hard, tough, and crystalline in its fracture. We find it also soft and brittle. This rock is found all along the Atlantic coast, intruding from below in the form of both small and large dikes, imbedded in the transition rock. It is very extensively found around the Lakes and in the Rocky Mountains. This rock is characterized by the presence of copper and heavy layers of iron ore. The native copper and silver of Lake Superior is imbedded in it; and in New Jersey, Pennsylvania, and the southern States, we also find copper ores in or near the trap-rock. Iron ore is found imbedded in this rock in almost all the States of the Union. Of the volcanic rocks, this is the most valuable as a matrix of useful minerals. The other rocks of this class are of less importance. All the rocks of this formation are hard, and, when broken into small pieces, if not partially decomposed, emit a sound like crockery, when struck with a piece of wood, or against one another. This rock furnishes the very best material for macadamizing roads, and some of it forms the most durable building-stone; but it is very difficult to work. Of useful minerals, we find in these rocks copper, gold, silver, iron, sulphur, alum-slate, arsenic, lead, pumice-stone, and other substances.

Alluvium.—Alluvium is a term used to designate the most recent deposit of matter. It comprises deposits of gravel, sand, loam, and clay; and frequently contains, or is entirely composed of, animal remains. It is found along the sea-coast, the lakes, rivers, and rivulets, and forms their banks and bottoms. Alluvium is generally loose ground or fragments of rock. Most of the valleys, swamps, and prairies are alluvial matter. We find the following useful minerals in these deposits of earthy matter: iron ore (bog ore only,) potters'-clay, fire-clay, gravel, brown coal, peat or turf, and some others.

Minerals, particularly the metallic ores, are chiefly distributed over and below the surface of the earth in layers or masses; in lodes, or large veins, running parallel with or traversing the general course of the stratification of the rock; in nests or pockets; in nodules, which are concretions or accumulations of minerals of small extent; and in small veins, which are either branches of heavy veins, or traversing larger veins, ramifying the rock in all directions. The transition rock is the domain of metalliferous deposits. Here we find more variety and abundance than in any other geological formation. In this rock the best qualities of ores are also found. The secondary rocks, or those which contain bituminous coal, do not furnish so great a variety of minerals as the transition rocks, and many kinds are not found at all in them. In the latter there is an absence of gold, silver, copper, antimony, and other substances. It furnishes chiefly stone-coal, iron, limestone, and often a little lead or zinc, but these latter only in a very limited quantity. Mineral substances, particularly those which are used for the production of metals,—the workable or useful ores,—are but few in number. They are generally oxides, that is, combinations of metal with oxygen; sulphurets, or metals combined with sulphur; and carbonates, or metallic oxides combined with carbonic acid. Combinations of metals with other substances than these, are rare. Minerals of the above description frequently form large bodies of pure ore by themselves, buried beneath the surface in the rock. In most cases, however, these ores are blended with foreign matter, as lumps or grains of quartz, lime, and other substances, which are mechanically mixed or in chemical combination with it. In some instances, the main body of the layer or vein is rocky matter, and the ore imbedded in that substance. The mineral deposits are often found in such heavy masses as to admit of their extraction without any admixture of rock; in other cases, rock and mineral must be raised together, as they cannot be separated. In some instances, the veins are too small for the entrance of the miner, and are consequently of no practical value.

Geographical Distribution.—The geographical distribution of minerals is very distinctly marked in the United States. The ridge of the Alleghany Mountains divides the surface of the country into transition rocks on the east side and secondary rocks on the west. In the first, or between the Atlantic and the Alleghanies, we find chiefly the minerals and rocks belonging to the transition series; and in the second, or between the Alleghanies and the Mississippi river, we find chiefly the minerals belonging to the secondary rock. Both slopes of the Rocky Mountains are of a uniform character, and the minerals on each side are those belonging to the east slope of the Alleghanies. The extent of mineral veins is as different as the character of the minerals themselves. In the western coal fields, particularly in that of Pittsburgh, we may trace the same vein of coal for hundreds of miles, as well as veins of iron ore and limestone. There are also small veins of coal and ores, of but a few miles in extent, in the same basin. The veins of gold ore in Virginia and North Carolina can be traced in a continuous belt for more than five hundred miles, running parallel with the Allegheny ridge. Immense beds of magnetic iron ore are found in the State of New York; also veins of peroxide of iron of uncommon magnitude in the Mississippi Valley. Layers of useful minerals are found in almost every State of the Union, in such abundance and extent as to render the raising of them most easy.

Origin of Minerals.—The origin of the minerals, and their form as veins or layers, may be considered as the result of infiltration from the surface, to which class many of the iron and copper ores belong; or the deposits have been formed in the bottom of a sea, as those of the coal measures; or the minerals are injected from below, raised by the power of internal heat, to which class the gold and silver ores of Virginia and North Carolina, and the native copper of Lake Superior, belong. The first class generally consists of wedges decreasing with the depth; the second of spheroidal masses, and the third of wedges increasing with the depth. The first class of veins is the most deceptive, and cannot be depended upon; the second may be measured by its appearance on the surface, or by sinking shafts into it; the third class may be depended upon as improving with the depth. Masses and veins of minerals are not always found in a horizontal position. The stratification of the great western coal field is almost horizontal; and as the mineral veins of this region are parallel to the stratification, these also are of course nearly horizontal. Except in the bituminous coal region, we find but few horizontal veins of minerals. The veins of Virginia and North Carolina run parallel with the stratification of the rock, and also with the layers of it; but the layers are in many cases almost vertical, and generally inclined not less than 60°. The inclination or dip of a vein is measured from the horizontal plane; if, therefore, a vein dips but 10°, it is nearly horizontal; and if it dips 80°, it is almost vertical. The dip of a vein is not always the same in its various parts, particularly if the plane of the vein is not parallel to the plane of the stratification. Veins of minerals are frequently found to be disturbed in their regular course, either by other mineral veins or by dead rock. Such disturbances, called, *faults*, slips, or slides, appear in every kind of vein; they are caused by matter which has penetrated the crevices of the rock after the main vein was formed. The mass of a vein is often found to divide itself into various small veins, which, at certain distances or at greater depths, reunite. Such faults, whether consisting of mineral or dead veins, are often perplexing to the practical workman; but the scientific miner is never at a loss what to do.

DESCRIPTION OF MINERALS.

A DESCRIPTION of well known minerals is needful for a full appreciation of what is said about them elsewhere in this volume. Doubtless, also, it will be appreciated by the reader who is unfamiliar with more than their names.

Iron and Iron Ores.—*Native iron* is a mere curiosity, of no practical value. It is found in Connecticut.

Brown hematite—brown oxide of iron; brown ironstone; pipe ore; bog ore.—This is found of almost all shades of color, and under the most varying forms. It is characterized by its powder when rubbed, or its streak, which are always yellow. We find this ore of all shades of yellow, brown, and black. Its lustre varies from the dulness of loam to the resinous brilliancy of pitch. Its compact or solid varieties are generally granulated, but are frequently found of fibrous texture and of a silky lustre, the fibres being from a lively brown to jet-black. It is mostly opaque, but often transmits light through thin scales and at its corners, in which it appears to be blood-red. It sometimes appears in the form of hollow nodules, which are often of a black velvety appearance on the inner surface. This ore is so extensively distributed, and appears under so many different forms, that a description of it would be very difficult. The most certain mode by which it may be distinguished is, to reduce it to a powder; if this is yellow, the ore belongs to the variety under consideration. The scientific term for this ore is hydrated oxide of iron. Its chemical composition, if pure, is peroxide of iron, with from 13 to 18 per cent. of water. In its purest condition it never contains more than 60 per cent. of iron. This kind of ore is the most profusely distributed over the United States. It is found in heavy beds near and in the anthracite region of Pennsylvania, and in the valleys of the western coal formation, where it forms the outcrops of the veins of argillaceous carbonates of iron. It occurs in Massachusetts, Connecticut, Tennessee, Kentucky, Alabama and elsewhere, sometimes in veins thirty feet thick. The iron ores found in the bogs of New York, Michigan, Ohio, and Illinois, belong to this variety. It is found in almost every State of the Union, and is the most generally distributed of the iron ores. It is best qualified for pig-metal; the impure varieties not being well adapted to the manufacture of bar iron.

Red iron ore—red hematite; iron-glance; specular iron ore. The appearance of this ore varies from a dull brownish red like reddle, to the lustre and colour of polished steel or plumbago. Its powder often feels greasy, like plumbago, but it is always red when rubbed upon white paper or on a white porcelain plate. Some kinds of this ore, like that of the Missouri iron mountain, are compact and possess the colour and lustre of steel; other ores of the same kind are found in crystals, in the form of fine leaves or cubes, and of the colour and lustre of black lead, as is the case in New York, New Jersey, Pennsylvania, Arkansas, and other States. A heavy body of this ore, of the red variety, has been found in Wisconsin and Michigan. Smaller veins are found in most of the States of the Union. The chemical composition of this ore is iron and oxygen; and, if pure, it may contain about 70 per cent. of metallic iron. It is frequently adulterated with clay or siliceous matter, and is often found to contain but from 10 to 20 per cent. of iron. Some kinds of red clay ore, though of an intensely red colour, contain but 5 per cent. of metal. This ore is not attracted by the magnet. If not too largely mixed with foreign matter, it forms one of the best and cheapest iron ores for the smelter. The quality of iron made of it is always found to be soft and strong. It is particularly qualified for the production of heavy wrought iron.

Magnetic iron ore—loadstone; black oxide of iron. Large beds and veins of this ore are found in the United States, particularly on the west side of Lake Champlain, in Essex county, New York and in the States of New Jersey, Pennsylvania, and Ohio. It is also found in the New England States. This ore is generally bluish-black, and sometimes pitch-black. It is of a metallic lustre, and exceedingly hard. It is found in compact, solid masses, and also in crystalline grains, from a large size down to the form of fine black sand. The compact and the crystalline varieties are frequently found in the same vein. This ore is characterized by always forming a black powder when rubbed upon a white body. If it contains impurities, its powder is more or less grey. It is exceedingly sensitive to the magnet, and is attracted by it. When it occurs in large pieces, it attracts iron, and imparts magnetism to it when rubbed over it. This ore is said to belong to the primitive rock formations; but in the United States we find it chiefly in the metamorphic rocks of Pennsylvania, New Jersey, and New York. It forms the main body of the iron ore in Sweden. If pure, this ore is better qualified for making strong iron than any other, provided it be not spoiled in the smelting operation. In Jersey City, an excellent cast-steel is manufactured of the iron derived from this kind of ore, found in the western part of the State of New York. Spring-steel and file-steel are also extensively made of it in New Jersey. This is the richest of the iron ores. The compact ore of Lake Champlain, which is nearly pure, contains 70 per cent. of metallic iron in 100 parts of ore. There are varieties which contain but from 20 to 25 parts of metal; these are conglomerates, in which the crystals of ore are imbedded in a cement of clay, silex, and often lime. Magnetic ore is frequently adulterated with foreign matter injurious to iron, as silex, copper, arsenic, titanium, and particularly sulphur; the latter often in large visible quantities, in the form of crystals of yellow pyrites. This is the case with most of the richest veins of magnetic ore in New Jersey and Pennsylvania.

Carbonate of iron.—This species comprises two varieties. The first of these, termed the compact, or argillaceous ore, is chiefly found on the western side of the Alleghanies. The other variety is the sparry ore, found on the eastern slope of that mountain chain. The first is the most extensively distributed in this country, and for that reason we shall speak of it first. The compact carbonate of iron—clay iron-stone; argillaceous ore—is chiefly found in the western bituminous coal formation. It is there deposited in veins of more or less extent and thickness. Some of these veins are more than fifty miles in length and eight feet in thickness; others are so small as not to be workable. The general form in which this ore is found is that of a flattened spheroidal body from the size of a pea to a mass of sufficient bulk to weigh half a ton. These balls form either a continuous vein, in which one is laid beside and above the other, and the spaces between them are filled with clay, or the balls are separated, sometimes many feet or yards, and imbedded in slate. We find this ore also in continuous veins, in a compact form, resembling limestone. All this kind of ore, when discovered near the surface, at the outcrop of the vein, is found to be decomposed, has lost its carbonic acid, and is converted into brown or yellow hematite (hydrated oxide). By following these veins or outcrops of veins, we always find the ore in the interior of the rock to be the compact carbonate. The finest qualities of this ore are found near Baltimore, which is not in the coal region. We also find it in the Frostburg coal region, in Maryland, and in almost all the western coal deposits. The color of this ore is sometimes white, but generally of a dirty gray, a yellowish-brown, or of a faint brick-red appearance. There are oxidized veins of this ore in the western coal-fields along the Alleghany and Ohio rivers, of fine quality, making a superior iron. Most of it adheres to the tongue like clay, and emits an odor like that of clay when breathed upon. All our bituminous coal formations contain this ore, which is not so generally the case in Europe. This carbonate of iron generally contains from 20 to 33 per cent. of metallic iron; seldom more than 36 per cent. Its composition is protoxide of iron, carbonic acid, clay, silex, lime, and often magnesia; and in most cases it contains manganese, which is often found in the centre of a decomposed ball, forming a black lump. The balls of this ore, when in the progress of decomposition, form shells of hydrated oxide of iron, which are distinguished by different color, and may be separated in the same manner as the different coats of an onion. In the centre of such a ball, we often meet with an undecomposed core, where the ore is in its original state, presenting the appearance of limestone.

Sparry ore—sparry carbonate; also called spathic ore. This is the second variety of the native carbonates of iron. In almost all instances where this ore occurs, it is adulterated with sulphur, and in some cases with copper, which detracts seriously from its practical value. The color of this ore is in most cases white, varying to yellowish-brown and dark brown. Its texture in the fresh fracture is always decidedly crystalline, and of a silky lustre. It is not attracted by the magnet—which is also the case with the compact variety before described; but if either kind be slightly heated, it is attracted by the magnetic steel. This ore is frequently found to form the main mass of a vein in which other valuable ores are present; and in this respect it is a guide to detect ores which would not otherwise be found. In North Carolina, it forms the bulk of a vein of gold ore, where it is accompanied by quartz, iron and copper pyrites, and a large quantity of gold. It associates with all kinds of metallic ores, changing the character of a vein from one kind of ore to another. The foregoing enumeration constitutes the bulk of useful iron ores. There are some few ferruginous minerals, which are used in the manufacture of iron; but they do not constitute iron ores proper, and may be considered as fluxes. Among these substances are ferruginous slate, shale, and clay-slate, which contains iron, red marl, and green marl. These minerals contain but from 5 to 10 per cent. of iron. Any mineral which does not contain at least 20 per cent. of iron, is not considered an iron ore.

Iron pyrites—sulphuret of iron; in some places simply called sulphur. This we do not consider as iron ore; but it is a species of mineral of great value in some parts of the country. There are two different kinds of iron pyrites: the one is yellow, of a brass or gold color; the other is white, of a silvery lustre. The chemical composition of both is nearly alike. Each of them contains more than half its weight of sulphur; the other part is metallic iron. This mineral is frequently confounded with more valuable substances, by those who are not expert metallurgists, on account of its great lustre, bright color, and hardness. It is easily distinguished from any other mineral; for the slightest heat drives off sulphur, the suffocating smell of which at once proves its character. This mineral is exceedingly hard: it strikes fire with steel. Sulphuret of iron is very extensively distributed all over the United States, and accompanies almost every description of mineral. It is found in all geological formations, in primitive rock as well as in alluvial gravel. In the coal regions it is distributed in small veins, leaves, or crystals, incorporated with the coal, and depreciating its value. Where the coal is slaty, and contains much sulphuret—or, as it is commonly called, sulphur—it is used for making copperas, or alum, provided the slate contains but little coal. Along the Ohio river, extensive use is made of the sulphurets in this way. In other parts of the United States, not much attention is paid to these minerals. Iron pyrites are of little value in themselves; but, as a matrix of other metals, namely, as the bearers of gold and silver, they deserve more attention than they have hitherto received. All iron pyrites contain gold and often silver, from which rule only those of the coal formation are excepted. The extensive gold deposits of the Southern States constitute virtually a belt, or accumulation of veins, of iron pyrites. The gold had its seat originally in the pyrites, which, when decomposed, liberated the gold, and it appears in a metallic state. The pyrites are the matrix of the gold. The veins of gold ore in those regions are and have been, veins of pyrites, decomposed at the surface to a certain depth; below that decomposition, the veins are essentially formed of pyrites, and at a greater depth, entirely so. The pyriteous slate of these regions contains gold in most cases, if the pyrites are perfectly decomposed. Iron pyrites and copper pyrites are not easily distinguished from each other. The first, however, is of a decidedly crystalline form, the latter not so; the first is very hard, the latter does not strike fire with steel. The color of the iron pyrites varies from a pure silvery white or golden yellow to red; the copper pyrites are of all the colors of the rainbow.

Copper.—*Native copper* is found in large quantities, in regular veins, in the Lake Superior region. The heavy masses of copper in these places are imbedded in volcanic rock, and small veins ramify it in all directions. It occurs in bodies of almost every size, from small grains to masses weighing ten tons and upwards. This native copper is frequently found to be mixed with silver in distinct fibres, the latter not being alloyed with the copper. Native copper is found in almost every vein of copper ore; it has been found in those of New Jersey, and also in those of Pennsylvania.

Sulphuret of copper.—There are two kinds of ore of this variety; the one is called grey sulphuret of copper, and other copper pyrites; the latter generally contains iron in admixture. The gray sulphuret is a compact ore; its surface is dull, and it is of the color of lead, or an iron-grey; it also occurs of a faint red color, if taken near the surface of the ground. It melts easily, if a small splinter of it be held in the flame of a candle. It may be cut with a hard and sharp knife. If the ore is pure, it contains 78 parts of copper and 18 parts of sulphur. It is always found in veins of copper ore, forming part of their mineral contents.

The foregoing are the most generally distributed copper ores. There are others, such as:—

Red oxide of copper, distinguished from oxide of iron by a lively red color, more brilliant than the latter.

Black oxide of copper, which is velvet-black, often inclined to blue or brown. *Hydrosilicate of copper, or siliceous oxide of copper.*—This is generally the green ore, found in most cases at the outcrop of veins of copper ore. It has a bright green color and resinous lustre; and when freshly broken, its fracture is like that of glass.

Carbonate of copper, or *malachite.*—This is generally of a blue color; but it is also found of all shades, from dark blue to light green. Specimens of this variety are found in every copper vein, particularly at the outcrop. *Phosphate* and *chlorides of copper* are also found. They are both green, and form no regular copper ore. There is a great variety of copper ores. They are of various shades of color, from a brilliant red to velvet-black; of a beautiful green, and sky-blue. They are all distinguished from other ores by their bright color, and their power of imparting that color to other substances. There is scarcely any variety of copper ore which does not betray the presence of that metal by a green film, particularly if it has been exposed to the influence of the atmosphere. Copper pyrites, if exposed to the air for a short time, exhibit a film of blue crystals of sulphate of copper.

Nickel.—This metal is usually found associated with cobalt, with arsenic, with iron and copper, with sulphur and antimony, as an oxide, as a sulphuret of nickel and as a sulphuret and arseniate of nickel. It is always present in meteoric stones. It posseses a fine silver white color and lustre; it is hard, but malleable both hot and cold, and it may be drawn into wire $\frac{1}{50}$ of an inch thick and rolled into plates $\frac{1}{100}$ of an inch thick; a small quantity of arsenic destroys its ductility. When pressed it has a specific gravity of 8.279 and when hammered of 8.66 or 8.82. It is susceptible of magnetism in a somewhat inferior degree to iron, but superior to cobalt. Its melting point is nearly as high as that of manganese. It is not oxydized by contact with air but may be burned in oxygen gas. It is found on this continent only in Pennsylvania and Lower Canada.

Lead.—*Native lead* is a mineral curiosity, of no practical value whatever. It is said to have been found in its metallic state; but that is of little consequence, because it can have been discovered only in small quantities, and because it costs but little to smelt it from its ores. The most important ore of this class is

Galena, or sulphuret of lead. This ore has the lustre and color of polished metallic lead. It is always grey, without a shade of any other color; but its powder, when finely rubbed, is black. It is always found in a crystalline form, the crystals being cubes, often composed of square plates, and frequently so small as only to be detected by the aid of a lens. In other instances, the cubes, or plates which form the cubes, are more than one inch square. Galena is composed of metallic lead and sulphur; it contains, if pure, 86 per cent. of lead and 13 per cent. of sulphur. It is very heavy, and equal to metallic iron in specific gravity. It is indeed, the heaviest of all metallic ores. Galena is very extensively distributed over the United States. It is found almost every where, except in the bituminous coal region. The most extensive deposits are in the States of Missouri, Illinois, and Arkansas; between the Blue Ridge and the Alleghanies, in Virginia; and in smaller quantities in all the States of the Union. Some varieties of galena contain silver to a large amount; but in that case the ore is generally mixed with other minerals. The ore of this description in the gold region is of a bluish tinge, often inclining to black, and contains an accumulation of small crystals, which may be distinctly recognized in it. It is a compound of the sulphurets of zinc, lead, iron, copper, tin, silver, and gold. The galena in this ore amounts to from five to ten per cent. of the bulk; and each ton of lead smelted from it contains from 180 to 200 ounces of silver and gold, and frequently more than that. This may be considered a rich silver ore, and will pay a handsome profit. Any galena which yields 50 ounces to a ton of ore, is considered a silver ore. This amount of silver alone will pay for refining the lead.

Carbonate of lead.—This is a lead ore of frequent occurrence; but it rarely forms a vein of itself. It accompanies other lead ores, in the form of soft white concretions, as a powder, or in crystals. The crystals of carbonate of lead are generally flat, and transparent like glass. When the crystals, or the earthy kinds of this ore, are kept in a room where stone-coal or coal-gas is burned, or where men or animals breathe, it gradually turns grey, and at last black; forming black sulphuret of lead, by the absorption of sulphuretted hydrogen. The clear crystals of this ore possess the double refracting power; that is, they show two images of any object viewed through them. They are very soft, and easily scratched or broken.

Phosphate of lead.—This variety is not so common as the foregoing, but occurs quite frequently in all lead districts. It is an indication of the presence of lead, for it is chiefly found at the outcrop of a vein. Its color is greenish; and if inclined to yellow, it contains arsenic and phosphorus. We find it, like the carbonate, or native white lead, in the form of a fine powder, in concretions and in crystals. There are, besides the above, quite a variety of minerals containing lead, but they are of little interest as ores. There are oxides, sulphates, chlorides, arseniates, &c., which are of little interest to the practical man. The lead ores appear of almost every color, from the brightest white in the sulphates, to the deepest black in the sulphurets. All these various compositions of lead, if exposed to the air in a room, turn black, except the sulphate, which remains white. The color of these lead ores is generally not distinct, but is of a dirty, earthy character, or becomes so in the atmosphere. They are all, however, characterized by forming a fine powder when rubbed, which possesses the adhesive property in an eminent degree, and are in this respect superior to any other mineral. Finely powdered lead ore, particularly galena, is used for glazing earthenware. The galena found in limestone formations, or accompanied by lime, is generally poor in silver. The richest and most numerous beds of ore are found in and near limestone rocks. The lead ores of siliceous formations, particularly those found in slates, are generally rich in precious metal; and it may be said that the lead ores of the oldest rocks, as, for example, those from granite, are the richest.

Gold.—*Native gold.*—California stands pre-eminent in the production of this precious metal. The gold in these regions is found in its native state, in small grains, in spangles, in crystals so small as to be almost invisible to the naked eye, and also in lumps of ten and twenty pounds weight. These grains of gold are often found to be imbedded in masses of quartz; at other times they are mechanically enclosed by quartz; but in most cases the grains are pure gold, alloyed with a little silver. The latter admixture diminishes the value of gold about 15 or 20 per cent. Gold-bearing rock is chiefly a talcose slate; that is, a slate resembling soapstone, but which does not feel so greasy. This slate is red, and ferruginous at the surface. At a greater depth it is filled with small crystals of iron pyrites, which are decomposed near the surface, and appear as peroxide of iron, which colors the slate brown, and, in a few instances, yellow. This slate is of various grades of hardness, and is, in the East, a metamorphic rock, running in a regular belt, parallel with the Alleghany mountain chain. The width of this belt is, in its broadest part, from twenty to twenty-five miles, which is often contracted to two or three miles. Within this belt the various veins of gold-bearing slate are distributed. Those parts of the vein which are richest in gold are characterized by small veins of quartz, running parallel with the slate. Where this quartz is wanting, not much gold is to be expected. The direction of the veins is parallel to the general course of the rocky strata or formation; that is, from north-east to south-west; and their inclination, which is also parallel to that of the strata, is from 45° to 90°. This belt of talcose slate extends farther north-east, through Maryland, Pennsylvania, and New Jersey; but it is changed in its composition. It appears in this extension as mica-slate, and ceases to contain gold. Farther south-west than North Carolina, it changes into feldspar and its relative rocks. The gold in this south-western district is found imbedded in heavy veins of quartz, which appear frequently in this rock, being parallel with its stratification. These veins of quartz are often twenty feet thick and upwards; they are pyriteous, and contain iron, copper, and sulphurets of lead, which are found sometimes to be rich in precious metal. The gold-bearing belt, which can be traced in a southerly direction through South Carolina, Georgia, and Alabama, sinks beneath the Mississippi river, and rises again to the surface near the Rocky Mountains. The gold found in the slate of Virginia and North Carolina occurs in exceedingly small grains, often so fine as to be not only invisible to the naked eye, but undiscernible even by the assistance of a strong lens. This is the case even when the ores are worth three or four dollars per bushel. Some veins of the slate region contain coarse gold, in grains as large as the head of a pin, and even larger. These are generally found in veins of quartz, in which the pyrites are concentrated into larger masses. Where the pyrites are disseminated in fine crystals through the mass of the rock, the gold is found to be very fine. In the fresh pyrites the gold is invisible, even if, after separation, it appears to be coarse. By natural or artificial decomposition the gold becomes visible; the pyrites are converted into oxide of iron, and by the aid of a lens, the gold may be detected, imbedded in the oxide of iron.

Another form in which native gold is found, is in quartz, in which it is imbedded. Solid white quartz, both in veins and in crystals, is found, in which the gold occurs in spangles, plates, grains, and also in perfectly developed crystals. Quartz of this description is met with in Virginia; more perfect specimens occur in North Carolina, and still better in Georgia; but the best quality is found in California. Gold never appears in solid veins; it is always disseminated through the mass of the rock, in some places more dense than in others. There are localities in the gold region where every piece of rock, every handful of soil, contains more or less of the precious metal. Gold is never found in secondary strata or the coal regions. We may look in vain for it on the western slope of the Alleghanies; it cannot be there. Its origin appears to be in primitive rock, or granite; but it is most abundantly found in the trap-rocks, or those of igneous origin. The geological formation of Canada is of this character; but that of the gold region of the Southern States is not. Greenstone-porphyry, syenite, and gneiss, appear to be the primary sources of gold. These are also found in dikes and veins in the gold regions. The immediate matrix of gold in these regions is evidently the pyrites, which, however, may be a secondary enclosure.

The next deposit and source of gold may be found in the infiltrated veins. Gold enclosed in crystallized quartz is evidently derived from alluvial soil, which has been washed into the crevices of the rock, and afterwards covered with quartz in solution; and to this result the heat of a volcanic region has no doubt greatly contributed. Silex is easily soluble in pure hot water, but is precipitated from it as soon as it comes in contact with any other matter, or when cooled. The crevices of the feldspathic rock of North Carolina are chiefly filled with crystalline quartz, which in many instances contains gold. This quartz is evidently the result of infiltration; and all the veins of this kind must be uncertain in their duration and extent.

The veins injected from below are a third source of gold. To these belong the pyriteous veins, and, as far as their decomposition is concerned, the ferruginous veins. Whether the gold in these veins is in a metallic form, and has been evaporated in that state; or whether the gold was raised and condensed along with other metals and sulphurets, is a question of no importance. It may be asserted as a fact, that all native sulphurets, particularly all the sulphurets of iron, contain gold. It does not follow from this that all pyrites contain sufficient gold to pay for its extraction. As sulphurets cannot possibly penetrate any rock but from below, we may naturally conclude that the heaviest body of such kind of ore must necessarily lie deep in the earth. This conclusion is supported and confirmed by practice; for all pyriteous veins are invariably found to improve in quality and quantity with the depth.

Silver.—*Native silver* occurs in various forms; and it is often difficult to decide by sight whether a mineral is pure, or contains silver in admixture. It is found in all mines where silver ores occur, in the regular form of crystals, but chiefly in irregular grains and formless aggregations. It appears in the native copper of Lake Superior, ramifying the copper in all directions, in the form of fine threads of pure silver. Silver has a great affinity for sulphur, which soon blackens its bright surface. For this reason we find most of the native silver in black masses, imbedded in the silver ores, filling fissures in a vein, or appearing as a black vegetation in cavities or on the surface of a vein. Metalic silver is found in all mines where silver ores are found, or where the ores of another metal are impregnated with silver.

Sulphuret of silver—silver glance. This is the most common of the silver ores. We find it in the form of crystals, hairs, and needles, or like wire twisted into nets; in plates, and in shapeless masses. This ore is opaque, or of a dark-grey color. It is malleable, and easily cut with a knife, like lead. It is not elastic, like metallic silver. The clean cut looks like metallic lead, but is soon covered with a film of various colors. This ore, in its pure form, contains 87 per cent. of silver, and 13 per cent. of sulphur. It is easily smelted, and yields metallic silver with but little trouble. Sulphuret of silver, and all the silver ores, are found in rocks of all ages, except in the coal region; and always accompany the ores of copper, lead, antimony, gold, arsenic, and others, along with quartz, calcspar, heavy spar, manganese, pyrites, and other minerals. It is a remarkable fact, that silver occurs more abundantly where mineral veins cross or meet each other, than in other places, or in the finer ramifications of a vein.

Horn-silver—chloride of silver. This ore is not so generally found as the above sulphuret, but it appears in almost every place where silver is found. It occurs chiefly at the outcrop of veins, along with native silver or sulphuret of silver. Chloride of silver is a horny substance, so soft as to be cut by the finger-nail. Its color is often grey, and it sometimes shows all the colors of mother-of-pearl. These colors darken, if the ore is exposed to light for some time. This ore is also found of a uniform green color. One variety of chloride of silver is called buttermilk ore. In this case it is mixed with foreign minerals, and with gold and copper. The greater portion of it, however, is clay.

Antimonial silver.—This is the richest of the silver ores, but not so frequently found as others. It has not been observed in the old States of the Union. It is found in Mexico and Central America, and in New Mexico, California, Utah, and Montana. Antimonial silver is a crystallized ore, of a white or yellowish-blue color, hard, and very brittle. It resembles arsenical iron very much, but is easily distinguished from that ore by its crystals being longer, and not quite so hard. The ore, when fresh from the mine, is white; but it is soon tarnished by a yellow film, and gradually becomes grey, blue, and at last dark-grey or black. This ore, when pure, contains 80 per cent. of silver and 20 per cent. of antimony.

Antimonial sulphuret of silver—red silver; rubyblende. This is a valuable silver ore. Its color embraces all the shades of red, and is sometimes of an iron-grey. It is rarely found of any other color. The lustre of this ore is remarkable, being metallic, and in many instances as brilliant as that of a diamond. It is found wherever other silver ores are found, and may be expected in the mineral veins of primitive, transition, and metamorphic rocks. It is accompanied by or associated with antimonial and arsenical ores, lead, cobalt, nickel, copper and iron pyrites, along with quartz, lime, heavy spar, fluorspar, and other minerals. There are other varieties of silver ore, but their appearance is very rare.

Platinum; Iridium; Osmium; Rhodium; Palladium.—These are called the platinum metals, because they always appear together or alloyed. Platinum has been found in the gold diggings of Virginia, North Carolina, Georgia, and California. These metals are as valuable as gold; and some of them are sold at even higher prices than that metal. They are chiefly found wherever gold occurs, and mostly or exclusively in alluvial gravel and sand. Platinum appears in flattened grains, of a greyish or lead color, resembling tarnished steel. In its ordinary state, it is as heavy as gold; and, if pure, even heavier.

Mercury; Quicksilver.—*Native Mercury* is found in all mercury mines. It occurs in small drops, attached to the body of the ore, to the gangue, or dead minerals of the vein, and to the rock. The most important quicksilver ore is the

Sulphuret of mercury—cinnabar. This mineral resembles, in color, oxide of iron, with which it is sometimes confounded. Its redness, however, is mingled with a yellowish hue, like that of minium, by which peculiarity it is distinguished. It is also easily distinguished from other minerals by its volatile character. It evaporates entirely, when thrown on red-hot iron, leaving no residuum, and emitting a strong smell of sulphur. The powder of cinnabar, when rubbed on gold or copper, whitens these metals, as if plated with silver. Cinnabar is found in California in heavy masses. The ore is of a beautiful appearance, pure, and compact. It contains 84 per cent. of metal, and 14 per cent. of sulphur.

Bituminous sulphuret of mercury.—This is a variety of cinnabar, of a more or less grey, brown, earth color and appearance. It generally accompanies the pure qualities, and is mainly distinguished from them by its color. On heating this quicksilver ore, it emits a very disagreeable smell, and leaves a residue of earthy matter. There are other ores of mercury, but they are of little importance. They may all be distinguished by their entire volatility, and their capacity of coating gold white when rubbed upon it. The geological position of the quicksilver ores is in the older rocks of the secondary formation, or the later series of the transition rocks. We find it therefore in the New England States, along the Lakes, and in the gold region of the Southern States, but in such small quantities that the mining of it cannot be carried on to advantage. Quicksilver ores may also be found in an earlier series of rocks than the bituminous coal; but in that case there is some metamorphic or volcanic rock in its vicinity, which appears to have been the means of depositing it where it is found. These ores are very volatile, and any volcanic eruptions will bring them from the interior of the earth, to condense on some convenient spot, colder than the place of their origin. Quicksilver ores are not always found in regular veins. We find these ores in grains, disseminated through the masses of rock, like gold, platinum, and other metals. One of the quicksilver ores of Spain is a black slate impregnated with metallic quicksilver.

Zinc.—*Native zinc* is never found; it has so much affinity for other matter, particularly oxygen, that it cannot exist very long in its pure state. The following are the principal ores of this metal:

Zinc-blende, or simply blende.—This is a sulphuret of zinc, and is composed of 68 per cent. of zinc, and 32 per cent. of sulphur. This ore is always found crystallized; and in most cases the masses of it are mere accumulations of crystals. Its color is generally a bright or yellowish-brown; but it is occasionally found to be black, red, green, or yellow. It is transparent, or at least admits of the passage of light, if in thin splinters. The lustre of this ore is brilliant, and more decidedly adamantine than any other ore. It is found in heavy veins and masses in the gold region of the Southern States, where it forms the principal silver ore. It also contains a considerable amount of gold. It is here associated with galena, iron and copper pyrites, tin, heavy spar, black manganese, and manganese-spar. The bulk of this ore is blende, which in most cases constitutes at least 50 per cent. Blende occurs chiefly in the rocks of the transition series, and is abundantly found in the United States. The operation of smelting this ore, and extracting from it the gold, silver, and lead, is extremely troublesome.

Red zinc ore.—Zinc ore is extensively deposited in New Jersey and Pennsylvania, and is used for the manufacture of brass. This ore is a compound of oxide of zinc, manganese, and oxide of iron. Its color is a brick-red, with a yellowish tinge, like cinnabar. Its texture is granular and massive. This ore, like the blende, belongs to the transition series of rocks.

Calamine—silicate of zinc, is very widely distributed, and is found in heavy beds in eastern Pennsylvania. There are two kinds of this ore, the silicate and the carbonate: the latter series is that alluded to as found in Pennsylvania. This ore appears in kidney-shaped masses, and in concretions like iron pipe-ore, honey-combed. It is of a dirty yellow or stone color. If pure, it consists of about one-half oxide of zinc; the other half is composed of carbonic acid, silex, iron, water, and other admixtures. It is found in heavy veins, and may be looked for in all limestone rock, from the most recent to the oldest formations.

Tin.—There are but two ores of tin known, which are of any practical use. One of these is tin-stone, or peroxide of tin; the other is sulphuret of tin, or tin pyrites. No tin of any moment is manufactured in the United States at present; still, there are indications of the ore, and, at some future day, it may be found advantageous to smelt it.

Tin-stone occurs chiefly in granite, in heavy masses or lodes, mixed with conglomerates of various rocks. It is also found in alluvial gravel, as the result of the decomposition of the above rock, and is then called stream-tin. Tin-stone is of a variety of colors, white, grey, yellow, red, brown, and black. Its most striking feature is its weight. Its specific gravity is equal to that of galena, from which it is easily distinguished. This ore is very hard, of a brilliant lustre in the fresh fracture, and is frequently found in detached double crystals. By striking with this stone upon steel, fire can be produced.

Tin pyrites are not very abundant, and cannot be considered an ore of tin; their presence in the silver ores of the southern gold region is so limited, as to render the extraction of the metal unprofitable. This ore is of a grey or yellowish colour, heavy, crystallized, and of a metallic lustre. It is always found to be adulterated with foreign matter, as iron, copper, lead, and other ores.

Coal.—All mineral substances containing sufficient carbon to supply their own fuel, and support combustion, may be called coal, mineral coal. There are vast beds of slate and limestone, containing a large amount of carbon, which cannot properly be classed as coal, because they do not perpetuate combustion.

Charcoal.—Mineral charcoal is frequently found in bituminous coal, in the form of thin seams and plates; but the quantity is so small as to render its separation from other coal impracticable.

Anthracite—hard stone-coal, is, with the exception of charcoal, the purest mineral carbon of which we have any knowledge; and it forms the bulk of the fuel used in the Atlantic cities. Anthracite coal forms heavy veins and masses in the metamorphic rocks of the eastern slope of the Alleghenies, but is seldom found on the western side of that mountain chain. Hard coal is a very black, hard substance, of great lustre: it breaks in irregular fragments, and is not affected by the atmospheric air. The chemical composition of this coal is, almost entirely pure carbon, a little hydrogen, and a small percentage of ashes. When a sufficient quantity of this coal is ignited, it creates an intense heat; but, in small quantities, it does not burn well, and requires a strong draft to support combustion in a small space. This coal is also more difficult to kindle than any other, requiring the use of wood, or wood-charcoal, to ignite it. This fuel is well adapted to smelting operations, for which purpose it is extensively employed. The geological position of anthracite coal is said to be in the transition rocks; but, in this country, we cannot place it in that series.

Bituminous coal—soft stone coal. This name is applied to a mineral coal, which has never been properly defined. A natural and well-marked distinction of this coal is, its property of coking; that is, if exposed to a red heat, it blazes, swells, and finally bakes together, forming a spongy mass, called coke. All the coal which is black, and makes a black powder, but does not coke, is anthracite; and all the coal which is soft, and makes a brown powder, but does not coke, is denominated brown coal. Bituminous coal is black, makes a black powder, has a bright, resinous lustre, and is liable to form slack when exposed to the air. It is distinguished from anthracite by possessing a more slaty structure. Some of this coal breaks into beautiful cubical pieces, of which the Pittsburg vein shows many fine samples. Most of this coal is inclined to break in that way, but the cubes are often very small, and form mere slack. Bituminous coal burns easily, with a bright, vivid flame, similar to pine wood. Anthracite usually burns without any flame; but, sometimes, with a faint, blue, scarcely-visible flame. Bituminous coal is easily kindled, and, in small quantities, supports combustion with facility. The chemical composition of this coal differs from anthracite, only in the larger amount of hydrogen it contains: this, in combination with carbon, forms bitumen, which can be extracted by distillation in iron retorts; and from this circumstance is derived its name, "bituminous coal." In the Mississippi valley, that is, in the region where this river and its tributaries flow, the amount of bituminous coal buried beneath the surface of the earth is so large, that no parallel can be drawn between the amount of coal in that district, and what is contained in all the other parts of the world. The quality of the coal in this large basin is, as may be expected very different. "The Pittsburg vein," is, notwithstanding its local appellation, of vast extent. This vein may be traced to a distance of from one hundred to one hundred and fifty miles from Pittsburg, and furnishes at every point where it has been opened, the same kind of coal. The coal from the Pittsburg vein, of which the coal from the Youghiogeny river, a branch of the Monongahela, may be considered the finest, is a beautiful jet-black coal, almost free from sulphur, of a high lustre, frequently displaying the colors of the rainbow. This coal breaks into cubes, of from two to six and eight inches. It is not very liable to form slack on being exposed to the air. This coal breaks into a beautiful, strong, and clear, coke, and may be considered a fine coal for making gas. This vein does not furnish an equally-beautiful coal throughout its extent, still, it produces in every part a superior coal. Within one hundred miles of Pittsburg, along the Monongahela river, this vein produces superior coal; below Pittsburg, on the Ohio river, and above Pittsburg on the Alleghany river this coal is not so good as at the first mentioned place. Pittsburg may be considered very near the centre of the large western coal field; and here the coal, particularly that of the thick vein, is superior to any coal, no matter whence it comes. The same vein furnishes a fine coal along the borders of the coal field, where the vein is generally from ten to fourteen feet thick—near Pittsburg it is but seven feet. The geological position of this coal forms a particular era, a separate period in the formation of rocks. It is not found in the old rocks—in granite and its associates—nor do we find it in transition or metamorphic rocks; yet, in Virginia, a bituminous coal is found imbedded upon granite, and surrounded by the younger transition rocks. This coal cannot be considered a true bituminous coal, but forms a link between this and the next following—brown coal. This Virginia coal burns with a vivid flame, and forms a sort of friable coke; still, we cannot consider it as a true bituminous coal, of the secondary formation.

Brown coal—lignite. This is a kind of coal more generally distributed than known. This coal is found among or above the rocks of all ages. We find it resting on granite in Virginia, on the James river, imbedded in tertiary rocks along the Atlantic coast, in Michigan and Missouri, in Oregon, on the shores of the Pacific, and in California. We find this coal jet black, and also of a brown color; we find it as hard as anthracite, and so soft as to crumble into fine dust on being touched. It is never found in extensive layers, like the coal of the secondary strata, and the deposits mostly form thin veins or elliptical masses. This coal is charaterized by its making a brown powder, which may be more or less dark, but always shows its brown color. Some of this coal forms coke, but the coke is weak, friable, and, on account of its impurities, not qualified for smelting iron and other metals. The greater bulk of this coal does not coke at all. It always contains more impurities than coal of the older rocks, makes more ashes, and is very sulphurous, which causes operate in the formation of clickers in the fire-grates, causing trouble to the firemen. If brown coal is very impure, slaty, and does not contain sufficient carbon to constitute fuel, it can be used for the manufacture of alum, either by burning or roasting in large piles, and may be considered the best material for that purpose. We may expect to find brown coal below the sand of the beach, as well as in the granitic and volcanic mountain regions. It is always accompanied by fossil remains of plants and animals. Coal which is too brittle to bear transportation, and diminishes the draft of a fire by falling into dust, may be moulded like fire-bricks, dried, and then used as fuel. If there is any difference between hard coal and soft coal, of equal purity, it is in favor of hard coal; for, the less hydrogen fuel contains, the greater the amount of heat liberated from the same weight. There are, however, differences of a practical nature, which considerably modify this theoretical fact. A fire-grate or furnace of any kind, which burns soft coal to advantage, is found to have a contrary effect upon hard coal; and the grate in which hard coal can be profitably consumed, will not answer so well for soft coal. Soft coal burns more rapidly, and distributes more heat in the same time, over the same space; but also consumes faster than hard coal would, under similar circumstances. The absolute amount of heat evolved, is greater in soft than in hard coal, but this heat cannot be used to so much advantage as that produced from hard coal.

—*Compiled from "Practical Mineralogy," by J. S. Overman.*

MINING AND METALLURGY AMONG THE ANCIENTS.

In the time of Moses, at least six metals were known, since, in his direction for the purification of the spoils of the Midianites, he says: "Only the gold and the silver, the brass, the iron, the tin, and the lead, every thing that may abide the fire, ye shall make it pass through the fire and it shall be clean.* Thus showing that the metallurgic arts had at that early period attained considerable perfection, and that the metals were of frequent occurrence and constant employment. Of the various metallurgic processes practised in the early ages of the world, little can be at present known; but it would appear likely, from some passages in the sacred writings, as well as from the somewhat confused and obscure accounts of profane authors, that they differed but little from those which are employed at the present day.

That silver was at a very early period purified by means of lead, the following passages would seem to indicate: "The house of Israel is to me become dross; all they are brass, and tin, and iron, and lead in the midst of the furnace, they are even the dross of silver."† And again, "The bellows are burned, the lead is consumed of the fire, the founder melteth in vain."‡ We also read of silver being purified in a furnace of earth. Strabo quotes Polybius as speaking of a silver ore which, after being washed seven times, was melted with lead and became pure silver. That tin was not only well known, but also highly valued, at the time of the Trojan War, we learn from Homer, who calls it *κασσίτερος*, and mentions it as forming part of the armour of Agamemnon,§ and shield of Achilles,‖ to make which, Vulcan is represented as throwing into the crucible, brass unconquered *κασσίτερος*, and honored gold and silver.

Among the ancient Greeks and Romans, the workers of metal had attained a pitch of excellence, in some instances scarcely to be surpassed in the present day: but although many proofs of their skill have come down to us, in the form of coins, statues, and implements of war, yet their authors afford but scanty information relative to the methods employed in their production. This may be accounted for by the fact, that those who have written on the subject could have been but imperfectly acquainted with it, the metals being generally found and extracted in mountainous countries, at a great distance from the large and populous cities in which the authors may be supposed to have usually resided, and who were, consequently, dependent for their facts on those who might be unable to enlighten them very fully on the subject. It is therefore not to be wondered at, that our stock of information should be limited, or that the ancient authors should treat rather of the uses of the metals, and the formation of alloys, than of their extraction from the ores.

The art of working the alloys of copper was cultivated in Rome at a very early period after the foundation of that city. King Numa, the immediate successor of Romulus, founded a fraternity of brass founders, from which it may be inferred that this trade was even then in a flourishing condition. At the date in which Pliny wrote his Natural History of the World, the Romans had acquired an extensive knowledge of the metals, and their uses; as we find him, in his thirty-third and thirty-fourth Books, not only de-

* Numbers xxxi. 22. † Ezek. xxii. 18. ‡ Jer. vi. 29.
§ Iliad, 2. ‖ Iliad, 18.

scribing gold, silver, brass, tin, iron, lead, antimony, mercury, and cadmia; but he gives us also the proportions in which these various metals should be mixed, in order to form suitable alloys for casting, soldering, and brazing, and moreover describes, with a great degree of accuracy, the medicinal and other properties of some of their oxides and salts, as well as the method of their preparation and the localities in which they were found. But his descriptions of the means used for the extraction of these metals from their ores, are not only imperfect, but also frequently obscure. This arises both from the abrupt transitions which continually occur, and also from frequent allusions to methods and apparatus long since obsolete, and relative to which at the present time we have no means of acquiring knowledge. In speaking of gold, Pliny says, "In these parts of the world in which we live, gold mines are found, to say nothing of India, where the ants cast it up out of the ground, or that which the griffins gather in Scythia. The gold with us is procured in three ways; among the sands of some great rivers, such as the Tagus in Spain, the Po in Italy, Hebrus in Thrace, Pactolus in Asia, and the Indian Ganges, all of which yield gold. Neither is there any gold finer or more perfect, from being thoroughly polished, by the rubbing and attrition which it meets with in the courses of streams of water. There is also another method of obtaining gold, viz.: by digging it out of pits which are sunk for that purpose, or else in the caverns and breaches which occur by the fall of mountains." He also goes on to say, that the gold obtained by cleaving and opening mountains needs no trying or refining, as it is naturally fine and pure. In speaking of the value of gold, the same author remarks: "The reputation which it has acquired is for the following reason,—that it alone, of all things, loses nothing in the fire, but withstands its action without change. Indeed the oftener it has been in the fire the more refined and purer it becomes. One method of testing the quality of gold is by the application of fire, of which it ought to take not only the color, but to a certain extent the radiance also. This kind is called *Obryzum*. This is another astonishing property of gold, that a fire made of light straw or chaff will quickly melt it, whilst if it be thrown on the strongest fire of wood-charcoal, it will with difficulty yield to its intensity and melt. With respect to its purification, it should be melted with *lead*. The second property which causes gold to be so highly valued is, that it loses but little of its weight by use and attrition, whilst silver, lead, and copper, leave metallic stains on bodies which they touch, and soil the skin of those who handle them. Neither is there any metal which can be beaten out broader by the hammer, or divided more easily into parcels, as every ounce of it may be reduced into more than seven hundred and fifty leaves, each one of which being four fingers square. The other minerals, after their extraction, require the fire for their conversion into metal; but gold, of which we now treat, is gold as soon as it is found." Again, "Neither rust nor canker alters the weight of gold, or affects in any way its quality. Salt and vinegar, though such active solvents, do not make the least impression on it."

The above quotations go to show, that many of the properties of gold were known at this period, and also that the methods of extracting it were similar to those employed at the present day. Pliny, however, gives us but little information relative to its metallurgic treatment, except that lead was employed in its purification, and also that when found in lumps it was of itself pure, and required no artificial refining. He also states, when speaking of the properties of mercury, "So penetrating is this liquor, that there is no vessel but it will eat and pass through. It supports everything which may be thrown into it, unless it be gold only, which sinks to the bottom. It is, besides, very useful for the purpose of refining gold; to effect which object, that metal mixed with cinders is placed in an earthen pot, and shaken with mercury, which rejects all the impurities mixed with it, but in return takes hold of the gold itself. To expel it from the gold, the mixture is poured on skins, which, on being pressed, allow the mercury to pass through them in drops, whilst the gold remains in all its purity." The above process differs little from those in general use, for the purposes of amalgamation, at the present day; but in this case Pliny's description is imperfect, inasmuch as the solid amalgam remaining on the skins would require the separation of the combined mercury before the gold could exist in the pure and fine state described. No mention is moreover made, of any means of separating gold from silver, or in fact of their ever being found associated, except in an alloy called *electrum*, said to be found in veins, and of which an artificial kind was made by mixing one part of silver and four parts of gold, and which appears to have been anciently in great request, since Homer describes the palace of King Menelaus as glittering with gold, electrum, silver, and ivory. This alloy, though sometimes made by the direct mixture of the two metals, was, doubtless, in most instances, a natural production, as many gold ores contain a portion of silver, and the ancients being ignorant of the method of separating them, and without any knowledge of the stronger acids,* might have been in the habit of occasionally adding a certain quantity of silver to specimens of gold which already contained a proportion of that metal, thereby converting them into electrum.

That silver was formerly, as at the present day, chiefly extracted from the ores of lead, we are distinctly informed by the author of the "Historia Naturalis," who adds, that those ores of silver which do not contain lead, or an ore of lead, cannot be successfully worked without the addition of either one or the other. Tin and lead he seems to regard as only two varieties of the same metal, as he describes them under the title of white lead, and black, and states that the white lead called in Latin *Plumbum candidum*, and by the Greeks *Cassiteros*, was much more valuable, and commanded a higher price than the black variety. His description of the *Plumbum candidum*, and the state in which it was found, leaves no doubt "that this much valued metal was tin, it being represented as occurring among sand, in the dried-up beds of rivers, and as only known from the other substances with which it was found associated, by its dark color and great weight.† There is likewise found in the gold mines a kind of lead-ore which they call Elutia (stream tin). The water which is let into the mines washes, and carries down with it, certain little black stones, streaked and marked with white, and as heavy as the gold itself. It is gathered with it, and they remain together in the baskets in which the gold is collected. These are not separated from it until after melting in the furnace, when the fusion transforms them into white lead." Again: "You cannot solder together two pieces of black lead without white lead, neither can this be united to the other without the aid of oil." He also says of this metal: "Neither out of the white lead can any silver be extracted; whereas out of the black this is commonly done."

In speaking of common lead, the same author says: It is much used for conduit pipes and for being hammered into thin plates," and then goes on to describe the mines of France, Spain and Britain, which he states, when quite worked out and exhausted, become as productive as ever, and even

* Nitric acid is first mentioned by Heber, who lived in the eighth century. He describes it under the name of "dissolving water," and prepared it by distilling in a retort one pound of sulphate of iron of Cyprus, half a pound of saltpetre, and a quarter of a pound of alum of Jameni. This process, although not economical, would certainly produce nitric acid, and to this when obtained he added sal-ammoniac, in order to give it the property of dissolving gold. Raymond Lully, who lived in the early part of the thirteenth century, employed the same process, except that he omitted the alum. Basil Valentine, who was born about the year 1400, describes a method of obtaining "Spirits of Nitre," by distilling nitrate of potash with powered porcelain or clay, with which the potash entering into combination the same result is obtained as by the former method. Basil Valentine is also the first who describes oil of vitriol, which he prepared by distilling sulphate of iron according to the method at present practised at Nordhausen in Saxony.

† "It is generally considered that the Greeks obtained their tin by means of the Phœnicians from the Scilly Islands or Cornwall, but there is no direct proof of this; and it appears probable, from the Sanskrit derivation of the Greek word (kassiteros, from kastira), that the Greeks originally obtained their tin from India. The Islands Cassiterides, however, the position of which was unknown to Herodotus (iii. 115), are supposed to be the Scilly Islands, or the peninsula of Cornwall, though their position is not exactly defined by Strabo (iii. 175). Still there can be little doubt that the Cassiterides, to which the Phœnicians from Gades (Cadiz) went for tin, and the Romans afterwards traded for the same commodity, were on the south-western angle of Great Britain."—Gen. Cyc. art. "Hindustan."

more so, if allowed to remain a short time without being worked; for which he accounts, by supposing the metal to be produced by the air, which has then free access into the mine. With regard to the state in which *Plumbum nigrum* occurs, we are informed: "Black lead has a double origin; for it is either produced in a vein of its own without any other metal; or otherwise it is mingled with silver in the same mine, being mixed together in one stone of ore, and they are only separated by melting and refining in a furnace. The first liquor that flows from the furnace is tin (*Stannum*), and the second silver. That part which remains behind is galena, the third element of the vein, which being again melted, after two parts of it are deducted, yields black lead." The above passage is obscure: tin, lead and silver, are not frequently found in the same stone, and were they thus to occur, the tin certainly would be the first to flow out of the furnace.

That cupellation has long been employed for the extraction of silver from lead may be inferred from the works of Agricola, who, in his "De Re Metallica," describes and gives drawings of the furnaces used in his time for that purpose, and which exactly in every respect correspond with the old German cupel.

The Greeks and Romans have left no treatises relative to mining or metallurgy; but it is scarcely reasonable to suppose, that had the method of refining lead by crystallization been known to them, it should either have been lost or fallen into disuse, as its advantages are too obvious not to have been evident to the rudest operators. Another argument against the opinion of Pliny having referred to this method, is the fact that rich lead, and not pure silver as described by him, is obtained by the crystallizing process, and if this method were ever known, it must evidently have fallen into disuse before the time of Agricola, who makes no mention of any knowledge on the subject, but gives the old German furnace as that ordinarily employed for the extraction of silver, and which, from the circumstance of its having remained unchanged in every respect since the days of Agricola, may be supposed to have existed in the same form long prior to that time: and to have been probably not only used by the Greeks and Romans, but possibly even at a much earlier date.

Of all the metals employed by the ancients for the manufacture of objects of luxury, as well as for those adapted to the everyday usages of life, copper and its alloys were the most common; as by far the greater portion of the coins, tools and implements of war, which are occasionally brought to light, are composed of some modification of either bronze or brass; and consequently, the making of these alloys, and their adaptation to the various wants of mankind, must have formed a very important branch of the manufactures among the Greeks and Romans. Accordingly the author of the "Natural History of the World," after describing the properties of this metal, and stating the localities in which that of the best quality was found, gives the composition and proportions employed in various alloys then common in Rome, and informs us to what uses they were severally applied. He also states that copper was first found in the Island of Cyprus, from whence two distinct kinds were exported: one called *Coronarium*, which, when reduced into thin leaves and colored with the gall of an ox, had a golden color, and was employed for making coronets and tinsel ornaments for actors, from which circumstance it derived its appellation. Another variety, which was named *Regulaire*, is not particularly described, except that, like the former, it would stand hammering, and might be thus made to take any required form. The brass (copper) of the next best quality came from Campania, where it was the custom to add eight parts of lead to every 100 pounds of copper. It is also mentioned, that in France it was usual to melt copper among red-hot stones, for the purpose of obtaining a steady heat, as a quick fire was found to blacken the metal and render it brittle. He moreover informs us that the process was completed in one operation, but states that the quality would be improved by more frequent melting: "Moreover, it may not be amiss to state also, that all kinds of brass melt best in the coldest weather. For statues and tables, brass is worked in the following manner: First the ore, or stone as it comes out of the mine, is melted, and as soon as this is done, they add to it a third part of scrap brass, consisting of broken pieces of vessels that have been used; for it is time and use alone that bring brass to perfection, it is the rubbing which conquers the natural harshness of the metal. They then mix twelve pounds and a half of tin to every hundred pound weight of the aforesaid melted ore. The softest alloy is called *Formall*, in which are incorporated a tenth of black lead, and one-twentieth part of argentine lead; it is this mixture which best takes the color called grecanic. The last alloy is that which is called *Ollaria*, or pot-brass, as it takes its name from the vessels for which it is mostly employed, and this is made by tempering every hundred pounds weight of brass with three or four pounds weight of argentine lead or tin."

The alloys above described are merely modifications of bell-metal or bronze; but it is not improbable that the ancients were acquainted with zinc-brass long before this period. Aristotle tells us that the Mosynæci, a people who inhabited a country not far from the Euxine Sea, were said to make copper of an exceedingly fine color, not by the addition of tin, but by mixing and cementing it with an earth found in that country. We are also informed by Strabo, that in the neighborhood of Andera, a city of Phrygia, a remarkable kind of stone was met with, which being calcined became iron, and on being fluxed with a certain kind of earth, yielded drops of silvery-looking metal, which, mixed with copper, formed an alloy called *Aurichalcum.* Sextus Pompeius Festus, who abridged a work of Verrius Flaccus, a writer of considerable note in the time of Augustus, mentions cadmia, which he defines as an earth thrown upon copper, in order to convert it into aurichalcum. On this subject Pliny affords us but little information, merely stating where cadmia was found, and naming some of its medicinal properties; but he seems to have regarded it rather as an earth which gave a yellow color to copper, than as the ore of a distinct metal, zinc being in no instance mentioned by him, although he speaks of a kind of brass which was manufactured in the Island of Cyprus from copper and cadmia. That metallic zinc, however, was known to the ancients, there is no evidence to prove, since the metal mentioned by Strabo as given out in drops from a certain stone when heated, could scarcely have been zinc, which would have been volatilized if treated in the way described, and we may therefore suppose, that if the stone referred to by him was an ore of zinc, it might also have contained some other metal, such as lead, with which it is often found associated, and which would produce the appearance in question. Ambrose, Bishop of Milan, describes the transformation of copper into aurichalcum as being effected by means of a drug, and not by the addition of another metal; from which we may infer he was unacquainted with the metallic nature of the material employed, although from his calling it a drug, he was perhaps aware of its medicinal properties. A similar description of the manufacture of brass is given by Primasius, Bishop of Andrumetum, in Africa, in the sixth century, and by Isidorus, Bishop of Seville, in the seventh. Agricola, who wrote in the sixteenth century, was also ignorant that cadmia contained zinc, of which we have no authentic account until we find it mentioned by Paracelsus; and from which it is evident, that although the manufacture of zinc-brass is of great antiquity, the extraction of the metal itself is comparatively a modern discovery.

Iron, the last of the six metals known to the ancients, was not, in the earliest times, very extensively employed, as the primitive heroes are described as being armed with weapons of brass. Plutarch informs us that when Cimon, the son of Miltiades, conveyed the bones of Theseus from the Island of Scyros to Athens, he found interred with him a bronze sword and spear-head of the same metal. Although generally used, however, brass was not universally employed for the manufacture of arms, as the celebrated robber, Periphetes, slain by Theseus, was named Korunetes (Κορυνήτης) from using an iron club. In the days of Herodotus iron must have already come into general use; since, when his interpreter reads to him an inscription on one of the Egyptian Pyramids relative to the amount of money expended on radishes, onions, and garlic for the workmen employed in its construction, he makes the reflection, that if this were true, how much more must have been paid for *iron tools* and bread! It would again seem almost incredible that these stupendous structures could have been erected without the aid of steel, both for quarrying and shaping the stone, as well as for cutting the hieroglyphics so common in the earliest specimens of Egyptian architecture. If, then, we allow that iron tools were employed in building these monuments, we must suppose this metal to have been in common use during the reign of the shepherd kings who conquered Egypt and occupied the throne of the Pharaohs during some part of the interval which elapsed between the birth of Abraham and the captivity of Joseph. In speaking of iron, Pliny says: "After copper, comes iron, both the most useful and most fatal instrument of life. With iron man delves the earth, plants trees, prunes his orchards, trims his vines, cutting off the older branches, and thereby throwing more vigor into the grapes; by its aid man builds houses, cuts stone, and prepares a thousand other implements; but by it war, atrocity, and villainy are effected and rendered common." He also describes iron as occurring in almost every part of the known world, but particularly in the Island of Elba, where the color of the earth indicated the presence of the ore. We are, moreover, informed that the ores of iron should be treated like those of copper, in order to extract the metal, and that it was a disputed point in Cappadocia whether the principle of iron was aqueous or earthy in its nature, as the water of a certain river of that country, when thrown on the earth, produced iron precisely similar to that obtained from a furnace. He then goes on to say that there are two distinct kinds of forges, as some produce steel (*nucleus ferri*), which is best adapted for cutting-instruments; whilst others shape it into instruments of common use, such as hammers and anvils; but that seasoning is the most important and delicate part of the operation. "It is a remarkable fact that, in the treatment of this mineral, the metal in melting is at first as liquid as the most limpid water, but becomes spongy in getting cold." *

Analyses of Ancient Arms and Cutting Instruments.—From the extracts already quoted, it will be seen that the information which has come down to us relative to the metallurgy of the early ages, is both vague, and, to some extent, uncertain; as those who describe the materials and methods employed have themselves acquired their information from others, and were, therefore, more subject to commit errors than if practically acquainted with the subjects of which they treated. This circumstance induced Mr. J. Arthur Phillips to believe that a careful analytical examination of such productions of the early metallurgists as have been discovered in different localities would not be without interest, and he, therefore, undertook the following series of analyses. From the advantage afforded for ascertaining dates, most of the analyses were executed on coins, care being first taken to well establish their authenticity. Some Celts and sword-blades were also examined. The analyses are placed consecutively, according to the supposed dates of the specimens examined.

It would be impossible to determine the dates of these relics of former times with the same accuracy with which we may ascertain the ages of coins; and we shall therefore merely give the weight and dimensions of the various specimens which have been examined, and endeavor to adduce such evidence as may show their great antiquity, without attempting to specify the precise dates at which they were employed. The ancient authors who have written on this subject, all agree that brass was used for the manufacture of arms before the discovery of iron. Lucretius says:

> "Arma antiqua manus, ungues, dentesque fuerunt,
> Et lapides, et item silvarum fragmina rami,
> Et flammæ, atque ignes, postquam sunt cognita primum
> Posterius ferri vis est ærisque reperta
> Sed prius æris erat quam ferri cognitus usus."

Hesiod also informs us that, "In remote ages, the earth was worked by brass, because iron had not been discovered." The Etrurians were acquainted with the use of copper, and appear to have used it for the purposes of agriculture at a very early period, as, when the boundaries of their city were marked out, it was done with a plowshare of bronze. Numerous other authorities might, if necessary, be quoted in support of the above statements; but the opening of divers Scandinavian tumuli, of very remote antiquity, in Denmark, fully establishes the accuracy of these accounts. From these barrows have been collected specimens of swords, daggers, knives, and implements of industry, since preserved and arranged in the Museum of Copenhagen, and among them are instruments of flint, resembling in their shapes, our wedges, axes, chisels, hammers, and knives; which we may infer, from their rude workmanship, as well as from the materials of which they are formed, to have been the first description of edge-tools used by mankind for the several purposes for which they were adapted. Specimens of swords, daggers, and knives were also found, of which the blades are made of gold, whilst the cutting edges only are of iron. Some of these objects are composed principally of copper, with edges of iron; and in the whole of them, the profuse application of copper and gold, in comparison with the parsimony evident in the expenditure of iron, seems to prove that at that early, though unknown period, both gold and copper were more plentiful and less highly valued than iron, among the now-forgotten people who manufactured these implements. Although we have the best evidence for believing that copper and bronze were employed for the purpose of making cutting instruments before the discovery of iron, it would be more difficult to ascertain at what date and among what nation this metal first came into general use. That it was known at a very early period we learn from various passages in the Books of Moses; and that it was used in the days of Job (about B. C. 1400) for the manufacture of arms, is evident from the following passage: "He shall flee from the iron weapon and the bow of steel shall strike him through." It is nevertheless probable that bronze might have been in common use long after the discovery of the harder metal, as the preparation of iron must have been a very tedious and expensive operation, to a people having but a scanty knowledge of the metallurgic arts, and we accordingly find a kind of compromise between its known utility and high commercial value in the case above-quoted, in which the cutting edge alone is made of steel. At the present day, a valuable discovery made in any part of the world speedily becomes known and appreciated throughout its whole extent, but at the remote time in which iron was first reduced from its ore, so little communication existed between the various nations, that a process well known and highly valued by the inhabitants of one country, might be quite unheard of in another; and, consequently, the uses of this metal may for a long time have been limited to a few districts, where accident, or the smelting of some other mineral, had first revealed its presence. In the earliest ages of recorded history, when the world was divided into numerous petty states and principalities, the constant feuds, which were the principal occupation of mankind, would certainly cause a demand for arms and weapons of defence. Such a state of things must, however, operate most unfavorably on the cultivation of the arts; and it is not reasonable to suppose that a conquering army on entering a foreign territory would have leisure to acquire the arts of the conquered nation, and, consequently, although they might find the arms of their enemies superior to their own, they would still be ignorant of the means by which they were manufactured; and thus the secret would remain for a long period in the possession of its first discoverers. At what precise epoch weapons of iron came into general use among the Romans, we have not sufficient information to decide, but in the time of Augustus, iron mines were worked to a considerable extent in the Noric Alps, and from them iron of the first quality was obtained. This was used for making the best weapons, and hence "*Noricus ensis*," was as much synonymous for a good sword, as a Toledo or Andrea Ferrara blade in more modern times. In this sense it is used by Horace, Book I. Ode xvi., v. 9. At the time in which Pliny wrote his "Historia Naturalis," iron was almost universally employed, not only for the blades of swords, but also for the manufacture of the different cutting instruments used for the purposes of daily life, as he both describes the metal and the means of forging it, and also refers to the difficulty of tempering steel in order to give it the requisite degree of hardness. From these considerations, it is evident that the various weapons of bronze must be of great antiquity, since

* Iron in Pliny's time was doubtless made by the direct or Catalan process, and the spongy appearance above described must have arisen, not from its cooling, as he seems to suppose, but from combustion of the combined carbon, and the consequent conversion of the compound into malleable iron.

iron was in common use prior to the Christian era, and we have therefore placed the analysis of these instruments in a part of the series which corresponds to that period, notwithstanding that in all probability some of them may belong to a much earlier date.

TABLE, SHOWING THE MEAN COMPOSITIONS OF THE SPECIMENS EXAMINED.

	Date.		Copper.	Tin.	Lead.	Iron.	Zinc.	Silver.	Sulph.	Nickel.	Cobalt.
	B.C.	A.D.									
Æs	500	—	69.69	7.16	21.82	.47	—	—	trace	trace	.57
Semis	500	—	62.04	7.66	29.32	.18	—	—	trace	.19	.23
Quadrans	500	—	72.22	7.17	19.56	.40	—	—	trace	.20	.28
Hiero I.	470	—	94.15	5.49	—	.32	—	—	—	—	—
Alexander the Great.	335	—	86.77	12.99	—	—	—	—	.06	—	—
Philippus III.	323	—	90.27	9.43	—	—	—	—	—	—	—
Philipus IV.	200	—	85.15	11.12	2.85	.42	—	—	trace	—	—
Copper coin of Athens	?	—	88.34	9.95	.63	.26	—	—	—	trace	trace
Egyptian, Ptolemy IX.	70	—	84.21	15.64	—	trace	—	—	trace	—	trace
Pompey, First Brass.	53	—	74.17	8.47	16.15	.29	—	—	—	—	—
Coin of the Atilia Family.	45	—	68.69	4.86	25.43	.11	—	—	—	trace	trace
Julius and Augustus.	42	—	79.13	8.00	12.81	trace	—	—	trace	—	—
Augustus and Agrippa.	30	—	78.45	12.96	8.62	trace	—	—	trace	—	—
Large Brass of the Cassia Family.	20	—	82.26	—	—	.35	17.31	—	trace	—	—
Sword-blade.	—	—	89.69	9.58	—	.33	—	—	trace	—	—
Broken sword-blade.	—	—	85.62	10.02	—	.44	—	—	—	—	—
Fragment of a sword-blade	—	—	91.79	8.17	—	trace	—	—	trace	—	—
Broken spear-head.	—	—	99.71	—	—	—	—	—	.28	—	—
Celt.	—	—	90.68	7.43	1.28	trace	—	—	trace	—	—
Celt.	—	—	90.18	9.81	—	trace	—	—	—	—	—
Celt.	—	—	89.33	9.19	—	.33	—	—	.24	—	—
Celt.	—	—	83.61	10.79	3.20	.58	—	—	—	trace	.34
Large Brass of Nero.	—	60	81.07	1.05	—	—	17.81	—	—	—	—
Titus.	—	79	83.04	—	—	.50	15.84	—	—	—	—
Hadrian.	—	120	85.67	1.14	1.73	.74	10.85	—	—	—	—
Faustina, Jun.	—	165	79.14	4.97	9.18	.23	6.27	—	—	—	—
Greek Imperial Samosata.	—	212	70.91	6.75	21.96	trace	—	—	—	—	—
Victorinus, Sen. (No. 1.)	—	262	95.37	.99	trace	trace	—	1.60	—	—	—
Victorinus, Sen. (No. 2.)	—	262	97.13	.10	trace	1.01	—	1.76	—	—	—
Tetrius, Sen. (No. 1.)	—	267	98.50	.37	trace	.46	—	.76	—	—	—
Tetrius, Sen. (No. 2.).	—	268	98.00	.51	—	.05	—	1.15	—	—	—
Claudius Gothicus, (No. 1.)	—	268	81.60	7.41	8.11	—	—	1.86	—	—	—
Claudius Gothicus, (No. 2)	—		84.70	3.01	2.67	.31	trace	7.93	—	—	—
Tacitus, (No. 1.).	—	275	86.08	3.63	4.87	—	—	4.42	—	—	
Tacitus, (No. 2.)	—		91.46	—	—	2.31	—	5.92	—	—	—
Probus, (No. 1.)	—	275	90.68	2.00	2.33	.61	1.39	2.24	—	—	—
Probus, (No. 2.)	—		94.65	.45	.44	.80	—	3.22	—	—	—

In addition to the foregoing analyses, the following estimations of silver were made by direct cupellation :—

Coin.	Legend.	Weight of coin. grs.	Percentage amount of silver.
Aurelian	Restituti orbis.	57.2	2.90
"	Fortuna redux.	50.5	2.96
Severina	Providentia Deorum.	54.5	4.37
"	Concordia militum.	54.0	5.80
Tacitus	Libertas Aug.	61.4	4.90
Victorinus, Sen.	Pax Aug:	38.0	2.20
" "	Providentia Aug:	35.7	1.10
Tetrius, Jun.	Pietas Aug:	31·5	.38
" "	" "	44.0	.41
Quintillus.	Fides militum.	52.4	2.32
"	" "	33.8	2.25
Marius.	" "	43.7	5.15

It will be seeu from the foregoing analyses that the metals entering into the composition of the brass of the earliest ages were copper, tin and lead, although the latter seldom occurs in any considerable quantity, except in the oldest specimens, and in many even of these, particularly in the early Macedonian coins, it is entirely wanting. The iron, cobalt and nickel, together with traces of sulphur, which sometimes occur, are evidently too small in quantity to have been intentionally added to the mixture, and consequently their presence must be rather ascribed to the localities from which the ancients drew their supply of ore, and the imperfect methods employed for their reduction, than to any design on the part of the artists. The cutting instruments which have been examined are uniformly composed of copper and tin, with the occasional admixture of a small quantity of lead, which was probably added for the purpose of communicating a certain degree of toughness to the alloy, and it is also remarkable that the proportion of tin to that of copper, both in the celts and sword-blades, is very nearly as one to ten. Zinc first makes its appearance a short time previous to the Christian era, and is continued in all the subsequent coins, although occasionally associated with lead and tin, until it almost entirely disappears in the small brass of the period of the Thirty Tyrants, when its place is supplied by a quantity of silver, varying from 0.76 to nearly 8 per cent., and which may perhaps have been intentionally added for the purpose of increasing the value of the metal. In speaking of these coins, Pinkerton remarks: "It may be proper to observe, before leaving this part of my subject, that the metal used in the Parts of the Assarion, or in the small brass coins, is, as may be supposed, very little attended to by the ancients. In those of the first emperors, yellow brass is sometimes employed, but it is always of a refuse or bad kind; as in the Semis of Nero, for instance, GENIO AVGVSTI. But copper is the general metal used in parts of the As, from the earliest times down to the latest; and if sometimes brass be employed, it is never such as appears in the Sestertii and Dupondiarii, which is very fine and beautiful; but only the refuse. Yellow brass of the right sort seems to have totally ceased in the Roman coinage, with the Sestertius, under Gallienus; though a few small coins of very bad metal, of that hue, appear so late as Julian II." On referring to the table of analyses, we shall, however, perceive, that although the results obtained seem to confirm the assertions made relative to yellow brass, in the above quotation, yet that in no one instance has a coin been found to consist of copper alone; and the only case in which this metal proved to be unalloyed, was in a spear-head found in Ireland. The largest proportion of lead occurs in the ancient Roman As, and its parts, in which it was probably employed for the purpose of rendering the alloy of which they consist easily fusible; for these coins being originally cast, and not stamped like other money, a metal melting at a low temperature would materially facilitate this operation. The later coins, containing a large proportion of tin, seem to have been struck while the metal was still warm, as it would be impossible to obtain such sharp impressions as they usually bear, by the force of any blow applied on a metal so very hard and brittle, at ordinary temperatures. With respect to the furnaces employed by the ancients, little information can be obtained, as these arts were formerly either held as secrets by a few individuals, who made a mystery of their operations, or they were too much despised by ancient authors to afford them a subject for their writings; and we are consequently more indebted for our scanty knowledge of ancient metallurgy to the vestiges of primitive foundries, which have occasionally been brought to light in various parts of the world, than to any accounts which may have been transmitted to us from those remote times. The first method of smelting ores, doubtless consisted in placing the mineral in heaps, together with several successive layers of wood, which being kindled, first roasted, and then reduced a portion of the material with which it was mixed. In Macedonia, where lead mines were worked in the time of Phillip, the father of Alexander, large heaps of slag are found so far above the level of the rivers of the country, that the furnaces in which they were produced must have been worked either by bellows moved by human labor, or by the force of the prevailing winds alone. We are also told that the Peruvians were in the habit of melting their ores by the simple application of fire, or, when they were of a very refractory nature, by means of furnaces so constructed on high ground as to yield a draught without the aid of bellows, a machine with which they were totally unacquainted. The boles of Derbyshire, many of which, from the pigs of Roman lead found in their vicinity, may be presumed to be of great antiquitity, were worked in a nearly similar manner, and continued to be thus carried on during several centuries, as this method of smelting was, according to Childrey, not quite extinct in the seventeenth century, who, in speaking of the Peak, says: "The lead-stones in the Peak lie but just within the ground, next to the upper crust of the earth. They melt the lead on the top of the hills that lie open to the west wind; making their fires to melt it as soon as the west wind begins to blow, which wind, by long experience, they find to hold longest of all others. But, for what reason I know not, since I should think lead were the easiest of all metals to melt, they make their fires extraordinary great."

Discoveries made by various travellers in Russia, during the last century, throw considerable light on the subject of mining and metallurgy as anciently practiced in that part of the world. The remains of numerous mines have been traced by Gmelin, Lepechin and Pallas, on the southern and eastern borders of the Ural Mountains; and in them were found hammers and chisels of copper, as well as various instruments of the same metal, of which the uses are at present unknown. From the absence of any remains of masonry in the neighborhood, these excavations are inferred to have been made by a nomadic people, probably the Scythians; and from no iron tools having been found in any of them, we may conclude that these operations were carried on before the conquest of Siberia by the Tartars, who effected the subjugation of that part of Asia, about 150 years before our era. Sledges made of large stones, to which handles had been attached, were also discovered, together with boars' fangs, with which the gold appears to have been collected, and leathern bags or pockets in which it was preserved. With such imperfect tools, the progress made must necessarily have been exceedingly slow, and in one instance, after reaching a band of rock, and penetrating it for a short distance, the miners seem to have lost patience and abandoned the works. The pits or shafts are well made, about seven feet in diameter, and of a circular form, some of them being twenty fathoms in depth. The passages are also well executed, but so low and narrow, that they could only have been excavated with the greatest difficulty to the workmen. The ores, when extracted, were carried to the nearest rivulet for the purpose of being crushed and washed, which operations were probably dispensed with in the richer varieties, which were sometimes melted in the mines themselves; metallic copper, together with slag, and the tools employed in melting and refining, having been found in some of them. Lumps of copper, containing no traces of gold, have also been discovered, although the copper ores of the district are found associated with that metal, and it is therefore evident that the ancient people who worked these mines were acquainted with a method of refining gold. The smelting was effected in small furnaces made of red bricks, and of which Gmelin found nearly a thousand in the eastern parts of Siberia. The height and breadth of these were about two feet, and the width three. They were also furnished with holes in two of their opposite sides, the one for the introduction of bellows, and the other for the escape of the metal and slags. In the neighborhood of the furnaces were found large quantities of broken pottery, together with numerous heaps of scoriæ, which indicate that operations to a very considerable extent have at some period been carried on in that locality. Gmelin likewise found in the same district the remains of various furnaces which had been employed for the extraction of silver, and remarked that the lead with which it was associated had been thrown away in the scoriæ, whilst the whole of the silver was carefully extracted. By what means this was effected, in this particular case, is of course now impossible to say, although it is highly probable that cupellation in some form was resorted to. Diodorus (iii. 14) informs us, that gold was purified by being melted and heated in earthen pots, together with an alloy of tin and lead, to which salt and barley-bran were added, and that the fire was kept up during five successive days. Another ancient author states, that gold was melted by a gentle fire, with the addition of salt, nitre, and alum, and that the same process was employed for refining silver. It is, however, difficult to understand what action these substances, with the exception of the nitre, could have on the purification of silver and gold, and we may therefore conclude, that the action of the air was, after all, the chief means of oxidation employed.*

In Britain, silver mines were worked before the invasion of the island by the Romans, and gold must also have been well known to the inhabitants before the arrival of Cæsar, since coins of that metal were in circulation among them. Cæsar and Strabo both state that the Britons obtained their copper from foreign countries, and we may hence infer that the art of refining this metal was either unknown or little cultivated by our forefathers at that remote period. Iron is described by Cæsar as being so rare, that pieces of it were sometimes used as a medium of exchange, and almost as highly valued as gold; but a century afterwards it had become very common, as in Strabo's time it was an article of exportation. Tin was anciently the most celebrated product of Britain, and appears even at that time to have been extracted in considerable abundance, since it was the desire of obtaining possession of these mines, and becoming thereby independent of the Phœnician monopoly, which first induced the Romans to visit the island. Before the conquest of their country, the ancient Britons extracted this metal from its ores by methods which they had themselves discovered, and which were probably improved on by their conquerors. The smelting process would seem to have been very simply conducted. The broken ore was placed in a hole in the ground, the sides of which were lined with pieces of wood; these, on being ignited, reduced the metal, which was separated from the slags by being run off through a narrow channel into an outer receptacle. Many of these rude furnaces have been found in various parts of Cornwall and elsewhere, in which not only charcoal and slags have been discovered, but also portions of the reduced metal, which in many instances had, from long exposure to oxidising influences, again become partially converted into tin ore. This very rude method must, in some cases, have been attended with considerable success, as the slags resulting from it often prove on examination to contain but a small amount of metal. From these and many other relics which have been met with in different parts of the world, we may infer that, although the arts of extracting minerals and working the metals were carried on formerly on a much smaller scale than at the present day, the operations of the early metallurgists were tolerably successful, and that, in spite of the rude apparatus which they employed, the results obtained by them were generally of a satisfactory nature. That a great degree of attention was, at a very early period, bestowed on the manufacture of alloys destined for particular purposes, is proved by the uniform composition of the several cutting instruments examined; although it is evident that but little care was taken to obtain a correct standard for the early brass money, as many pieces of nearly the same date, and of similar value, differ materially in the amounts of the metals of which they consist. One of the oldest mines in Europe, producing copper in comparatively modern times, is that of Rammelsberg, near Goslar, in Lower Saxony, the records of which have been traced back to the tenth century. The celebrated Swedish mine of Fahlun, commenced in the twelfth century, first entered into competition with Rammelsberg, and yielded large quantities of copper ores. The mines of Thuringia were opened at the commencement of the thirteenth century, and, together with others of less note situated in different parts of Germany

* The nitre of the ancients was probably carbonate of soda.

and Sweden, supplied during the succeeding three hundred years the wants of a great portion of the civilized world. In the thirteenth century Cumberland is known to have produced copper; since it appears, from records still preserved, that at Newlands, near Keswick, rich veins of this ore were worked in the year 1250. It is also further evident, from a charter granted by Edward IV., A. D. 1470, to the town of Keswick, that it was, at that period, the seat of extensive copper works. In Camden's time these works were re-opened, but afterwards "destroyed, and the miners killed in the civil wars."

In the reigns of Henry VIII. and Edward VI. several Acts of Parliament were passed prohibiting the exportation of copper, brass, latten, bell-metal, gun-metal, &c., &c., under penalty of forfeiting double the value of the metal exported. The reasons assigned being, "lest there should not be left metal enough in the kingdom for making guns and other engines of war, nor for household utensils." Copper was also produced in considerable abundance at Ecton Hill, in Staffordshire, previous to its discovery in Cornwall, since Dr. Pot, who wrote in 1686, speaks of the copper mines having been wrought long previous to that date. The Pary's mine, in Anglesea, is believed to have been first opened by the Romans, and became exceedingly productive about the year 1773, and, during the twelve years from that date to 1785, produced such large quantities of copper as to reduce in a very considerable degree the price of that metal throughout Europe. Subsequently to this date, the produce of the Anglesea mines began rapidly to decline, and in 1799 the Pary's Mountain had become almost exhausted, and the price of copper was again raised to £128 per ton. A work entitled "A Just and True Remonstrance of His Majesties Mines-Royall to his Majestie," published in 1641, affords a good idea of the state of lead mining in this country at that time. This little volume consists of a series of letters, or rather memorials, addressed to the King (Charles I.), the Prince of Wales (afterwards Charles II.), and to the Privy Council, by Mr. Bushell and others interested in the "Mines-Royall" of Cardiganshire, praying for the extension of the lease, the employment of convicts in the mines, and the liberty of cutting peat and turf for the purpose of smelting the ores raised. When speaking of the reasons which induced him to undertake these mines, Mr. Bushell says:—"That which first wrought in me a desire to try and fathom those mines, was a sensible discourse delivered me by a *Portugall*, in presence of Sir Francis Godolphin, (by whose death I lost the hope of a most knowing partner), who had been for many years imployed under the King of *Spaine* in his *West Indian Mines*, purporting that if his Master were Soveraine Lord of those Brittish hils, as is your Majestie, he would not doubt but to make them a second *Indies*, and affirming with deepe protestations, that the greatest riches in those mountaines lay in their lowest levels, which I finde to be true by laborious experiment, in those five mountaines; for by this way of working, and driving through the depth of rocks, we are not only freed from the danger and deluge of waters, but also have discovered an increase of rich veines in quantity and qualitie, some containing twentie pound, some fifteene, some tenne, and some six in silver, in the tunne of lead upon the great test, which are answerable to most of the mines of the King of *Spaine*, the Emperour of *Germany*, and the Duke of *Saxony;* moreover we find that by mixing and smelting these severall veines together, the one proves a good additament to the other, and becomes thereby a meanes to advance the Mines-Royall, and in them the good of your kingdome and subjects." He subsequently goes on to say:—"And as I am bound to give to *Cæsar* that which is *Cæsar's*, I must further humbly acknowledge your Majesties large addition to your former royall favours in granting mee (the meanest of your creatures) liberty to give your Majesties impression to such silver as the mole-like miners cast out of the earth, for their speedier payment, for they are the men who make the rocks their resting-place, and expect no other reward or benefit for their sweaty browes then what they gaine from out of the darke cavernes of the earth by harmlesse and importunate labor."

In the memorial praying the employment of convicts in mines, Mr. Bushell enumerates several precedents, both in England and foreign countries, of such persons being condemned to labor for the public good, and "especially for the enlargement of his (the King of Spain's) Indian mines of gold, silver, quicksilver, and the like." On the use of peat and peat-charcoal for the purpose of smelting, Mr. Bushell makes the following observations:—"For furthering and facilitating of which worke I caused a meeting of *Smelters*, *Refiners*, and *Monyers*, to consult and try whether fuel of turfe would separate the oare, extract the silver, and reduce litharge, as well as the vast expence of whole forests of woods formerly consumed for that purpose; and upon an exact triall made thereof, by altering the earthy substance turfe into charkie cyndars, we found by infallible experience, that your Majesties Turffaries will furnish your *Mines-Royall* with fuel to all future ages." The following is given as "The declaration of learned Lawyers what a Mine-Royall is, according to former presidents," and is signed by Sir Ralph Whitfield, "His Majesties Sergeant-at-Law," and about thirty other lawyers of the day:—"Although the gold or silver contained in the base mettall of a mine, in the lands of a subject be of lesse valew then the baser mettall, yet if the gold or silver doe countervaile the charge of the refining, or be of more worth than the base mettall spent in refining it, this is a *Mine-Royall*, and as well the base mettall, as the gold and silver in it, belong by prerogative to the Crowne."

Sir John Pettus, who published his "Fodinæ Regales" in 1670, remarks, while treating of the mines of Cardiganshire: "The chief mines which produce silver now in working (though not effectually) are those at Coomsumblock, and the Darien Hills, Cogincan, Tallabont, Coomustwith, Tredole, Thruscott, and Rossevawre, which were the old Roman works, near to which are conveniently placed the smelting and refining mills, which therefore are called the silver mills, all of which are in the township of Skibery Coed in the parish of Llanny Hangell Genne Glyme, and in the county of Cardigan, *alias* Shire Abertivy." These five great works were wrought for many years with the joint-stock of the first incorporators, under the conduct of themselves; but afterwards Sir Hugh Middleton undertook those in Cardiganshire, paying £400 per annum rent to the society, and he cleared monthly the sum of £2000, and had he not diverted his gains to the making of the new river from Ware to London, certainly he would have been master of a mass of wealth; but great wits and purses seldom know how to give bounds to their designs, and, by undertaking too many things, fail in all. And we may further give credit to the beneficialness of those mines, when, as Mr. Thomas Bushell, by his knowledge and ingenuity to work them to the best advantage, did find business enough there for a mint, and with the product thereof made provision for the clothing of the late King's whole army." In speaking of the tin mines of Cornwall, Camden makes the following observations: "After the comming in of the Normans, the Earles of Cornwal gathered great riches out of these mines, and especially Richard, brother to King Henrie the Third: and no marvell, sith that in those daies Europe had tinne from no other place; for the incursions of the Mores had stopped up the tinne mines of Spaine, and as for the tinne veines of Germanie, which are in Misnia and Bohemia, they were not as yet knowen, and those verily not discovered before the yeere after Christ's nativitie 1240. For then (as a writer of that age recordeth) *was tinne mettall found in Germanie, by a certain Cornishman driven out of his native soile, to the great losse and hindrance of Richard, Earle of Cornwal.* This Richard began to make ordinances for these tin works, and afterward Edmund his sonne granted a charter and certain liberties, and withall prescribed certaine lawes concerning the same, which he ratified or strengthened under his seale, and imposed a tribute or rent upon tinne to be answered unto the Earls. "These liberties, priviledges, and lawes, King Edward the Third did afterward confirme and augment. The whole commonwealth of those tinners and workmen, as it were one bodie, hee divided into four quarters which of the places they call *Foy-more, Blackmore, Trewarnaile*, and *Penwith*. Over them all he ordained a warden called *Lord Warden of the Stanniers, of Stannum*, that is, *Tinne;* who giveth judgement as well according to equitie and conscience as law, and appointed to every quarter their stewards, who once every iij. weeks (every one in his severall quarter) minister justice in causes personall between Tinner and Tinner, and between Tinner and Forrainer, except in causes of land, life, or member,—From whom there lieth an appeale to the Lord Warden, from him to the Duke, from the Duke to the King. In matters of moment, there are by the Warden generall parliaments or severall assemblies summoned, whereunto jurats are sent out of every Stannarie, whose constitutions do bind them. As for those who deale with tinne, they are of foure sorts: the owners of the soile, the adventurers, the merchants, or regraters, and the laborers, called the *Spaniards* (of their spade) who, poore men, are pitifully out-eaten by usurious contracts." In the reign of King John, the production of tin in the county of Cornwall was so small that the farms of that mineral yielded no more than 100 marks per annum, according to which valuation the Bishop of Exeter received, in lieu of his tenth part, the sum of £6 13*s*. 4*d*., while those in Devonshire at the same period amounted to £100 per annum. Although tin mining appears to have been extensively carried on from the earliest period of our history, it is nevertheless evident, from the following account given by Carew of the method of dressing tin ore in the reign of Queen Elizabeth, that but few refinements had been introduced into this branch of industry at that time: "As much almost dooth it exceede credite, that the tynne, for and in so small quantitie digged vp with so much toyle, and passing afterwards thorow the managing of so many hands, ere it come to sale, should be any way able to acquite the cost; for being once brought aboue ground in the stone, it is first broken in peeces with hammers, and then carryed, either in waynes or on horses backs, to a stamping-mill, where three, and in some places sixe, great logges of timber, bounde at the ends with yron, and lifted vp and downe by a wheele driven with the water, doe break it smaller. The stream, after it hath forsaken the mill, is made to fall by certaine degrees, one somwhat distant from another, vpon each of which, at every discent, lyeth a green turfe, three or four foot square, and one foot thicke. On this the tynner layeth a certayne portion of the sandie tynne, and with his shuell softly tosseth the same to and fro, that through thus stirring the water which runneth over it, may wash away the light earth from the tynne, which, of a heauier substance, lyeth fast on the turfe. Hauing so cleansed one portion, he setteth the same aside, and beginneth with another, vntil his labor take end with his taske. After it is thus washed, they put the remnant into a wooden dish, broad, flat, and round, being about two foote ouer, and having two handles fastened at the sides, by which they softly shogge the same to and fro in the water between their legges, as they sit ouer it, untill whatsoever of the earthie substance that was left be flitted away. Some of later time, with a sleighter inuention and lighter labor, doe cause certayne boyes to stir it vp and down with their feete, which worketh the same effect: the residue, after this often cleansing, they calle black tynne. But sithence I gathered sticks to the building of this poor nest, Sir Francis Godolphin entertained a Duch mynerall-man, and taking light from his experience, but building thereon farre more profitable conclusions of his owne inuention, hath practised a more saving way in these matters, and, besides, made tynne with good profit of that refuse which tynners rejected as nothing worth."

In the year 1693, in consequence of a fall in the price of tin, the tinners of the counties of Cornwall and Devon published a proposal for the redress of their grievances, and the raising of the price of that metal. This document, after setting forth the various means by which the object is to be attained, concludes with the following appeal to the king and nation:—

"Henry the Eighth of this great nation,
Began the famous Reformation,
His daughter, Queen Elizabeth,
Finisht the second ere her death;
And now the King is almost rife
To cut the third out to the life,
And raise the nation to that stature
For which it was cut out by nature,
And 'twas the nature of our white tin,
From whence it hath the name of Britain."

Pryce, who wrote in 1778, describes the various methods of treating tin ores then employed and which very closely resemble—exception being made of certain mechanical appliances—those now in use. He, however, very properly remarks that "the mode of dressing tin and its leavings are too numerous to lay before the reader without danger of prolixity. All of them depend upon the difference of the kinds of tin in the stone, and must be dealt with, agreeable to the judgment of the several manufacturers. So much depends upon the skill of a dresser, that one may save one-twelfth part of a batch of tin, which another for want of equal knowledge may cast away in waste, or perhaps take up so much waste with it as to depreciate the value of the whole by two parts in twenty. Nevertheless, all the dressers save the hinder stuff from the frame end, as it washes off in a pit, by the name of catchers, which is expressive enough; and likewise the mud at the trunk ends, by the other name of loobs, both of which are denominated the loobs, after leavings, or leavings of leavings. These are wrought over in the same manner as the former, mostly upon tribute, by an aged workman and a few little boys in the summer months, when they can stand out in good weather, and do a long day's easy labor. The tribute paid by the undertaker is one-third of the produce in white tin; the other two-thirds he has for himself to pay his cost and charges." The smelting of tin ores in Cornwall appears to have been anciently conducted in furnaces scooped out of the ground, and in which a mixture of black tin and charcoal was employed, the heat being kept up by means of a blast supplied by the aid of rude bellows. Remains of ancient establishments of this kind are frequently met with in various parts of the country, and are known by the name of "Jews' Houses." Not long since a relic of this description was found buried beneath a stratum of peat, twelve feet in thickness, at Redmoor, in the parish of Luxillian. At this place, in addition to a considerable amount of metallic tin, more or less oxidised on the exterior, large quantities of imperfectly fused scoriæe, mixed with imbedded charcoal and metallic globules, were discovered. A Romano-British fibula, some stone arrow-heads, a fragment of an earthen tuyere, and numerous blocks of peat, which had evidently been collected for the purpose of being employed as fuel, and subsequently covered by a deposit of the same material, were also found.

Another ancient smelting-house found in the same neighborhood was probably of a more recent date; since not only were portions of the stonework of the furnace still *in situ*, but the slags were more completely fused, and entirely free from metallic globules. These slags presented the appearance of thin fragments of bottle-glass, and were found on analysis to have the following composition:—

ANALYSIS ON 100 PARTS.

Silica	40·60
Alumina	19·22
Oxide of tin	22·95
Protoxide of iron	7·31
Sulphide of iron	9·04
Lime	Traces
Potash	1·00
	100·12

In this place were discovered fragments of tobacco-pipes, and a silver coin of Charles I. Previous to the time of Charles I. no attempt had been made to effect the smelting of tin by means of pit-coal; but at this period some unsuccessful experiments were undertaken by Sir Beville Greenville, of Stow, in Cornwall: no satisfactory results were, however obtained till the second year of the reign of Queen Anne, when a Mr. Liddell, with whom was associated a Mr. Moult, celebrated for his knowledge of chemistry, obtained letters patent for the reduction of tin ores by the use of fossil-fuel in a blast furnace. The invention of the reverberatory furnace soon followed this discovery. This apparatus, slightly modified in form and dimensions, is employed by the tin-smelters of the present day. Coal was not generally employed as fuel until the beginning of the reign of Charles I. It is, however, mentioned in documents anterior to the reign of Henry III.; for that monarch, in the year 1234, renewed a charter granted by his father to the inhabitants of Newcastle, who were permitted to dig for coal upon paying a yearly tax of £100. That fossil fuel had been introduced into London before 1306, is proved by the fact that in that year its use was prohibited, from the supposed tendency of its smoke to corrupt the atmosphere. The coal-fields at Colliery, near Lanchester, were first opened in the year 1330; those at Merrington and Ferry Hill in 1343; and those of Gateshead, Wickham, and Tynemouth in 1500. In 1625, a patent was granted by James VI. of Scotland to Mr. Ramsey for machinery to be employed in draining collieries by water-power. Grey, in his "Chronographia," published in 1649, says:—"Some South gentlemen, upon hope of benefit, came in to this county (Durham) to hazard their monies in coal mines. Mr. Beaumont, a gentleman of great ingenuity and rare parts, adventured into our mines with his £30,000 who brought with him many rare engines not known then in these parts, as the art to bore with rods, to try the deepness and thickness of the coal, rare engines to draw water out of the pits, wagons with one horse to draw coal from the pits to the staiths, to the river, &c. Within a few years he consumed all his money, and rode home upon his light horse."

"Now the trade of coal began not past *fourscore years* since. Coals in former times were only used by smiths, and for burning lime. Notwithstanding this, it appears that in 1602 the trade had arrived at such an extent as to occupy twenty-eight acting fitters, or hostmen, who were to vend by the year nine thousand and eighty tons of coal, and find eighty-five keels for that purpose."

"In the year 1600, among other regulations made at a Courte of the Hostman's Company at Newcastle, wains were ordered to be measured and marked; for it appears that 'for time out of mind yt hath been accustomed that all cole wains did usuallie carry and bring eighte boules of coles to all the staiths upon the ryver of Tyne; but of late several had brought only or scarce seven boules.' The same record mentions 'two small maunds or pannyers, holdinge two or three pecks a-piece.'"

From the foregoing paragraphs it appears that coals were in those days not only carried in carts along ordinary roads, but also on the backs of horses. Amongst the rare engines introduced by "Master Beaumont" into the coal trade, were, "waggons with one horse to carry down coales from the pits to the staiths, to the river." They are thus described by Lord Keeper Guilford:—The manner of the carriage is by laying rails of timber from the colliery down to the river, exactly straight and parallel, and bulky carts are made with four rollers fitting these rails, whereby the carriage is so easy that one horse will draw down four or five chaldrons of coals, and is an immense benefit to the coal merchants." In 1676, Lumley Colliery, as well as the collieries of Heaton and Jesmond, had chain pumps worked by water-wheels. The earliest mention of a steam-engine for mining purposes is at the colliery of Griff, near Coventry, in the year 1711; and in the following year, Newcomen and Crawley contracted to pump water by this means, for Mr. Black, of Wolverhampton. Mr. Bald, in his "Coal Trade of Scotland," published in 1812, says, that in 1690, water-wheels and chains of buckets were commonly employed to drain the collieries in that country. The axle of the wheel extended across the pit's mouth, and small carriers were fixed upon it to receive endless chains, consisting of two or three tires, which reached down to the coal. To these chains were attached wooden buckets or troughs in a horizontal position, which circulated with the chains, ascending on one side, and descending on the other, filling at the bottom, and discharging at the top, as they turned over the wheels on the great axletree. This apparatus was subject to the inconvenience that, whenever a joint gave way, the whole set of chains fell to the bottom, every bucket being splintered to pieces by the fall. When water could not be procured, the same sort of machinery upon a smaller scale was worked by horses. In 1708, windmills were erected to work pumps in several collieries in Scotland; but, being ineffective in calm weather, their application was very limited. In 1709, John, Earl of Mar, who paid great attention to the improvement of his collieries in Clackmannanshire, sent the manager of his works to Newcastle to inspect the machinery of that district. From the report of this gentleman, it appears that the machines there in use were water-wheels, and horse-engines, furnished with chain-pumps: the common depth of the pits being from twenty to thirty fathoms, whilst a few were from fifty to sixty fathoms deep. When it was found requisite to draw water from the depth of thirty fathoms, two pits were usually sunk. The first of these was made thirty fathoms deep; and the other only half that depth. One machine drew the water half-way up the deeper pit, where it was poured into a level communicating with the bottom of the other; from this the water was raised to the surface by another machine. In deep mines, a third pit with a third machine was resorted to. In Scotland, however, at the same time, the machinery employed was more powerful, since water was raised at once from the depth of forty fathoms, by a chain of buckets as before described. The first steam engine created near Newcastle, was put up at Byker, in 1714, by the son of a Swedish nobleman, who taught mathematics. These engines were worked by atmospheric pressure above the piston, whilst the vacuum beneath was created by the injection of water into the cylinder; the alternate movements were executed by the hand of an attendant, until the year 1718, when a Mr. Beighton invented a method of performing this operation by means of the engine itself. The history of mining in England is intimately connected with that of the steam-engine; and we invariably find that the mining districts have been the fields of operation for the inventors and early improvers of this machine. In this way, mining has not only been vastly benefited by the application of steam-power, but, on the other hand, has itself in a great degree contributed to produce the present high state of perfection to which this machine has been brought. The old atmospheric engine was capable of raising 5,000,000 lbs. of water one foot high, by the expenditure of one bushel of coal. In 1776, Watts' improved engine yielded an average of 18,900,000. In 1800, the duty had been raised to 20,000,000. In 1820, the average duty of thirty-seven Cornish engines was 28,736,398. In 1828, the fifty-four engines reported afforded an average duty of 37,000,000. The total number of engines reported in 1856 was forty-six; and their mean duty, 44,650,000. Of these machines some are known to have performed more than 100,000,000; and still better results have been obtained by the employment of high-pressure condensing engines, and a greater length of stroke in the cylinder.

—*Compiled from "Records of Mining and Metallurgy," by Philips & Darlington.*

IRON; HISTORICALLY CONSIDERED.

THE use of iron can be traced to the earliest ages of antiquity. It was first used in Asia, the birthplace of the human race, and soon after the time when "men began to multiply on the face of the earth." Tubal Cain who was born in the seventh generation from Adam, is described as "an instructor of every artificer in brass and iron." The Egyptians, whose existence as a nation probably dates from the second generation after Noah, and whose civilization is the most ancient of which we have any exact knowledge, were at an early period familiar with the use of iron, and it seems probable that they were engaged in its manufacture. Iron tools are mentioned by Herodotus as having been used in the construction of the pyramids. In the sepulchres at Thebes and Memphis, cities of such great antiquity that their origin is lost, butchers are represented as using tools which archæologists decide to have been made of iron and steel. Iron sickles are also pictured in the tombs at Memphis, and at Thebes various articles of iron have been found which are preserved by the New York Historical Society and are probably three thousand years old. Keurick, in his *Ancient Egypt under the Pharaohs*, is authority for the statement that Thothmes the First, who reigned about seventeen centuries before Christ, is said, in a long inscription at Karnak, to have received from the chiefs, tributary kings, or allied sovereigns of Lower Egypt, presents of silver and gold, "bars of wrought metal, and vessels of copper, and of bronze, and of iron." From the region of Memphis he received wine, iron, lead, wrought metal, animals, etc. An expedition which the same king sent against Chadasha returned, bringing among the spoil "iron of the mountains, 40 cubes." Belzoni found an iron sickle under the feet of one of the sphinxes at Karnak, which is supposed to have been placed there at least six hundred years before Christ.

A piece of iron was taken from an inner joint of the great pyramid at Gizeh in 1837. The reference to iron in Deuteronomy, iv. 20, apparently indicates that in the time of Moses the Egyptians were engaged in its manufacture, and that the Israelites, if they did not make iron for their taskmasters, were at least familiar with the art of manufacturing it. "But the Lord hath taken you, and brought you forth out of the iron furnace, even out of Egypt." This expression is repeated in I. Kings, viii. 51. A small piece of very pure iron was found under the Egyptian obelisk which has recently been removed to New York. The use of iron and the art of manufacturing it were introduced into the southern and western portions of Arabia at a very early day, and this may have been done by the Egyptians; it is at least established that some of their own works were located east of the Red sea. In 1873 the ruins of extensive iron works of great antiquity and of undoubted Egyptian origin were discovered near the Wells of Moses, in the Sinaitic peninsula. The country which lay to the south of Egypt is supposed to have produced iron in large quantities. Iron was also known to the Chaldeans, the Babylonians, and the Assyrians, who were cotemporaries of the early Egyptians. Some writers suppose that the Egyptians derived their supply of iron principally from these Asiatic neighbors and from the Arabians. Babylon was built about seventeen centuries before Christ, and Nineveh was of about equal antiquity. Iron ornaments have been found in Chaldean ruins, and Chaldean inscriptions show that iron was known to the most ancient inhabitants of Mesopotamia. In the ruins of Nineveh the antiquarian Layard found many articles of iron and inscriptions referring to its use. Among the articles discovered by him were iron scales of armor, from two to three inches in length. "Two or three baskets were filled with these relics." He also found a "perfect helmet of iron, inlaid with copper bands." In the British Museum there are preserved several tools of iron which were found at Nineveh by Layard, including a saw and a pick. The art of casting bronze over iron, which has only recently been introduced into modern metallurgy, was known to the Assyrians. At Babylon iron was used in the fortifications of the city just prior to its capture by Cyrus, in the sixth century before Christ. In a celebrated inscription Nebuchadnezzar declares: "With pillars and beams plated with copper and strengthened with iron I built up its gates." The huge stones of the bridge built by his daughter, Nitocris, were held together by bands of iron fixed in place by molten lead.

The Book of Job, which relates to a patriarchal period between Abraham and Moses, contains frequent references to iron, "even to bars of iron," "barbed irons," "the iron weapon," and "the bow of steel." In the 28th chapter and 2d verse it is declared that "iron is taken out of the earth." In the 19th chapter and 24th verse the "iron pen," which could be used to engrave upon a rock, is mentioned. Job is supposed to have lived in the northern part of Arabia, in the Land of Uz, which was separated from Ur of the Chaldees, where Abraham was born, by the Euphrates. Iron ore of remarkable richness is still found between the Euphrates and the Tigris. Moses led the children of Israel out of Egypt fifteen or sixteen hundred years before the Christian era. In the story of their wanderings iron is frequently mentioned. In Leviticus, vii. 9, the frying-pan is mentioned. When the Israelites under Moses spoiled the Midianites they took from them iron and other metals; when they smote Og, the king of Bashan, they found with him an iron bedstead. Canaan, the Land of Promise, was described by Moses in Deuteronomy, viii. 9, as "a land whose stones are iron." Iron is still made in the Lebanon mountains. In Deuteronomy, xxvii. 5, 6, and in Joshua, viii. 31, the use of iron tools in building an altar of "whole stones" to the Lord is prohibited, which shows that, not only did the Israelites in the days of Moses have a knowledge of iron tools that would cut stone, but that the Egyptians must have possessed the same knowledge. After the Israelites came into possession of Canaan iron is frequently mentioned in their history, some of the earliest references being to chariots of iron, which the Canaanites used in their wars with them, and which were probably armed with iron scythes. Chariots of the same kind were doubtless used by the Egyptians. Frequent mention is made of agricultural implements and tools of iron, and of iron weapons of war. In the description of the armor of Goliath it is said that "his spear's head weighed six hundred shekels of iron." Axes and saws and harrows of iron are mentioned in the reign of David, and axes and hammers and tools of iron in the reign of Solomon. Isaiah also speaks of harrows of iron. Daniel says that "iron breaketh in pieces and subdueth all things." When David, about a thousand years before Christ, made preparations for the building of the temple he "prepared iron in abundance for the nails for the doors of the gates and for the joinings;" and in his instructions to Solomon concerning it he said that he had prepared "brass and iron without weight," and that of gold, silver, brass, and iron "there is no number." It would appear that the Israelites in the early part of their history were not skilled in the manufacture or manipulation of iron, but were generally dependent upon their neighbors for iron itself and for the skill to fashion it. In the reign of Saul, because of the oppression of the Philistines, "there was no smith found throughout all the land of Israel; but all the Israelites went down to the Philistines to sharpen every man his share, and his coulter, and his axe, and his mattock." When Solomon came to build the temple he sent to Hiram, king of Tyre, for "a man cunning to work in gold, and in silver, and in brass, and in iron." The Phœnicians were celebrated as workers in all the metals. In Jeremiah, xv. 12, the question is asked by the prophet: "Shall we break the northern iron and the steel?" The northern iron and steel here referred to were probably products of Chalybia, a small district lying on the southeastern shore of the Euxine, the inhabitants of which, called Chalibees or Chalybians, were famous in the days of Asiatic pre-eminence for the fine quality of their iron and steel. Herodotus, in the fifth century before Christ, speaks of "the Chalybians, a people of iron-workers." They are said to have invented the art of converting iron into steel, but it is probable that, as they used magnetic sand, they made steel mainly. Latin and Greek names for steel were derived from the name of this people. From the same source we obtain the words "chalybean" and "chalybeate." But other eastern nations doubtless made steel as early as the Chalybians. In Ezekiel, xxvii. 12, the merchants of Tarshish are said to supply Tyre with iron and other metals, and in the 19th verse of the same chapter the merchants of Dan and Javan are said to supply its market with "bright iron." Tarshish is supposed to have been a city in the south of Spain, and Dan and Javan were probably cities in the south of Arabia. The name Tarshish may, however, have referred generally to the countries lying along the western coast of the Mediterranean and beyond the Pillars of Hercules. Dan and Javan may have supplied iron made in the southern part of Arabia, or they may have traded in the "bright iron," or steel, of India. The period embraced in the references quoted from the prophet was about six hundred years before Christ. Both Tyre and Sidon traded in all the products of the East and the West for centuries before and after Ezekiel, and iron was one of the products which they supplied to their neighbors, the Israelites. The Persians and their northern neighbors, the Medes, made iron long before the Christian era, and so did the Parthians and other Scythian tribes. The Parthian arrow was first tipped with bronze, but afterwards with steel. The Parthian kings are said to have engaged with pride in the forging and sharpening of arrow-heads. Iron is still made in Persia by primitive methods.

India appears to have been acquainted with the manufacture of iron and steel from a very early period. When Alexander defeated Porus, one of the Punjaub kings, in the fourth century before the Christian era, Porus gave him thirty pounds of Indian steel, or wootz. This steel, which is still made in India and Persia, was a true steel, and of a quality unsurpassed even in our day. It was and still is manufactured by a process of great simplicity, similar to that by which crucible steel is now manufactured. Long prior to the Christian era, as well as for many centuries afterwards, Damascus, the capital of Syria, manufactured its famous swords in part from Indian wootz. The people of India further appear to have become familiar, at an early period in their history, with processes for the manufacture of iron on a large scale which have since been lost.

It is circumstantially stated that a cylindrical wrought-iron pillar is now standing at the principal gate of the ancient mosque of the Kutub, near Delhi, in India, which is about 60 feet long, 16 inches in diameter near the base, contains about 80 cubic feet of metal, and weighs probably over 17 tons. The immense proportions of this pillar are not more striking than its ornate finish. An inscription in Sanscrit is variously interpreted to assign its erection to the ninth or tenth century before the Christian era or to the early part of the fourth century after it. In the ruins of Indian temples there have been found wrought-iron beams similar in size and appearance to those used in the construction of buildings at the present time. Metallurgists are unable to understand how these large masses of iron could have been forged by a people who appear not to have possessed any of the mechanical appliances for their manufacture which are now necessary to the production of similar articles. The period at which China first made iron is uncertain, but great antiquity is claimed for its manufacture in that mysterious country. In a Chinese record which is supposed to have been written two thousand years before Christ iron is mentioned, and in other ancient Chinese writings iron and steel are both mentioned. Pliny the Elder, writing in the first century of the Christian era, thus speaks of the iron of China, the inhabitants of which were known in his day as the Seres: "Howbeit, as many kinds of iron as there be, none shall match in goodness the steel that cometh from the Seres, for this commodity also, as hard ware as it is, they send and sell with their soft silks and fine furs. In a second degree of goodness may be placed the Parthian iron." It may be assumed as susceptible of proof that the knowledge of the use of iron, if not of its manufacture, was common to all the people of Asia and of Northern Africa long previous to the Christian era. The Phœnicians would carry this knowledge to their own great colony, Carthage, which was founded in the ninth century before Christ, and to all the colonies and nations inhabiting the shores of the Mediterranean. Phœnician merchants obtained iron from such distant countries as Morocco and Spain, and possibly even from India and China, as well as from nearer sources. But in time the merchants of Tyre and the "ships of Tarshish" deserted the places that long had known them, empire after empire fell in ruins, and with the fading away of Asiatic and Africian civilization and magnificence the manufacture and the use of iron in Asia and Africa ceased to advance. Egypt has probably not made iron for nearly three thousand years, and probably no more iron is made in all Asia to-day than was made in its borders twenty-five centuries ago, when Babylon was "the glory of kingdoms, the beauty of the Chaldees' excellency."

The Early Use of Iron in Europe.—The authentic history of the use of iron in Europe does not begin until about the period of the first Olympiad, corresponding to the year 776 before the Christian era, although both Grecian poetry and the traditions of the Grecian heroic age have transmitted to us many references to iron long prior to that period. About the time of Moses the Phœnicians are said to have introduced into Greece the art of working in iron and other metals. Minos, king of Crete, was indebted to them for the tools which enabled him to build his powerful fleet. In the fifteenth century before Christ the burning of the forests on Mount Ida, in Crete, is said to have accidentally communicated to the inhabitants the art of obtaining iron from native ores. This discovery enabled the Idæi Dactyli, who were priests of Cybele, to introduce the manufacture of iron and steel into Phrygia, a Greek colony in Asia Minor. So read some of the stories which have come down to us from the heroic age of Greece, and which, like the well-known story of Vulcan and his forges on the island of Lemnos, may be wholly fabulous; but there is nothing improbable in the conclusion which may be derived from them, that they point to a very early use of iron by the Greeks. From Phœnicia certainly, and probably also from Egypt, they would be likely to derive a knowledge of its use in the mechanic arts at least a thousand years before Christ. It is worthy of notice that the mythologies of both Greece and Egypt attributed the invention of the art of manufacturing iron to the gods—a fact which of itself may be regarded as establishing the great antiquity of the art in both countries.

We come next to that period of Grecian history which introduces us to historical personages and historical events. Lycurgus, who lived about the time of the first Olympiad, required the Spartans to use iron as money; he "allowed nothing but bars of iron to pass in exchange for every commodity." These bars, for which iron rings or quoits were afterwards substituted, may have been made from the iron ores which were found in abundance in Laconia, or they may have been obtained abroad; but the use of iron as a measure of value in the days of Lycurgus indicates that this metal could not then have been a rare commodity. If it had been a precious metal Lycurgus would not have enforced its use as money. The iron ores of Elba were worked by the Greeks as early as the year 700 before Christ. They called the island Æthalia, "from the blazes of the iron works." The working of the ores of this island is mentioned by Herodotus, who lived in the fifth century before Christ; by Diodorus, a Sicilian historian of the first century before Christ; and by Strabo, a Greek traveler and geographer, who lived at the beginning of the Christian era. The Phœnicians made iron on the island of Eubœa at a very early day, and the Greeks afterwards actively prosecuted the same pursuit. Strabo speaks of the mines of Eubœa as being partially exhausted in his day. In Bœotia, on the mainland of Greece, iron was also made in very early times, and probably in other parts of the Grecian mainland and on the Grecian islands where iron ores are now found. On the island of Seriphos the ores are of the richest quality. Herodotus speaks of iron heads to lances and arrows in his day. He also mentions a silver bowl inlaid with iron, the work of Glaucus the Chian, which Alyattes dedicated at Delphi about the year 560 before Christ. Chalybian steel was imported into Greece in the time of Herodotus; and in the time of Aristotle, who lived a century later, the Greeks were themselves familiar with the manufacture of steel. Sophocles, who died in the year 406 before Christ, speaks of the tempering of iron in water. The manufacture of swords of steel about this time received some attention in Greece, as it did elsewhere. The father of Demosthenes, who was a manufacturer of arms, probably made steel swords. Iron and steel weapons of war began to displace those of bronze in most Mediterranean countries about the time of the battle of Marathon, which was fought in the year 490 before Christ. When Xerxes invaded Greece, ten years after the battle of Marathon, the Assyrians in his army carried wooden clubs "knotted with iron." The use of iron scythes as well as iron sickles was common among the Greeks about this time. Alexander, in the fourth century before Christ, is said by Pliny to have strengthened a bridge over the Euphrates, at Zeugma, with a chain made of links of iron. Daimachus, a writer who was cotemporary with Alexander, enumerates four different kinds of steel and their uses—the Chalybdic, Synopic, Lydian, and Lacedæmonian. Each kind of steel was adapted to the manufacture of a particular tool. From the Chalybdic and Synopic were made ordinary tools; from the Lacedæmonian were made files, augers, chisels, and stone-cutting implements; and from the Lydian were made swords, razors, and surgical instruments. The accounts left by this and other writers indicate great proficiency by the Greeks in the use of steel, and the possession of much skill in its manufacture. According to accepted chronology, Rome was founded in the year 753 before the Christian era. It reached the culmination of its power about the end of the first century of that era. From its foundation to the beginning of its decline embraced a period of about nine hundred years. During the first part of this period Rome was favored with the experience of older nations in the use and manufacture of iron, and during the last part of it she greatly contributed by her energy and progressive spirit to extend its use and to increase its production. The Greeks were the great teachers of the Romans in all the arts, including metallurgy; but the Etruscans, who were the near neighbors of the Romans, and whom they in time supplanted, also contributed greatly to their knowledge of the arts of ancient civilization. The Etruscans, however, owed their civilization in large part, to the Tyrrhenian Greeks, with whom they coalesced centuries before Rome was founded. Etruria was largely devoted to commerce, and among the countries with which it traded were Phœnicia and Carthage, as well as Greece and its colonies. From all these countries Etruscan civilization was invigorated and diversified, and Rome in its early days enjoyed the benefit of this invigoration and diversification. That it early acquired from the Etruscans a knowledge of the use and manufacture of iron can easily be imagined, and subsequent direct contact with Grecian colonies and with Greece itself would extend this knowledge. The island of Elba lay off the Etruscan coast, and, as has already been stated, its iron ores were extensively used by the Greeks about the time when Rome was founded. Its mines were also worked by the Etruscans, and its ores were smelted both on the island and on the mainland. They were also taken to other countries to be converted into iron. After a lapse of twenty-five centuries the iron ores of this celebrated island are still exported, many cargoes finding their way to the United States. The Romans would also obtain iron from the islands of Corsica and Sardinia, but chiefly from the former. This island was occupied by the Ligurians and the Etruscans about the time of the founding of Rome, and by the Etruscans for centuries afterwards. The Carthaginians succeeded the Etruscans, and the Romans the Carthaginians. Iron was made in Corsica from the earliest times, and is still made in small quantities. The island has given a name to the Corsican forge, which is yet in use. A few years ago ten of these forges were in operation in Corsica, and they were probably almost identical in character with those which were used on the island when Rome was founded.

Some of the swords and javelins of the Romans were made of iron or steel in the fifth century before the Christian era, but their agricultural implements, as has been shown in the reference to Etruria, were made of iron at an earlier period. The Roman battering-ram, which was borrowed from the Greeks, had a head of iron, and iron rings were placed around its beam. The Romans used this engine of war at the siege of Syracuse, in the year 212 before Christ. Prior to this time iron and steel tools were in common use among the carpenters, masons, shipwrights, and other tradesmen of Rome. At the beginning of the Christian era iron was in general use throughout the Roman Empire, the supply being derived from many countries which were subject to its sway. In the Acts of the Apostles, xii. 10, is a statement which indicates that iron was used at this period for architectural purposes and in public works. "When they were past the first and second ward they came unto the iron gate that leadeth unto the city." Iron was, however, used especially for tools, agricultural implements, and weapons of offense and defense. Pliny says that "iron ores are found almost everywhere," and that "the processes for refining the metal are nearly everywhere the same." It does not appear, however, that the Romans made iron at this time either at Rome or in its immediate vicinity. Pliny remarks that "in abundance of metals of every kind Italy yields to no land whatever, but all search for them has been prohibited by an ancient decree of the Senate." This prohibition probably applied only to the territory surrounding Rome. Vestiges of iron used by the Romans in the first century after Christ have been found in the ruins of the Coliseum, which was built by the Emperor Vespasian. This iron was used as clamps to bind together the stones of that remarkable structure. Iron has also been found in the ruins of Pompeii, which was destroyed about the time the Coliseum was built. In the northern part of Italy, just south of the Alps, corresponding to Piedmont and Lombardy of the present day, iron was made by the Romans in the first and second centuries before the Christian era. Pliny speaks of the excellence of the water at Comum, now Como, for tempering iron, although iron ores were not found there. Among the provinces which contributed largely to the Roman supply of iron at this time was Noricum, corresponding to Styria and Carinthia in Austria. Both Pliny and Ovid, who lived at the beginning of the Christian era, speak of Norican iron as being of superior quality, and it is certain that *ferrum noricum* was celebrated throughout Italy before their day. The best of swords were made from it in the reign of Augustus: Horace speaks of them. The spathic ores of Styria and Carinthia are still held in high favor; and the supply of ore, especially in the famous iron mountains of Erzberg and Huttenberg, shows no signs of exhaustion at the end of twenty centuries of almost constant use. Iron is still made in these provinces of Austria in small forges which are almost as primitive in character as those used by their ancient Celtic inhabitants. Celtic and Roman implements and medals, including a coin of the Emperor Nerva, who lived in the first century of the Christian era, have been found in mounds of slag in the vicinity of Carinthian mines. Cotemporaneously with the working of the Norican iron mines by the Celts, the Quadi, who inhabited the province of Moravia, lying north of Noricum, also made iron. The geographer Ptolemy, who lived in the second century of the Christian era, makes mention of the Quadi as ironworkers. Great antiquity is also claimed for the iron industry of that vast country which was known to the Romans as Sarmatia, now known as Russia in Europe. The nomadic Scythians would doubtless carry the art of ironmaking to the Ural mountains, where iron ore was and still is abundant. One of the Greek poets calls Scythia "the mother of iron"—Scythia comprising the countries lying north, east, and south of the Caspian sea.

The Phœnicians are known to have founded colonies in France and in Spain prior to the sixth century before Christ. They had settlements in Southern Gaul, on the Garonne and Rhone. The ancient city of Massilia, now Marseilles, is supposed to occupy the site of a Phœnician trading-post, which fell into the possession of the Phocæan Greeks about the period we have mentioned, who gave to it great commercial and manufacturing importance. The Greeks also planted other colonies in Southern France. The city of Tartessus, or Tarshish, is supposed to have been one of the Phœnician settlements in the south of Spain; the city of Gades, or Cadiz, was another. Tartessus stood between the two arms of the Guadalquivir; but in the time of Strabo, who died about the year 25 of the Christian era, it had ceased to exist; Gades was its near neighbor, and still exists. It is probable that the Phœnicians introduced the manufacture of iron among the native inhabitants of France and Spain; the Iberians and Celtiberians of the latter country were certainly active in mining and working in metals several hundred years before the Christian era, and enjoyed an extensive trade in metals with Tyre and Carthage. Under Grecian influence, which succeeded that of the Phœnicians in Spain, the Celtiberians, who inhabited the central and northeastern parts of the country, continued to make iron, and to this was joined the manufacture of steel. The famous forges of Aragon and Catalonia were active during the Grecian occupation of Spain. The Romans succeeded the Carthaginians. The Romans greatly extended the arts of their advanced civilization among the native inhabitants. They gave special encouragement to the manufacture of iron and steel, although in justice to the Celtiberians it must be said that their metallurgical skill was at least equal to that of the Romans. Polybius, a Greek historian, who flourished in the second century before Christ, says that the helmet and armor of the Roman soldier were of bronze, but that the sword was a cut-and-thrust blade of Spanish steel. At the battle of Cannæ, in the year 216 before Christ, the Romans had learned from the Carthaginians at very great cost the value of the Spanish sword. Livy has recorded the fines which were imposed by Cato the Censor on the Celtiberian iron works after the Roman war with Spain in the year 194 before Christ. About the time these fines were imposed, the town of Bilbilis, near the present Moorish-built town of Calatayud, in Aragon, and the little river Salo were celebrated as the center of the iron district of Celtiberia. The water of the Salo was supposed to possess special qualities for the tempering of steel. The same excellence was attributed to other streams in Spain and in some other countries. Diodorus speaks of the excellent two-edged swords, "exactly tempered with steel," and of other arms which the Celtiberians in Aragon manufactured from rods of iron which had been rusted in the ground "to eat out all the weaker particles of the metal, and leave only the strongest and purest." He says that the swords which were manufactured from these rods "are so keen that there is no helmet or shield which cannot be cut through by them." Plutarch, who died about the year 140 of the Christian era, gives the same account of the Celtiberian method of purifying iron. Pliny speaks of the excellent iron of Bilbilis and Turaisso, the latter a town in Tarragona, and of an extensive mountain of iron upon the coast of Biscay, probably Somorrostro. Iron ore from the coast of Biscay is now exported in large quantities to Great Britain, the United States, and other countries. Toledo has been famous since the Roman occupation of Spain for its manufacture of swords, but this industry existed at Toledo before the appearance of the Romans. The town was captured by them in the year 192 before Christ. The Roman army from that time forward was provided with steel swords from Toledo and other places in Spain. The manufacture of Toledo blades probably attained its greatest development in the fifteenth and sixteenth centuries. The business still continues. A certain degree of mystery has always surrounded the manufacture of these swords, and the same may be said of the manufacture of the equally-celebrated Damascus blades.

The iron industry of Spain was the first in the world for many hundred years after the Romans obtained a foothold in the country, surviving the downfall of the Roman power in the peninsula, and flourishing under the subsequent rule of the Visigoths. This distinction was strengthened when the Moors became masters of the greater part of Spain, in the beginning of the eighth century of the Christian era. They stimulated the further development of the iron manufacture in the districts subject to their sway. At the same time the native inhabitants who had successfully resisted the Moorish arms continued to push their small Catalan forges still farther into the Pyrenees and along the coast of Biscay, lighting up the forests in every direction. So prominent did the iron industry of Spain become that its iron-workers were sought for by other countries, and on the French side of the Pyrenees, and in the mountains of Germany, and along the Rhine, they set up many of their small forges. The Catalan forge, which received its name from Catalonia, has been introduced into every civilized country of modern times that produces iron, and it still exists in almost its original simplicity in the mountains of both Spain and France. France did not at an early period in its history make the same progress in the manufacture of iron that has been recorded of Spain, partly because it did not receive the same outside attention which made Spain a center successively of Grecian, Roman, Gothic, and Moorish civilization, but partly also because it did not possess iron ores of the same rich quality as those of Spain. It may be said, however, that the use of iron weapons was well known to the Gauls who confronted the Romans hundreds of years before the Christian era, and to their successors who opposed the armies of Julius Cæsar, who refers frequently to their use of iron. In speaking of the Veneti, who inhabited the southern part of Brittany, he makes the remarkable statement that the anchors for their ships were fastened to them with iron chains instead of cables. He also says that the benches of the ships were fastened with iron spikes of the thickness of a man's thumb. This circumstantial statement denotes great familiarity with the use of iron by the Veneti. In describing the siege of Avaricum, the modern Bourges, a fortified town of the Bituriges, Cæsar says that "there are in their territories extensive iron mines, and consequently every description of mining operations is known and practiced by them." For hundreds of years after Cæsar's time only faint glimpses are furnished us of an iron industry in France. During this period it was doubtless wholly confined to Catalan forges. *Stückofens*, or high bloomaries, were in use in Alsatia and Burgundy in the tenth century. When William the Norman invaded England in 1066 he was accompanied by many smiths who were armorers and horse-shoers, and therefore skilled workers in iron. The modern blast furnace is supposed to have originated in the Rhine provinces about the beginning of the fourteenth century, but whether in France or Germany or Belgium is not clear. A hundred years later, in 1409, there was a blast furnace in the valley of Massevaux, in France, and it is claimed by Landrin that France had many blast furnaces about 1450. Iron was made by the Belgæ as early as the time of Julius Cæsar, and possibly at an earlier date. Heaps of iron cinder, which archæologists decide to be as old at least as the Roman occupation of Gallia Belgica, have recently been found on the tops of ferruginous hillocks in the provinces of Brabant and Antwerp, and in these cinder heaps flint arrow-heads and fragments of coarse pottery, characteristic of the earliest dawn of civilization, have been discovered. During the Roman occupation of the country iron was produced in many places in Belgium, a fact which is attested by heaps of cinder or slag which yet exist and are found in association with Roman relics. It has been supposed that the iron which was made in Belgium at this period was produced in low bloomaries without an artificial blast. We do not again hear of the Belgian iron industry until the tenth century, when high bloomaries, or wolf furnaces, otherwise *stückofens*, were in operation in the valley of the Meuse. We are informed that "iron was made to perfection in the Netherlands" in the twelfth century. In the fourteenth century high furnaces, or *flussofens*, were in existence in Belgium. In 1340 a furnace of this description was built at Marche les Dames, near Namur, to which, in 1345, special privileges were granted by William, count of Namur. These furnaces were true blast furnaces, producing cast iron. In 1560 there were in operation in Belgium, according to the authority of M. Deby, 35 blast furnaces and 85 forges.

Near Saarbrucken, in Rhenish Prussia, where the first battle between the French and the Germans was fought in the war of 1870, iron is said to have been made in the days of Roman ascendancy, but the Germans do not appear during this period to have been as familiar as their neighbors with its manufacture. Polybius, however, states that the Teutons and the Cimbri, from northwestern Germany, who invaded Italy and Gaul near the close of the second century before Christ, "were already familiar with iron, and possessed weapons of that metal." Tacitus informs us that "iron does not abound in Germany, if we may judge from the weapons in general use. Swords and large lances are seldom seen. The soldier grasps his javelin, or, as it is called in their language, his *fram*, an instrument tipped with a short and narrow piece of iron, sharply pointed, and so commodious that, as occasion requires, he can manage it in close engagement or in distant combat." He further says that the use of iron was unknown to the Æstyans, who inhabited the northern part of Germany lying upon the Baltic; "their general weapon was the club." The Gothinians are described by Tacitus as a people who "submit to the drudgery of digging iron in mines" for the Quadi, who were their neighbors. Ernest, the German editor, says the Gothinians had iron of their own, and did not make use of it to assert their liberty. Tacitus wrote his *Treatise on Germany* about the close of the first century of the Christian era. From this time forward the condition of the German iron industry is enveloped in obscurity until the eighth century, when we hear of iron works, probably wolf furnaces or *stuckofens*, in the district of the river Lahn, in Nassau, where iron of great celebrity was made by a guild of "forest smiths" in 780. We are informed by Maw and Dredge that "they had their special privileges, kept an iron mart at Wetzlar, and sent their products regularly to the great annual fairs at Frankfort-on-the-Main. This iron industry was especially flourishing during the thirteenth, fourteenth, and fifteenth centuries." During the eighth century we hear also of the iron industry of the principality of Siegen. There was a steel forge at the town of Siegen in 1288, which had been in existence before the eleventh century. The iron industry of Siegen was very active during the Middle Ages. About the middle of the thirteenth century *stückofens* were in use in Siegen. Percy says that in the beginning of the fifteenth century pig iron was made in Siegen in *blaus-fens*. Iron was made in Saxony as early as the eighth century. Alexander informs us that the *flussofen* was introduced into Saxony in 1550, and that the wooden bellows was invented about this time by Hans Lobsinger, an organist of Nuremberg. Iron was made in the Hartz mountains in the eighth century. In the Thuringian mountains wolf furnaces and bloomaries were in existence in the tenth century, and blast furnaces in the fourteenth century. Alexander states that in the latter half of the sixteenth century there was a furnace in these mountains 24 feet high and six feet wide at the boshes, built by Hans-sien, a Voigtlander. In 1377 cast-iron guns were made near Erfurt, in Thuringia. In the fifteenth century pots, plates, balls, etc., of iron were cast at the celebrated Ilsenberg foundry in Germany. Stoves are said to have been cast for the first time in 1490, in Alsace. Recurring to the iron industry of Austria, Alexander says that the mines of Styria were "opened again" in 712. It appears probable that wolf furnaces were in use in Styria, Carinthia, and Carniola as early as the eighth century, which appears to be the epoch of their introduction in most European countries. The first blast furnace in the Alps provinces was, however, introduced very much later than in Belgium or on the Rhine—the first in Carinthia being built in 1567, at Urtl; the first in Styria in 1760, at Eisenerz: and the first in Carniola in the early part of the present century. Iron was made in Bohemia and Silesia at an early period. "The Bohemian chronicler, Hajek, of Liboschan, mentions that iron works existed in 677, near Schasslau."

Heaps of cinder and remains of wolf furnaces and ore bloomaries are numerous in Bohemia. In 1365 bloomaries were in use in Upper Silesia. The iron industry of Sweden had an existence as early at least as the thirteenth century. A Swedish historian says that the oldest iron mine in Sweden is probably Norberg, in Westmanland, on the southern borders of Dalecarlia. There are documents still in existence, dated July 29, 1303, signed by Thorkel Knutson, the royal marshal, in which Norberg is mentioned as an iron mine. To the miners of Norberg, also, the first recorded privileges exclusively for iron mines appear to have been granted by King Magnus Ericsson, on February 24, 1354. In 1488 the mines of Dannemora were opened, and in 1614, Gustavus Adolphus encouraged the immigration of German furnacemen into Sweden. The celebrated iron works at Finspong were established in 1641 by Louis de Gier, from Liege, as a cannon foundry. The Walloon refining process, which takes its name from the Walloons, who were inhabitants of Flanders, was introduced into Sweden from Flanders in the time of Charles the Twelfth, who reigned from 1697 to 1718. Percy states that the osmund furnace, which was a modification of the *stückofen*, was formerly very common in Sweden. The iron industry of Russia dates historically from 1569, in which year as recorded by Scrivenor, the English "obtained the privilege of seeking for and smelting iron ore, on condition that they should teach the Russians the art of working this metal." The first historical iron works in Russia, however, were established long afterwards. according to the same author, in the reign of the czar Alexis Michaelovitch, about sixty miles from Moscow, and were the only ones in Russia prior to the reign of Peter the Great, who is said to have worked in them before he set out, in 1698, on his first journey into foreign countries. It is not known when the celebrated Russia sheet iron was first made. There is reason to believe that the Russians were skilled ironworkers and metallurgists long before the historic period above mentioned. The bells of Moscow have been famous for hundreds of years. The use of iron in a limited way was known to the Britons before the invasion of England by Julius Cæsar in the year 55 before Christ. The Phœnicians, who traded with the Britons probably as early as the year 600 before Christ, may be supposed to have introduced among this barbarous people the use of iron, but we have no proof that they instructed them in its manufacture. The Greeks and Carthaginians succeeded the Phœnicians in trading with the Britons, but there is no evidence that they taught them the art of making iron. They, as well as the Phœnicians, probably took iron into Britain in exchange for tin and other native products. Cæsar, in his *Commentaries*, says of the Britons who opposed his occupation of the island that "they use either brass or iron rings, determined at a certain weight, as their money. Tin is produced in the midland regions; in the maritime, iron; but the quantity of it is small: they employ brass, which is imported." This quotation from Cæsar would appear to establish the fact that iron was a precious metal in Britain at the time of his invasion; at least it would seem to show that it was not in common use, and could not have been used as an article of export. Cæsar nowhere mentions the use of iron weapons of war by the Britons. It is worthy of mention that the Belgæ had passed over to Britain before Cæsar's time and made settlements upon its coast, and whatever arts they possessed they would of course take with them. It cannot be *proved* that the Belgæ made iron in their own country before Cæsar's invasion of it; if it could be shown that they did, it might safely be assumed that they would introduce their methods of manufacture into Britain. Cæsar says that a small quantity of iron was made in the maritime regions of the island, and this the Belgæ may have made.

The Growth of the British Iron Industry.—If the manufacture of iron by the Britons prior to the Roman invasion is enveloped in obscurity and even in doubt, there can be no doubt that iron was made in considerable quantities during the Roman *occupation* of Britain, which nominally extended from about the middle of the first century of the Christian era to the year 411. The Romans, it may here be remarked, were never themselves prominent as iron manufacturers in any country occupied by them; but, knowing the value of iron, they encouraged its manufacture wherever their arms were borne and the necessary conditions existed. The remains of iron works which were in existence and were operated during their stay in Britain are still pointed out. Dismissing all speculation concerning the origin of the first iron works in Britain, the remains of some of these works may well receive attention. They relate to a most interesting period in the history of the British iron trade. Large heaps of iron scoria, or cinder, as old as the Roman era, have been discovered in the Wealds of Kent and Sussex, in the hills of Somerset, and in the Forest of Dean in Gloucestershire; also at Bierley, a few miles from Bradford in Yorkshire, and in the neighborhood of Leeds in the same county. There is also evidence that iron was made under the Romans in Northumberland, which is near Yorkshire; in Surrey, which adjoins Kent and Sussex; and in Monmouthshire, Hereford, and Worcester, which adjoin Gloucester. Except Bierley, Leeds, and Northumberland, all the places and districts named as having produced iron lie in the southeastern or southwestern parts of England, or within the ancient boundaries of South Wales—"the country of the Silures." Next to Cornwall, where tin was obtained by the Phœnicians and their successors, these southern portions of the country would be most likely to be visited and influenced by foreigners before the Roman invasion. Cæsar described the island of Britain as being shaped like a triangle, with one of its sides looking toward Gaul. "One angle of this side is in Kent, whither almost all ships from Gaul are directed." The cinder mentioned has been found almost invariably in connection with Roman coins, pottery, and altars. A coin of Antoninus Pius, who lived in the second century after Christ, was found in the Forest of Dean in 1762, together with a piece of fine pottery. Coins of other Roman Emperors have been found in the cinder heaps of the Forest of Dean. In the cinder beds of Beauport, between Hastings and Battle, in Sussex, a bronze coin of Trajan has been found, and one of Adrian. These emperors lived in the first and second centuries after Christ. Coins found in the cinder heaps of Maresfield, not far from Uckfield, have dates ranging from Nero to Diocletian, or from the year 54 to the year 286 after Christ. In the cinder mounds of Sussex many specimens of pottery have been discovered, including black and red Samian ware. On one of these, the base of a *patera*, is the potter's mark, "Albvciani." One relic consisted of a bronze *ligula*, very thin and elastic, more than four inches long, in good preservation, and having an elegantly-shaped bowl. Altars erected by Jupiter Dolichenus, the protector of iron works, have been discovered in various places in association with the remains of such works. Much of the cinder has been found on the tops of hills or mounds, a circumstance which has led to the belief that bellows were not employed in producing a blast, but that the wind was relied upon to produce a draft sufficient to smelt the ore in charcoal bloomaries, some of which were mere excavations in the tops of hills, with covered channels leading to the hillside in the direction of the prevailing winds. This method of making iron is that which appears to have prevailed in Belgica at the same time. It is a curious fact that bloomaries of similar form and adoption were in use in Derbyshire, for smelting lead, as late as the seventeenth century. Scrivenor mentions that similar furnaces were used by the Peruvians to smelt the silver ore of the country before the arrival of the Spaniards. Other air-bloomaries in England are supposed by Fairbairn and other writers to have been simple conical structures, with small openings below for the admission of air, and erected on high grounds that the wind might assist combustion. Iron is made to-day in Burmah without the aid of an artificial blast. The cinder found in England and Wales was very rich in iron; in the Forest of Dean it was so rich and so abundant that for many years after its discovery, a few centuries ago, about twenty small charcoal furnaces were engaged in smelting it. Recent researches by Mr. James Rock, of Hastings, in Sussex, throw much new light on the Roman and early British methods of manufacturing iron. Cinder beds, or cinder heaps, were formerly very numerous in East Sussex, and many of them still exist. The neighborhood of Hastings appears to have been a great center of the iron industry "from the earliest times." The cinder heaps yet remaining are large enough to be quarried, and contain many thousand tons of scoria, some of the heaps having large oak trees growing upon their summits. It was stated in 1681, by Andrew Yarranton, in the second part of his *England's Improvements by Sea and Land*, that "within 100 yards of the walls of the city of Worcester there was dug up one of the hearths of the Roman foot-blasts, it being then firm and in order, and was seven foot deep in the earth; and by the side of the work there was found a pot of Roman coin to the quantity of a peck." The foot-blast here referred to must have been a leather bellows, with which the Romans and their Mediterranean neighbors were certainly acquainted. There is nothing improbable in the supposition that the Romans while in Britain used both the wind-bloomaries and the foot-blasts. Strabo mentions the exportation of iron from Britain in his day. This was before the Romans had subdued the Britons, but after the influence of Roman civilization had been felt in the island. The emperor Adrian landed in Britain in the year 120, and in the following year there was established at Bath, in Wiltshire, a great Roman military forge, or *fabrica*, for the manufacture of iron arms. This forge was close to the bloomaries in Somerset and the Forest of Dean, from which it was supplied with iron. That the manufacture of iron at this time and for some time subsequent was almost wholly confined to the southern parts of England seems probable from a passage in Herodian, quoted by Smiles in his *Industrial Biography*, who says of the British pursued by the emperor Severus, in the year 208, through the fens and marshes of the east coast, that "they wore iron hoops round their middles and their necks, esteeming them as ornaments and tokens of riches, in like manner as other barbarous people then esteemed ornaments of silver and gold."

The Anglo-Saxons, who succeeded the Romans in the early part of the fifth century as the rulers of Britain, used iron weapons of war, and it is a reasonable supposition that they manufactured all the iron that was required for this purpose; but their enterprise as iron manufacturers probably extended but little further, although Bede speaks of the importance of the iron industry in his day, the beginning of the eighth century. The Anglo-Saxon monks frequently engaged in the manufacture of iron. Saint Dunstan, who lived in the tenth century, is said to have had a forge in his bedroom, and to have been a skilled blacksmith and metallurgist. During the ascendency of the Danes, and afterwards down to the accession of William the Conqueror in 1066, iron was made in the Forest of Dean and elsewhere, but in limited quantities. In the eleventh century the Anglo-Saxon plow consisted of a wooden wedge covered with straps of iron; to this the Normans added the coulter. The shipbuilders of Edward the Confessor, the last king of the Anglo-Saxons prior to Harold, who lost the battle of Hastings, obtained bolts and bars of iron from the city of Gloucester. The antiquarian Camden, quoted by Scrivenor and others, states that "in and before the reign of William the Conqueror the chief trade of the city of Gloucester was the forging of iron; and it is mentioned in *Doomsday-Book* that there was scarcely any other tribute required from that city by the king than certain *dicars* of iron and iron bars for the use of the royal navy. The quantity required was thirty-six *dicars* of iron; a *dicar* containing ten bars and one hundred iron rods for nails or bolts." Giraldis Cambrensis, who lived in the twelfth century, speaks of "the noble Forest of Dean, by which Gloucester was amply supplied with iron and venison." Nicholls, in *The Forest of Dean*, says that in the time of Edward the First, in the early part of the thirteenth century, the Free Miners of the Forest "applied for and obtained their 'customes and franchises,' which were granted, as the record of them declares, 'time out of mind.'" In 1282, according to Nicholls, there were "upward of seventy-two *forgeæ errantes*, or movable forges, in the Forest, each of which paid a license of 7*s*. a year to the crown. Scrivenor states that during the period from the Conquest to the death of John, in 1216, iron and steel were imported into Britain from Germany and other countries. The Normans, however, contributed much to develop English iron and other resources. Green, in his *History of the English People*, says that one immediate result of the Conquest was a great immigration into England from the Continent. "A peaceful invasion of the industrial and trading classes of Normandy followed quick on the conquest of the Norman soldiery." Still the English iron industry made but slow progress. It is mentioned by Scrivenor that there were but few iron mines in the north of England in the thirteenth and fourteenth centuries, and that, in the tenth year of the reign of Edward the Second, in 1317, iron was so scarce in that section and in Scotland that the Scots, "in a predatory expedition which they made in that year, met with no iron worth their notice until they came to Furness, in Lancashire, where they seized all the manufactured iron they could find, and carried it off with the greatest joy, though so heavy of carriage, and preferred it to all other plunder." The Scots at this time were in great need of iron, which they did not produce, but for which they were wholly dependent on the Continent and on the favor or ill-fortune of England. Alexander says that there were iron works at Kimberworth, in Yorkshire, in 1160, and Smiles gives an extract from a contract for supplying wood and ore for iron "blomes" at Kirskill, near Otley, in Yorkshire, in 1352. A recent writer, Mr. H. A. Fletcher, says that "the earliest record which has been found of iron-ore mining in Cumberland seems to be the grant of the forge at Winfel to the monks of Holm Cultram Abbey, in the twelfth century, which also included a mine at Egremont, by inference of iron, being in connection with a forge; and Thomas de Multon confirms a gift to the same abbey *de quartour duodenis minæ ferri in Coupland*." Scrivenor mentions one art related to the manufacture of iron which flourished in England from William to John, if the manufacture itself did not. The art of making defensive armor was brought to such perfection during the period mentioned that "a knight completely armed was almost invulnerable." The history of the Crusades shows that the English were then very proficient in the manufacture of both arms and armor, as were the Turks who resisted them. Smiles says that it was the knowledge of the art of iron forging which laid the foundation of the Turkish empire. By means of this art they made the arms which first secured their own freedom and then enabled them to extend their power.

Edward the Third, who reigned from 1327 to 1377, did much to advance the manufacturing industries of England. He protected domestic manufactures by legislation which restricted the importation of foreign goods, and he encouraged the immigration into England of skilled workmen from the Continent. The use of iron was greatly extended in his reign, and its manufacture was active in Kent and Sussex and in the Forest of Dean. Nevertheless the domestic supply did not meet the wants of the people. Scrivenor says: "By an act passed in the twenty-eighth year of Edward the Third no iron manufactured in England, and also no iron imported and sold, could be carried out of the country, under the penalty of forfeiting double the quantity to the king; and the magistrates were empowered to regulate the selling price and to punish those who sold at too dear a rate, according to the extent of the transaction." This act appears to have remained in force long after Edward's death. Smiles quotes from Parker's *English Home* the statement that in Edward the Third's reign the pots, spits, and frying-pans of the royal kitchen were classed among the king's jewels. The methods of manufacturing iron which were followed in England in the thirteenth and fourteenth centuries were still of a slow and restricted character, although greatly advanced beyond those which existed in the days of the Romans. The English were yet mainly devoted to agriculture, and were not even good farmers, their implements of husbandry and their methods of cultivating the soil being equally rude. Wool was their great staple, and this was largely exported to the Continent, where it was manufactured into finer fabrics than the English were capable of producing. Iron was often scarce and dear, because the domestic supply was insufficient. The iron industry on the Continent was at this period in a much more advanced stage of development, and most of the Continental iron was also of a better quality than the English iron. Professor

James E. Thorold Rogers, in his *History of Agriculture and Prices in England*, gives many interesting details concerning the iron industry of England in the thirteenth and fourteenth centuries. Iron was made at this time in Tindale, in Cumberland; at or near the city of Gloucester; and in Kent and Sussex. It was, doubtless, made in many other places. Steel is frequently mentioned, the first reference to it being in 1267. It is not clear whether all the steel used in England during the period under consideration was imported, but most of it certainly was. Much of the iron used was imported, frequent mention being made of Spanish and Osemond iron. Osemond steel is also frequently mentioned. In 1281 Norman iron, of a superior quality, was bought for the Newgate jail. Spain appears to have been the principal source of the supply of imported iron. It is probable that the Osemond iron and steel were imported from Sweden and Norway, the osmund furnace having been in use in these countries and in Finland about this time. Iron and steel were generally bought at fairs and markets. The Spaniard attended the Stourbridge fair with his stock of iron, and iron from the Sussex forges was sold at the same place. The prices of iron and steel were usually lower near the sea and at the great towns in the south of England than elsewhere. Among the farmers it was customary for the bailiff to buy the iron that might be needed on the farm, and to employ a smith to make the horseshoes and nails and to iron the implements. Steel appears to have been but little used by the farmers. Rogers says that "no direct information about the seasons, scanty as it is, is so frequent as that found in the notices which the bailiff gives of the great cost of iron." Iron for the tires of wagons and carts was so dear that many wheels were not ironed.

Iron was sold in several forms. The iron made at the works at Tendale was sold in the form of blooms in 1333 and subsequently. Blooms were sold as early as 1318, but the place of their manufacture is not given. Slabs and bars of iron are also mentioned, but the commonest form in which iron was sold was the *piece*, twenty-five pieces constituting a hundred-weight. "The small fagot of iron, each bar of which weighed a little over four pounds, was kept by the bailiff, and served, as occasion required, for the various uses of the farm." The Tendale bloom weighed about one hundred pounds, and was sold at a much lower price than other forms of iron. It was, of course, unrefined iron. Steel was usually sold by the garb, or sheaf, each sheaf containing thirty small pieces, the exact weight of which is not stated. Rogers supposes that the pieces of iron and steel were of about the same weight, and that the price of steel was about four times the price of iron. Occasional mention is made of steel, which was sold by the cake; it was "a little higher in value and much greater in weight than the garb." Plow-shoes, which appear to have been iron points to wooden shares, are of frequent occurrence in the accounts quoted by Rogers, and so are lath and board nails, clouts and clout nails, and horseshoe and horseshoe nails. Horseshoes were not purchased from the smiths until about the close of the fourteenth century; down to that time the smiths were supplied by the bailiffs with the iron for their manufacture. "Hinges, staples, and bolts were occasionally manufactured by the village smith, from iron supplied him by the bailiff, but were more frequently bought at the market-town or fair." Iron mattocks and hoes were used in the fourteenth century, as were iron sickles, scythes, and hay and other forks. Domestic utensils of iron were not in general use; pots and other articles used in the kitchen were usually of brass. A brass jug and pan are mentioned in 1272; a brass jug and basin in 1360; and two brass pots in 1383. Such iron utensils as were in use appear to have been made of wrought iron. Tinware was certainly unknown. Hammers, axes, pickaxes, and other tools were made of iron. Iron hoops were used for buckets and grain measures in the fourteenth century; "the iron-bound bucket that hung in the well" had an existence as early at least as 1331. Passing to other authorities we find that arrow-heads were manufactured at Sheffield in the thirteenth century, and that knives were manufactured at the same place in the fourteenth century, as they are to-day. Chaucer, who wrote his *Canterbury Tales* near the close of the latter century, in describing the miller of Trompington, says that "a Schefeld thwytel bar he in his hose." Birmingham was then, as it is now, a center of the manufacture of swords, tools, and nails. Smiles pays a deserved compliment to the English smith, to whom England owes so much of her greatness. In Anglo-Saxon times his person was protected by a double penalty, and he was treated as an officer of the highest rank. The forging of swords was then his great specialty. William the Conqueror did much to exalt the art of the smith, to which he was much indebted for his victory at Hastings, his soldiers being better armed than those of the Saxon Harold. At the close of the fourteenth century the smith had fairly entered upon the brilliant career which has since contributed so much to the industrial pre-eminence of England. Mr. Picton, in a recent address, says: "Iron work at this period was of the most elaborate description. The locks and keys, the hinges and bolts, the smith's work in gates and screens, exceed in beauty anything of the kind which has since been produced." England appears to have first used cannon in field warfare at the battle of Cressy and the siege of Calais in the year 1346, when the bowmen of Edward the Third were drawn up "in the form of a harrow," with small bombards between them, "which, with fire, threw little iron balls to frighten the horses." These bombards were made of "iron bars joined together longitudinally, and strengthened by exterior hoops of iron." France, however, according to Scrivenor, appears to have used cannon as early as 1338, in which year it is reported that the government had an account with Henry de Faumichan "for gunpowder and other things necessary for the cannon at the siege of Puii Guillaume." But the archers of the English army continued to be the main reliance of the English kings for many years after Edward's first use of the bombards, and on the Continent gunpowder did not come into general use until the sixteenth century At the battle of Pavia, in 1525, the match-lock was first used in an effective form, and it was then fired from a rest.

During the fifteenth and sixteenth centuries the manufacture of iron in England was greatly extended. The encouragement which Edward the Third and his immediate successors had given to the immigration of foreign workmen into England had resulted in the settlement in the country of many Flemish and French ironworkers, whose skill was eagerly sought by many landed proprietors, who entered with zeal into the manufacture of iron. Sussex became the principal seat of the industry; it possessed both ores and forests, the latter supplying the necessary fuel, and small streams furnished the requisite power to drive the "iron mills." As one marked result of the extension of the iron manufacture in England, the dependence of the country upon foreign sources of iron supply was greatly lessened; so much so that in 1483 an act was passed prohibiting the importation of gridirons, grates, iron wire, knives, hinges, scissors, and many other manufactured articles of iron or steel which competed with like articles of domestic production. Landrin, however, states that fine tools were still imported from Bilbao, in Spain, as late as 1548. About the beginning of the fifteenth century, blast furnaces were introduced into England from the Continent, and this event gave a fresh impetus to the iron industry of Sussex, Kent, Surrey, and other sections. Prior to the introduction of blast furnaces, all the iron that was manufactured in England was produced in forges or bloomaries directly from the ore, and was, consequently, when finished, wrought or bar iron. Little of it was cast iron. These bloomaries were doubtless modeled after the German *stückofen* during the latter part of the period antecedent to the introduction of the blast furnace. The exact date of the erection of the first blast furnace in England is unknown, but this event must have followed closely upon the introduction of the *flussofen*, or *blauofen*, on the Continent in the fourteenth century. The English antiquarian writer, Mr. A. Lower, in his account of the iron industry of Sussex, mentions iron castings which were made in Sussex in that century, but these may have been produced by the *stückofen*, or high bloomary. Mushet supposes that cast iron was made in the Forest of Dean in 1540, and he says that the oldest piece of cast-iron he ever saw bore the initials "E.R." and the date "1555." Camden, who lived between 1551 and 1623, says that "Sussex is full of iron mines everywhere, for the casting of which there are furnaces up and down the country, and abundance of wood is yearly spent." He also says that the heavy forge-hammers, which were mostly worked by water-power, stored in hammer-ponds, "beating upon the iron, fill the neighborhood round about, day and night, with continual noise." About 1612, John Norden, quoted by Smiles, stated in a published document that "there are, or lately were, in Sussex neere 140 hammers and furnaces for iron." At this time Sussex is supposed to have produced one-half of all the iron made in England. The best of the Sussex furnaces did not, however, at this time produce more than eight or ten tons of pig iron in a week. At Pontypool, in Monmouthshire, a blast furnace was built in 1565 by Capel Hanbury, to smelt the Roman cinder which was found there, and about the same time several furnaces were built in the Forest of Dean to rework the cinder which was found there in large quantities. The first furnaces built in the Forest were 15 feet high and six feet wide at the boshes. The furnaces at work in 1677 were blown with bellows 20 feet long, driven by "a great wheel" turned by water. Smiles says that "the iron manufacture of Sussex reached its height toward the close of the reign of Elizabeth, when the trade became so prosperous that, instead of importing iron, England began to export it in considerable quantities in the shape of iron ordnance." This ordnance was cast, and the time referred to was the close of the sixteenth century. Bronze cannon had succeeded the bombards about the beginning of that century, and as early as 1543 cast-iron cannon were made in Sussex, at a place called Bucksteed, by Ralph Hoge, who employed a Frenchman named Peter Baude as his assistant. "Many great guns" were subsequently cast in Sussex, John Johnson and his son Thomas Johnson, the former a servant of Peter Baude, being prominent in their manufacture. John Johnson is said to have "succeeded and exceeded his master in this his art of casting ordnance." About 1595 the weight of some of the cannon cast in Sussex amounted to three tons each. At a later period, in 1648, Bishop Wilkins, in his *Mathematicall Magick*, says that "a whole cannon weighed commonly 8,000 pounds, a half cannon 5,000, a culverin 4,500, a demi-culverin 3,000. A whole cannon required for every charge 40 pounds of powder and a bullet of 64 pounds." But a still greater honor is claimed for Peter Baude than that with which his name is above associated. Stow, in his *Chronicle*, quoted by Froude and Smiles, says that two foreign workmen, whom Henry the Eighth tempted into his service, first invented shells. "One Peter Baude, a Frenchman-born, and another alien called Peter Van Cullen, a gunsmith, both the king's feed men, conferring together, devised and caused to be made certain mortar pieces, being at the mouth from 11 inches unto 19 inches wide, for the use whereof they caused to be made certain hollow shot of cast iron, to be stuffed with firework or wild-fire, whereof the bigger sort for the same had screws of iron to receive a match to carry fire kindled, that the fire-work might be set on fire for to break in pieces the same hollow shot, whereof the smallest piece hitting any man would kill or spoil him." There is deposited in the library of the Historical Society of Pennsylvania, at Philadelphia, a stone cannon-ball, one of twenty-three which are said to have been fired at the boat in which Queen Mary and Douglass made their escape from Loch Leven in 1568. It is about 8 inches in diameter, is round, but not smooth, and weighs probably 15 pounds.

The exportation of cast-iron cannon became so extensive that complaint was made that Spain armed her ships with them to fight the ships of England, and the trade was for a time prohibited. Hume says that "shipbuilding and the founding of iron cannon were the sole manufactures in which the English excelled in James the First's reign," from 1603 to 1625. In 1629 the crown ordered 600 cannon to be cast for the States of Holland. England, however, continued to import from the Continent, particularly from Sweden, Germany, and Spain, some of the finer qualities of iron and considerable steel. Before 1568 all iron wire that was made in England was "drawn by main strength alone," according to Camden. The Germans, says this author, then introduced into the Forest of Dean and elsewhere, the art of drawing it by a mill. Prior to the year mentioned the greater part of the iron-wire and ready-made wool-cards used in England was imported. Scrivenor quotes Williams' *History of Monmouthshire* as authority for the statement that the iron and wire works near Tintern Abbey were erected by Germans. There can be no doubt that the iron industry of England in the fourteenth, fifteenth, and sixteenth centuries was greatly indebted to the inventive genius and mechanical skill of the Continental nations. Near the close of the sixteenth century there was introduced into England an invention for slitting flattened bars of iron into strips, called nail-rods. This invention was the slitting mill. Scrivenor, upon the authority of *Gough's Camden*, states that Godfrey Bochs, of Liège, Belgium, set up at Dartford, in 1590, "the first iron mill for slitting bars." Dartford is a market town in Kent. Another story associates the name of "the founder of the Foley family, who was a fiddler living near Stourbridge," with the honor of introducing the first slitting mill into England, a knowledge of which he surreptitiously gained by visiting Swedish iron works and fiddling for the workmen. Percy states that Richard Foley, the founder of the Foley family at Stourbridge, who was first a seller of nails and afterwards a forgemaster, died in 1657, at the age of 80 years. In 1606 and 1618 patents were granted in England to Sir Davis Bulmer and Clement Dawbeny, respectively, for cutting iron into nail-rods by water-power. The slitting mill, by whomsoever invented and perfected, greatly benefited the nail trade of England. Birmingham became the center of this industry, and it was here, probably, that women and girls were first regularly employed in England in the manufacture of nails. Hutton, quoted by Dr. Young in his *Labor in Europe and America*, says that in 1741 they were thus employed in the numerous blacksmiths' shops of Birmingham, "wielding the hammer with all the grace of their sex." They were called "nailers." Machinery was not applied to the manufacture of nails until near the close of the eighteenth century. The art of tinning iron was first practiced in Bohemia, and about 1620 it was introduced into Saxony. These countries for a time supplied all Europe with tin plates. In 1681 Andrew Yarranton asserted that tin plates were then made in England through his means, he having learned the art of making them in Saxony in 1665.

The exact date of the introduction of the manufacture of tin plates into England by Yarranton is said to have been 1670. The first attempt to establish the new industry in England was made at Pontypool, in Monmouthshire. Scrivenor states that in 1740 the art "was brought to considerable perfection in England." But, notwithstanding the progress which had been made in the development of the English iron trade, especially in the reigns of Henry the Eighth, Elizabeth, and James the First, an influence was at work which was destined to weigh heavily for a hundred and fifty years upon all further development. This was the growing scarcity of wood for the use of the forges and furnaces; mineral fuel, or pit-coal, not yet having come into use as a substitute for wood. The forests of England in the ironmaking districts had been largely consumed by "the voragious iron mills," and there were loud complaints that the whole community would be unable to obtain fuel for domestic purposes if this denudation was persisted in. In response to these complaints we learn from Scrivenor that, in 1558, the first year of the reign of Elizabeth, an act was passed which prohibited the cutting of timber in certain parts of the country for conversion into coal or fuel "for the making of iron," special exception being made of the Weald of Kent, certain parishes, and "high in the Weald of the county of Surrey." In 1581 a further act to prevent the destruction of timber was passed, which set forth the increasing scarcity of timber for fuel in consequence of "the late erection of sundry iron mills in divers places not far distant from the city of London and the suburbs of the same, or from the downs and sea-coast of Sussex," and provided that "no new iron works should be erected within twenty-two miles of London, nor within fourteen miles of the river Thames," nor in certain parts of Sussex near the sea; nor should any wood within the limits described, with certain exceptions, be converted to coal "or other fuel for making of iron." A more sweeping act was passed in 1584, which prohibited the erection of any new iron works in Surrey, Kent, and Sussex, and ordered that no timber one foot square at the stub should be used as fuel "at any iron work." It is said that these restrictions were not very rigidly enforced, but they served to narrow the limits within which the manufacture of iron could be prosecuted. About the middle of the seventeenth century the iron industry experienced

—Drawn and Engraved for the Mines, Miners and Mining Interests of the United States.

another serious check through the civil commotion which then prevailed. Many of the forges and furnaces in Sussex and in the south of Wales were then destroyed, and not again rebuilt. Soon after the Restoration all of the royal iron works in the Forest of Dean were destroyed, owing to the scarcity of timber. There was then much apprehension felt whether the Forest of Dean should fail to supply timber for the royal navy. Owing to the scarcity of timber many of the iron works in Kent, Sussex, Surrey, and in the north of England were "laid down" in 1676, when England's supply of iron was largely derived from "Sweadland, Flanders, and Spain." Dudley, in his *Metallum Martis*, says that in 1644 there were nearly 20,000 smiths of all sorts within ten miles of Dudley Castle, in Staffordshire, and that there were also "many iron works at that time within that circle decayed for want of wood (yet formerly a mighty woodland country)."

Notwithstanding these severe checks, the iron industry of England bravely refused to be utterly destroyed, and as late as 1720 it was still second in importance to the manufacture of woolen goods. In 1740, however, only 59 furnaces were left in all England and Wales, and their total production was but 17,350 tons of pig iron, or about 294 tons for each furnace. All of the furnaces may not have been in blast, as it has been proved that, ten years later, in 1750, each of the charcoal furnaces of Monmouthshire produced 24 tons of iron in a week. Ten of the furnaces existing in 1740 were in Sussex, but in 1788 only two of these were left. In 1740 there were ten furnaces in the Forest of Dean. Pig iron is still made in this district, but with coke as fuel. The iron industry of Kent and Sussex is now extinct. The last furnace in the Weald of Sussex, at Ashburnham, was blown out in 1829. During the seventeenth and eighteenth centuries England imported iron largely from Sweden, and in the latter century both Russia and the American colonies contributed to her supply. The scarcity of timber for fuel for blast purposes in England continuing, a proposition was made in the British Parliament in 1737 to bring all pig iron from the British colonies in America; and in 1750, to facilitate the importation of pig iron from these colonies, the duty which had previously been imposed for the protection of British ironmakers was repealed. At this time the business of manufacturing iron in some parts of Great Britain was conducted upon such primitive principles that both charcoal and iron ore were carried to the furnaces of Monmouthshire on the backs of horses. Soon after the passage of the act of 1750, mineral coal in the form of coke came into general use in the manufacture of iron in England, and the iron trade of that country and of Wales at once revived, while that of Scotland may be said to have been created by the new fuel. The first successful use of mineral coal in the blast furnace was by Abraham Darby, of Shropshire, at his furnace at Coalbrookdale, in 1735. This coal was coked. In 1740 a coke furnace was built at Pontypool, in Monmouthshire. In 1796 charcoal furnaces had been almost entirely abandoned in Great Britain. The manufacture of pig iron with mineral coal was greatly facilitated by the invention of a cylindrical cast-iron bellows by John Smeaton, in 1760, to take the place of wooden or leather bellows, and by the improvements made in the steam engine by James Watt about 1769—both these valuable accessions to blast-furnace machinery being used for the first time, through the influence of Dr. Roebuck, at the Carron iron works in Scotland. The effect of their introduction was to greatly increase the blast, and, consequently, to increase the production of iron. The blast, however, continued to be cold air at all furnaces, both coke and charcoal, and so remained until 1828, when James B. Neilson, of Scotland, invented the hot-blast. These and other changes in the manufacture of pig iron were speedily followed by equally important innovations in the manufacture of finished iron. In 1783 Henry Cort, of Gosport, England, obtained a patent for rolling iron into bars with grooved iron rolls, and in the following year he obtained a patent for converting pig iron into malleable iron by means of a puddling furnace. These patents did not relate to absolutely new inventions in the manufacture of iron, but to important improvements on existing methods, which had not, however, been generally employed. Mineral coal was now used in the puddling furnace as well as in the blast furnace: it had long been used in refineries. To the improvements introduced by Cort the iron trade of Great Britain is greatly indebted. The refining of pig iron in forges and its subsequent conversion into bars and plates under a tilt-hammer virtually formed the only method of producing finished iron down to Cort's day, both in Great Britain and on the Continent, and it was wholly inadequate to the production of large quantities of iron of this character. With mineral fuel, powerful blowing engines, the puddling furnace, and grooved rolls Great Britain rapidly passed to the front of all ironmaking nations. The invention of crucible cast steel originated with Benjamin Huntaman, an English clockmaker, about the middle of the eighteenth century, and not only Sheffield, the principal seat of the manufacture of fine cutlery, but all England as well, has greatly profited by his discovery.

We now turn from the iron industry of England to that of Wales, Ireland, and Scotland. In the sixteenth century, owing to the scarcity of timber in England, some of the ironmasters of Sussex emigrated to Glamorganshire, in South Wales, where they founded the iron works of Aberdare and Merthyr Tydvil, and other iron works. Remains of the works in the Aberdare valley still exist, and Merthyr Tydvil is the centre of a great iron industry to-day. In 1770 the first coke furnace in South Wales was built at Cyfarthfa. In 1788 there were six coke furnaces in South Wales. Cort's inventions were promptly appropriated by Welsh ironmasters. According to Scrivenor, iron-ore mines were opened in Ireland by the English who settled in the country during the reign of Elizabeth, and iron itself was extensively manufactured in Ireland by the English during the reign of James the First and afterwards. The most extensive works were in the provinces of Munster, Connaught, and Ulster, and in the counties of Queens, Kings, and Thomond. In some instances iron ore was taken from England to the sea-coast of Ulster and Munster, in Ireland, the latter country then abounding in forests, but generally Ireland supplied both the ore and the fuel. Most of the iron produced was in bars from forges, but ordnance, pots, and other articles were also cast in foundries or furnaces. The rebellion of 1641 put an end to many of the English iron works in Ireland, some valuable works in the county of Mayo escaping. In 1660 Sir William Petty established extensive iron works in the county of Kerry, which continued in operation until the middle of the eighteenth century, when they were stopped in consequence of the scarcity of timber. In 1672 this gentleman stated that one thousand tons of iron were then made in Ireland. Near the close of the seventeenth century an act of the British Parliament remitted the duties on bar iron and on iron slit and hammered into bars imported from Ireland, the manufacturing industries being then greatly depressed. The iron industry of Ireland survived until the reign of George the Second, in the early part of the eighteenth century, when it came to an end in consequence of the scarcity of timber, the competition of English iron, and the unsettled condition of the country. An effort was made to revive it at the close of the century, but it met with slight success. In 1840 there were no iron works in Ireland "going on." In 1857 there was but one furnace yet standing in Ireland. There are now no iron works in the country. Irish ores were imported into the United States in 1879 and 1880. It has already been stated that iron was very scarce in Scotland in the closing centuries of the Middle Ages, Scotland obtaining all her supply of iron at that time from outside her borders. The Scotch, however, were noted during the period mentioned for the excellence of their swords and armor, the former vying in temper with those of Toledo and Milan. In Sir Walter Scott's story of *The Fair Maid of Perth*, the events of which are supposed to have occurred during the last years of the fourteenth century, the hero, Henry Gow, is an armorer—a forger of swords, and bucklers, and coats-of-mail. In 1547 an English chronicler wrote that "the Scots came with swords all broad and thin, of exceeding good temper, and universally so made to slice that I never saw none so good, so I think it hard to devise a better." Scotland had no noteworthy iron-producing industry of her own until the middle of the eighteenth century. It is conjectured, however, that her ancient inhabitants may have made iron in very small quantities, as pieces of iron slag were discovered in 1861 in the ruins of Celtic fortified towns in the Cheviot hills, on the border between England and Scotland. Mr. Richard Meade informs us that the earliest information bearing on iron smelting in Scotland dates from 1750, in which year the first furnace was erected at Bunawe, in Argyleshire, by a Mr. Ford. In this furnace the blast was driven by water-power obtained from the river Awe, the ore used being brought from Ulverstone, in Lancashire, while charcoal was exclusively used as fuel. The Bunawe furnace, now known as the Lorne, is still in existence, although not in operation. Previous to 1788 a similar furnace was erected at Goatfield, also in Argyleshire. In 1760 the first blast furnace at the celebrated Carron iron works, in Stirlingshire, was put in operation, where for some time charcoal was used. The manufacture of carronades was long a specialty of the Carron iron works. Mineral coal was soon substituted for charcoal at this furnace, and from that time forward the iron industry of Scotland was rapidly developed. In 1788 there were six coke furnaces in Scotland and the two charcoal furnaces of Bunawe and Goatfield.

The following statistics will show how rapidly the manufacture of pig iron in Great Britain has grown in the last hundred years. In 1788 there were 77 furnaces in England and Wales, and 8 furnaces in Scotland, the total production of which was 68,300 tons. Of the whole number of furnaces, 26 used charcoal and 59 used coke. The imports of iron by Great Britain in this year amounted to about 15,000 tons. In 1796 there were 104 furnaces in England and Wales, producing 107,797 tons of iron. In Scotland there were 17 furnaces, producing 16,086 tons. In 1806 there were 173 furnaces in Great Britain, producing 258,006 tons. In 1820 there were 285 furnaces, producing 400,000 tons. In 1827 the production was 690,500 tons. In 1840 it was 1,396,400 tons. In 1854 it rose to 3,069,838 tons. This quantity was then estimated to be fully one-half of the world's production of pig iron. The same proportion was steadily maintained by Great Britain for many years, but it is now lost. In 1857 Great Britain's production of pig iron was 3,659,477 tons, smelted from 9,573,281 tons of ore in 628 blast furnaces, of which 333 were in England, 170 in Wales, 124 in Scotland, and 1 in Ireland. In 1872 the product was 6,741,929 tons. In 1880 the production of pig iron by Great Britain was 7,749,233 tons. For several years there have been preserved only 4 charcoal furnaces in Great Britain, and these have produced but little iron. The whole number of blast furnaces in Great Britain in 1880 was 967, only 567 of which were in blast. The eighteenth century marked a new era in many branches of manufacturing industry in which the British people have become prominent. It was the era of machinery, which then began to receive general attention as a substitute for hand labor. This era gave to the people of Great Britain the manufacture of Indian cotton goods, and it largely increased their woolen manufacture and assisted to develop their iron manufacture. It was in the eighteenth century that Great Britain, in consequence of her quick appreciation of the value of labor-saving machinery, became the first manufacturing nation in the world; in the preceding century four-fifths of the British working people were still farmers or farm laborers. During the latter part of the eighteenth century and the whole of the nineteenth century down to the present time no other country has occupied so conspicuous a position as Great Britain in the manufacture of iron and steel. Spain and Germany had in turn led modern nations in the production of these essentials in civilization, but Great Britain passed to the head when she began to make pig iron with the aid of mineral fuel and her powerful blowing engines. She had abundance of iron ores and bituminous coal, and her people had applied to the utilization of these products their indomitable energy and newly-developed inventive genius. France, Germany, Belgium, and other Continental countries might have substituted mineral coal for charcoal, invented the puddling furnace, or perfected the rolling mill and the steam engine, but none of them did. To England and also to Scotland is the world indebted for the inventions that gave a fresh impetus to the manufacture of iron in the eighteenth century; and it is also indebted to the same countries for most of the inventions and changes of the present century which have further developed the manufacture of iron and increased the demand for it, and which have almost created the manufacture of steel. Stephenson, the Englishman, improved the locomotive in 1815, and in 1825 the first passenger railroad in the world was opened in England, Stephenson's locomotive hauling the trains. Neilson, the Scotchman, invented the hot-blast in 1828; Crane, the Englishman, applied it to the manufacture of pig iron with anthracite coal in 1837; Nasmyth, the Scotchman, invented the steam hammer in 1838 and the pile driver in 1843: and Bessemer, the Englishman, invented the process which bears his name, and which is the flower of all metallurgical achievements. The Siemens regenerative gas furnace, which has been so extensively used in the manufacture of iron and steel, is also an English invention, although the inventors, Charles William and Frederick Siemens, while citizens of England, are natives of Hanover, in Germany. That Great Britain did not at first seek to extend the influence of her new light and life to other countries, but by various acts of Parliament sought to prevent the introduction of her inventions and the emigration of her skilled artisans into those countries, is not here a subject for comment; nor is the strict adherence of Great Britain to a policy of protection to home industries by customs duties during many centuries and down to almost the middle of the present century a subject of comment. Both measures undoubtedly fostered the growth of British manufacturing industries, and in the end the world was benefited by British inventions, which found their way across the British channel and the Atlantic ocean, and by the example of British energy and British enterprise in the utilization of native manufacturing resources.—

—Compiled from James M. Swank's "Report on Iron and Steel, Tenth Census of the U. S."

HISTORICAL SKETCH OF SILVER.

SILVER had already taken a high rank among the metals in the days of Abraham, and even at that early period we find it playing the same part in the economy of nations that gives it so much importance to us of the present day. It was a standard of value, and a medium for the transaction of exchanges when first mentioned; this is still its chief function, and will probably continue to be as long as mankind buy and sell. In the time of the patriarchs it would appear that money, as we understand it, was already but partially in use; since sometimes we read of Abraham receiving so many *pieces* of silver, and at others that he *weighed* out a certain number of shekels of the same metal. Hence we may conclude that the plan of employing a piece of determined size in commercial transactions, was only then superseding the more ancient system of determining, by a separate weighing, the amount of silver necessary in each exchange. Whether these *pieces* were stamped with a device or not we have no means of knowing, but that silver as well as gold was at that period wrought into various household utensils and articles of ornament, we have abundant evidence in the book of Genesis. There is a passage in the account of a purchase of the field of Hebron which, in investigating the ancient history of silver, demands more than our passing attention. It is the statement that the silver weighed by Abraham was *current money with the merchants*. This leads to the conclusion that various sorts of silver were already recognized, and that the merchants possessed the knowledge necessary to distinguish between the current and the uncurrent, or the pure and alloyed; in short, that the rudiments of assaying were practically understood. Numismatologists concur in considering the oldest stamped money that has come down to us to be that made from silver by the Æginetans, and in the Parian chronicle the origin of coined money is ascribed to that nation, the date of its discovery being placed in the time of Phidon, who reigned 895 years before the Christian era. Homer's heroes carried weapons ornamented with silver, and that bard even mentions the locality from whence the precious substance was brought; but where to search upon modern maps for the region thus made known by name will probably continue to be, as it now is, an unsolved problem for the antiquary. It is generally supposed that the silver possessed by the nations along the eastern end of the Mediterranean came from some country to the north or east, and Chaldea, Bucharia, and the mountains belonging to the modern Russian Empire have been mentioned as probable localities. That silver was abundant in early historical times is clear from the vast quantities that were obtained by conquering armies in the form of plunder, ransom, or tribute. Thus Rawlinson has found on a Babylonian monument an inscription stating that the city of Damascus, after its conquest by Phuluk, was adjudged to pay a tribute of 2300 talents of silver, beside gold, copper and brass; and if it were possible to credit the figures of Pliny, Cyrus obtained from his conquests in Asia an amount of silver equivalent to 7,720,000,000*l.*; while according to Herodotus, the nations subdued by the Persians, excepting the Indies and Antioch, paid a yearly tribute in silver of about 3,000,000*l.*

The metallic treasures of the East, won from the degenerate successors of Alexander by victorious Roman warriors, flowed into the lap of the Mistress of the World, where they joined the precious streams coming northward from the coffers of the sumptuous Carthaginians. For fifty years after the second Punic war, the conquered city paid an annual tribute of 9000 pounds of silver. This treasure was partly collected in the hands of private individuals or families, and partly in the public treasury. The latter is said to have received, during the nine years following the second Punic war, 112,000 pounds of silver from Spain alone. The spectacles of the Emperors were often accompanied by the most lavish display of metallic wealth. To such an extent was this carried, that Caligula, we are told, loaded 124,000 pounds of silver upon the armor and weapons that he caused to be brought into the circus. Indeed, the extraordinary accounts given by various classic authors of the amount of silver collected in ancient Rome, would often have the appearance of gross exaggeration, were we not aware that the treasures of the world gathered for generations within her walls; and had we not incontestable statistics of the products of a region that in modern times has yielded treasures far exceeding those possessed by Rome even in the most brilliant period of her decadence:—I allude to the meridional countries of the new world, which will claim our attention presently. The localities from whence the ancients obtained their silver seem to have been quite numerous. The mines of Laurium, which Eschylus calls the "fountain of silver treasure of the earth," were possesssed by the Athenians: their production appears to have largely decreased in early days, so that Strabo speaks of them as exhausted. Diodorus relates that the shepherds on the Pyrenees having set fire to their forests, the silver in the earth was fused and ran upon the ground in numerous streams, and that the natives not knowing the value of the extraordinary substance thus springing from the mountains, exchanged it with the Phœnician traders for wares of small value. Pliny writes, what we may believe with less extension of our credulity that in his time the miners of Spain sought silver in the bowels of the earth a mile and a half beyond the light of day. The Carthaginians, according to Polybius, had 40,000 men engaged in the Spanish mines, and the Moors are known to have continued the search that had in turn yielded so largely for nearly all the great nations of antiquity; yet when in 1571, the German family of Fugger re-opened the deserted veins, they succeeded in the space of thirty-six years in taking out more than 3,000,000*l.* worth of the precious metal. Thus from the most remote periods, strangers have sought in Spain the silver which the natives have allowed to remain dormant in the earth. Nor is this rule at present reversed, since by royal decrees of 1825 and 1849 the mines were thrown open to foreign enterprise, and several English companies are now exploring districts that were wrought in the grey antiquity, perhaps for the merchants of Tyre. When Rome lost her proud precedence, her stores of silver and gold moved eastward toward the seat of the Byzantine Government, and the dark centuries that then followed were not of a character to favor mining or to preserve records of metallic discovery. German fable carries the first opening of some of the middle European mines back to the seventh century. In the tenth century, according to records that appear quite reliable, silver mines existed in Bohemia; and in the twelfth century, Tyrolese mines were worked. From Bohemia mining knowledge and the spirit of mining enterprise spread to the countries toward the north and west; in the tenth century mines of the Hartz were discovered, and in the twelfth those of Saxony were opened. The mines of England, France, Hungary, and Norway were already in operation when the discovery of the new world, with its fabulous stores of metallic wealth, opened a new epoch in the history of the precious metal. It was the fortune of Spain to reach this land of gold and silver first, and to appropriate to herself not only the treasure in possession of the natives, but what was far more important, the districts where the strata still held untold millions. The Incas of Peru drew their silver from the mines of Porco, but without any of those ingenious and expensive contrivances that miners of the present day bring to their aid. They sank no shafts, but simply drove adits horizontally upon the vein, and worked out the ore that happened to lie above the water level. Their processes of reduction were as primitive as their methods of mining. They had no idea of the virtues of quicksilver—a metal not at all rare in their land—but fused the ore in rude furnaces, so built upon the mountain side that the prevailing winds fanned the wasteful flames. No money circulated in their empire, but the precious metals were lavished upon the walls of their temples, so that the polished surfaces threw back brilliant images of their governing deities, the sun and the moon. The palaces of the Inca nobility were georgeously decorated. To such an extent was this carried, that it is recorded that the soldiers of Pizarro found, near Cuzco, three beams of silver each twenty feet long, one foot broad, and two to three inches thick, which were intended to form ornaments for a country seat then in process of erection. The unfortunate prince Atahulapa, when made a prisoner by the conquerors, sought to obtain his liberty by offering rooms full of the precious metals as a ransom. The ornaments torn from the temples of the various deities, and removed from the royal palaces by the loyal subjects who did not foresee the dark deed of treachery that awaited them, amounted to a value at that period of 3,5000,000*l.* of gold and 51,610 marks,* or about 25,805 pounds of silver. But the rapacious conquerors of the new world found but a comparatively small portion of the precious metals that their victories brought them into possession of, in the hands of the inhabitants. The veins of silver, discovered and undiscovered, held a treasure that could scarcely have been exceeded by their wildest dreams. The silver production of the world is at the present time largely concentrated in the western hemisphere, and the richness and abundance of the ores of the Cordilleras and Andes promise a prize so tempting that almost continual revolution, and consequent insecurity of property, combined with the many difficulties which nature has thrown in the way, cannot prevent both native and foreign companies from pushing forward their precarious but often highly remunerative operations. Peru is considered by Whitney to exceed all other countries in the vastness of its silver deposits, but the desolate region of snow and rock, in which some of the mines are situated, strikes even the most hardy miner with terror. The mines of Potosi are worked at a height even greater than that of Mont Blanc. Among the richest silver mines in the world is that of Pasco, which was discovered by accident in 1630. It is so miserably worked that at one time 300 laborers were killed by the falling of a portion of the mine, and hence it is known as the Matagenti, or Kill-people. The well-known Cornish engineer, Richard Trevithick, introduced nine steam-engines into this mine; in 1814 he visited the country himself, and was received with the highest honors; it was even proposed to erect a statue to him in solid silver. In consequence of political dissensions and civil war he was afterwards forced to escape, and he carried with him as the only remnant of his former wealth a single pair of silver spurs. The total amount of silver smelted at the Pasco works from 1784 to 1827 was 4,967,710 pounds troy, while the value of the metal yielded in 1851 was about 400,000*l.* sterling. The Republic of Bolivia contains mines whose riches have passed into a proverb. The immense deposits in the isolated mountain known as the "Great Potosi," were discovered in 1545, since which date, according to various estimates, they have supplied the world with silver to the amount of 240,000,000*l.* The greatest store of metal appears to have been near the

* Prescott's History of the Conquest of Peru.

surface, so that the most flourishing period occurred shortly after they were opened. The average annual yield from 1545 to 1556 was about 2,318,000*l*., and at that date silver possessed a value fully six times that which it holds at present. The Potosi mines, however, have fallen from their rank as the first in the world in point of quantity produced, and Chevalier estimates that at present they do not give an annual yield of over 192.000*l*.

The sad condition of the mining interest in Bolivia may be perceived, when the fact is mentioned that in that country in 1852 there were 4,165 abandoned mines, and only sixty-six in actual operation. The mines of Peru and Bolivia, notwithstanding their depressed condition during recent years, yielded, from the period of their discovery to the year 1845, a quantity of silver equal to 155,839,180 lbs. troy, or a money value of not less than 506,220,000*l*. The political condition of Chili has been more favorable for the prosecution of mining adventure, and English enterprise has served to open a number of mines within its borders. Not less than 1,750,000 pounds of silver were raised in this country between 1846 and 1853. The vast metallic deposits of Mexico began to claim attention about the same period as those of South America. Workings were commenced at Zacatecas in 1548, and at Guanaxuato in 1558. In the early period of their history the mines of Mexico produced, according to the estimates of Humboldt, from 400,000*l*. to 600,000*l*. per annum. During the 18th century this production gradually rose to 4,600,000*l*. per annum. This yearly sum decreased during the War of Independence, but within the last ten years it appears to have been higher than ever before, having, according to the most reliable accounts, reached 5,000,000*l*. sterling. Chevalier calculates the total yield of the Mexican mines, between the advent of the whites and the year 1845, to be at least 162,858,700 pounds troy.

The earliest method of obtaining silver from its ores, of which we have any knowledge, bears an astonishing resemblance to that made use of at the present day. The reader will recall in this connection the striking similes used by the Prophet Ezekiel: "Son of man, the house of Israel is to me become dross: all they are brass, and tin, and iron, and lead, in the midst of the furnace; they are even the dross of silver." And, "As they gather silver, and brass, and iron, and lead, into the midst of the furnace, to blow the fire upon it, to melt it; so will I gather you in mine anger and in my fury, and will leave you there and melt you." Only those who have seen beneath the glowing arch at the smelting works, flames surging wave after wave across the surface of the liquid metal carrying all the substances here called dross from the pure silver, and only those who have heard the roar of the fiery blast that ceases neither day nor night until its task of purification is accomplished, can appreciate the terrible force of the figure made use of by the prophet. Several other passages in Holy Writ show us that the plan of extracting silver from its ores in those ancient times was first to obtain the silver in combination with lead and other easily oxidisable metals, and then, by heating the compound in a furnace and blowing air upon it, the impurities, or "dross," were turned into light oxides that were absorbed by the hearth, or floating on the surface were scraped away. The student of metallurgy will find that the method adopted in most of the silver furnaces of the present day, is in principle analogous to this. The Romans made use of a similar plan. Strabo quotes Polybius as speaking of a silver ore which, after being washed seven times, was melted with lead, and became pure silver. Pliny says that most of the silver in his time was found in connection with lead, and he further remarks that neither metal can be extracted from its ores without the addition of the other. The plans in use for extracting silver from its natural combinations, without in one form or another introducing lead into the furnace, are probably all of modern invention, and it is hence likely that this last expression of Pliny gives a general fact in the metallurgy of silver in his time. That silver must always be added to the ores of lead to insure the production of the latter metal is an error, probably originating in the circumstance that pieces of native silver, in order that they may be readily fused, are frequently given directly to the argentiferous lead in the process of cupelation. And it is further probable that in ancient times all the commercial lead contained a very perceptible quantity of silver which it might readily be supposed had been added purposely. But it is not to be expected that very distinct accounts of the metallurgic processes of the Romans should have descended to us, since the reduction of ores was carried on in mountain fastnesses, far from regions frequented by men of cultivation; and mining and metallurgy were not then, as they have become in modern times, subjects to which men of the highest mental capacity directed their attention. What in later days such men as Swedenborg, Humboldt, Le Play, Rivot, and Scheerer have studied and written upon with laborious care, was then left almost entirely in the hands of serfs and malefactors. The accounts that Diodorus has handed down to us of the cruelties practised in the mines of Spain are shocking to every sense of humanity. Here the wretched laborers were driven, under the whip of overseers, night and day, along the dark passages of the mine, and, forced to crawl with their loads of ore through cramped crevices charged with all the vapors that collect in subterranean excavations.

It is pleasing to one hopeful for the grand principle of human progress to observe the immense and universal change for the better in the condition of the laborers, that has gradually taken place in this branch of industry. In England each precious life that is lost in the mines is counted with scrupulous care; and by governmental and private efforts it is sought to prevent accidents and save bodily suffering. In Westphalia can be seen vast bathing establishments, where all the miners belonging to the works may take their warm baths as regularly as did the old Roman ædile. The silver mines of Saxony have an organ at their mine to accompany them in their religious exercises that precede their hours of labor. In southern Austria furnace-men and miners are generally pensioned by the Government, at full pay, after a faithful service of 40 years, and in many lands steam not only draws the ore that was once laboriously carried out by human labor, but even transports the miner himself to and from his daily employment. The mining of silver has led more than that of any other metal to this ameliorated condition of the miner, since its veins, penetrating deep into the earth, have carried the adventurer gradually forward, compelling him continually to devise new expedients for the purpose of raising the water that threatened to flood his treasure, to supply himself with pure air, and to draw to the surface the mineral that he had collected in his rocky caverns. The study of Hydraulics, Pneumatics, and Mechanics was thus encouraged, by supplying a profitable field for the practical application of the results of these sciences. Gunpowder, which has wrought a change in the underground economy of the miner, as radical as that which it has effected in the habits of civilized nations, is stated to have been first employed for blasting, in a mine producing silver; that of Rammelsberg in the Hartz. The mines of silver are among the most extensive with which man has pierced the surface of the earth. Recently could be seen, at the bottom of the Samson mine, in Hanover, figures indicating that the main pit is 2,600 English feet, or within 40 feet of half a mile deep. It is a subject for wonder, how, with the aid of water power alone, and with wooden pumps that seem ready to fall to pieces with every stroke, even the most patient miner should have reached a depth so extraordinary. The vein of Guanaxuato, in Mexico, has been explored for about 2,000 feet. The deeper mines about Clausthal on the Hartz reach 1,900 feet below the surface. Some of the most extensive engineering works connected with mining have their origin in the search for silver. The adit level, commenced in 1782 with the object of draining the Schemnitz district, in Hungary, is intended to be nearly 9 miles long, and each fathom it is estimated will cost 40*l*. The Freiberg silver mines, in Saxony, are about to be tapped by a level nearly 8 miles (42,640 feet) in length, which will carry the water off at a point 410 feet below the level of the present deepest drainage. This tunnel will be 9 feet 11 inches in height, about 8 feet wide, and will rise in the whole distance 12.6 feet. The metallic district of the Hartz around Clausthal is drained by what is known as the "Tiefe Georg-stollen," which was partly excavated in the latter years of the last century, and completed in 1835. It is 11⅛ miles long, and taps the mines 840 feet below the surface. At a depth of 375 below the "Stollen' above mentioned, is a subterranean canal, upon which ore is transported in boats from different mines to a convenient place for winding. The length of this navigable channel is over two and a half miles.

Beside stimulating mankind to the profound study of the Divine laws by which matter is governed, by furnishing a domain where knowledge thus gained could be brought into daily and profitable use, silver, in its purified condition, has played among the nations of the earth a very important part as a civilizer. I allude to its employment in the form of money in facilitating necessary exchanges of property, and thus encouraging the ennobling intercourse of nations. Mention has been already made of the period when it is supposed that coins were invented. From the earliest historical times to the present, silver has been *par excellence* the metal of the mint, and in pieces of determined value it now circulates under a thousand familiar names wherever commerce is known. As a standard of value silver possesses advantages over all other substances. Gold alone presents qualities that can be brought into comparison with it in this connection. The fact that since the discovery of America gold has fallen, when compared with the necessities of life —as, for example, food—but in the proportion of 4 to 1, while silver in the same period has experienced a depression in the proportion of 6 to 1, has been adduced to show that the former metal is the most staple in its worth, and hence best suited for a standard. But the circumstances that have taken place within the last century can never occur again. No virgin hemisphere yet remains with mountains teeming with silvery ores, whose discovery can work a new epoch in the history of the precious metals. But, as a substance of universal distribution in nature, and requiring long, laborious, and ingenious processes to extract it from its layer in the solid rock, and bring it into a form adapted for circulation, silver must always retain a worth among men that will bear a steady relation to the necessities of life.

—*Compiled from " Metallurgy of Silver and Lead, by R. H. Lamborn, Ph. D."*

HISTORICAL SKETCH OF LEAD.

In ancient times lead appears to have held quite a subordinate position among the metals, both as regards the number of its uses and the value it possessed in the market. Of its discovery history furnishes us with no information. The Greek term *molybdus*, by which the metal was known, is so closely analogous to its Indian name, *mulva*, that some authors have been led to the conclusion that the knowledge and usage of the metal originated in remote ages in the distant East, and from hence was disseminated among the nations of Europe. Nature produces, in sufficient quantities to attract the attention of the primitive worker in metals, only such compounds of lead as furnish the pure metal after a chemical process requiring the aid of heat; so that, unlike gold, copper, or silver, its earliest use must have come subsequent to that condition of cultivation that enabled the reduction of an ore. The discovery of native lead among natural productions is due to the scientific acumen of more recent times. An elementary acquaintance with the properties of ores once possessed, it is not difficult to follow the course of reasoning and experiment that would lead to the discovery of lead. Its most valuable and abundant ore—galena—possesses so many qualities calculated to make it remarked by an uncultivated race; its weight, its brilliant metallic glance, its hardness, would all favor the conclusion that it was an unrefined metal, and a very simple operation of the mind would lead to the attempt to make it malleable by subjecting it to the action of the fire. The occurrence of the ores of lead with silver, and the attempts to purify the latter, may have been the immediate cause of the discovery of the former metal. The winning of lead from plumbiferous silver ores was in the earliest times not connected with the reduction of the litharge, as is at present so generally the case. The lead was deemed the impurity of the more precious metal, and was " burned " or oxidized away, as has been described in the history of silver. The earliest mention that we have of lead occurs in Numbers, where it is spoken of with various other metals among the spoils brought by the children of Israel to Moses, after their victories over the Midianites; and it is evident that the same metal was an article of trade, together with silver, iron, and tin, at the fairs of the Phœnicians.* The Romans employed for lead the name *plumbum*, which clearly had its origin in the Greek and Indian appellations. They appear to have regarded lead and tin as but varieties of the same metal, distinguishing the former as black lead, and the latter as white lead. Remarkable differences, however, were observed as existing between the two, and the process of collecting the mineral, producing the white variety (stream tin) from the *débris* of the valleys, is distinctly described; and, further, the fact that *black* lead only, of the two varieties, could be refined for the purpose of obtaining silver, appears to have been well understood. The employment of lead in ancient times was much less general than one might anticipate from the abundance with which it occurs in nature. It was often used in connection with tin as an alloy, and this mixture, being employed in the manufacture of bronze, probably led to the introduction of the lead which is found to constitute a portion of many works of plastic art, and coins, that have descended to us. I have seen, in the Museo Borbonico, at Naples, portions of an ancient water conduit from the island of Capri, in which an exceedingly malleable lead was employed apparently for tightening the joints. Lead also appears to have been made into plates and tubes, and to have answered as a material for vessels for household purposes. Some of the chemical compounds of the metal appear to have been well known to the Romans. Litharge, produced in the treatment of argentiferous lead, was a common substance. As it was crystalline or amorphous, or more or less pure, it received different names, which names were supposed to designate entirely different substances. The finer qualities were employed in medicine, in the preparation of plasters.

What is now known as white lead was called by the Romans " *cerussa*," and they prepared it by a method not very dissimilar to that in use at present in many localities, by allowing vinegar to act upon the commercial metal. This substance was used as a color, and also extensively in medicine. It is related that some casks of white lead, that happened to be in a burning building, were so affected by the heat, that their contents became a fine red color that was found to make an excellent pigment, and which, after this accidental discovery, was manufactured and sold under the name of " burned white lead." This was the beginning of the knowledge of what we call " red lead," a substance now so valuable to the painter. The Romans knew how to reduce the litharge formed in the process of smelting silver to the condition of metallic lead, but this knowledge, limited as it may seem, does not appear to have been possessed by the tribes of eastern Siberia, where Gmelin states that he observed the remains of many old furnaces where silver had been extracted, but where the lead with which it had been combined was, after oxidation, thrown away. The poisonous qualities of the vapors of lead were known to the ancients, and the deplorable effects it produces upon laborers employed in the furnace were early noticed, as were also the highly poisonous qualities of many of the lead compounds. Although they appear to have used lead in the form of a thin sheet, to detect by its color, upon being immersed in wine, the state of acidity to which that fluid had arrived, it does not appear that they had discovered the more modern plan of adding litharge to sour wine, for the purpose of improving its taste, by bringing about therein the formation of a sweet salt. The countries standing first as producers of lead in modern times are Great Britain, Spain, and the United States. The royal decree that in 1825 opened the Spanish mines to native and foreign competition was followed by a period of rapid expansion in the mining and metallurgic industry of the kingdom. For a period previous to 1820, with the exception of a few inconspicuous iron pits, the only mine in activity in Spain was that of Almaden, where the Government monopolised the production of quicksilver. But in 1826 no less than 3000 mines had been opened in the Sierras of Gador Lujar. So large

* Ezek. xxvii. 12.

and rich were the lead deposits here, that in 1823 the production of the region had reached 25,000 tons per annum, and in 1827 the quantity produced was 42,000 tons. The markets of the world were soon overflowing, and, as a consequence, a universal depression in the price of lead was experienced throughout Europe, and many of the poorer mines of Germany and England were compelled to suspend operations. At length, in order to raise the price of the metal to a remunerative point, the miners of the country were obliged to enter into a mutual agreement to work the deposits only during half the year. These vast stores of metal were, however, chiefly near the surface; their productiveness soon began to diminish. Their point of culmination was in 1827, since which there has been a rapid falling off, until at present the yield is comparatively inconsiderable. The lead and silver mines of Sierra de Almagrera were discovered in 1839, and the excitement which the discoveries there made produced was extraordinary. The influx of population was such that in 1845, 8000 miners were employed in that district in 826 mines, and there were 38 smelting works in operation, which produced in that year 108,230 pounds troy of silver and 8,350 tons of lead. The ore which furnished the great quantity of precious metal was an argentiferous galena holding from 130 to 180 ounces of silver to the ton. But upon sinking deeper the miners found that their ore decreased in quantity, and this deposit has also become of less importance than it formerly was. Besides these districts, the ancient mining region of Linares has produced much lead since having become a locality for the exertion of English enterprise. Great Britain contains a large number of lead-bearing districts, and her production of this metal, as well as that of tin, copper and iron, is enormous. The production of silver and lead are intimately connected, and the introduction of new processes that will be described in subsequent chapters, has brought her yield of the latter metal to a large figure during the last few years. From the circumstances that pigs of lead, evidently of Roman origin, have been found in Derbyshire, we are led to the conclusion that Britain was a lead-producing country even in those remote times. It is generally stated that Derbyshire supplied the only mines where that metal was raised until 1289, when the lead deposits of Wales were discovered. In 1661 Childey, speaking of the Peak of Derbyshire, gives the following curious account of the treatment of the ores in that district;—"The lead stores of the Peak are just within the ground, next to the upper crust of the earth. They melt the lead on the tops of the hills that lie open to the west wind, making their fire to melt it as soon as the west wind begins to blow, which wind, by long experience, they find holds longest of all others. But for what reason I know not, since I should think that lead was the easiest of all metals to melt, they make the fires extraordinarily great." The most important lead-mining district at present is in the north of England, in the vicinity of Alston Moor, where the three counties of Northumberland, Durham, and Cumberland come together. Near this point are the large possessions of Mr. Beaumont, which produce about one-fourth of the whole quantity of lead raised in England, and one-tenth of the entire yield of Europe. The increase in the amount of lead raised in Cornwall and Devon within the last twenty years has been quite extraordinary. Borlase, who wrote in 1758, says, that lead mines had been anciently worked in the first-named county; that those of Penrose, near Helston, had been wrought for about 200 years, but the only mine worthy of note in his time was that of St. Issy, near Padstow. In 1835 only about 140 tons were produced by the mines of the two counties, and in 1839, according to De la Bèche, the whole produce amounted to scarcely 180 tons, while in the years from 1845 to 1850 over 10,000 tons were raised annually. One mine alone of extraordinary richness, East Wheal Rose, produced from 1845 to 1849 from 3000 to 5000 tons of metallic lead annually. In 1858, 9710 tons were sent to market from 34 Cornish mines, and among these were 13, each of which furnished more lead than was raised in the whole county twenty years before. The ore raised in Cornwall is largely silver-holding; the average of that metal per ton of lead produced in 1858 was 41 ounces, while the average for the entire United Kingdom for the same year was between 8 and 9 ounces. Isolated mines produce ore much richer than the above average; thus Huel Mary Anne in 1858 yielded 906 tons of lead, containing an average of over 68 ounces. The mines of Derbyshire furnish some examples of ores extremely rich in silver. Huel Florence gave ore in 1858 containing 150 ounces, or equivalent to 225 ounces per ton of metallic lead. Two tons of this ore realised 193*l.* 16*s.* The yield of the lead mines of Great Britain in 1810, although exceeding in amount that of all the rest of Europe, did not amount to over 12,500 tons. In 1845, according to the estimates of Mr. Taylor, it had increased to 46,112 tons. In 1858 the invaluable statistics prepared by Mr. Hunt show that 68,303 tons of metallic lead were produced from 95,855 tons of ore, being an average of 71 per cent. There are few articles occupying such an important place in commerce, that experience such large variations in price, as lead. In the period between 1800 and 1810 its average price was 27*l.* 14*s.* 6*d.* per ton; from 1811 to 1821, 23*l.* 6*s.* 6*d.*; from 1822 to 1832, 20*l.* 7*s.* In 1832 the price was as low as 13*l.* 10*s.*, and in 1858 the mean value per ton was about 21*l.* 10*s.* In the United States, lead ores are widely distributed among the several States, but by far the most considerable amount is raised in that portion of Wisconsin, Iowa and Illinois, which is generally known as the "Upper Mississippi Lead Region." Here the ore is non-argentiferous galena, occurring in limestone in irregular deposits or veins that do not appear to retain their richness below a moderate depth. The ancient inhabitants of the country appear to have been aware of the existence of the mineral, but it is doubtful whether they understood the process of smelting it, for although galena has been found in their sepulchral mounds, no metallic lead has as yet been discovered. Le Sueur, the French explorer, notices many mines of lead along the bank of the Mississippi during his expedition in 1700-1701, but little attention appears to have been paid to the wealth there until 1788, a French miner named Dubuque obtained a grant of a tract of land and opened mines, which he continued to work until his death in 1810. In 1839 a geological exploration was ordered by the United States Government, and, aided by 139 assistants, Dr. D. D. Owen made a rapid exploration of a region embracing 2880 square miles, which he reported to be plumbiferous.—

—Compiled from the "Metallurgy of Lead by R. H. Lamborn, Ph. D."

HISTORICAL SKETCH OF COPPER.

COPPER is one of the six metals spoken of in the Old Testament, and one of the most important of the seven mentioned by ancient historians. It was known at least as early as the time of Tubal Cain, since he was an instructor of artificers in brass and iron. Grecian historians relate that Cadmus discovered copper, and taught its application to the wants of mankind. It was found on the island of Eubœa, near the town of Chalkis, and hence, it has been assumed, came the Grecian name *Chalkos*, by which the metal was known to Homer, Hesiod, and other ancient Achaean authors. The Romans knew copper as *aes cyprum*, and later as *cuprum*, names derived from that of the island of Cyprus, where Pliny declares the method of working it was discovered. It is certain that upon this island the Phœnicians had opened mines at a very early date. Hence in the mystic nomenclature of the Alchymists copper came to be called *Venus*, to which goddess Cyprus was sacred, and among their signs it was known by the astronomical designation of that planet ♀. The English word *copper*, the French *cuivre*, and the German *kupfer*, were introduced into those languages during the middle ages, and are plainly but alterations of the Latin name. The mention of copper in the oldest records, and among the first metals whose use was known to mankind, is consistent with what we would be led to conclude, after a close consideration of its nature and the manner of its occurrence. Masses of the tough native metal, detached by water from their original beds, and deposited in spots where a warlike people went to seek stones from which to shape their rude weapons, by reason of their weight, color, lustre, and malleability, would quickly attract attention. These qualities, connected with the fact that the native masses are often of considerable size, render it more than probable that copper was the first metal upon which were made the unskilled attempts of primeval smiths and smelters. In the Hebrew manuscripts no distinction is made between pure copper and the alloy with tin, which in modern times has been known as bronze, but which in our translations is rendered by the word brass. This alloy, however, was undoubtedly the discovery of a generation long posterior to that which made the earliest use of native copper, since tin not being found in the countries bordering on the shores of the Mediterranean, could only have been introduced after commercial relations with distant European or Asiatic regions had been established. It is generally assumed, without any particular evidence to support the assumption, that the ancients had a means of making this alloy of tin and copper so hard that it would cut the most refractory rocks, and the existence of vast monuments of syenite and porphyry are spoken of by antiquaries as inexplicable under any other supposition. It is a fact provoking speculation, that the race of the Incas in Peru, although unable to reduce the iron ores that were scattered in abundance around them, and hence ignorant of the use of that metal, were well aware of the peculiarities of this hard alloy of copper and tin, and forming it from proportions almost identical with those adopted by the ancients of the old world, used it to construct the tools required for dressing the stones necessary in building their vast aqueducts and temples.

The Israelites had bronze weapons in the time of David. Homer represents his heroes fighting with arms made from the same substance, and it formed an important portion of many of the agricultural implements of the ancients. Bronze was early recognized as a material adapted to the needs of the fine arts; the Colossus of Rhodes, which was constructed of this metal, is a remarkable proof of the abundance of copper even at that early date; and it is said that Mummius after the sacking of Corinth, filled Rome with bronze statues, thus transporting Grecian art to the banks of the Tiber. Whether the Phœnicians who carried tin from Britain found there the knowledge of making bronze is uncertain; but it is a probable hypothesis, that the enigmatical weapons and tools of bronze found in the graves of some ancient race in various European lands, and which archæologists have determined to be Celtic remains, were obtained by the wandering tribes from that region in Britain where at the present day the descendants of those same metallurgic Celts have made themselves the largest refiners of copper on the globe, and in whose vicinity occurs the richest and almost the only known tin region within a circumference of many thousands of miles. The earlier money of the Romans was of bronze, or more rarely of the alloy of copper with zinc, known as brass. Before the time of the Cæsars no pure copper pieces appear to have been struck, and those of the time of the emperors often show indications of having been silvered, by which process it is probable they were made to take the place of solid pieces of the more valuable metal. Descending into the middle ages, we find a new and important application of copper in its combination with tin originating in the triumph of the Christian religion. Church bells, which are made of this alloy, are first definitely mentioned in ecclesiastical records of the seventh century; they were brought into general use by Charlemagne, and for several centuries were almost the only object for the employment of the founder's art. In the construction and ornamenting of churches, copper, bronze, and brass, have played an important part: the roof, the altars, and the sepulchral monuments were often wrought of these substances; and the statues and decorations of pantheistic temples still exist in renovated forms in the worshipping places of Christendom. The invention of gunpowder, and the subsequent introduction of bronze cannon in the wars of the fourteenth and fifteenth centuries, had an important influence in increasing the value and the production of copper; and, as the civilization of more modern periods grew, the demand for a cheap metal, approaching in its properties those of gold and silver, increased rapidly, until at present there is scarcely a branch of human economy where copper is not found an important means of arriving at greater perfection. Either unmixed or in the form of a compound, it is employed in the construction of nearly all kinds of machinery; for forming the delicate instruments of the astronomer, natural philosopher, engineer, and musician; for increasing the security of commercial enterprise by adding to the durability of ships; as a path for the electric current in its bold journey from continent to continent in the service of civilization. It furnishes a re-agent for the chemist, and for the physician a remedy against disease. The sculptor employs it to express his conceptions, the painter, aided by the engraver, to reproduce and disseminate his beautiful thoughts. The electro-metallurgist uses it to catch and make prominent the evanescent forms of nature and art. The glassmaker, the cook, the dyer, and those engaged in many other employments, use it constantly, whilst almost every advance made in technical science adds to the number of its applications. Eubœa and Cyprus have already been mentioned as localities known to the ancients for their mines of copper-producing minerals. The Egyptians, in early times, drew their supply of the metal from Arabia, and it is related that one of the objects in view by Ramses the Great, in digging the canal across the isthmus of Suez, was to connect the copper-producing countries of the Arabian peninsula with his kingdom on the Nile. Travellers of the present day find in the midst of the waste, far removed from the region of fuel, remains of mines, and hieroglyphic inscriptions proving them to belong to an age almost beyond the reach of history. Upon the highlands of the Urals and the Altai are found remains of mines dating from the most remote period, before the use of iron was introduced as a material for the construction of tools. The Phœnicians brought copper from Asia Minor, the Taurus Mountains, England, Portugal, and Spain, and during the middle ages the last-mentioned countries produced a notable quantity of the metal under consideration.

The information we have regarding the early stages in the progress in Britain of both the mining and metallurgic divisions of this important branch of industry, is remarkably scanty, and records or traditions treating of the period prior to the beginning of the seventeenth century, are seldom of a reliable character. At Newlands, near Keswick in Cumberland, some rich mines of copper were wrought about 1250, and it would appear that in 1470 the place was still famous for the metal it produced. Ecton Hill, in Staffordshire, was another spot where copper was obtained in considerable abundance, previous to the era of copper mining in Cornwall. It is amusing, with our present knowledge of the mineral resources of England, to meet with Acts of Parliament passed in the reigns of Henry VIII. and Edward VI. for preventing the exportation of brass and copper, lest there should not be metal enough left in the kingdom fit for making guns and other engines of war, and for household utensils;" and even at so late a date as 1708, to find a memorial presented to the House of Commons by the brass manufacturers, stating that "England, by reason of the inexhaustible plenty of calamine, might become the staple of brass manufacture for itself and foreign ports, and that the continuing the brass works of England would occasion *plenty of rough copper to be brought in.*" At this period the supply of copper came from the Continent, metal produced by the mines of the Hartz and Hungary was sold in the magazines of London, and, indeed, not until 1717 were English pennies struck from English metal. At the end of the seventeenth century the attention of Cornish tin miners began to be seriously drawn to the more valuable cupreous deposits around them; previous to that date, it is true, copper ore had been sold at a low price under the name of *poder*, but this was produced by mines worked or originally opened for tin. The yellow copper pyrites was the first ore recognized as valuable by the miner, the far richer sulphide and black oxide of copper were for a long time not considered worth preserving, and thousands of pounds were cast into the sea or left standing in the lodes to surprise and delight subsequent and wiser explorers. Deposits began to be opened, exclusively for the copper they contained, about the commencement of the last century, and from that time to the present the produce of ore has gradually but steadily increased. The discovery of the rich mines of Anglesea in 1768, the addition of Devonshire and Ireland to the list of copper-producing regions, and, of late years, the immense importation of ores from Chili, Cuba, and the Pacific islands, have neither destroyed the demand for Cornish ore nor materially disturbed the law of growth. The advantage of sending ore to be smelted in the rich repository of fuel in the Welsh coal basin was very early perceived, and, even in 1586, according to Carew, ore was shipped thence from Cornwall. In 1765 several furnaces were in existence near Bristol, and others along the coast toward the westward. The general plan of the various processes then in use appears to have been extremely similar to that now practised at Swansea, and known as the English method of smelting copper; and when we consider the complex nature of the numerous operations which it includes, and the remarkable difference that exists between them and those practised at that time in all other copper-refining countries, we cannot but admire the ingenuity and judgment of those old metallurgists who, aided only by their clear powers of observation, worked out a system which, while it is so excellently adapted to all the circumstances of the locality, can be used in the treatment of every known variety of ore, and has withstood, with but slight changes, the keenest researches of modern science.

In the United States of America copper, in workable quantities, has been found in nearly all the States penetrated by the Appalachian chain of mountains. The oldest incorporated mining company in the country appears to have been one for the purpose of working copper ores in Connecticut, the date of whose charter is 1709. But all other deposits at present sufficiently developed to warrant a judgment regarding their value, are exceeded by that which, within the last sixteen years, has been re-opened upon the shores of Lake Superior. That this remarkable region was known to a race existing at a period anterior to the earliest authenticated dates in aboriginal history, is evident from the remains which still exist of gangways, tools, and other proofs of skill which the races occupying the country at the time of its discovery nowhere evinced. The Indians found by the first travellers were utterly ignorant of the methods of working that had been in use by the former race; they had no traditions to explain the existence of the numerous excavations, and what copper they possessed was only such as they gathered among the surface stones. The first record of the deposit is found in the missionary report of the Society of Jesuits for 1659-60. The savages had then rude utensils made from the metal, and huge blocks of it were erected and worshipped among their gods. In 1763, one Henry, a practical Englishman, explored the country at the imminent risk of his life, and in 1771 he established works, which were, however, soon abandoned. The recent mining era of the region begins with the year 1844. The explorations of various scientific men had made the region partially known to the world, and miners drawn thither by the reports of mineral wealth, soon discovered large blocks of the native copper, containing much silver. A feverish excitement set in among adventurers and capitalists, and companies were formed in various parts of the world to work localities, of which, in many cases, not even a survey had been made. In 1847, the inevitable crisis came, and of the hundreds of companies nominally existing, only six were found actually engaged in mining. The distrust naturally resulting from these early disasters has gradually disappeared. The convulsion was beneficial in exposing the spurious and worthless schemes, and in pointing out those enterprises whose inherent strength made them capable of weathering the storm. Since that period the progress of the region has been healthy, legitimate, and unwavering.—

—*Compiled from "The Metallurgy of Copper, by R. H. Lamborn, Ph. D."*

FIRST ATTEMPT BY EUROPEANS TO MANUFACTURE IRON IN THE UNITED STATES.

IT would not be profitable to inquire minutely whether the mound-builders or other aboriginal inhabitants of the United States, or the aboriginal inhabitants of any other part of the American continent, possessed a knowledge of the use and consequently of the manufacture of iron. It may be assumed that it has not been proved that they possessed this knowledge. Antiquarians have not neglected a subject of such importance, but thus far their researches have been fruitless of decisive results. Rude hatchets and other small implements of iron have been found in situations which give color to the theory that they may have been of aboriginal origin, but the weight of much concurrent testimony is strongly against this supposition. Prescott expressly says that the inhabitants of Mexico and Peru, who were, at the time of the conquest, the most advanced in all the arts of civilization of the immediate predecessors of the white race in North and South America, were unacquainted with the use of iron, copper serving them as a substitute. Our North American Indians were certainly unacquainted with the use of iron when the English, the Dutch, and other Europeans first landed on the Atlantic coast. In the absence of conclusive information concerning the use of iron by any of the aboriginal inhabitants of America, the interesting fact may be parenthetically stated that iron is now made in Cherokee county, in the western part of North Carolina, by some members of the remnant of a band of Cherokee Indians. They use the primitive Catalan forge, which was introduced into North Carolina by the early white settlers. North Carolina first gave to Europeans the knowledge that iron ore existed within the limits of the United States. The discovery was made in 1585 by the expedition fitted out by Sir Walter Raleigh, and commanded by Ralph Lane, which made in that year, on Roanoke Island, the first attempt to plant an English settlement on the Atlantic coast. Bishop, in his *History of American Manufactures*, says that "Lane and his men explored the country along the Roanoke and on both sides from Elizabeth river to the Neuse." Thomas Hariot, the historian of the colony, and servant to Sir Walter Raleigh, says that, "in two places of the countrey specially, one about foure-score and the other sixe score miles from the fort or place where wee dwelt, wee founde neere the water side the ground to be rockie, which, by the triall of a minerall man, was founde to hold iron richly. It is founde in manie places of the countrey else. I know nothing to the contrarie but that it maie bee allowed for a good marchantable commoditie, considering there the small charge for the labor and feeding of men; the infinite store of wood; the want of wood and deereness thereof in England; and the necessity of ballasting of shippes." But no attempt was made to utilize this discovery, as the colonists were in search of gold and not iron. In 1586 they quarreled with the Indians and returned to England. A permanent settlement in North Carolina was not effected until many years afterward. Iron ore was not mined in North Carolina nor was iron made within its boundaries until after many of the other colonies had commenced to make iron. In 1607 the first permanent English colony in the New World was founded at Jamestown, in Virginia, by the Virginia Company of London, and on the 10th of April in the following year, 1608, the company's ship, commanded by Captain Christopher Newport, sailed from Jamestown, loaded with iron ore, sassafras, cedar posts, and walnut boards, and on the 20th of May it arrived in England. From Neill's history of the company we learn that the iron ore was smelted, and "seventeen tons of the metal were sold at £4 per ton to the East India Company." This was undoubtedly the first iron made by Europeans from American ore. In 1610 Sir Thomas Gates, who had spent some time in Virginia, testified before the council of the company, at London, that there were divers minerals, especially "iron oare," in Virginia, lying upon the surface of the ground, some of which ore, having been sent home, had been found to yield as good iron as any in Europe. The iron here referred to was that which had been sold to the East India Company. In 1619 the Virginia Company sent to Virginia a number of persons who were skilled in the manufacture of iron, to "set up three iron works" in the colony. The enterprise was undertaken in that year, and was located on Falling creek, a tributary of the James river, which it enters on its right or southern bank in Chesterfield county, about seven miles below Richmond, and about sixty-six miles above Jamestown. In 1620, as stated by Beverley in his *History of Virginia*, "an iron work at Falling creek, in James River," was set up, "where they made proof of good iron oar, and brought the whole work so near a perfection that they writ word to the company in London that they did not doubt but to finish the work and have plentiful provision of iron for them by the next Easter"—in the spring of 1621. But neither "plentiful provision" or any other provision of iron was made on Falling creek in 1621, owing to the death of three of the master workmen who had the enterprise in charge. In July of that year the company sent over Mr. John Berkley, "formerly of Beverstone Castle, Gloucester, a gentleman of an honorable family," to take charge of the work. He was accompanied by his son Maurice and twenty experienced workmen. In a letter from the company to the colonial authorities, dated July 25, 1621, it was stated that "the advancement of the iron works we esteeme to be most necessarie, by perfecting whereof we esteeme the plantation is gainer. We therefore require all possible assistanee be given to Mr. Berkley now sent, and all furtherance to his ship, especially good entertainment at their landinge." On the 12th of August of the same year the company, in a communication to the authorities, wrote respecting the iron works and the saw-mills which had been projected: "We pray your assistance in the perfectinge of these two workes; the profitt will redound to the whole colony, and therefore it is necessary that you extend your authoritie to the utmost lymitts to enforce such as shall refuse the help to a business so much tending to the generall good." On the 5th of December, 1621, the company again wrote, enjoining "all possible dilligence and industrious care to further and accomplish those great and many designes of salte, sawinge mills, aud iron." In January, 1622, the authorities wrote to the company that "the care we have taken of the iron workes we reserve to be reported by Mr. Threasurer and Mr. Berkley himself." On June 10th the company wrote of "the good entrance we have understood you have made in the iron works, and other staple comodities," and added, "let us have at least by the next returnes some good quantitie of iron and wyne." But before this letter was written the colony had been visited by the Indian massacre of the 22d of March, 1622, in which John Berkley and all his workmen were slain and the iron works were destroyed. The works were not rebuilt. Beverley, writing in 1705, says the project of iron works on Falling creek "has never been set on foot since, till of late; but it has not had its full trial." In 1624 the charter of the Virginia Company was revoked. And thus ended disastrously the first attempt by Europeans to make iron in America.

The "good entrance" mentioned in the company's letter of June 10th doubtless referred to satisfactory progress in the construction of the works, but there is no positive evidence that iron was ever made on Falling creek. Letters from Mr. John Berkley had promised that "the company might relye upon good quantities of iron made by him" by Whitsuntide of 1622, but the massacre occurred before that time. Beverley, however, in referring to the Falling creek enterprise, says that "the iron proved reasonably good; but before they got into the body of the mine the people were cut off in that fatal massacre." The ore on Falling creek is described as having been brown in color. Mr. Berkley declared that "a more fit place for iron workes than in Virginia, both for woods, water, mynes, and stone," was not to be found; and Mr. George Sandys wrote to the company on the 3d of March, 1622, that Falling creek was fitted for ironmaking "as if Nature had applyed herselfe to the wish and dictation of the workeman; where also were great stones, hardly seene elsewhere in Virginia, lying on the place, as though they had beene brought thither to advance the erection of those workes." We have failed to discover whether the works on Falling creek embraced a blast furnace and refinery or a bloomary only, but the frequent references to building stone in connection with the works, and the length of time and the number of workmen occupied in their erection, lead to the inference that a furnace formed a part of the enterprise. No further attempt to make iron in Virginia appears to have been made for many years after the failure on Falling creek. In a pamphlet entitled *A Perfect Description of Virginia*, published at London in 1649, it is stated that "an iron work erected would be as much as a silver mine." In 1650 another pamphlet, quoted by Bishop, says of iron ore in Virginia: "Neither does Virginia yield to any other province whatsoever in excellency and plenty of this oare." In 1687, and again in 1696, Col. William Byrd, the first of the name in Virginia, set on foot the project of reviving the works on Falling creek, but it was not carried into execution. This is the project referred to by Beverley in 1705 as not having had its "full trial." To encourage manufactures in Virginia the exportation of hides, wool, and iron from the colony was forbidden by an act of the assembly in 1662, on penalty of one thousand pounds of tobacco for every hide exported, and fifty pounds of tobacco for every pound of wool exported, and ten pounds of tobacco for every five pounds of iron exported. The restriction was removed in 1671, "no successe answering the conceived hopes and apparent losses accrueing to all inhabitants by the refusall of those concerned to buy the commodityes aforesaid," but it was reenacted in 1682. We cannot learn that duringall the time covered by these enactments, and down to the beginning of the eighteenth century, there was a single pound of iron manufactured in Virginia. Notwithstanding the wise encouragement given by the Virginia Company and by some succeeding colonial authorities to the establishment of manufactures, the Virginia settlers for a hundred years after the settlement of Jamestown devoted themselves almost entirely to the raising of tobacco and other agricultural products.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

IRON MANUFACTURE IN THE NEW ENGLAND COLONIES..

ALTHOUGH iron ore in this country was first discovered in North Carolina, and the manufacture of iron was first undertaken in Virginia, the first successful iron works were established in the province of Massachusetts Bay. In 1632 mention is made by Morton of the existence of "iron stone" in New England, and in November, 1637, the General Court of Massachusetts granted to Abraham Shaw one-half of the benefit of any "coles or yron stone w^{ch} shal be found in any comon ground w^{ch} is in the countryes disposeing." Iron ore had also been found in small lakes or ponds on the western banks of the Saugus river, near Lynn, soon after its settlement in 1629, and in 1642 specimens of it were taken to London by Robert Bridges, in the hope that a company might be formed for the manufacture of iron. This hope was realized in the formation of "The Company of Undertakers for the Iron Works," consisting of eleven English gentlemen, who advanced £1,000 to establish the works. John Winthrop, Jr., had previously gone to England, and he appears to have assisted Mr. Bridges to secure the organization of the company, as did others among the colonists. Thomas Dexter and Robert Bridges, both of Lynn, were among the original promoters of the enterprise. Alonzo Lewis, in his *History of Lynn*, published in 1844, says that in 1643 "Mr. John Winthrop, Jr., came from England with workmen and stock to the amount of one thousand pounds, for commencing the work. A foundry was erected on the western bank of Saugus river. . . . The village at the foundry was called Hammersmith by some of the principal workmen, who came from a place of that name in England." In Newhall's revision of Lewis's history, published in 1865, the iron works are said to have been located near the site of the present woolen factories in Saugus Centre, a suburb of Lynn, where large heaps of scoria are still to be seen. "This iron foundry at Lynn," says Lewis, "was the first which was established in America. Lynn is eleven miles north-east of Boston. In 1644, and subsequently, as stated by Lewis, the General Court granted many special privileges to the company. On March 7, 1644, it was granted three miles square of land at each of six places it might occupy in the prosecution of its business. On November 13, 1644, it was allowed three years "for y^e perfecting of their worke and furnishing of y^e country with all sorts of barr iron." The citizens ware granted liberty to take stock in the enterprise "if they would complete the finery and forge, as well as the furnace, which is already set up." On the 14th of

May, 1645, the general court passed an order declaring that "y^e^ iron worke is very successfull (both in y^e^ richness of "y^e^ ore and y^e^ goodness of y^e^ iron)" and that between £1,200 and £1,500 had already been disbursed, "with which y^e^ furnace is built, with that which belongeth to it, . . and some tuns of sowe iron cast . . in readiness for y^e^ forge. . . There will be neede of some £1,500 to finish y^e^ forge." On the 14th of October of the same year the company was granted still further privileges by the general court, on the condition "that the inhabitants of this jurisdiction be furnished with barr iron of all sorts for their use, not exceeding twentye pounds per tunn," and that the grants of land already made should be used "for the building and seting up of six forges, or furnaces, and not bloomaries onley." The grant was confirmed to the company of the free use of all materials "for making or moulding any manner of gunnes, potts, and all other cast-iron ware." On the 6th of May. 1646, Mr. Richard Leader, the general agent of the company, who is described as a man of superior ability, purchased "some of the country's gunnes to melt over at the foundery." On August 4, 1648, Governor Winthrop wrote from Boston to his son, who had removed to Pequod, Connecticut, that "the iron work goeth on with more hope. It yieldeth now about 7 tons per week." On September 30th he writes again: "The furnace runs 8 tons per week, and the bar iron is as good as Spanish." Newhall quotes from a Lynn account book for 1651, the following entry: "James Leonnarde, 15 days worke about finnery chimneye and other worke in y^e^ forge, 1: 13: 0. To ditto Leonard for dressing his bellows 3 times, 1: 10 0." Edward Johnson, of Woburn, in describing Lynn in 1651, in his *Wonder Working Providence*, printed in that year, says: "There is also an iron mill in constant use;" and Mr. Lewis states that, prior to 1671, "the iron works for several years were carried on with vigor, and furnished most of the iron used in the colony." After 1671 they passed under a cloud, and about 1688 they appear to have finally ceased operations. Their owners were harassed after 1651 with frequent lawsuits, arising from the overflow of the water in the dam. The fear that the works would create a scarcity of timber also appears to have added to their unpopularity. Hubbard, writing about 1677, says that "a work was set up at Lynn upon a very commodious stream, which was very much promoted and strenuously carried on for some time, but at length, instead of drawing out bars of iron for the country's use, there was hammered out nothing but contention and lawsuits."

From the foregoing details it is plainly established that the enterprise at Lynn embraced a blast furnace or "foundery" and a refinery forge. The term "foundery" was long a synonym for "furnace," castings being made directly from the furnace, as has been previously stated. This practice continued in this country down to almost the middle of the present century, and is still followed in many European countries. That the furnace was in operation in May, 1645, is certain, and that the forge was in operation in Septemper, 1648, is equally certain. These dates may be accepted as definitely determining, respectively, the first successful attempts in this country to make "sowe iron" and other castings in a blast furnace and to make "barr iron in a refinery forge from "sowe iron." Joseph Jenks was a machinist at the Lynn iron works, who had come from Hammersmith in England, and was a man of much skill and inventive genius. He prepared the molds for the first castings that were made at Lynn. "A small iron pot, containing about one quart," was the first article cast in the furnace. It 1844 it was in the possession of Mr. Lewis's mother, who was a lineal descendant of Thomas Hudson, the first owner of the lands on Saugus river on which the iron works were built, and who obtained possession of the pot immediately after it was cast, "which he preserved as a curiosity." "It has been handed down in the family ever since," wrote Mr. Lewis in 1844. Joseph Jenks, who became the founder of an eminent New England family, purchased from Richard Leader on the 20th of January, 1647, the privilege of building a forge at the Lynn iron works for the manufacture of scythes and other edge tools. This enterprise was successful. In 1652 he made at the Lynn iron works, for the mint which was that year established at Boston, the dies for the first silver pieces coined in New England. On one side of these coins was the impression of a pine tree. In 1654 he made for the city of Boston the first fire engine made in America. In 1655 the general court granted him a patent for an improved scythe. He died in 1683. Henry and James Leonard were also skilled workmen at the Lynn iron works. They and their descendants were afterwards connected with other colonial iron enterprises. They had a brother Philip, who does not appear to have lived at Lynn. Rev. Dr. Forbes, in referring to the Leonard family in his *Topographical Description of the town of Raynham*, written in 1793, says that "the circumstance of a family attachment to the iron manufacture is so well known as to render it a common observation in this part of the country, "Where you can find iron works there you will find a Leonard." Henry and James Leonard are said to have learned their trade at Pontypool, in Monmouthshire. The second iron enterprise that was undertaken in New England embraced a furnace and forge at Braintree, about ten miles south of Boston. The works of Lynd and Braintree belonged to the same company. Bishop says that, on the 19th of November, 1643, a grant of 3,000 acres of the common land at Braintree was made to Mr. Winthrop and his partners, the Lynn company, "for the encouragement of an iron work to be set up about Monotcot river." But this grant, according to Lewis, was not surveyed until January 11, 1648. On the 29th of September, 1645, as stated by Lewis, the first purchase of land, consisting of twenty acres, "for a forge at Braintree," was made from George Ruggles by Richard Leader, who was the general agent for the company of undertakers. The furnace was probably built in 1646. Robert Child, writing from Boston on the 15th of March, 1647, to John Winthrop, Jr., "at Pequot river," says of the Lynn and Braintree enterprises: "We have cast this winter some tuns of pots, likewise mortars, stoves, skillets. Our potter is moulding more at Brayntree as yet, which place after another blowing we shall quit, not finding mine there." We find, however, that iron ore was mined at Braintree in the early part of 1652, and that, on the 28th of September of that year, it was proposed at London, on behalf of the undertakers to employ William Osborne, "at Brantry furnas & fordges." Lewis states that in 1691 "iron ore, called 'rock mine,' was taken from the ledges at Nahant for the forge at Braintree." Henry Leonard is supposed to have superintended the erection of the Braintree works. John Gifford was the manager of the works, according to Newhall, and in 1651 he succeeded Richard Leader as agent for the works at Lynn. The next iron enterprise in New England was located in the town, or township, of Taunton, now Raynham, two miles from the city of Taunton, in Bristol county. This enterprise was undertaken in 1652 by Henry and James Leonard and Ralph Russell. At a town meeting at Taunton, held October 21, 1652, "it was agreed and granted by the town to the said Henry Leonard and James Leonard, his brother, and Ralph Russell, free consent to come hither and join with certain of our inhabitants and set up a bloomery work on the Two-mile river." The Taunton works, sometimes called the Raynham works, are referred to by Lewis as "Leonards' celebrated iron works." They were well managed, and long continued in a prosperous condition. At these works bar iron was made directly from the ore. As Henry Leonard was at Lynn in 1655, and as James Leonard does not appear to have been there after 1652, it is probable that the latter and his sons became the sole owners of the Raynham works. Dr. Forbes gives an account of the intimacy which existed between the Leonards at Raynham and King Philip, through which they were protected against Indian outrages. Sanford, in his *History of Raynham*, says: "Philip had a summer hunting seat near the Fowling pond. The Leonards had supplied him with beef, repaired his muskets, and furnished him with such simple tools as the Indians could use." Philip's head, says Dr. Forbes, was deposited in the cellar of James Leonard's house for a considerable time after his death in 1676. At the date of Dr. Forbes's book, 1793, this house was occupied by Leonards of the sixth generation. The forge, says the writer, was situated on "the great road, and, having been repaired from generation to generation, it is to this day still in employ." In William Read Dean's *Genealogical Record of the Leonard Family*, published in 1851, it is stated that "the old forge, though it has been several times remodeled, has been in constant use for nearly two hundred years, and is now in the full tide of successful operation. It is owned by Thomas Dean, Esq., who is descended from the Leonards." The forge was at that time employed in the manufacture of anchors. In 1865 it was still so employed, with six forge fires, two hammers and four water-wheels; but about that time it ceased to be active and has not since been in operation. The works are now in a dilapidated condition. Theodore Dean was recently the owner. This forge is the oldest iron establishment in the country that is now in existence. Fowling pond, which was originally nearly two miles long and three-quarters of a mile wide, was close to the forge, and supplied it with ore. A blast furnace, for the manufacture of hollow-ware, was built on a branch of Two-mile river before the Revolution, and has long been abandoned.

In Ricketson's *History of New Bedford* it is stated that "one of the earliest settlers of Dartmouth was Ralph Russell, who came from Pontypool, England, and had been engaged in the iron business with Henry and James Leonard, of Taunton. He set up an iron forge at "Russell's Mills,' which place received its name from him." In 1657 the General Court of Massachusetts, owing to the failure of the undertakers at Lynn and Braintree to furnish the colony with a constant supply of iron, whereby unsufferable damage may accrew," granted to the inhabitants of Concord and Lancaster, and such as they should associate with them, "liberty to erect one or more iron workes within the limitts of theire oune tonne bounds, or in any common place neere thereunto." That this grant resulted in the establishment of an iron work at Concord—since become famous through its association with the outbreak of hostilities between the mother country and the colonies in 1775—appears probable from the grant by the Court in 1660, "to ye company in partnership in the iron worke at Concord," of "free liberty to digg mine without molestation in any lands now in the court's possession." About 1668 Henry Leonard went to Rowley Village, about 25 miles northeast of Lynn, as stated by Newhall, "and there established iron works." Lewis says that in 1674 Henry Leonard's sons, Nathaniel, Samuel, and Thomas, contracted to carry on these works for the owners whose names are given by Bishop as "John Ruck and others of Salem." The works did not prove to be profitable. After establishing the Rowley works Henry Leonard went to New Jersey, "and there again engaged in the iron manufacture." At some time previous to his removal to New Jersey he appears to have been connected with the establishment of iron works at Canton, about 14 miles south of Boston. Other iron enterprises in Massachusetts speedily followed in the same century those that have been mentioned. In 1677 one of these works, the name of which has not come down to us, was destroyed by the Indians. About the same year iron was made at Topsfield, near Ipswich, and in 1680 its manufacture was commenced at Boxford. Hubbard, writing about 1677, says that at that time there were in the colonies "many convenient places, where very good iron, not much inferior to that of Bilbao, may be produced, as at this day is seen in a village near Topsfield, seven or eight miles west from Ipswich." About 1696 George Leonard is said to have erected "an iron-working establishment" at Newton, about 27 miles southwest of Boston. For a hundred years after its settlement in 1620 Massachusetts was the chief seat of the iron manufacture on this continent. Most of its iron enterprises during this hundred years were bloomaries, but there were blast furnaces also, although the latter as a rule produced only hollow-ware and other castings, and not pig iron. During the period mentioned the iron industry of Massachusetts was confined to the eastern counties of the colony, where bog and pond ores formed almost the only kinds of ore that were obtainable. The English settlement at New Haven closely followed Massachusetts in the manufacture of iron. John Winthrop, Jr., who removed from Lynn to Pequod, (New London,) Connecticut, in 1645, had obtained from the General Court in the preceding year permission to set up an iron work, and in 1651 he obtained a grant of certain privileges to enable him to "adventure" in the manufacture of iron; but he does not seem to have embarked in the iron business until subsequently. On the 30th of May, 1655, according to Bishop, it was ordered by the assembly of New Haven "that if an iron worke goe on within any part of this jurisdiction the persons and estates constantly and onely imployed in that worke shall be free from paying rates." In 1658 Captain Thomas Clarke, in connection with John Winthrop and others, put in operation an "iron worke" at New Haven, and in 1659 he seems to have been still engaged in the same enterprise, for in that year the General Court of Connecticut continued the exemption already noted for another seven years, "for encouragement of the said worke in supplying the country with good iron and well wrought according to art." This enterprise embraced a blast furnace and refinery forge. On the 22d of June, 1663, John Davenporte wrote from New Haven to John Winthrop, Jr., as follows: "The freshest newes here, & that which is *e re vestra*, is, that they have bene blowing, at the iron worke, and have runne, from the last 6th day to this 2d day, 5 sowes of iron, which are commended for very good; & this night it's thought they will run another, & begin to-morrow to make pots. The work is hopeful, but the workemen are thought to be very changeable and froward." This frowardness was due apparently to the influence of an old enemy of iron works, and ironworkers, John Barleycorn. Bishop records "a proposition made in May, 1662, 'in ye behalfe of Capt. Clarke, that wine and liquors drawn at the iron workes might be custome free,' which was allowed to the extent of one butt of wine and one barrel of liquors, and no more." Rhode Island made iron soon after its settlement in 1636—certainly at Pawtucket and elsewhere as early as 1675, when the forge at Pawtucket, erected by Joseph Jenks, Jr., son of Joseph Jenks, the machinist at Lynn, was destroyed by the Indians in the Wampanoag war, together with other iron works and infant enterprises. A third Joseph Jenks was governor of Rhode Island from 1727 to 1732. The few forges and furnaces which were erected in this colony in the seventeenth and eighteenth centuries used bog or pond ore, and all or nearly all of them were located on the border of Bristol county, Massachusetts. Iron does not appear to have been made within the limits of Maine, New Hampshire, or Vermont until the eighteenth century.

Doctor James Thacher, in his valuable essay on the iron ores and iron enterprises of Plymouth county, Massachusetts, printed in 1804, says: "The first furnace for smelting iron ore, known in the county of Plymouth, was erected in the year 1702 by Lambert Despard (a founder) and the family of Barkers, his associates, at the mouth of Mattakeeset pond in the town of Pembroke, but the wood in the vicinity being exhausted the works were long since abandoned." In James Torrey's *History of Scituate*, in Plymouth county, written in 1815, mention is made of an iron enterprise in the township of Scituate, as follows: "In 1648 Mr. Timothy Hatherly, the principal founder and father of the town of Scituate, requested liberty of the colony to erect an iron mill. It was granted in 1650, conditional to be erected within three years, or the privilege, certain woodlands about Mattakeeset pond, (now Pembroke,) to revert to the colony. It did not, however, take place at that period, but 'a smelting furnace was erected on the precise grant, by Mark Despard and the family of Barker, about 1702.'" With the building of this furnace the iron history of Massachusetts in the eighteenth century may be said to begin. The enterprise of Despard and the Barkers was speedily followed by the erection of a bloomary forge on Bound brook, near Hingham, in 1703, by a company in which two brothers, Daniel and Mordecai Lincoln, were partners. Mordecai Lincoln is supposed to have been an ancestor of Abraham Lincoln. In Torrey's *History of Scituate* mention is made of the erection of the Drinkwater iron works, near Abington, about 1710, by a person named Mighill, probably Rev. Thomas Mighill. The first slitting mill in the colonies, for slitting nail rods, is said by tradition to have been erected at Milton, in Norfolk county, as early as 1710; but Bishop accords this honor to Middleborough, in Plymouth county, at a later day. About 1722 a bloomary forge was built at Bridgewater, which was active in 1750. In 1738 Hugh Orr, Scotchman, established at this place a gun factory, and about 1748 he made five hundred muskets for the province of Massachusetts Bay, which are believed to have been the first muskets manufactured in the country. Subsequently he established a cast-iron cannon foundry at Bridgewater, and was instrumental in promoting various other manufacturing enterprises. In 1730 iron works were erected at Plympton, now Carver, which appear to have embraced a blast furnace, as mention is made of iron tea-kettles having been cast at Plympton between 1760 and 1765. In 1731 there were officially reported to be in Massachusetts "several forges for making bar iron, and some furnaces for cast iron or hollow-ware, and one slitting mill, and a manufacture for nails." At the same time there were in all New England "six furnaces, meaning hollow-ware furnaces, and nineteen forges, meaning bloomaries, not refineries." "At that time," says Douglass, in his *British Settlements*, "we had no pig furnaces nor refineries of pigs" in New England. Refineries were in use about twenty years later. In 1750 there were four slitting mills in Massachusetts—two at Middleborough, one at Hanover, and one at Milton; also a plating-forge with a tilt-hammer, and one steel furnace. About 1750 Douglass thus described the iron industry of New England:

Iron is a considerable article in our manufactures; it consists of these general branches: (1) Smelting furnaces reducing the ore into pigs; having coal enough and appearances of rock ore. In Attleborough were erected at a great charge three furnaces, but the ore proving bad and scarce this projection miscarried as to pigs. They were of use in casting of small cannon for ships of letters of marque and in casting cannon-balls and bombs toward the reduction of Louisbourg. (2) Refineries which manufacture pigs, imported from New York, Pennsylvania, and Maryland furnaces, into bar iron. (3) Bloomeries, which, from bog or swamp ore, without any furnace, only by a forge hearth, reduce it into a bloom or semi-liquidated lump to be beat into bars, but much inferior to those from the pigs or refineries. (4) Swamp ore furnaces; from that ore smelted they cast hollow-ware which we can afford cheaper than from England or Holland.

Bog or swamp ore lies from half a foot to two feet deep. In about twenty years from digging it grows or gathers fit for another digging; if it lies longer it turns rusty and does not yield well. Three tons of swamp ore yield about one ton of hollow-ware.

One hundred and twenty bushels of charcoal are sufficient to smelt rock ore into one ton of pigs. The complement of men for a furnace is eight or nine, besides cutters of wood, coalers, carters, and other common laborers.

In New England we have two slitting mills for nail rods: one in Milton, eight miles from Boston, and another in Middleborough, about thirty miles from Boston, which are more than we have occasion for. Our nailors can afford spikes and large nails cheaper than from England, but small nails are not so cheap.

In New England they do not forge bar iron sufficient for their home consumption by bloomeries and refineries; they import from England, New York, Jersies, Pennsylvania, and Maryland.

The development of the rich iron ores of the Berkshire hills, in Western Massachusetts, commenced about 1750. A furnace was built at Lenox, in Berkshire county, in 1765, and it made pig iron in the following year. It had an exceptionally high stack for that day—28 feet high, and was blown with one tuyere. This furnace was torn down in 1881. Previous to 1773 a furnace was built at Furnace Village, in Worcester county, and a few years after that date there were several bloomaries and one refinery forge in the same county. In 1793 the county contained several manufactories of edge tools, hardware, machinery, etc. In the township of Sutton there were at this time one axe, one hoe and five scythe manufactories, and several naileries. In the whole county there were seventeen trip-hammers. At Springfield, in Hampden county as stated by Bishop, some cannon were cast and some forging was done during the Revolutionary war, but small arms were not made until after the peace. The Government armory at Springfield was established in 1794. While the iron manufacture of Massachusetts was thus being extended westward it continued to make rapid progress in the eastern counties. Charlotte furnace at Middleborough was built in 1758, and was in operation for many years. During our two wars with the mother country it was employed in casting shot and shells. The shot which the *Constitution* carried in her conflict with the *Guerrière* were cast at this furnace. In 1784 there were seventy-six iron-works in Massachusetts, "many of them small." At Amesbury, in Essex county, a furnace was erected about 1790, and at Boxborough, in Middlesex county, a bloomary forge was built about the same time. In 1795 Dr. Morse reported eleven slitting mills in Bristol, Norfolk, and Plymouth counties, which rolled and cut in that year 1,732 tons of iron into hoops and nail rods. Bishop says that "the two counties of Plymouth and Bristol had in operation in 1798 fourteen blast and six air furnaces, twenty forges, and seven rolling and slitting mills, in addition to a number of trip hammers and a great number of nail and smith shops. Cut and hammered nails, spades and shovels, card teeth, saws, scythes, metal buttons, cannon balls, bells, fire arms, sheet iron for tin ware, wire, etc., were made in large quantities." Steel was made from crude iron at Canton about 1797 "by the German process." In 1804 there were ten blast furnaces in Plymouth county, all producing castings exclusively. In 1830 only three of these were left—Charlotte, Federal, and Pope's Point, all in Carver township, and all in operation. There were also in 1804 ten forges in the same county, which were principally employed in working "old iron scraps," broken pots, kettles, etc., and produced in all about 200 tons of bar iron per annum. Dr. James Thacher, who was a part owner of Federal furnace, wrote in 1804 a description of this furnace, which was built in 1794, and is said by him to have been the most valuable furnace with which he was acquainted, the manufacture of castings being "there prosecuted to great extent and advantage." The furnace was built of stone, as were all other Plymouth furnaces. It was 20 feet high and 24 feet square, its walls being 7 feet thick and its interior 10 feet in diameter. Charcoal was the only fuel used, and marine shells formed the only fluxing material. The furnace was lined with "fire-stone" composed of "soft slate." A brick funnel at the top of the stack served "to convey off the blaze and smoke." The Doctor continues his description as follows:

At the bottom of an arch in the front of the furnace is an aperture, from which the workmen remove the scoria and dip out the metal. And in another arch on one side there is a small aperture for the insertion of the pipes of two large bellows 22 feet long and 4 feet wide, which being kept in constant alternate motion by the agency of a water-wheel 25 feet diameter, a powerful current of air is excited; and being impelled upon the surface of the fuel the fusion of the metal is greatly accelerated. The whole of this machinery is included in a large wooden building, affording accommodation to the workmen with their apparatus for moulding and casting.

The specific articles manufactured at the Federal furnace are, besides hollow-ware of every description, Seymour's patent rolls for slitting mills, of a superior quality, cast in iron cylinders, potash kettles, stoves, fire-backs and jambs, plates, gudgeons, anvils, large hammers, cannon shot of every kind, with a vast variety of machinery for mills, etc.

The ores used in the furnaces and bloomaries of eastern Massachusetts were chiefly bog and pond ores. Dr. Thacher says, however, that in 1804 "a very considerable proportion of ore smelted in our furnaces is procured from the very productive mines at Egg Harbor, in the state of New Jersey, of a reddish brown color, producing from 30 to 40 per cent. of excellent iron. The usual price is $6.50 per ton." He also says that "reddish brown" ore in large lumps was obtained from a mine on Martha's Vineyard, "affording about 25 per cent. and worth $6 per ton." The pond ores contained from 20 to 30 per cent. of iron, and the average price was about $6 per ton at the furnace. Bog ore, found in swamps and other low places, was of a "rusty-brown color, yielding about 18 per cent. and worth $4 per ton at the furnace." The following letter from the Rev. Isaac Backus, of Middleborough, dated July 25, 1794, gives a description of the manner in which pond ores were obtained.

Vast quantities of iron, both cast and wrought, have been made in this part of the country for more than a hundred years past; but it was chiefly out of bog ore, until that kind was much exhausted in these parts, and then a rich treasure was opened in Middleborough, which had been long hid from the inhabitants. About the year 1747 it was discovered that there was an iron mine in the bottom of our great pond at Assowamset; and after some years it became the main ore that was used in the town, both at furnaces and forges, and much of it has been carried into the neighboring places for the same purpose. Men go out with boats, and make use of instruments much like those with which oysters are taken, to get up the ore from the bottom of the pond. I am told that for a number of years, a man would take up and bring to shore two tons of it in a day; but now it is so much exhausted that half a ton is reckoned a good day's work for one man. But in an adjacent pond is now plenty, where the water is twenty feet deep, and much is taken up from that depth, as well as from shoaler water. It has also been plenty in a pond in the town of Carver, where they have a furnace upon the stream which runs from it. Much of the iron which is made from this ore is better than they could make out of bog ore, and some of it is as good as almost any refined iron. The quantity of this treasure, which hath been taken out of the bottom of clear ponds, is said to have been sometimes as much as five hundred tons in a year.

In 1735 Samuel Waldo erected a furnace and foundry on the Pawtuxet river, in Rhode Island, which were afterward known as Hope furnace. They are said to have been the most important iron works in the state during the eighteenth century. Cannon and other castings were made here. During the Revolution they were active in producing cannon, cannon balls, and other munitions of war. About the year 1735 three other furnaces were erected in Cumberland township, in the northeastern part of the state, but they seem to have been abandoned before the Revolution. They made "cannon, bombs, and bullets" during the French war of 1755. Before 1800 a slitting mill had been erected on one of the branches of Providence river; a slitting and rolling mill at Pawtucket falls; and other iron-manufacturing establishments in various parts of the state. Bishop says that "manufactures of iron, including bar and sheet iron, steel, nail rods and nails, farming implements, stoves, pots, and other castings and household utensils, iron works for shipbuilders, anchors, and bells formed the largest branch of productive industry in the state toward the close of the eighteenth century."

Litchfield county, in northwestern Connecticut, contains iron-ore mines of great value, from which the ore for the celebrated "Salisbury iron" has been taken for a hundred and fifty years. This ore is of a similar quality to that found in Berkshire county, Massachusetts, already referred to. As early as 1734 a bloomary forge was erected at Lime Rock, in Litchfield county, by Thomas Lamb, which produced from 500 to 700 pounds of iron per day. About 1748 a forge was erected at the village of Lakeville, in the same county, and in 1762 John Haseltine, Samuel Forbes, and Colonel Ethan Allen purchased the property and built a blast furnace, but soon afterwards sold it to Charles and George Caldwell, of Hartford. It made two and a half tons of iron in twenty-four hours, and three tons of ore and 250 bushels of charcoal were used per ton of iron. Its blowing apparatus consisted of a pair of leather bellows driven by a water-wheel. In 1768 the furnace was sold to Richard Smith, of Hartford. Smith was a royalist, and fled to England during the Revolution, but his furnace was made to produce large quantities of cannon, cannon balls, shells, etc., for the Continental army. After the Revolution it made cannon for the navy, potash kettles weighing nearly half a ton each, and pig iron for forges and foundries. Many bloomary forges were erected in this country about the close of the last century. One of these was built on Mount Riga, about five miles north of Lakeville, in 1781, by Abner or Peter Woodin. It was afterwards owned by Daniel Ball, and was called Ball's forge. About 1806 Seth King and John Kelsey commenced to build a furnace on Mount Riga, but were not able to finish it, and in 1810 it fell into the hands of Holley & Coffing, who completed it in that year and operated it for many years. Twenty-seven furnaces have been built and operated within a radius of thirty miles of Lakeville, a few of which were in New York and Massachusetts, but the majority were in Connecticut. At the close of the eighteenth century Litchfield county contained fifty bloomary forges, making iron directly from the ore, and three slitting mills. At the same time the county was so prominent in the manufacture of nails that only Plymouth and Bristol counties in Massachusetts, of all the nail-making districts in the country, exceeded its production. The iron of Litchfield county is now entirely used for foundry purposes and most of it in the manufacture of car wheels. Bishop says that Oldmixon mentions "a small iron mill" at Branford, in New Haven county, in 1741, on a small stream, running into Long Island sound, and adds that on many of the small streams and branches of the rivers which fall into the sound "bloomaries and small works for a variety of manufactures in iron were established, some of them quite early." The bloomaries were in part supplied with bog ore, "dug near them," and in part with better ores obtained elsewhere. Bishop also says that in 1794 a slitting mill and other iron works had been erected in East Hartford, a forge at Glastonbury, and two furnaces at Stafford "which made sufficient hollow and cast-iron wares for the whole state." Lesley says that there were at one time, about the beginning of the present century, three blast furnaces in northern Connecticut, near the Massachusetts line, on a branch of Willimantic river, a mile or two apart. Three forges near them converted their pig iron into bar iron. Hebron furnace was south of the above mentioned furnaces, and Enfield forge stood a few miles east of Windsor Locks. All these furnaces and forges were stopped about 1837, when Scotch pig iron began to come into the country. Connecticut was among the first of the colonies to make steel. Bishop relates that in 1728 Joseph Highby, "an ingenious blacksmith," of Simsbury, Hartford county, represented to the legislature that he had, "with great pains and cost, found out and obtained a curious art, by which to convert, change, or transmit common iron into good steel, sufficient for any use, and was the very first that ever performed such an operation in America." The certificates of several smiths, who had made a trial of the steel and pronounced it good, were produced. He and Joseph Dewey were granted the exclusive right for ten years "of practicing the business or trade of steel-making." A "steel furnace" was owned by George Eliot, of Killingworth, in Middlesex county, previous to 1759, and in 1761 the Rev. Jared Eliot, of the same place, father of the above-mentioned George Eliot, succeeded in producing in a common bloomary forge a bar of excellent iron, weighing 50 pounds, from 83 pounds of black magnetic sand, and in his son's steel furnace a portion of the bar was converted into good steel. For this discovery he was awarded a gold medal in 1764 by the London Society of Arts. But this sand, which is found in the southern parts of Connecticut, as well as in other states, never received much further attention for conversion into iron or steel. Iron ore was discovered near Portsmouth, in New Hampshire, as early as 1634, some of which was shipped to England, but there is no evidence that its discovery led to the establishment of any iron works in that century. The manufacture of iron in this state dates from about 1750, when several bloomaries, using bog ore, were in existence on Lamper Eel river, but were soon discontinued. About the period of the Revolution there were a few bloomaries in operation in the state. In 1791 mention is made of iron works at Exeter. At Furnace Village the magnetic ore of Winchester was first smelted in 1795 by a Rhode Island company. Franconia furnace, in Franconia county, was built in 1811 by a company which was organized in 1805. Maine had a few bloomary forges in York county during the Revolution and for some years afterwards, but she has had but few blast furnaces. A small furnace, capable of yielding a ton and a half of iron daily, was erected at Shapleigh, in York connty, about 1838. It was used to prodnce castings, and cost but $13,000. A larger furnace in Piscataquis county, called Katahdin, was built in 1845, and is now active. This is the only furnace now in the state. At an early period in its history it was successfully operated for several years by Hon. John L. Hayes, now of Cambridge, Massachusetts. A forge was erected near the furnace soon after 1845. In 1853 it made 700 tons of blooms. There were in 1880 two rolling mills in Maine—one at Portland and one at Pembroke. The manufacture of iron was commenced in Vermont about 1750. Large deposits of iron ores similar to those of western Massachusets and western Connecticut had previously been found in the southern and western parts of the state. In Rutland county a mine was opened in 1785, and in 1794 there were fourteen forges, three furnaces, and a slitting mill in the county. In other counties there were seven forges in 1794—one in Bennington, four in Addison, and two in Chittenden counties, and before 1800 other forges and a slitting mill were added; possibly some furnaces, the township of Randolph, in Orange county, had two forges and a slitting mill at the same period About the beginning of the nineteenth century there were twenty bloomaries in the neighborhood of Vergennes, in Addison county, all built with Boston capital. The manufacture of nails was one of the household industries of New England during the eighteenth century. In a speech in

Congress in 1789 Fisher Ames said: "It has become common for the country people in Massachusetts to erect small forges in their chimney corners; and in winter, and in evenings, when little other work can be done, great quantities of nails are made even by children. These people take the rod iron of the merchant and return him the nails, and in consequence of this easy mode to barter the manufacture is prodigiously great." In a description of the town of Middleborough, in Plymouth county, Massachusetts, written in 1793 by Nehemiah Bennet, it is mentioned that "the most common and general employment of the inhabitants of said town is agriculture, which seems to be increasing; though there are a number of mechanicks. Nailing, or the business of making nails, is carried on largely in the winters, by the farmers and young men, who have but little other business at that season of the year." When Jacob Perkins, of Newburyport, Massachusetts, invented his machine for making cut nails, which was patented in 1795 and speedily followed by other inventions for the same purpose, the occupation of making wrought nails in the chimney corner virtually came to an end. The manufacture of tacks by hand was also a New England household industry during the last century, and down to about fifty years ago. A writer in the *Furniture Trade Journal* thus describes this industry: "In the queer-shaped, homely farm-houses, or the little contracted shops of certain New England villages, the industrious and frugal descendants of the Pilgrims toiled providently through the long winter months at beating into shape the little nails which play so useful a part in modern industry. A small anvil served to beat the wire or strip of iron into shape and point it; a vice, worked by the foot, clutched it between jaws furnished with a gauge to regulate the length, leaving a certain portion projecting, which, when beaten flat by a hammer, formed the head. By this process a man might make, toilsomely, perhaps 2,000 tacks per day." Nearly all the bloomary and refinery forges and blast furnaces of New England have long disappeared, and in their stead have grown up reproductive iron industries of almost endless variety and vast extent, employing large numbers of skilled mechanics and adding greatly to the productive wealth of the country. The rolling mills, machine shops, hardware establishments, nail and tack factories, foundries and other iron enterprises of New England, together with a few steel works and modern blast furnaces, form to-day a striking contrast to the ore bloomaries, not much larger than a blacksmith's fire, and the small charcoal furnaces and chimney-corner nail factories of the last century. "All that," says Lesley, "has given way and disappeared before the inventive spirit of New England, sustained and incited by the wealth of its commercial cities."

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

EARLY IRON ENTERPRISES IN THE MIDDLE, SOUTHERN AND WESTERN STATES.

THE following paragraphs will furnish the reader with interesting historical memoranda concerning iron and iron industry in the different states other than those of New England:

New York.—Peter Kalm, the Swedish traveler, writing in 1748, says of the commerce of New York: "Of late years they have shipped a quantity of iron to England." Some of this iron was made in Connecticut and New Jersey. Douglass in his *British Settlements,* written in 1750, speaking of New York says: "The article of iron in pigs and bars is a growing affair." Bishop says that iron works were established in Orange county prior to 1750, but by whom he does not state. In 1750 Governor Clinton reported that, at a place called Wawayanda, in Orange county, about twenty-six miles from the Hudson, there was a planting-forge with a tilt-hammer, which had been built four or five years before, but was not then in use. It was the property of Lawrence Scrawley, a blacksmith. It was the only mill of that kind in the province. There was no rolling or slitting mill or steel furnace at that time in the province." In 1750 a vein of magnetic iron ore was discovered on Sterling mountain, in Orange county, and in 1751 Ward & Colton built a furnace at the outlet of Sterling pond. In Eager's *History of Orange County* it is stated that "at the early establishment of this furnace the charcoal used was transported several miles on the backs of horses from the mountains where it was burned, there being no roads at the time." Bishop says that in 1752 "Abel Noble, from Bucks county, Pennsylvania, erected a forge in Monroe, near the furnace, at which anchors are said to have been made." Eager says that the first anchor made in New York was made at this forge in 1753. In 1765 William Hawkhurst published an advertisement stating that he had lately erected "a finery and great hammer for refining the Sterling pig iron into bars," but the location of this enterprise is not mentioned. The furnace of Ward & Colton and the forge of Abel Noble became the property of Peter Townsend before the Revolution. They had named the Sterling iron works, presumably after Lord Stirling, the owner of the land, who became a general in the Continental army, and who was engaged in the manufacture of iron in New Jersey before the Revolution. He may have been part owner of the Orange county enterprises. (The Sterling works have always been spelled as here given, but Lord Stirling's name was differently spelled.) In 1773 Mr. Townsend made anchors at Sterling. We are informed by Mr. A. W. Humphreys that the anchors of the United States frigate *Constitution* were made here, as well as the anchors for the first ships of war that carried the stars and stripes. In 1777 "the Townsends" had two forges with eight forge fires. In 1776 Mr. Townsend, according to Bishop, "produced the first steel in the province, at first from pig and afterwards from the bar iron, in the German manner." Bishop also says that "the first blister steel made in the state was made by Peter Townsend, Jr., in 1810, from ore of the Long mine on the Sterling estate." This mine was discovered in 1761 by David Jones. Other valuable mines than those mentioned were discovered and opened on the Sterling estate in the last century. In 1777 a second Sterling furnace was erected by the Townsends, and in 1806 Southfield furnace was built, about six miles distant from the Sterling mines, and is still standing. The two early Sterling furnaces have made way for one modern stack. Other mines of rich ore were discovered in Orange county during the last century, and many furnaces and forges were built in connection with them which have long been abandoned. In 1756 there was a Forest of Dean furnace five miles west of Fort Montgomery, which was supplied with ore from the Forest of Dean mine, near which it stood. The furnace was abandoned twenty-one years later. Eager says that "Captain Solomon Townsend, a cousin of Peter Townsend, and who married his daughter Anne in 1783, purchased the mountain estate adjoining that of his father-in-law, which he named Augusta, and established the iron works, anchory, forges, etc., at the place." These works were on the Ramapo, three miles above the Orange county line, in Orange county. There was a forge and anchory on Murderer's creek during the Revolution, owned by Samuel Brewster; after the war they passed into the hands of his son-in-law, Jonas Williams. Queensborough furnace, which went out of blast about 1800, and which was built to make pig iron, was located about two and a half miles southwest of Fort Montgomery. On the stream issuing from Hazzard's pond there was a furnace named Woodbury about the beginning of this century. During the last century Orange county was the chief seat of the iron manufacture in New York. Greenwood furnace, in this county, was erected in 1811 by the Messrs. Cunningham. In 1871 it was the only charcoal furnace in Southern New York that remained in blast; since that year it also has been silent.

In 1765 there were iron works in Duchess county. A furnace and foundry at Amenia in this county were in operation during the Revolution, "at which steel and castings were made for the use of the army." A bloomary was in operation about the period of the Revolution at Patchogue, in Brookhaven township, Suffolk county, Long Island. At Riverhead, in Suffolk county, Captain Solomon Townsend established "a manufactory of bar iron" before the close of the last century. Iron ore was mined in Putnam county in the last century, some of which was taken to iron works on Long Island sound. In the manor of Philipsburg, in Westchester county, iron ore was mined and furnaces were erected before the close of the same century. About the time of the Revolution a furnace named Haverstraw and several bloomaries were in existence in Rockland county, on the western side of the Tappan Zee. About the year 1800 the celebrated Champlain iron district was developed, and in 1801 the first iron works in the district were built at Willsborough falls, on the Boquet river, in Essex county, to manufacture anchors. George Throop, Levi Highly, and Charles Kane were the owners. Among other early iron enterprises in this district were the New Russia, Jay and Elba forges in Essex county, and the Eagle rolling mill at Keeseville, in Clinton county. This district is now and for a long time has been the most important iron district in the state. It now contains six rolling mills, six blast furnaces, and twenty-two forges. The forges are all true bloomaries, manufacturing blooms, chiefly for conversion into steel, directly from the rich magnetic and specular ores of the neighborhood. The district comprises the counties of Essex, Clinton, and Franklin. A forge was built at West Fort Ann, in Washington county, south of Lake George, about 1802. West of the Champlain district, in the counties of Saint Lawrence, Jefferson, Lewis, Oswego, and Oneida, many charcoal furnaces were built after the beginning of the present century, among the earliest of which were Rossie furnace in Saint Lawrence county, Taberg furnace in Oneida county, and Constantia furnace in Oswego county. In the extreme western and southwestern parts of the state the few iron enterprises that have had an existence during the present century have all been of yet more modern origin. Nails were extensively manufactured by hand at Albany in 1787. Twenty years later, in 1807, John Brinkerhoff, of Albany, lighted the fires in his newly-erected rolling mill on the Wynantskill. The Troy *Daily Times* says that "the operations of the little wooden rolling mill built by him were confined to converting Russian and Swedish bar iron into plates, which were slit into narrow strips, and these cut into required length and made into nails by hand." In 1826 the nail factory of John Brinkerhoff was sold at auction, and was purchased for $5,280 by Erastus Corning, who was then engaged at Albany in the hardware business. It now forms part of the works of the Albany and Rensselaer Iron and Steel Company, the most extensive and important iron and steel works in the state. The iron industry of New York was not so prominent during the eighteenth century as that of some other states, but soon after the beginning of the present century the development of the Champlain district gave to the industry more prominence, which was still further increased after 1840, when anthracite coal was applied to the manufacture of pig iron on the Hudson river and elsewhere in the state. In 1870, and again in 1880 it ranked third in the list of iron and steel producing states.

New Jersey.—In William Reed Deane's *Genealogical Memoirs of the Leonard Family*, already referred to, it is stated that Henry Leonard left Rowley Village, Massachusetts, early in 1674, "and at that time, or soon after, went to New Jersey, establishing the iron manufacture in that state." His sons, Samuel, Nathaniel, and Thomas, probably left Rowley Village soon after their father's departure, and followed him to New Jersey. Bishop says that Shrewsbury, a township lying northwest of Long Branch, in Monmouth county, was settled by Connecticut people soon after New Jersey was surrendered to the English by the Dutch in 1664, and that it was "to this part of Jersey" that Henry Leonard removed. About the time of the Connecticut settlement, James Grover, who had been a resident of Long Island, also settled in Shrewsbury, and is said to have established iron works in that township, which he afterwards sold to Colonel Lewis Morris, then a merchant of Barbadoes, but born in England. On October 26, 1676, a grant of land was made to Colonel Morris, with full liberty to him and his heirs "to dig, delve, and carry away all such mines for iron as they shall find or see fit to dig and carry away to the iron work," which establishes the fact that the iron works in Shrewsbury were built prior to 1676, and that they were then owned by Colonel Morris. They were probably undertaken about 1674, in which year Henry Leonard is said to have emigrated from Massachusetts to New Jersey. They were the first iron works in New Jersey.

In a brief account of the province of East Jersey, published by the proprietors in 1682, it is stated that "there is already a smelting furnace and forge set up in this colony, where is made good iron, which is of great benefit to the country." Smith, in his *History of New Jersey*, says that in 1682 "Shrewsbury, near Sandy Hook, adjoining the river or creek of that name, was already a township, consisting of several thousand acres, with large plantations contiguous; the inhabitants were computed to be about 400. Lewis Morris, of Barbadoes, had iron works and other considerable improvements here." In 1685 it was stated in *The Model of the Government of East New Jersey* that "there is an iron work already set up, where there is good iron made." In the same year Thomas Budd, in his *Good Order in Pennsylvania and New Jersey*, wrote that there was but one iron work in New Jersey, and that this was located in Monmouth county. All of these statements refer to the Shrewsbury works, which do not seem to have had a long life. According to Oldmixon, they were located between the towns of Shrewsbury and Middletown. They used bog ore.

The rich deposits of magnetic iron ore in northern New Jersey were discovered at an early day, and about 1710, as we are informed by the Rev. Dr. Joseph F. Tuttle, in his *Early History of Morris County*, written in 1869, settlements were made on the Whippany river, in Hanover township, in Morris county; and at a place now called Whippany, four miles northeast of Morristown, a forge was erected. Bishop says that the first settlers of Hanover located there "for the purpose of smelting the iron ores in the neighborhood." They "early erected several forges and engaged extensively in the iron manufacture." Whippany is about fifteen miles east of the celebrated Succasunna iron ore mine, in the present township of Roxbury, and it was here that the settlers obtained their supply of ore. The ore was carried to the works in leather bags on pack-horses, and the iron was carried in the same way over the Orange mountains to Newark. Bishop says that "forges at Morristown, and some in Essex county, were long supplied in the same way from the rich ore of the mine. The ore was for some time free to all." Dr. Tuttle says: "The Succasunna mine lot was located in 1716 by John Reading, and sold the same year to Joseph Kirkbride, containing 558 acres, and after his death the tract was divided between his three sons, Joseph, John, and Mahlon Kirkbride, except the mine lot, which was held by them in common until such time as the same should be sold." This celebrated iron-ore deposit has long been known as the "Dickerson mine."

Dr. Tuttle says that in 1722 Joseph Latham sold a tract of land in the present township of Mendham, in Morris county, to "one John Jackson, who built a forge on the little stream which puts into the Rockaway near the residence of Mr. Jacob Hurd. The forge was nearly in front of Mr. Hurd's house," a mile west of Dover. Wood for charcoal was abundant, and the mine on the hill was not far distant. For some reason Jackson did not succeed in his iron enterprise, and was sold out by the sheriff 1753. Dr. Tuttle says that Rockaway was settled about 1725, or possibly as late as 1730, "at which time a small iron forge was built near where the upper forge now stands in Rockaway, Denmark, Middle Forge, Ninkee, Shaungum, Franklin." This statement fixes the date and location of the first forge at Rockaway. The Doctor says that subsequently "forges were built on different streams at Rockaway and other places from the year 1725 to 1770." At Troy, in Morris county, as we learn from another source, a forge was built in 1743, which was in operation as late as 1860. All these forges were bloomaries, manufacturing bar iron from the ore.

At the close of the seventeenth century and for some years after the beginning of the eighteenth century New Jersey was the only colony outside of New England that was engaged in the manufacture of iron, and this manufacture was almost wholly confined to its bloomaries. The rich magnetic ores, the well-wooded hillsides, and the restless mountain streams of Northern New Jersey afforded every facility for the manufacture of iron of a superior quality by this primitive method, while the nearness of good markets furnished a sufficient inducement to engage in the business. The bloomaries of New Jersey were Catalan forges of the German type.

Not much progress was made, however, in the establishment of the iron industry in New Jersey until the middle of the eighteenth century. From about 1740 down to the Revolution many furnaces and other iron works were built in New Jersey. Its iron industry during the greater part of this period was exceedingly active, although greatly hampered by restrictions imposed by the mother country. To the iron enterprises which were then built up within its borders the patriotic cause was afterwards greatly indebted for much of the iron and steel that were needed to secure its ascendency.

Peter Hasenclever, a Prussian gentleman of distinction, who is usually referred to as Baron Hasenclever, emigrated to New Jersey in 1764, as the head of an iron company which he had organized in London, and brought with him a large number of German miners and ironworkers. The Ringwood Company, which was organized in 1740 and was principally composed of several persons named Ogden. In the year named and in 1764 the company purchased about thirty acres of land at Ringwood, near Greenwood lake in Bergen, now Passaic county. By one of the purchases of 1764 Joseph Board conveys to the company a tract of land at Ringwood, near Greenwood lake, in Bergen, now Passaic county. By one of the purchases of 1764 Joseph Board conveys to the company a tract of land at Ringwood "near the old forge and dwelling house of Walter Erwin." On July 5, 1764, the Ringwood Company sell to "Peter Hasenclever, late of London, merchant," for £5,000 all of the company's lands at Ringwood. The deed states that on the property there are "erected and standing a furnace, two forges and several dwelling-houses." It speaks of "Timothy Ward's forge;" also of the "old forge at Ringwood." Hasenclever also bought from various persons other tracts of land in 1764 at Ringwood and in its vicinity, and in 1765 he bought several tracts of land from Lord Stirling. These various purchases were located at Ringwood, Pompton, Long Pond, and Charlottenburg, all in Bergen county. Hasenclever also probably purchased an interest in the iron-ore mines at Hibernia. Dr. Tuttle says that "Hasenclever at once began to enlarge the old works and build new ones at each of the places just named," that is Ringwood, Pompton, Long Pond, and Charlottenburg. It is probable that he built a furnace and one or more forges at each place. Three furnaces and six forges he certainly erected. The furnaces were erected, respectively as follows: Charlottenburg, on the west branch of the Pequannock; Ringwood, on the Ringwood branch of the Pequannock; Long Pond, on the Winockie, and about two miles from Greenwood lake. Charlottenburg was built in 1767, and was capable of producing from 20 to 25 tons of pig iron weekly. Long Pond was in blast in 1768.

Hasenclever undoubtedly succeeded in making good iron some of which was shipped to England. He also made steel of good quality directly from the ore. In 1768 he became financially embarrassed, and in 1770 was formally declared a bankrupt. He was succeeded in the management of the company's works by John Jacob Faesch, who had come to New Jersey with him, under an engagement as manager of the iron works for seven years. Faesch was a native of Hesse Cassel. He is said to have mismanaged the affairs of the company, and in 1771 or 1772 was succeeded by Robert Erskine, a Scotchman, who appears to have met with success until 1776, when all the works were stopped by the opening of hostilities, and Charlottenburg furnace was accidentally burned. The Adventure furnace, at Hibernia, in Morris county, was a famous furnace during the Revolution, casting ordnance and other iron supplies for the army. It was built about 1765. Mr. Halsey says that a tract of land was located November 23, 1765, "about three-quarters of a mile above the new furnace called the Adventure." The name usually given to this furnace is Hibernia. Dr. Tuttle says that "the names of Lord Stirling, Benjamin Cooper, and Samuel Ford are connected with the original building and ownership of the Hibernia works." Mount Hope furnace, about four miles northwest of Rockaway, was built in 1772 by John Jacob Faesch. It was active until about 1825. It also was a noted furnace during the Revolution, casting shot and shells and cannon for the Continental army. In September, 1776, Joseph Hoff, who was at this time manager of Hibernia furnace, wrote to its owner that Faesch had spoken to him "to inform you that he wanted 200 tons of pig metal, and wanted to know your price and terms of payment. Iron will undoubtedly be in great demand, as few works on the continent are doing anything this season." This letter indicates that at the time it was written Faesch owned or controlled a forge for converting pig iron into bar iron. On the 14th of November, 1776, Hoff wrote to General Knox that there were then 35 tons of shot at Hibernia furnace, and on the 21st of November he wrote that it was the only furnace in New Jersey which he knew to be then in blast. The Hibernia and the Mount Hope furnaces were both in blast in 1777. Mr Halsey informs us that among the laws of New Jersey for 1777 is an act, passed October 7, exempting men to be employed at Mount Hope and Hibernia furnaces from military services and reciting the necessity of providing the army and navy of the United States with cannon, cannon shot, etc., and that the works "have been for some time past employed" in providing such articles and "are now under contract for a large quantity."

Colonel Jacob Ford, Sr., was a large landholder in Morris county about the middle of the last century. In 1736 he was the owner of "iron works" at Mount Pleasant, three miles west of Rockaway. There was a forge at this place as late as 1856, but almost in ruins. In 1764 John Harriman owned a forge called Burnt Meadow-forge, at Denmark, about five miles north of Rockaway, of which Colonel Jacob Ford, Jr., afterwards became the owner. Colonel Ford also about the same time became the owner of the forge below Denmark and above Mount Pleasant, called ever since Middle forge, which was built on land located by Jonathan Osborne in 1749. The United States Government now owns the site of the forge last mentioned. John Johnson had "iron works" at Horse Pound, now Beach Glen, a mile and a half below Hibernia, from 1753 to 1765, as appears from references to them in the title papers of adjoining lands. In Andover township in Sussex county, a furnace and forge was erected by a strong company before the Revolution, probably about 1760, and the works were operated on an extensive scale. About the beginning of hostilities the works were stopped, the company being principally composed of royalists. The excellent quality of the iron made from the ore of the Andover mine led, however, to such legislation by Congress in January, 1778, as resulted in again putting them in operation. Mr. Whitehead Humphreys, of Philadelphia, was directed by Congress to make steel for the use of the army from Andover iron, as the iron made at the Andover works was the only iron which would "with certainty answer the purpose of making steel." The action of Congress is given in detail by the Hon Jacob W. Miller, in his address before the New Jersey Historical Society in 1854, who also records the interesting fact that William Penn was an early owner of the Andover mine. He says that, "on the 10th of March, 1774, by a warrant from the council of proprietors, he acquired title to a large tract of land, situated among the mountains, then of Hunterdon, now of Sussex, county, and William Penn became the owner of one of the richest mines of iron ore in New Jersey. This mine, since called Andover, was opened and worked to a considerable extent as early as 1760. Tradition reveals to us that the products of these works were carried upon pack-horses and carts down the valley of the Mosconetcong to a place on the Delaware called Durham, and were thence transported to Philadelphia in boats, which were remarkable for their beauty and model, and known as Durham boats to this day." Israel Acrelius, the historian of New Sweden, who resided in this country from 1750 to 1756, mentions five iron enterprises then existing in New Jersey—the Union iron works, and Oxford, Sterling, Ogden's, and Mount Holly furnace. Oxford furnace, on a branch of the Pequest river, at Oxford, in Warren county, was built by Jonathan Robeson in 1742. Tradition says that it was first blown by a water-blast. A pig of Oxford iron, bearing the date "1755," is now in possession of the Historical Society at Trenton. Oxford cannon balls, cast during the French war, have also been preserved. Cannon balls were cast at this furnace for the Continental army. The furnace is still standing and was in operation in 1880, using anthracite coal. It is the second furnace in New Jersey of which there is any exact record, the Shrewsbury furnace being the first. It divides with Cornwall furnace, in Pennsylvania, the honor of being the oldest furnace in the United States that is now in operation. The Union iron works were situated near Clinton, in Hunterdon county, and embraced at the time of Acrelius's visit two furnaces and two forges, "each with two stacks;" also a trip-hammer and a "flatting-hammer." These works were then owned by William Allen and Thomas Turner, of Philadelphia. William Allen was chief justice of Pensylvania from 1751 to 1774. Allentown, in Pennsylvania, was named after him. He was largely interested in the manufacture of iron in Pennsylvania and New Jersey. In October, 1775, he gave his "half of a quantity of cannon shot belonging to him and to Turner for the use of the Board of the Council of Safety;" but he remained loyal to the British crown, nevertheless, dying in London in 1780. The Union iron works appear to have been entirely abandoned in 1778. Judge Allen informed Acrelius that at the Union iron works, and also at Durham, (hereafter to be mentioned), one and a half tons of ore yielded one ton of pig iron, and that a good furnace yielded from twenty to twenty-five tons of pig iron weekly. Ogden's furnace was situated near Newton, in Sussex county. Mount Holly furnace was situated at the town of that name, in Burlington county. It was built between 1730 and 1747, and is probably as old as Oxford furnace. A forge was connected with the furnace. The works stood where the saw-mill at the south end of Pine street, on Rancocas creek, now stands. All of the furnaces named, except Mount Holly, used magnetic ore; Mount Holly, according to Acrelius, used "brittle bog ore in gravel," which was "only serviceable for castings." But the existence of the forge, and the further fact that pig iron has been found in the ruins of the works show that the ore was used for something else than castings. The furnace was in operation before and partly through the Revolution. It was destroyed by the British during that period.

On the 10th of November, 1750, Governor Belcher certified that there were in New Jersey "one mill or engine for slitting and rolling of iron, situate in the township of Bethlehem, in the county of Hunterton, on the south branch of the river Raritan, the property of Messrs. William Allen and Joseph Turner, of Philadelphia, which is not now in use; one plating-forge, which works with a tilt-hammer, situate on a small brook at the west end of Trenton, the property of Benjamin Yard, of Hunterton, which is now used, one furnace for the making of steel, situate in Trenton, the property of Benjamin Yard, which is not now used." Steel was, however, made at Trenton during the Revolution. A rolling and slitting mill was burnt at Old Boonton, in Morris county, before the Revolution, and a similar enterprise was established at Dover, in the same county, in 1792, by Israel Canfield and Jacob Losey. In 1800 there were in this county three rolling and slitting mills, two furnaces, "and about forty forges with two to four fires each."

Mr. Halsey furnishes us with the following interesting episode in the history of Old Boonton slitting mill: "A slitting mill was erected at Old Boonton, on the Rockaway river, about a mile below the present town of Boonton, in defiance of the law, by Samuel Ogden, of Newark, with the aid of his father. The entrance was from the hillside, and in the upper room first entered there were stones for grinding grain, the slitting mill being below and out of sight. It is said that Governor William Franklin visited the place suddenly, having heard a rumor of its existence, but was so hospitably entertained by Mr. Ogden, and the iron works were so effectually concealed, that the Governor came away saying that he was glad to find that it was a groundless report, as he had always supposed." In the southern part of New Jersey several furnaces were built at an early day to smelt the bog ores of that section. Of these the furnace at Mount Holly, already mentioned, was probably the oldest. Batsto furnace, also in Burlington county, was built about 1766 by Charles Reed, and cast shot and shells for the Continental army. Many bloomaries were also built in this section in the last century to work bog ores. The "Jersey pines" furnished the fuel for both the furnaces and bloomaries. Batsto furnace was situated on Little Egg Harbor river, and ran until after the middle of the present century. Sheet iron was made at a forge at Mount Holly in 1775, by Thomas Mayburry, some of which was used to make camp-kettles for the Continental army. A nail factory was in operation at Burlington in 1797. In 1814 or 1815 Benjamin and David Reeves, brothers, established the Cumberland nail and iron works at Bridgeton, in Cumberland county, and for many years successfully manufactured nails, with which they largely supplied the eastern markets. These works are still in operation.

In 1784 New Jersey had eight furnaces and seventy-nine forges and bloomaries, but principally bloomaries. In 1810 there were in New Jersey, according to a memorial to Congress adopted in that year, 150 forges, "which at a moderate calculation, would produce twenty tons of bar iron each annually, amounting to 3,000 tons." At the same time there were in the state seven blast furnaces in operation and six that were out of blast; also four rolling and slitting mills, "which rolled and slit on an average 200 tons, one-half of which was manufactured into nails." Of the forges mentioned, about 120 were in Morris, Sussex, and Bergen counties. Of the numerous charcoal furnaces which once dotted New Jersey not one now remains which uses charcoal, the introduction of anthracite coal in the smelting of iron ores, which took place about 1840, rendering the further production of charcoal pig iron in New Jersey undesirable. The last charcoal furnace erected in the state was built at Split Rock, in Morris Co., by the late Andrew B. Cobb, just prior to the civil war, but it was soon abandoned. Only two or three of the old bloomaries of New Jersey now remain, although there are in the state a few bloomaries and forges of modern origin, as well as a number of large rolling mills, steel works, wire works, pipe works, and anthracite furnaces. Peter Cooper, now living in New York at the age of 92 years, embarked in the iron business at Trenton, in New Jersey, in 1845, where, as is stated by the *American Cyclopædia*, "he erected the largest rolling mill at that time in the United States for the manufacture of railroad iron, and at which subsequently he was the first to roll wrought-iron beams for fire-proof buildings." He had previously, however, been prominently engaged in the manufacture of iron at Baltimore and New York. In connection with members of his family he also embarked in many other important enterprises in New Jersey. His name has been the most prominent and the most honored in the iron history of the state during the present century. In 1870 New Jersey was fourth in rank among the iron-producing states of the Union, but in 1880 it had fallen to fifth place.

Pennsylvania.—The settlers on the Delaware, under the successive administrations of the Swedes and Dutch and the Duke of York, down to 1682, appear to have made no effort to manufacture iron in any form. In the *Journal of a Voyage to New York*, in 1679 and 1680, by Jasper Dankers and Peter Sluyter, who then visited the Swedish and other settlements on the Delaware, it is expressly declared that iron ore had not been seen by them on Tinicum Island or elsewhere in the neighborhood. Jasper Dankers says: "As to there being a mine of iron ore upon it, I have not seen any upon that island, or elsewhere; and if it were so, it is of no great importance, for such mines are so common in this country that little account is made of them." Under the more energetic rule of William Penn, the manufacture of iron in Pennsylvania had its beginning. In a letter written by Penn to Lord Keeper North, in July, 1683, he mentions the existence of "mineral of copper and iron in divers places" in Pennsylvania. In his *Further account of the Province of Pennsylvania*, written in 1685, speaking of "things that we have in prospect for staples of trade," he says: "I might add iron, (perhaps copper, too,) for there is much mine, and it will be granted us that we want no wood." In a letter to James Logan, the secretary of the province, dated London, April 21, 1702, he says, under the heading of "*Iron Works:*" "Call on those people for an answer to the heads I gave them from Ambrose Crawley. Divers would engage here in it as soon as they receive an account, which, in a time of war, would serve the country. Things as to America will come under another regulation after a while." To this letter Logan replied from Philadelphia, under date of October 1, 1702, as follows: "I have spoke to the chief of those concerned in the iron mines, but they seem careless, having never had a meeting since thy departure; their answer is that they have not yet found any considerable vein." Samuel Smiles, in his *Industrial Biography*, says: "William Penn, the courtier Quaker, had iron furnaces at Hawkhurst and other places in Sussex." It was, therefore, but natural that he should encourage the manufacture of iron in his province, and it was certainly through no indifference or neglect of his that it was not established at an early day. In 1692 we find the mention of iron having been made in Pennsylvania. It is contained in a metrical composition entitled *A Short Description of Pennsylvania*, by Richard Frame: printed and sold by William Bradford, in Philadelphia, in 1602. He says that at "a certain place about some forty pound" of iron had then been made. The entire reference is as follows:

A certain place here is, where some begun
To try some Mettle, and have made it run,
Wherein was Iron absolutely found,
At once was known about some Forty Pound.

It was possibly made in a bloomary fire—probably in a blacksmith's fire. In 1698 Gabriel Thomas published at London *An Historical and Geographical Account of the Province and Country of Pennsylvania and of West New Jersey in America*, in which mention is made of the mineral productions of these colonies. Alluding to Pennsylvania, he says: "There is likewise ironstone or ore, lately found, which far exceeds that in England, being richer and less drossy. Some preparations have been made to carry on an iron work." But neither these preparations nor the enterprise alluded to by Richard Frame led to satisfactory results. Mrs. James, in her *Memorial of Thomas Potts, Junior*, gives an account of the first successful attempt that was made to establish iron works in Pennsylvania. The event, which occurred in 1716, is briefly described in one of Jonathan Dickinson's letters, written in 1717, and quoted by Mrs. James: "This last summer one Thomas Rutter, a smith, who lives not far from Germantown, hath removed further up in the country, and of his own strength hath set upon making iron. Such it proves to be, as is highly set by by all the smiths here, who say that the best of Sweed's iron doth not exceed it; and we have accounts of others that are going on with iron works." Rutter's enterprise was a bloomary forge, located on Manatawny creek, in Berks county, about three miles above Pottstown. The name of this first forge is uncertain. Mrs. James says that the name was Pool Forge. There was certainly a Pool forge on the Manatawny as early as 1728, in which year it is mentioned in Thomas Rutter's will. The name of Rutter's pioneer enterprise may, however, have been Manatawny. In the Philadelphia *Weekly Mercury* for November 1, 1720, Thomas Fare, a Welshman, is said to have run away from "the forge at Manatawny." Bishop says: "A forge is mentioned in March, 1719-'20, at Manatawny, then in Philadelphia, but now in Berks or Montgomery county. It was attacked by the Indians in 1728, but they were repulsed with great loss by the workmen." Mrs. James says that Rutter was an English Quaker, who was a resident of Philadelphia in 1685, and who removed in 1714 from Germantown "forty miles up the Schuylkill, in order to work the iron mines of the Manatawny region." She gives a *verbatim* copy of the original patent of William Penn to Thomas Rutter for 300 acres of land "on Manahatawny creek," dated February 12, 1714-'15. The following obituary notice in the *Pennsylvania Gazette*, published at Philadelphia, dated March 5 to March 13, 1729-'30, ought to be conclusive proof of the priority of Thomas Rutter's enterprise; "Philadelphia, March 13. On Sunday night last died here Thomas Rutter, Senior, of a short illness. He was the first that erected an iron work in Pennsylvania." In his will he is styled a blacksmith. Many of his descendants have been prominent Pennsylvania ironmasters. Mrs. James says that Dr. Benjamin Rush, a signer of the Declaration of Independence, was a great-grandson of Thomas Rutter. The next iron enterprise in Pennsylvania was Coventry forge, on French creek, in the northern part of Chester county, which was built by Samuel Nutt, also an English Quaker. Egle's *History of Pennsylvania* says that Nutt arrived in the province in 1714, and that "he took up land, on French creek, in 1717, and about that time built a forge there. A letter written by him in 1720 mentions an intention of erecting another forge that fall." We have seen this letter, which is dated July 2, 1720. It is written in Friends' language. Nutt proposed to build the new forge on French creek. Mrs. James states that Nutt purchased 800 acres of land at Coventry in October, 1718. This was in addition to his earlier purchases. He probably made iron at Coventry forge in that year. Bishop refers to a letter written by Dickinson, in July, 1718, stating that "the expectations from the iron works forty miles up Schuylkill are very great." In April, 1719, Dickinson again wrote: "Our iron promises well. What hath been sent over to England hath been greatly approved. Our smiths work up all they make, and it is as good as the best Swedish iron." Dickinson probably referred to Nutt's forge as well as to Rutter's. Coventry forge was in operation in 1756, and in 1770 it is noted on William Scull's map of Pennsylvania. It was in operation after the Revolution, and in 1856 a forge of the same name, which is now abandoned, was in operation at or near the original site.

The next iron enterprise in Pennsylvania was undoubtedly Colebrookale furnace, which was erected about 1720 by a company of which Thomas Rutter was the principal member. It was located on Ironstone creek, in Colebrookdale township, in Berks county, about eight miles north of Pottstown, three-fourths of a mile west of Boyertown, and about two hundred yards from the Colebrookdale railroad. Plenty of cinder marks the exact site to-day. A large grist and saw mill stands about one hundred feet distant. This furnace supplied Pool forge with pig iron, and in course of time other forges. Both Pool and Coventry forges were at first probably operated as bloomaries. The company which built Colebrookdale furnace appears to have been composed of Thomas Rutter, James Lewis, Anthony Morris, and others—Rutter owning two-thirds interest, as is shown by his will, dated November 27, 1728, on file in the office of the register of wills in Philadelphia. In 1731, according to Mrs. James, Colebrookdale furnace and Pool forge were both owned by companies. In the list of owners of both establishments appears the name of Thomas Potts, the founder of a family of the same name which has ever since been prominent in the manufacture of iron in Pennsylvania, and in other states. He died at Colebrookdale in January, 1752. He was in his day the most successful iron manufacturer in Pennsylvania. In his will, dated 1747, he leaves his "two-thirds of Colebrookdale furnace and iron mines" to his son Thomas, and his "one-third of Pine forge" to his son John. He was of English or Welsh extraction. In 1733 the furnace was torn down and rebuilt by the company, Thomas Potts being the manager. A second Pool forge appears to have been built prior to this time, higher up the stream than the first venture. Mrs. James writes us as follows: "I have a large calf-bound folio ledger of nearly 200 folios of Colebrookdale furnace, marked 'B.' The first date is August. 1728, but there are several pages referring to the first ledger, one of them in 1726. Mention is constantly made of sending 'piggs' to Pool forge, proving that Pool was then in full blast. 'A' would seem to be a large volume from reference to the folios," and therefore to have covered the operations of a number of years. Mrs. James thinks that it is lost. She adds that on the title-page of ledger "B" the name of Thomas Potts is written in connection with the year 1728, probably as the manager or lessee of the furnace. He was a resident of Manatawny in 1725. On Nicholas Scull's map of Pennsylvania, published in 1759, Colebrookdale furnace is noted, and in a list of iron works existing in Pennsylvania in 1793, and published by Mrs. James, it is again mentioned, although it was not then active. We have not found it mentioned at any later period. A stove-plate cast at this furnace in 1763 was exhibited at the Philadelphia Exhibition of 1876. In 1731 pig iron sold at Colebrookdale furnace "in large quantities" at £5 10*s*. per ton, Pennsylvania currency, a pound being equal to \$2 66⅔. It would seem that friendly Indians were employed at Colebrookdale furnace, as "Indian John" and "Margalitha" are found in the list of workmen about 1728. The furnace was located in the heart of one of the richest deposits of magnetic iron ore in the United States. After being neglected for a long time this deposit is now the center of great mining activity.

Durham furnace, on the Delaware river, in the extreme northern part of Bucks county, was built in 1727 by a company of fourteen persons, of which Anthony Morris, William Allen, Joseph Turner, and James Logan (Penn's secretary) were members. Its first blast took place in the spring of

1728, and in November of that year James Logan shipped three tons of Durham pig iron to England. At the Philadelphia exhibition of 1876 the keystone of the Durham furnace, bearing date "1727," was an object of interest. It is probable that about 1750 there were two Durham furnaces. On Nicholas Scull's map of Pennsylvania (1759) an old and a new furnace and a forge at Durham are distinctly marked. In 1770 there were two furnaces and two forges at Durham. There were at one time three forges on Durham Creek. As late as 1780 negro slaves were employed at Durham, twelve of whom in that year escaped to the British lines. Much of the iron made at Durham was taken to Philadelphia in boats fashioned somewhat like an Indian canoe, and first built at Durham; hence the term afterwards in common use, "Durham boats." Redmond Conyngham, quoted by Day, says that iron works are supposed to have been established in Lancaster county in 1726 by a person named Kurtz, who is said by another authority to have been an Amish Mennonite. In Egle's *History of Pennsylvania* it is stated that Kurtz's works were on Octorara creek, and that it is possible they were in Maryland, and not in Lancaster county. Conyngham also says that the enterprising family of Grubbs "commenced operations in 1728," also in Lancaster county. Both history and tradition are silent concerning the nature of these alleged "operations" at that time. In 1728 James Logan wrote that "there are four furnaces in blast in the colony." Colebrookdale and Durham were certainly two of these, but the names of the others are in doubt. The iron industry of Pennsylvania may be fairly said to have been established on a firm foundation at this period. In 1728–'29 the colony exported 274 tons of pig iron to the mother country. The production of a Pennsylvania furnace at this time was about two tons of iron in twenty-four hours.

The manufacture of nails in Pennsylvania commenced at a very early day. In 1731 George Megee, nailer, at the corner of Front and Arch streets, Philadelphia, advertised for sale, wholesale and retail, all sorts of nailes of his own manufacture. The erection of other forges and furnaces proceeded with great rapidity in the Schuylkill valley and in other eastern portions of Pennsylvania after Rutter and other pioneers had shown the way. McCall's forge, afterwards called Glasgow forge, on Manatawny creek, in Berks county, a short distance above Pottstown and below Pool forge, was built by George McCall about 1725. Spring forge, on the Manatawny, in Berks county, west of Colebrookdale furnace and about five miles north of Douglassville, was built in 1729, probably by Anthony Morris. These forges, as well as Pool forge, were supplied with pig iron from Colebrookdale furnace. Green Lane forge, on Perkiomen creek, in Montgomery county, twenty miles north of Norristown, was built in 1733 by Thomas Mayburry. The workmen employed here were at one time chiefly negro slaves. This forge was supplied with pig iron from Durham furnace before 1747. Mount Pleasant furnace, on Perkiomen creek, in Berks county, thirteen miles above Pottstown, was built by Thomas Potts, Jr., in 1738. A forge of the same name was added before 1743. Pine forge, on the Manatawny, in Berks county, about five miles above Pottstown, was built about 1740 by Thomas Potts, Jr. Spring, Glasgow, Mount Pleasant, and Green Lane forges were in operation down to the middle of the present century. Pine forge was converted into Pine rolling mill in 1845, and upon the site of Glasgow forge there was erected in 1874 and 1876 a rolling mill which is known as the Glasgow iron works.

It is supposed that Nutt built a furnace called Reading soon after he built Coventry forge, but this is uncertain. Mrs. James says that two furnaces bearing that name were erected, about a mile from each other, the second after the first was abandoned. It is certain that a furnace of this name was built by Samuel Nutt and William Branson, on French creek, about 1736. We think that this was the second Reading furnace, and that both were built by Nutt and Branson. In the inventory of the estate of Samuel Nutt, which Gilbert Cope, of West Chester, has kindly placed in our hands, mention is made of "a ring round the old shaft at the old furnace," and of "one tonn of sow mettle at new furnace." Acrelius, in speaking of the iron ore on French creek, says: "Its discoverer is Mr. Nutt, who afterwards took Mr. Branz into partnership." The reference is to William Branson. This event occurred as early as March 29, 1728, as their names then appear in the Philadelphia *Weekly Mercury* as partners. Acrelius further says: "They both went to England, brought workmen back with them, and continued together." Mrs. James says: "The 15th day of March, 1736, Samuel Nutt and William Branson entered into an agreement with John Potts to carry on their furnace called Redding, recently built near Coventry, and of which they are styled 'joint owners.'" At a meeting of the Provincial Council on January 25, 1737, "a petition of sundry inhabitants of the county of Lancaster was presented to the board and read, setting forth the want of a road from the town of Lancaster to Coventry iron works, on French creek, in Chester county, and praying that proper persons of each of the counties may be appointed for laying out the same from Lancaster town to the said iron works, one branch of which road to goe to the new furnace, called Redding's furnace, now erecting on the said creek." On October 7th of the same year commissioners were appointed to lay out the road.

Samuel Nutt died late in 1737. In his will, dated September 25, 1737, he gave one-half of his "right" to Redding furnace and Coventry forge to his wife, and the other half to Samuel Nutt, Jr., and his wife. He also made provision for the erection of a new furnace by his wife. This furnace was commenced in the same year, and was built on the south branch of French creek. It was probably finished in 1738. In 1740 its management fell into the hands of Robert Grace, (a friend of Benjamin Franklin,) who then married the widow of Samuel Nutt, Jr. This lady was the grand-daughter of Thomas Rutter. The new furnace was called Warwick. The celebrated Franklin stove was invented by Benjamin Franklin in 1742, and in his autobiography he says: "I made a present of the model to Mr. Robert Grace, one of my early friends, who, having an iron furnace, found the casting of the plates for these stoves a profitable thing, as they were growing in demand." Mrs. James has seen one of these stoves with the words "Warwick Furnace" cast on the front in letters two inches long. Bishop says that Warwick furnace "was blown by long wooden bellows propelled by water wheels, and when in blast made 25 or 30 tons of iron per week." It continued in operation during a part of almost every year, from its erection in 1738 down to 1867, when its last blast came to an end and the furnace was abandoned. During the Revolution it was very active in casting cannon for the Continental army, some of which were buried upon the approach of the British in 1777. After Samuel Nutt's death Reading furnace became the property of his partner, William Branson. It is noted on Nicholas Scull's map of 1759. Coventry forge finally fell to Samuel Nutt's heirs. The German traveler, Schoepf, writing in 1783 of some Pennsylvania furnaces and forges, makes the following mention of Warwick and Reading furnaces: "Warwick furnace, 19 miles from Reading, near Pottsgrove, makes the most iron, often 40 tons a week; the iron ore lies ten feet under the surface. Reading furnace, not far from the former, is at present fallen into decay. Here the smelting would formerly often continue from 12 to 18 months at a stretch. At an uncertain period before 1750 William Branson and others established on French creek the first steel works in Pennsylvania. They were called Vincent steel works. They are thus described by Acrelius: "At French creek, or Branz's works, there is a steel furnace, built with a draught hole, and called an 'air oven.' In this iron bars are set at the distance of an inch apart. Between them are scattered horn, coal-dust, ashes, etc. The iron bars are thus covered with blisters, and this is called 'blister steel.' It serves as the best steel to put upon edge-tools. These steel works are now said to be out of operation." Vincent forge, with four fires and two hammers, was connected with Vincent steel furnace, but the date of its erection is also uncertain. It is noted on William Scull's map of 1770. The furnace and forge were located about six miles from the mouth of French creek, and about five miles distant from Coventry forge, which was farther up the stream. Before February 15, 1797, a rolling and slitting mill had been added to the forge. We do not hear of the steel furnace after 1780, nor of the forge after 1800. In 1742 William Branson, then owner of Reading furnace, bought from David Jenkins a tract of 400 acres of land on Conestoga creek, near Churchtown, in Caernarvon township, Lancaster county, on which in 1747 he erected a forge, which he called Windsor. This forge was speedily followed by another of the same name. In a short time afterwards, as we are informed by Mr. James McCaa, "Branson sold out to the English company, who were Lynford Lardner, Samuel Flower, and Richard Hockley, Esqs., who held it for thirty years, when, in 1773, David Jenkins, son of the original proprietor, bought the half interest of the company for the sum of £2,500, and in two years afterwards bought the other half for the sum of £2,400, including the negroes and stock used on the premises." Robert Jenkins inherited the Windsor property from his father David, and managed Windsor forges with great success for fifty years, dying in 1848. They have since been abandoned.

Acrelius, narrating events which occurred between 1750 and 1756, mentions the enterprises of Nutt and Branson as follows: "Each has his own furnace—Branz at Reading, Nutt at Warwick. Each also has his own forges—Branz in Windsor. Nutt supplies four forges besides his own in Chester county." Nutt was not living at the time this was written, but Acrelius's confounding of ownership is easily understood. Nor is it probable that Branson operated Windsor forges in 1750. In that year he is reported as having then owned a furnace for making steel in Philadelphia, and soon after 1743 it is known that he sold Windsor forges to the "English company," which was composed of his sons-in-law. William Branson was himself an Englishman who emigrated to Pennsylvania about 1708 and became a Philadelphia merchant. He died in 1760. There was a forge on Crum creek, about two miles above the town of Chester, in Delaware county, which was built by John Crosby and Peter Dicks about 1742. Peter Kalm, the Swede, in his *Travels into North America*, written in 1748 and 1749, thus describes it: "About two English miles behind Chester I passed by an iron forge, which was to the right hand by the road side. It belonged to two brothers, as I was told. The ore, however is not dug here, but thirty or forty miles from hence, where it is first melted in the oven, and then carried to this place. The bellows were made of leather, and both they and the hammers, and even the hearth, [were] but small in proportion to ours. All the machines were worked by water. The iron was wrought into bars." The "oven" here referred to was a blast furnace, which was probably located in the Schuylkill valley, the pigs for the forge being boated from it down the Schuylkill and Delaware and up Crum creek. Acrelius says that the forge was owned at the time of his visit by Peter Dicks, had two stacks, was worked sluggishly, and had "ruined Crosby's family." As early as 1742 John Taylor built a forge on Chester creek, in Thornbury township, Delaware county, where Glen Mills now stand, which he called Sarum iron works. In 1746 he added a rolling and slitting mill. These works are said to have been carried on with energy by Mr. Taylor until his death in 1756. Acrelius, writing about the time of Mr. Taylor's death, says: "Sarum belongs to Taylor's heirs; has three stacks, and is in full blast." Peter Kalm states that at Chichester (Marcus Hook) "they build here every year a number of small ships for sale, and from an iron work which lies higher up in the country they carry iron bars to this place and ship them." This "iron work" was certainly Sarum. Taylor was the descendant of an English settler in the province. His rolling and slitting mill was the first in Pennsylvania. In 1750 there was a "plating forge with a tilt-hammer" in Byberry township, in the northeastern part of Philadelphia county, the only one in the province, owned by John Hall, but not in use in that year. In the same year there were two steel furnaces in Philadelphia, one of which, Stephen Paschall's, was built in 1747, and stood on a lot on the northwest corner of Eighth and Walnut streets; the other was owned by William Branson, and was located near where Thomas Penn "first lived at the upper end of Chestnut street." These furnaces were for the production of blister steel. There appear to have been no other steel furnaces in the province in 1750. Whitehead Humphreys was in 1770 the proprietor of a steel furnace on Seventh street, between Market and Chestnut, in Philadelphia, where he also made edge tools. In February, 1775, Uriah Woolman and B. Shoemaker, "in Market street, Philadelphia," advertised in Dunlap's *Pennsylvania Packet* "Pennsylvania steel manufactured by W. Humphreys, of an excellent quality, and warranted equal to English, to be sold in blister, faggot, or flat bar, suitable for carriage springs." Returning to the Schuylkill valley, we find in 1751 a forge called Mount Joy at the mouth of East Valley creek, on the Chester county side of the creek, the one-third of which was advertised for sale on the 4th of April of that year by Daniel Walker, and the remaining two-thirds on the 26th of September of the same year by Stephen Evans and Joseph Williams. In Daniel Walker's advertisement it was stated that the forge was "not so far distant from the furnaces." Pennypacker, in his *Annals of Phœnixville and its Vicinity*, says that "the ancestor of the Walker family" had come from England with William Penn, and "at a very early date had erected the small forge on the Valley creek." It is clear, however, that in 1751 Daniel Walker owned only the one-third of the forge, Evans and Williams owning the remainder. In 1757, as we learn from Mrs. James, the forge was sold to John Potts by the executors of Stephen Evans. In 1773 it was owned by Joseph Potts, at which time it continued to be legally designated as Mount Joy forge, although for some time previously it had been popularly known as Valley forge. In that year Joseph Potts sold the half of the forge to Colonel William Dewees. The pig iron used at Valley forge was hauled from Warwick furnace. In September, 1777, the forge was burned by the British, and in December of the same year the American army under Washington was intrenched on the Montgomery county side of Valley creek, opposite Valley forge. General Washington's headquarters were established at the substantial stone house of Isaac Potts, also on the Montgomery county side of Valley creek. The house is still standing. Isaac Potts was not, however, at this time an owner of Valley forge. After the close of the Revolutionary war Isaac and David Potts, brothers, erected another forge on the Montgomery county side of Valley creek and about three-eighths of a mile below the old Mount Joy forge. A new dam was built, which raised the water partly over the site of the old forge. About the same time, and as early as 1786, a slitting mill was built on the Chester county side of the stream by the same persons. The new forge was called Valley forge. It was in ruins in 1816. About 1824 all the iron works at the town of Valley Forge were discontinued. Mrs. James says that "nothing now remains but an immortal name."

Charming forge, on Tulpehocken creek, two miles from Womelsdorf, in Berks county, was built in 1749, probably by Pennsylvania Germans, as we find that in 1754 it was styled *Tulpehocken Eisen Hammer*. This forge is still in operation. Another early forge in the Schuylkill valley was Amity forge, on the Manatawny or one of its branches. Helmstead, Union, and Pottsgrove were the names of other forges existing in 1750. Mary Ann furnace, in Long Swamp township, Berks county, was in existence as early as 1762, when it was owned by George Ross and George Ege. This furnace was in blast until 1869. Oley furnace, on Manatawny creek, about eleven miles northeast of Reading, was built in 1779, by Daniel Udree, a Pennsylvania German, and is still in operation. In 1780 a forge of the same name was built on the same stream by Mr. Udree. It has been abandoned since 1856. Green Tree forge, near Reading, was built in 1770. On William Scull's map of 1770 Moselem forge, on Maiden creek, Berks county, and Gulf forge, on Gulf creek, in Upper Merion township, Montgomery county, are noted. William Bird was an enterprising Englishman who established several iron enterprises in Berks county before the Revolution. A person of this name was a witness of Thomas Rutter's will, on November 27, 1728, when he appears to have been a resident of Amity township, Berks county. In 1740 or 1741 William Bird built a forge on Hay creek, near its entrance into the Schuylkill, where the town of Birdsboro now stands. In 1759 he built Hopewell furnace on French creek, in Union township, Berks county, which is still in operation and still using charcoal. In the same year he built Nine Pine forge, near Hopewell furnace, in the same township. As early as 1760 he built Roxborough furnace in Heidelburg township, Berks county, the name of which was subsequently changed to Berkshire. Dying in 1762, his estate was divided between his six children and his widow. Berkshire furnace fell to a son, Mark Bird, who in 1764 sold it to John Patton and his wife Bridget, who had been the wife of William Bird. In 1789 Bridget Patton, again a widow, sold the furnace to George Ege. Mark Bird built a rolling and slitting mill and a nail factory at Birdsboro about the time of the Revolution. He also built Spring forge in Oley township, and Gibraltar forges in Robeson township. At Trenton, New Jersey, he manufactured wire. He failed in business about 1788. Elizabeth furnace, near Brickersville, in Lancaster county, on Middle creek, a branch of Conestoga creek, was built about 1750 by John Huber, a Pennsylvania German. It was a small furnace, and did not prove to be profitable. In 1757 Huber sold it to Henry William Stiegel and his partners, who built a new and larger furnace, which was operated until 1775, when through Stiegel's embarrassments, it passed into the hands of Daniel Benezet, who leased it to Robert Coleman, who subsequently bought it and eventually became the most prominent ironmaster in Pennsylvania at the close of the last and far into the present century. Bishop states that "some of the first stoves cast in this country were made by Baron Stiegel, relics of which still remain in the old families of Lancaster and Lebanon counties." Rev. Joseph Henry Dubbs, of Lancaster, says that Stiegel's stoves bore the inscription:

Baron Stiegel ist der mann
Der die Ofen machen kann.

That is, "Baron Stiegel is the man who knows how to make stoves." On the furnace erected by Huber the following legend was inscribed:

John Huber, der erste Deutche man
Der das Eisenwerk vollfuren kann.

Freely translated this inscription reads: "John Huber is the first German who knows how to make iron." Henry William Stiegel was a man of great enterprise and business capacity, but of a too sanguine temperament; hence his failure where others succeeded. On the fifth of February, 1763, he was associated with Charles and Alexander Stedman as a lessee of Charming forge. In 1772 the forge was leased by him and Paul Zantzinger to George Zantzinger and George Ege. Between 1760 and 1770 he established a glass factory at Manheim, in Lancaster county, called the American flint glass factory, which was in operation as late as 1774. He was a native of Germany, arriving in this country on August 31, 1750, (old style,) in the ship *Nancy* from Rotterdam. He is buried in the Lutheran graveyard in Heidelberg township, Berks county, a few miles from Womelsdorf. In his last days he taught school in this township.

After Elizabeth furnace came into the possession of Robert Coleman he cast shot and shells and cannon for the Continental army, and some of the transactions which occurred between him and the Government in settlement of his accounts for these supplies are very interesting. On November 16, 1782, appears the following entry: "By cash, being the value of 42 German prisoners of war, at £30 each, £1,260;" and on June 14, 1783, the following: "By cash, being the value of 28 German prisoners of war, at £30 each, £840." In a foot note to these credits Robert Coleman certifies "on honour" that the above 70 prisoners were all that were ever secured by him, one of whom being returned is to be deducted when he produces the proper voucher. Rupp, in his history of Lancaster county, mentions that in 1843 he visited one of the Hessian mercenaries who was disposed of in this manner at the close of the war for the sum of £80, for the term of three years, to Captain Jacob Zimmerman of that county. Elizabeth furnace continued in operation until 1856, when it was abandoned by its owner, Hon. G. Dawson Coleman, the grandson of Robert Coleman, for want of wood. Among the persons who were employed at Windsor forges under the "English company" was James Old, a forgeman. He was shrewd and energetic. About 1765 he built Pool forge on Conestoga creek, about a mile below Windsor forges. Early records mention his ownership of Quitapahilla forge, near Lebanon, and of Speedwell forge, on Hammer creek, in Lancaster county. Tradition also associates his name with the ownership of other forges in Chester, Lancaster, and Berks counties. In 1774 he was a lessee of Reading furnace, on French creek. In 1795 he conveyed Pool forge and 700 acres of land attached to his son, Davies Old.

James Old was born in Wales in 1730. He emigrated to Pennsylvania previous to September 7, 1754, when his name for the first time appears in the register of Bangor church, at Churchtown, Lancaster county, as the contributor of £5 toward the erection of the church building. Soon after his settlement at Windsor he married Margaretta Davies, a daughter of Gabriel Davies, of Lancaster county. Gabriel Davies is supposed to have been the owner of the site on which Pool forge was built. James Old died on May 1, 1809, in his 79th year, and is buried in the graveyard of Bangor church. He was one of the most enterprising and successful of early Pennsylvania ironmasters. He had a brother William, also a forgeman, who had been employed at Windsor forges, and who afterwards embarked in the manufacture of bar iron on his own account. William Old, a son of James Old, married Elizabeth Stiegel, the daughter of Baron Stiegel. She is buried in the same graveyard which holds the remains of her father. Mrs. Henry Morris, of Philadelphia, is her grand-daughter. Robert Coleman was in his younger days in the service of James Old, and while with him at Reading furnace in 1773 he married his daughter Ann. Soon after his marriage he rented Salford forge, above Norristown, in Montgomery county, where he remained three years. While at this forge he manufactured chain bars, which were designed to span the Delaware river for the defense of Philadelphia against the approach of the British fleet. From Salford Forge he went to Elizabeth furnace. He was born near Castle Fin, in Donegal county, and not far from the city of Londonderry, in Ireland, on the 4th of November, 1748. In 1764, when 16 years old, he left Ireland for America. He died at Lancaster in 1825, at which place he is buried. Cyrus Jacobs married Margaretta, another daughter of James Old, about 1782. At that time he was living at Churchtown, in the employment of James Old as a clerk at Pool forge. He was at Gibraltar forge, in Berks county, in 1787, and at Hopewell forge, in Lancaster county, from 1789 to 1792. Tradition says that he was a lessee of both these forges from James Old. In 1793 he built Spring Grove forge, on Conestoga creek, about three miles west of Pool forge, and in 1799 he purchased Pool forge from Davies Old. Both these forges were active until 1856, after which they were abandoned. The Jacobs family came to Pennsylvania from Wales about 1693, and settled on Perkiomen creek. Cyrus Jacobs was born in 1761, and died in 1830 at Whitehall, near Churchtown.

Cornwall furnace, located within the limits of the now celebrated Cornwall ore hills, on Furnace creek, in Lebanon county, a few miles south of Lebanon, was built in 1742 by Peter Grubb, whose descendants to this day have been prominent Pennsylvania ironmasters. He was the son of John Grubb, a native of Cornwall, in England, who emigrated to this country in the preceding century, landing at Grubb's Landing, on the Delaware, near Wilmington, at which latter place he is buried. There is record evidence that Peter Grubb was already an ironmaster before he built Cornwall furnace, and a tradition in his family says that in 1735 he built a furnace or bloomary, most likely the latter, about five-eighths of a mile from the site of Cornwall furnace. He died intestate about 1754, and his estate, including the Cornwall ore hills, descended to his two sons, Curtis and Peter Grubb—both afterwards colonels in the Revolution. In 1756, just after the death of Peter Grubb, Acrelius wrote of Cornwall furnace as follows: Cornwall, or Grubb's iron works, in Lancaster county. The mine is rich and abundant, forty feet deep, commencing two feet under the earth's surface. The ore is somewhat mixed with sulphur and copper. Peter Grubb was its discoverer. Here there is a furnace which makes twenty-four tons of iron a week, and keeps six forges regularly at work—two of his own, two belonging to Germans in the neighborhood, and two in Maryland. The pig iron is carried to the Susquehanna river, thence to Maryland, and finally to England. The bar iron is sold mostly in the country and in the interior towns; the remainder in Philadelphia. It belongs to the heirs of the Grubb estate, but is now rented to Gurrit & Co." The firm was doubtless Garret & Co. During the Revolution Cornwall furnace cast cannon and shot and shells for the Continental army. It is still in operation, and is the oldest active charcoal furnace in the United States. It has always used charcoal. In 1785 Robert Coleman purchased a one-sixth interest in Cornwall furnace and the ore hills. After that year, through successive purchases from the Grubbs, he obtained four additional sixths of the Cornwall property. His total purchases of this valuable property remain in the hands of his descendants to-day. Martic forge, on Pequea creek, near the present village of Colemanville, Lancaster county, was built in 1755, and is still in operation. Early in this century cemented or blistered steel was made here. Mr. R. S. Potts, one of the present owners of Martic forge, writes us as follows: "There used to be a small rolling mill near the forge that stopped running some fifty years ago. There was also a charcoal furnace called Martic some six miles east of the forge, but I have been unable to ascertain its history beyond the fact that it was owned and operated by the Martic Forge Company; when that was, however, or how long it was in blast, I cannot learn. The old cinder bank is still visible. During the Revolution round iron was drawn under the hammer at the forge and bored out for musket barrels at a boring mill, in a very retired spot, on a small stream far off from any public road, doubtless with a view to prevent discovery by the enemy. The site is still visible. In 1769 Martic furnace and forge were advertised for sale by the sheriff, together with 3,400 acres of land and other property —"all late the property of Thomas Smith, James Wallace, and James Fulton." The furnace was in existence in 1793, but it was not then active.

Hopewell forge, on Hammer creek, in Lancaster county, about ten miles south of Lebanon, was built by Peter Grubb soon after he built Cornwall furnace. Speedwell forge, on the same stream, near Brickersville, in Lancaster county, was built in 1750, also by Peter Grubb. The iron industry of Pennsylvania crossed the Susquehanna at a very early period. Acrelius says that there was a bloomary in York county in 1756, owned by Peter Dicks, who had but recently discovered "the mine." Spring forge, in the same county, was built in 1770, was still in operation in 1849, and was abandoned about 1850. About the year 1760 a forge was built at Boiling Springs, in Cumberland county, forming the nucleus of the Carlisle iron works, which afterwards included a blast furnace, a rolling and slitting mill, and a steel furnace. The furnace was built in 1762 by John Rigbey & Co Michael Ege was the proprietor after 1768. On a tax list at Carlisle Robert Thornburg & Co. appear in 1767 as the owners of a forge to which 1,200 acres of land were attached. We cannot locate this forge. A forge is supposed to have been built at Mount Holly in 1765. Pine Grove furnace, in the same county, was built about 1770 by Thornburg & Arthur. In 1782 Michael Ege became part owner and subsequently sole owner. A forge was attached to this furnace. Both the furnace and forge are still in operation. No other iron works west of the Susquehanna are known to have been established previous to the Revolution. About 1777 William Denning, an artificer of the Revolutionary army, had a forge in active operation at Middlesex, in Cumberland county, at which he manufactured wrought-iron cannon. Although all the iron enterprises which were established in Pennsylvania prior to the Revolution have not been mentioned in the preceding pages, those which have been mentioned indicate remarkable activity in the development of the iron resources of the province. Pennsylvania was one of the last of the thirteen colonies to be occupied by permanent English settlements, and even after these settlements were made a long time elapsed before the erection of iron works was successfully undertaken. Very strangely, the business of manufacturing iron was not fairly commenced in Pennsylvania until 1716, but after this time it grew rapidly, and in the sixty years which intervened before the commencement of hostilities with the mother country probably sixty blast furnaces and forges were built—a rate of progress which was not attained by any other colony in the same period. Acrelius said in 1756: "Pennsylvania, in regard to its iron works, is the most advanced of all the American colonies." Many of these enterprises were upon a scale that would have done credit to a much later period of the American iron industry.

Cornwall and Warwick furnaces were each 32 feet high, 21½ feet square at the base, and 11 feet square at the top. Warwick was at first 9 feet wide at the boshes, but was afterwards reduced to 7½ feet. The forges were usually those in which pig iron was refined into bar iron "in the Walloon style," as stated by Acrelius. There were few ore bloomaries, and nearly all of these were built at an early day. Acrelius mentions only one of this class—Peter Dicks' bloomary, in York county. The smaller furnaces yielded only from 1½ to 2 tons of pig iron daily, but the larger ones yielded from 3 to 4 tons. The Reading and Warwick furnaces, when in blast, each made from 25 to 30 tons of iron per week. The furnaces were used to produce both pig iron and castings, the latter consisting of stoves, pots, kettles, andirons, and similar articles. Of the product of the forges Acrelius says that "one forge, with three hearths in good condition, and well attended to, is expected to give 2 tons a week." The same author says that "for four months in summer, when the heat is most oppressive, all labor is suspended at the furnaces and forges." The scarcity of water at this season would also have much to do with this suspension, all of the works being operated by water-power. It was not until about the close of the first third of the present century that blowing engines were used to produce the blast at either furnaces or forges in Pennsylvania, or in any other state. At first large leather bellows were used to blow both the furnaces and the forges, but afterwards, about the time of the Revolution, wooden cylinders, or "tubs," were substituted. Reading, Warwick, and Cornwall furnaces—three of the best furnaces of the last century—retained their long leather bellows until a late day. The Cornwall bellows was 20 feet 7 inches long, 5 feet 10 inches across the breech, and 14 inches at the insertion of the nozzle. Only one tuyere was used at the furnaces. The fuel used was exclusively charcoal, and the blast was always cold. About 400 bushels of charcoal were required to produce from the ore a ton of hammered bar iron.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

THE MANUFACTURE OF CHARCOAL IRON IN EASTERN PENNSYLVANIA AFTER THE REVOLUTION.

AFTER the Revolution the business of manufacturing iron received a fresh impulse in the eastern part of Pennsylvania, and was further extended into the interior. Chester, Lancaster, and Berks counties shared conspicuously in the development at this period of the leading manufacturing industry of the state. Many blast furnaces and forges and a few rolling and slitting mills were built in these counties before 1800, and after the beginning of the present century this activity was continued. A few of the more important enterprises in each of these counties and in other eastern counties may be mentioned. In 1790 Benjamin Longstreth erected a rolling and slitting mill at Phœnixville, where the foundry now stands, to roll bars into plates to be slit into nail rods. This was the beginning of the present extensive works of the Phœnix Iron Company.

Federal slitting mill, on Buck run, about four miles south of Coatesville, in East Fallowfield township, Chester county, was built in 1795 by Isaac Pennock. The name of this mill was afterwards changed to Rokeby rolling mill. It was used to roll sheet iron and nail plates and to slit the latter into nail rods. It continued in operation until 1864, when it was burned down and abandoned. During the latter part of its history it rolled boiler plates. A paper mill now occupies its site. About 1810 Mr. Pennock built the Brandywine rolling mill at Coatesville, which was afterwards operated for him by Dr. Charles Lukens, who had been employed at the Federal slitting mill. At this mill it is claimed that the first boiler plates in the United States were rolled by Dr. Lukens in 1816. The puddling mill of the Lukens rolling mill at Coatesville occupies to-day the site of the Brandywine mill. Upon the death, in 1825, of Dr. Lukens, who had become the owner of the Brandywine mill, the management of the mill devolved upon his wife, by whom the business was greatly extended and profitably conducted for twenty years. As a tribute to her memory the name of the works was, after her death, changed to Lukens rolling mills. Mount Hope furnace, located on the Big Chiquisalunga creek, in Lancaster county, about ten miles south of Lebanon, was built in 1785 by Peter Grubb, Jr., and is still operated by members of the Grubb family. Colebrook furnace, on the Conewago, in Lebanon county, seven miles southwest of Cornwall furnace, was built by Robert Coleman in 1791 and abandoned about 1860. Mount Vernon furnace, on the same stream, about twenty-three miles west of Lancaster, and in Lancaster county, was built in 1808 by Henry Bates Grubb. A second furnace of the same name was built near the first in 1831. Both have been abandoned. Conowingo furnace, on the creek of the same name, and about sixteen miles southeast of Lancaster, was built in 1809.

About 1840 steam-power for driving the blast was successfully introduced by its owner, James M. Hopkins, the boilers being placed at the tunnel-head. Soon after the introduction of steam at Conowingo furnace it was successfully applied to Cornwall furnace by the manager, Samuel M. Reynolds. In 1786 there were seventeen furnaces, forges, and slitting mills within thirty-nine miles of Lancaster. In 1838 there were 102 furnaces, forges and rolling mills within a radius of fifty-two of Lancaster. At this time Lancaster was the great iron center of eastern Pennsylvania. In 1805 there were seven forges and one slitting mill in Delaware county. Franklin rolling mill, at Chester, in Delaware county, was built in 1808. In 1828 there was in this county five rolling and slitting mills and some manufactories of finished iron products. The Cheltenham rolling mill, on Tacony creek, in Montgomery county, one mile below Shoemakertown, was built in 1790. In 1856 it was owned and operated by Rowland & Hunt; it has since been abandoned. Joanna furnace, on Hay Creek, in Berks county, was built as early as March, 1793. It is still in operation, and still uses charcoal. A neighboring furnace called Rebecca was situated in Chester county, and was in existence in 1793. Reading furnace, two miles east of Womelsdorf, in Berks county, was built in 1793 by George Ege, on the site now occupied by the Robesonia furnaces. It was a near neighbor of Berkshire furnace. Sally Ann furnace, in Rockland township, about five miles south of Kutztown, was built in 1791. After having been idle for many years it was refitted in 1879 and is now in operation under the name of Rockland furnace. In 1798 there were six furnaces and six forges in Berks county. In 1832 there were eleven furnaces and twenty-one forges.

The first iron enterprises in the Lehigh valley are said to have been established in the last century, in Carbon county. These were Maria forge and furnace, on Pocopoco creek, near Weissport. The forge is said to have been built in 1753. It was abandoned in 1858, and the furnace in 1861. Several charcoal iron enterprises were established in this valley during the early part of the present century, including a few bloomaries. All of the forges and bloomaries in the Lehigh valley have been abandoned. Nearly all of the bloomaries were supplied with ore from northern New Jersey. Of the charcoal furnaces only one is now in operation which uses charcoal—East Penn, formerly Pennsville, in Carbon county, built in 1837. In 1836 a rolling mill and wire factory were built at South Easton, in Northampton county, by Stewart & Co. This was probably the first rolling mill in the valley. In 1805 there were two forges in York county, one of which was Spring forge, which stood on Codorus creek. Castle Fin forge, formerly called Palmyra forge, on Muddy creek, in York county, was built in 1810, by a person named Withers, and rebuilt in 1827 by Thomas Burd Coleman, who also erected a steel furnace about 1832. Both have been abandoned. In its day Castle Fin forge was a very prominent enterprise. In 1850 there were five furnaces and three forges in this county. Since then its iron industry has sensibly declined. Chestnut Grove furnace, at Whitestown, in Adams county, was built in 1830, and is still active. About 1830 Maria furnace was built in Hamiltonban township, in this county, by Stevens & Paxton (Thaddeus Stevens), but was abandoned about 1837. The first furnace in Franklin county was Mount Pleasant, in Path valley, five miles northwest of Loudon, which was erected soon after the peace of 1783 by three brothers, William, Benjamin, and George Chambers. A forge was also erected by them as early as 1783. This furnace and forge were destroyed in 1843. A furnace called Richmond, built in 1865, now occupies the site of Mount Pleasant furnace. Soundwell forge, at Roxbury, sixteen miles north of Chambersburg, on Conodoguinet creek, was built in 1798, by Leephar, Crotzer & Co., and was active until 1857. Roxbury furnace, at or near the same place, was built in 1815 by Samuel Cole, and is now abandoned. In the old "pack-horse" days there was an active iron trade carried on at Roxbury. Carrick forge, four miles from Fannettsburg, in Franklin county, was built in 1880, and was in operation in 1856. A furnace of the same name was built in 1828 by General Samuel Dunn, which is still active. Loudon forge and furnace were built about 1790 by Colonel James Chambers, and destroyed about 1840. Valley forge, near Loudon, in Franklin county, was built in 1804, and abandoned after 1856. Other old forges in Franklin county were abandoned before 1850. Mont Alto furnace, in the same county, was built in 1807 by Daniel and Samuel Hughes, and is still active. Two forges of the same name, which are yet in operation, were built in 1809 and 1810 about four miles from the furnace. A foundry was built in 1815, a rolling mill in 1832, and a nail factory in 1835. About 1850 the nail factory was burned down, and soon after 1857 the mill was abandoned. Caledonia forge, in Franklin county, on Conococheague creek, ten miles southeast of Chambersburg, was built in 1830 by Stevens & Paxton. Caledonia furnace, at the same place, was built in 1837 by the same firm, after the abandonment of Maria furnace, in Adams county. For many years previous to 1863 this furnace and forge were owned by Hon. Thaddeus Stevens, in which year they were burned by the Confederates, under General Lee, when on the march to Gettysburg. Franklin furnace, in St. Thomas township, was built by Peter and George Housum in 1828, and is still running on charcoal. There were a few other charcoal furnaces in this county which have left scarcely their names by which to be remembered. Early in the present century nails and edge tools were made in large quantities at several establishments at Chambersburg and in its vicinity. One of these, the Conococheague rolling mill and nail factory, was established by Brown & Watson in 1814. Liberty forge, at Lisburn, on Yellow Breeches creek, in Cumberland county, was built in 1790, and is still active. An older forge, long abandoned, is said to have been built at Lisburn in 1783. A few other forges in Cumberland county were built prior to 1800. Cumberland furnace, ten miles southwest of Carlisle, on Yellow Breeches creek, is said to have been built in 1794 by Michael Ege. It blew out permanently in December, 1854. Holly furnace, at Papertown, in the same county, is said to have been built about 1785 by Stephen Foulk and William Cox, Jr. A forge was in existence here in 1848. Holly furnace was torn down in 1855 to give place to a paper mill. It was once owned by Michael Ege. Two furnaces, now abandoned, once stood near Shippensburg in this county—Augusta, built in 1824, and Mary Ann, built in 1826. Big Pond furnace, built in 1836, between Augusta and Mary Ann furnaces, was burned down in 1880. Jacob M. Haldeman removed from Lancaster county to New Cumberland, at the mouth of Yellow Breeches creek, on the Susquehanna, about 1806. He purchased a forge at this place and added a rolling and slitting mill, which were operated until about 1826, when they were allowed to decay. Fairview rolling mill, about a mile from the mouth of Conodoguinet creek, in Cumberland county, and two miles above Harrisburg, was built in 1833 by Gabriel Heister and Norman Callender, of Harrisburg, to roll bar iron. Jared Pratt, of Massachusetts, leased the mill in 1836, and added a nail factory. Michael Ege was for nearly fifty years a prominent ironmaster of Cumberland county, owning, a short time before his death, Pine Grove furnace, the Carlisle iron works, Holly furnace, and Cumberland furnace. He and his brother George Ege, already mentioned, were natives of Holland. He died on August 31, 1815. In 1840 there were 8 furnaces and 11 forges, bloomaries, and rolling mills in Franklin county, and 6 furnaces and 5 forges and rolling mills in Cumberland county.

Schuylkill county has had several forges, mainly at or near Port Clinton, the first of which at that place appears to have been built in 1801. Between 1800 and 1804 a small charcoal furnace was built by Reese & Thomas at Pottsville. In 1807 Greenwood furnace and forge were erected at Pottsville by John Pott, the founder of the town, which was laid out in 1816. In 1832 there were in operation in Schuylkill county Greenwood furnace and forge, and Schuylkill, Brunswick, Pine Grove, Mahanoy, and Swatara forges. A furnace called Swatara, six miles from Pine Grove, was built in 1830, which was followed by Stanhope furnace, still nearer to Pine Grove, in 1835. All of these were charcoal enterprises. In 1785 Henry Fulton established a "nailery" in Dauphin county, probably at Harrisburg. It is said to have been "only a little remote from a smithy." In 1805 there were two furnaces and two forges in the county. Oakdale forge, at Elizabethville, appears to have been built in 1830. Victoria furnace, on Clark's creek, was built in that year. In 1832 there were three forges and two furnaces in the county. Emeline furnace, at Dauphin, was built about 1835. The first furnace at Middletown, in this county, was built in 1833, and a second furnace was built in 1849—both cold-blast charcoal furnaces. Manada furnace, at West Hanover, was built in 1837 by E. B. & C. B. Grubb. The first rolling mill in the county was the old Harrisburg mill, at Harrisburg, built in 1836. The first anthracite furnace in the county was built at Harrisburg, in 1845, by Governor David R. Porter. Hon. Simon Cameron has been prominently identified with the iron interests of this county. A furnace and forge, probably Paxinas, were in operation in Shamokin township, Northumberland county, as early as 1830. Berlin furnace and forge were built near Hartleytown, in Union county, in 1827. Forest furnace, near Milton, in Northumberland county, was built in 1846, and Beaver furnace, near Middleburg, in Snyder county, in 1848—both charcoal furnaces. Esther furnace, about three miles south of Catawissa, on East Roaring creek, in Columbia county, was built in 1802 by Michael Bitter & Son, who cast many stoves. In 1836 the furnace was rebuilt by Trago & Thomas. Catawissa furnace, near Mainville, in Columbia county, was built in 1825, and a forge was built in 1824, near the same place. In 1832 there were two furnaces and two forges in Catawissa township. In 1837 Briar Creek furnace, two miles from Berwick, in Columbia county, was built. In 1845 Fincher & Thomas built Penn charcoal furnace, on Catawissa creek, one mile east of Catawissa. All of these furnaces have been abandoned, but the forge at Mainville is still active.

A charcoal furnace called Liberty was built at Mooresburg in Montour county, in 1838. A furnace at Danville, in Montour county, was built in 1838 to use charcoal, but was altered in the following year to use anthracite. Danville rolling mill was built in 1845, Montour in 1845, and Rough-and-Ready in 1847—all at Danville. About 1778 a bloomary forge was built on Nanticoke creek, near the lower end of Wyoming valley, in Luzerne county, by John and Mason F. Alden. Another bloomary forge was erected in 1789 on Lackawanna river, about two miles above its mouth, by Dr. William Hooker Smith and James Sutton. Still another bloomary forge was erected in 1799 or 1800, on Roaring brook, at Scranton, then called Slocum's Hollow, by two brothers, Ebenezer and Benjamin Slocum. The product of these bloomaries was taken down the Susquehanna river in Durham boats. They all continued in operation until about 1828. Nescopeck forge, in Luzerne county, was built in 1824, and abandoned about 1854. Shickshinny charcoal furnace was built in 1846, and abandoned about 1860. In 1811 Francis McShane established a small cut-nail factory at Wilkesbarre, "and used anthracite coal in smelting the iron." Wyoming rolling mill, at Wilkesbarre, was built in 1842, and abandoned about 1850. It was followed by Lackawanna, at Scranton, in 1844. Lackawanna county owes its present prominence in the iron industry to the courage, energy, and business sagacity of two brothers, George W. and Selden T. Scranton, and their cousin, Joseph H. Scranton, the two brothers commencing operations in 1840 at Scranton, and their cousin joining them soon afterwards.

A furnace was built in Lycoming county in 1820, four miles from Jersey Shore, and named Pine creek. In 1832 it was owned by Kirk, Kelton & Co. A forge was added at the same place in 1831. Heshbon forge, furnace and rolling mill, on Lycoming creek, five miles above its mouth, were built, respectively, in 1828, 1838, and 1842. Hepburn forge, on the same creek, twelve miles north of Williamsport, was built in 1830 and Cresson rolling mill, one mile lower down the stream was built in 1842. About 1835 Astonville furnace, near Ralston, was built to use coke, but charcoal was soon substituted. At Ralston a charcoal furnace, rolling mill, nail factory, etc., were erected by the Lycoming Valley Iron Company in 1837. Washington Furnace, on Fishing creek, at Lamar, in Clinton county, was built in 1811. It was last in blast in 1875. A forge was added in 1837, and it also is silent. A furnace at Farrandsville, near the mouth of Lick run, in this county, which was built about 1836, to use coke, is said to have sunk, in connection with a nail mill, foundry, and other enterprises, over half a million dollars, contributed by Boston capitalists. Mill Hall, Sugar Valley, and Lamar are the names of other charcoal furnaces in the same county. Of the enterprises above named, Washington furnace and forge and Mill Hall furnace are the only ones that have not been abandoned. In 1814 Peter Karthaus, a native of Hamburg, in Germany, but afterwards a merchant of Baltimore, and Rev. Frederick W. Geissenhainer, a native of Muhlberg, in Germany, established a furnace at the mouth of the Little Moshannon, or Mosquito creek, in the lower end of Clearfield county. The firm of Karthaus & Geissenhainer was dissolved on the 18th day of December, 1818. It had been organized in 1811, partly to mine and ship to eastern markets the bituminous coal of Clearfield county. The furnace was operated with partial success for several years. A furnace was built about 1840 at Blossburg, in Tioga county, to use charcoal, but in 1841 it was altered by J. G. Boyd and another person to use coke. It soon chilled, however, and was abandoned.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

THE MANUFACTURE OF CHARCOAL IRON IN THE JUNIATA VALLEY.

AS early as 1767 a company called the Juniata Iron Company was organized, apparently by capitalists of eastern Pennsylvania, to search for iron ore in the Juniata valley, and probably with the ulterior object of manufacturing iron. It was in existence from 1767 to 1771, during which its agent, Benjamin Jacobs, made for it some surveys and explorations and dug a few tons of iron ore, but where these operations were conducted and who were the members of this pioneer company some future antiquarian must discover. The first iron enterprise in the Juniata valley was Bedford furnace, built in 1785, on Black Log creek, below its junction with Shade creek at Orbisonia, in Huntingdon county, by the Bedford company, composed of Edward Ridgely, Thomas Cromwell, and George Ashman. It made from eight to ten tons of pig iron weekly. It was constructed in part of wood, and was five feet wide at the bosh, and either fifteen or seventeen feet high. A forge was built on the Little Aughwick creek by the same company, a short distance from the furnace, about 1785, which made horseshoe iron, wagon tire, harrow teeth, etc. Large stoves and other utensils were cast at the furnace. At the Philadelphia Exhibition was a stove-plate cast at this furnace in 1792. Bar iron made at Bedford forge was bent into the shape of the letter U, turned over the backs of horses, and in this manner taken by bridle-paths to Pittsburgh. Bar iron and castings from Bedford furnace and later iron works in the Juniata valley were also taken down the Juniata river in arks, many of them descending to as low a point as Middletown on the Susquehanna, whence the iron was hauled to Philadelphia, or sent to Baltimore in arks down the Susquehanna river. The furnace and forge have long been abandoned. Three other charcoal furnaces have been built at or near the site of Bedford furnace during the present century. One of these was Rockhill, on Black Log creek, three-quarters of a mile southeast of Orbisonia, built in 1830. It was in operation in 1972, but in 1873 gave place to the two new coke furnaces of the Rock Hill Iron and Coal Company. Centre furnace, on Spring creek in Centre county, was the second furnace in the Juniata valley. It was built in the summer of 1792 by Colonel John Patton and Colonel Samuel Miles, both Revolutionary officers. The latter afterwards founded the iron works at Milesburg, in this county. The first forge in Centre county was Rock forge, on Spring creek, built in 1793 by General Philip Benner, of Chester county, who subsequently became an extensive manufacturer of Juniata iron. He died in 1832, aged 70 years, long before which time his Rock forge enterprise had expanded into a rolling and slitting mill, nail factory, blast furnace, etc. The furnace was built in 1816. General Benner had made iron at Nutt's forge at Coventry after the Revolution. In 1795 Daniel Turner built Spring creek forge, and in 1796 Miles, Dunlop & Co. built Harmony forge, on Spring creek. Logan furnace, near Bellefonte, was built in 1800 by John Dunlop, who afterwards originated other iron enterprises in Centre county, including a forge at Bellefonte. Tussey furnace, in Ferguson township, fourteen miles south of Bellefonte, was built about 1805 by General William Patton. In 1807 Roland Curtin, a native of Ireland, and father of Governor Andrew G. Curtin, in company with Moses Boggs, erected Eagle forge on Bald Eagle creek, about five miles from Bellefonte, Boggs remaining a partner only a short time. Pig iron for this forge was obtained from Tussey furnace. In 1817 Mr. Curtin built a furnace called Eagle, near his forge. In 1828 a small rolling mill was added, for the manufacture of bar iron and nails. About 1832 he built Martha furnace, on Bald Eagle creek, about eleven miles west of Bellefonte. He died in 1850, aged 84 years. About 1820 Hardman Philips, an enterprising Englishman, erected at Philipsburg a forge, foundry, and screw factory—the last named being one of the first of its kind in this country. Cold stream forge was erected about 1832 by John Plumbe, Sr., in Rush township, Centre county. Hecla furnace, near Hublersburg, was built in 1820. Hannah furnace, about ten miles northeast of Tyrone, was built in 1828. Julian furnace, on Bald Eagle creek, was built in 1835. A rolling mill was built by Valentines & Thomas, near Bellefonte, in 1824. Abram S. Valentine, of this firm, was the inventor of an ore washing machine.

Barree forge, on the Juniata, in Huntingdon county, was built about 1794 by Edward Bartholomew, of Philadelphia, and his son-in-law, Greenberry Dorsey, of Baltimore, to convert the pig iron of Centre furnace into bar iron. Huntingdon furnace, in Franklin township, was built in 1796, four miles from the mouth of Spruce creek, on Warrior's Mark run, but after one or two blasts a new stack was built a mile lower down the stream. The furnace was built for Mordecai Massey and Judge John Gloninger by George Anshutz, who in 1808 became the owner of one-fourth of the property. At the same time George Shoenberger purchased a one-fourth interest. Prior to 1808 Martin Dubbs had become part owner. A forge called Massey, on Spruce creek, was connected with Huntingdon furnace, and was built about 1800. The furnace has been silent since 1870. Tyrone forges, on the Juniata, were built by the owners of Huntingdon furnace, the first of the forges in 1804. In 1832 Gordon, in his *Gazetteer of the State of Pennsylvania*, stated that these forges, with a rolling and slitting mill and nail factory attached, formed "a very extensive establishment," owned by Messrs. Gloninger, Anshutz & Co. "The mill rolls about 150 tons, 75 of which are cut into nails at the works, 50 tons are slit into rods and sent to the West, and about 25 tons are sold in the adjoining counties."

Juniata forge was built at Petersburg about 1804 by Samuel Fahnestock and George Shoenberger, the latter becoming sole owner in 1805. Coleraine forges, on Spruce creek, were built in 1805 and 1809, by Samuel Marshall, an Irishman. There have been many forges on Spruce creek, none of which are now in operation. Union furnace in Morris township, Huntingdon county, was built by Edward B. Dorsey and Caleb Evans in 1810 or 1811. Pennsylvania furnace, on the line dividing Huntingdon from Centre county, was built by John Lyon, Jacob Haldeman, and William Wallace in 1813. It is now in operation, using coke. About 1818 Reuben Trexler, of Berks county, built a bloomary called Mary Ann, in Trough Creek valley, and about 1821 he added Paradise furnace. In 1832 John Savage, of Philadelphia, built a forge near Paradise furnace, which is said to have been the first forge in this country "that used the big hammer and iron helve on the English plan."

George Shoenberger was born in Lancaster county, and during the closing years of the last century settled on Shaver's creek, in Huntingdon county, as did also his brother Peter. The town of Petersburg was laid out in 1795 by Peter Shoenberger. On September 27, 1800, Peter sold to his brother George the Petersburg tract of land. George Shoenberger died in 1814 or 1815. His only son, Dr. Peter Shoenberger, succeeded him in the ownership of his iron enterprises. Etna furnace and forge, on the Juniata, in Catharine township, Blair county, were built in 1805 by Canan, Stewart & Moore. John Canan was an Irishman from Donegal. The furnace was the first in Blair county. Cove forge, on the Frankstown branch of the Juniata, in Blair county, two miles northeast of Williamsburg, was built between 1808 and 1810 by John Royer, who was born in Franklin county in 1779 and died at Johnstown in 1850. Allegheny furnace was built in 1811 by Allinson & Henderson, and was the second furnace in Blair county. In 1835 it was purchased by Elias Baker and Roland Diller, both of Lancaster county. The next furnace in Blair county was Springfield, built in 1815 by John Royer and his brother Daniel. Springfield furnace and Cove forge are now owned by John Royer, born in 1799, son of Daniel. The next furnace in this county was Rebecca, built in 1817. It was the first furnace erected by Dr. Peter Shoenberger, who afterwards became the most prominent ironmaster in the state. His other iron enterprises in the Juniata valley and elsewhere were numerous and extensive, and their beginning followed closely upon the building of Rebecca furnace. The Doctor was born at Manheim, Lancaster county, in 1781; died at Marietta, Lancaster county, on June 18, 1854, aged 73 years; and was buried at Laurel Hill cemetery, Philadelphia.

Elizabeth furnace, near Antestown, in Blair county, is said to have been the first in the country to use gas from the tunnel-head for the production of steam. The furnace was built in 1832, and the gas was first used in 1836. The improvement was patented about 1840 by the owner of the furnace, Martin Bell. A furnace and forge were built at Hopewell, in Bedford county, about the year 1800, by William Lane, of Lancaster county. On Yellow creek, two miles from Hopewell, Mr. Lane built Lemnos forge and slitting mill in 1806. In 1841 Loy & Patterson built Lemnos furnace, on the same creek, two miles west of Hopewell, to use charcoal. The furnace is now abandoned. Bedford forge, also on Yellow creek, was built by Swope & King in 1812. Elizabeth furnace, now Bloomfield, was built at Woodbury, in Bedford county, in 1827, by King, Swope & Co., Dr. Shoenberger being a partner. In 1845 the furnace was removed to Bloomfield, in Bedford county. In 1840 Bedford county, which then embraced Fulton county and a part of Blair county, contained nine furnaces and two forges. Hanover furnace and forge, nine miles below Mc Connellsburg, in Fulton county, known as the Hanover iron works, were regarded in their day as an extensive enterprise. The forge was built in 1822 by John Doyle, and the furnace in 1827 by John Irvine. Both were abandoned about 1850. There are now no iron enterprises in Fulton county. Cemented or blister steel was made at Caledonia, near Bedford, for several years before the beginning of this century by William McDermett, who was born near Glasgow, Scotland, and emigrated to this country at the close of the Revolutionary war. Mr. McDermett's works continued in successful operation for about ten years, when financial reverses caused their abandonment. A few years later he removed to Spruce creek, in Huntingdon county, and there ended his days about 1819. Josephine, one of his daughters, married, in 1820, David R. Porter, then a young ironmaster on Spruce creek, but afterwards governor of Pennsylvania. About 1818 David R. Porter and Edward B. Patton built Sligo forge, on Spruce creek. After Mr. McDermett's removal to Spruce creek a forge and steel works, called Claubaugh, were built on the creek by his nephew, Thomas McDermett, at which steel was made by the process that had been in use at Caledonia. These works became the property of Lloyd, Steel & Co. about 1819, by whom they were operated for a few years, when they were abandoned.

There was a very early forge in Juniata county. It was built in 1791 by Thomas Beale and William Sterrett on Licking creek, two miles west of Mifflintown. It had two hammers and was in operation about four years. The pig iron for this forge was mainly obtained from Centre furnace, but some was brought from Cornwall furnace and some from Bedford furnace. Hope furnace, a few miles from

Lewistown, and Freedom forge, three miles from the same place, were built in 1810, and were probably the first iron enterprises within the present limits of Mifflin county. General James Lewis was one of the proprietors of Hope furnace. In 1832 there were three furnaces and one forge in Mifflin county, and in 1850 there were five furnaces and two forges. The first iron enterprise in Perry county was probably a forge on Cocalamus creek, built in 1807 or 1808 by General Lewis, and operated by him in connection with Hope furnace. It was abandoned about 1817. It had two fires and two hammers, and was called Mount Vernon. Juniata furnace, three miles from Newport, was built in 1808 by David Watts, Esq., an eminent lawyer of Carlisle. In 1832 it was owned by Captain William Power. A forge called Fio was built on Sherman's creek, about four miles from Duncannon, in Perry county, in 1829, by Lindley & Speek. A forge was also built at Duncannon in the same year by Stephen Duncan and John D. Mahon. Duncannon rolling mill was built in 1838 by Fisher, Morgan & Co. Montebello furnace, at Duncannon, was built in 1834; Perry furnace, four miles from Bloomfield, in 1840; Oak Grove, four miles from Landisburg, by Dr. Adam Hayes and his brother John, in 1830; and Caroline, at Bailysburg, in 1833. All of the charcoal furnaces of Perry county have been abandoned. Many other charcoal furnaces and forges and a few rolling mills were built in the upper part of the Juniata valley before 1850. In 1832 there were in operation in Huntingdon county, which then embraced Blair county, eight furnaces, ten forges, and one rolling and slitting mill. Each of the furnaces yielded from 1,200 to 1,600 tons of iron annually. In the same year an incomplete list enumerated eight furnaces and as many forges in Centre county. In 1850 there were in Huntingdon and Centre counties and in Blair county (formed out of Huntingdon and Bedford in 1846) and in Mifflin county forty-eight furnaces, forty-two forges, and eight rolling mills, nearly all of which were in Huntingdon and Centre. Most of these charcoal furnaces and forges and rolling mills have been abandoned. Among the persons who have been prominent in the iron manufacture in the Juniata valley special reference may be made, in addition to those who have been mentioned, to Henry S. Spang, of Montgomery county, John Lyon, of Cumberland county, and Anthony Shorb, of Lebanon county Most of the iron made in the Juniata valley during the palmy days of its iron industry was sold at Pittsburgh. Before the completion of the state canal and railroads it was transported with great difficulty. Bar iron from Centre county was at first carried on the backs of horses to the Clarion river, where it was loaded on boats, upon which it was floated to Pittsburg. Pig iron from Huntingdon county was hauled to Johnstown, and thence floated to Pittsburg in the same manner as the bar iron from Centre county.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

THE MANUFACTURE OF CHARCOAL IRON IN WESTERN PENNSYLVANIA.

THE first iron manufactured west of the Allegheny mountains is said to have been made in 1790, in Fayette county, Pennsylvania, "in a smith's fire," by John Hayden, of Haydenville, in that county. Taking a sample on horseback to Philadelphia, he enlisted his relative, John Nicholson of that city, then state comptroller, in a scheme for building Fairfield furnace, on George's creek, seven miles south of Uniontown, and the two "then went on to build the furnace," which they completed in 1792. A forge was built about the same time, and probably before the furnace. In the mean time William Turnbull and Peter Marmie, of Philadelphia, built a furnace and forge on Jacob's creek, a mile or two above its entrance into the Youghiogheny river. The furnace was first blown in on November 1, 1790, and the iron was tried the same day in the forge. The furnace and forge were on the Fayette county side of the creek, and were called the Alliance iron works. The furnace was successfully operated for many years, and the stack is still standing, but in ruins. An extract from a letter written by Major Craig, deputy quartermaster general and military storekeeper at Fort Pitt, to General Knox, dated January 12, 1792, says; "As there is no six-pound shot here, I have taken the liberty to engage four hundred at Turnbull & Marmie's furnace, which is now in blast." The firm was dissolved August 22, 1793, Peter Marmie becoming sole owner of the works. John and Andrew Oliphant bought a half interest in Fairfield furnace in 1795, and in a few years they became its sole owners. Fairchance furnace, on George's creek, six miles south of Uniontown, was built in 1794 by John Hayden, William Squire, and Thomas Wynn. J. & A. Oliphant bought it about 1805. It was rebuilt two or three times, and kept in operation until 1873. A forge was built near the furnace about 1794. The Oliphants built Sylvan forges, on George's creek, below Fairfield and Fairchance furnaces, to convert their pig-iron product into bar iron. Union furnace, now Dunbar furnace, was built by Colonel Isaac Meason on Dunbar creek, four miles south of Connellsville, in 1791, and was put in blast in March, 1791. A forge was connected with this furnace. It was succeeded in 1793 by a larger furnace of the same name, built near the same site by Colonel Meason, John Gibson, and Moses Dillon. Another of Colonel Meason's enterprises was Mount Vernon furnace, on Mountz's creek, eight miles east of its mouth, built before July, 1800. In 1801 it was rebuilt. It is still standing but abandoned. In 1805 there were five furnaces and six forges in Fayette county. In 1811 there were ten blast furnaces, one air furnace, eight forges, three rolling and slitting mills, one steel furnace, and five trip-hammers. At a subsequent date there were twenty furnaces in this county. Fayette county was a great iron centre at the close of the last and far into the present century. For many years Pittsburg and the Ohio and Mississippi valleys were almost entirely supplied by it with castings of all kinds, and with pig and bar iron. Long before 1850, however, the fires in most of its furnaces and forges were suffered to die out. In 1849 only four of its furnaces were in blast. Other furnaces, to use coke, have since been built within its boundaries, but its fame as a centre of iron production has departed. In its stead it now enjoys the reputation of being the centre of production of the far-famed Connellsville coke. The steel furnace above referred to was at Bridgeport, adjoining Brownsville, was owned by Morris Truman & Co., and made good steel. In that year Truman & Co. advertised that they had for sale "several tons of steel of their own converting, which they will sell at the factory for cash, at 12 dollars per cwt., and 20 dollars per faggot for Crowley." The first nail factory west of the Alleghenies was built at Brownsville, before 1800, by Jacob Bowman, at which wrought nails, made by hand, were produced in large quantities. The rolling and slitting mills which were in existence in Pennsylvania prior to 1816 neither puddled pig iron nor rolled bar iron, but rolled only sheet iron and nail plates with plain rolls from blooms heated in a hollow fire and hammered under a tilt-hammer. Cramer's *Pittsburg Almanac* for 1812 says that in 1811 there were three such mills in Fayette county.

The first rolling mill erected in the United States to puddle iron and roll iron bars was built by Colonel Isaac Meason in 1816 and 1817, on the Redstone creek, about midway between Connellsville and Brownsville, at a place called Plumsock, in Fayette county. Colonel Meason had previously erected forges at Plumsock. Thomas C. Lewis was the chief engineer in the erection of the mill, and George Lewis, his brother, was the turner and roller. They were Welshmen. The project was conceived by Thomas C. Lewis, and by him presented to Colonel Meason. F. H. Oliphant told us in his lifetime that it was built "for making bars of all sizes and hoops for cutting into nails." He said further that "the iron was refined by blast, and then puddled." Samuel C. Lewis, the son of Thomas C. Lewis, assisted as a boy in rolling the first bar of iron. He is still living at Pittsburg, at the age of 80 years. Mr. Lewis informs us that his father and uncle, being skilled workmen, and therefore prohibited by an English statute from leaving their native land, were compelled to resort to artifice to secure their passage across the Atlantic. The mill contained two puddling furnaces, one refinery, one heating furnace, and one tilt-hammer. Raw coal was used in the puddling and heating furnaces, and coke in the refinery. The rolls were cast at Dunbar furnace, and the lathe for turning the rolls was put up at the mill. The mill went into operation on September 15, 1817, and was kept in operation until 1824, the latter part of the time by a Mr. Palmer. A flood in the Redstone caused the partial destruction of the mill, the machinery of which was subsequently taken to Brownsville. Colonel Meason, who did so much to develop the iron resources of Fayette county, was a native of Virginia. His wife was a Miss Harrison of that state. He died in 1819. A furnace named Mary Ann was erected in Greene county at a very early day, about twenty miles from Uniontown, and on the opposite side of Ten-mile creek from Clarksville. It was abandoned long before 1820. An advertisement for its sale, by "Samuel Harper, agent for the proprietors," dated July 23, 1810, called it "The Iron Works," late the property of Captain James Robinson. It was probably built about 1800. Gordon, in his *Gazetteer*, (1832), says that " there were formerly in operation on Ten-mile creek a forge and furnace, but they have been long idle and are falling to decay." This reference is to Robinson's works. Greene county has probably never had any other iron enterprises within its limits.

The beginning of the iron industry at Pittsburg was made at a comparatively modern period. George Anshutz, the pioneer in the manufacture of iron at Pittsburg, was an Alsacian by birth, Alsace at the time being under the control of France. He was born November 28, 1753. In 1789 he emigrated to the United States, and soon afterwards located at a suburb of Pittsburg now known as Shady Side, where he built a small furnace on Two-mile run, probably completing it in 1792. In 1794 it was abandoned for want of ore. It had been expected that ore could be obtained in the vicinity, but the expectation was not realized, and the expense entailed in bringing ore from other localities was too great. In 1794 the fire of the furnace lighted up the camp of the participants in the whisky insurrection. The enterprise seems to have been largely devoted to the casting of stoves and grates. The ruins of the furnace were visible until about 1850. After the abandonment of his furnace Anshutz accepted the management of John Probst's Westmoreland furnace, near Laughlinstown, and remained there about one year, whence he removed to Huntingdon county, where, in connection with Judge John Gloninger and Mordecai Massey, he built Huntingdon furnace in 1796. He died at Pittsburg, February 28, 1837, aged 83 years. In 1807 there were three nail factories in existence at Pittsburg — Porter's, Sturgeon's, and Stewart's, according to Cramer's *Pittsburg Almanac*, one of which made 100 tons of cut and wrought nails annually. In 1810 about 200 tons of cut and wrought nails were made at Pittsburg. In 1813 there were two iron foundries at Pittsburg—McClurg's and Anthony Beelen's, and one steel furnace, owned by Tuper & McKowan.

The first rolling mill at Pittsburg was built in 1811 and 1812 by Christopher Cowan, an Englishman. It was called the Pittsburg rolling mill. This mill had no puddling furnaces, nor was it built to roll bar iron. It was built to manufacture sheet iron, nail and spike rods, shovels, spades, etc. Cramer's *Pittsburg Almanac* for 1812 says of this enterprise: "Christopher Cowan is erecting a powerful steam-engine, 70-horse power, to run a rolling mill, slitting mill, and tilt-hammer; to make iron, nails, sheet iron, spike and nail rods, shovels and tongs, spades, scythes, sickles, hoes, axes, frying pans, cutting knives, chains, plough irons, hatchets, claw hammers, chizzels, augurs, spinning-wheel irons, and smiths' vises—capital $100,000." This rolling mill stood at the intersection of Penn street and Cecil's alley, where the fourth ward school-house now stands. In 1818 it was owned by Ruggles, Stackpole & Whiting, who failed in 1819. In 1826 it was owned by R. Bowen. The second rolling mill at Pittsburg was the Union on the Monongahela river, built in 1819, and accidentally blown up and permanently dismantled in 1829, the machinery being taken to Covington, Kentucky. This mill had four puddling furnnces—the first in Pittsburg. It was also the first mill in Pittsburg to roll bar iron. It was built by Baldwin, Robinson, McNickle & Beltzhoover. It is claimed that the first angle iron in the United States was rolled at this mill by Samuel Lenard, one of its proprietors, who also rolled ell iron for saltpans. On Pine creek, on the site of the present works of Spang, Chalfant & Co., at Etna, Belknap, Bean & Butler manufactured scythes and sickles as early as 1820, but in 1824 their works were enlarged and steam-power introduced for the purpose of rolling blooms. In 1826 they were operated by M. B. Belknap. They afterwards passed into the hands of Cuddy & Ledie, and were purchased by H. S. Spang in 1828, to roll bar iron from Juniata blooms. Sligo rolling mill was erected where it now stands by Robert T Stewart and John Lyon in 1825, but was partly burned down that year. The Juniata iron works were built in 1824 by Dr. Peter Shoenberger. Grant's Hill works were erected in 1821 by William B. Hayes and David Adams. They stood near where the court-house now stands. Water for the generation of steam had to be hauled from the Monongahela river. The Dowlais works, in Kensington, were built in 1825 by George Lewis and Reuben Leonard. In 1826 all of these mills did not make bar iron ; some only manipulated rolled and hammered iron.

In 1829 Pittsburg had eight rolling mills, using 6,000 tons of blooms, chiefly from the Juniata valley, and 1,500 tons of pig iron. In the same year there were nine foundries which consumed 3,500 tons of iron. In 1828 the iron rolled was 3,291 tons; in 1829 it was 6,217 tons; and in 1830 it was 9,282 tons. In 1831 there were two steel furnaces at Pittsburg. Cast iron began to be used in this year for pillars, the caps and sills of windows, etc. In 1856 there were nine rolling mills in operation, and eighteen foundries, engine-factories, and machine-shops. In 1836 there were in Pittsburg and Allegheny county twenty-five rolling mills.

Clinton furnace, built in 1859 by Graff, Bennett & Co., and blown in on the last Monday of October in that year, was the first furnace built in Allegheny county after the abandonment in 1794 of George Anshutz's furnace at Shady Side—a surprisingly long interregnum. Westmoreland county speedily followed Fayette county in the manufacture of iron. Westmoreland furnace, near Laughlinstown, in Ligonier valley, or Four-mile run, was built about 1792 by John Probst, who also built a small forge about the same time. Neither the furnace nor the forge was long in operation, both probably ceasing to make iron about 1810. On the 1st of August, 1795, George Anshutz, manager of Westmoreland furnace, advertised stoves and castings for sale. General Arthur St. Clair built Hermitage furnace, on Mill creek, two miles northeast of Ligonier, abont 1802. It was managed for its owner by James Hamilton, and made stoves and other castings. It was in blast in 1806. In 1810 it passed out of the hands of General St. Clair, and was idle for some time. In 1816 it was started again by O'Hara & Scully, under the management of John Henry Hopkins, afterwards Protestant Episcopal bishop of Vermont. In October, 1817, Mr. Hopkins left the furnace, himself a bankrupt, and it has never since been in operation. The stack is still standing. General St. Clair died a very poor man in 1818, aged 84 years, and was buried at Greensburg. Mount Hope furnace was built about 1810, in Donegal township, by Trevor & McClurg. Mount Pleasant furnace, on Jacob's creek, in Mount Pleasant township, was built about 1810 by Mr. McClurg, and went out of blast in 1820 while under the control of Mr. Freeman. Washington furnace, near Laughlinstown, was built about 1809 by Johnston, McClurg & Co. It was abandoned in 1826, and rebuilt in 1848 by John Bell & Co. It was in blast as late as 1854. Jonathan Maybury & Co. owned Fountain furnace before 1812. It stood on Camp run, in Donegal township, at the base of Laurel hill. The firm was dissolved on August 19, 1812. Kingston forge, erected in 1811 on Loyalhanna creek, ten miles east of Greensburg, by A. Johnston & Co., went into operation early in 1812. Ross furnace, on Tub-mill creek, in Fairfield township, was built in 1814 by Colonel Meason, and abandoned about 1850. It made pig iron, stoves, sugar-kettles, pots, ovens, skillets, etc. Hannah furnace, in Fairfield township, was built about 1810, a short distance below Ross furnace, on Tub-mill creek, by John Beninger. He also built a small forge on the same stream, where the borough of Bolivar now stands. Both the furnace and forge ceased to make iron soon after they were built. Baldwin furnace, on Laurel run, near Ross furnace, is said to have been built by James Stewart about 1810. It ran but a short time. In 1831 there were in operation in Westmoreland county one furnace, Ross, operated by Colonel Mathiot, and one forge, Kingston, on Loyalhanna creek, operated by Alexander Johnston. The latter named gentleman, whose name appears above in connection with another iron enterprise, was the father of Governor William F. Johnston. He was born in Ireland July, 1772, and died July 15, 1872, aged 100 years. Seven other charcoal furnaces in Westmoreland county were built between 1844 and 1855. All of the charcoal furnaces of Westmoreland county have been abandoned. The early Westmoreland furnaces shipped pig iron and castings by boats or arks on the Conemaugh and Allegheny rivers to Pittsburg, much of which found its way down the Ohio river to Cincinnati and Louisville. Shade furnace was built in 1807 or 1808, on Shade creek, Somerset county, and was the first iron enterprise in the county. It was built by Gerehart & Reynolds upon land leased from Thomas Vickroy. In November, 1813, Vickroy advertised the furnace for sale, at a great bargain. A sale was effected in 1819 to Mark Richards, Anthony S. Earl, and Benjamin Johns, of New Jersey, constituting the firm of Richards, Earl & Co., who operated the furnace down to about 1830. In 1820 they built a forge called Shade, below the furnace, which was carried on by William Earl for four or five years, and afterwards by John Hammer and others. The furnace was continued, at intervals, by various proprietors to the close of 1858. About 1811 Joseph Vickroy and Conrad Piper built Mary Ann forge, on Stony creek, about five miles below Shade furnace, and a half a mile below the mouth of Shade creek. David Livingston was subsequently the owner of the forge, and operated it for several years. Richard Geary, the father of Gov. John W. Geary, was the millwright who built the forge for the owners. Pig iron was sometimes packed on horseback to this forge from Bedford county, the horses taking salt from the Conemaugh salt works, and bar iron as a return load. In the year 1809 or 1810 Peter Kimmell and Matthias Scott built a forge for the manufacture of bar iron on Laurel Hill creek, now in Jefferson township, in the western part of Somerset county. It ceased operations about 1815. Supplies of metal were obtained from Bedford and Fayette counties. About the year 1810 Robert Philson erected a forge and furnace on Casselman's river, in Turkeyfoot township, to use ore mined in the immediate vicinity. The enterprise was a failure. Four other charcoal furnaces were afterwards built in Somerset county. All of the furnaces and forges in this county have long been abandoned.

The first iron enterprise in Cambria county was a forge at Johnstown, built on Stony creek, about 1809, by John Buckwalter, and subsequently removed to the Conemaugh river, also at Johnstown, where it was operated with more or less regularity down to about 1835. It was used to hammer bars out of Juniata pig iron. In 1817 Thomas Burrell, the proprietor, offered wood-cutters "fifty cents per cord for chopping two thousand cords of wood at Cambria forge, Johnstown." About 200 pounds of nails, valued at $30, were made at Johnstown by one establishment in the census year 1810. About this time an enterprise was established at Johnstown by Robert Pierson, by which nails were cut with a machine worked by a treadle, but without heads, which were afterwards added by hand. Cambria county has been noted as an iron center since its first furnace, Cambria, was built by George S. King, David Stewart, John K. Shryock. and William L. Shryock in 1841, on Laurel run. It was followed in the next six years by five other charcoal furnaces. All of these furnaces have been abandoned. The Cambria iron works, at Johnstown, were commenced in 1853 by a company of which Mr. King was the originator and of which Dr. Peter Shoenberger was a member.

The first iron enterprise in Indiana county was Indiana forge, on Finley's run, near the Conemaugh, built about 1837 by Henry and John Noble, who also built a small furnace as early as 1840. The forge was operated by water-power, but the furnace by steam-power. The furnace and forge were both running in the last-named year. Pig iron for the forge was at first obtained from Allegheny furnace, in Blair county. Iron ore for the furnace was obtained from the Allegheny furnace mines. Becoming embarrassed, the firm was succeeded about 1843 by William D. and Thomas McKernan. About 1846 the property passed into the hands of Elias Baker, who built a new furnace and forge. John Noble owned about 1837 a farm of about 200 acres in the heart of the present city of Altoona, which he sold to David Robinson, of Pleasant valley, for $4,500, taking in payment the contents of Mr. Robinson's country store, which he removed to Finley's run and added to the capital stock of the firm of Henry and John Noble. The Altoona farm is now worth many millions of dollars. Three other charcoal furnaces in Indiana county were built in 1846 and 1847. All of the Indiana furnaces and its solitary forge have long been abandoned.

A blast furnace was built at Beaver Falls, on the west side of Beaver river, in Beaver county, in 1802, by Hoopes, Townsend & Co., and was blown in in 1804. A forge was connected with it from the beginning, and was in operation in 1806. The furnace and forge were in operation in 1816. The whole enterprise was abandoned about 1826. The ore used was picked out of gravel banks in the neighborhood in very small lumps. There was another early furnace in this county, named Bassenheim, built in 1814 by Detmar Basse Muller, on Connoquenessing creek, about a mile west of the Butler county line. In February, 1818, $12 per ton was paid for hauling the pig metal made at this furnace to Pittsburg, thirty miles distant over a bad road. The furnace was abandoned at an early day. John Henry Hopkins previously mentioned in connection with General St. Clair's furnace near Ligonier, was engaged about 1815 as a clerk at Bassenheim furnace. Prior to 1846 there were only a few furnaces in the Shenango valley—all charcoal, one of the oldest of which was Springfield furnace, half a mile from Leesburg and seven miles southeast of Mercer, built in 1837 and active in 1849. Day, in 1843, says: "Two furnaces were wrought formerly, but have since been abandoned." The geographer, Joseph Scott, says in 1806 that "a forge and furnace are now nearly erected" at New Castle. About 1810 there was a forge on Neshannock creek, "midway between Pearson's flour mill and Harvey's paper mill," for the manufacture of bar iron from the ore. The first rolling mill in Lawrence county was built in 1839 at New Castle by James D. White, of that place, under the superintendence of S. Wilder, a native of Massachusetts. It made bar iron and cut nails, and was subsequently known as Cosalo rolling mill. Orizaba rolling mill, at the same place, was built in 1845 by Joseph H. Brown, Joseph Higgs, and Edward Thomas, who had been employed at the Cosalo mill. In 1846 and soon afterwards several furnaces were built in this valley to use its splint coal in the raw state. The first furnace in the once important but now nearly neglected ironmaking district composed of Armstrong, Butler, Clarion, Venango, and other northwestern counties, was doubtless Bear Creek, in Armstrong county, commenced in 1818 by Ruggles, Stackpole & Whiting, who then owned the Pittsburg rolling mill. In the following year, owing to the failure of this firm, it passed uncompleted into the hands of Baldwin, Robinson, McNickle & Beltzhoover, of Pittsburg. The furnace went into operation in 1819. It was abandoned long before 1850, but was running in 1832, in which year Gordon says it was owned by Henry Baldwin, Esq., and was reputed to be the largest furnace in the United States, having made forty tons of iron in a week. This furnace had a tram-road with wooden rails, in 1818. Rock furnace, on Roaring run, a tributary of the Kiskiminetas, four miles east of Apollo, in Armstrong county, was built about 1825 by James W. Biddle, of Pittsburg, and others. It has been abandoned since 1855. Slippery Rock furnace, in Butler county, and Clarion furnace, in Clarion county, were built in 1828—the latter by Hon. Christian Myers, a native of Lancaster county, who built another furnace about 1844, which he called Polk. Judge Myers was the pioneer in the manufacture of iron in Clarion county, and was a man of great enterprise. Allegheny furnace, at Kittanning, in Armstrong county, and Venango furnace, on Oil creek, in Venango county, were built in 1830. In 1832 the former was owned by A. McNickle, and made about fourteen tons of iron weekly. From 1830 to 1850 this section of the state produced large quantities of charcoal pig iron. In 1850 there were 11 furnaces standing in Armstrong county, 6 in Butler, 28 in Clarion, and 18 in Venango—63 in all. In 1858 there were 18 in Armstrong, 6 in Butler, 27 in Clarion, and 24 in Venango—75 in all. All of these were charcoal furnaces, except four coke furnaces at Brady's Bend. Many of these furnaces had, however, been abandoned at the latter date. Nearly every one has since then been abandoned. The Great Western iron works at Brady's Bend, embracing a rolling mill, and four furnaces to use coke, were commenced by Philander Raymond in 1840. They have been abandoned for many years. The rolling mill was built in 1841 to roll bar iron, but it afterwards rolled iron rails. The iron manufactured in the Allegheny valley was taken down the Allegheny river to Pittsburg on keel-boats and arks, the business of transporting it being quite extensive. Erie charcoal furnace, at Erie, was built in 1842, and abandoned in 1849. It used bog ore. It was owned by Charles M. Reed. Liberty furnace on the north side of French creek, in Crawford county, was built in 1842 by Lowry & Co., of Meadville, and abandoned in 1849. In 1791 there were 16 furnaces and 37 forges in Pennsylvania. In 1816 there were 44 furnaces, 78 forges, and 175 naileries. In 1849 there were 298 furnaces, 121 forges, 6 bloomaries, and 79 rolling mills. Of the furnaces existing in 1849 nearly all were charcoal furnaces, only 57 being anthracite and 11 bituminous coal and coke furnaces. The charcoal iron industry of Pennsylvania still exists in a healthy condition, but its glory has departed. About 1840 a revolution was created in the iron industry of the country, by the introduction of bituminous and anthracite coal in the blast furnace, and since about 1850 the manufacture of charcoal iron in Pennsylvania has declined. Since about the middle of the last century Pennsylvania, whose early iron history has unavoidably occupied so much of our space, has been the foremost ironmaking state in the Union.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

EARLY IRON ENTERPRISES IN DELAWARE AND MARYLAND.

IN the *Colonial Records of Pennsylvania*, volume 1, page 115, mention is made of one James Bowle, "living near iron hill, about eight miles distance from New Castle," in Delaware, in 1684. In Oldmixon's *British Empire in America*, edition of 1708, in referring to New Castle county, then in Pennsylvania, but now in Delaware, it is stated that there is a place in the county "called iron hill, from the iron ore found there," but the existence of an "iron mill," to use the ore, is expressly denied. This "iron hill" is undoubtedly the one referred to in the *Colonial Records* as having been discovered as early as 1684. Mrs. James says that on the 24th of September, 1717, Sir William Keith, governor of Pennsylvania, "wrote to the Board of Trade in London that he had found great plenty of iron ore in Pennsylvania," and Bishop says that "Sir William Keith had iron works in New Castle county, Delaware, erected previous to 1730, and probably during his administration from 1717 to 1726." This enterprise consisted of a furnace and forge, which were located on Christiana creek, and are said to have had a short life. Iron was, however, made in Bloomaries on the Christiana and its branches after 1730, and there is a tradition that a furnace was in existence at the foot of "iron hill" after this date. In the gable of an old Baptist church near "iron hill" is a cast-iron plate dated 1746, which is said to have been cast at this furnace. Among the bloomaries was one on White Clay creek, in New Castle county, owned by John Hall. In the edition of Oldmixon for 1741 the author says that "between Brandywine and Christiana is an iron mill." These references point out with all the exactness that is now possible the character and location and date of erection of the first iron enterprises in the state of Delaware. Bishop says that in Sussex county, at the southern extremity of Delaware, "where bog ore in the shape of a very pure hydrate, yielding from 55 to 66 per cent. of iron, exists in large beds in the vicinity of Georgetown, and on the branches of the Nanticoke and Indian rivers, the manufacture of iron and castings was carried on before the Revolution to a considerable extent. The compact hydrated peroxide of some of these beds has, since the early part of this century, been raised in quantities for exportation, and the local production of iron is consequently less than it might have been." Tench Coxe, in his report on *The Arts and Manufactures of the United States* in 1810, mentions five forges in Sussex county, which produced in that year 215 tons of iron, but he makes no reference to a blast furnace in the whole state. Bog ore from near Milton, in Sussex county, was at one time taken to Millville, New Jersey, to be smelted in a furnace at that place which was built in 1815. The shipment of this ore ceased about 1853. About 1820, as we are informed by Judge Caleb S. Layton, of Georgetown, in Sussex county, a blast furnace was established at Millsborough, on the Indian river, about eight miles south of Georgetown, by Colonel William D. Waples and others, In connection with this furnace was a foundry. An interest in the furnace was purchased in 1822 by Hon. Samuel G. Wright, of New Jersey, and in 1830 his son, Colonel Gardiner H. Wright, obtained an interest, and afterwards operated the furnace until 1836, when it went out of blast finally. The foundry continued in operation until 1879. In 1859 Lesley stated that "Millsborough charcoal furnace, owned by Gardiner H. Wright, of Millsborough, Sussex county, Delaware, is the only furnace in the state, and has not made iron for ten years. A cupola furnace is in activity beside it." Francis Vincent, of Wilmington, informs us that the castings for the eastern penitentiary of Pennsylvania, and for Moyamensing prison, and the iron railing which once surrounded Independence Square, in Philadelphia, were cast at Millsborough furnace—presumably at the "cupola furnace." He also informs us that ten or twelve years before the Revolution an English company, under the leadership of Colonel Joseph Vaughan, built a furnace near Concord, in Sussex county. The company had a stone wharf at the head of Nanticoke river, and shipped its iron direct to England. The iron was named "Old Meadow." "The stone wharf is there yet," says Mr. Vincent. Colonel Vaughan commanded one of the Delaware regiments during the Revolution. In 1828 and in the two subsequent years Millsborough furnace and foundry produced 450 tons of pig iron and 350 tons of castings.

A rolling and slitting mill near Wilmington, in Delaware, existing and in operation in 1787 or 1788, has already been referred to in the chapter relating to New York. This mill then rolled and slit Swedish and Russian iron for the use of a New York cut-nail factory. In 1810 there were three rolling and slitting nails in New Castle county. Lesley stated in 1859 that the Delaware iron works, located five miles northwest of Wilmington, owned by Alan Wood, of Philadelphia, and built in 1812, "began to manufacture sheet iron thirty years ago in what had been a nail-plate works. At that time only Townsend in New Jersey made sheet iron." Marshall's rolling mill, on the Red Clay creek, two miles west of Newport, was built in 1836. The Wilmington rolling mill, near Wilmington, was built in 1846. The Diamond State rolling mill, at Wilmington, was built in 1854. These were the only rolling mills existing in Delaware in 1859. Others have since been built. The business of iron shipbuilding has been added to the iron industries of Delaware within the last few years. The iron hill to which reference has been made is situated about twelve miles from Wilmington, and near the Pennsylvania line. Ore taken from this place has been used at Principio furnace, in Cecil county, Maryland, since 1847. This ore has also been used in some of the furnaces of Pennsylvania. Previous to 1847 the mines had been worked but little. Between 1832 and 1847 some ore was mined here and taken to a furnace in New Jersey.

Maryland.—In his *Report on the Manufacture of Iron*, addressed to the governor of Maryland in 1840, Alexander gives 1715 as "the epoch of furnaces in Maryland, Virginia, and Pennsylvania." We have seen that this statement is true of Pennsylvania, and there is no reason to believe that it is not substantially true of Maryland. Scrivenor says that in 1718 Maryland and Virginia exported to England three tons and seven cwt. of bar iron, upon which the mother country collected a duty of £6 19*s.* 1*d.* This indicates that iron was made in both of these colonies before that year. In 1719 the general asembly of Maryland passed an act "authorizing 100 acres of land to be laid off to any who would set up furnaces and forges in the province." Other inducements were offered in 1721 and subsequently to those who would engage in the manufacture of iron. The preamble to the act of the general assembly of 1719 recites that "there are very great conveniences of carrying on iron works within this province, which have not hitherto been embraced for want of proper encouragement to some *first undertakers*," which clearly implies that iron enterprises had already been undertaken in Maryland but were not in operation. Who these "first undertakers" were will presently appear. As a result of the encouragement given by the general assembly official reports show that in 1749 and again in 1756 there were eight furnaces and nine forges in Maryland, and that on the 21st of December, 1761, there were eight furnaces, making about 2,500 tons of pig iron annually, and ten forges, capable of making about 600 tons of bar iron annually. During the colonial period Maryland had no manufacturing industry worthy of the name except that of iron. Tobacco-growing and wheat-growing formed the principal employment of the people.

The first iron works in Maryland were erected in the northeastern part of the state, in Cecil county. A forge at North East, at the head of the North East river erected previous to 1716, is supposed to have been the pioneer iron enterprise. That iron works were built at North East previous to 1716 is proved by a deed, dated in that year, in which Robert Dutton conveyed a flour mill near the "bottom of the main falls of North East," together with fifty acres of land, to Richard Bennett for £100 in silver money. In this deed "iron works" are mentioned as among the appurtenances which were conveyed by it. They were probably not then active. In 1722 the iron works at North East appear to have been owned by Stephen Onion and Thomas and William Russell. These works embrace only a forge, which was at first probably used only to make iron direct from the ore. At or about the time when the forge at North East was built a furnace was built by the Principio Company at Principio, on Principio creek, which empties into the Chesapeake near the mouth of the Susquehanna, about six miles from North East, in Cecil county. A forge was afterwards erected at Principio. Stephen Onion, Joshua Gee, Joseph Farmer, William Russell, and John Ruston were the original members of the company. The North East and Principio companies appear to have been united about 1722. Stephen Onion and Thomas Russell were the leading spirits in both companies. Henry Whiteley has published an exceedingly full and valuable history of the Principio Company, from which we compile the following interesting details. The most prominent members of the Principio Company, which existed for about sixty years, were Sir Nicholas Hackett Carew, Bart., of Beddington, Surrey; Thomas Russell, of Birmingham, and his sons, Thomas and William Russell; Stephen Onion; John England; Joshua, Samuel, and Osgood Gee; William Chetwynd, Esq.,—all of England; and Augustine and Lawrence Washington, of Virginia, father and brother of George Washington. In 1724 Stephen Onion and Thomas Russell left their works in charge of John England, a practical ironmaster, and sailed from New Castle for Great Britain, in the same ship with Benjamin Franklin, who says in his autobiography that they were "masters of an iron work in Maryland" and had engaged "the great cabin." Onion soon returned, and in 1726 was in active superintendence at Principio; but Russell remained in England. Ore for the furnace was at first obtained in the immediate neighborhood, but as early as September 4, 1724, it was obtained from Gorsuch's point, below Canton, on the eastern shore of the Patapsco, about opposite to Fort McHenry. In 1727 the Principio Company, through John England, purchased all the iron ore, "opened and discovered, or shut and not yet discovered," on Whetestone point, at the extremity of which Fort McHenry now stands, for £300 sterling and £20 current money of Maryland. This was for many years one of its principal sources of ore supply.

The company did not confine its operations to Principio and North East. It was early in treaty with Captain Augustine Washington for land in Virginia, at Accokeek, on which to erect a furnace. In February, 1725, the furnace was ready for work, and John Barker, the founder at Principo, was sent there to start it. After Accokeek, Kingsbury furnace was the company's next venture. It was situated on Herring run, at the head of Back river, in Baltimore county. It was built in 1744 and went into blast in April, 1745, producing at the first blast, which lasted till December 18th of the same year, 480 tons of pig iron. The first four blasts embraced the period extending from April, 1, 1745, to December 26, 1751, and produced 3,853 tons, or an average of 75 tons per working month. More than 3,300 tons of the iron were shipped to the company in England. In 1751 Lancashire furnace was purchased from Dr. Charles Carroll, of Annapolis. It was located near Kingsbury, on the west side of a branch of Back river, a few miles northeast of Baltimore. The deed embraced 8,200 acres of land, and was "signed" on behalf of the company by Lawrence Washington. Lancashire furnace was operated by the company from the time of its purchase until the Revolution. It was its last acquisition of property in America. At the time of its purchase the company outranked all competitors, being the sole proprietor of four furnaces and two forges, viz: Principio furnace, Cecil county, Maryland, built about 1715; Principio forge at the same place; North East forge, Cecil county, Maryland, built about 1715; Accokeek furnace, Virginia, built in 1725; Kingsbury furnace, Baltimore county, Maryland, built in 1744; Lancashire furnace, Baltimore county, Maryland, purchased in 1751. It owned slaves and live stock in abundance, and its landed estates were of great extent, amounting to nearly thirty thousand acres exclusive of the Accokeek lands in Virginia. One-half of the pig iron exported to Great Britain from this country is said by Mr. Whitely to have come from its works.

After 1776 the company had no actual control over any of its American property. Thomas Russell, who had been the company's general manager, continued to operate the furnaces and forges, and supplied bar iron and cannon balls in large quantities to the Continental army. In the Lancashire furnace ledger is an "account of shott made at Lancashire furnace in the year 1776." In 1780 the general assembly of Maryland passed an act to seize and confiscate all British property within the state, and this was the end of the Principio Company, after an existence of more than sixty years. All the possessions of the company, with two exceptions, passed under the auctioneer's hammer and into new hands. The works at North East were retained by Thomas Russell, one of the company and a son of the first Thomas Russell, who had cast his fortunes with the patriotic cause. The Accokeek lands are supposed to have fallen to "a certain Mr. Washington," who owned a one-twelfth interest in the possessions of the company, and was also a patriot."

In 1744 William Black, secretary of the commissioners appointed by Governor Gooch, of Virginia, to unite with those from Pennsylvania and Maryland to treat with the Iroquois, or Six Nations of Indians, in reference to the lands west of the Alleghenies, wrote in his journal, on May 25th, while at North East in Maryland: "I must not forget that in the forenoone the Com'rs and their company went to the Principio iron works, in order to view the curiosities of that place. They are under the management of Mr. Baxter, a Virginian, and was at work forming barr-iron when we came there. For my part I was no judge of the workmanship, but I thought everything appeared to be in very good order, and they are allowed to be as compleat works as any on the continent by those who are judges." This visit was made to North East forge, which being owned by the Principio Company, formed a part of the "Principio iron works." Iron works have been almost continuously in operation at Principio and North East since their first establishment, or about one hundred and sixty years. At Principio George P. Whittaker and his associates have had a charcoal furnace in operation since 1837, and at North East, on the very site of the old forge, are the present extensive iron works of the McCullough Iron Company. Pig iron from Virginia furnaces was taken to the forge at North East, and perhaps to Principio forge, to be refined into bar iron. About thirty years ago a whole pig of iron was found near the site of the first Principio furnace, which was plainly stamped "Principio, 1727." A few years ago two or three pigs of iron, marked "Principio 1751," were discovered in the bed of the Patapsco river. All of these relics have been preserved. A furnace at the mouth of Gwynn's falls, and a forge at Jones's falls, called Mount Royal, were built by the Baltimore Company soon after 1723 and before 1730 Messrs. Carroll, Tasker, and others forming the company. Stephen Onion severed his connection with the Principio Company and built a furnace and two forges of his own at the head of Gunpowder river, about a mile from Joppa, then one of the principal towns of Maryland, but now wholly deserted. These works were advertised for sale in 1769, after Stephen Onion's death. The exact date of the erection of these extensive works has not been preserved.

Bush furnace, in Harford county, and Northampton furnace, in Baltimore county, were built about 1760—the latter by members of the Ridgely family. The proprietors of this furnace owned a forge on the Great Gunpowder river, called Long Cam forge, which was probably older than the furnace. Bush furnace, located on Bush creek, was owned about 1767 by John Lee Webster. On the Patapsco, near Elkridge Landing, were Elkridge furnace and forge, owned by Edward Dorsey; at a locality not now known was York furnace; in Anne Arundel county were the Patuxent furnace and forge, owned by Thomas, Richard, and Edward Snowden. There was once a furnace on Stemmer's run, about seven miles from Baltimore. There was also a furnace on Curtis creek, in Patapsco county, built by William Goodwin and Edward Dorsey, which remained in operation until 1851. Nottingham furnace, in Baltimore, was built before the Revolution. In 1762 Robert Evans, Jonathan Morris, and Benjamin Jacobs built Unicorn forge at a place called Nasby, in Queen Ann County. The castings for the forge were procured at "Bush river furnace," which appears to have been then operated by Isaac Webster. The firm of Evans, Morris & Jacobs was not long in existence In Frederick county were several early iron enterprises, particulars of which have been preserved by Alexander. Old Hampton furnace, on Tom's creek, about two miles west of Emmetsburg, was built between 1760 and 1765 by persons whose names have not survived. Legh furnace was built about the same time by an Englishman named Legh Master, at the head of Little Pipe creek, two or three miles southwest of Westminster. Both of these furnaces were soon abandoned. Catoctin furnace, situated about twelve miles northwest of Frederick, was built in 1774 by James Johnson & Co. It was rebuilt in 1787 by the same company, "about three-fourths of a mile further up Little Hunting creek, and nearer the ore banks." It was again rebuilt about 1831. We may add that in 1856 a new furnace was built at the same place, called Catoctin No. 2, and in 1874 another furnace was added, called Catoctin No. 3. All of the Catoctin furnaces were in operation in 1880, and all used charcoal, although No. 3 usually uses anthracite and coke. The yield of the first Catoctin furnace was from twelve to eighteen tons of pig iron weekly. Shortly after the erection of the first Catoctin furnace the same owners erected on Bush creek, about two miles above its mouth, the Bush creek forge. The forge was in operation until 1810, when it was abandoned. About the time when Catoctin furnace and Bush creek forge were built, the Johnsons built a rolling and slitting mill at a spot known in 1840 as Reel's mill. About 1787 they built Johnson furnace on a small stream one mile above the mouth of the Monocacy. In 1793 the various iron properties belonging to the Johnsons were divided, and Johnson furnace fell to Roger Johnson, who soon afterwards built a forge in connection with the furnace. It was situated on Big Bennett's creek, about five miles above its junction with the Monocacy, and was called Bloomsburg forge. Its weekly product was between four and five tons of finished iron. The furnace and forge were abandoned soon after 1800. Fielderea furnace, on the Harper's Ferry road, three miles south of Frederick, was built by Fielder Gantt shortly after the Revolution, but after making the one blast it was abandoned. This event occurred before 1791.

In Washington county there were many iron enterprises at an early day, most of which have been noted by Alexander. In 1770 James Johnson superintended the erection of Green Spring furnace, on Green Spring run, one mile above its entrance into the Potomac. It was owned by a Mr. Jacques and Governor Johnson. The neighboring iron ore not being of good quality, the furnace was abandoned in a few years. James Johnson also built Licking creek forge, near the mouth of Licking creek, for the same firm. It was at first supplied with pig iron from Green Spring furnace, but was afterwards sold to "Mr. Chambers, of Chambersburg, who carried it on for several years with pig supplied from his furnace in Pennsylvania." Mount Etna furnace, on a branch of Antietam creek, five or six miles north of Hagerstown, was built by Samnel and Daniel Hughes about 1770, and was in successful operation for many years. During the Revolution it cast the first Maryland cannon. About a mile and a half from the furnace, and about four miles from Hagerstown, the same owners built Antietam forge, which was in operation after the furnace was abandoned. Bishop states that General Thomas Johnson and his brother were the owners in May, 1777, of a furnace at Frederick, but it was not then in blast. Between 1775 and 1780 Henderson & Ross built a furnace at the mouth of Antietam creek. A forge was built at the same place about the same time. There were at least three forges on Antietam creek during the last century. In 1845 a new furnace was built on the site of the original Antietam furnace, and it is still in operation. A small rolling mill, with a nail factory attached, was built at the same place about 1831 and abandoned about 1853. Bishop says that a slitting mill was established at or near Baltimore in 1778 by William Whetcroft, and that about the same time two nail factories were established in the city—one by George Matthews and the other by Richardson Stewart. At Elkridge Landing Dr. Howard owned a tilting forge in 1783. On Deer creek, in Harford county, a forge and slitting mill were built during the last century. During the Revolution there were 17 or 18 forges in operation in Maryland, in addition to furnaces and other iron enterprises.

After the Revolution the iron manufacture of Maryland experienced a healthy development, which has continued without serious interruption to the present time. One of the first successful rolling mills in the state was the celebrated Avalon iron works, on the Baltimore and Ohio railroad, half a mile above the Relay House, built about 1796 and in use down to about 1860. It first made nails exclusively, but afterwards it also rolled nails. A rolling mill was built on the Big Elk river, five miles north of Elkton, in 1810, on the site of copper works which had existed before the Revolution. It was active until about 1860, making sheet iron chiefly. Octorara forge and rolling mill, on Octorara creek, four miles above its mouth and eight miles north of Port Deposit, were built about 1810. These works are still active, and, together with two other Maryland rolling mills of modern origin, are owned by the McCullough Iron Company. The once numerous forges of Maryland have gradually given place to rolling mills. In 1840 several forges were in operation; in 1856 two forges were active, and in 1880 there was only one forge active—the one at North East.

The development of the iron ores belonging to the coal measures of the extreme western part of Maryland appears to have been undertaken about fifty years ago. Near the village of Friendsville, on Bear creek, a branch of the Youghiogheny river, there were erected, in 1828 and 1829, the Yohogany iron works, consisting of a furnace and two forges, to use charcoal. These works were abandoned about 1834. In 1837 a furnace 50 feet high and 14½ feet wide at the boshes was built at Lonaconing, eight miles southwest of Frostburg, by the George's Creek Coal and Iron Company, to use coke. In June, 1839, it was making about 70 tons per week of good foundry iron, with coke as fuel. Overman claims that this was the first successful coke furnace in the United States. Two large blast furnaces were built in 1840 by the Mount Savage Iron Company, nine miles northwest of Cumberland, also to use coke. This enterprise was also successful. In 1845 the same company built an additional furnace, but it was never lined. The Mount Savage rolling mill was built in 1843, especially to roll iron rails, and in 1844 it rolled the first rails used in this country. These rails were of the inverted U pattern, and weighed 42 pounds to the yard. Alleghany county, Maryland, is thus entitled to two of the highest honors in connection with the American iron trade. It built the first successful coke furnace and rolled the first heavy iron rails. The furnaces and rolling mill of the Mount Savage Iron Company have long been inactive and abandoned. In 1846 a furnace called Lena was built at Cumberland, which at first used charcoal and afterwards used coke. It was not long in operation. Alexander mentions a furnace on the Eastern Shore of Maryland, built in 1830 by Mark Richards, about five miles from Snow Hill, to use bog ore yielding only 28 per cent. of iron. Its annual production about 1834 was 700 tons. In 1840 the furnace was owned by T. A. Spence. It was called Naseongo, and it was the only furnace in the state that used bog ore exclusively or in large quantities. A bloomary which used bog ore once stood near Federalsburg, but it was abandoned long ago. The prominence of Maryland as an iron-producing state was relatively much greater in 1870 than in 1880. In the former year it was fifth in rank, and in the latter year it was twelfth. A furnace was built at Georgetown, in the District of Columbia, in 1849, and finally went out of blast about 1855. A second stack was built at the same place, but was never lined and consequently never put in blast. Before 1812 the United States Government built an anchor forge at the navy-yard at Washington, which was enlarged about 1830, and afterwards used to produce anchors, shafts, chains, etc. The District of Columbia never had any other iron enterprises until 1878, when the Government established a small rolling mill at the navy-yard. The forge is still in operation, as is also the rolling mill.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

EARLY IRON INDUSTRIES IN VIRGINIA, THE CAROLINAS AND GEORGIA.

AFTER the failure to manufacture iron on Falling creek in 1622, no successful effort was made to revive the iron industry in Virginia until after the beginning of the succeeding century—a delay of almost a hundred years. To Colonel Alexander Spotswood, who was governor of Virginia from 1710 to 1723, the honor of having established the iron industry of the colony on a firm and permanent basis is fairly due, although the exact date of the commencement of the various iron enterprises is lost. We are indebted to the researches of R. A. Brock, Esq., of Richmond, for the following information concerning the inception of Governor Spotswood's schemes to effect a revival of the iron industry in Virginia. In the collections of the Virginia Historical Society are two MS. volumes of the letters of Governor Spottswood to the lords' commissioners, the council of trade at London, covering the period from 1710 to 1721. On October 24, 1710, the Governor writes: "There is a project to be handed to the next assembly for improvement of the iron mines, lately discovered in this country, the ores of which upon tryall have been found to be extraordinary rich and good. It is proposed that the work be carried on at publick charge." This scheme appears not to have been acted upon by the assembly. On December 15, 1710, the Governor writes: "I humbly propose to your lordships' consideration, whether it might not turn to good account if her majesty would be pleased to take that work [the iron] into her own hands, sending over workmen and materials for carrying it on." He states that the "iron mines lie at the falls of James river." On January 27, 1714, he asks that the German Protestants settled at the head of the Rappahannock river, who came over with Baron de Graffenreidt "in hopes to find out mines," be exempted from the payment of levies for the support of the government. In the latter part of 1716 lengthy charges for malfeasance in office were anonymously preferred against Governor Spotswood to the council of trade, the counts of which are numerous. In one of them Governor Spotswood is charged, under pretence of guarding the frontiers, with building, at the cost of the government, two forts, one at the head of James river and another at the head of Rappahannock river, only to support his two private interests, at least one of which, that on the Rappahannock, related to the manufacture of iron. Another account charges the maintenance at public cost, at these forts, of "rangers," for three years, ending in December, 1716. The beginning of this period would be near that of the German settlement the members of which were the operatives of Governor Spotswood. It may be assumed that some of his iron enterprises were in operation certainly in 1716, and, most likely, two years earlier.

In 1727 the general assembly of Virginia passed "an act for encouraging adventurers in iron works," which begins as follows: "Whereas, divers persons have of late expended great sums of money in erecting furnaces and other works for the making of iron in several parts of the country, . . . and for as much as it is absolutely necessary for roads to be laid out and cleaned from all such iron works to convenient landings," etc. In *A Progress of the Mines*, by Colonel William Byrd, of Westover, Virginia, written in September, 1732, is given a full account of the iron enterprises of Virginia at that time. They embraced three blast furnaces and one air furnace, but no forge. One of the blast furnaces was at Fredericksville, a village which has disappeared from the maps, but which was located about twenty-five miles south of Fredericksburg, in Caroline county or Spottsylvania county. Mr. Chiswell, the manager, told Colonel Byrd that the pig iron produced at the furnace was carted twenty-four miles over an uneven road to the Rappahannock river, about a mile below Fredericksburg. This furnace was built of brick, but it had been idle "ever since May, for want of corn to support the cattle." Colonel Byrd says: "The fire in the furnace is blown by two mighty pair of bellows, that cost £100 each, and these bellows are moved by a great wheel of 26 foot diameter." The owners of the furnace had invested about £12,000 in land, negroes, cattle, etc., and had made 1,200 tons of iron. "When the furnace blows it runs about 20 tons a week." Colonel Byrd says the company was formed as follows: "Mr. Fitz Williams took up the mine tract, and had the address to draw in the Governor, [Spotswood,] Captain Pearse, Dr. Nicholas, and Mr. Chiswell to be jointly concerned with him, by which contrivance he first got a good price for the land, and then, when he had been very little out of pocket, sold his share to Mr. Nelson for £500, and of these gentlemen the company at present consists. And Mr. Chiswell is the only person amongst them that knows anything of the matter." One of the mines attached to the furnace was fifteen or twenty feet deep, and the ore was dislodged by blasting, after which it was carried away "in baskets up to the heap." It was calcined before being used, a layer of charcoal and ore alternating. The limestone used at the furnace was brought from Bristol as ballast, and carted from the Rappahannock to the furnace by the ox teams which brought down the iron. Colonel Byrd recommended the substitution of oyster shells for limestone, but without effect.

The next furnace visited by Colonel Byrd was directly controlled by Colonel Spotswood, and was situated in Spottsylvania county, about twenty miles southwest of Fredericksburg, and about thirteen miles from Germania. This last place was situated in Orange county, on the south side of the Rapidan, and about fourteen miles distant from its junction with the Rappahannock. It had been settled by Germans and afterwards abandoned for another location on "land of their own, ten miles higher, in the Fork of Rappahannock." The furnace, according to Colonel Spotswood, was the first in Virginia. "It was built of rough stone, having been the first of that kind erected in the country." The iron made at this furnace was carted fifteen miles to Massaponux, on the Rappahannock, five miles above Fredericksburg, where Colonel Spotswood had recently erected an air furnace, which he "had now brought to perfection, and should be thereby able to furnish the whole country with all sorts of cast iron, as cheap and as good as ever came from England." The blast furnace "had not blown for several moons, the Colonel having taken off great part of his people to carry on his air furnace at Massaponux." "Here the wheel that carried the bellows was no more than 20 feet diameter." The ore at this furnace was also blasted with gunpowder. "All the land hereabouts seems paved with iron ore, so that there seems to be enough to feed a furnace for many ages." Colonel Byrd next mentions "England's iron mines, called so from the chief manager of them, tho' the land belongs to Mr. Washington." These mines he states were on the north side of the Rappahannock river, "not far from a spring of strong steel water," which was in King George county, twelve miles distant from Fredericksburg. Two miles distant from the mines was a furnace. "Mr. Washington raises the ore, and carts it thither for 20 shillings the ton of iron that it yields. The furnace is built on a run, which discharges its waters into Potomeck. And when the iron is cast they cart it about six miles to a landing on that river. Besides Mr. Washington and Mr. England there are several other persons in England concerned in these works. Matters are very well managed there, and no expense is spared to make them profitable, which is not the case in the works I have already mentioned." This was Accokeek furnace, already referred to in the Maryland chapter as forming one of the possessions of the Principio Company. It was situated in Stafford county. The "Mr. Washington" referred to was Augustine Washington, the father of George Washington. Colonel Byrd did not visit Accokeek furnace. He visited Colonel Spotswood's air furnace at Massaponux, which he fully describes. It was a very ambitious and creditable enterprise, and appears to have been successfully managed. Colonel Spotswood used it "to melt his sow iron, in order to cast it into sundry utensils, such as backs for chimneys, andirons, fenders, plates for hearths, pots, mortars, rollers for gardeners, skillets, boxes for cart wheels, and many other things. And, being cast from the sow iron, are much better than those which come from England, which are cast immediately from the ore for the most part." "Here are two of these air furnaces in one room, that so in case one want repair the other may work, they being exactly of the same structure." Colonel Spotswood informed Colonel Byrd that Robert Cary, of England, was a silent partner of his in all his iron enterprises.

In the valley of Virginia many furnaces and forges were built prior to the Revolution, and others were built before the close of the century. Zane's furnace and forge, on Cedar creek, in Frederick county, are said to have been the first iron works in the valley. Pine forge, in Shenandoah county, three and a half miles north of New Market, was built in 1725, according to Lesley. Isabella furnace, on Hawksbill creek, near Luray, in Page county, was built in 1760. In Augusta county, fifteen miles north of Staunton, a forge was built in 1757 on Mossy creek, and on the same stream a furnace was built in 1760. Union forge, near Waynesborough, in Augusta county, was built about 1800. In Rockbridge county were two forges, built about 1800—Gibraltar forge, on North river, nine miles north of Lexington, and Buffalo forge, on Buffalo creek, the same distance south of Lexington. Moore's furnace, on Steele's creek, in this county, and a furnace on Smith's creek, in Rockingham county, were built before 1800.

A furnace was built in Loudon county before 1800, concerning which Bishop states Mr. Clapham, its owner, "cut a canal through the end of Cotocktin mountain, 500 feet through solid rock and 60 feet beneath the surface, to obtain water for his furnace and mill." Iron works were erected in Craig, Grayson, Wythe, Washington, Carroll and other southwestern counties about the close of the last century. A forge on Chestnut creek, in Carroll county, was built about 1790, and another on Little Reed Island creek was built about the same time. Bishop says that an excellent air furnace was built at Westham, six miles above Richmond, on the north side of the river, during the Revolution; there was also a cannon foundry here at the same period. Benedict Arnold destroyed the works at Westham in 1781. A rolling and slitting mill was afterwards built at Westham, which was probably the first in the state. The Government armory at Harper's Ferry was established in 1798. At Lynchburg and in its vicinity, in the James River valley, several furnaces and forges were built in the last century.

No state in the Union gave more attention to domestic manufactures after the close of the Revolution than Virginia. Richmond, Lynchburg, Staunton, Winchester, and some other places became noted for the extent and variety of their manufactures. Household manufactures were also everywhere cultivated. The manufacture of nails was one of these household industries. Thomas Jefferson required about a dozen of the younger slaves owned by him to make nails, and it is said that "they made about a ton of nails a month at a considerable profit." Lesley enumerates no less than 88 charcoal furnaces and 59 forges and bloomaries as having been built in Virginia prior to 1856; also 12 rolling mills. Several of these various enterprises were within the limits of the present state of West Virginia. The furnaces were located in 31 counties and the forges in 25 counties.

The first rolling mill of any kind west of the Allegheny mountains of which we can obtain exact information was located in West Virginia, and is described in Cramer's *Pittsburg Almanac* for 1813, issued in 1812, as follows: "Jackson & Updegraff, on Cheat river, have in operation a furnace, forge, rolling and slitting mill, and nail factory—nails handsome, iron tough." Like all the rolling and slitting mills of that day, the Cheat river mill did not puddle iron nor roll bar iron, but rolled only sheet iron and nail plates. Hon. James Veech informed us in his lifetime that its location was on the road from Uniontown to Morgantown, about three miles south of the Pennsylvania state line, and eight miles north of Morgantown. In the old days before the civil war Wheeling was the center of the rolling mill industry of Virginia, having seven of the twelve rolling mills in the state. Of the remaining five mills, four were in Richmond and one was on Reed creek, in Wythe county, twelve miles east of Wytheville. Since the war two rolling mills have been established at Lynchburg, and new mills have been built at Wheeling. A large number of the furnaces and forges of Virginia were abandoned before 1850. In 1856 there were 39 charcoal furnaces and 43 forges enumerated by Lesley as being then in operation or prepared to make iron. Since 1856 many of the charcoal furnaces and most of the forges which were then in existence have been abandoned. Insufficient transportation facilities, coupled with the failure of ore in certain localities, have had much to do with the abandonment of many charcoal furnaces in Virginia, while the disappearance of the forges is attributable to other well-known causes. Of late years, however the extension of railroads and the discovery of new and valuable ore deposits have given a fresh impetus to the manufacture of pig iron in Virginia and West Virginia, much of which is made with coke, West Virginia supplying an excellent quality of this fuel. The future of the iron industry of these two states is to-day very promising. The young state, however, in both 1870 and 1880 took higher rank among iron-producing states than the old state. It ranked tenth in 1870 and seventh in 1880; whereas Virginia ranked thirteenth in 1870 and sixteenth in 1880.

North Carolina.—Scrivenor says that in 1728–'29 there were imported into England from "Carolina" 1 ton and 1 cwt. of pig iron, and that in 1734 there were imported 2 qrs. and 12 lbs. of of bar iron. Shipments of pig iron and bar iron from "Carolina" were made in subsequent years down to the Revolution. It is a curious fact that hose made in Virginia and Carolina were sold in New York several years before the Revolution. Bishop says that several iron works were in operation in North Carolina before the Revolution, some of which were put out of blast by that event. They were situated on branches of the Cape Fear, Yadkin, and Dan rivers. When the shadow of the approaching conflict with the mother country reached North Carolina, her patriotic citizens, first in convention at New Berne and afterwards in the provincial legislature, encouraged, by the offer of liberal premiums, the manufacture of crude and finished iron and steel, as well as other manufactured products. "John Wilcox was the proprietor of a furnace and iron works on Deep run in the beginning of the war. There were also iron works in Guilford county, probably on the same stream. In April, 1776, the provincial congress sent commissioners to treat with Mr. Wilcox for the use of his furnace and works for two years, or to purchase and repair those in Guilford, for casting ordnance, shot, etc., and empowered them to draw on the treasury for £5,000 for that purpose." Buffalo Creek furnace and forge were also built before the war on Buffalo creek, in Cleveland county, not far from King's mountain, on the southern border of the state. Prior to 1800 there were in operation in Lincoln county four forges, two bloomaries, and two furnaces. One of the furnaces, Vesuvius, on Anderson's creek, built in 1780, was in operation down to 1873. Of other iron enterprises established in North Carolina in the last century we condense from Lesley and Bishop the following information: Union bloomary forge, on Snow creek, in Stokes county, six miles northeast of Danbury, was built in 1780. Iron works were built on Iron creek, also in the same county, and were conducted with spirit about 1790. Keyser's bloomary forge, on the headwaters of Town fork, in the same county, ten miles southwest of Danbury, was built in 1796. Hill's bloomary forge, on Tom's creek, in Surry county, nineteen miles west of Danbury, was built in 1791. In the same county, near the Yadkin, iron works were erected a few years after the Revolution, probably by Moravians from Pennsylvania, who had settled in the county as early as 1753. In Wilkes county a forge was built about the same time. A furnace and forge were erected on Troublesome creek, in Rockingham county, at an early day. In Burke county, at the foot of the Blue Ridge, two bloomaries and two forges were erected before the close of the last century.

After 1800 the iron industry of North Carolina was still further developed. This development was, however, mainly confined to the manufacture of iron in bloomaries, the magnetic and hematite ores of the state being well adapted to this primitive mode of treatment. In 1810, according to Tench Coxe, there were six bloomaries, two rolling and slitting mills, and two naileries in Lincoln county; one bloomary in Iredell county; six bloomaries and one trip-hammer in Burke county; and five bloomaries in Surry county—eighteen bloomaries in all. In 1856 Lesley enumerated about forty bloomaries and a few forges, most of which were then in operation. The *trompe* or waterblast, was in general use. He also described six furnaces: Vesuvius, already referred to; Madison, on Leiper's creek, in Lincoln county, built in 1810; Rehoboth, on the same creek and in the same county, built in 1810; Columbia, seven miles west of High Shoals, in Gaston county, then in ruins; Tom's Creek, near Hill's forge, on Tom's creek, destroyed by a flood in 1850; Buffalo creek, already referred to, and then in ruins. Vesuvius, Madison, and Rehoboth were blown with wooden "tubs." There was also active at this date a small rolling mill on Crowder's creek, in Gaston county, a mile and a quarter north of King's mountain, owned by Benjamin F. Briggs, of Yorkville, South Carolina, and built in 1853. At the same time another small rolling mill and forge, known as High Shoals iron works, and situated in Gaston county, were in ruins. At least two furnaces were built in North Carolina during the civil war, one in Chatham and one in Lincoln county, and two were built in Chatham county after the war, but of these four furnaces, and Vesuvius, Madison, and Rehoboth, all of which are still standing, as may possibly be one or two other furnaces, not one has made a pound of iron since 1877. Of the long list of bloomaries and forges which the state could once boast, less than a dozen are now active, and there is not to-day a rolling mill or steel works in the state.

South Carolina.—If the iron industry of North Carolina has declined in late years, that of South Carolina has suffered a worse fate; it has been an extinct industry for many years. Yet this state made some iron as early as the Revolutionary period, and subsequently it made iron in considerable quantities. In the northwestern part of South Carolina, including the counties of Union, Spartanburg, and York, are deposits of magnetic ores, and here, according to Dr. Ramsay, quoted by Bishop, the first iron works in the state were erected by Mr. Buffington in 1773, but they were destroyed by the Tories during the Revolutionary war.

At the beginning of the Revolution South Carolina followed the example of many other colonies by offering liberal premiums to those who would establish iron works, but we do not learn that the manufacture of iron was thereby increased. Mr. Buffington's experience probably deterred others from embarking in the business. Several furnaces and forges were erected in this state a few years after the peace, the principal of which were the Era and Etna furnaces and forges in York county. The Era was built in 1787 and the Etna in 1788. These enterprises were situated on a creek flowing into the Catawba river, and about two miles west of it. In 1795 the nearest landing to these works was at Camden, seventy miles below. They were on the road leading from Charlotte, in North Carolina, to Yorkville. Iron ore was abundant in the neighborhood, and was easily smelted after having been roasted. "It was obtained, massive, in such quantity above the surface that it was thought there would be no occasion to resort to shafts or levels for half a century." William Hill was one of the principal owners of the works. He is said to have devised "a new blowing apparatus," by the aid of which he contrived to blow "all the fires, both of the forges and furnaces, so as to render unnecessary the use of wheels, cylinders, or any other kind of bellows." This apparatus was undoubtedly the *trompe*, or water-blast, but Mr. Hill did not invent it, nor was he the first in this country to use it. The statement, which Bishop quotes from some unknown authority, is, however, valuable, as it contains one of very few references to the use of the *trompe* in blowing a blast furnace in this country that have come under our notice. Bishop says that other iron works soon followed those of Mr. Hill, and that "they were erected in different places, including several in the mountain district of Washington, where iron, the only article made for sale to any extent, was manufactured, at the beginning of this century, as cheap and good as the imported." In 1810 Tench Coxe enumerates two bloomaries in Spartanburg county, four in Pendleton county, two in Greenville county, and one in York county—nine in all. He also mentions one small nailery and one small steel furnace in the state. He makes no reference to blast furnaces.

Scrivenor mentions the following iron enterprises in South Carolina as existing apparently about 1815. "On Allison's creek, in York district, there are a forge, a furnace, a rolling mill for making sheet iron, and a nail manufactory. On Middle Tiger river are iron works on a small scale; also on the Enoree river and Rudy river, on the north fork of Saluda river, on George's creek, and on Twenty-six-mile creek. In 1802 an air-furnace was erected on a neck of land between Cooper and Ashley rivers, where good castings are made." (York district is the same as York county, the subdivisions of South Carolina having been known as districts down to 1868.) In 1856 South Carolina had eight furnaces—one in York, one in Union, and six in Spartanburg county. They are described by Lesley. Four of these furnaces were then in operation, producing in the year named 1,506 tons of charcoal iron, but three others had been "out of repair for twenty years," and the remaining furnace had been abandoned. In 1856 there were also three small rolling mills in the state—one on Pacolet river, in Spartanburg county; one on Broad river, in Union county; and one on the same river, in York county. At the first two of these mills dry wood was used in the puddling and heating furnaces. In 1856 the three mills made 1,210 tons of bar iron and nails. In the same year there were also in South Carolina two bloomaries—one connected with the rolling mill in Union county, and the other connected with the rolling mill in York county. Their joint product was 640 tons of blooms. But South Carolina no longer makes iron. Every iron-producing establishment in the state is to-day silent, and has been silent for many years, and all are in a more or less dilapidated condition. South Carolina furnishes the only instance in the history of the country of a state having wholly abandoned the manufacture of iron.

Georgia.—Georgia is the last of the original thirteen colonies whose iron history remains to be noticed. Unlike its sister colonies, however, Georgia has no colonial iron history. It was the last of the thirteen to be settled, and it was not until within a few years of the commencement of the Revolutionary struggle that the few settlements on the coast began to experience even moderate prosperity. After the close of the Revolution the settlement of the interior was for many years retarded by difficulties with the Indians, and it was not until 1838 that the Cherokees were induced to surrender their claims to a portion of the territory of the state. It will be seen that, under the circumstances which have been mentioned, the manufacture of iron in Georgia was destined to be the result entirely of comparatively modern enterprise. In 1810 there was a bloomary in Warren county, a forge in Elbert county, and a nailery in Chatham county. These enterprises were on or near the Atlantic coast, and were doubtless among the first of their kind in the state, if they were not, indeed, the very first. Sequee bloomary forge, three miles south of Clarksville, in Habersham county, was built about 1830, and abandoned about 1835. Hodge's forge, in the same county, was probably built at an earlier date. Lesley says of it: "Situation unknown; history unknown; abandoned very long ago." The coast sections of Georgia did not possess ample resources for the manufacture of iron. No iron industry exists there to-day.

Old bloomary forges in Cass county, now Bartow county, were built as follows: Etowah, No. 1, in 1838; Etowah, No. 2, in 1841; Allatoona, about 1846. Ivy Log bloomary, in Union county, was built about 1839. Aliculsie bloomary, in Murray county, was built about 1843. A bloomary was built on Armuchy creek, in Walker county, about 1848. Lookout bloomary, in Dade county, was built at an earlier day. All of these enterprises were abandoned before 1856, in which year, however, several other bloomaries of more recent origin were in operation. In 1880 only two bloomaries in the state were reported to be in use. One forge, at Allatoona, made blooms from scrap iron in that year. The first furnace in Georgia of which we have any account was Sequee furnace, built prior to 1832, near Clarksville, in Habersham county, and abandoned in 1837. Etowah furnace, on Stamp creek, in Cass county, now Bartow county, was built in 1837, abandoned in 1844, and torn down in 1850. A new furnace, built by its side in 1844, is now in ruins. Allatoona furnace, in Cass county, built in 1844; Union furnace, in the same county, built in 1852; Lewis furnace, in the same county, built about 1847; and Cartersville furnace, in the same county, built in 1852, have been abandoned. Clear Creek furnace, in Walker county, built about 1852, and rebuilt in 1857, has also been abandoned. All of these were charcoal furnaces. Of the furnaces existing in Georgia in 1880 Bartow county contained five charcoal furnaces and two coke furnaces—seven in all. Of these, the two Bear Mountain charcoal furnaces, built in 1842, were the oldest. Four other furnaces in the state were situated in Polk, Floyd, and Dade counties—two in Polk and one in Floyd using charcoal, and one in Dade using coke. Rising Fawn furnace, in Dade county, is 63 feet high by 16 feet wide at the boshes, and was the first furnace in the United States to use the Whitwell hot-blast stove, blowing in for the first time on June 18th, 1875. Georgia had two rolling mills in 1859—Etowah, in Cass county, built about 1849, and Gate City, at Atlanta, built in 1858. It is a curious fact that the state had just two rolling mills twenty-one years later, in 1880,—Atlanta, built in 1865, and Rome, built in 1869. The latter has been idle for several years. Lesley, in 1859, thus describes the Etowah rolling mill and its blast furnace and other connections, situated on the Etowah river: "This property has been building up and developing for twelve years. On it there has been expended $250,000. It contains a rolling mill, nail and spike factory, and all necessary apparatus; a blast furnace and foundry, with full equipment; a wheat mill (150 to 250 bushels per day), warehouse, cooper-house, hotel, and operative houses, two corn grist mills, two saw mills, and a coal mine; all using not one-tenth of the water-power on the premises. River 600 feet wide. Iron ore and wood are abundant. It is on the metamorphic rocks of the gold and copper belt, both minerals being found on it," etc. Notwithstanding the decadence of its bloomaries, and the slow progress it has made in building up a rolling-mill industry, Georgia possesses to-day a very promising blast-furnace industry, which has been almost wholly rehabilitated during the past decade.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

THE EARLY DAYS OF THE IRON INDUSTRY IN KENTUCKY AND TENNESSEE.

THE first iron enterprise in Kentucky is said byLesley to have been Slate furnace, erected by government troops in 1791 on Slatecreek, a branch of Licking river, in Bath county, then Bourbon. It was successfully operated until 1838. This is the only furnace in Kentucky whose history can be definitely traced back to the last century. It will be remembered that Jefferson, in the extract from his *Notes on the State of Virginia*, already quoted, says that there were iron mines "on Kentucky, between the Cumberland and Barren rivers," and also "between Cumberland and Tanissee." It is probable that about the year 1800 there were a few bloomaries in eastern Kentucky, to supply local wants for bar iron, and possibly Slate furnace was not the only furnace that supplied castings to the Kentucky pioneers in the last century. The original of the following memorandum was handed to the editor of the Portsmouth (Ohio) *Tribune* in 1880 by Mr. L. C. Robinson. It refers to a furnace in Kentucky called Bourbon, but which was probably the same as Slate furnace.

KENTUCKY, *ss:* Memorandum of an Agreement made and Concluded upon this day between John Cockey Owings & Co., in Iron Works at the *Bourbon* Furnace of the one part, and Robert Williams (potter) of the other part. Witnesseth that the aforesaid Company doth this day agree to give the said Williams five pounds p month for three months work and to find him provisions during the time he shall work until the three months are expired, and said Company doth further agree, in case the furnace is not ready to blow before or at the expiration of the three months, if the water will admit, or as soon as the water will admit after that time, to give him p month as much as he can make in a month at the potting Business for such time as said Furnace may not be Ready to put in Blast ---as witness our hands this second day of June, 1793.

JN. COCKEY OWINGS,
WALTER BEALL,
Test: JNO. MOCKBEE. CHRIST GREENUP.

Lesley says that Slate furnace "was run by Colonel Owing," and that it went out of blast in 1838. The name of Bourbon furnace indicates its location in Bourbon county, and it is hardly probable that there were two furnaces in this county as early as 1793. The term "potter" was applied to the molder, who cast pots, kettles, etc., from the melted iron which was taken direct from the furnace and poured into molds. Colonel Christopher Greenup afterwards became the third governor of Kentucky, serving from 1804 to 1808, and it was in his honor that Greenup county was so named.

For a number of years after 1800 the iron industry of Kentucky made but slow progress. Tench Coxe in 1810 mentions only four furnaces and three forges. One furnace was in Estill, one in Wayne, and two were in Montgomery county. One of the forges was in Estill, and one in Wayne, and one in Montgomery county. About 1815 there were four nail factories at Lexington, making 70 tons of nails yearly. About 1815 Richard Deering, a farmer of Greenup county, smelted in a cupola the first iron ore used in the Hanging Rock district of Kentucky. His experiment with the cupola proving to be successful, he took into partnership David and John Trimble, and these three persons erected as early as 1817 the first blast furnace in the district. It was called Argillite, and was located in Greenup county, about six miles southwest of Greenupsburg, upon the left bank of Little Sandy River. The stack, which was 25 feet high and 6 feet wide at the boshes, was cut in a cliff of black slate—hence the name, Argillite. Lesley says: "It was not a structure, but an excavation in the solid slate rock of the cliff, the archway below being excavated to meet it." This furnace was operated until 1837, when it was abandoned, but its product was always small. The next furnace in this district appears to have been Pactolus, built by Ward & McMurtry in 1824, in Carter county, on the Little Sandy river, above Argillite furnace. It also was abandoned about 1837. A forge was connected with this furnace. The next iron enterprise in the district is said to have been Steam furnace, in Greenup county, situated about three miles from the Ohio river and five miles from Greenupsburg. It was built in 1824 by Leven Shreeves & Brother, and was operated with steam. It was abandoned after 1860. Enterprise furnace, on Tygart's creek, in Greenup county, was built in 1826, but Richard Deering is said to have erected a forge of the same name, on the same creek, in 1824. Bellefonte furnace on Hood's creek, two and a half miles southwest of Ashland, in Boyd county, was built in 1826 by A. Paull, George Poague, and others, and was the first furnace in this county. It is still in operation. Between 1817 and 1834 at least thirteen furnaces were built in Greenup, Carter, and Boyd counties. One of the earliest of these was Camp Branch, or Farewell, situated on Little Sandy river, fourteen miles from Greenupsburg, near the Carter county line, built by David and John

Trimble. Subsequent to 1834 about fifteen other charcoal furnaces were built in these three counties and in Lawrence county. Many of the charcoal furnaces of this district have been abandoned. A few excellent bituminous coal and coke furnaces have, however, been erected in late years. Notwithstanding these additions to its furnace capacity, this district is not now so prominent in the manufacture of iron as it has been.

About 1830 there were a dozen forges in Greenup, Estill, Edmonson, and Crittenden counties, all of which, with one exception, were abandoned before 1840. Two forges were built below Eddyville, in Lyon county, about 1850. All of the forges mentioned refined pig iron into blooms, many of which found a market at Pittsburg, Cincinnati, and Kentucky rolling mills. There is now only one forge in the state—Red River, in Estill county, and it is not active. The bloomaries that once existed in Kentucky were abandoned early in this century. In addition to the iron enterprises in the Hanging Rock region of Kentucky, furnaces were built before 1860 in several of the middle and western counties of the state—in Bath, Russell, Bullitt, Nelson, Muhlenburg, Lyon, Crittenden, Trigg, Calloway, and Livingston counties. In this period eight rolling mills were also built in various sections. The period from about 1825 to 1860 witnessed great activity in the development of the iron industry of Kentucky. Since the close of the civil war this activity has been maintained, but it cannot be said that the state has of late devoted that attention to the manufacture of iron which its position and resources would seem to invite. It was seventh in the list of iron-producing states in 1870, and eleventh in 1880. Of twenty-two furnaces in the state in 1880 eighteen used charcoal, the others used bituminous coal. In the same year there were eight rolling mills—two at Covington, two at Newport, two at Louisville, one at Ashland, and one in Lyon county; there were also two steel works in the state. The first rolling mill in Kentucky appears to have been built at Covington in 1829, a portion of its machinery having been obtained from the dismantled Union rolling mill at Pittsburg. Ashland, in Boyd county, has recently become prominent as an iron centre.

Tennessee.—The first settlers of Tennessee erected iron works within its limits soon after the close of the Revolution. Bishop says that a bloomary was built in 1790 at Emeryville, in Washington county. At Elizabethton, on Doe river, in Carter county, a bloomary was built about 1795. Wagner's bloomary, on Roane creek, in Johnson county, is said to have been built in the same year. A bloomary was also erected on Camp Creek, in Greene county, in 1797. Two bloomaries in Jefferson county—the Mossy creek forge, ten miles north of Dandridge, and Dumpling forge, five miles west of Dandridge—were built in the same year. About the same time, if not earlier, David Ross, the proprietor of iron works in Campbell county, Virginia, erected a large furnace and forge at the junction of the two forks of the Holston river, in Sullivan county, near the Virginia line on the "great road from Knoxville to Philadelphia." Bishop states an interesting fact in the following words: "Boats of 25 tons burden could ascend to Ross's iron works, nearly 1,000 miles above the mouth of the Tennessee. At Long Island, a short distance above on the Holston, where the first permanent settlement in Tennessee was made in 1775, boats were built to transport iron and castings made in considerable quantities at these works, with other produce, to the lower settlements and New Orleans." A bloomary was built about 1795 below the mouth of the Watauga, and another at the same time about twenty-five miles above the mouth of French Broad river and thirty miles above Knoxville.

All of the above-mentioned enterprises were in East Tennessee. In West Tennessee iron was also made in the last decade of the last century. Nashville was founded in 1780, and a few years later iron ore was discovered about thirty miles west of the future city. Between 1790 and 1795 Cumberland furnace was erected on Iron fork of Barton's creek, in Dickson county, seven miles northwest of Charlotte. This furnace was rebuilt in 1825, and was in operation in 1880. Dickson county and its neighbors, Stewart and Montgomery counties, afterwards became very prominent in the manufacture of charcoal pig iron. Other counties in the same section of the state have also, but in a less conspicuous degree, made iron in charcoal furnaces. The first furnace in Montgomery county was probably Yellow Creek, fourteen miles southwest of Clarksville, built in 1802. The iron industry of Tennessee made steady progress after the opening of the present century. Both furnaces and bloomaries multiplied rapidly. In 1856 Lesley enumerated over seventy-five forges and bloomaries, seventy-one furnaces, and four rolling mills in Tennessee, each of which had been in operation at some period after 1790. Of the furnaces, twenty-nine were in East Tennessee, and forty-two in Middle and West Tennessee. Of the latter, fourteen were in Stewart county, twelve in Montgomery, seven in Dickson, two in Hickman, two in Perry, two in Decatur, two in Wayne, and one in Hardin county. There were at one time forty-one furnaces on the Cumberland river in Tennessee and Kentucky. The furnaces in East Tennessee were mainly in Sullivan and Carter counties—Sullivan having five and Carter seven, but Johnson, Washington, Greene, Cocke, Sevier, Monroe, Hamilton, Claiborne, Campbell, Grainger, and Union counties each had one or two furnaces, while Roane county had three. There was a very early furnace in Polk county, which is not noted by Lesley but is mentioned by Bishop. The forges and bloomaries were mainly located in East Tennessee. Johnson county contained fifteen, Carter ten, Sullivan six, Washington three, Greene ten, Campbell seven, Blount four, Roane seven, Rhea three, and a few other counties one and two each. Nearly all of these were bloomaries. In West Tennessee there were less than a dozen refinery forges, and one or two bloomaries. The forges of West Tennessee, like those of Kentucky, were mainly employed from about 1825 to 1860 in the manufacture of blooms for rolling mills, many of which were sold to mills in the Ohio valley. Most of the furnaces, forges, and bloomaries enumerated by Lesley have long been abandoned. There still remain in Tennessee twenty charcoal furnaces and about the same number of forges and bloomaries. There were also in the state in 1880 five bituminous furnaces—all of recent origin, four rolling mills, and two steel works. Cumberland rolling mill, on the left bank of the Cumberland river, in Stewart county, was built in 1829, and was probably the first rolling mill in the state. It was the only rolling mill in Tennessee as late as 1856.

Since the close of the civil war Chattanooga has become the most prominent iron center in Tennessee, having several iron enterprises of its own and others in the vicinity. Prior to the war Bluff furnace had been built in 1854 to use charcoal, and at the beginning of the war, in 1861, S. B. Lowe commenced the erection of the Vulcan rolling mill, to roll bar iron. This mill was not finished in 1863, when it was burned by the Union forces. Mr. Lowe rebuilt the mill in 1866. It is now owned and operated by the Powell Iron and Nail Company. In 1864 a rolling mill to reroll iron rails was erected by the United States Government, under the supervision of John Fritz, then superintendent of the Cambria iron works. It is now owned and operated by the Roane Iron Company. The first open-hearth steel made in any southern state was made by the Siemens-Martin process at Chattanooga, by this company, on the 6th day of June, 1878. Lookout rolling mill was built by the Tennessee Iron and Steel Company in 1876, and was started in October of that year. Lewis Schofield was at the time the president of the company. The prominence of Chattanooga as an iron center is partly due to the excellent bituminous coal which is found in the neighborhood, and partly to its superior transportation facilities.

Tennessee is destined to become much more prominent in the manufacture of iron than it has ever been. It will owe this prominence largely to the abundance of good bituminous coal which it possesses, but largely also to the improvements in the manufacture of charcoal pig iron which have already been adopted in many instances, and which are certain to be generally adopted at an early day. Of the good quality of Tennessee ores nothing needs to be said.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

PRIMITIVE CHARACTER OF THE IRON WORKS OF NORTH CAROLINA AND TENNESSEE.

THE establishment at an early day of so many charcoal furnaces and ore bloomaries in western North Carolina and East Tennessee—sections of our country remote from the sea-coast and from principal rivers—is an interesting fact in the iron history of the country. The people who built these furnaces and bloomaries were not only bold and enterprising, but they appear to have been born with an instinct for making iron. Wherever they went they seem to have searched for iron ore, and having found it, their small charcoal furnaces and bloomaries soon followed. No states in the Union have shown in their early history more intelligent appreciation of the value of an iron industry than North Carolina and Tennessee, and none have been more prompt to establish it. It is true that their aim has been mainly to supply their own wants, but this is a praiseworthy motive, and people are not to be found fault with if a lack of capital and of means of transportation prevents them from cultivating a commercial spirit.

The enterprise of the early ironworkers of Western North Carolina and East Tennessee assumes a picturesque aspect when viewed in connection with the primitive methods of manufacture which were employed by them, and which they have continued to use until the present day. Their charcoal furnaces were blown through one tuyere with wooden "tubs" adjusted to attachments which were slow in motion, and which did not make the best use of the water-power that was often insufficiently supplied by mountain streams of limited volume. A ton or two of iron a day, in the shape of pigs or castings, was a good yield. The bloomaries, with scarcely an exception, were furnished with the *trompe*, or water-blast,—a small stream with a suitable fall supplying both the blast for the fires and the power which turned the wheel that moved the hammer. Of cast iron cylinders, steam power, two tuyeres, and many other improvements in the charcoal-iron industry these people knew but little, and that little was mainly hearsay. They were pioneers and frontiersmen in every sense; from the great world of invention and progress they were shut out by mountains, and streams, and hundreds of miles of unsubdued forest. It is to their credit, and it should not be forgotten, that they diligently sought to utilize the resources which they found under their feet, and that they were not discouraged from undertaking a difficult task because the only means for its accomplishment of which they had any knowledge were crude in conception and often difficult to obtain.

It is a curious fact that the daring men who pushed their way into the wilds of western North Carolina and East Tennessee in the last century, and who set up their small furnaces and bloomaries when forts yet took the place of hamlets, founded an iron industry which still retains many of the primitive features that at first characterized it. There are to-day in Tennessee about two dozen bloomaries, and in North Carolina a dozen or more, which are in all respects the counterparts in construction of those which the pioneers established. Nearly every one of these bloomaries is to-day blown with the *trompe*, and in all other respects they are as barren of modern appliances as if the world's iron industry and the world itself had stood still for a hundred years. They are fitfully operated, as the wants of their owners or of the neighboring farmers and blacksmiths require, or as the supply of water for the *trompes* and hammers will permit. They furnish their respective neighborhoods with iron for horseshoes, wagon-tires, and harrow-teeth. Mr. J. B. Killebrew, of Nashville, informs us that throughout the counties of Johnson and Carter, in Tennessee, where many of these bloomaries are located, bar iron is used as currency. He says: "Iron is taken in exchange for shoes, coffee, sugar, calico, salt, and domestic and other articles used by the people of the country. It is considered a legal tender in the settlement of all dues and liabilities. This bar iron, after being collected by the merchants, is sent out and sold in Knoxville, Bristol, and other points affording a market."

The explanation of the survival in this day and in this country of primitive methods of making iron which have long been abandoned by progressive communities lies in the fact that the environments which hedged about the pioneers of western North Carolina and East Tennessee have never been broken down, and have been only slightly modified. Few of the mountains and streams and forests of these sections have been tunneled, or bridged or traversed by modern means of communication. The iron horse has made but slow progress in bringing this part of our country into association with other sections. Cut off by their isolated situation and their poverty from all intimate relations with the outside world, the pioneers we have mentioned are not to be blamed for not adopting modern methods and for clinging to the customs of their fathers. They are rather to be praised for the efforts they have made to help themselves. But old things must pass away, even in the iron industry of North Carolina and East Tennessee. At Chattanooga, Rockwood, Oakdale, Knoxville, South Pittsburgh, and Cowan the transformation has already commenced. Before this century closes the people of whom we have been writing will wonder that the old ways of making iron stayed with them so long. There are a few ore bloomaries still left in southwestern Virginia which are similar in all respects to those of western North Carolina and East Tennessee, and which are used for precisely similar purposes. But the manufacture of iron in bloomaries was never relatively so prominent a branch of the iron industry of Virginia as of the other two states mentioned.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S

EARLY IRON INDUSTRIES OF ALABAMA.

THE earliest furnace in Alabama mentioned by Lesley was built about 1818, a few miles west of Russellville, in Franklin county, and abandoned in 1827. This unsuccessful venture appears to have had a dispiriting effect on other schemes to build furnaces in Alabama, as we do not hear of the erection of any for many years after it was abandoned. A furnace was built at Polksville, in Calhoun county, in 1843; one at Round Mountain, in Cherokee county, in 1852; and Shelby furnace at Shelby, in Shelby county, in 1848. These were all charcoal furnaces, and were the only ones in Alabama enumerated by Lesley in 1856. The total product in that year of the three last-named furnaces was 1,495 tons. Shelby furnace was built by Horace Ware, who many years afterwards added a small foundry and a small mill for rolling cotton-ties and bar iron. The furnace was burned in 1858, but was immediately rebuilt. The mill was commenced in 1859, and on the 11th of April, 1860, the first iron was rolled. It was burned in April, 1865, by General Wilson's command of Union troops, and has not been rebuilt.

Alabama had a bloomary two and a half miles southwest of Montevallo, in Shelby county, in 1825; several bloomaries in Bibb county between 1830 and 1840; one in Talladega county in 1842; two in Calhoun county in 1843; and others in various counties at later periods. In 1856 seventeen forges and bloomaries, mostly the latter, were mentioned as having been built at various periods prior to that year, about one-half of which were then in operation, producing 252 tons of blooms and bar iron. Since 1856 all of the forges and bloomaries of Alabama have gradually disappeared. Most of them were blown with the *trompe*, and the remainder with wooden "tubs."

It will be observed that as late as 1856 Alabama possessed a very small iron industry. During the civil war several new iron enterprises were undertaken. A furnace in Sanford county was built in 1861; Cornwall furnace, at Cedar Bluff, in Cherokee county, was built in 1862; a second Shelby furnace, in Shelby county, was built in 1863; Alabama furnace, in Talladega county, was built in 1863, burned by General Wilson in April, 1865, and rebuilt in 1873. Two furnaces and a small rolling-mill were built at Brierfield, in Bibb county, in 1863 and 1864. All of the furnaces were built to use charcoal. The Brierfield rolling-mill was first used for rolling bar iron and rails. In 1863 or early in 1864 it was sold to the Confederate government, by which it was operated until 1865, when it was burned by the Union troops under General Wilson. It was rebuilt after the war, and for some time was used to roll bar iron and cotton-ties, principally the latter. After having been idle for several years, this mill is again in operation. Since the close of the civil war the attention of Northern capitalists has been attracted to the large deposits of rich ores in Alabama, and several new furnaces, with modern improvements, have been built by them, some to use charcoal and others to use coke. Most of these furnaces are now in operation. Two new rolling-mills have also been built in Alabama since the war—one at Helena, in Shelby county, built in 1872, and one at Birmingham, in Jefferson county, built in 1880.

The existence of bituminous coal in Alabama was first observed in 1834, by Dr. Alexander Jones, of Mobile, but little was done to develop the ample coal resources of the State until after the close of the civil war, when it was found that the coal in the neighborhood of Birmingham and at other places would produce excellent coke for blast furnaces, and that at least two coal fields—the Black Warrior and Coosa—were so extensive as to set at rest all apprehension concerning a constant supply of coal for a long period of time. These discoveries, joined to the possession of an abundant supply of good ores, at once gave Alabama prominence as a State which would, before many years, boast a large iron industry, and this promise is now being fulfilled.

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

IRON INDUSTRIES IN THE WESTERN AND SOUTH-WESTERN STATES.

THE beginning of the iron industry of Ohio is cotemporary with the admission of the state into the Union. It was admitted in 1802, and in 1803 its first furnace, Hopewell, was commenced by Daniel Heaton, and in 1804 it was finished. (The name of Daniel Heaton was afterwards changed by act of assembly to Dan Eaton.) The furnace stood on Yellow creek, about one and a quarter miles from its junction with the Mahoning river, in the township of Poland, in Mahoning county. On the same stream, about three-fourths of a mile from its mouth, and on the farm on which the furnace of the Struthers Furnace Company now stands, in the village of Struthers, another furnace was built in 1806 by Robert Montgomery and John Struthers. This furnace was called Montgomery. Thomas Struthers writes: "These furnaces were of about equal capacity, and would yield about two and a half or three tons each per day. The metal was principally run into molds for kettles, bake-ovens, flat irons, stoves, andirons, and such other articles as the needs of a new settlement required, and any surplus into pigs and sent to the Pittsburg market." The ore was obtained in the neighborhood. Hopewell furnace is said by Mr. Struthers to have had a rocky bluff for one of its sides. It was in operation in 1807, but soon afterwards it was blown out finally. Montgomery furnace was in operation until 1812, when, Mr. Struthers says, "the men were drafted into the war, and it was never started again." This furnace stood "on the north side of Yellow creek, in a hollow in the bank." We are informed by Hon. John M. Edwards, of Youngstown, that Hopewell furnace was sold by Eaton to Montgomery, Clendenin & Co. about 1807, who were then the owners of Montgomery Furnace, John Struthers having sold his interest, or part of it, to David Clendenin in 1807, and Robert Alexander and James Mackey having about the same time become part owners. The above mentioned iron enterprises were the first in Ohio, and, as will be observed, they were both on the Western Reserve. There were other early iron enterprises on the Reserve. At Nilestown, now Niles, in Trumbull county, as we are informed by Colonel Charles Whittlesey, of Cleveland, James Heaton built a forge in 1809, for the manufacture of bar iron from "the pig of the Yellow Creek furnace"—Montgomery furnace. "This forge produced the first hammered bars in the state." It continued in operation until 1838. About 1812 James Heaton built a furnace at Nilestown, near the mouth of Mosquito Creek, where the Union school building now stands. It was called Mosquito Creek furnace, and for many years used bog ore, the product being stoves and other castings. It was in operation until 1856, when it was abandoned.

About 1816 Aaron Norton built a furnace at Middlebury, near Akron, in Summit county, and in 1819 Asaph Whittlesey built a forge on the Little Cuyahoga, near Middlebury. A furnace at Tallmadge, in the same county, was built about the same time. These two furnaces were operated until about 1835. The beginning of the iron industry in the counties on Lake Erie probably dates from 1825, when Arcole furnace was built in Madison township, in the present county of Lake, by Root & Wheeler, and Concord furnace, in the same county, was built by Fields & Stickney. Geauga furnace, one mile north of Painesville, in Lake county, and Railroad furnace, at Perry, in Geauga county, were built about 1825—the former by an incorporated company and the latter by Thorndike & Drury, of Boston. During the next ten or twelve years several other furnaces were built near Lake Erie, in Ashtabula, Cuyahoga, Erie, Huron, and Lorain counties. At a still later period other charcoal furnaces were built in the lake counties. All of these lake furnaces, writes John Wilkeson in 1858, "were blown some eight months each year, and made about 30 tons per week of metal from the bog ore found in swales and swamps near, and generally to the north of, a ridge of land which was probably once the shore of Lake Erie, found extending, with now and then an interval, along from the west boundary of the state of New York to the Huron river in Ohio. The want of wood for charcoal, consequent upon the clearing up of the land, has occasioned the stoppage of most of these works. For a long time the settlers upon the shores of Lake Erie and in the state of Michigan were supplied with their stoves potash-kettles, and other castings by these works." All of the above-mentioned iron enterprises were on the Western Reserve. Just outside of its limits Gideon Hughes built a furnace in 1807 or 1808, on the Middle fork of Little Beaver creek, one and a half miles northwest of New Lisbon, in Columbiana county. It was in operation in 1808 and 1809. It was first called Rebecca of New Lisbon, but was afterwards named Dale furnace. Attached to this furnace a few years after its erection was a forge, which was used for making bar iron. John Frost, of New Lisbon, to whom we are indebted for this information, also writes us that "some two or three miles up the same stream Mr. Hughes and Joshua Malin erected a rolling mill in 1822, to which a company of Englishmen, said to be from Pittsburg, not long afterwards added nail-making machinery. In addition to manufacturing bar iron, these works placed large quantities of nails in the market. This concern was more or less active till 1832, when the great flood of waters early in that year destroyed it, and it was never rebuilt." New Lisbon is located about twelve miles from the mouth of Little Beaver creek, which empties into the Ohio river.

Soon after the beginning of the iron industry on the Western Reserve the manufacture of iron was undertaken in some of the interior and southern counties of the state. Bishop says that Moses Dillon, who had been associated with Colonel Meason and John Gibson in the building of Union furnace, in Fayette county, Pennsylvania, in 1793, "afterwards erected a forge on Licking river, near Zanesville, Ohio, possibly the first in the state." This enterprise was preceded or immediately succeeded by a furnace, and the date of its erection is said to have been 1808, but it may have been a few years later. It was located "at the falls of Licking," four miles northwest of Zanesville, in Muskingum county, and its capacity was about one ton per day. It was used to produce castings, as well as pig iron for the forge. Lesley says that this furnace was not abandoned "until 1850 or later." The forge was also operated until about 1850. The furnace and forge were known as Dillon's, and were widely celebrated. Mary Ann furnace, ten miles northeast of Newark, in Licking county, was built about 1816 by Dr. Brice and David Moore. It was burned down about 1850. In Tuscarawas county the Zoar Community owned two early charcoal furnaces. One of these, called Tuscarawas, was built about 1830 by Christmas, Hazlett & Co., and was afterwards sold to the Community; the other, called Zoar, was built about the same time by the Community. Both furnaces were blown out finally before 1850. Three furnaces were built in Adams county between 1811 and 1816. The first of these, Brush Creek, on the stream of that name, and twelve miles from the Ohio river, was operated in 1813 by James Rodgers. It was probably built in 1811, its builders being Andrew Ellison, Thomas James, and Archibald Paull. It was in operation as late as 1837, when it produced 200 tons of iron in 119 days. On the same stream, twenty-two miles from the Ohio, was Marble furnace, built in 1816. Another furnace, known as Old Stream, was built in 1814. This furnace is said to have been built by James Rodgers, Andrew Ellison, and the Pittsburg Steam Engine Company. Thomas W. Means informs us that "the first blast furnace run by steam in southern Ohio, if not in the United States, was built by James Rodgers in Adams county about 1814." This reference is to Old Stream furnace. "Its product was less than two tons of iron a day. Brush Creek furnace, in the same county, and other furnaces of that period which were run by water, hardly averaged one ton of iron a day." Marble and Old Stream furnaces were abandoned about 1826. Lesley mentions three forges in Adams county—Stream, at Old Stream furnace; Scioto, on the Little Scioto; and Brush Creek, probably connected with Brush Creek furnace. The date of the erection of these forges is not given, but they were doubtless built soon after the three Adams county furnaces. They were all abandoned many years ago. There is now no iron industry in Adams county.

In the chapter relating to Kentucky the beginning of the iron industry in the Hanging Rock region has been noted. This celebrated iron district embraces Greenup, Boyd, Carter, and Lawrence counties in Kentucky, and Lawrence, Jackson, Gallia, and Vinton counties and part of Scioto county in Ohio. Just north of the Ohio portion of this district is the newly-developed Hocking Valley iron district, embracing Hocking and several other counties. The Hanging Rock district takes its name from a projecting cliff upon the north side of the Ohio river, situated back of the town of Hanging Rock, which is three miles below Ironton, in Lawrence county. The first furnace in the Ohio part of Hanging Rock district was Union furnace, situated a few miles northwest of Hanging Rock, built in 1826 and 1827 by John Means, John Sparks, and James Rodgers, the firm's name being James Rodgers & Co. Franklin furnace was the second on the Ohio side. It stood sixteen miles east of Portsmouth and half a mile from the Ohio river, in Scioto county, and was built in 1827 by the Rev. Daniel Young and others. The next furnace was Pine Grove, on Sperry's fork of Pine creek, back of Hanging Rock, and five miles from the Ohio river, in Lawrence county, built in 1828 by Robert Hamilton and Andrew Ellison. In the same year Scioto furnace, in Scioto county, fifteen miles north of Portsmouth, was built by William Salters. From this time forward blast furnaces increased rapidly on the Ohio side of the district, as well as on the Kentucky side. From 1826 to 1880 the whole number built on the Ohio side was about sixty, and on the Kentucky side about thirty. All of the early furnaces were built to use charcoal, but timber becoming scarce, coke was substituted at some of them, while others were abandoned. In late years a few furnaces have been built in the district expressly to use coke or raw coal. In 1880 there were on the Ohio side thirty-one charcoal furnaces and seventeen bituminous coal or coke furnaces.

At Vesuvius furnace, on Storm's creek, in Lawrence county, Ohio, six miles northeast of Ironton, the hotblast was successfully applied in 1836 by John Campbell and others, William Firmstone putting up the apparatus. The Hanging Rock district, on both sides of the Ohio, has produced many eminent ironmasters, and its iron resources have been developed with great energy. Most prominent among its ironmasters of the generation now passing away are John Campbell, of Ironton, and Thomas W. Means, of Hanging Rock. Mr. Campbell, who is a native of Brown county, Ohio, was born in 1808. In connection with others he has built eleven furnaces in the Hanging Rock district. He projected the town of Ironton and gave it its name, and also assisted in the founding of Ashland, Kentucky, and in building its railroad. Like most of the ironmasters of this district he is of Scotch-Irish extraction, his ancestors having removed in 1612 from Inverary, in Argyleshire, Scotland, to the neighborhood of Londonderry, in Ulster, Ireland. Their descendants removed in 1729 and 1739 to Augusta county, Virginia; thence, in 1790, to Bourbon county, Kentucky; and thence, in 1798, to that part of Adams county, Ohio, which is now embraced in Brown county. Mr. Means was born in South Carolina in 1803, and is also of Scotch-Irish origin. His father, John Means, was an owner of one of the furnaces and forges in Adams county, Ohio. He was born in Union district, South Carolina, on March 14, 1770, and moved to Adams county, in 1819, taking with him his slaves, whom he liberated. He died on his farm near Manchester, in Adams county, on March 15, 1837, and was buried in the churchyard in Manchester. Andrew Ellison, Robert Hamilton, James Rodgers, and Andrew Dempsey, now deceased, were enterprising and prominent iron manufacturers. In December, 1844, Mr. Hamilton successfully tried the experiment of stopping Pine Grove furnace, which he then owned, on Sunday, and his example has since been generally followed in the Hanging Rock region. This furnace is still active. John Campbell, Robert Hamilton, and Thomas W. Means were united in marriage with members of the Ellison family. The third generation of this family is now engaged in the iron business of southern Ohio.

In 1833 a forge was built at Hanging Rock, after which it was named, to manufacture blooms. It was owned by J. Riggs & Co., and was built under the superintendance of John Campbell and Joseph Riggs. A Rolling mill was added before 1847. Both the forge and rolling mill have long been abandoned. A forge was built at Sample's Landing, fifteen miles below Gallipolis, soon after 1830, to make blooms for the Covington rolling mill. Bloom forge was built at Portsmouth, in Scioto county, in 1832, and in 1857 a rolling mill was added. A forge called Benner's, on Paint creek, near Chillicothe, in Ross county, once owned by James & Woodruff, was abandoned about 1850. There never were many forges in Ohio for refining iron, and there have been few, if any, for making bar iron directly from the ore. The first iron enterprise in the state preceded by only a few years the building of rolling mills at Pittsburg.

The Globe rolling mill was built at Cincinnati in 1845. Joseph Kinsey writes us that it "was the first built in Cincinnati for the purpose of making general sizes of merchant iron, hoops, sheets, and plates. It was built by William Sellers and Josiah Lawrence, and was considered a great enterprise at that time. Soon afterwards a wire mill was added for the purpose of making the first wire used for the lines of telegraph extending through this country." The foregoing details relate to what may be termed the charcoal era of the Ohio iron industry. The second stage in the development of the iron industry of this state dates from the introduction in its blast furnaces of the bituminous coal of the Mahoning valley in its raw state. This coal is known as splint, or block coal, or as Brier Hill coal, from a locality of that name near Youngstown where it is largely mined. The first furnace in Ohio to use the new fuel was built expressly for this purpose at Lowell, in Mahoning county, in 1845 and 1846, by Wilkeson, Wilkes & Co., and it was successfully blown in on the 8th of August, 1846. The name of this furnace was Mahoning. A letter from John Wilkeson, now of Buffalo, New York, informs us that William McNair, a millwright, was the foreman who had charge of its erection. It was blown in by John Crowther, who had previously had charge of the furnaces of the Brady's Bend Iron Company, at Brady's Bend, Pennsylvania. Mr. Wilkeson and his brothers had for many years been prominent charcoal-iron manufacturers on the Western Reserve. They are of Scotch-Irish extraction. Their father was a native of Carlisle, Pennsylvania. Immediately after the successful use of uncoked coal in the furnace at Lowell many other furnaces were built in the Mahoning valley to use the new fuel, and it was also substituted for charcoal in some old furnaces. At a later day the use of this fuel and of Connellsville coke contributed to the further development of the manufacture of pig iron in Ohio, and at a still later and very recent date the opening of the extensive coal beds of the Hocking valley and the utilization of its carbonate ores still further contributed to the same development.

The beginning of the iron industry at Youngstown, which now has within its own limits or in the immediate vicinity twelve furnaces and six rolling mills, dates from about 1835, when a charcoal furnace called Mill Creek was built on a creek of the same name, a short distance southwest of the city, by Isaac Heaton, a son of James Heaton. There was no other furnace at Youngstown until after the discovery at Lowell that the block coal of the Mahoning valley could be successfully used in the smelting of iron ore. In a recent sketch of the history of Youngstown Hon. John M. Edwards says: "In 1846 William Philpot & Co. built in the northwestern part of Youngstown, adjoining the present city, and near the canal, the second furnace in the state for using raw mineral coal as fuel. In the same year a rolling mill was built in the southeastern part of the village, and adjoining the canal, by the Youngstown Iron Company. This mill is now owned by Brown, Bonnell & Co." In a sketch of *Youngstown, Past and Present*, printed in 1875, a fuller account is given of the first bituminous furnace at that place. It was known as the Eagle furnace, and was "built in 1846 by William Philpot, David Morris, Jonathan Warner, and Harvey Sawyer, on land purchased of Dr. Henry Manning, lying between the present city limits and Brier Hill. The coal used was mined from land contiguous, leased from Dr. Manning." The second furnace at Youngstown to use raw coal was built in 1847 by Captain James Wood, of Pittsburg. It was called Brier Hill furnace. The proximity of the coal fields of Ohio to the rich iron ores of Lake Superior has been an important element in building up the blast-furnace industry of the state. The use of these ores in Ohio soon followed the first use in the blast furnace of the block coal of the Mahoning valley. An increase in the rolling-mill capacity of Ohio was naturally coincident with the impetus given to the production of pig iron by the use of this coal and Lake Superior ores. David Tod, afterwards governor of Ohio, bore a prominent part in the development of the coal and iron resources of the Mahoning valley. The iron industry of Cleveland has been built up during this period, and the city is now one of the most prominent centers of iron and steel production in the country. Charles A. Otis, of Cleveland, writes us as follows concerning the first rolling mills in that city: "The first rolling mill at Cleveland was a plate mill, worked on a direct ore process, which was a great failure. It went into operation in 1854 or 1855. The mill is now owned by the Britton Iron and Steel Company. The next mill was built in 1856 by A. J. Smith and others, to reroll rails. It was called Railroad rolling mill, and is now owned by the Cleveland Rolling Mill Company. At the same time a man named Jones, with several associates, built a mill at Newburgh, six miles from Cleveland, also to reroll rails. It was afterwards operated by Stone, Chisholm & Jones, and is now owned by the Cleveland Rolling Mill Company. In 1852 I erected a steam forge to make wrought-iron forgings, and in 1859 I added to it a rolling mill to manufacture merchant bar, etc. The Union rolling mills were built in 1861 and 1862 to roll merchant bar iron."

In the list of persons connected with the development of the iron and steel industries of Cleveland, the name of Henry Chisholm is most prominent. Mr. Chisholm was born at Lochgelly, in Fifeshire, Scotland, on April 27, 1822, and died at Cleveland on May 9, 1881, aged 59 years. From 1846 to 1880 the iron industry of Ohio has made steady progress, and the state now ranks second among the iron producing states of the Union. This was also its rank in 1870.

Indiana.—Indiana possessed a small charcoal-iron industry before 1850, but at what period in the present century this industry had its beginning cannot now be definitely determined. Tench Coxe makes no reference to it in 1810, but mentions one nailery in the territory, which produced in that year 20,000 pounds of nails, valued at $4,000. He does not locate this enterprise. In 1840 the census mentions a furnace in Jefferson county, one in Parke, one in Vigo, one in Vermillion, and three in Wayne county, the total product being only 810 tons of "cast iron." A forge in Fulton county, producing twenty tons of "bar iron," is also mentioned. The census of 1840, however, frequently confounds furnaces with foundries, and it is therefore possible that some of the alleged furnaces in Indiana at that period were foundries. In 1859 Lesley enumerated five charcoal furnaces in Indiana, as follows: Elkhart, in Elkhart county, date of erection unknown; Laporte near the town of that name, in Laporte county, built in 1848; Mishawaka, in Saint Joseph county, built about 1833; Richland, on Richland creek, in Greene county, built in 1844 by A. Downing; and Indiana, a few miles northwest of Terre Haute, in Vigo county, built in 1839. The three last named were in operation in 1857, but were abandoned about 1860. Elkhart and La Porte furnaces were idle in 1857, and probably had been abandoned at that time. Elkhart, La Porte, and Mishawaka used bog ore exclusively, and Richland used it in part; in 1857 Mishawaka was still using it. Indiana furnace used brown hematite found in the neighborhood. In a chapter on the geology of Monroe county, by George K. Greene, printed in 1881, it is stated that "nearly forty years ago an iron furnace was erected by Randall Ross, of Virginia, on the lands of George Adams, of Monroe county, on section 7, township 7, range 2, west. The investment soon proved a failure, and the furnace has long since gone to decay. The ruins of the 'old iron furnace' are to-day the mournful monument of an early spirit of enterprise that deserved a better fate." The early Indiana furnaces doubtless made more castings than pig iron.

In 1860 there was only one furnace in blast in Indiana—Richland. It was abandoned probably in that year, and from this time until 1867 no pig iron was made in Indiana. In the latter year the manufacture of pig iron in this state was revived, the development of the block-coal district in the neighborhood of Brazil, in Clay county, having led to the belief that this fuel might be profitably used in blast furnaces. Planet furnace, at Harmony, in Clay county, built in the summer of 1867, and put in blast in November of that year, was the first of eight furnaces that were built in Indiana between 1867 and 1872 to use this coal, the ores for the furnaces being mainly obtained from Missouri and Lake Superior. Five of these furnaces were in Clay county. Of the eight furnaces built, four have been abandoned and torn down since 1872, and, of the remaining four, one is now using charcoal and three are using block coal. No furnaces have been built in Indiana since 1872. Except the solitary forge above mentioned we have no record of any forges or bloomaries having been built in Indiana at any period. The first rolling mill in the state was probably the Indianapolis mill, built by R. A. Douglas, which was completed in the autumn of 1857, and put in operation in November of the same year. Lesley in 1858 says: "The machinery and building were planned by Lewis Schofield, of Trenton, New Jersey, who also built the Wyandotte mill and is building the mill at Atlanta, Georgia." There were in 1880 nine rolling mills in Indiana, four of which were rail mills. The state contained no steel works in that year.

Illinois.—In 1839 a small charcoal furnace was built four miles northwest of Elizabethtown, in Hardin county, in the extreme southeastern part of Illinois, by Leonard White, Chalen Guard & Co. It was called Illinois. This is the first furnace in the state of which there is any record, and it probably had no predecessor. In 1853 it was purchased by C. Wolfe & Co., of Cincinnati, who tore down the stack and built a larger one in 1856, with modern editions. In 1873 this furnace, after having been out of blast for several years, was repaired, but it has not since been put in blast. A charcoal furnace called Martha was built in 1848 by Daniel McCook & Co. about two miles east of Illinois furnace. It was probably the second furnace in the state. Illinois and Martha furnaces were both in blast in 1850, but in 1860 only Illinois was in blast. Martha had not been in operation since 1856, and it probably never made any iron after that year. It has long been abandoned. These furnaces were supplied with limestone ore from the immediate neighborhood. They seem to have been the only charcoal-iron enterprises of any description that ever existed in Illinois. In the census of 1840 mention is made of a furnace in Cook county, one in Fulton, one in Hardin, and one in Wabash county. The furnaces in Fulton and Hardin counties were idle; the furnaces in Wabash county produced eight tons, and the furnace in Cook county produced 150 tons of "cast iron." As the census of 1840 frequently confounds blast furnaces with foundries, reliance cannot be placed in the correctness of its statements concerning furnaces in Illinois. We have definitely ascertained that there was no furnace in Cook county in that year, and that the furnace with which it is credited in the census was Granger's foundry, the only one in Chicago at that time.

There appears to have been no furnace in operation in Illinois from 1860 to 1868. Soon after the close of the civil war the attention of iron manufacturers was attracted to the Big Muddy coal fields, in the southwestern part of Illinois, and to the proximity to these coal fields of the rich iron ores of Missouri. In 1868 the Grand Tower Mining, Manufacturing, and Transportation Company, built two large furnaces at Grand Tower, in Jackson County, Illinois, to use the Big Muddy coal in connection with Missouri ores; and in 1871 another large furnace, called Big Muddy, was built at Grand Tower by another company, to use the same fuel and ores. The two Grand Tower furnaces have been out of blast for several years and are now abandoned, but the Big Muddy furnace is still in blast. At East Saint Louis the Meier Iron Company built two large coke furnaces between 1873 and 1875. These furnaces are now in operation, their fuel being mainly Carbondale coke from Jackson county, Illinois, The iron industry at Chicago and its vicinity properly dates from 1857, when Captain E. B. Ward, of Detroit, built the Chicago rolling mill, on the right bank of the Chicago river, "just outside of the city." This mill was built to re-roll iron rails. It formed the nucleus of the present very extensive works of the North Chicago Rolling Mill Company. There was no furnace at Chicago until 1868, when two furnaces were built by the Chicago Iron Company. They are now owned by the Union Iron and Steel Company. One was blown in early in 1869, and the other late in the same year. Two furnaces were built at Chicago in 1869 by the North Chicago Rolling Mill Company. No other furnaces were built in Chicago until 1880, when seven new furnaces were undertaken, three of which were finished in that year and two in 1881. At Joliet, thirty-seven miles southwest of Chicago, the Joliet Iron and Steel Company built two furnaces in 1873. They are now owned by the Joliet Steel Company. In 1880 there were thirteen rolling mills and steel works in Illinois, three of which were Bessemer steel works—two at Chicago and one at Joliet, and one was an open-hearth steel works at Springfield. At the beginning of 1880 there were ten blast furnaces in the state, and, as has been mentioned, three new furnaces were finished during the year and four others were undertaken. In 1880 Illinois ranked fourth among the iron and steel producing states of the Union, making a great stride since 1870, when it ranked fifteenth.

Michigan.—If we could credit the census of 1840 there were fifteen blast furnaces in Michigan in that year—one in each of the counties of Allegan, Branch, Cass, Kent, Monroe, and Oakland, two in Calhoun, two in Washtenaw, and five in Wayne county. Some of these alleged furnaces were doubtless foundries, particularly in counties lying upon or not very remote from Lake Erie, vessels upon which could bring pig iron for their use from neighboring states. Others were undoubtedly true blast furnaces, producing household and other castings from bog ores. All of the fifteen enterprises mentioned were in the southern part of the state. Their total production in 1840 was only 601 tons of "cast iron." Neither forges nor bloomaries are mentioned in the census of 1840. From 1840 to 1850 the iron industry of Michigan certainly made no progress, and possibly declined. From 1850 to 1860 a marked improvement took place. Three new furnaces were built in the southern part of the state to use bog ore, and in the northern peninsula and at Detroit and Wyandotte a commencement was made in smelting the rich ores which had been discovered in the now celebrated Lake Superior iron-ore region. In 1859 Lesley enumerated the following bog-ore furnaces in the southern part of the state: Kalamazoo, at the city of that name, in Kalamazoo county, built in 1857 to take the place of an earlier furnace; Quincy, three miles north of the town of that name, in Branch county, built in 1855; and Branch county, one mile from Quincy furnace, built in 1854. All of these bog-ore furnaces made pig iron in 1857. It is a curious fact that furnaces to use bog ore should have been built in this country after 1850. The development of the Lake Superior iron-ore region marks an important era in the history of the American iron trade, and the incidents attending its commencement have fortunately been preserved. We learn from A. P. Swineford's *History of the Lake Superior Iron District* that the existence of iron ore on the southern border of Lake Superior was known to white traders with the Indians as early as 1830. The same writer further informs us that the first discovery by white men of the iron ore of this region was made by William A. Burt, a deputy surveyor of the General Government, on the 16th of September, 1844, near the eastern end of Teal lake. In June, 1845, the Jackson Mining Company was organized at Jackson, Michigan, for the purpose of exploring the mineral districts of the southern shore of Lake Superior, and in the summer of the same year this company, through the disclosures of a half-breed Indian, named Louis Nolan, and the direct agency of an old Indian chief, named Man-je-ki-jik, secured possession of the now celebrated Jackson iron mountain, near the scene of Mr. Burt's discovery. It appears, however, that the representatives of the company had not heard of Mr. Burt's discovery until they met Nolan and the Indian chief. Mr. P. M. Everett, the president of the company, was the leading spirit of the exploring party which secured possession of this valuable property. The actual discovery of Jackson mountain was made by S. T. Carr and E. S. Rockwell, members of Mr. Everett's party, who were guided to the locality by the Indian chief.

In a letter written on the 10th of November, 1845, at Jackson, Michigan, Mr. Everett, referring to the ore of Jackson Mountain, says that "since coming home we have had some of it smelted, and find that it produces iron and something resembling gold—some say it is gold and copper." This smelting is not further described. In 1846 A. V. Berry, one of the Jackson Mining Company, and others, brought about 300 pounds of the ore to Jackson, and in August of that year, writes Mr. Berry, "Mr. Olds, of Cucush Prairie, who owned a forge, then undergoing repair, in which he was making iron from bog ore, succeeded in making a fine bar of iron from our ore in a blacksmith's fire—the first iron ever made from Lake Superior ore." Mr. Swineford says that "one end of this bar of iron Mr. Everett had drawn out into a knife-blade." In 1847 the Jackson Mining Company commenced the erection of a forge on Carp river, about ten miles from its mouth, and near Jackson mountain, which was finished early in 1848, and on the 10th of February of that year the first iron made in the Lake Superior region was made at this forge by Ariel N. Barney. Mr. Swineford says that the forge, which was named after Carp river, had "eight fires, from each of which a lump was taken every six hours, placed under the hammer, and forged into blooms four inches square and two feet long, the daily product being about three tons. The first lot of blooms made at this forge – the first iron made on Lake Superior, and the first from Lake Superior ores, except the small bar made by Mr. Olds—was sold to the late E. B. Ward, and from it was made the walking-beam of the side-wheel steamer *Ocean*." The forge was kept in operation until 1854, when it was abandoned, having in the mean time "made little iron and no money." In 1849 the Marquette Iron Company, a Worcester (Massachusetts) organization, undertook the erection of a forge at Marquette, and in July, 1858, it was finished and put in operation. Mr. Swineford says that it "started with four fires, using ores from what are now the Cleveland and Lake Superior mines." It was operated irregularly until December, 1853, when it was burned down and was not rebuilt.

The Collins Iron Company was organized in 1853, with Edward K. Collins, of New York, at its head, and in 1854 it built a forge on Dead river, about three miles northwest of Marquette, and in the fall of 1855 the manufacture of blooms was commenced from ore obtained at the company's mines. This forge was in operation in 1858, after which time it seems to have been abandoned.

Another forge on Dead river was built in 1854 or 1855 by William G. McComber, Matthew McConnell, and J. G. Butler. The company failed in a few years, and in 1860 Stephen R. Gay erected Bancroft furnace on the site of the forge. Before 1860 every forge in Michigan appears to have been abandoned. It will be observed that all of the first iron enterprises in the Lake Superior district were bloomary forges, the intention evidently having been to build up an iron industry similar to that of the Lake Champlain district. The first pig iron produced in the Lake Superior region was made in 1858 by Stephen R. Gay, who then leased the forge of the Collins Iron Company and converted it in two days, at an expense of $50, into a miniature blast furnace. Mr. Gay writes to C. A. Trowbridge that this furnace was "2½ feet across the bosh, 8 feet high, and 12 inches square at the top and 15 inches square in the hearth," and would hold eight bushels of coal. He gives the following details of its first and only blast: "Began on Monday, finished and fired on Wednesday, filled with coal Thursday noon, blast turned on Friday noon, and thenceforth charged regularly with 1 bushel coal, 20 pounds of ore, and 7 pounds of limestone. Cast at six o'clock 500 pounds, and again at eight o'clock Saturday morning, half a ton in all, 92 pounds of which were forged by Mr. Eddy into an 85-pound bloom. This little furnace was run two and a half days, made 2½ tons, carrying the last eight hours 30 pounds of ore to a bushel of coal, equal to a ton of pig iron to 100 bushels of coal." These experiments were made in February. The first regular blast furnace in the Lake Superior region was built by the Pioneer Iron Company in the present city of Negaunee, convenient to the Jackson mine. It was commenced in June, 1857, and in February, 1858, it was finished. Another stack was added in the same year. These furnaces took the name of the company. Pioneer No. 1 was put in blast in April, 1858, and Pioneer No. 2 on May 20th, 1859. Both furnaces are now owned by the Iron Cliffs Company, and both were in operation in 1880. The second regular blast furnace in this region was the Collins furnace, built in 1858 by Stephen R. Gay, near the site of the Collins forge. It made its first iron on December 13th of that year. It was abandoned in 1873, owing to the failure of a supply of charcoal. Other furnaces in the Lake Superior region soon followed the erection of the Pioneer and Collins furnaces. While these early furnaces and the few forges that have been mentioned were being built on the shore of Lake Superior two furnaces were built at or near Detroit to smelt Lake Superior ores. These were the Eureka furnace, at Wyandotte, built in 1855 by the Eureka Iron Company, of which Captain E. B. Ward was president, and put in blast in 1856; and the Detroit furnace, at Detroit, built in 1856 by the Detroit and Lake Superior Iron Manufacturing Company, of which George B. Russell was president, and put in blast in January, 1857. These furnaces and the others that have been mentioned used charcoal as fuel.

The first shipment of iron ore from the Lake Superior region was made in 1850, according to Mr. Swineford, and consisted of about five tons, "which was taken away by Mr. A. L. Crawford, of Newcastle, Pennsylvania." A part of this ore was made into blooms and rolled into bar iron. "The iron was found to be most excellent, and served to attract the attention of Pennsylvania ironmasters to this new field of supply for their furnaces and rolling mills." In 1853 three or four tons of Jackson ore were shipped to the World's Fair at New York. The first use of Lake Superior ore in a blast furnace occurred in Pennsylvania. The important event is described in a letter to us from David Agnew, of Sharpsville, Mercer county, Pennsylvania, from which we quote as follows:

The Sharon Iron Company, of Mercer county, Pennsylvania, about the year 1850 or 1851 purchased the Jackson mines, and, in expectation of the speedy completion of the Sault canal, commenced to open them, to construct a road to the lake, and to build docks at Marquette, expending a large sum of money in these operations. The opening of the canal was, however, unexpectedly delayed until June, 1855. Anxious to test the working qualities of this ore, the Sharon iron Company brought, at great expense, to Erie, in the year 1853, about 70 tons of it, which was shipped by canal to Sharpsville furnace, near Sharon, owned by David and John P. Agnew. The first boat-load of ore, on its receipt, was immediately used in the furnace, partly alone and partly in mixture with native ores, and the experiment was highly successful, the furnace working well and producing an increased yield of metal, which was taken to the Sharon Iron works and there converted into bar iron, nails, etc., of very superior quality. The second boat-load of ore was also brought to Sharpsville, but, having been intended to be left at the Clay furnace, owned by the Sharon Iron Company, was returned and used at that establishment.

In 1854, 1855, and 1856 Clay furnace continued the use of Lake Superior ore, most of it mixed with native ore, and used in all until August, 1856, about 400 tons. "Up to that date," as is stated by Mr. Frank Allen, its manager, "the working of it was not a success. In October, 1856, we gave the Clay furnace a general overhauling, put in new lining and hearth, and made material changes in the construction of the same, put her in blast late in the fall, and in a few days were making a beautiful article of iron from Lake Superior ore alone." The fuel used at Sharpsville and Clay furnaces was the block coal of the Shenango valley. After 1856 other furnaces in Pennsylvania and in other states began the regular use of Lake Superior ore. Until about 1877 the mining of iron ore in the Lake Superior region was confined to the territory in the immediate vicinity of Marquette. Since 1877, and particularly since 1879, a new iron-mining region has been developed in the northern part of Menominee county and the southern part of Marquette county, which takes its name from the former county. This region has proved to be very productive and the ore to be very desirable. Since the discovery of iron ore in the Lake Superior region there have been built on the upper peninsula, in the vicinity of the mines, twenty-three furnaces, of which ten have been abandoned. There have also been built at other points in the state of Michigan, to use Lake Superior ore, fifteen furnaces, of which none had been abandoned in 1880. All of these furnaces, with the exception of two at Marquette, were built to use charcoal, and the abandonment of many of them in the upper peninsula is attributable to the scarcity of timber for fuel. Michigan is, however, the first state in the Union to-day in the manufacture of charcoal pig iron, having twenty-eight furnaces of which all but one furnace at Marquette now use charcoal when in operation. The three bog-ore furnaces in Kalamazoo and Branch counties have been abandoned.

There are now two active rolling mills in Michigan—the Eureka, formerly the Wyandotte, at Wyandotte, built in 1855, and the rolling mill of the Baugh Steam Forge Company, at Detroit, built in 1877, the forge having been built in 1870. In 1871 a rolling mill was built at Marquette, which has since been abandoned. In 1872 a rolling mill was built at Jackson, in Jackson county, but it was torn down in 1879, and the machinery removed to the mill of the Springfield Iron Company at Springfield, Illinois. From the Marquette *Mining Journal*, edited by Mr. Swineford, we take the following statement in gross tons of the aggregate production of the Lake Superior iron-ore mines for each calendar year since the commencement of mining operations in the district.

Year.	Gross tons.	Year.	Gross tons.
1856 and previous	86,319	1870	859,507
1857	25,646	1871	813,984
1858	22,876	1872	948,553
1859	68,832	1873	1,195,234
1860	114,401	1874	935,488
1861	114,258	1875	910,840
1862	124,169	1876	993,311
1863	203,955	1877	1,025,129
1864	247,059	1878	1,125,093
1865	193,758	1879	1,414,182
1866	296,713	1880	1,987,598
1867	465,504	1881	2,321,315
1868	510,522		
1869	639,097	Total	15,321,128

The iron ores of Lake Superior that are not used in Michigan are mainly shipped to Ohio, Pennsylvania, Illinois and Wisconsin. About one-third of all the pig iron that is now manufactured in the United States is made from these ores. Captain Ward was the most prominent of all the iron manufacturers of Michigan, his enterprise in this respect extending to other states than his own. He was born in Canada, of Vermont parents, on December 25, 1811, and died suddenly at Detroit, on January 2, 1875. In 1870 Michigan ranked eighth in the list of iron-producing states, and in 1880 its rank was the same.

Wisconsin.—In 1840 the census mentions a furnace in "Milwaukee town," which produced three tons of iron in that year. This was doubtless a small foundry. In 1859 Lesley mentions three charcoal furnaces in Wisconsin—Northwestern, or Mayville, at Mayville, in Dodge county, forty miles northwest of Milwaukee, and five miles from the Iron ridge, built in 1853 by the owners of Mishawaka furnace in Indiana, and to which a foundry was added in 1858; Ironton, at Ironton, in Sauk county, built in 1857 by Jonas Tower; and Black River, built in 1857 by a German company on the east bank of Black river, near the falls, in German county. Of these furnaces at least one, Ironton, was built to produce castings. A description of it in 1858 says: "It is a small blast furnace capable of producing about three tons of iron per day, and intended for the manufacture of stoves, castings, etc." The Ironton furnace still produces castings as well as pig iron. The Mayville furnace is also still in operation, having been rebuilt in 1872, but the Black River furnace has long been abandoned. There appear to have been no forges or bloomaries in Wisconsin in 1840, 1850, or 1860. The furnaces which have been mentioned were all that the state could boast until 1865, when a charcoal furnace at Iron Ridge, in Dodge county, was built by the Wisconsin Iron Company. This was soon followed by several other furnaces, some of which were built to use native ores and some to use Michigan ores from Lake Superior. The Appleton Iron Company built two furnaces at Appleton, in Outagamie county, in 1871 and 1872; C. J. L. Meyer built a furnace at Fond du Lac in 1864, but it had not been put in blast down to November 15, 1881; the Fox River Iron Company built two furnaces at West Depere, in Brown county, in 1869 and 1872; the Green Bay Iron Company built a furnace at Green Bay, in the same county, in 1870; and the National Furnace Company built two furnaces at Depere, in the same county, in 1869 and 1872. All of these furnaces were built to use charcoal. In 1870 and 1871 the Milwaukee Iron Company built two large furnaces at Bay View, near Milwaukee, and in 1873 the Minerva Iron Company built a furnace at Milwaukee. These three furnaces were built to use mineral fuel and Lake Superior ores. A furnace called Richland was built in 1876 at Cazenovia, in Richland county, and was torn down in 1879. In 1880 there were fourteen furnaces in the state, eleven of which used charcoal and three used anthracite coal and coke. Wisconsin had no rolling mill until 1868, when its first and thus far only mill was built at Milwaukee by the Milwaukee Iron Company, of which Captain E. B. Ward was a leading member. This was from the first a large mill, and was built to roll new iron rails. In 1874 a merchant bar mill was added. This mill and the two Bay View furnaces are now operated by the North Chicago Rolling Mill Company. Wisconsin advanced rapidly in the manufacture of iron in the decade between 1870 and 1880, and in the latter year it ranked sixth among the iron-producing states of the Union. In 1870 it was twelfth in rank.

Missouri.—Missouri has an iron history which antedates its admission into the Union in 1820. The celebrated iron district, in Iron and Saint Francois counties, which embraces Iron Mountain and Pilot Knob, contained a blast furnace before 1819, and possibly as early as 1812 or 1814, as we find in a prospectus of the Missouri Iron Company, written in 1837, the statement that "cannon balls, made from the Iron Mountain ore during the late war, after having been exposed for several years to the open atmosphere and rains, still maintained their original metallic lustre." The cannon balls referred to would probably be used for the defense of New Orleans. This furnace was called Springfield, and was situated in the vicinity of Iron Mountain, and about forty miles from the Mississippi river, but its exact location we cannot learn. It was in Washington county as the county was then bounded. In 1858 Lesley says that "an old charcoal furnace was once in operation in township 33, range 4 north, half section 2" of Iron county. This may have been Springfield furnace. John Perry and Colonel Ruggles, whether jointly or severally the authority from which we quote does not state, operated Springfield furnace "for more than fifteen years" prior to 1837. In that year the furnace was in operation, when it was called "a small furnace." A forge was then attached to it, and "a blooming forge" was promised "the ensuing year." Maramee furnace, in Phelps county, about sixty miles west of Iron Mountain, was built in 1826, and rebuilt many years afterwards. It is still standing but not in operation. At an early day a forge was added to the furnace, to convert its pig iron into bar iron, and this forge, with eight fires, is also still standing but not in operation, its product when last employed being charcoal blooms. In 1843 a rolling mill was added, but it was "abandoned after one year's trial, because of the sulphur in the stone coal obtained at a bank fourteen miles southeast." In the census of 1840 Missouri is credited with two furnaces—one in Crawford county, and one in Washington county. It is also credited with three forges in Crawford county and one in Washington county. The furnace in Crawford county was Maramec—Phelps county not having been then organized, and the forges in Crawford county were probably attached to Maramec furnace. The furnace in Washington county was Springfield, and the forge was doubtless the one attached to this furnace We do not hear of Springfield furnace and forge after this time. In 1836 the remarkable iron-ore mountains already mentioned—Iron Mountain and Pilot Knob—attracted the attention of some Misssouri capitalists, and in the fall of that year the Missouri Iron Compay, with a nominal capital of $5,000,000, was formed to utilize their ores, the legislature chartering the company on December 31, 1836. In January, 1837, the company was fully organized under the presidency of Silas Drake, of Saint Louis, who was soon succeeded by J. L. VanDoren, of Arcadia, but active work in the development of its property does not appear to have been undertaken until some years afterwards when a few furnaces were erected at the foot of the mountains by other companies. In 1846 a furnace was built at the southwest base of Little Iron Mountain, which was followed in 1850 by another furnace at the same place, and in 1854 by still another. In 1849 a furnace was built on the north side of Pilot Knob, which was followed in 1855 by another at the same place. These were all charcoal furnaces, and were exceptionally well managed in 1857, when they were visited and described by Charles B. Forney, of Lebanon, Pennsylvania. At that time two of the Iron Mountain furnaces and one of the Pilot Knob furnaces were blown with hot blast.

In 1846 Moselle furnace was built at Moselle, in Franklin county, and in 1859 a furnace was built at Irondale, in Washington county—both furnaces to use charcoal. These, with the furnaces previously mentioned, appear to be all that were built in Missouri prior to 1860. It will be observed that they were all built in the same part of the state—southwest of Saint Louis.

The iron industry of Saint Louis appears to have had its commencement in 1850, when the Saint Louis, or Laclede, rolling mill was built. It was followed by the Missouri rolling mill, built in 1854; by the Allen rolling mill, built in 1855; by the Pacific rolling mill, built in 1856; and by Raynor's rolling mill, built in 1858. In 1880 there were seven rolling mills in Saint Louis, and there were no others in Missouri. One of these mills, the Vulcan, built in 1872, was connected with the Bessemer steel works of the Vulcan Steel Company and rolled steel rails. Two other mills rolled light rails and bar iron. The Bessemer works of the Vulcan Steel Company were built in 1875 and 1876. The state had no other steel works in 1880. Saint Louis had no blast furnaces until 1863, when the Pioneer furnace was built at Carondelet, to use coke. It was in blast in 1873, but in 1874 it was torn down and removed by the Pilot Knob Iron Company. In 1869 the Vulcan Iron Works, now called the Vulcan Steel Company, built two furnaces, which were followed in 1872 by another furnace built by the same company. In 1870 and 1872 the South Saint Louis Iron Company built two furnaces; in 1870 the Missouri Furnace Company built two; and in 1873 Jupiter furnace was built, but it was not put in blast until 1880. These eight furnaces were all built to use Illinois or Connellsville coke and Missouri ores. In 1871 a large forge was built at South Saint Louis, called the Germania iron works, to make charcoal blooms from pig iron, but it has been idle for several years. In 1863 a forge was built at Kimmswick, in Jefferson county, and enlarged and remodeled in 1877 by the Peckham Iron Company, its product after the enlargement being charcoal blooms from the ore. It was in operation in 1880. There were in 1880 ten charcoal furnaces and eight coke furnaces in Missouri, and two charcoal furnaces were in course of erection. During the decade between 1870 and 1880 the iron industry of Missouri was subject to exceptional vicissitudes, but in the latter year it was apparently placed upon a more substantial basis of prosperity than it had ever before occupied, and to-day its future is hopeful, although it has lost the prominent rank it held among iron-producing states in 1870. It then ranked sixth, but in 1880 it had fallen to the tenth place. The shipments of iron ore from Missouri to other states have for many years averaged over 100,000 tons annually.

Minnesota has one furnace, situated at Duluth, which was commenced in 1873 and not finished until 1880, when it was put in blast. Its projectors failed, and after passing through the hands of creditors it was purchased by the Duluth Iron Company, its present owners. It uses charcoal as fuel and obtains its supply of ore from the Lake Superior mines in Michigan.

Arkansas.—In 1857 a bloomary called Big Creek was built about six miles southwest of Smithville, in Lawrence county, Arkansas, by Alfred Bevens & Co. In 1858 Lesley describes it as "a bloomary with two fires and a hammer, making 250 pounds of swedged iron per day per fire, with a cold-blast in November, 1857, but has now a hot-blast, and is making perhaps 800 pounds, using 300 bushels of charcoal to the ton of finished bars, made out of brown hematite ore." The bloomary was driven by water-power. It is not mentioned in the census of 1860 or 1870, and has been abandoned. We have no knowledge of any other iron-manufacturing enterprise having ever existed in this state.

Texas.—Texas does not appear to have had any iron enterprises of any kind before the civil war, but three small furnaces are reported to have been abandoned at the close of the war. They were probably built during its continuance to meet the necessities of the Confederate government. In 1869 a charcoal furnace was built at Jefferson, in Marion county, which was rebuilt in 1874. It was in operation in 1880, and was then the only furnace in the state. It is called Kelly furnace, after Mr. G. A. Kelly, the president of the Jefferson Iron Company, by which it is owned. It uses brown hematite ore found in the neighborhood.

Kansas had two rolling mills in operation in 1880, both of which were built to reroll rails. One of these, at Rosedale, in Wyandotte county, three miles from Kansas City, is owned by the Kansas Rolling Mill Company. This mill was once in operation at Decatur, Illinois, where it was built in 1870, and whence it was removed to Rosedale in 1875. The other mill is located at Topeka, and was built in 1874 by the Topeka Rolling Mill Company. This mill was burned in April, 1881, but will probably be rebuilt.

Nebraska.—Nebraska had one iron enterprise in operation in 1880—a rolling mill and cut-nail factory at Omaha, owned by the Omaha Iron and Nail Company. These works were first built at Dunleith, Illinois, in 1875 and 1876, and were removed to Omaha in 1879 and considerably enlarged. They have a capacity of 60,000 kegs of nails annually. They use old iron exclusively.

Colorado.—In 1877 a rolling mill was removed by William Faux from Danville, Pennsylvania, to Pueblo, Colorado, and put in operation on March 1, 1878, its product being rerolled rails. In the same year it was removed to Denver. It was in operation in 1880, rolling bar iron as well as rerolling rails. This mill is now owned by the Colorado Coal and Iron Company. In 1880 this company commenced the erection of a large coke furnace at South Pueblo, in Colorado, which was put in blast on September 7, 1881. In the former year it commenced the construction of Bessemer steel works at the same place. These enterprises are the pioneers of a very extensive and complete iron and steel establishment which has been projected by this company, and which is to embrace two blast furnaces, Bessemer steel works, and a rolling mill for rolling steel rails. Coke works on an extensive scale have already been built by the company at El Moro. The number of ovens now completed is over 200, and others are being erected. Colorado has apparently a great future before it in the production of iron and steel, all the elements necessary to their manufacture being found within its limits.

Wyoming.—The Union Pacific Railroad Company built a rolling mill to reroll rails at Laramie City, Wyoming territory, in 1874, and put it in operation in April, 1875. It was in operation in 1880.

Utah.—In 1859 Lesley reported a forge in Utah territory, "smelting iron ore found in the mountains east of Salt Lake City, but no reliable information could be obtained respecting it." It does not appear in the census of 1860. Dr. J. S. Newberry writes that in 1880 he "visited the deposit of crystalline iron ore of Iron county, in the southern part of the territory. These ore beds have been long known, and were to some extent utilized by the Mormons in their first advent thirty years ago. The iron region referred to lies nearly 300 miles directly south of Salt Lake City." In 1874 the Great Western Iron Company, of which John W. Young was president, built a charcoal furnace at Iron City, in Iron county. It was in blast in that year and in the two following years, but has since been idle. This is a very small furnace, being only nineteen feet high and four feet wide at the boshes, with a daily capacity of five tons. The erection of a much larger furnace, also to use charcoal, was commenced at Ogden City, Utah, in 1875, by the Ogden Iron Manufacturing Company, and was intended to use hematite and magnetic ores found in the neighborhood. The furnace had not been put in blast at the close of 1880, and was not then entirely completed. The same company commenced to build a rolling mill at Oregon City in 1875, which had not been completed in 1880.

California.—California has for many years had a very complete rolling mill at San Francisco, owned by the Pacific Rolling Mill Company. It was first put in operation on July 25, 1868. It rolls rails, bar iron, angle iron, shafting, etc. It was in operation in 1880, and has always been well employed. The California Iron Company commenced in 1880 the erection of a charcoal furnace at Clipper Gap, in Placer county, where iron ore had been discovered, and in the same year the Central Pacific Railroad Company commenced the erection at Sacramento City of a small mill to roll bar iron. The Clipper Gap furnace was successfully put in blast in April, 1881, and the first cast was made on the 24th of that month. California may have had a forge or two while it was Mexican territory, but it is doubtful whether its Mexican inhabitants ever engaged in the manufacture of iron.

Oregon.—At Oswego, in Clackamas county, Oregon, a furnace to use charcoal was built in 1866 and enlarged in 1879. It was in blast in 1880, when it produced 5,000 net tons of pig iron. Its charcoal is made exclusively from the fir tree.

Washington Territory.—A furnace at Irondale, near Port Townsend, in Jefferson county, Washington territory, was built in 1880, and put in blast early in 1881. It is a small furnace, and was built to make charcoal pig iron from Puget sound bog ore mixed with Texada Island magnetic ore. It is owned by the Puget Sound Iron Company, of Port Townsend. The company is said to contemplate the erection of another blast furnace on Texada Island, which is in British Columbia.

The First Iron Works in Canada.—A brief notice of the first iron works in Canada seems proper to be inserted here, more especially as these works are still in operation. They are known as the Forges of the St. Maurice, and are located near Three Rivers, in the province of Quebec. Mr. A. T. Freed, one of the editors of the Hamilton (Ontario) *Spectator*, informs us that iron ore in the vicinity of Three Rivers was discovered as early as 1666. In 1685 the Marquis de Denouville sent to France a sample of the ore at Three Rivers, which the French ironworkers found to be "of good quality and percentage." In 1672 the Count de Frontenac reported that he had begun to mine the ore at Three Rivers. He strongly urged the establishment of forges and a foundry. But no effort to establish iron works at this place appears to have been made until the next century, when the St. Maurice works were undertaken. Dr. T. Sterry Hunt, of Montreal, has supplied us with the following brief history of these works.

"King Louis XIV. gave a royal license in 1730 to a company to work the iron ores of St. Maurice and the vicinity, and advanced 10,000 livres for aid in erecting the furnace, etc. No work being done he took back the license, and in 1735 granted it to a new company, which received 100,000 livres in aid and in 1737 built a blast furnace. In 1843, however, the works reverted to the crown, and were worked for the king's profit. He then sent out from France skilled workmen, who rebuilt, in part at least, the blast furnace as it now stands, and erected a Walloon hearth, which is still in use, for refining. The works became the property of the British Crown at the conquest, and were at first rented to a company and afterwards sold. Smelting has been carried on at this place without interruption to the present time, the bog ores of the region being exclusively used. Three tons of ore make one ton of iron.

There seems to be no doubt that the stack is the one built in 1737, and is still in blast. It is 30 feet high, and the internal diameter at the hearth is 2½ feet, at the boshes 7 feet, and at the throat 3½ feet. There are two tuyeres, and the blast is cold, with a pressure of one pound. The daily production of iron is four tons, and the consumption of charcoal is 180 bushels, (French,) of about 12 pounds each, per ton of iron. The metal was formerly used in the district for ordinary castings, but is now in great demand for car wheels. A very little is, however, refined in the Walloon hearth, and is esteemed by the blacksmiths for local use. The analysis of a sample of the gray pig of St. Maurice made by me in 1868 gave: Phosphorus, .450; silicon, .860; manganese, 1.240; graphite, 2.820; carbon combined, 1.100."

In addition to the above information from Dr. Hunt, we find some facts of interest concerning the St. Maurice iron works in Peter Kalm's *Travels into North America*, written in 1749.

"The iron work, which is the only one in this country, lies three miles to the west of Trois Rivieres. Here are two great forges, besides two lesser ones to each of the greater ones, and under the same roof with them. The bellows were made of wood, and everything else as it is in Swedish forges. The melting ovens stand close to the forges, and are the same as ours. The ore is got two French miles and a half from the iron works, and is carried thither on sledges. It is a kind of moor ore, which lies in veins, within six inches or a foot from the surface of the ground. Each vein is from six to eighteen inches deep, and below it is a white sand. The veins are surrounded with this sand on both sides, and covered at the top with a thin mould. The ore is pretty rich and lies in loose lumps in the veins, of the size of two fists, though there are a few which are eighteen inches thick. These lumps are full of holes, which are filled with ochre. The ore is so soft that it may be crushed betwixt the fingers. They make use of the grey limestone, which is broke in the neighborhood, for promoting fusibility of the ore; to that purpose they likewise employ a clay marble, which is found near this place. Charcoals are to be had in great abundance here, because all the country round this place is covered with woods which have never been stirred. The charcoals from evergreen trees. that is from the fir kind, are best for the forge, but those of deciduous trees are best for the smelting oven. The iron which is here made was to me described as soft, pliable, and tough, and it is said to have the quality of not being attacked by rust so easily as other iron; and in this point there appears a great difference between the Spanish iron and this in shipbuilding.

This iron work was first founded in 1737, by private persons, who afterwards ceded it to the king; they cast cannon and mortars here, of different sizes, iron stoves, which are in use all over Canada, kettles, etc., not to mention the bars which are made here. They have likewise tried to make steel here, but cannot bring it to any great perfection, because they are unacquainted with the manner of preparing it."

Mr. Freed says that the French company which established the St. Maurice iron works in 1737 was known as *Cugnet et Cie.* He also says that there was a French garrison at Trois Rivieres at the time, and that the soldiers were the principal workmen. He sends us a copy of a report made in 1752 to M. Bigot, Intendant of New France, residing at Quebec, by M. Franquet, who had been instructed to visit and examine the St. Maurice works. From this report the following extract is taken:

On entering the smelting forge I was received with a customary ceremony; the workmen moulded a pig of iron about 15 feet long for my especial benefit. The process is very simple; it is done by plunging a large ladle into the liquid-boiling ore and emptying the material into a gutter made in the sand. After this ceremony, I was shown the process of stove moulding, which is also a very simple but rather intricate operation. Each stove is in six pieces, which are separately moulded; they are fitted into each other and form a stove about three feet high. I then visited a shed where the workmen were moulding pots, kettles, and other hollow-ware. On leaving this part of the forge we were taken to the hammer forge, where bar iron of every kind is hammered out. In each department of the forges the workmen observed the old ceremony of brushing a stranger's boots, and in return they expect some money to buy liquor to drink the visitor's health. The establishment is very extensive, employing upward of 180 men. Nothing is consumed in the furnaces but charcoal, which is made in the immediate vicinity of the post. The ore is rich, good, and tolerably clean. Formerly it was found on the spot; now the director has to send some little distance for it. This iron is preferred to the Spanish iron, and is sold off in the king's stores in Quebec.

Still quoting from Mr. Freed, we learn that in 1815 a visitor to the St. Maurice works wrote as follows: "The foundry itself is replete with convenience for carrying on an extensive concern; furnaces, forges, casting-houses, workshops, etc. The articles manufactured consist of stoves of all descriptions that are used throughout the provinces, large caldrons or kettles that are used for making potashes, machinery for mills, with cast or wrought iron-work of all denominations. There are likewise large quantities of pig and bar iron exported. The number of men employed is from 250 to 300." The works remained in the ownership of the British government until 1846, when they were sold to Henry Stuart. The latest information concerning them is contained in a report to the Dominion Parliament in 1879, which says that they were then owned by F. Macdougall & Son, of Three Rivers, and were using bog ore and making good iron with charcoal. "The first furnace was erected in 1737; still running; capacity four tons."

—Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.

THE MANUFACTURE OF IRON WITH ANTHRACITE COAL.

THE details given above of the early iron history of the Atlantic states of the Union relate almost entirely to the manufacture of charcoal iron, no other fuel than charcoal having been used in American blast furnaces until about 1840. The period of our iron history prior to 1840 may therefore very properly be styled the charcoal era.

The line which separates the charcoal era of our iron history from the era which succeeded it, and which may be said to still continue, is marked by the introduction of anthracite and bituminous coal in the manufacture of pig iron. This innovation at once created a revolution in the whole iron industry of the country. Facilities for the manufacture of iron were increased; districts which had been virtually closed to the manufacture because of a local scarcity of charcoal were now opened to it; and the cheapening of prices, which was made possible by the increased production and consequent increased competition, served to stimulate consumption. A notable effect of the introduction of mineral fuel was that, while it seriously affected the production of charcoal pig iron in States which, like Pennsylvania, possessed the new fuel, it did not injuriously affect the production of charcoal pig iron in other States. Some of these States, like Michigan, which scarcely possessed an iron industry of any kind in 1840, now manufacture large quantities of charcoal pig iron. The country at large now annually makes more charcoal pig iron than it did in 1840 or in any preceding year. The introduction of mineral fuel did not, therefore, destroy our charcoal iron industry, but simply added to our resources for the production of iron. This introduction, however, marked such radical changes in our iron industry, and so extended the theatre of this industry, that we are amply justified in referring to it as a revolution, and as one which ended the distinctive charcoal era. Of the two forms of mineral fuel—anthracite and bituminous coal—anthracite was the first to be largely used in American blast furnaces, and for many years after its adaptability to the smelting of iron ore was established it was in greater demand for this purpose than bituminous coal. In recent years the relative popularity of these two fuels for blast furnace use has been reversed. The natural difficulties in the way of the successful introduction of anthracite coal in our blast furnaces were enhanced by the fact that, up to the time when we commenced our experiments in its use, no other country had succeeded in using it as a furnace fuel The successive steps by which we were enabled to add the. manufacture of anthracite pig iron to that of charcoal pig iron will be presented in chronological order. In 1840 Jesse B. Quinby testified, in the suit of Farr & Kunzi against the Schuylkill Navigation Company, that in 1815 he used anthracite coal for a short time at Harford furnace, Maryland, mixed with one-half charcoal. Between 1824 and 1828 Peter Ritner, whose brother, Joseph Ritner, afterwards became Governor of Pennsylvania, was successful for a short time in using anthracite coal in a charcoal furnace in Perry county, Pennsylvania, mixed with charcoal. In 1826 the Lehigh Coal and Navigation Company erected near Mauch Chunk, in Pennsylvania, a small furnace intended to use anthracite coal in smelting iron ore. The enterprise was not successful. In 1827 unsuccessful experiments in smelting iron ore with anthracite coal from Rhode Island were made at one of the small blast furnaces in Kingston, Plymouth county, Massachusetts. In 1827 and 1828 a similar failure in the use of anthracite coal took place at Vizille, iu France. All of these experiments failed because the blast used was cold. The hot-blast had not then been invented.

In 1828 James B. Neilson, of Scotland, obtained a patent for the use of hot air in the smelting of iron ore in blast furnaces, and in 1829 pig iron was made in several Scotch furnaces with the apparatus which he had invented. But the coal used was bituminous. It was not until 1836 that the smelting of iron ore with anthracite coal by means of the hot-blast invented by Neilson was undertaken in Great Britain. In the mean time the application of the hot-blast to anthracite coal in American furnaces was successfully experimented upon by an enterprising German-American, the Rev. Dr. Frederick W. Geissenhainer, a Lutheran clergyman of New York city. A copy in his own handwriting of a letter written by him in November, 1837, to the commissioner of patents, gives some interesting and valuable details concerning his experiments. In this letter, which we have before us, he says: "I can prove that, in the month of December, 1830, and in the months of January, February, and March, 1831, I had already invented and made many successful experiments as well with *hot air* as with an atmospheric air blast to smelt iron ore with anthracite coal in my small experimenting furnace here in the city of New York."

On the 5th of September, 1831, Dr. Geissenhainer filed in the patent office at Washington an account of his invention for which he claimed a patent. On the 19th of December, 1833, a patent was granted to him for a "new and useful improvement in the manufacture of iron and steel by the application of anthracite coal." From the long and remarkably clear and learned specification by the Doctor, which accompanied the patent, we learn that he discovered that iron ore could be smelted with anthracite coal by applying "a blast, or a column, or a stream or current of air in or of such quantity, velocity, and density or compression as the compactness or density and the continuity of the anthracite coal requires. The blast may be of common atmospheric *or of heated air*. Heated air I should prefer in an economical point of view." The Doctor distinctly disclaims in his specification "an exclusive right of the use of heated air for any kind of fuel," from which it is to be inferred that he had full knowledge of Neilson's experiments with hot air in Scotland. He appears to have relied for success largely upon the effect of a strong blast.

The patent having been granted, Dr. Geissenhainer proceeded to build a furnace for the practical application of his invention. This was Valley furnace, situated on Silver creek, in Schuylkill county, Pennsylvania, about ten miles northeast of Pottsville. In August and September, 1836, he was successful in making pig iron at this furnace exclusively with anthracite coal as fuel. His own testimony on this point is given in the letter from which we have already quoted. The blast used varied from $3\frac{1}{2}$ to $3\frac{1}{4}$, to 3, and to $2\frac{3}{4}$ pounds to the square inch. That the furnace did not continue to make iron after the fall of 1836 is explained by Dr. Geissenhainer to have been due to an accident to its machinery. He adds: "My furnace would have been put in operation again long before this time, with strong iron machinery and a hot-air apparatus, had I not been prevented by the pressure of the times and by a protracted severe sickness from bestowing my attention to this matter. The drawings for the iron machinery and for the hot-air apparatus are already in the hands of Messrs. Haywood & Snyder, in Pottsville, who are to do the work." The blast used in August and September, 1836, was heated. Before the Doctor's plans for improving his furnace were completed he was called to another world. He died at New York on the 27th of May, 1838, aged sixty-six years and eleven months. He was born at Muhlberg, in the Electorate of Saxony, in 1771, and came to this country when about eighteen years old. His remains rest in the family burial vault in the Lutheran cemetery in Queen's county, New York. Prior to his erection of Valley furnace, Dr. Geissenhainer had been engaged in the development of the iron and coal resources of Pennsylvania. As early as 1811 he was associated with Peter Karthaus, of Baltimore, in the mining of bituminous coal in Clearfield county, and a few years later in the ownership of a charcoal furnace in that county. For two or three years before 1830 he owned and operated a small charcoal furnace in Schuylkill county, and it was near this furnace that he afterwards built Valley furnace. Attached to the charcoal furnace was a puddling furnace. He was the pioneer in the development of the Silver creek anthracite coal mines, the projector of the Schuylkill Valley Railroad, and the sole owner of the Silver Creek Railroad. Dr. Geissenhainer was, as will be seen, a man of great enterprise. His memory as the first successful manufacturer of pig iron with anthracite coal and the hot-blast is entitled to greater honor than it has yet received. On the 28th of September, 1836, when Dr. Geissenhainer's Valley furnace was successfully making pig iron, and almost three years after the Doctor had obtained a patent for his invention, George Crane, the owner of several furnaces at Yniscedwin, in South Wales, obtained a patent from the British government for the application of the hot-blast to the smelting of iron ore with anthracite coal. On the 7th of February, 1837, he successfully commenced the use of anthracite with the hot-blast at one of his furnaces, obtaining 36 tons a week. In May of that year Solomon W. Roberts, of Philadelphia, visited his works and witnessed the complete success of the experiment, which was the first successful experiment with anthracite coal in a blast furnace in Europe.

Mr. Crane endeavored to obtain a patent in this country for his application of the hot-blast to anthracite coal in the blast furnace, but was unsuccessful, Dr. Geissenhainer's invention being accorded priority. His patent, which was only for the United States, was purchased from his executors in 1838 by Mr. Crane, who, in November of that year, patented some additions to it in this country. The patents could not be enforced here, but Mr. Crane compelled the ironmasters of Great Britain to pay him for the use of his invention. Dr. Geissenhainer never attempted to enforce his patent. The consideration which his executors received from Mr. Crane was $1,000 and the privilege of erecting, free of royalty, fifteen furnaces for the use of anthracite coal with the hot-blast. The following advertisement by Mr. Crane's agents in this country we take from a Philadelphia newspaper published in December, 1839:

ANTHRACITE IRON.—The subscribers, agents of George Crane, Esq., are prepared to grant licenses for the manufacture of iron with anthracite coal under the patent granted to Mr. Crane by the United States, for smelting iron with the above fuel, in addition to which Mr. Crane holds an assignment of so much of the patent granted to the late Reverend Dr. Geissenhainer as pertains to making iron with anthracite coal. The charge will be 25 cents per ton on all thus manufactured. It has been completely successful both in Wales and at Pottsville, one furnace at the latter place yielding an average product of 40 tons per week of excellent iron. All persons are cautioned against infringing upon either of the above patents. Any application of hot-blast in the smelting of iron ore with anthracite coal, without a license, will be an infringement, and will be treated accordingly. Apply to

A. & G. RALSTON & CO.,
dec 9—1m 4 South Front st.

Mr. Crane was born about 1785 at Bromsgrove, in Worcestershire, England, whence he removed in 1824 to Wales. Two interesting experiments in the use of anthracite coal in the blast furnace were made in this country about the time that Dr. Geissenhainer was successful with his experiment at Valley furnace. In 1836 and 1837 John Pott experimented at Manheim furnace, at Cressona, in Schuylkill county, with anthracite coal as a fuel for smelting iron ore. He first used a mixture of anthracite coal and charcoal with cold-blast. The results accomplished were so encouraging that he added a hot-blast and gradually reduced the proportion of charcoal until only anthracite was used. This he used alone and successfully for a short time. But the blast was too weak, and the furnace was not long in operation. Before necessary improvements could be made it was destroyed by a freshet. In 1837 Jarvis Van Buren, acting for a company, built a furnace at South Easton, in Northampton county, for the purpose of experimenting with anthracite coal. Early in 1838 he was successful in making 20 tons of pig iron, when further operations were stopped in consequence of the blast being too weak. We are not informed whether it was hot or cold.

It is claimed that a successful experiment in the manufacture of pig iron with anthracite coal was made in 1837 by a Mr. Bryant, in a foundry cupola at Manayunk, near Philadelphia. The blast used was produced by "wooden bellows." A few tons of the iron made were used by Parke & Tiers, the owners of the foundry, "and proved to be of good gray quality and of uncommon strength." The experiment was conducted under the auspices of this firm and of Mr. Abraham Kunzi, of the firm of Farr & Kunzi, manufacturing chemists, of Philadelphia. We cannot learn whether the blast was hot or cold. The record which we shall now give of the successful use of anthracite coal in American furnaces, after Dr. Geissenhainer and George Crane had established the practicability of such use, will embrace only a few of the early anthracite furnaces, and this we condense from Walter R. Johnson's *Notes on the Use of Anthracite*, published in 1841, and from William Firmstone's *Sketch of Early Anthracite Furnaces*, published in the third volume of the *Transaction of the American Institute of Mining Engineers*. Late in 1837 Joseph Baughman, Julius Guiteau, and Henry High, of Reading, experimented in smelting iron ore with anthracite coal in the old furnace of the Lehigh Coal and Navigation Company at Mauch Chunk, using about 80 per cent. of anthracite. The results were so encouraging that they built a small water-power furnace near the Mauch Chunk weigh-lock, which was completed in July 1838. Blast was applied to this furnace on August 27, and discontinued on September 10, the temperature being heated up to about 200° Fahrenheit. The fuel used was mainly anthracite, but not exclusively. A new heat apparatus was procured, placed in a brick chamber at the tunnel head, and heated by a flame therefrom. Blast was applied late in November, 1838, the fuel used being anthracite exclusively, and "the furnace worked remarkably well for five weeks," up to January 12, 1839, when it was blown out for want of ore. Some improvements were made, and on July 26, 1839, the furnace was again put in blast, and so continued until November 2, 1839. Mr. F. C. Lowthorp, of Trenton, was one of the partners at this time. For "about three months" no other fuel than anthracite was used, the temperature of blast being 400° to 600°. About 100 tons of iron were made. The next furnace to use anthracite was the Pioneer, built in 1837 and 1838 at Pottsville, by William Lyman, of Boston, under the auspices of Burd Patterson, and blast was unsuccessfully applied on July 10, 1839. Benjamin Perry then took charge of it, and blew it in on October 19, 1839, with complete success. This furnace was blown by steam-power. The blast was heated in ovens at the base of the furnace, with anthracite, to a temperature of 600°. The product was about 28 tons a week of good foundry iron. The furnace continued in blast for some time. A premium of $5,000 was paid by Nicholas Biddle and others to Mr. Lyman, as the first person in the United States who had made anthracite pig iron continuously for one hundred days.

Danville furnace, in Montour county, was successfully blown in with anthracite in April, 1840, producing 35 tons of iron weekly with steam-power. Roaring Creek furnace, in Montour county, was next blown in with anthracite on May 18, 1840, and produced 40 tons of iron weekly with water-power. A charcoal furnace at Phœnixville, built in 1837 by Reeves, Buck & Co., was blown in with anthracite on June 17, 1840, by William Firmstone, and produced from 28 to 30 tons of pig iron weekly with water-power. The hot-blast stove, which was planned and erected by Julius Guiteau, of the Mauch Chunk furnace, was situated on one side of the tunnel-head, and heated by the flame of the furnace. This furnace continued in blast until 1841. Columbia furnace, at Danville, was blown in with anthracite by Mr. Perry on July 2, 1840, and made from 30 to 32 tons of iron weekly, using steam-power. The next furnace to use anthracite, and the last one we shall mention, was built at Catasauqua, for the Lehigh Crane Iron Company, in 1839, by David Thomas, who had been associated with Mr. Crane in his experiments at Yniscedwin. It was successfully blown in by him on the 3d of July, 1840, and produced 50 tons a week of good foundry iron, water power being used. This furnace was in active use until 1879, when it was torn down. Mr. Firmstone says that "with the erection of this furnace commenced the era of higher and larger furnaces and better blast machinery, with consequent improvements in yield and quality of iron produced." David Thomas who died in the first half of June, this year —1882—was the oldest ironmaster in the United States in length of service, and, next to Peter Cooper, the oldest in years.

He was born on November 3, 1794, at a place called, in English, Grey House, within two and a half miles of the town of Neath, in the county of Glamorgan, South Wales. He landed in the United States on June 5, 1839, and on July 9 of that year he commenced to build the furnace at Catasauqua. Father Thomas's character and services to the American iron trade are held in high honor by every American iron and steel manufacturer. William Cullen Bryant and Mr. Thomas were born on the same day. In 1835 the Franklin Institute, of Philadelphia, offered a premium of a gold medal "to the person who shall manufacture in the United States the greatest quantity of iron from the ore during the year, using no other fuel than anthracite coal, the quantity to be not less than twenty tons," but we cannot learn that it was ever awarded to any of the persons who were instrumental in establishing the manufacture of anthracite pig iron in this country.

The discovery that anthracite coal could be successfully used in the manufacture of pig iron gave a great impetus to the iron industry in Maryland, New Jersey, and New York as well as in Pennsylvania. In 1840 there were only six furnaces in the United States which used anthracite coal, and they were all in Pennsylvania. The first anthracite furnace outside of Pennsylvania was built at Stanhope, New Jersey, in 1840 and 1841, by the Stanhope Iron Company, and it was successfully blown in on April 5, 1841. On the 1st of April, 1846, there were forty-two furnaces in Pennsylvania and New Jersey which used anthracite coal as fuel, their annual capacity being 122,720 gross tons. In 1856 there were 121 anthracite furnaces in the country which were either "running or in running order"—ninety-three in Pennsylvania, fourteen in New York, six in Maryland, four in New Jersey, three in Massachusetts, and one in Connecticut. Soon after 1856 many other furnaces were built to use anthracite as fuel. Although the revolution to which we have referred properly dates from the first successful use of anthracite coal in the blast furnace, this fuel had been previously used in a small way in our country in other ironmaking operations. Its use in these operations became general about the time when pig iron was made with it. The first use of anthracite coal in connection with the manufacture of iron in the United States dates from 1812, in which year Colonel George Shoemaker, of Pottsville, Pennsylvania, loaded nine wagons with coal from his mines at Centreville, and hauled it to Philadelphia, where with great difficulty he sold two loads at the cost of transportation and gave the other seven loads away. He was by many regarded as an impostor for attempting to sell stone to the public as coal. Of the two loads sold, one was purchased by White & Hazard, for use at their wire works at the Falls of Schuylkill, and the other was purchased by Malin & Bishop, for use at the Delaware County rolling mill. By the merest accident of closing the furnace doors Mr. White obtained a hot fire from the coal, and from this occurrence, happening in 1812, we may date the first successful use of anthracite coal in the manufacture of iron in this country and in other American manufactures. At both the establishments mentioned it was used in heating their furnaces. Previous to this time bituminous coal from Virginia and Great Britain had been relied upon for manufacturing purposes in the Atlantic States in all cases where wood was not used. In the latter part of 1823 the Boston Iron Company, owning the Boston iron works, obtained a full cargo of Lehigh anthracite coal, for use in heating iron to be rolled in its mill, and for smith-work. A short time previous to this transaction, and in the same year, Cyrus Alger, of South Boston, obtained a lot of about thirty tons of Lehigh coal, which he used in a cupola for melting iron for castings. Anthracite coal for the generation of steam was first used in this country in January, 1825, under the boilers of the rolling mill at Phœnixville, of which Jonah and George Thompson, of Philadelphia, were the proprietors. It is also claimed that, two years later, in 1827, the first use of anthracite coal in the puddling furnace in this country was at the same rolling mill, Jonah and George Thompson still being the proprietors. The use of anthracite for puddling did not become general until about 1840. In 1839 anthracite coal was used in puddling at the Boston iron works by Ralph Crooker, the superintendent. About 1836 Thomas and Peter Cooper, brothers, used anthracite in a heating furnace at their rolling mill in Thirty-third street, near Third avenue, New York, and about 1840 they began to puddle with anthracite. In April, 1846, there were twenty-seven rolling mills in Pennsylvania and New Jersey which used anthracite coal.

The following notice of the success of the Messrs. Thompson in the use of anthracite coal for the production of steam appeared at the time in a newspaper published at West Chester, Pennsylvania. "We understand that the Messrs. Thompson, at the Phœnix nail-works, on French creek, have fully succeeded in constructing a furnace for a steam engine calculated for the use of anthracite coal, and in discovering a mode by which this fuel may be most advantageously applied to that important purpose. We would heartily congratulate the eastern section of our state upon this valuable discovery. Nothing within our knowledge has occurred of recent date which can have a more auspicious influence upon our manufacturing interests."

—*Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.*

THE MANUFACTURE OF IRON WITH BITUMINOUS COAL.

It is remarkable that the introduction of bituminous coal in the blast furnaces of this country should have taken place at so late a day in our history, and within the memory of men who are not yet old. Bituminous coal had been discovered in the United States long before any attempt was made to use it in our blast furnaces, and Great Britain had taught us while we were still her colonies that it could be so used. In 1735 Abraham Darby, at his furnace at Coalbrookdale, in Shropshire, had successfully made pig iron with coke as fuel; in 1740 a coke furnace was built at Pontypool, in Monmouthshire; and in 1796 charcoal furnaces had been almost entirely abandoned in Great Britain. Our delay in following the example of the mother country may be variously explained. There was a lack of transportation facilities for bringing iron ore and coke together; not all of the bituminous coal that had been discovered was suitable for making good coke; the manufacture of coke was not well understood; the country had an abundance of timber for the supply of charcoal; and, finally, a prejudice existed in favor of charcoal pig iron and of bar iron hammered in charcoal forges.

The introduction about 1840 of bituminous coal as a fuel in American blast furnaces, was naturally preceded by many experiments in its use, which were attended with varying success, but none of them with complete success. It appears to be mathematically certain that down to 1835 all these experiments had been unsuccessful, as in that year the Franklin Institute, of Philadelphia, offered a premium of a gold medal "to the person who shall manufacture in the United States the greatest quantity of iron from the ore during the year, using no other fuel than bituminous coal or coke, the quantity to be not less than twenty tons." The Institute would not have been likely to make this offer if even so small a quantity as twenty tons of pig iron had been made in one furnace with bituminous coal, either coked or uncoked. In a report by a committee of the Senate of Pennsylvania, of which Hon. S. J. Packer was chairman, read in the Senate on March 4, 1834, it was stated that "the coking process is now understood, and our bituminous coal is quite as susceptible of this operation, and produces as good coke, as that of Great Britain. It is now used to a considerable extent by our iron manufacturers in Centre county and elsewhere." It is certain that, at the time this report was written, coke could not have been used in blast furnaces in any way than as a mixture with charcoal, and then only experimentally. The offer of the gold medal by the Franklin Institute doubtless assisted in stimulating action upon a subject which had already attracted much attention. In the year in which the premium was offered, that accomplished furnace manager, William Firmstone, was successful in making good gray forge iron for about one month at the end of a blast at Mary Ann furnace, in Huntingdon county, Pennsylvania, with coke made from Broad Top coal. This iron was taken to a forge three miles distant and made into blooms. Mr. Firmstone did not claim the medal. He may not have known that a premium had been offered for the achievement which he undoubtedly accomplished. In a pamphlet published in April, 1836, Isaac Fisher of Lewistown, Pennsylvania, stated that "successful experiments have lately been tried in Pennsylvania in making pig iron with coke." It is probable that Mr. Fisher had in mind Mr. Firmstone's experiment. William Firmstone was born at Wellington, in Shropshire, England, on October 19, 1810. When quite a young man he was manager at the Lays Works, near Dudley, which were then owned by his uncles, W. & G. Firmstone. He emigrated to the United States in the spring of 1835. After filling many responsible positions in connection with the manufacture of pig iron, he died at his residence near Easton, on September 11, 1877, and is buried in the cemetery at Easton. He was one of the first to introduce the hot-blast in the United States, having successfully added this improvement to Vesuvius furnace, in Lawrence County, Ohio, in 1836. In 1839 he added a hot-blast to Karthaus furnace, in Pennsylvania.

In 1836 or 1837, F. H. Oliphant, a skillful iron master, made at his furnace called Fairchance, near Uniontown, Fayette County, Pennsylvania a quantity of coke pig iron in excess of twenty tons, and probably in excess of 100 tons. He did not, however, long continue to make coke iron, and resumed the manufacture of iron with charcoal. Mr. Oliphant had heard of the offer of the gold medal, and in a letter to the Institute, dated October 3, 1837, he modestly referred to his success in making pig iron with coke, and suggested that possibly he was entitled to the premium. Accompanying his letter was a box of pig iron and the raw materials of its manufacture. We do not learn that he ever received the medal, or that anybody received it.

Between 1836 and 1839 other attempts were made at several furnaces in Pennsylvania to use coke, but the experiments were unsuccessful or unfortunate. The legislature of Pennsylvania passed an act on June 16, 1836, "to encourage the manufacture of iron with coke or mineral coal," which authorized the organization of companies for the manufacture, transportation, and sale of iron made with coke or coal. At Farrandsville, six miles north of Lock Haven, in Clinton county, half a million dollars was sunk by a Boston company in a disastrous attempt to smelt the neighboring ores with coke, and to establish other iron and mining enterprises. This company had commenced operations in the mining of coal as early as 1833. The furnace was blown in the summer of 1837, and ran probably until 1839. About 3,500 tons of iron were made, but at such great cost, owing to the impurity of the coal and the distance of the ore, that further efforts to make iron with coke were abandoned. At Karthaus, in Clearfield county, the Clearfield Coal and Iron Company, composed of Henry C. Carey, Burd Patterson, John White, and others, succeeded in 1839, under the management of William Firmstone, in making pig iron with coke in a furnace which was built in 1836 by Peter Ritner (brother of Governor Ritner) and John Say, but at the close of the year the whole enterprise was abandoned, owing to the lack of proper transportation facilities. A furnace at Frozen run, in Lycoming county, made some pig iron with coke in 1838, but in 1839 it was using charcoal. The furnaces at Farrandsville and Karthaus were both supplied with hot blasts—the former in 1837 and the latter in 1839. The apparatus for that at Farrandsville was made at Glasgow, and was the best then known. The first notable success in the use of bituminous coal in the blast furnace in this country was achieved at three furnaces in western Maryland. Lonaconing furnace, in the Frostburg coal basin, on George's creek, eight miles northwest of Frostburg, in Alleghany county, was built in 1837 by George's Creek Company, to use coke, and in June 1839, it was making about 70 tons per week of good foundry iron. Alexander says that "the air was heated by stoves placed near the tuyere arches, and attained a temperature of 700 degrees Fahrenheit." The furnace was blown by an engine of 60-

MINING LIFE—A COAL MINE EXPLOSION.

—FROM "LA VIE SOUTERRAINE" BY L. SIMONIN.

horse power. In the same coal basin, on the south branch of Jenning's run, nine miles northwest of Cumberland, two large blast furnaces were built in 1840 by the Mount Savage Company to use the same fuel. These furnaces were for several years successfully operated with coke. But the use of coke did not come rapidly into favor, and many experiments with it were attended with loss. It was not until after 1850 that its use began to exert an appreciable influence upon the manufacture of pig iron. In 1849 there was not one coke furnace in Pennsylvania in blast. Thus far coke had not noticeably contributed to the revolution to which we have referred in the preceding chapter. But in 1856 there were twenty-one furnaces in Pennsylvania, and three in Maryland which were using coke. After 1856 the use of this fuel rapidly increased in Pennsylvania, and was extended to other states.

While the effort was being made in a few localities in Pennsylvania and Maryland to introduce the use of coke in the blast furnace, attention was also directed to the possibility of using uncoked coal for the same purpose. Alexander says that the proprietors of Lonaconing furnace, in western Maryland, used raw coal before 1840. He leaves the reader to infer that it was successfully used, but he probably wrote from imperfect information. Some unsuccessful experiments were made with raw coal in Clarion county, Pennsylvania, about 1840. In the sketch of Mercer county, Pennsylvania, in Day's *Historical Collections*, printed in 1843, it is stated that "in the vicinity of Sharon, on the Pittsburgh and Erie canal, exists a most valuable bed of coal of peculiar quality, between anthracite and bituminous, without the least sulphur. It has been tried successfully for smelting iron in a common charcoal furnace." It is not certain that the furnace referred to was in Mercer county. The coal mentioned is now classed among bituminous varieties. At Arcole furnace, in Lake county, Ohio, operated by Wilkeson & Co., raw coal from Greenville, Mercer county, Pennsylvania, was experimented with about 1840. John Wilkeson, one of the owners of the furnace at that time, writes us that the experiment met with a small measure of success. Doubtless the several experiments mentioned were not the only ones that were made with raw coal before success in its use was fully achieved; and doubtless, too, none of the experiments mentioned produced any more satisfactory results than the qualified success attained at Arcole furnace. The first truly successful use of raw bituminous coal in the blast furnace occurred in the autumn of 1845. It is circumstantially described in the following extract from a pamphlet, entitled *Youngstown, Past and Present*, published in 1875: "In July, 1845, Himrod and Vincent, of Mercer county, Pennsylvania, blew in the clay furnace not many miles from the Ohio line on the waters of the Shenango. About three months afterwards, in consequence of a short supply of charcoal, as stated by Mr. Davis, the founder, a portion of coke was used to charge the furnace. Their coal belongs to seam No. 1, the seam which is now used at Sharon and Youngstown, in its raw state, variously known as 'free-burning splint,' or 'block coal,' and which never makes solid coke. A difficulty soon occurred with the cokers, and, as Mr. Himrod states, he conceived the plan of trying his coal without cokeing. The furnace continued to work well, and to produce a fair quality of metal. It is admitted that Mr. David Himrod, late of Youngstown, produced the first metal with raw coal, about the close of the year 1845." The furnace here alluded to was situated on Anderson's run, in Mercer county, Pennsylvania, about two and one-half miles southeast of Clarksville, and was built in 1845. It has been abandoned for many years. In the chapter relating to Michigan we have mentioned the part taken by this furnace at an early day in smelting Lake Superior ores with the block coal of the Shenango valley.

While Himrod and Vincent were using the raw coal of the Shenango valley at Clay furnace, Messrs. Wilkeson, Wilkes & Co., of Lowell, in Poland township, Mahoning county, Ohio, were building Mahoning furnace, as related in the chapter devoted to Ohio, expressly to use in its raw state coal of the same quality from their mine near Lowell. This furnace was successfully blown in with this fuel by John Crowther on the 8th of August, 1846. The *Trumbull Democrat*, of Warren, Ohio, for August 15, 1846, in an account of the blowing in of Mahoning furnace, states that "to these gentlemen (Wilkeson, Wilkes & Co.) belongs the honor of being the first persons in the United States who have succeeded in putting a furnace in blast with raw bituminous coal." John Crowther was an Englishman, born at Brosely, in Shropshire, on May 7, 1797. He emigrated to the United States in 1844, immediately prior to which time he had been the manager of seven blast furnaces in Staffordshire—five at Stowheath and two at Osier Bed. Prior to his connection with the Lowell furnace he had been employed as manager of the furnaces at Brady's Bend. He adapted many furnaces in the Mahoning and Shenango valleys to the use of block coal, and instructed three of his sons in their management, namely, Joshua, Joseph J., and Benjamin. He died on April 15, 1861, at Longton, in Staffordshire, England, where he is buried. After it had been demonstrated at Clay and Mahoning furnaces that the block coal of the Shenango and Mahoning valleys could be used in the manufacture of pig iron, other furnaces in these two valleys were built to use this fuel, and some charcoal furnaces were altered to use it. In 1850 there were, however, only four furnaces in the Mahoning valley and only seven in the Shenango valley which used raw coal. After 1850, and especially after the introduction into these valleys of Lake Superior ores, about 1856, the use of raw coal greatly increased. In 1856 six furnaces in Pennsylvania and thirteen in Ohio were using this fuel. Some progress was afterwards made in its use in other states, particularly in Indiana, but down to 1880 its use had been mainly confined to the two valleys mentioned. The American Iron and Steel Association has published a table which exhibits the production of pig iron in this country in each year from 1854 to 1880, classified according to the fuel used. So much of this table is here reproduced as will show the growth of the manufacture of pig iron with anthracite and bituminous coal since 1854, and also the period at which the use of bituminous coal in the blast furnace overtook that of anthracite coal.

Years.	Anthracite.	Charcoal.	Bituminous Coal & Coke	Total.
	Net Tons.	*Net Tons.*	*Net Tons.*	*Net Tons.*
1854	339,435	342,298	54,485	736,218
1855	381,866	339,922	62,390	784,178
1856	443,113	370,470	69,554	883,137
1872	1,369,812	500,587	984,159	2,854,558
1873	1,312,754	577,620	977,904	2,868,278
1874	1,202,144	576,557	910,712	2,689,413
1875	908,046	410,990	947,545	2,266,581
1876	794,578	308,649	990,009	2,093,236
1877	934,797	317,843	1,061,945	2,314,585
1878	1,092,870	293,399	1,191.092	2,577,361
1879	1,273,024	358,873	1,438,978	3,070,875
1880	1,807,651	537,558	1,950,205	4,295,414
1881	1,734,462	638,838	2,268,264	4,641,564

Some of the pig iron classed above as having been produced with anthracite and bituminous coal, respectively, was produced with a mixture of these fuels, the quantity of pig iron so produced being mainly represented in the anthracite column. The mixed fuel referred to was not used to any considerable extent until within the past few years. Before the close of the charcoal era steam had been applied to the blowing of American furnaces, but water-power was still in general use. The necessity of increasing the blast, and other considerations, soon led to the more general use of steam blowing engines in connection with anthracite and bituminous furnaces. Another improvement in blast-furnace management also had its beginning about the close of the charcoal era, namely, the utilization of the combustible gases emitted from blast furnaces. These gases were first used to heat the boilers for the blowing engines, and afterwards to heat the hot-blast stoves. Bituminous coal was used at an early day in the heating furnaces attached to American rolling and slitting mills, and in 1817, when the rolling mill was established at Plumsock, in Fayette county, Pennsylvania, it was used in puddling furnaces. It was not, however, until about 1830, when rolling mills became numerous at Pittsburgh, that the use of bituminous coal in these establishments assumed noteworthy importance.

—*Compiled from James M. Swank's Report on Iron and Steel, Tenth Census of the U. S.*

THE EARLY HISTORY OF THE MICHIGAN COPPER DISTRICT.

PRIOR to the admission of Michigan as one of the States of the Federal Union, the Territory claimed as a valued portion of its domain a strip of land bordering on Lake Erie, in which was included the now flourishing city of Toledo. The right of possessing this parcel of land was insisted upon with equal strenuousness by the State of Ohio, and when, in 1835, a covention assembled at Detroit and formed a constitution defining the boundaries of the proposed State, and comprised within them this disputed territory, so great did the excitement become that men upon both sides began to arm and to organize for a conflict, that for a time it seemed must inevitably occur. The matter coming before Congress on the application of Michigan to become a State, that body passed an act admitting her into the Union upon condition that she should relinquish her claim to the disputed territory. A sugar-coating was given to this bitter pill by offering to her people, in lieu of the coveted territory so strenuously claimed, the isolated and little regarded region known as the Upper Peninsula. A convention being called soon after, these conditions were indignantly rejected; but a second convention, acting upon the matter in December of the same year, concluded discretion to be the better part of valor, and reluctantly accepted the proviso, and in January thereafter (1837) Michigan was admitted into the Union. Thus it is 45 years since the Upper Peninsula was given to Michigan by Congress as a final settlement of a serious dispute; it was thrown in, not as possessing intrinsic value, but to soothe the pride of an irritated people. The magnificent territory thus acquired was given as an offset to a mere strip of land insignificant in comparison, yet which was nevertheless regarded as of far greater value. But slowly the people awakened to a knowledge of the magnitude of their gain in the exchange which was thus thrust upon them. The State possesses in this northern peninsula one of the most wonderful and valuable regions within the limits of the national domain. Rich it is in minerals in an unparalleled and almost to an incredible degree, producing ores of iron unsurpassed in quality and unequalled in richness, and native copper in an abundance and of value found nowhere else.

The possession of this country, known as the region of Lake Superior, as a portion of the territory of the United States is said to be due to Dr. Franklin, who, while in Paris, in the days of the American Revolution, represented the interests of the struggling colonies, became acquainted through the records of the government departments to which he had access, with the reports that had been made concerning the existence of copper along the margin of the Great Lake; and thus conceiving the region to possess a possible mineral value that would be available at some future period, he subsequently in arranging the treaty with England, in which she acknowledges our independence, drew the boundary line so as to include the south shore of Lake Superior within the limits of the new nation. The first exploration of the country bordering on Lake Superior was undertaken by Charles Raymbault and Isaac Jogues, two Jesuit priests, who, with a party of Hurons, landed at the Sault de Ste. Marie in the fall of 1641. Here they met a large body of Indians encamped upon the banks of the river engaged in catching fish in the rapids, and from them they learned that these waters were the outflow of a great lake lying beyond, which they designated as Kitchigummi, or Big Lake, as it exceeded, as they declared, in dimensions any other of the great lakes. In the following year, Raymbault, having died at Quebec from the effects of his previous exposures, Jogues set out with some Huron attendants to revisit the Sault, and to extend still further his knowledge of the country and his intercourse with the tribes who inhabited it; but almost at the outset of his expedition, himself and party were captured by the Mohawks, and after suffering the most cruel torments, short of death, and witnessing the burning of his companions at the stake, he was finally ransomed by the Dutch, at Albany, whence he proceeded to France. Soon after, with unabated zeal, he returned to the scene of his former labors.

Pierré Mesnard set out from Quebec in 1660, and having arrived at the Sault, proceeded in his canoe along the south shore of the lake to the head of Keweenaw Bay, where he remained through the winter, laboring to promote the spiritual welfare of the Indians. In the following summer, accompanied by a single Indian, he entered Portage Lake intending to cross the peninsula, and to push westward along the shore beyond; but while his guide was engaged in conveying the canoe across the Portage, the good father wandered into the woods and no trace of him was ever afterwards obtained. In 1666 Claude Allouez established a mission at La Pointe, in Chaquomegon Bay, where he remained for two years extending his travels and his teachings among the Indians who gathered in great numbers to listen to his wonderful disclosures. Allouez makes mention of the veneration in which the lake is held by the savages who worship it, he says, as a divinity, and he also states that he has observed that they have in their possesssion pieces of copper, which are sometimes of a considerable size, which they esteem as domestic gods. Claude Allouez returned to Quebec to secure aid for his mission, but such was his zeal that in two days thereafter he again started to go back to the scene of his labors. Two years subsequent to the establishment of his mission at La Pointe, James Marquette and Claude Dablon founded a permanent mission at the Sault de Ste Marie, and from this period the place dates its settlement, making it thus the oldest within the State. A grand council with the Indians was held and formal possession of the country was taken in the name of the King of France. In 1690 two of the Jesuit fathers made a map of the Lake which was published in Paris three years later. A copy of this map is contained in Foster & Whitney's report, and shows with what care these men must have explored the coast which they thus represented. Since considering the great extent of the coast to be traversed, and their utter want of facilities to accomplish such a task other than their own almost unaided powers of observation, this graphical delineation of the outlines of the Great Lake is indeed a marvel of accuracy. Mesnard, Marquette, and Dablon were overtaken by death while in the midst of their labors and their bodies became mingled with the dust of the rude land they had discovered; but their names deserve to be cherished with the memory of those who gave all in their zeal to promote the welfare of the poorest of their fellow-men.

The occurrence of copper was one of the objects that early attracted the attention of the Jesuits, and its presence, so frequently met with among the Indians, naturally excited their curiosity and wonder. Frequent mention of it is made, and in some instances the descriptions relate to masses of considerable size. But long prior to this period the metal that attracted the attention of the missionaries and early *voyageurs*, and which now forms the basis of a great and growing industry, had been sought and mined for by a people who have left no record but the implements which they used and the excavations which they made. These excavations the slow accumulations of debris during the years which have since elapsed had obscured from view, and the Indians, whom the good fathers labored to Christianize, had no knowledge whatever of the matter. No suspicion that any such work had ever been performed occurred until within a recent period, after the country was thrown open to settlement and actual mining had begun. Then it became known that this ground had beeen previously occupied, and that these metalliferous veins had been long ago extensively worked and apparently large amounts of copper obtained; but when and by whom is a mystery. But that this mining work" is of a high antiquity is evident from many facts; the pits and tunnels which had been made had become filled up with rubbish and with decayed vegetation and grown over with forest trees. If the depressions were ever observed they were naturally regarded as those made by overturned trees or as hollows in the rocks, and it was not suspected until the discovery was actually made, so late as 1847-48, that here, too, men had formerly delved in search of metals. These ancient excavations are found in all portions of the Mineral Range and in Isle Royal. So general is this fact, that there is scarcely a vein or outcrop of mineral in the whole copper district but the evidences are found of their ancient workings, extending into the solid rock from a few feet to sixty feet in depth. In these pits when cleared of the accumulated dirt and rubbish, have sometimes been found large masses of copper which these primitive seekers had unsuccessfully endeavored to remove. Masses of copper of many tons weight have thus been discovered surrounded with stone hammers in great numbers, pieces of burnt wood and other evidences of former labor. The method of mining which these people apparently pursued was to heat the rock by fire and then by pouring on water and pounding the rock with their stone hammers to disintegrate and separate it. Quantities of these stone hammers are nearly always obtained from the bottom of these ancient pits. They consist of small boulders of hard trap rock of from three to thirty pounds in weight, around which a groove has sometimes been made for the purpose of holding a withe which fastened on the handle. Copper tools and other utensils and materials have also been found, but no indications that would lead to the identification of the race to which these miners belonged, have been, as yet, discovered. These ancient "diggings," as they are locally called, are everywhere so abundant and have now become so well known and familiar to those engaged in mining in Michigan, as to be no longer a matter of surprise or wonder. In one respect they have undoubtedly been of great service, serving as guides which have led to the discovery of lodes, which were thus shown to have been previously worked and as indicative of the value of such lodes.

As in the iron region, the magnetic needle has guided to the discovery of many valuable deposits of ore, so in the copper district these pits of the ancient miners extending along the surface outcrop of the copper bearing veins, have silently betokened to the eager explorer where was hidden the object of his search. But to the Indians who roamed the country at the time of its discovery, to the Jesuits, and to the early *voyageurs* and explorers this fact of ancient mining was wholly unknown. The evidence of the existence of copper in this region—a knowledge which had already become wide-spread—was derived from the specimens in the possession of the Indians and from seeing the erratic boulders of that metal which were sometimes found in traversing the country, and from observing the copper-bearing veins which outcropped along the streams and near the shore of the lake.

Among those who early visited this country was Alexander Henry, who came to Mackinaw in about 1760 for the purpose of traffic with the Indians. Henry was a man of intelligence and education, and spent many years in this country, meeting with numberless adventures and actively engaged in various undertakings. He subsequently published a well written and interesting narrative of his experience and his observations in the country. Henry became familiar with the fact of the existence of copper in the country, and, as he thought, of more precious minerals also. He describes the great copper rock, an erratic boulder or mass of native copper which lay in the margin of the Ontonagon River, about 20 miles above its mouth, at the foot of a high bluff, from which it had rolled down or had been brought to the spot by some transporting agency, and which he describes as probably weighing five tons. Ten years thereafter Henry was chosen the agent of a company organized in England to conduct practical mining work in Lake Superior, and after some preliminary examinations elsewhere, selected this location as the seat of his operations. To this place he proceeded in the fall of 1770, with a small party of miners, in a vessel which he had previously built at the Sault. He himself soon after returned to the Sault, leaving his men to work through the winter. In the spring he sent his barge with provisions to the relief of his men, but was soon after surprised to see the vessel return with the whole party aboard. They had drifted into the bluff a distance of about 40 feet, and failing to secure the work, in the spring, when the frost went out and the ground became loosened, the walls fell in, and the miners, realizing the futility of the undertaking at that point, decided to abandon the work. Some copper was obtained, possibly chipped off from the great boulder. A second attempt was made, equally unsuccessful, but conducted upon the north shore of the lake. Here they punctured the rock to a depth of 30 feet in a vein that rapidly narrowed as they proceeded downward, until it nearly disappeared. Satisfied that nothing was likely to be gained here, and his associate members refusing to advance any more money, further effort was relinquished. What copper had been obtained was sent to England, and the vessel and other company property were sold to pay the debts. The parties to this enterprise, the first mining undertaking in the Lake Superior country within historical times, were His Royal Highness the Duke of Gloucester, Mr. Secretary Townshend, Sir Samuel Touchet, Mr. Baxter, Consul to the Empress of Russia, Mr. Cruickshank, Sir William Johnson, Mr. Bostwick, and Alexander Henry. A charter was applied for and granted, but never taken from the seals office. Henry, in reflecting upon the matter, states that the country must be settled and peopled before mining can be carried on to advantage. He avers that the soil is productive and will grow good crops, and cites some facts to corroborate the statement, among which he says he distributed seed corn among the Indians, which they planted and which yielded well, though he thinks them too improvident to preserve their seed from year to year. Capt. Jonathan Carver published in 1796 an account of three years' travel in this country, in which he speaks of the Ontonagon River as a stream of considerable size that flows into the lake, the head of which is composed of an assemblage of small streams. He declares the river to be remarkable for the abundance of virgin copper, which is found near its banks, and states that this metal is also met with elsewhere in the country. He opines that at some future period it may furnish the basis of a profitable industry, and relates how the metal may be carried in vessels to the Sault, thence around the rapids and re-shipped to Niagara Falls, here another portage to a point below the Falls, whence it may be conveyed to Quebec or elsewhere.

It was not until 1796 that Michigan came into possession of the American government, and the uncertainty of affairs, the trouble with the English government and with the Indians prevented any effort being made towards the exploration or settlement of the Territory, much less of the Lake Superior country. In 1818–19 the survey of Michigan was begun, a delegate was sent to Congress, some important Indian cessions made, and the lands thrown open to sale. And in the latter year Gen. Lewis Cass, the Governor of the Territory, proceeded, under directions from the War Department, on a tour of inspection, which included the south shore of Lake Superior. This expedition was accompanied by Mr. H. R. Schoolcraft in the capacity of geologist, etc., and he had for his object an especial purpose to determine as far as possible the truth of the reports regarding the mineral value of the country. The party entered the mouth of the Ontonagon River in July and proceeded up the stream a distance of twenty miles and upwards, to view the celebrated copper rock previously spoken of, the fame of which had reached their ears. He speaks of finding copper along the banks of the river, and that La Houton, Charlevoix, Carver, and McKenzie have successively noted the same remarkable fact and published accounts thereof which had given to the stream a notoriety which it would not otherwise have possessed. Many of the reports regarding the minerals found in the country referred especially to this river, but nothing very definite was known and it was for the purpose of endeavoring to determine the facts that they entered the river. The party experienced excessive difficulty in ascending the rapids and in climbing over the range with the thermometer indicating at 90° in the shade, and with the swarms of musquitoes and flies attacking them. The General, who remained in the boat, became exhausted; however, both divisions of the party finally reached their destination and found the object of their search. The size of the rock scarcely met their expectations, still Mr. Schoolcraft thought it a remarkable object and one well worth the journey to see. It evidently had been frequently visited since it bore the marks of much pounding and many cuts, and broken tools lay strewn about. The mass had apparently been removed some distance from its original bed as the adhering rock, mainly serpentine, was foreign to the vicinity; its whole appearance, the intimate association of the metal and matrix, pointed to a common and contemporaneous origin. This mass of native copper, which up to the period of its removal was the largest known in the world, was, in the spring of 1842, taken to the mouth of the river by James Paull who came to the country from the lead mines of Wisconsin for that purpose. Paull prepared a truck car upon which he hoisted the rock and succeeded in drawing it over the range by using a windlass, taking it to a point below the rapids and thence conveying it to the mouth of the river on a flat boat. The mass was soon after sold to a Mr. Eldridge who in turn sold it to the U. S. Government, and it has since been on the grounds of the War Department, at Washington. Paull claims to have bought of an Indian a second mass of copper of about 800 lbs. weight, which was found on the west shore of the peninsula, above the Portage, and which he took to Copper Harbor, whence, he thinks, it found its way into the cabinet of Yale College. Paull remained at Ontonagon where he still resides, and was thus the first permanent resident in the copper region.

By a succession of treaties made with the various Indian tribes in 1836, 1837 and 1842, the lands comprising the Lake Superior district were ceded to the United States, and all Indian claims thereto were finally extinguished. Immediately thereafter large numbers of persons proceeded to the country with authority from the Government to mine on the lands of the newly acquired territory. Public attention had been recently awakened to the copper deposits of the northern peninsula through the first published report of Dr. Houghton, who, having been appointed geologist of the newly made State, eagerly entered upon the active prosecution of his labors, extending his geological observations to the shores of Lake Superior, and in 1841 submitted to the Legislature the results of this preliminary examination. In this report the prominent geological features of the country were ably outlined, and the first definite information regarding the occurrence of copper and the character of the deposits was given to the world. Dr. Houghton, a few years later, entered upon the prosecution of a detailed survey of the entire Upper Peninsula, upon a plan which he successfully inaugurated, but the fulfillment of which was unfortunately prevented by his untimely death, by drowning, which occurred on the 13th of October, 1847, near the mouth of Eagle river, in Keweenaw county. With him was thus lost to the world the valuable results of his extended observations, and the system which he had devised of combining with the government linear survey of the country, geological and other scientific work was gradually abandoned. But his previous announcements had already drawn the public attention to the country. The copper district was now swarming with speculators, prospectors and explorers; and the rocks were being everywhere perforated with incipient mining. The first operations were undertaken under grants or permits obtained from the War Department, of which about 1,000 in all were issued, and 960 locations actually made. The essential conditions of these leases were that the lessee, or his assigns, should, during the first three years, pay to the government six per cent. of all metal produced; at the expiration of that period the lease should be renewed, at the option of the holder, for an additional three years on condition of payment to the government of ten per cent. of the mineral obtained, at the end of which time the lease could be further extended for the same length of time on the same conditions, unless Congress should otherwise dispose of the lands. Very many of these locations were made along the Keweenaw peninsula, and this portion of the country became the seat of the earliest mining work, and for some years before operations were conducted elsewhere to any extent this immediate region was teeming with active industry. The mineral range in this county, which begins at the extremity of Keweenaw Point, and trends westerly a distance of about twenty miles, and thence southwesterly, is characterized by the occurrence of a broad belt of green stone or semi-crystaline trap, which forms the southern escarpment or wall in this portion of the range. This greenstone formation terminates at about the south line of the county, and does not again appear throughout the further prolongation of the mineral range. The greenstone has a northerly and northwesterly dip, corresponding with the other belts of this portion of the range, of about 24° to 30° to the horizon, and attains an elevation above the lake of about 800 feet. From the top of the range the land slopes with a general gradual descent to the north and to the west to the lake, which is distant in this direction from two to three miles. On the south side the elevation drops abruptly a distance of one to two hundred feet to a low lying plane which forms the valley of the Eagle river and other streams, and which reaches to the east till it meets the foot of a second range of hills having a trend generally parallel with the principal elevation, and known as the Southern or Bohemian range. This portion of the range, as far as the greenstone extends, is frequently crossed by veins having a nearly vertical dip and a lateral direction generally at right angles to the formation and a width of from one foot to three feet, and have been found to carry copper sometimes in extraordinary quantities, some of them having proved among the most remarkable deposits of copper that the world has revealed. Both north and south of the greenstone are numerous amygdaloid beds, which are crossed by the fissure veins, and which usually carry a greater or smaller percentage of copper. There are also found in some portions, immediately underlying the greenstone and further to the south, beds of conglomerate, which in some instances contain copper in workable quantities. But surpassing all these, except the fissure veins, the most important of the copper-bearing deposits of this district is what is known as the ash bed, a scoriacious amygdaloid bed lying north of the greenstone, having a varying width of from five to twenty feet, and yielding at favorable points about one per cent. of copper. This ash bed, as it is called, through the invention and use of the compressed air drill, high explosives and greatly improved stamping and washing apparatus, seems likely to become the basis of the future mining prosperity of Keweenaw county, although in the past all attempts to work it at a profit have proved ruinous to the companies engaged in the undertaking.

In the earlier period of copper mining on Lake Superior, the fissure veins, yielding copper in masses, were the ones which gave to the country its celebrity, and the ones in which the mining operations were attended with profit, and of these the most noted and the most productive lie south of the greenstone—an important feature of this region geologically as well as geographically. As before remarked, what has proved to be, thus far, the great copper-bearing belt of Keweenaw county, lies immediately south of the greenstone, and pitches beneath it. In this belt are situated the Cliff, Phœnix, Central, Delaware and many other noted mines which have produced the greater portion of the copper obtained. South of this copper-bearing range which underlies the greenstone, is another belt having a parallel direction, but of an entirely different character, and too lean in copper to have afforded to the companies that worked it any degree of prosperity. Of these are the South Cliff, Manhattan, North American, Boston & Northwestern, and other companies, all of whose operations have resulted unprofitably. The same transverse veins which have proved so abundantly rich beneath the greenstone in crossing this belt, are poor and of a character in keeping with the country rock. Still further to the south is another belt quite distinguishable in character, within which are several beds of amygdaloid exposed at the surface, but the working of which has proved equally unprofitable.

The ash bed, to the north of the bluff, is crossed by the fissure veins which have here also yielded, in the aggregate, a large amount of copper, but occurring in pockets and not in any degree of certainty or with the comparative richness or regularity pertaining to the ground underneath the greenstone when crossed by the fissure veins. Underlying the greenstone and in contact with it, occurs a belt of conglomerate which at some points is utterly barren of copper, at others becomes a mere slide, while at the Allouez and at the Conglomerate Mining Company's location it becomes a distinct workable deposit. The fissure veins crossing the greenstone have never proved sufficiently rich in copper, in this formation, to be profitably mined. As before stated, immediately succeeding the final treaty extinguishing the possessory rights of the Chippewas to the lands in the Upper Peninsula in 1842, and the decision of the General Government to issue to applicants exploring permits, the country became at once flooded with searchers for mineral who made locations and obtained Government leases therefor which they subsequently sold to eastern capitalists. A person by the name of Raymond secured, thus early, several of these leases, three of which he disposed of to parties in Pittsburg and Boston. These leases comprehended: First, three square miles including Copper Harbor—a name given to this point by the early *voyageurs* by reason of the cupriferous vein which conspicuously outcrops here; second, three miles square on the west side of Eagle River, in which tract is included the Cliff mine; and third, a like tract in the next township west. Work was begun by these Pittsburg and Boston gentlemen in 1844, consisting of sinking a shaft to the depth of forty feet, on Hog's Point, under the direction of Charles Avery, the president of the association. This was the first mining shaft that was sunk on the lake. Soon after a continuation of this vein, with much more favorable indications, was discovered on the opposite side of the harbor near the site of old Fort Wilkins. This vein contained a deposit of black oxide of copper, a remarkable fact, since it has proved to have been the only similar deposit that has thus far been found, excepting, perhaps, traces of the same vein which has occasionally been observed elsewhere in this vicinity. The mining work was immediately transferred to this point, and two shafts were sunk at a distance apart of about 100 feet. The pocket of black oxide proved of brief duration; about 40 tons were obtained and sold for $4,500. The main shaft was carried down a distance of 120 feet and levels were driven each way from the shaft, in the vein, without finding any more of the ore.

In the meantime an important discovery was made on the Eagle River location by a party of explorers, under the direction of Mr. Cheny, in the greenstone bluff in the s. w. ¼ of sec. 36, T. 58 N., R. 32 W., being about three miles distant from the lake, which is what became known as the Cliff Mine. This celebrated vein was first discovered in 1845 on the upper surface of the greenstone, where it is narrow and gave little indication of the enormous wealth concealed below. It was examined by Dr. Jackson and Mr. Whitney, geologists, who advised, as the vein became wider and richer as it was traced downward on the wall of the bluff, that it would be well to uncover and examine it at the foot. The rocks at the foot of the bluff were cleared away in the winter of 1845, and indications obtained which stimulated to increased activity. An adit was driven a distance of about 70 feet, when it intersected a mass of copper—the first mass of native copper that had been found in place in the Lake Superior region. This discovery was one of the most important that was made in the copper district, since it determined the fact that the erratic boulders which had been previously found had their origin in the region itself, and since it was but the precursor of a continued succession of masses that astonished the world and gave confidence to investments in the country and enthusiasm and zeal in its investigation. After the discovery of the Cliff Mine the Eagle River location was purchased of the government and the other leases were abandoned. About the time the first work was done the gentlemen holding these leases entered into articles of agreement for the formation of a company; these parties were H. G. Hussey, T. M. Howe, and five others. The association was formed May 13, 1844, as the Pittsburg and Boston Mining Company, and under that name was incorporated by a special act of the Legislature of Michigan, approved March 18, 1848, with a capital stock of $150,000, divided into 6,000 shares. The number of shares were subsequently increased to 20,000, without any increase in the capital stock. The cost of the lands purchased from the government—about 5,000 acres—was $11,600. The Cliff vein, an amygdaloid trap, was from the start remarkably rich in mass copper, and subsequently also afforded a considerable amount of stamp rock obtained especially from the beds of amygdaloid, or the amygdaloid floors, which intersected the vein at right angles, having a varying thickness, and which were of frequent occurrence, dipping and running with the formation, and some of which were found to be highly productive in copper. They occasioned some trouble from the crumbling character of the rock, tending constantly to close up the shafts and the levels, making it frequently necessary to enlarge the shafts and lower the tramways in the levels. The rock did not crumble off in fragments to any great extent; it was hard and sufficiently difficult to mine, but the pushing force was stronger than any timbers were able to resist. Work was fairly begun in 1846, and during the seven years thereafter the vein was penetrated to a depth of 462 feet and a range of about 1,200 feet, and sufficient copper taken out to realize in net sales the sum of $1,328,406.83. It may be safely asserted that nowhere in the world had there previously been produced so large an amount of copper from the same amount of ground. The mine was paying to the company a net profit of $20,000 per month. The dividends paid during this period aggregated the sum of $462,000, or $77 per share, the first dividend, $60,000, being paid in 1849, and the total assessments had amounted to $18.50 per share, $110,000; at this time the stock and the quotations of the stock in the Boston market, June, 1854, was $175 per share.

To illustrate how little was definitely known regarding the geological structure of the country at this time, the opinion was entertained that the greenstone would, in itself, prove productive in copper. It was also thought to be possibly an overcap, or to compose a basin, and thus did not extend far into the earth, so that the lower levels, if extended northward, would pass under it. With a view to settle these conjectures, the upper levels were driven into this formation, but all the workings in this direction went to establish the fact that the veins in the greenstone do not carry copper in paying quantity, and the scientific supposition, previously made, became verified that the greenstone belongs to the regular geological strata of the country.

No. 1 shaft was sunk at the foot of the bluff, and the levels therefrom, carried to the north, intersected No. 3 shaft which was sunk vertically from near the edge of the bluff, passing 129 feet through the greenstone to the slide where it intersected No. 1 level; but as the mine attained depth and the levels were pushed to the north under the greenstone, the necessity began to be greatly felt for increased facilities for hoisting to the surface. The peculiar geological features of the mine, being overlaid with the heavy belt of crystalline trap, rendered it necessary that either a vertical shaft should be sunk, although it must pass through 650 feet of unproductive rock, exceedingly difficult to excavate, or an inclined shaft must be built running down into the mine following, substantially, the direction of the limiting greenstone wall. The objections to the latter arose from the irregular and tortuous course of the vein and the frequent enlargements from 10 ft., 15 ft., and even to 20 ft. in width, so that the necessary alignment could not be secured and keep within the vein; added to this was the fact that the ground had been very fully stopped out, in some places to an enormous width, which would render it extremely difficult to adequately support the track for a skip road. If the incline were made, it would require to be driven, mainly off the lode, to one side of it, in which case it would be all dead work—be driven in unproductive trap—and therefore it was thought to have little advantage in matter of economy of construction over the vertical shaft; in fact the matter was held under consideration for several years. The company's engineer carefully estimated the matter and it was concluded that the latter would involve the less cost. It was finally decided to sink the vertical shaft, and the work was begun in 1854 at a point 943 feet north from No. 3. This shaft, called No. 4, involved a nice problem of engineering, the work being carried upward and downward at the same time, and it being exceedingly important that the alignment should be exact. It will be readily understood that the carrying of a line down a deep shaft and thence for a long distance underground to be finally extended upwards hundreds of feet through solid rock to intersect an exact point, must require extreme accuracy to be successfully performed; in this instance the result was entirely satisfactory. The mine yielded many large masses of copper at this time—1854. In driving north in the 7th level a mass was found 80 feet in length and 20 feet in breadth, so heavy that a sand blast of several kegs of powder did not suffice to stir it. The company built a dock at the mouth of Eagle River and constructed a road from the mine thereto, warehouses, both at the mine and at the harbor, were built and many other surface improvements made, which included a 24-head stamp mill, to which 12 more heads were subsequently added. The total expenditures to the close of the year 1853 were $948,839.83. The average number of miners employed, 120, and the average monthly earnings were $39 per month. Average cost of drifting in the levels was $30 per yard, and average cost for stoping per fathom $23. The company owned its own smelting furnace in Pittsburg, at which its mineral was smelted. Abovt 70 per cent of the product was in masses, the remainder being about equally divided between barrel and stamp work. During its time there was nothing in mining history to compare with the surpassing richness of the Cliff. The Minnesota approached it in productiveness, but scarcely equalled it. For years there was scarcely a foot of ground that did not fully pay the cost for excavating, yielding in 1856 for each fathom of mineral ground broken the unprecedented amount of 1,851 pounds of mineral, yielding 67 per cent. refined copper. The business of mining, especially for the more valuable metals, is at all times precarious and uncertain, but the owners were confident, and surely they found in their mine an abundant reason for the faith that was in them. During each year explorations were being made to discover additional workable deposites on the company's property, but without any conspicuous result. The number of men employed had increased to about 460 in 1856, at an average wage per month of $32. The mining work was generally done on contract. The cost per ton for hauling to Eagle River was $1 to $1.12. The number of shares in 1858 was increased to 20,000, and the market value of the shares was about $300 per share.

The company was one of the pioneer companies of the region. As before stated it sunk the first mining shaft in 1844, at Cooper Harbor, and afterward acquired at the Cliff mine the greatest degree of success heretofore experienced by any company, and while the stockholders were well compensated in dividends for their enterprise, their experience and success contributed greatly to aid and encourage others, and thus indirectly resulted in developing the material interests of the country. The whole amount of the capital stock paid in was $110,905. and from 1848 to the cessation of work in 1870 the Cliff mine had not only sustained the expenses of the company, but had paid to the stock-holders the net sum of $2,627,660, or a little over 2,000 per cent. of the capital paid in. The capital stock paid in does not, however, represent the total expenditure incurred in bringing the mine to the divided paying point; it sufficed to open the mine to the extent that the product met the expenses. Over half a million of dollars were expended before any dividends were paid. If it had not been for the excessive productiveness of this mine this preliminary expenditure would have been a failure. The wonderful success of this mine occasioned the starting of many others in similar situations, with apparently as reasonable prospects of success, but with perhaps the exception of the Central it has had no rival among the mines that have worked underneath the greenstone.

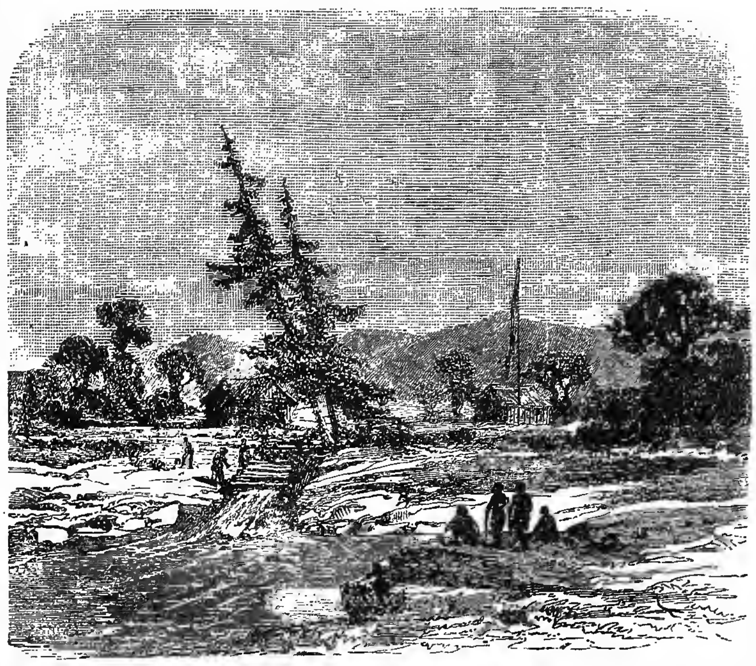
Contemporary with the Pittsburg and Boston Mining Company, and really antedating it by a few months in the time of organization, was the old Lake Superior Copper Company, the progenitor of the present Phœnix Company. The originators of this pioneer enterprise, one of the most important ever undertaken on the lake, were among the first who proceeded to Lake Superior after the relinquishment of the Indian rights to this country in 1843. They represented mainly gentlemen from Boston, who selected seven three-mile square locations, and afterward secured them by leases obtained from the War Department, and in 1844, February 22d, organized a company, dividing the capital stock into 1,200 shares of $100 each, 400 of which were assigned to the proprietors of the locations in payment for the lands conveyed to the company; these purchased shares were to be exempt from assessment. In addition to the 400 shares, the original holders of the leases were to receive compensation for the expenses incurred in locating the lands, etc., to be paid out of the first earnings of the company. The conditions on which these leases were granted were very advantageous to the lessees, as it gave them several years in which to explore the lands and to determine as far as they deemed requisite their mineral value before deciding to purchase; they were virtually long options, in which the government only secured to itself a percentage of the mineral products which should be removed. The trustees of this early organization were David Hanshaw, Samuel Williams, of Boston; D. G. Jones, of Detroit, and Col. Chas. H. Gratiot; the latter recently from the lead mines of Missouri. Several veins had been discovered on the property, and Dr. C. T. Jackson, who was employed to examine them, found them so favorable that he recommended the prosecution of mining work, which was begun October 22, 1844, in the east bank of the Eagle river, near the center of the line between sections 19 and 30, T. 58 N., R. 31 W. The preliminary work was directed by Dr. Jackson, but when he left the country late in the season, for his home in Boston, the charge of affairs was given over to Col. Gratiot, who had had previous experience in the lead mines. A stamp mill was decided upon, and the necessary machinery contracted for in Detroit, which on completion, was transferred to the lake and got ready for work in August, 1845. This was the first attempt at a stamp mill on Lake Superior, but it proved unsuitable for the purpose intended, and was of little service. The building is yet standing in which this stamping work was thus early begun.

—*Compiled from annual report Michigan Commissioner of Mineral Statistics*, 1880.

EARLY DAYS OF MINING, ON THE PACIFIC SLOPE.

THE first mention of gold in California is made in Hakluyt's account of the voyage of Sir Francis Drake, who spent five weeks in June and July, 1579, in a bay near latitude 38°; whether Drake's bay or San Francisco bay is a matter of dispute. It certainly was one of the two, and of neither can we now say with truth, as Hakluyt said seriously, "There is no part of the earth here to be taken up wherein there is not a reasonable quantity of gold or silver." This statement, taken literally, is untrue, and it was probably made without any foundation, merely for the purpose of embellishing the story and magnifying the importance of Drake and of the country which he claimed to have added to the possessions of the English crown. If any "reasonable quantity" of gold or silver had been obtained by the English adventurers, we should probably have had some account of their expeditions into the interior, of the manner and place in which the precious metals were obtained, and of the specimens which were brought home, but of these things there is no mention. Neither gold nor silver exists "in reasonable quantity" near the ocean about latitude 38°, and the inference is that Drake's discovery of Gold in California was a matter of fiction more than of fact. Some small deposits of placer gold were found by Mexicans near the Colorado river at various times from 1775 to 1828, and in the latter year a similar discovery was made at San Isidro, in what is now San Diego county, and in 1802 a mineral vein, supposed to contain silver, at Olizal, in the district of Monterey, attracted some attention, but no profitable mining was done at either of these places. Forbes, who wrote the history of California in 1835, said "No minerals of particular importance have yet been found in Upper California, nor any ores of metals." It was in 1838, sixty-nine years after the arrival of the Franciscan friars, and the establishment of the first mission, that the placers of San Francisquito, forty-five miles northwest from Los Angeles, were discovered. The deposit of gold was neither extensive nor rich, but it was worked steadily for twenty years. In 1841 the exploring expedition of Commodore Wilkes visited the coast, and its mineralogist, James D. Dana, made a trip overland from the Columbia river, by way of Willamette and Sacramento valleys to San Francisco bay, and in the following year he published a book on mineralogy, and mentioned in it that gold was found in the Sacramento valley, and that the rocks similar to those of the auriferous formations were observed in southern Oregon. Dana did not regard his discovery as of any practical value, and if he said anything about it in California no one paid any attention to it. Nevertheless, many persons had an idea that the country was rich in minerals, and on the 4th of May, 1846, Thomas O. Larkin, then United States consul in Monterey, a gentleman usually careful to keep his statements within the limits of truth, said in an official letter to James Buchanan, then Secretary of state: "There is no doubt but that gold, silver, quicksilver, copper, lead, sulphur, and coal mines are to be found all over California, and it is equally doubtful whether, under their present owners, they will ever be worked." The implication here is that if the country were only transferred to the American flag, these mines, of whose existence he knew nothing save by surmise, or by the assertion of incompetent persons, would soon be opened and worked. In sixty-six days after that letter was written, the stars and stripes were hoisted in Monterey, and now California is working mines of all the minerals mentioned by Larkin save lead, which also might be produced if it would pay, since there is no lack of its ores.

Marshall's Discovery.—The discovery of the rich gold fields of the Sacramento basin is an American achievement, accomplished under the American dominion, by a native of the United States, and made of world-wide importance by American enterprise and industry, favored by the liberal policy of American law. It was on the 19th day of January, 1848, ten days before the treaty of Guadalupe Hidalgo was signed, and three months before the ratified copies were exchanged, that James W. Marshall, while engaged in digging a race for a saw-mill at Coloma, about thirty-five miles eastward from Sutter's Fort, found some pieces of yellow metal, which he and the half dozen men working with him at the mill supposed to be gold. He felt confident that he had made a discovery of great importance, but he knew nothing of either chemistry or gold mining, so he could not prove the nature of the metal or tell how to obtain it in paying quantities. Every morning he went down to the race to look for the bits of the metal; but the men at the mill thought Marshall was very wild in his ideas, and they continued their labors in building the mill, and in sowing wheat, and planting vegetables. The swift current of the mill-race washed away a considerable body of earthy matter, leaving the coarse particles of gold behind, so Marshall's collection of specimens continued to accumulate, and his associates began to think there might be something in his gold mine after all. About the middle of February, a Mr. Bennett, one of the party employed at the mill, went to San Francisco for the purpose of learning whether this metal was precious, and there he was introduced to Isaac Humphrey, who had washed for gold in Georgia. The experienced miner saw at a glance that he had the true stuff before him, and after a few inquiries he was satisfied that the diggings must be rich. He made immediate preparation to go to the mill, and tried to persuade some of his friends to go with him, but they thought it would be only a waste of time and money, so he went with Bennett for his sole companion. He arrived at Coloma on the 7th of March, and found the work at the mill going on as if no gold existed in the neighborhood. The next day he took a pan and spade and washed some of the dirt from the bottom of the mill race in places where Marshall had found his specimens, and in a few hours Humphrey declared that these mines were far richer than any in Georgia.



THE SAW MILL OF COLOMA, WHERE GOLD WAS DISCOVERED, JANUARY 19, 1848.

He now made a rocker and went to work washing gold industriously, and every day yielded him an ounce or two of metal. The men at the mill made rockers for themselves, and all were soon busy in search of the yellow metal. Everything else was abandoned; the rumor of the discovery spread slowly. In the middle of March, Pearson B. Reading, the owner of a large ranch at the head of the Sacramento valley, happened to visit Sutter's Fort, and hearing of the mining at Coloma, he went thither to see it. He said that if similarity of formation could be taken as proof, there must be gold mines near his ranch, so after observing the method of washing, he posted off, and in a few weeks he was at work on the bars of Clear creek, nearly two hundred miles northwestward from Coloma. A few days after Reading left, John Bidwell, once representative of the northern district of the State in the lower house of Congress, came to Coloma, and the result of his visit was that in less than a month he had a party of Indians from his ranch washing gold on the bars of Feather river, seventy-five miles northwestward from Coloma. Thus the mines were opened at far distant points. The first printed notice of the discovery was given in the California newspaper published in San Francisco, on the 15th of March, as follows:

"In the newly made race-way of the saw-mill recently erected by Captain Sutter on the American Fork, gold has been found in considerable quantities. One person brought thirty dollars to New Helvetia, gathered there in a short time."

On the 29th of May the same paper, announcing that its publication would be suspended, says:

"The whole country, from San Francisco to Los Angeles, and from the sea-shore to the base of the Sierra Nevada, resounds with the solid cry of *gold! gold! gold!* while the field is left half planted, the house half built, and everything neglected but the manufacture of picks and shovels, and the means of transportation to the spot where one man obtained one hundred and twenty-eight dollars' worth of the real stuff in one day's washing; and the average for all concerned is twenty dollars per diem."

The towns and farms were deserted, or left to the care of women and children, while rancheros, wood-choppers, mechanics, vaqueros, and soldiers and sailors who had deserted or obtained leave of absence, devoted all their energies to washing the auriferous gravel of the Sacramento basin. Never satisfied, however much they might be making, they were continually looking for new places which might yield them twice or thrice as much as they had made before. Thus the area of their labors gradually extended, and at the end of 1848 miners were at work in every large stream on the western slope of the Sierra Nevada, from the Feather to the Tuolumne river, a distance of one hundred and fifty miles, and also at Reading's diggings, in the northwestern corner of the Sacramento valley. The first rumors of the gold discovery were received in the Atlantic States and in foreign countries with incredulity and ridicule; but soon the receipts of the precious metal in large quantities, and the enthusiastic letters of army officers and men of good repute, changed the current of feeling, and an excitement almost unparalleled ensued. Oregon, the Hawaiian islands, and Sonora sent their thousands to share in the auriferous harvest of the first year; and in the following spring all the adventurous young Americans east of the Rocky mountains wanted to go to the new Eldorado, where, as they imagined, everybody was rich, and gold could be dug by the shovelful from the bed of every stream. Before 1850 the population of California had risen from 15,000, as it was in 1847, to

100,000, and the average increase annually for five or six years was 50,000. As the number of mines increased, so did the gold production and the extent and variety of the gold fields. In 1849 the placers of Trinity and Mariposa were opened, and the following years those of Klamath and Scott's valleys.

Primitive Mining Methods.—In the first two years the miners depended mainly for their profits on the pan and the rocker. The placer miner's pan is made of sheet-iron, or tinned iron, with a flat bottom about a foot in diameter, and six inches high, inclining outwards at an angle of thirty or forty degrees. We frequently see and hear the phrase "golden sands," as if the gold were contained in loose sand; but usually it is found in a tough clay, which envelops gravel and large boulders as well as sand. This clay must be thoroughly dissolved; so the miner fills his pan with it, goes to the bank of the river, squats down there, puts his pan under water and shakes it horizontally, so as to get the mass thoroughly soaked; then he picks out the larger stones with one hand and mashes up the largest and toughest lumps of clay, and again shakes his pan; and when all the dirt appears to be dissolved so that the gold can be carried to the bottom by its weight, he tilts up the pan a little to let the thin mud and light sand run out; and thus he works until he has washed out all except the metal which remains at the bottom. The rocker, which was introduced into California mines at their discovery, is made somewhat like a child's cradle. On the upper end is a riddle, made with a bottom of sheet-iron punched with holes. This riddle is filled with pay-dirt, and a man rocks the machine with one hand while with a dipper he pours water into the riddle with the other. With the help of the agitation, the liquid dissolves the clay and carries it down with the gold into the floor of the rocker, where the metal is caught by traverse riffles or cleets, while the mud, water and sand run off at the lower end of the rocker, which is left open. The riddle can be taken off so that the larger stones can be conveniently thrown off. In places where there was not water enough for washing, and where the gold was coarse, the miners sometimes scratched the metal from the crevices in the rocks with their knives; but the pan and rocker were their main reliance for three or four years. In many places the rich spots were soon exhausted, and there was a rapid decrease in the profits of the miners. It was necessary that they should devise new and more expeditious methods of working, so that they could wash more in a day, and thus derive as much profit as they had obtained by washing a little dirt. The chief want of the placer miner is an abundant and convenient supply of water, and the first noteworthy attempt to convey the needful element in an artificial channel was made at Coyote Hill, in Nevada county, in March, 1850. A ditch was built about two miles long, and, proving a decided success, was imitated in many other places, until, in the course of eight years, six thousand miles of mining canals had been made, supplying all the principal placer districts with water, and furnishing the means for obtaining the greatest portion of the gold yield of the State. Many of the ditches were marvels of engineering skill. The problem was to get the largest amount of water at the greatest altitude above the auriferous ground, and at the least immediate expense, as money was worth from three to ten per cent. per month interest. As the pay-dirt might be exhausted within a couple of years, and as the anticipated profits would in a short time be sufficient to pay for an entirely new ditch, durability was a point of minor importance. There was no imperial treasury to supply the funds for a durable aqueduct in every township, nor could the impatient miners wait a decennium for the completion of gigantic structures in stone and mortar. The high value of their time and the scarcity of their money made it necessary that the cheapest and most expeditious expedients for obtaining water should be adopted. Where the surface of the ground furnished the proper grade, a ditch was dug in the earth; and where it did not, flumes were built of wood and sustained in the air by frame-work that rose sometimes to a height of three hundred feet in crossing deep ravines, and extending for miles at an elevation of a hundred or two hundred feet. All the devices known to mechanics for conveying water from hill-top to hill-top were adopted. Aqueducts of wood and pipe of iron were suspended upon cables of wire, or sustained on bridging of wood; and inverted siphons carried water up the sides of one hill by the heavier pressure from the higher side of another. The ditches were usually the property of companies, of which there were at one time four hundred in the State, owning a total length of six thousand miles of canals and flumes. The largest of these, called the Eureka, in Nevada county, had two hundred and five miles of ditches, constructed at a cost of $900,000; and their receipts at one time from the sale of water were $6,000 per day. Unfortunately these mining canals, though more numerous, more extensive, and bolder in design than the aqueducts of Rome, were less durable, and some of them have been abandoned and allowed to go to ruin, so that scarcely a trace of their existence remains, save in the heaps of gravel from which the clay and loam were washed in the search for gold. As the placers in many districts were gradually exhausted, the demand for water and the profits of the ditch companies decreased; and the more expensive flumes, when blown down by severe storms, carried away by floods, or destroyed by the decay of the wood, were not repaired.

Miners' "Rushes."—The year 1850 was marked by the first of a multitude of "rushes" or sudden migrations in search of imaginary rich diggings. The miners, although generally men of rare intelligence as compared with the laborers in other countries, had vague ideas of the geological distribution of gold, and the marvellous amounts dug out by them, sometimes ascending to thousands of dollars per day to the laborer, excited their fancy so much that they could scarcely have formed a sound judgment if they had possessed the information neccessary for its basis. Many believed that there must be some volcanic source from which the gold had been thrown up and scattered over the hills, and they thought that if they could only find that place, they would have nothing to do but to shovel up the precious metal and load their mules with it. More than once, long trains of pack animals were sent out in the confident expectation that they would get loads of gold within a few days. No story was too extravagant to command credence. Men who had never earned more than a dollar a day before they came to California were dissatisfied when they were here clearing twenty dollars, and they were always ready to start off on some expedition in search of distant diggings reputed to be rich. Although the miners of to-day have far better ideas of the auriferous deposits than they had thirty years ago, and no longer expect to dig up the pure gold by the shovelful, they are now, as they have been since the discovery of the mines, always prepared for migration to any new field of excitement. In the spring of 1850 a story was circulated that gold was lying in heaps on the bank of Gold Lake, a small body of water eastward of where Downieville now is. Thousands of men left good claims to join this rush, but after weeks or months they returned much poorer than they started. The next year witnessed a rush to Gold Bluff, on the ocean shore about latitude 41°. The sea beating against a high auriferous hill had left a wide beach containing much gold, which was mixed with sand that was very rich in spots, but was shifted about under the influence of a heavy surf. A gentleman of much intelligence, secretary of a mining company which claimed a portion of the beach, examined the place and seriously wrote to his associates that each one would receive at least $43,000,000 if the sand proved to be only one-tenth as rich as that which he had examined. Several other similar statements were made in corroboration. The mining population were wonderfully excited by these reports, and preparations were made for a large migration to the golden beach; but more precise information was soon published, and most of the adventurers who had started were disenchanted before the vessels in which they were to sail could get to sea. The construction of hundreds of ditches within three or four years after the successful experiment at Coyote Hill gave a great impulse to placer mining, and had much influence to change its character. Before the water had been carried in artificial channels to the tops or high upon the sides of the hills, nearly all the miners spent their summers in washing the dirt in the bars of the rivers and their winters in working the beds of gullies, which were converted into brooks during the rainy season. In the gullies the supply of pay-dirt was usually small, and the claims were exhausted in the course of a few weeks. On the bars the water was below the level of the pay-dirt, and had to be dipped or pumped up by hand. These circumstances were favorable to the use of the rocker; but the ditch brought the water to places where the dirt was far more abundant and could be obtained with more facility, though it was poorer in quality, and, therefore, the washing of a larger quantity would be necessary to yield an equal profit. New modes of working and new implements must be introduced to accomplish the greater amount of work, and the tom and the sluice came rapidly into use. The tom had been employed for years in the placers of Georgia, and some Georgians had their sluices in Nevada county in the later part of 1849, and in February the following year a party at Gold Run, in that county, finding that the bed of the ravine did not give them enough fall, made a long board trough on the hill-side leading down to their tom, and the pay-dirt from the claim was thrown up to a board platform, and from that thrown up to the head of the trough, and the water carried the dirt down to the tom. The purpose of this trough was mainly to save the labor of carrying the dirt by hand from the claim to the tom; but the trough having been once built, its value in washing gold was soon apparent. It was, however, the ditch that gave opportunities for the general introduction of the tom and sluice, and in most districts they were unheard of until late in 1850 or 1851.

The tom is a trough about twelve feet long, eight inches deep, fifteen inches wide at the head and thirty at the foot. A riddle of sheet-iron punched with holes half an inch in diameter forms the bottom of the tom at the lower end, so placed that all the water and their mud shall fall down through the holes of the riddle and none pass over the sides or end. The water falls from a riddle into a flat box with transverse cleets or riffles, and these are to catch the gold. A stream of water runs constantly through the tom, into the head of which the pay-dirt is thrown by several men, while one throws out the stones too large to pass through the riddle, and throws back to the head of the tom the lumps of clay which reach the foot without being dissolved. The tom was a great improvement on the rocker, but it was soon superseded by a still greater, the sluice, which is a board trough, from a hundred to a thousand feet long, with transverse cleets at the lower end to catch the gold. With a descent of one foot in twenty the water rushes through it like a torrent, bearing down large stones and tearing the lumps of clay to pieces. The miners, of whom a dozen or a score may work at one sluice, have little to do save to throw in the dirt and take out the gold. Occasionally it may be necessary to throw out some stones, or to shovel the dirt along to prevent the sluice from choking, but these attentions cost relatively very little time. The sluice is the best device for washing gold. It was used in California during the early days more extensively than elsewhere, although it has been introduced by men who have been in our own mines, into Australia, New Zealand, British Columbia, Transylvania, and many other countries. The sluice, though an original California invention had been previously invented in Brazil; but it was never brought to much excellence there nor used extensively, and no such implement was known in 1849 in the industry of gold mining. At first the sluices were made short, and afterwards lengthened, until some were a mile long, the length being greater as the gold was finer; that is, if the surface of the earth in the direction of the sluice was favorable.

There were many little variations in the form of the sluice, to suit different circumstances. The ground sluice is a mere ditch on a hillside or slope, and the miners dig up the bottom and dig down the banks, while the water carries away the clay and leaves the gold; but the dirt at the bottom of the ground sluice must afterwards be washed in a board sluice. The ground sluice has been used to grade roads and to carry away snow from the streets of mining towns, as well as to wash-gold. In claims where many large stones were found in the pay dirt, and had to be carried by the water through the board sluice, or where the sluice was to be used for a long period, they were paved with stones, because any wooden bottom was rapidly worn out. Sometimes the bed of a stream into which many sluices emptied was converted into a "tail sluice," which yielded a large revenue, with no labor save that of occasionally "cleaning up" or washing out the metal from the sand deposited in the crevices between the stones.

Placer Leads Traced to Quartz.—The placer gold had originally been confined in rocky veins which were disintegrated by the action of chemical or mechanical forces, and the lighter material was swept away by the water, while the heavier remained near its primeval position. The gold found in the bars of large streams far from the mountains, after having been carried a long distance, is in small smooth particles, as though it had been ground fine and polished by long attrition. In small gullies in the mountains the gold is usually coarse and rough, as if it had suffered little change after having been freed from the quartz by which it was once surrounded. In hundreds of instances the abundance of gold in a gully has been traced unmistakably to an auriferous quartz lode in the hill-side above it, and the placer miners, following streaks of loose gold, have been brought to the rocky source from which it came. In this manner the Allison mine and the Comstock lode, not to mention other less celebrated mines or veins, were found. Such discoveries were made in 1850, and in the following year capitalists in New York and London, anxious to get their share of the marvellous wealth of the Sierra Nevada, formed companies to work the quartz mines at Grass valley and at Mariposa. Millions of dollars were invested in machinery, and superintendents, with the wildest ideas, were sent to erect mills and to take charge of the precious metals. All these ventures proved complete failures. In most instances the machinery was utterly useless, and the superintendents utterly incompetent. The castings for the mills lay about the wharves of San Francisco for many years, objects of curiosity for experienced miners, and of ridicule for the general public. In one mill the metal was to be caught in a coarse sieve, and in another the quartz was to be crushed by a rolling ball. The mismanagement was so gross and the losses so severe that foreign capitalists became very shy of California quartz mines, and the development of that branch of industry was much retarded. It was not, however, in quartz mining alone that ridiculous blunders were made. Large sums of money were expended in the eastern states by men who had never seen a placer mine, and had no correct idea of the nature of the gold deposits, in making machinery to take gold more expeditiously from the river beds and bars than could be done by hand. One enterprising New York company sent a dredging machine to dig the metal from the bottom of the Yuba river, never questioning whether that stream was deep enough in the summer to float such a machine, or whether the tough clay and gravel in its bed could be dug up by a dredger, and entirely ignorant of the fact that the gold is mostly in the crevices of the bed-rock, where the spoon and knife of the skilful and attentive miner would be necessary for cleaning out the richest pockets. With the introduction of the sluice, the ditch, and the hydraulic process, it became customary to hire laborers. The pan and the rocker required every man to be his own master. In 1849 each miner worked for himself, or the exceptions were so few that they were almost unknown. The method of working made it impossible for the employer to guard against the dishonesty of the servant, who could always make more in his own claim than any one could afford to give him. Men become servants usually because they have no capital, and cannot get into profitable employment without it; but there was no lack of profitable employment for the miner in 1849, nor did he need any capital, even if he had it. But the sluice brought deep diggings, with large masses of pay dirt, into demand, and the claims were held at high prices so that their possession was in itself a capital.

There had been an abundance of rocker claims in 1849; but there were not enough good sluice claims three years later to supply one-third of the miners. The erection of a long sluice, the cutting of drains, often necessary to carry off the tailings, and the purchase of water from the ditch company, required capital, and the manner of cleaning up rendered it possible for the owner of a sluice to prevent his servants from stealing any considerable portion of his gold before it came to his possession. Thus it was that the custom of hiring miners for wages became common in the placer diggings. In 1852 the wages were $6 or $7 per day;

the next year about $5, since which time they have gradually fallen.

The development of the quartz mining interest was slow and steady, unlike the placer mining, which, rising suddenly to gigantic proportions, soon reached its culminating point, and then began to decline rapidly. The placers had been discovered by miners who were searching for them, and who spent much time and labor in the search; but in early years most of the richest auriferous lodes were found by men who were not looking for quartz. Hunters, travelers, placer miners and road makers occasionally came, without thinking of it, upon valuable veins, which they immediately claimed, and proceeded to work or sell. The first quartz miners in California were Mexicans, who knew how gold-bearing rocks were reduced in their native country. They pounded up the quartz in mortars, or, if not rich enough to pay for reduction in that way, they made an arrastra or little circular stone pavement in the centre of which stood a post. To an arm extending out from this was hitched a mule which dragged round a heavy piece of granite, between which and the pavement, the quartz was pulverized, and, when fine, the gold was caught with quicksilver and separated from the base matter by washing. This process required neither capital nor skilled labor, nor delay, nor a number of laborers. The owner of the arrastra could dig out his own rock one day, and reduce it the next. As a matter of profit he usually selected only the richest pieces to work in the arrastra, throwing aside those portions that would not yield at the rate of $75 or more per ton. With experience in the observation of quartz, and a mode of working in which failure was almost impossible, these Mexicans frequently did very well. Their success excited the envy of the Americans, who would purchase the claims at high prices, and tell the Mexicans to see the wonders that would be done by American enterprise. The common result was that a large and costly steam-mill was erected; a multitude of laborers were employed; they did not know how to select the rich from the poor quartz; the mill was so large that it could not be kept going at its full capacity without receiving all the poor as well as the rich rock accessible in the vein; the amalgamator did not understand his buiness; the rich rock in which the Mexicans had been at work was soon exhausted; the creditors who had loaned money for the erection of the mill brought suit to foreclose their mortgage; the work stopped; the title of the property was insecure; and the people in the neighborhood said that quartz mining was a very uncertain business. And so it is under that system of management; and that system, leading to failure, was followed in more than a hundred cases. Mills were built in places where only a little pocket of rich quartz had been found, and if the pay-quartz was abundant it was not properly selected; or, if selected, the amalgamation was intrusted to a man who knew nothing of the business, and the gold was lost. Horace Greeley was near the truth when he said, "I am confident that fully three out of every four quartz mining enterprises have proved failures, or have at best achieved no positive success." And yet in nearly every case prudent and competent management would have secured success, perhaps on only a small scale, because in many instances the quantity of pay-rock was small. But the failure of three-fourths of the quartz mills built in early years did not prevent the continuous increase of mills, and of the yield of gold from quartz. When a miner found a vein yellow with gold, he could not turn his back on it because his neighbor's mill did not pay. Gradually more caution was used; competent miners and metallurgists became numerous, and the veins were carefully examined as to the quantity of pay-rock before mills were built. As the placers declined the miners were compelled to turn their attention to quartz, and prospecting for quartz became a regular business.

Improvement in Mining.—The sluice, though perfect as a device for washing the dirt, was not the last invention in placer mining. The shovel did not furnish the earth to the sluice fast enough, and the wages of a dozen workmen must be saved if possible. In 1852, Edward E. Mattison, a native of Connecticut, invented the process of hydraulic mining, in which a stream of water was directed under a heavy pressure against a bank or hill-side containing placer gold, and the earth was torn down by the fluid and carried into the sluice to be washed; thus the expense of shoveling was entirely saved. The man with the rocker might wash one cubic yard of earth in a day; with the tom he might average two yards; with the sluice four yards; and with the hydraulic and sluice together fifty or even a hundred yards. The difference is immense. A stream of water rushing through a three-inch pipe, under a pressure of two hundred feet perpendicular, has a tremendous force, and the everlasting hills themselves crumble down before it as if they were but piles of cloud blown away by a breath of wind or dissipated by a glance of the sun.

And yet even this terrific power did not suffice. When the hills have been dried by months of constant heat and drought, the clay becomes so hard that the hydraulic stream, with all its momentum, does not readily dissolve it, and much of the water runs off nearly clear through the sluice, and thus is wasted for the purposes of washing. The sluice could wash more dirt than the hydraulic stream will furnish when the clay is hard and dry. To prevent this loss, the miner will often cut a tunnel into the heart of his claim, and by powder blast the clay loose, so that it will give way more readily to the water. There have been instances in which two tons of powder have been used at one blast in a hydraulic claim. As the introduction of the ditch led to the use of the sluice and hydraulic power, so the introduction of the latter led to a change in the mining ground. The miners were now able, and they even preferred to attack high hills of gravel, which afforded them an immense mass of auriferious earth, and furnished profitable employment to large streams of water for months or even years. Those counties which contained the most extensive districts suitable for the application of hydraulic power were the most prosperous, while the towns dependent on river mining, or on shallow placers fell into decay, and were partially, and in some cases entirely, deserted.

Decline of River Mining.—From 1850 to 1856 river mining occupied a very important place in the industry of the State. The beds of all the streams in the auriferous regions were rich in gold, which could only be obtained by taking the water from its natural course by means of dams and ditches or flumes. The beds being deep, and the banks steep, rocky, and crooked, these enterprises to drain the rivers were very expensive, and they were also very dangerous pecuniarily, since only a brief portion of the year was suitable for the work, and an early rain might come and sweep away dam and flume before an ounce of gold had been obtained. The comb of the Sierra Nevada along nearly its whole length rises almost to the limits of perpetual snow, and the white caps do not disappear or the rivers reach a low stage until late in the summer, so that three months may be considered as the limit of the period in which a river can be flumed and the bed emptied of its gold. Every perennial stream of much note in the auriferous districts was flumed at some time in its history, but after 1860 such enterprises became rarities. One of the most costly and remarkable river flumes in the State was erected in 1857 to drain the Feather river at Oroville. It was three-quarters of a mile long and twenty feet wide; the expenditures of the company during the season were $176,985 and their profits $75,000. They flumed the river again in 1858, and then lost $45,000. In some of the diggings the auriferous clay is so hard and tough that the hydraulic stream and sluice are unable to dissolve it, and mills were built to crush it fine so that the water in the sluice could get an opportunity to dissolve all the earthy particles and set free the metal. The discovery of gold in Australia, was made in 1851, by a miner from California, and it proved to be equal in magnitude to that of our own State; and, singular to say, it attracted little attention, and drew from us within two years only about a thousand of our residents, while many thousands were ready to rush to imaginary diggings in other directions.

The Miners' Madness.—Placer mining was at the height of its prosperity in 1852 and 1853. Wages were high, employment abundant for everybody that wished to hire out, and there was plenty of ground that would pay, at least, moderately for working with the rocker. But the rich spots were few, and the miners who had shared the prosperity of 1849 were longing for the discovery of some new gold field that would again reward them with an ounce a day. In the latter part of 1853, and the beginning of 1854, a series of newspaper letters and articles were published asserting that there were very rich placers on the head waters of the Amazon in Peru. These articles probably came from the same source, and must have been written with the deliberate purpose of throwing trade into the hands of a few ship-owners and merchants. Whatever the design of the writer or writers may have been, the result was that two thousand miners went from California and Australia to Peru, where they found no placers, nor could they learn of any such place as that mentioned in the articles. The next year was marked by a greater rush to Kern river, in the southern part of the State. Some small placers had been found there, and they served as the basis or the suggestion of a multitude of false letters, asserting that the basin of Kern river was as rich in gold as those of American and Yuba rivers had been in 1849. These statements were copied into the newspapers, which had no means of verification, and the entire industry of the state was thrown into confusion. Miners abandoned good claims, farm laborers and clerks left their employers, the rate of wages and the cost of mining implements rose in the market, and soon six or eight thousand men were on the road to Kern river and as many more were ready to start, when the newspapers began to show the folly of such a rush to diggings that had as yet produced no considerable amount of gold. The tide of migration was arrested, and soon it turned back, the dis-appointed adventurers returning with the satisfaction of knowing that every river between the Mariposa and Feather, even after seven years' working, was richer than Kern river had ever been. It was in October, 1855, that a very remarkable discovery was made near Columbia, in Tuolumne county. In various parts of the State, the miners in following up rich deposits of gold had come upon what appeared to be the channel of ancient rivers, which had been filled up and covered over with beds of clay and gravel in some places a thousand feet deep. The high banks, the bars, the bends, the rapids, the deep places, the tributary gullies and brooks, the water-worn gravel, the remains of fresh-water mollusks, the flat stones pointing down stream, the heaps of gravel formed by eddies, the drift-wood, and the deposit of coarse gold in the centre and deep places of the channel—unmistakable evidences of a stream that had existed for centuries—were all distinctly recognizable.

In these ancient rivers the gold was distributed in the same manner as in those of the present geological era, but in greater abundance and usually in larger particles, as though it had not been subjected to so much wear. The primeval streams were intersected in places by water courses of our own day, and these latter were usually richer just below the points of intersection than at any other places. The largest and most noted of the ancient river beds discovered before 1867 in California, called the Blue lead, runs nearly through the middle of Sierra and Nevada counties, has a width varying from a hundred to three hundred yards, and has been traced nearly forty miles. Its course is at right angles to that of the present streams in the same neighborhood. The amount of gold taken from its bed has never been ascertained, but it could not have been, up to 1868, less than $25,000,000, and perhaps twice as much.

New Discoveries.—The traveller in the mining districts frequently sees "table mountains;" that is, high rocky elevations, with flat surfaces and steep sides. They are evidently remains of lava floods, from which the earth, by which they were once surrounded, has been washed away, leaving the basalt towering above the adjacent country. The most remarkable of these table mountains is in Tuolumne county, through which runs the Stanislaus river, and with the same general course. Its length, with its bends, is about thirty-five miles, its height from three hundred to one thousand feet above the clay and gravel near it, and its width from a quarter to half a mile. The smoothness of its surface, the gradual inclination to the westward, the basaltic nature of the rock, its proximity to a center of great volcanic activity, and various other circumstances which cannot be stated here in detail, leave no room for doubt that this table mountain is a solidified bed of lava. Some miners, sinking a shaft at a place where the lava had been carried away, leaving the sandstone or gravel under it bare, found gold, and some other miners, working along the side of the mountain, found a rich streak of pay-dirt, which ran down in a deep rocky channel obliquely under the mountain. They attempted to follow it, but they soon met a body of water, which they could neither avoid nor pump out. This put them on nettles. Further examination showed that there were other little channels running under the mountain and on both sides, and all going deeper as they went further in, and nearly all tending westward, with a course oblique to that of the mountain, and all containing more or less gold. There must, then, be an ancient river bed under the mountain. This opinion, advanced by a few men without education, who wished to induce wealthy men to undertake the exploration of the mountain by tunnels, was met by incredulity and ridicule. Nevertheless, the projectors of the scheme had got the idea fixed in their minds, and they were determined to see what the mountain was made of. The storekeepers, in accordance with the general custom of assisting in developing the resources of their own neighborhood, willingly trusted them for provisions, tools, and clothes, while they were cutting a tunnel to reach the bed of the supposed ancient river. They commenced their work at some distance from the basalt, and after cutting through clay and gravel reached a slate rock, which seemed to have been the ancient bank, and then they came to a bed of gravel of such character that the theory of the primeval river was fully established. But the tunnel was not deep enough. It was far above the bed rock, and the water stood, as before, between the miner and the gold. Months of labor had been lost, and it was uncertain whether the next tunnel would strike the right level, nor could it be known whether the bed would be rich enough to pay. Nevertheless, hope and confidence are the chief divinities of the miner. He is happy in their smiles even when privation is his companion and when experience tells him that no gold fortune is in store, they continue to sustain him. The Table mountain prospectors, however, had reason and experience, as well as hope and confidence, to cheer them, and the second tunnel was undertaken with the encouragement of many men who had sneered at the first. The right elevation had been struck this time, the bottom of the river bed was reached and was drained by the tunnel, and the gravel was found to be extremely rich. Ten feet square of superficial area yielded $100,000. A pint of gravel not unfrequently contained a pound of gold. The whole mountain was soon claimed. The State echoed with the discovery. A stream of lava had filled up the bed of an ancient river for thirty miles, and in the course of ages the earth and slate that once formed the banks were washed away, leaving the basalt to mark the position of the golden treasure. Other similar deposits were found elsewhere, and other explorations, as bold in their conception but less successful or less important in their results, were undertaken in nearly every county. The years 1856 and 1857 were marked by no peculiar excitement or sudden change. The working of the gullies and river bars and beds was gradually becoming less profitable and productive, the quartz and ditch interests continued to grow larger, wages kept their downward tendency, and the number of hired laborers increased. In 1858 the State received a shock that was felt in every fibre of her political and industrial organization. Rich diggings were found in the spring on a bar of Fraser river, and it was asserted and presumed that there were large tracts of excellent placers in the upper basin of the stream. The presumption was not without its foundation in experience and reason, but after all it was but a presumption. The miners, however, were not disposed to listen to any doubts; they were ready to sacrifice everything in the hope of finding and being the first to enjoy another virgin gold field like that of California. In the course of four months, 18,000 men, nearly one-sixth of all the voters in the State went to Fraser river, and many thousands of others were preparing for an early start. The confident belief prevailed that "the good old times" of '49 were to come again. Servants threw up their positions, farmers and miners left their valuable property, wages rose, houses and land fell in value, and many persons believed that California would soon be left without a tenth part of her population. All this excitement was made before any gold had been received in San Francisco, and before there was any direct and trustworthy evidence of the existence of paying diggings beyond the limits of a few bars, which could not give occupation to more than a hundred men. Suddenly, and with no material addition to the evidence, the conviction burst on the people that Fraser river would not pay, and five-sixths of the truant miners had returned before the end of the year.

The Comstock Lode and Washoe Fever.*—A party of emigrants discovered placer diggings on Gold cañon, a little tributary of Carson river, east of the Sierra Nevada, in 1849, and a permanent mining camp was established there in 1852. It was observed that the gold contained a large proportion of silver, in some claims nearly one-half in value, but this fact was not without precedent in the placers of California, and was regarded simply as a misfortune for the miner, who did not receive more than $10 or $12 an ounce for his dust, while that obtained on the western slope of the Sierra usually sold for $17 or $18. The Gold cañon diggings had been worked for seven years, and gave employment to about fifty men, when, in the spring of 1859, the miners, following up a rich streak of placer gold, came upon a quartz lode in the place now known as Gold Hill. A couple of months later, some miners, in following up a placer lead in which the gold was mixed with about an equal weight of silver, came on the lode from which the metal had been washed down.† They were working here in a rude way, with no idea of the value of their claim, when James Walsh, an intelligent quartz miner from Grass valley, passed their place and examined their mine. His attention was attracted by the dark gray stone which he suspected was silver ore, and as an assay of it he sent a ton and a half of it to San Francisco, where it was sold for $3,000 per ton. He and some friends then bought out four of the five partners, paying $22,000 for four-fifths of 1,800 feet, or at the rate of $14 per foot. Some shafts sunk on the vein showed that the gray stone, a rich sulphuret of silver, could be obtained in large quantities. The lode was soon claimed as far as it could be traced, and the market value of the shares rose so rapidly that before the end of the year $1,000 a foot had been offered for a portion of the lode. The excitement about the silver mines spread throughout California in the spring of 1860, and thousands of miners crossed the mountains to work in the newly-discovered mines or to seek for others. In every town companies were formed to equip and send out prospectors, and the work was continued on a large scale for three years. Thousands of square miles, never before visited by white men, were explored and examined, and many thousands of metalliferous lodes were found and claimed. It was in 1860 that the silver districts of Esmeralda, Bodie, Potosi, Coso, and Humboldt were discovered, besides many others of less note. The chief silver mining town grew up at the Comstock lode, and was soon the home of a large and excited population. Every man owned thousands of feet of argentiferous lodes, and considered himself either possessed of a fortune or certain of soon acquiring one. The confidence in the almost boundless wealth of the country was universal, but many were bothered to convert their ore into ready cash. Men who considered themselves millionaires had sometimes not enough money to pay for a dinner, and in their dress they looked like beggars. The following extract from a letter written at Virginia, in April, 1860, gives a picture of the condition of society there at that time:

"Of a certainty, right here, is Bedlam broke loose. One cannot help thinking, as he passes through the streets, that all the insane geologists extant have been corraled at this place. Most vehement is the excitement. I have never seen men act thus elsewhere. Not even in the earlier stages of the California gold movement were they so delirious about the business of metalliferous discovery. Hundreds and thousands are now here, who, feeling that they may never have another chance to make a speedy fortune, are resolved this shall not pass unimproved. They act with all the concentrated energy of those having the issues of life and death before them. They demean themselves not like rational beings any more. Even the common modes of salutation are changed. Men, on meeting, do not inquire after each other's health, but after their claims. They do not remark about the weather, bad as it is, but about out-croppings, assays, sulphurets, &c. They do not extend their hands in token of friendship on approaching, but pluck from their well-filled pockets a bit of rock, and, presenting it, mutually inquire what they think of its looks. During the day they stand apart, talking in couples, pointing mysteriously hither and yon: and during the night mutter in their sleep of claims and dips and strikes, showing that their broken thoughts are still occupied with the all-absorbing subject. I shall be able to convey to your readers some idea of the intensity of this mining mania, when I assure them that this portion of the American people do not even ask after newspapers, nor engage in the discussion of politics. Little care they whom you choose President; conventions and elections, wars and rumors of wars, are nothing to them. They have their own world here. Here, bounded by the Sierra and the mountains of Utah, spread over the foot-hills and the deserts, is a theatre beyond which their thoughts are not permitted to roam; to this their aspirations and aims are all confined. Whatever of energy, ambition, and desire are elsewhere expended on love, war, politics, and religion, are here all devoted to this single pursuit of finding, buying, selling, and trading in mines of silver and gold. Everybody makes haste to be rich; and so great is the mental tension in this direction, that it may well be questioned whether, if a sweeping disappointment should overtake them, many will not be reduced to a condition of absolute lunacy. What guarantee this wildly-excited multitude have against the happening of this fearful contingency, I am not fully prepared to say, having, as yet, not been able to give the subject much examination since my return. To attempt eliciting information from those now here, only tends to confuse and complicate what is already incomprehensible. If you talk with one man, he is only concerned lest the argentiferous metal be rendered worthless by the superabundance here met with; while another, with equal opportunities, and perhaps better ability for forming a correct judgment, derides the idea of there being any silver apart from the Comstock vein, telling you that the whole thing is an inverted pyramid, having that truly wonderful lead for a base."

Manipulation Troubles.—There was much difficulty in extracting the metal even from the richest ore. There were no mills to crush the rock, no skilful metallurgists to

* The credit of this discovery has been claimed by so many parties, and the testimony is so conflicting, that we are induced to give two of the popular versions. Substantially they agree upon the main points.

† S. H. Marlette, surveyor general of Nevada, in his annual report for 1865, gives the following history of the discovery of the Comstock lode:

"In 1852, H. B. and E. A. Grosch or Grosh, sons of A. B. Grosh, a Universalist clergyman of considerable note, and editor of a Universalist paper at Utica, New York, educated metallurgists, came to the then Territory, and the same or the following year engaged in placer mining in Gold canon near the site of Silver City, and continued there until 1857, when, so far as I can learn, they first discovered silver ore, which was found in a quartz vein, probably the one now owned by the Kossuth Gold and Silver Mining Company, on which the Grosh brothers had a location. Shortly after the discovery, in the same year, one of the brothers accidentally wounded himself with a pick, from the effects of which he soon died, and the other brother went to California, where he died early in 1858, which probably prevented the valuable nature of their discovery from becoming known. In the mean time placer mining was carried on to considerable extent in various localities, principally in Gold canon. In 1857, Joe Kirby and others commenced placer mining in Six Mile canon, about half a mile below where the Ophir works now are, and worked at intervals with indifferent success until 1859. On the 22d day of February, 1858, the first quartz claim was located in Virginia mining district, on the Virginia croppings, by James Finney, generally known as Old Virginia, from whom the city of Virginia and the croppings have taken their name. This must be considered the first location of the Comstock lode, unless we consider the Kossuth claim as upon one branch of the Comstock, which may not be impossible in case we adopt the one lode system, for the lode is about one hundred feet in thickness, and its strike would take it to the eastern slope of Mount Davidson, as explorations prove, as I have been informed, the Virginia croppings to be the outcrop of the western portion of the Comstock. The discovery of rich deposits of silver ore was not made until June, 1859, when Peter O'Reilly and Patrick McLaughlin, while engaged in gold washing on what is now the ground of the Ophir Mining Company, and near the south line of the Mexican Company's claim, uncovered a rich vein of sulphuret of silver in an excavation made for the purpose of collecting water to use in their rockers in washing for gold. This discovery being on ground claimed at the time by Kirby and others, Comstock was employed to purchase their claim, whereby Comstock's name has been given to this great lode, by which those entitled to the credit of its discovery have been defrauded—a transaction, to compare small things with great, as discreditable as that by which Americus Vespucius bestowed his name upon the western continent, an honor due alone to the great Columbus. From this discovery resulted the marvellous growth of Nevada. Immediately the lode was claimed for miles; an unparalleled excitement followed, and miners and capitalists came in great numbers to reap a share of the reported wealth. The few hardy prospectors exploring the mountains for hidden wealth soon counted their neighbors by thousands; soon walked along miles of busy streets, called into existence by the throng of adventurers, and soon the prospectors were ransacking almost every part of the (at present) State of Nevada in search of silver lodes."

reduce the ore, and no confident opinion in regard to the best means of extraction. The simple processes used for reducing auriferous quartz would not suffice. The gold exists in the metallic form, and so soon as the rock is pulverized can be obtained by washing or amalgamation. But silver is in chemical combination with baser substances, and must be separated from them by chemical influences before the metal will submit to unite with quicksilver, by which it must usually be caught. All the silver produced in civilized countries was obtained by two processes, the Frieberg German barrel, and the Mexican yard or patio. In the German process three hundred pounds of the ore, finely pulverized, are mixed with water to the thickness of cream, and after the addition of some salt, iron pyrites, scraps of iron, and quicksilver are put into a strong barrel, and kept revolving rapidly for fourteen hours, at the end of which time the silver and quicksilver have united, and they can easily be separated from the mud by washing. The barrels are rapidly worn out, the amount of work done is little, and the labor required is much. In the Mexican process the pulverized ore is mixed with water, salt, iron pyrites, and quicksilver, and left out in an open yard for three weeks, the mass being stirred or trodden with mules occasionally. This mode of reducing is very slow, and is unsuited to the cool climate of Nevada, in latitude 38°, and at an elevation of 5,000 or 6,000 feet above the sea. There was a general belief that some mode of amalgamation better than either of these could and would be devised, so while one set of men were engaged in hunting and opening mines, another set were busy in studying a mode for reducing the ores. A satisfactory result was not reached for several years, but it came at last in the invention of the pan process, as distinguished from the barrel and yard processes. The pan was of cast-iron, about five feet in diameter and eighteen inches deep. Five hundred or a thousand pounds of ore were put in with salt, iron pyrites, quicksilver, and enough water to make a thin mud. A muller revolved on the bottom of the pan, and served to grind the matter, which was not fine enough, and also brought all the particles of the ore into contact with the chemicals and the quicksilver. Besides the motion of the muller, various devices were used to keep up a regular current, so that all portions of the mixture were successively brought to the bottom, and exposed to the action of the quicksilver. In some pans heat was applied. The American process extracted silver from the common sulphuret ore as thoroughly as any other process, with much more rapidity, and with less expense. It was, therefore, in almost universal use in the American silver mines of the Pacific slope, and has been introduced into Mexico. While the metallurgists were working away at their pans, the miners generally were afraid to erect mills lest buildings and machinery might be unsuited to the new modes of working. The mills that were built charged $50 and $60 per ton for crushing and amalgamating, though the same work was done at Grass Valley, only one hundred miles distant, for less than $5 a ton. The amalgamation was so conducted that only the free gold was saved. All the silver and much of the gold were lost. Ore that contained $500 to the ton was sent to the mill if it yielded $70 or $80, leaving about $10 profit, and a loss of $400 of silver. The value of the ore and the amount of silver lost were precisely understood, but there was no remedy. It was necessary to take some silver from the mines at any sacrifice to keep up the confidence of the shareholders. Although the ore in sight was worth millions, the bullion sent across the mountains from Nevada amounted to only $90,897 in 1860. The next year, however, the export rose to $2,275,256; in 1862 to $6,247,074, and in 1863 to $12,486,238. This increased rate might well astonish the world, and dazzle people in the vicinity.

New Developments.—The silver excitement which pervaded California in the spring of 1860 continued to increase steadily for three years. Washoe, by which name the mining region near the Comstock lode was generally known, was the main topic of conversation, and the main basis of speculation. Everybody owned shares in some silver mine. High prices were paid to strangers for mines at places of which the purchaser had never heard until a day or two before the purchase. Men seemed to have discarded all the dictates of prudence. Their judgment was overwhelmed by the suddenly acquired wealth of a few and by the general anxiety of the many to buy any kind of silver shares. People acted as though there were so many rich silver mines that men who had been searching for them would not be so mean as to offer a poor one for sale. Three thousand silver mining companies were incorporated in San Francisco, and 30,000 persons purchased stock in them. The nominal capital was $1,000,000,000, but their actual market value never exceeded $60,000,000, and not one in fifty owned a claim of the least value. And yet the organization of each company cost $100 on an average, and that money had to be paid by somebody. Although the mines were in Western Utah, which was organized afterwards into the Territory and then into the State of Nevada, the shares were mostly owned in San Francisco, and that place was the centre of speculation and excitement, of profit and loss. On every side were to be seen men who had made independent fortunes in stocks within a few months. The share in the leading mines on the Comstock lode were the preferred security for loans by money lenders and banks. The shares, or feet, as they were most commonly called (for in most of the companies a share represented a lineal foot lengthwise on the vein), of the Comstock claims advanced with great rapidity, in some cases as much as $1,000 per month. A foot of the Gould and Curry mine, worth $500 on the 1st of March, 1862, was sold for $1,000 in June; for $1,550 in August; for $2,500 in September; for $3,200 in February, 1863; for $3,700 in May; for $4,400 in June, and for $5,600 in July. Other claims advanced with a rapidity less rapid but scarcely less startling. In the middle of 1863, Savage was worth $3,600 per foot; Central $2,850; Ophir $2,550; Hale and Norcross $1,850; California $1,500; Yellow Jacket $1,150; Crown Point $750; Chollar $900, and Potosi $600. Virginia City, the centre of the mining industry, rose to be the second town west of the Rocky mountains. It had a population of 15,000, and the assessed value of its taxable property was $11,000,000. The amount of business done was twice as great as in any other town of equal size in the United States. And well might the town be large and busy. It produced more silver within a year than any other one mining district of equal size ever did. Neither Potosi nor Guanajuato could equal it. The former town yielded $10,000,000 annually for a time, but with that yield supported a population of 160,000. In 1863 it may be doubted whether any town of 15,000 persons ever before produced an average of $12,000,000 annually, or an average of $800 to the person. Well might excitement run high, and money be flush. But though the silver yield kept up, distrust set in, and prices of stocks commenced to fall in the summer of 1863. The people began to count up how many millions they had paid as assessments on claims that had been worked for years and had never yielded a cent. Experts from other silver mining countries said that no rich and permanent deposits of silver had been opened, save on the Comstock lode, and that the management of the mines there was grossly wasteful.

It was a notorious fact that many companies had been organized for the purpose of swindling the ignorant by selling worthless stock to them. Prices declined slowly until the middle of the next year, and then they were attacked by a panic which smote hundreds of the Washoe speculators with terror and bankruptcy. Gould & Curry fell from $5,600 to $900 per foot; Savage, from $3,600 to $750; Ophir, from $2,550 to $425; California, from $1,500 to $21; Hale & Norcross, from $1,850 to $310, and others in like proportion. The wild-cat or baseless speculations were swept away to destruction by the thousand, and never heard of more. The dray-men, the hod-carriers, the mechanics, the clerks, the seamstresses, the servant-girls, who had cheerfully paid assessments for years, in the confidence that they would soon have a handsome income from their silver mines were disenchanted. The name of Washoe, which had once been blessed, was now accursed by the multitude, though still a source of profit to a few. People wondered how they could have been so blind. It was found on examination that the most deliberate and most dishonest deception had been systematically practiced in many cases. Most of the mines had been managed not with the object of taking silver from the ore, but for the purpose of making profit by the sale and purchase of stocks. The officers, or some of them, combined to raise or depress the shares as suited their schemes. It was an easy matter to instruct the miners to take out the richest or the poorest of the ore, and the returns of the mill could be published as a fair indication of the value of all the ore within sight. "When a bulling operation was in progress the superintendent would write glowing letters; rich rock, selected from a large mass of poorer material, would be sent to mill; debts would be incurred to be paid in the future, and large dividends would be declared. If a 'bearing' operation was in contemplation, the rich deposits would be avoided; the rock sent to mill would prove to be very poor; assessments would be levied to pay off the debts of the company; suits would be commenced against it, and every device that could discourage stockholders would be adopted." In the erection of buildings the financial management of the companies was grossly extravagant. Money was thrown about almost as if it had no value. It was presumed that the rich and extensive deposits found near the surface, instead of being exhausted, would become still richer as the works advanced in depth. The ignorance of metallurgy and lack of experience in silver mining led to many costly mistakes. Wages much higher than those of California were paid. The overestimate of the value of the mines was one of the causes of a great litigation, for which opportunities were given by the careless manner in which claims were located, recorded, and transferred in early times. The lawyers charged fees high almost beyond example. Witnesses who found that their testimony was necessary in important suits suddenly had business in the eastern states, or in some other remote place, and could not be persuaded to remain till the trial unless some large sums of money were paid to them. Subornation of perjury became a profession in which many engaged. So much money was spent in a law-suit that it materially affected business. When the trial of the suit between the Ophir and the Burning Moscow was transferred from Virginia City to Aurora, property in certain parts of the latter town rose fifty per cent., so confident were the residents there that the attendants at the court would be numerous and flush of money. In several cases more money was spent in litigation than the entire mine was worth. The surveyor general of the state, in his report for the year 1865, says:

"I have understood that $1,300,000 have been expended in litigation between the Chollar and Potosi companies, and $1,000,000 more have been expended in the Ophir-Moscow trials. * * * I believe one-fifth of the proceeds of the Comstock would not more than pay the expenses of litigating the title thereto."

The yield of the Comstock lode, up to the date of that report, was about $45,000,000; so Mr. Marlette's estimate of the amount spent in litigation would be $9,000,000, and four-fifths of this was expended within a period of three years. The sum paid as dividends to stockholders in many permanent mines was less than that expended in litigation. One of the main sources of the lawsuits was the doubt whether the Comstock lode had at its side a number of branches, or whether it was one of a series of independent and parallel lodes within a distance of two hundred yards. At the surface several seams of ore were perceptible, and the first claimants had taken the seam which was largest and lowest on the hill, and they asserted that the seams above were mere branches. This assertion, however did not prevent others from claiming the other seams, and thus arose the suits between the Ophir and the Burning Moscow, that between the Gould & Curry and the North Potosi, and that between the Potosi and the Bajazet, which were all cases of much importance in their day. The people were divided between the one-lode and the many-lode parties, and elections turned more than once on that question. Most of the stock of the one-lode companies was held in San Francisco, while a larger proportion of the stockholders of the many-lode companies were residents of Virginia City, so it was argued that it was the interest of Nevada that the old companies should be defeated. But the latter had the evidence of geology, and what was, perhaps, still more important, the money, on their side, and the many-lode theory was at last completely overthrown, but not until after a struggle that cost years of time and millions of money. The Comstock vein has a dip of 45° to the horizon, and while it was in the process of formation large bodies of porphyry split off from the hanging wall, fell down into the vein stone and were there suspended, leaving a seam of quartz above as well as one below. These pieces of hanging wall are usually long, narrow and deep, but not large enough in any direction to make two lodes out of one. Another source of disappointment to the mining companies was that as the works advanced in depth expenses increased in an unexpected manner. The immense excavations for the extraction of ore required vast quantities of timber; as the forests were distant and transportation dear, the mines were compelled to pay three-quarters of a million dollars annually for timbering alone. The water increased, and powerful engines, consuming much wood, were required to pump constantly at an expense of $100 per day to each of half-a-dozen companies. Foul air made it impossible for miners to work rapidly in the deep drifts, and ventilation was expensive. These, and a multitude of other considerations, contributed to the panic and kept the general stock market down. But such influences could not entirely govern the price of particular stocks. Gould & Curry, which was sold for $900 per foot in July, 1864, advanced to $2,000 in April, 1865, and fell to $600 in October, 1866. Savage was $7,000 in April, 1865, and $1100 in October, 1866. Of stocks, which were not noticed in the stock-boards in the summer of 1864, Yellow Jacket rose in April, 1865, to $2,590 per foot, and was sold in October, 1866, for $700; Belcher, worth $1,650 in April, 1865, was offered for $95 in October, 1866. Alpha, worth $2,100 in April, 1865, was worth only $50 in October, 1866, and Crown Point fell from $1,225 in April, 1865, to $950 in October, 1866. A fall of fifty per cent. or a rise of two hundred per cent. in the market value of a large mine within the space of six months was nothing very unusual, and it is easily understood that in such events fortunes were made and lost with great rapidity, and that the mining days in the Pacific slope from the date of the gold discovery in 1848 to 1865 were, exciting, busy days, days of millions, days of poverty, ruin and death as well as of affluence, and the wild riot of the baser passions.

—*Compiled from J. Ross Browne's Reports.*

A CENTURY OF MINING AND METALLURGY IN THE UNITED STATES.

MINING enterprises were among the motive powers to the exploration, conquest, and colonization of the New World. The desire to find a shorter route to the profitable trade of India, and the desire to conquer new territory wherever it might be found, in the name of some Catholic or Protestant sovereign of Europe, were accompanied both in North and South America, by eager hopes of the discovery of gold and silver. The history of the plunder of the metallic wealth and the development of the mineral resources of Mexico and South America, does not lie within our present purpose. The early enterprises of this kind in the northern part of the continent were less successful, though the progress of two hundred years has made them more beneficial to national prosperity, for reasons which I shall, perhaps, be able to indicate. Gold was found in moderate quantities in use among the Indian tribes of the present Southern States. The Spaniards under De Soto, following this clue, and led on by stories, exaggerated or misunderstood, of their Indian guides, made a wide superficial exploration in search of the origin of this treasure. They are supposed to have excavated many of the diggings in North and South Carolina and Georgia, which are now overgrown with forests. But no rich deposits appear to have been discovered, and no permanent operations undertaken. In the great charter of King James, by which, in 1606, the right to explore and settle the North American continent from the thirty-fourth to the forty-fifth parallel, was granted to the London and Plymouth Companies, it was provided that one-fifth of the gold and silver, and one fifteenth of the copper, which might be discovered, should belong to the crown. One of the earliest expeditions of

Captain John Smith, in Virginia, was the exploration of the Chickahominy River, in the hope that it might constitute a water-way to the Pacific Ocean; and one of the next events in the history of the same colony was a mining excitement, such as would be called in our California tongue a "stampede," caused by the supposed discovery of gold; in which, fortunately, John Smith did not avail himself of his official position to take "stock." It is a curious circumstance that gold really occurs in that region, though the glittering dust, of which a ship-load was sent by the deluded colonists to the jewelers of London, proved to be but mica or iron pyrites; and it seems probable (albeit this suggestion is not based upon any explicit record known to me) that the presence of gold among the Indians, and the discovery of specimens of the quartz or slates of Virginia, containing visible particles of it, gave rise to the general excitement, under the influence of which, without further tests of value, a large amount of worthless material was collected, to the neglect of necessary and profitable industry. From this point of view the Jamestown mining fever was the prototype of many that have since occurred—all of which may be summed up in the general expression, that the mine "did not pan out according to the samples."

A more promising industry was inaugurated at the same time by the sending of a quantity of iron ore from Jamestown to England in 1608. This ore, smelted in England, yielded seventeen tons of metal, probably the first pig-iron ever made from North American ore. In 1620, a hundred and fifty skilled workmen were sent to the colony to erect iron-works; and it is said that a fund, subscribed for the education of the colonists and Indians, was invested in this enterprise, as a safe and sure means of increase. But, in 1622, an Indian massacre broke up the enterprise; and both the manufacture of iron and the education of citizens and Indians have been obliged ever since, to rely upon other sources of support.

According to the statement of Colonel Spotswood, quoted by Mr. Pearse, it appears that, previous to 1724, neither New England, Pennsylvania, nor Virginia, possessed blast furnaces. Their product of iron was from bloomeries only. According to Prof. Hodge, quoted by Prof. Whitney, however, a furnace was built at Pembroke, Mass., in 1702; and another authority states that, in 1721, New England possessed six furnaces and nineteen forges. In 1719 was passed the famous resolution of the British House of Commons, "that the erection of manufactories in the colonies tended to lessen their dependency on Great Britain." Only the earnest protest of the colonial agents prevented the prohibition at the time of the American iron manufacture. The next thirty years witnessed two instructive contests. The first was that of the colonial with the domestic pig-iron manufacture—a competition in which America was favored by her abundance of her vegetable fuel (the employment of mineral coal in iron-making not having yet found introduction), in comparison with the rapidly waning forests of Great Britain. The British manufacture being protected by heavy duties on colonial pig-iron, the latter began to be more and more worked up into bar-iron, nails, steel, etc., at home; and this brought on a new competition with the British manufactures of these articles. In 1750, a further legislative attempt to regulate this trade was made by Parliament, which decreed the admission of colonial pig-iron duty free but prohibited the erection in America of slitting, rolling, or plating mills, or steel furnaces, ordering that all new ones thereafter built should be suppressed as "nuisances." It will be recollected that arbitrary acts of this kind, for the destruction of our infant manufactures, were among the grievances cited in the Declaration of Independence. The extent of the American iron manufacture, during the ante-revolutionary period, can be inferred only from scanty records of exports. These, beginning in 1717 with three tons, had increased, in 1750, to about 3000 tons; in 1765, the total is reported at 4342 tons; and, in 1771, at 7525 tons, the maximum annual report. The outbreak of the war of course put an end to exportation and caused a great demand for war material, which occupied and rapidly extended the manufacture possessed by the country. The expanded iron industry suffered a severe collapse when, at the close of the war, not only this demand ceased, but the reopened ports admitted large quantities of foreign iron—the successful employment of mineral coal, the steam engine and puddling having by that time laid the foundation of English supremacy in the iron manufacture.

The earliest copper-mining company of which we find any record—according to Prof. Whitney, in his excellent work on the metallic wealth of the United States, the earliest incorporated mining company of any kind—was chartered in 1709, to work the Simsbury mines, at Granby, Conn. These mines were abandoned in the middle of the eighteenth century, afterwards bought by the State of Connecticut, and used as a prison for sixty years. Mining was resumed in them about 1830, and after a few years they were again abandoned. The ores were mostly shipped to England, and seem to have been lean. The deposit belongs to the class of irregular bunches, nodules, seams, or limited beds, in the New Red Sandstone, near its junction with trap. This formation was the scene in New Jersey, also, of early mining activity. The Schuyler mine, near Belleville, on the Passaic, was discovered about 1719, and proved more profitable to its owners before the Revolution than it ever has been since that time, to any of the series of individuals and companies that have expended large sums in its development. In fact, the chief blessing conferred upon mankind by the Schuyler mine arises from the circumstance that the first steam engine ever built wholly in America was constructed in 1793–4, at the small machine shop attached to the smelting works at Belleville, Mr. Hewitt being the pattern-maker in the party of mechanics sent out by Boulton & Watt for the purpose of erecting an engine for the Philadelphia Water-works in Centre Square. In 1751 a copper mine was opened near New Brunswick; and the Bridgewater mine, near Somerville, was operated previous to the Revolution, though even then, it is said, with much loss of capital. New Jersey's record in copper-mining is not a cheerful one; but her unsurpassed ranges of iron ores may well console her. Betrayed by the treachery of Triassic and trap, she can flee to the shelter of the crystalline schists. Pennsylvania was not without her copper-mining in the colonial period, the Gap mine, in Lancaster County, having been opened in 1732.

Already during the colonial period the first red gleams of the future glory of the Lake Superior mines had appeared. The intrepid Jesuit fathers, Marquette and others, who penetrated the wilderness from Acadia to the Gulf, to carry both the Cross of their religion and the Lilies of their Sovereign, had made extensive explorations on the Upper Peninsula, and published glowing accounts of the abundance of copper, to which later travelers added legends of gold and precious stones. Before them the Indian tribes, whose stone tools now furnish subjects of inquiry to the archeologist, had wrought rudely upon the deposits which nature had left in a condition so exceptionally pure as not to need, for the production of limited amounts of metal, the intervention of metallurgical process. The first recorded mining operations on the part of white men were those of Alexander Henry, near the Forks of the Ontonagon, in 1771. As is well known, however, the active development of this region dates from the publication of Houghton's *Geological Report*, in 1841, and the extinguishment of the Chippewa title by the treaty of 1843. Lead mining in this country may also claim an ancient origin—as we reckon antiquity. As early as 1651, Governor John Winthrop received his famous license to work any mines of "lead, copper, or tin, or any minerals as antimony, vitriol, black-lead, alum, salt, salt-springs, or any other the like," and "to enjoy forever said mines, with the lands, woods, timber. and water within two or three miles of said mines." As he received also a special grant of mines or minerals in the neighborhood of Middletown, Conn., it is not unlikely that the old Middletown silver-lead mine, the date of the discovery of which is not precisely known, was opened by him or his successors. The nickel and cobalt mines near Chester, in Connecticut, once held to be very promising deposits, are also believed to have been originally worked by Governor Winthrop; but nickel was not valuable in those days; and the lead and copper in these ores do not seem to have been abundant. Unfortunately, now that nickel and cobalt are so valuable as to repay amply the cost of extracting them when they are present in a small percentage only, these Connecticut ores no longer correspond (if indeed they ever did) to the analysis and accounts formerly given as to their niccoliferous character. The old Southampton silver-lead mine, in Massachusette, well known to mineralogists, was commenced in 1765, by Connecticut adventurers; but its operations were suspended by the Revolutionary war. Lead mines in Columbia and Dutchess Counties, N. Y., were also worked at an early period; and, no doubt, all over the country occupied or controlled during the war by the American forces, there were small and desultory surface operations, furnishing lead for the use of the army. The Indians inhabiting the Mississippi Valley before the advent of the whites probably did not understand the metallurgy of lead. Galena has been found in the Western mounds, but, it is said, no lead. In 1700 and 1701 Pere Le Sueur made his famous voyage up the Mississippi, discovering as he claimed, many lead mines. Lead mining was begun in Missouri in 1720, while that country belonged to France, and under the patent granted to Law's famous Mississippi Company. Mine la Motte, named after a mineralogist who came over with Renault, the superintendent, was one of the first discoveries. It has been in operation at intervals ever since, and is now successfully managed by Mr. Cogswell, who may, I think, truthfully claim that he has charge of the oldest mining enterprise still active in the United States. The ores yield a small percentage of nickel and cobalt, as well as lead. It was in 1788 that Dubuque obtained from the Indians the grant under which he mined until the year of his death, where the city now stands which bears his name. The land was subsequently ceded to the United States by the Indians, and the representatives of Dubuque were forcibly ejected.

Such, then, was the condition of our mining industry at the commencement of our national existence. We occupied but a strip of territory on the Atlantic; and even in that limited area we had scarcely learned the nature and extent of the mineral resources to be utilized. Anthracite and petroleum, quicksilver and zinc, were unknown as treasures within our reach. The rapid extension of possession, goverment, population, and industry over plains and mountains to the Pacific, which has been effected in a hundred years, is but the type of a conquest and progress which has advanced with equal rapidity in every department of human labor, and nowhere more notably than in the departments of mining and metallurgy. The tables which accompany these remarks, show that this country has produced during the century ending with 1875, of gold, about 66,680,000 troy ounces, worth about $1,332,700,000; of silver, about 201,300,000 troy ounces, worth about $261,450,000; of quicksilver, 840,000 flasks, or 64,206,000 pounds avoirdupois; of copper, 200,000 tons; of lead, 855,000 tons; of pig-iron, 40,000,000 tons; of anthracite coal, 351,521,423 tons (the ton in all these cases being 2240 pounds avoirdupois); and of petroleum, 76,594,-600 barrels. The product of these leading industries for the year 1875 were: gold, $33,400,000; silver, $41,400,000; quicksilver, 53,706 flasks; copper, 15,625 tons; lead, 53,000 tons; pig-iron, 2,108,554 tons; zinc, about 15,000 tons; anthracite, 20,643,509 tons; bituminous coal, about 26,000,000 tons; petroleum, 8,787,506 barrels.

In order that a clear idea may be formed as to the relative position now held by the United States in the world of mining and metallurgy, I have selected the production of coal, which is the main reliance for power of all organized industry, and of iron, which is the chief agent of civilization, and as the basis of comparison with other nations, using, so far as coal is concerned, the figures given in the 42nd Annual report of the Philadelphia Board of Trade, for the year 1873.

	Tons.	Per cent.
Great Britain,	127,016,747	46.4
United States,	50.512,000	18.4
Germany,	45,335,741	16.5
France,	17,400,000	6.4
Belgium,	17,000,000	6.2
Austria and Hungary,	11,000,000	4.0
Russia,	1,200,000	0.5
Spain,	570,000	0.2
Portugal,	18,000	—
Nova Scotia,	1,051,567	0.4
Australia,	1,000,000	0.4
India,	500,000	0.2
Other countries,	100,000	0.4
Total	273,604,055	100,0

The following estimate, in round numbers, of the world's present production of iron, is taken from various sources, and may be considered approximately correct. The figures for Great Britain and France are those of 1874, and the product of the United States for the same year has been taken. For other countries the estimates are principally for 1871 or 1872, except Austria and Hungary, for which the official returns for 1873 have been taken. The quantities are given in tons of 2240 pounds.

		Per cent.
Great Britain,	5,991,000	45.2
United States,	2,401,000	18.1
Germany,	1,600,000	12.1
France,	1,360,000	10.3
Belgium,	570,000	4.3
Austria and Hungary,	365,000	2.7
Russia,	360,000	2.7
Sweden and Norway,	306,000	2.3
Italy,	73,000	0.5
Spain,	73,000	0.5
Switzerland,	7,000	—
Canada,	20,000	0.2
South America,	50,000	0.4
Japan,	9,000	0.1
Asia,	40,000	0.3
Africa,	25,000	0.2
Australia,	10,000	0.1
	13,260,000	1.00

An examination of these tables will serve to show that in the products which measure the manufacturing industry of nations, Great Britain stands first and the United States second on the roll, and that there is a clear and almost identical relation between the product of coal and the product of iron. The United States now produces as much coal and iron as Great Britain yielded in 1850. We are thus gaining steadily and surely upon our great progenitor, and in the nature of things, as the population of this country grows, must, before another century rolls around, pass far beyond her possible limits of production, and become the first on the International list, because we have the greatest geographical extent, and our natural resources are upon so vast a scale that all the coal area of all the rest of the world would only occupy one-fourth of the space in which, within our borders, are stored up the reserves of future power. In a hundred years, we have thus far reached a point at which for coal, iron, gold, silver, copper, lead, and zinc, we are independent of the world, with abundant capacity to supply as well our growing wants, as to export these blessings of civilization to other and less favored lands, as soon as our labor and our legislation are adjusted to the conditions which will enable us to compete in foreign markets.

One hundred years ago we proclaimed our political independence, and we maintained it by force of arms; we are now in a position to proclaim our industrial and commercial independence, and maintain it by the force of peaceful agencies against friendly competition. Never was a century of free government celebrated under such favorable conditions; never was free government so justified by the material results it has produced. But let us not conceal from ourselves the fact that mere growth in wealth, mere develepement in industry, mere increase in population are not the best evidences of national greatness; and unless our progress in art, learning, morals, and religion keeps pace with our material growth we have cause rather for humiliation than glorification. "Whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report" constitute the real glory of a nation, without which the magnificent material structure which in a century we have reared, will disapear "like the baseless fabric of a vision."

In a hundred years, as I have said, we have reached a point at which, for every one of the minerals and metals named we are independent of the world, having the capacity to supply our own growing domestic demand, also to export to foreign lands. It is not my purpose to trace in detail the steps by which this degree of progress has been achieved. The narration of succcessive events alone, without any discussion of underlying causes and accompanying effects, would consume far more time than I could command. So far as the leading epochs of the history are concerned, I think they may be fairly summed up in the following brief catalogue:

1. First of all, must be named the erection in Philadelphia, in 1794, of the first steam engine in America. We celebrated in 1876 the centennial anniversary of a greater power than the United States of America—a wider revolution than our War of Independence. It was in 1776 that James Watt presented to the world the perfected steam engine, all the improvements of which since his day are not to be compared with those which he devised upon the rude machines of his predecessors. In one hundred years, the steam engine has transformed the face of the world and affected to its remotest corners the condition of the human race. Few changes have been so profound; not one in history has been so rapid and amazing. With reference to the special subject now under consideration, if I were asked what elements had most to do with the swift progress of our country, I should answer, freedom and the steam engine. But deeper even than any organized declarations or outward forms of freedom lies the influence of the steam engine, which has been from the day of its birth, in spite of laws and dynasties, and all accidents of history, the great emancipator of man.

2. *Gold Mining in the South.*—Already Jefferson, in his *Notes on Virginia*, mentioned the finding of a lump of gold weighing seventeen pennyweights, near the Rappahannock; and, about the beginning of this century, the famous Cabarrus nugget, weighing twenty-eight pounds, was discovered at the Reed Mine, in North Carolina. But the great gold excitement in the South followed the discoveries in Georgia, from 1828 to 1830. The maximum of production (probably never more than $600.000 in any one year) was from 1828 to 1845, since which time it has declined, though a few enterprises, both in hydraulic and quartz mining, are now actively prosecuted.

3. *The Opening of the Anthracite Coal Fields and the use of Anthracite in the Blast Furnace.*—The first of these events practically dates from the year 1820, although some anthracite found its way to market much earlier, and the second from the year 1839. The latter was followed by the development of the vast anthracite iron industry, which has contributed so much to the prosperity of Pennsylvania. The connection between anthracite and civilization was long ago pointed out by Sir Charles Lyell, in connection with his visit to this country, when he observed in Pennsylvania and in Philadelphia, the strange phenomenon of a vast manufacturing population, dwelling in neat houses and able to keep themselves and their houses clean. This smokeless fuel is a great moral and æsthetic benefactor. It has also proved specially useful in metallurgy—one process at least, the American zinc-oxide manufacture, being impracticable without it; and in war no one will deny its superiority who remembers how our cruisers burning anthracite, and hence not traceable at sea by their smoke, were able to spy and pursue the blockade-runners, whose thick clouds of escaping bituminous smoke betrayed them. A table of the production of anthracite is given herewith; and some further observations concerning its control and management will be appropriate under another head of my remarks.

4. *The Use of Raw Bituminous Coal in the Blast Furnace.*—This was introduced in 1845.

5. *The Development of the Copper Mines of Lake Superior,* beginning in 1845 and increasing slowly but steadily to 1862, when about eight thousand tons of ingot copper were produced; then declining for some years, to recover in 1868 and 1869 its lost ground, and since the latter year, by reason of the great production of the Calumet and Hecla Mine, to attain an unprecedented yield. The tables of copper production for the United States, herewith given, show that our present product is not far from sixteen thousand tons, of which three-fourths must be credited to the Lake Superior mines.

6. *The Discovery of Gold in California,* in 1848, or rather its rediscovery, since it had previously been known to both the natives and the Jesuit missionaries, and also to hunters and trappers. The wonderful direct and indirect results of this event have been too often the theme of orators, historians, and political economists to need a further description from me. Its direct result in the way of mining was the rapid exploration of the Western territories by eager prospectors, and the successive development of placer-mines in nearly all of them. It is difficult to fix the dates of these beginnings; but we may assume with sufficient accuracy that gold mining practically began in Oregon in 1852, in Arizona in 1858, in Colorado in 1859, in Idaho and Montana in 1860. With the completer exploration of the country, and the decline of the placer-mines, stampedes have grown less frequent and extensive than in the earlier days. There is scarcely any corner of the country left, except the Black Hills of Dakota, which has not been ransacked sufficiently to show whether it contains extensive and valuable placer deposits; and those districts which present accumulations of gold in such a way as to offer returns immediately to labor without capital have been already over-run. The principal reliance of our gold-mining industry for the future must be quartz and hydraulic or deep gravel mines. These may be expected to maintain for years to come their present rate of production, if not to increase it. In the table of gold production, herewith given, there is, it is true, a falling off of late years; but this is to be attributed to the placer-mines.

7. *The Commencement, about* 1851, *of Regular Mining Operations at the New Almaden Quicksilver Mine, in California.*—The production of this metal in the United States has been thus far confined to the State of California; and it will be seen from the table of the production of the New Almaden mine, that it has always furnished a large, though of late a waning, proportion of the grand total for the country.

8. The middle of the nineteenth century was crowded with important events in metallurgy and mining. It was in 1856 that Mr. Bessemer read his paper at the Cheltenham meeting of the British Association for the Advancement of Science, which inaugurated for both continents the age of steel. Within sixty days after that event an experimental Bessemer Converter was in readiness at the furnaces of Cooper & Hewitt, at Phillipsburg, New Jersey. But the experiment was not carried far enough to demonstrate the value of the newly-proposed process, and it was left to the late John A. Griswold and his associates to introduce and perfect this wonderful method in the United States.

9. *The Commencement of the Hydraulic Mining Industry.*—The position of the auriferous slates and quartz veins, on the west flank of the Sierra, with the precipitous mountains behind them, and the broad plain before, has favored exceptionally the formation of deep auriferous gravels in which California far exceeds any other known region. And the same topographical features furnish the two other prime requisites of hydraulic mining, namely, an abundant supply of water and a sufficient grade of descent to permit the use of flumes and the escape of tailings. These advantages the keen-witted miners of the Pacific coast were quick to make available; and I think we may set down the invention of hydraulic mining, which occurred, I believe, about 1853, as an epoch in the progress of American mining. It has given us an entirely new and original branch of the art, involving many ingenious hydrodynamic and hydrostatic contrivances; and it has certainly made possible the exploitation of thousands upon thousands of acres of auriferous gravel which could not have been profitably handled in any other way. The mountain torrents of the Sierra, caught on their way to the Pacific, have been forced to pause and do the work of man. The same agencies that buried the gold among the clay and pebbles of the river-beds are now made to strip the covering from it and lay it bare again. The hydraulic mines produce, at present, not less than $10,000,000 or $12,000,000 annually; and many enterprises of this kind which have been prosecuted through years of expensive preparation, and are now just beginning to touch their harvests of profit, will add henceforward to the product. I may mention as an illustration the extensive operations of the North Bloomfield and its two allied companies in California, which have expended in works $3,500,000, and will have six deep tunnels, aggregating over 20,000 feet, and canals supplying 100,000,000 gallons of water daily.

10. We must turn for a moment to the East again, to note the commencement of iron mining at Lake Superior, about the year 1856. The extraordinarily pure and rich ores of the upper peninsula of Michigan now find their way to the extent of a million of tons per annum, in fleets of vessels across the lakes to Cleveland, and are thence distributed to the furnaces of Ohio and Pennsylvania. The similarly pure

Missouri ores have built up in like manner their own market. The growth of the Lake Superior iron business is shown in the accompanying table.

11. The next great event in the history of American mining was the discovery, in 1859, that the Comstock lode was rich in silver. This opened an era of activity and speculation which has scarcely ceased since that time. Single districts have been subjected to fluctuating experiences, passing from the first enthusiasm through all the stages of hope to reaction and despair; but though the fortunes of each have risen and fallen like the changing tide, it has nearly always been high water somewhere. Thus we have had a succession of favorites in the way of silver-mining districts, each one crowding its predecessor out of the public notice. Of these the following list includes the most permanently productive: In Nevada, the Unionville, Reese River, Belmont, White Pine, Eureka, Esmeralda, and Pioche districts: in California, the argentiferous district of Inyo County; in Idaho, the Owyhee district; in Utah, the Cottonwood and Bingham districts; in Colorado, the silver districts of Clear Creek, Boulder and Summit Counties, to which the latest favorite, the San Juan region, may be added. It is amazing that under the adverse conditions surrounding the industry of mining in regions "remote, unfriended, solitary"—though not "slow"—so many communities should have succeeded in taking permanent root. Too much is expected of this industry when it is required to supply the lack of labor, food, transportation, government, and the organized support which in settled societies all the trades and occupations give to each other. Pioneer work is full of peril and of waste; and in view of the wonderful results achieved by our pioneers in mining, it ill becomes us to sneer at the losses and failures which constitute the inevitable cost of such conquests. When the battle has been gloriously won, and the spoils of victory are ours, we do not greatly mourn over the number of bullets that may have been fired in vain. But through all the vicissitudes of silver mining in other districts, the Comstock mines have maintained their place, an instance of rapid exploitation, and of aggregated wealth of production unexampled in history. Here, too, there have been intervals of failing hope; but a new *bonanza* has always made its appearance before the resources at hand were entirely exhausted; and we have seen extracted from the ores of this one vein, during the past fifteen years, the round sum of $200,000,000 in gold and silver. Dr. Raymond, in the table herewith given, assumes the product of gold to have been (on the authority of Mr. Hague) about 40 per cent. of the entire value. We have, therefore, from the Comstock mines during the period named, $80,000,000 gold, and $120,000,000 silver. The swift development of these mines, and the active commencement about the same time, of deep quartz mining operations in California led to a remarkable progress in mining machinery, and to the perfection of two distinctively American processes. I refer to the California stamp mill and amalgamation process for gold, and the Washoe pan-process for silver. Neither of these is so novel in principle as the hydraulic process of gold mining already mentioned; but both of them have received the peculiar impress of an ingenuity and mechanical skill, partly innate in our national character, and partly the product of the stern pressure of economic necessities. Into the fruitful field of further metallurgical improvements born of our Western mining industry—or adopted by it—such as the Blake rock-breaker, the Stetefeldt roasting furnace, the Bruckner cylinder, the Plattner chlorination, and many others less widely known, I cannot enter here. Our people have advanced in this line with headlong energy, and accomplished great results—at great expense. Much, undoubtedly, remains to be done; and it may be hoped that future progress will be equally rapid, but less costly. The introduction, three or four years ago, of the smelting processes of Europe for the treatment of the silver ores of the West, is a striking and encouraging instance of the quickness of our mining communities to seize upon the advantages of experience elsewhere, as soon as they are brought to notice. The ignorance which has led to many disasters in such enterprises, was not voluntary or obstinate. Give our people light, and they do not keep their eyes shut. I am assured that already the smelting works of the West present many features of interest and suggestiveness even to the study of skilful engineers from abroad.

12. I may be permitted, in closing this imperfect review, to refer to the great improvements in mining machinery, in rock-drilling, in explosives, in the use of gaseous fuel, in the construction and management of blast furnaces, puddling furnaces, rolling mills, and other branches of the iron manufacture, which have crowded upon us during the last ten years. It is impossible here to give even an enumeration of them which shall do them justice. They have been worthily commemorated by others upon other pages. With regard to one of them, the Martin process for the manufacture of open-hearth steel, I may speak with some personal satisfaction, since I had the privilege of introducing it into this country, after studying its merits abroad in 1867. I am convinced that it has a great future, as the ally, if not the rival, of the Bessemer process.

Returning now to the contemplation of the general field over which we have passed, we may inquire what the government of the United States has done, with regard to the mining industry. Other nations have elaborate mining codes and bureaus of administration. In comparison with these, the meagerness of our governmental supervision of mining is remarkable; yet, in view of the progress I have sketched, may it not be possible that our system has been on the whole the best for us? Certainly a complicated mining code like that of Spain and Mexico, whatever it may have brought to the coffers of the State, seems to have conferred, in centuries of operation, little benefit upon the people. The common law of England is the foundation of our jurisprudence in this, as in so many other respects. According to that law, as laid down in a noted case in the reign of Elizabeth, all gold or silver ores belonged to the crown, whether in private or public lands; but any ores containing neither gold nor silver belonged to the proprietor of the soil. Apart from the claims of the crown, the property in minerals, is, according to the common law, *prima facie* in the owner of the fee of the land, but the property in minerals, or the right to search for them, may be vested in other persons by alienation, prescription, or custom. Since the two latter rights require an origin beyond the time of legal memory, they are practically out of the question in this country. The crown right to the precious metals, as declared in the case referred to, was a survival or remainder of the royalty claimed in ancient times by the sovereign over all minerals. This sweeping claim, born of the despotisms of the Orient and made the subject of much conflict among emperors, feudal lords, and municipal authorities during the middle ages, dwindled at last till it covered only gold and silver. But it disappeared entirely from English America, for the simple reason that there was no private land ownership in this country, and the sovereign of England claimed, by right of discovery, soil and metals alike, barring only the Indian title, which it was his exclusive privilege (or that of his authorized representatives or grantees) to extinguish. After the Revolution, the United States succeeded to the rights of the British crown, and by the treaty of peace and the subsequent cessions by the different States of their colonial claims upon the public lands, the federal government became possessed of a vast domain over which, after extinguishing the Indian title, it had complete control. In the territories subsequently acquired from France and Spain, the United States assumed the rights and obligations of those sovereigns; and this circumstance, particularly in the adjustment of Spanish mineral and agricultural grants, has caused some apparent variations from the general policy. But it is sufficiently accurate to say that at the present time, throughout the country, the owner of the fee, or the party who has obtained from him by lease or purchase the mineral right, has supreme control. The mining legislation of the United States, therefore, is simply a part of the administration of the public lands; and for this reason it is executed by the Commissioner of the General Land Office. In 1807 an act was passed, relating primarily to the lead-bearing lands of Illinois. They were ordered to be reserved from sale, and leased to miners by the war department. The leases covered tracts at first three miles square (afterward reduced to one mile), and bound the lessee to work the mines with due diligence and return to the United States 6 per cent. of all the ores raised. "No leases were issued under this law," says Prof.

Whitney, "until 1822, and but a small quantity of lead was raised, previous to 1826, from which time the production began to increase rapidly. For a few years the rents were paid with tolerable regularity; but, after 1834, in consequence of the immense number of illegal entries of mineral land at the Wisconsin Land Office, the smelters and miners refused to make any further payments, and the government was entirely unable to collect them. After much trouble and expense, it was, in 1847 finally concluded that the only way was to sell the mineral land, and do away with all reserves of lead or any other metal, since they had only been a source of embarrassment to the department." Meanwhile, by a forced construction (afterwards declared invalid) of the same act, hundreds of leases were granted to speculators in the Lake Superior copper region, which was, from 1843 to 1846, the scene of wild and baseless excitement. The bubble burst during the latter year; the issue of permits and leases was suspended as illegal, and the act of 1847, authorizing the sale of the mineral lands, and a geological survey of the district, laid the foundation of a more substantial prosperity. This policy of selling the mineral lands has been that of the government ever since. But it has necessarily been modified in the West by the peculiar circumstances under which that region has been settled. Before lands can be sold they must be surveyed; and before they can be sold as mineral lands, their mineral-bearing character must be ascertained. Our miners and explorers overran and occupied the Pacific slope in advance of the public surveys. They built cities that were not shown on any map; they cut timber, turned water-courses, dug canals, tunneled mountains, bought and sold their rights to these improvements under laws established by themselves, and enforced by public sentiment only. For nearly twenty years the government looked on, without asserting its dominant ownership of the public lands; and when by the acts of 1866, 1870, and 1872, and other minor enactments, a general system was created, it was necessary to recognize as far as possible the rights which had grown up by general consent, and to seek only to give to them certainty, practical uniformity, and reasonable limitations. It is not my purpose to discuss in detail the mining laws of the United States, or to trace the curiously complicated origins of the local customs on which they are largely based. Suffice it to say that the system recognizes the English common law principle, that the mineral right passes with the fee to the lands; so that, in the words of the commissioner (July 10th, 1873) "all mineral deposits discovered upon land, after United States Patent therefor has issued to a party claiming under the laws regulating the disposal of agricultural lands, pass with the patent, and the Land Office has no further jurisdiction in the premises." But the principle is also recognized that the mineral right may be separated from the fee by the owner, whether he be an individual or the United States; and this principle is curiously applied in the form of patents for mining claims upon lodes, which, following the form of the possessory title, grant to the patentee the right to follow all veins, the top or apex of which lies within the exterior boundaries of his claim, downward to any depth, though they pass under the surface of the land adjoining. As the size and the price per acre of the tracts sold under the agricultural laws are different from those to which the mining laws apply, and as, under the homestead law, a certain amount of agricultural land may be obtained without any payment, it is evident, that no known mineral deposits can be acquired under the agricultural laws; and this reservation is enforced both in the preliminary proceedings and in the patents finally issued under those laws. With regard to the mineral lands, however, it is certain that the patent for a claim carries with it both the fee of the land and also a mineral right, though not the same mineral right as is contemplated by the common law; since it is enlarged on the one hand by the permission to follow mineral deposits beneath the surface of adjoining land, and limited on the other hand by the operation of the same permission in favor of the adjoining owner. The latter limitation is incorporated in agricultural patents also, and may become operative whenever they adjoin mining patents. Previous to the application for a patent, the law permits free exploration and mining upon the public lands to all citizens and those who have declared their intention to become such. The rights of this class of miners, under what is known as the possessory title, are regulated by local laws and customs, subject only to a few simple conditions, which the United States enforces upon all, and which chiefly concern the maximum size of individual claims, the definite character of their boundaries and landmarks, and a certain quantity of labor which must be bestowed upon them annually, in order to maintain possession. I will not pause to state the different features which these conditions present for lode and placer claims. It is sufficient to say that the miner, conforming to them, and thus maintaining his possessory title, may, after a certain expenditure, and upon due application, survey, and advertisement, in the absence of any valid opposing claim, perfect his purchase from the Government, receive his patent, and be thereafter free from the necessity of performing any given annual amount of labor to hold his claim. There are features in the present law concerning the rights of prospecting tunnels which seem both obscure and unwise; and some serious questions remain to be settled as to the precise meaning of the law in these and other respects; but these we must pass by.

Looking at the legislation on this subject as a whole, we see that it is confined to one department—that of title. The whole system is devised to facilitate the purchase of the mines by citizens. They are freely permitted to work them experimentally, but it is made their interest to buy them. No inspection, no police regulation, no technical control, is exercised by the Government. Turning to the State and Territorial Legislatures, we find that they have, in some cases, provided for inspecting mines, in the interest of the safety of the workmen. Perhaps the best law of this kind is that of Pennsylvania, in which State the peculiar perils of coal mining have forced the legislature to take measures of protection. But we find nowhere such a technical control of mining as is exhibited in many European States, where the Government requires of the miner that he shall not waste wantonly or ignorantly the resources which, once exhausted, will never grow again. Our people waste as much as they like, and no one interferes. Admitting that this is an evil, it still remains a matter of doubt how far, under the circumstances of our particular case, the supervision of authority could remedy it. For my own part, though inclined to restrict as far as possible the functions of government, I am not disposed to say that for so great an end as the conservation of the mineral wealth of the country, it may not properly enforce some measures of economy, with as good right as it may forbid the reckless waste of timber or the slaughter of game out of season. But, in our nation, at least, governmental interference is the last resort, and a poor substitute for other causes, which, in the atmosphere of freedom and intelligence, ought to be effective. We are, perhaps, in our material career as a nation, like the young man who has "sown his wild oats," and now, by mature reflection and the lessons of experience, is likely to be better restrained than by the hand of parental authority.

Permit me, in drawing my remarks to a close, to suggest two agencies which seem to me to be co-operating already, and to open still wider future prospect, for the steady social and economical improvement of our mining and metallurgical industry. The first of these is the spread of knowledge on these subjects throughout the country. Under this head we must recognize the great importance of that series of explorations of our great Western domain, which was recommended by Mr. Lincoln, with sublime faith in the salvation of his country, in the midst of the civil war, and which has been, by the liberality of the Government, prosecuted under various departments ever since. I need hardly make special mention, in addition, of the reports of the Commissioner of Mining Statistics, which have appeared annually since 1866, and have reflected upon our own community the light of the gathered technical knowledge of the world, while they have in turn exhibited to the world the resources and the progress of America. Such works as these, together with the technical periodicals and the occasional volumes, translated or original, which have come from the American press, have contributed already a great deal to the education of our mining communities. The government has not done too much in this direction; but it seems to me that it should continue this most necessary and proper work in a more systematic and uniform way. There ought to be no conflict of authorities, no duplication of work, no unnecessary expenditure of labor and money in the face of a task so great. Next in order, I may rank the influence of the technical schools. The number of these has rapidly increased during the past ten years; and I venture to say that many of them compare favorably, in theoretical instruction at least, and several of them in the apparatus of instruction, with the famous schools of the old world. The Massachusetts Institute of Technology, at Boston; the School of Mines of Columbia College, at New York; the Sheffield Scientific School of Yale College, at New Haven; the Stevens Institute of Technology, at Hoboken; the Pardee Scientific Department of Lafayette College, at Easton; the excellent school at Rutgers College, under the direction of Prof. Cook; the new Scientific Department of the College of New Jersey; the School of Mining and Metallurgy of Lehigh University, at Bethlehem; the School of Mining and Practical Geology of Harvard University, at Cambridge; the Scientific Department of the University of Pennsylvania, in Philadelphia; the School of Mines of Michigan University, at Ann Arbor; the Missouri School of Mines and Metallurgy, at Rolla; the Polytechnic Department of Washington University at St. Louis; and the similar department of the University of California, at Oakland; and perhaps some others which I have omitted to name—this is a list of schools for instruction in the sciences involved in mining and metallurgical practice, of which we need not be ashamed. What our schools undoubtedly need, is a more intimate relation with practice. But this theme I need not touch.

One more agency of the spread of technical knowledge deserves special mention. I refer to the influence of societies like the Institute of Mining Engineers. The five years' activity of this Institute has impressed upon the professions which it represents a spirit of union, an enthusiasm of progress, a mutual recognition of the claims of theory and practice, which cannot be too highly estimated. Perfect our schools as much as we may, the association of the young engineer with experienced engineers, the contact of his mind with mature minds, their recognition of his merit, their correction of his errors, constitute the necessary supplement to the school-training. The average man, at least, should not be left to wrestle with his professional career alone. He will make better progress and take more pleasure in it, if he calls to his aid the element of social sympathy, and the intellectual reinforcement expressed in the proverb, "many heads are better than one."

One further consideration, and I have done. The effect of growing intelligence and knowledge in improving our methods of industry would come short of some great ends if it operated only through the self-interest of the individual. Many reforms are beyond the power of the individual; some are not even to his interest. Thus the miner under a possessory title on a gold-bearing quartz vein in Colorado may know that with a greater investment of capital he could manage to reduce his losses of gold in extraction; but the capital may be wanting; or, he may know that by robbing the mine of its richest ores only, and allowing it to cave, he is probably destroying more valuable resources than he utilizes; but the mine is only temporarily his, and he prefers quick gains to permanent ones. So long as the anthracite lands of Pennsylvania were leased to countless small operators, who paid royalty only on the coal which they sent to market, it was useless to explain to them that they wasted a third of the coal in the ground, and another third in the breaker, or that they ruined thousands of acres of coal-beds, overlying those which they recklessly worked. If there were no natural remedy for this wicked waste of the reserved force upon which the future prosperity and comfort of mankind depend, it would be the highest duty of Government promptly to take into its own hands the direction and management of the mines of coal which society holds in trust for the future; but already it is easy to detect the operation of a new social law developed within the memory of man, yet the fruit of the preparation of the ages during which society has been slowly built up, and matured into its present form and conditions. To the philosophic observer, the controlling law which runs through the whole history of man down to the present century, is the law of dispersion, diffusion, distribution, the centrifugal social force, so to speak, which by its irresistible power has tended not merely to scatter mankind over the face of the habitable globe, but through what are termed civilizing and Christianizing agencies to place communities and individuals upon the common plane of equal rights in the domain of nature and before the law. From the time of the confusion of tongues at the Tower of Babel, through the long history of the early Oriental Empires, which reduced society to the rule of order and then broke up into fragmentary political organizations, retaining, nevertheless, the principles of cohesion acquired by bitter experience; through the Greek and Roman imperial political structures upon which were ingrafted the civilization and the religion which their downfall made the common heritage of the northern barbarians who came for destruction, but were themselves transformed into the apostles of a more liberal and enlightened social organization, this law of dispersion has never ceased to exercise its power and its supremacy. The very inventions of man are only so many proofs of the unceasing operation of this law. In warfare, gunpowder and firearms merely enlarged the area over which it was possible to carry on military operations; the magnetic compass only widened the field of commerce; the printing-press and the telegraph are merely agencies for the diffusion of thought; the steam engine is but a means whereby it becomes possible to establish local industries in every part of the habitable globe; and the canal and the railway are essentially distributers of the products and the wealth of the human race. Although there is an impression abroad that this age is one of growing concentration of property, no man can study the history and the facts of the development of society without coming to the conclusion that at no period has there been so general and equal a distribution of rights and property as in the present age. The destruction of the feudal system was, in reality, the establishment of a new and better theory, in regard to the ownership of land, which has borne its legitimate fruits in the subdivision of estates in France, through the convulsions of a revolution; in the more general distribution of landed property in Germany, and in that steady, remarkable, and successful agitation in England, which is now showing its results in the limitation of entail, the simplification of transfer, the enlargement of the suffrage, and the acquisition of small freeholds, whereby political power is being slowly but surely transferred from the great landholders to the middle classes of the most powerful and compact political organization which the world has ever seen.

While, then, there is thus an unmistakable progress in the world towards a juster and more general distribution of the control of the resources of nature and of the fruits of human industry, the present century has, undoubtedly, developed a new and remarkable centralizing tendency, which might be denominated the centripetal industrial force. I speak of the application of the corporate principle to the management of industrial enterprises, producing a concentration of property and management through the diffusion of ownership. Under the corporate system, the number of owners may be unlimited, but the management is necessarily confined to a few hands. It is the political idea of representation applied to industrial enterprises; it is the common wealth in its industrial, and not its political sense, which is concentrated for the material wants and progress of the human race. Now, this law of universal ownership, under limited management, heretofore applied with marked success during the latter half of the present century to great manufacturing establishments in this country, and of late in Europe, and of necessity to railroads everywhere, has at length, by slow but irresistible steps, taken possession of the great mining enterprises of the United States, and to-day has its strongest and most interesting development in the anthracite coal region, which may be said to be monopolized by six great corporations, administered by a very small number of able officers representing a vast body of owners who rely upon steady but not excessive dividends for their support. It is the fashion to denounce these corporations as monopolizers, but it is only the thoughtless who do not investigate below the surface, who take this view of what is really the most interesting and suggestive application in our day of a powerful and irresistible force originating in the very heart of the social fabric. The monopoly is not the monopoly of ownership, for everybody is free to buy and sell, and there is no day when a man with money may not, at its value, procure a share in these enterprises. And no one familiar with business will pretend that the profits have been out of proportion to the cost and the risk of the undertakings, and no more conclusive answer, to any complaint on the score of monopoly can be made, than that to-day the shares in these corporations, in many cases, are selling below the original money cost. These corporations are, in fact, not the creators, but the outgrowth of a new and beneficent principle, which has begun to assert itself in society, and will continue to grow in power until the end of time. This principle is the practical association of diffused capital, through the agency of corporate organization, with labor, for the promotion of economy, for the improvement of processes, and for the general welfare of mankind. The capital is derived from innumerable sources, just as the little rills, finally, through streams and rivers, constitute the great ocean. The laborer himself may thus be the capitalist, and the capitalist may thus be the laborer, each taking his share of that portion of the fund which is appropriated to labor and to capital, and often in a double capacity taking a share from both. In its perfect and ultimate development it embodies the Christian idea of "having all things in common," yet "rendering unto Cæsar the things that are Cæsar's." The rate of profit which may be derived from these great enterprises, subject as they are to the scrutiny, criticism, and judgment of the public, in an age when nothing escapes notice, and all rights and property are virtually subordinated to the popular will, can never be excessive, for two reasons: on the one side the public will inevitably demand lower prices for an article of primary consequence in every household, and these corporations, creatures of the public will as they are, could not successfully resist such a demand, based upon excessive or unreasonable profits. On the other hand, whenever the dividends rise above a reasonable rate of compensation, the laborers engaged in the production of coal, from whom these profits cannot be concealed, will justly claim, and rightfully secure, a larger share of the fruits of their labor. The checks upon any unreasonable exercise of the power conferred by the ownership under limited management of the anthracite coal-fields, are in reality so powerful that the public have nothing to fear from this cause, but the corporations have rather reason to dread that they may not have justice at the hands of the public and the working classes. This justice they can only hope to secure by the wisest, best, and most economical management and administration of the property they control, and whatever profits they may hereafter derive and be allowed to divide among the owners, will be rather due to the economies which they may be able to introduce, whereby the article is furnished at the lowest possible rate, than to any fancied monopoly which they may have in the coal itself, or in its transportation to market.

Already, by the application of adequate capital, guided by the largest experience and the highest technical skill, the anthracite coal mines, from being worked in a wasteful and extravagant manner, are being rapidly put in the best possible shape for the economical delivery of coal at the surface, and for the preservation of every portion of the store upon which the future value of the property must depend. But besides economy in mining and care in preserving, there must be regularity and stability in the operations of the mine. There can be no real profit where these operations are subject to constant interruption, caused by strikes or other artificial impediments. The loss of interest on the plant at the mines, and in the lines of transportation caused by any serious stoppage to the works, would, of itself, be sufficient to render investments of this kind unprofitable. Hence the out-put must be regulated and proportioned to the wants of the market. But this regulation must be continuous and not spasmodic. To enable this to be done, large stocks of coal must necessarily be kept on hand, in order that any sudden demand may be properly met without any serious increase in price; and in dull times the accumulation and restoration of the stocks will give steady employment to the miners, to whose families any cessation of work is a calamity of the most serious character, and to society an unmitigated evil. To insure continuous operations, the best relations must exist between the corporate owners and the laborers in their employ. It is notorious that throughout the coal regions these relations have been of the most unsatisfactory character, resulting, at often-recurring intervals, in strikes and lock-outs, which have no redeeming feature, but, on the contrary, have raised the price of coal to the consumer, have impaired the dividends of the owners, and have reduced the working men and their families to a condition of suffering and demoralization, appalling to every well-wisher of his race. It is fortunate, therefore, that the interests of all classes concur in the prevention of these destructive and demoralizing collisions, and that the owners of the property, for their own self-protection, will be driven to remove the causes which have produced them. It is idle for them to expend their capital for the best machinery, for the highest skill, for the most economical transportation, unless they can, at the same time, insure a continuous production from a contented laboring population. This they have it in their power to do. If the same spirit of sacrifice which has sent out our missionaries into every heathen land, had been shown in the coal regions, and the same efforts had been made to establish and maintain the school-house, the church, and above all the Sunday-school, which have borne such fruits elsewhere in this broad land; if the hospital for the sick, and the comfortable refuge for the unfortunate had been carefully provided; if reading-rooms and night-schools, and rational places of amusement had, from the outset, been maintained for a growing and restless population, the coal regions to-day might have been a paradise upon earth instead of a disgrace to civilization. And here it is that this new power of concentrated management can exert itself with a sure and absolute success. The appropriation of a few cents per ton on the coal mined to the work of improving the moral and intellectual conditions of the miners and their families will, in a time incredibly short, change the whole face of society in the coal regions. To be effective, however, this consecration of a fixed amount on each ton of coal sent to market must be as absolute and final as that portion of the proceeds which is devoted to pumping the mines, or driving the gangways. It must not come from grace, but from a sense of duty involved in the ownership of property, and dictated by a wise regard for its preservation and permanent value. Even if this percentage were added to the price of the coal the addition would not be grudged by the public; but in fact no such addition could possibly occur, as there is no surer way of promoting economy in the cost of production than by improving the social condition, the self-respect, and the intelligence of those who are engaged in the work of production, which thus becomes continuous and systematic. Until the great companies thus recognize the duties, the responsibilities, and the opportunities for good, which are offered by the new social development which has rendered their existence a necessity as well as a possibility, they must not complain that they are regarded with distrust, and as enemies, both by the public which consumes their products, and by the working classes who see in them only grasping employers without a conscience. What individual owners could not do, it is easy for these great companies to put in practice; but the effort must be as earnest and serious as is the business of producing the coal and getting it to market. The very best talent must be secured for the organization and management of the various agencies necessary for the moral, intellectual, and social improvement of the working classes, who must be themselves associated in the administration of the fund created and expended for their benefit. Five cents per ton would produce an annual revenue of over $1,000,000 applicable to this necessary and noble use, and five years of its intelligent and conscientious administration would convert what in some regions has been aptly termed a "hell upon earth" into a terrestrial paradise which would be the pride and glory of the new world.

(The various tables to which Mr. Hewitt has drawn the reader's attention will be found on the following page:)

Table of Production of Leading Metals and Minerals in the United States during the First Century of National Independence. Prepared by R. W. Raymond.

	Anthracite, in tons of 2240 lbs. avoir.	Pig-iron, in tons of 2240 lbs. avoir.	Lead, in tons of 2240 lbs. avoir.	Copper, in tons of 2240 lbs. avoir.	Quicksilver, in flasks of 76½ lbs. avoir.	Gold, in dollars, U. S. coin.	Silver, in dollars, U. S. coin.	Petrol'm, in barrels of 42 gallons.
1819	18,000*							
1820	1,965							
1821	3,273							
1822	4,940							
1823	9,023							
1824	13,641		4,432*					
1825	38,499		1,281					
1826	54,815		1,771					
1827	71,167	2,178,239*	3,927					
1828	91,914	130,000	7,815					
1829	133,203	142,000	7,824					
1830	209,634	165,000	7,163					
1831	230,320	191,000	6,646					
1832	448,171	200,000	8,888					
1833	592,210	218,000	9,767					
1834	456,859	236,000	10,552					
1835	678,517	254,000	11,696					
1836	825,729	272,000	14,216					
1837	1,039,241	290,000	11,994					
1838	873,013	308,000	13,512					
1839	957,436	326,000	15,539					
1840	1,008,220	347,000	15,000					
1841	1,115,045	290,000	18,171					
1842	1,286,618	230,000	21,586					
1843	1,478,926	312,000	21,000					
1844	1,899,805	394,000	22,000	2,680*				
1845	2,352,984	486,000	26,500	100				
1846	2,707,321	765,000	25,000	150				
1847	3,327,155	800,000	25,000	300		20,000,000*		
1848	3,572,695	800,000	22,500	500		10,000,000		
1849	3,724,806	650,000	21,000	700		40,000,000		
1850	3,863,365	563,755	19,500	600	25,424*	50,000,000		
1851	5,190,690	413,000	16,500	800	24,000	55,000,000		
1852	5,725,148	540,755	14,000	1,000	20,000	60,000,000		
1853	5.940,905	723,214	15,000	1,850	19,000	65,000,000		
1854	6,846,556	662,216	14,000	2,250	27,000	60,000,000		
1855	7,684,542	700,159	14,000	3,000	33,000	55,000,000		
1856	7,999,767	788,515	14,000	4,000	30,000	55,000,000		
1857	7,694,842	712,640	14,000	4,800	28,000	55,000,000		
1858	7,864,230	629,552	14,000	5,500	31,000	50,000,000	1,000,000*	
1859	9,010,726	750,560	14,000	6,300	12,000	50,000,000	100,000	3,500
1860	9,807,118	821,223	14,000	7,200	10,000	46,000,000	150,000	650,000
1861	9,147,461	653,164	14,000	7,500	35,000	43,000,000	2,000,000	2,113,600
1862	9,026,211	702,912	14,000	9,000	42,000	39,200,000	4,500,000	3,056,606
1863	10,953,077	846,075	14,000	6,474	40,531	40,000,000	8,500,000	2,611,359
1864	11,631,400	1,013,837	14,000	6,618	47,489	46,100 000	11,000,000	2,116,182
1865	10,783,032	831 768	13,165	6,811	53,000	53,200,000	11,250,000	3,497,712
1866	14,233,919	1,200,199	14,312	6,978	46,550	53,500,000	10,000,000	3,597,527
1867	14,345,644	1,305,015	13,662	7,774	37,000	51,700,000	13,550,000	3,347,306
1868	15,810,466	1,431,250	14,636	9,467	37,000	48,000,000	12,000,000	3,715,741
1869	16,375,678	1,711,276	15,653	11,858	33,713	49,500,000	13,000,000	4,215.000
1870	17,819.700	1,696,429	15 922	12,650	29,546	50,0 0,000	16,000,000	5,659.000
1871	17,370,463	1,707,685	17,854	12,546	31,881	43,500,000	22,000,000	5,795,000
1872	22,032,265	2,539,783	23,106	11,948	30,306	36,000,000	25,750,000	6,539,103
1873	22,828,178	2,560,962	46,661	15,573	28,600	35,000,000	36,500 000	9,879,455
1874	21,667,386	2,401,261	53,219	17,548	34,254	39,600,000	32,800,000	10,910,303
1875	20,643,509	2,108,554	53,000	15.625	63.706	33,400,000	41,400,000	8,787,506
Total,	341,521,423	40,000,000	855,000	200,000	840,000	1,332,700,000	261,450,000	76,594,600

* Including the whole previous period from 1776.

Production of Quicksilver at New Almaden for Twenty-three Years and Three Months.

Dates.	Class and Quantity of Ore.			Total pounds.	Flasks from furnaces.	Flasks from washings.	Flasks, total.	Av'ge amount per month flasks.	Percentage including all.	Per-cent'ge, Tierras.	True per ct. of ore ex'ld tier & wings.	No. of months.
	Grueso, Pounds.	Granza, Pounds.	Tierras, Pounds.									
July 1850 to June 1851.				4,970,717	23,875		23,875	1,989½	36.74		36.74	12
" 1851 " " 1852.				4,643,290	19,921		19,921	1,660	32.82		32.82	12
" 1852 " " 1853.				4,839,520	18,035		18,035	1,503	28.50		28.50	12
" 1853 " " 1854.				7,448,000	26,325		26,325	2,193¾	27.03		27.03	12
" 1854 " " 1855.				9,109,300	31,860		31,860	2,655	26.75		26.75	12
" 1855 " " 1856.				10,355,200	28.083		28,083	2,340¼	20.74		20.74	12
" 1856 " " 1857.				10,299,900	26,002		26,002	2,167	19.31		19.31	12
" 1857 " " 1858.				10,997,170	29,347		29,347	2,445½	20.41		20.41	12
" 1858 " Oct. 1858.				3,873,085	10,588		10,588	2,647	20.91		20.91	4
Nov. 1858 " Jan. 1861.	Closed by	injunction.										
Feb. 1861 " " 1862.				13,323,200	32,402	2,363	34,765	2,897	19.96		18.64	12
" 1862 " " 1863.				15,281,400	39,262	1,129	40,391	3,366	20.22		18.65	12
" 1863 " Aug. 1863.				7,172,660	17,316	2,248	19,564	2,795	20.86		19.46	7
Sep. 1863 " Oct. 1863.				2,346,000	4,820	700	5,520	2,760	18.00		15.67	2
Nov. 1863 " Dec. 1863.	54,800	1,586,500	718,000	2,359,300	4,040	407	4,447	2.223½	18.65	3	17.52	2
Jan. 1864 " Dec. 1864.	1,259,400	18,730,300	3,287,900	23,277,600	42,176	313	42,489	3.540¼	13.96	3	15.64	12
" 1865 " " 1865.	2,288,900	25,749,000	3,910,500	31,948,400	47,078	116	47,194	3,933	11.30	3	12.42	12
" 1866 " " 1866.	1,506,000	19,939.100	5,340,200	26,885,300	34,726	424	35,150	2,929	10.00	3	11.62	12
" 1867 " " 1867.	731,5 0	15,689,288	9,603,145	26,02 ,933	23,990	471	24,461	2,038½	7.19	3	9 42	12
" 1868 " " 1868.	2,274,208	14,566,600	12,564,722	29,405,530	25,577	51	25,628	2.135⅔	6.66	2	10.12	12
" 1869 " " 1869.	150,000	11,942,175	13,366 000	25,458,175	16,898		16,898	1,408	5.07	2	8.48	12
" 1870 " " 1870.	30,000	12,531,900	8,535,800	21,097,700	14,423		14.423	1,202	5.23	2	7.42	12
" 1871 " " 1871.		13,661,700	8,373.000	22.034,700	18,563	5	18,568	1.547⅓	6.44	2	9.16	12
" 1872 " " 1872.	142,000	12,777.000	8,497,600	21,416,600	18,391	183	18,574	1,548	6.63	2	9.57	12
" 1873 " " 1873.		8,492,375	8,838,000	17,330,375	11,042		11,042	920	4.87	2	7.86	12
" 1874 " " 1874.		11.294,000	12,160,000	23,454,000	8,867	217	9,084	757	2.96	1.59	4.29	12
" 1875 " " 1875.		12,236,000	18,870, 00	31,106.200	13,541	107	13,648	11.37⅓	3.35	1	6.92	12
Totals and averages,	8,436,808	179,195,938	114,165,067	406,457,255	587,148	8,734	595,882	21.363¾	11.21	1.99	14.58	279

Product of Enriqueta from 1860 to 1863, 10,571.
Total Product of all the mines on the Company's property, 606,453 flasks of 76½ lbs. each, or 46,393,654½ lbs.—*San Francisco Scientific Press.*

Production of Comstock Lode.

1860	$1,000,000
1861	2,275,256
1862	6,247,047
1863	12,486,238
1864	15,795,585
1865	15,184,877
1866	14,167,071
1867	13,738,618
1868	8,499,769
1869	7,528,607
1870	8,319,698
1871	11,053,328
1872	13,669,724
1873	21,534,727
1874	22,400,684
1875	26,023,036
	$199,824.364

Or, in round numbers, $200,000,000; of which, about $80,000-000 has been gold, and $120,000,000 silver, according to Mr. J. D. Hague.

Production of Iron Ore and Pig-Iron at Lake Superior.

Dates.	Ore Tons.	Pig-iron. Tons.	Total.	Value.
1856	7,000	..	7,000	$28,000
1857	21,000	....	21,000	60,000
1858	31,035	1,629	32,684	249,202
1859	65,679	7,258	72,937	575,529
1860	116,908	5,660	122,568	736,496
1861	45,430	7,970	53,400	419,501
1862	115,721	8,590	124,311	984,977
1863	185 257	9,813	195,070	1,416,935
1864	235,123	13,832	248,955	1,867,215
1865	196,256	12,283	208,539	1,590,430
1866	296,072	18,437	315,409	2,405,960
1867	466,076	30,911	496,987	3,475,820
1868	607,813	38,248	646,059	3,992,413
1869	633,238	39,003	672,241	4,968,435
1870	866,471	49,298	905,769	6,300,170
1871	813,379	51,225	864,604	6,115,895
1872	952,055	83,195	1,015,250	9,188,055
1873	1,066,875	85,245	1,102,120	7,500,000
1874	840,295	72,740	913,035	6,800,000
1875	829,115	76,874	905,989	6,900,000
	8,281,698	542,209	8,823,907	$65,575,033

—Compiled from a paper by Hon. Abram S. Hewitt, Transactions of American Institute of Mining Engineers.

PROGRESS IN MINING AND METALLURGICAL ART, SCIENCE, AND INDUSTRY FROM 1875 TO 1881.

THE period since 1875 has been marked by a degree of activity in mining and metallurgical industry never before equalled in our history, while the progress made in the science and art has been, if possible, still more noticeable. Whether we consider the mining of iron, ore, and coal, or of the precious metals—the advances made in smelting the former and in reducing the latter, the extraordinary increase in the production of Bessemer steel, or the science of Thomas and Gilchrist, which makes the hitherto rejected phosphorus the corner-stone of success—the past five years are alike memorable for the progress they have shown. It may be of interest in this connection to note the following figures, showing the growth of the population of the United States during the last three decades:

Year.	Population.	Increase.	Per cent.
1850.	23,191,876		
1860.	31,443,321	8,251,445	35.6
1870.	38,558,371	7,115,050	22.6
1880.	50,300,000	11,741,629	30.5

Coal.—The known area of useful and workable coal in the United States has been greatly extended since 1875 by discoveries in Utah, Colorado, Indian Territory, and New Mexico, good coking coals having recently been found in the two latter, which seem destined to open these territories very rapidly to metallurgical industry. A comparison of the production of anthracite coal during the last five years with that of the preceding five years shows that there was mined of anthracite coal:

	Gross tons.
In 1871—1875	104,655,254
In 1876—1880	111,482,727
Increase	6,827,473, or 6.51 per cent.

The great increase in the capacity for its production is shown by the output for 1879—27,711,250 gross tons—being 4,730,329 in excess of the largest previous output (that for 1873), or 21 per cent. The total coal production of the United States is thus stated in gross tons:

	Anthracite.	Bituminous.	Total.
1870	13,985,960	15,231,668	29,217,628
1875	20,654,509	26,031,720	46,686,235
1879	27,711,250	33,665,709	61,376,959

showing an increase from 1870 to 1879 of 109.7 per cent., of which two-thirds occurred since 1875. The past five years have witnessed many improvements in the mining and handling of coal; notably in restricting the waste in the preparation of anthracite and in utilizing the culm, both by apparatus for burning it in its natural condition, such as that of Mr. John E. Wootten, applied to the engines of the Reading Railroad, and by forming it into bricks, in combination with clay or tar, as is done by the Delaware and Hudson Canal Company, and used on their locomotives. Machinery for washing bituminous coal for coking has been greatly improved, and a practicable arrangement has been devised for burning pulverized fuel which promises well. It is in the preparation by comminution, or by conversion to gas, that further economy in the use of fuel is to be looked for.

Pig Iron.—The production of pig iron in the United States for the periods named aggregated as followes:

	Gross tons.
1871—1875	11,233,424
1876—1880	12,813,814
Increase	1,580,390, or about 14.07 per cent.

The production for 1880 was reported by Mr. James M. Swank as 3,835,191 gross tons, an amount 50 per cent. greater than the production of 1872 and 1873, and over double that of 1876. We are accustomed to regard the five years 1874–78 as years of great depression in the iron industry, and yet the product of pig iron for those years was 10,-652,836 tons, while it was for the ante-panic years, 1869–73, 10,192,933 tons, showing an increase of 459,903 tons, or 4.51 per cent. in five panic years over the production of the best five consecutive years ever known to the iron trade of this country. The use of regenerative stoves with blast furnaces of large hearth area opened a new era in the history of blast furnaces, evidenced by the product of the furnaces of the Edgar Thomson Steel Company, Limited, their "B" furnace of 20 feet bosh by eighty feet high having averaged upward of 140 tons per day during a blast of seven months, and having made 208 tons in 24 hours. That large blowing, combined with high heating capacity, in furnaces having large hearths, will result in still greater production, with less consumption of fuel per ton, seems assured.

Iron Ore.—The production of iron ore received an impetus in the increased production of pig iron, shown by the increased production of the Lake Superior region, as follows. The output for the five year periods before referred to shows as follows:

	Gross tons.
For 1871-75	4,779,114
For 1876-80	6,451.092
Increase	1,673,978, or 34 per cent.

The production for 1880 reached 1,975,602 gross tons an amount exceeding by 800,000 tons the largest year's output prior to 1876, and by 560,000 tons the greatest production of any previous year—that of 1879.

Wrought Iron.—There was a material advance in the production of the various forms of wrought iron, and some decided improvements in the economy of its production. The ordinary consumption of fuel per ton of iron puddled was 3000 to 3200 pounds, but the Swindell regenerative furnace puddle a ton of iron with 1250 pounds of slack coal.

Steel.—In the production of Bessemer steel there was an increase as unexpected as it was extraordinary, whether considered in its commercial aspects or as the result of the skilful handling of machinery originally designed for a much smaller output, for it must be considered that up to the end of 1880 there was no increase in number and very little in the size of converters since 1876. The output of Bessemer steel ingots was for five years:

	Net tons.
1871–75, .	907,000
1876–80, .	3,950,954
Increase, .	3,043,894, or 333 per cent.

The product of 1879 was 928,972 net tons, or 21,000 tons in excess of the five years 1871–75, while that for 1880 was 1,203,173 net tons, an amount greater than the output of any two years prior to 1878. The output of ingots of some of the leading steel works during 1880 was reported as follows:

	Gross tons.
Edgar Thomson, . .	123,303
Cambria, .	122,143
Joliet, ...	116.750
Lackawanna, .	105,304
North Chicago, .	100,178

Of steel rails there was a more than proportionate increase, due to greater economy in the production, whereby a slightly larger percentage of rails was obtained from the ingots than was previously done. The product for five years was:

	Net tons.
1871–76, .	697,142
1876–80, ...	3,046,584
Increase, ...	2,349,442, or 335 per cent.

The steel rails produced in 1879 were 683,964 tons, nearly equal to the five years 1871–75, while for 1880 there were made 967,592 tons, or 40 per cent. in excess of that five-year product. Improvement in the quality of Bessemer steel is to be looked for in the direction of allowing time for the steel to settle, the ingredients to become more thoroughly distributed, the fine particles of slag to rise to the surface, and the free oxygen to escape before casting into ingots. The question of the removal of the occluded gases from steel is also attracting attention abroad, and appears likely to affect very materially the quality of the ingot metal of the future. One of Edison's experiments with platinum wire, effecting what he calls the removal of the contained air, but which was evidently the removal of the occluded gases, raised the melting-point of the wire to double its original temperature, and increased its light-giving capacity eight times. It is noted that the Wheeler process of rolling steel scrap in an iron casing is being utilized at Chester, Pa., in the manufacture of ship plates.

Gold and Silver.—The product of the precious metals for the periods named was as follows:

GOLD.	
1871–75, .	$197,662,244
1876–80, .	196,690,603
Decrease, .	$971,641
SILVER.	
1871–75, .	$133,697,510
1876–80, .	206,210,848
Increase, .	$72,603,338

The product of the two precious metals showing an increase of $71,631,697. The great increase in the output of silver was largely due to the great carbonate deposits of Colorado, the product of the Leadville mines in 1879 being $10,189,521, and in 1880, $15,095,153.

Petroleum.—The mining product showing the greatest increase in output is petroleum, which was:

In 1871–75, .	41,911,367
In 1876–80, .	83,042,121
Increase, .	41,130,754, or nearly 100 per cent.

The production in 1880 reached the enormous total of 26,032,421 barrels, compared with which the greatest year's output prior to 1876 was 10,910,303 barrels in 1874.

Machinery.—There have been great improvements in mining and metallurgical machinery during the last five years, prominent among which, may be mentioned the Porter-Allen high-speed engine for rolling-mills; the Leavitt compound engine for pumping and hoisting, the Bulkley condenser, which is coming into general use for rolling-mill and blast-furnace engines; and the Kloman eye-bar universal mill, for producing weldless eye-bars of iron and steel, the only process so far used adapted to eye-bars of Bessemer steel.

Railroads.—Much of the increased output of iron ore, pig iron, and steel rails was due to the demand created by the construction of railroads, of which there were 19,397 miles constructed since 1875, and of which 7150 miles were built in 1880, an amount nearly equalling the mileage of 1872, which was 7340 miles.

—Compiled from Annual Address, W. P. Shinn, American Institute Mining Engineers.

Statement of Annual Production of Leading Mining and Metallurgical Products, During the Ten Years 1871—80.

Years.	Anthracite coal. Gross tons.	Pig Iron. Gross Tons.	Bessemer Steel Ingots. Net tons.	Steel rails. Net tons.	Gold.	Silver.	Petroleum Barrels.	Lake Superior region.	
								Ore. Tons.	Pig. Tons.
1871	17,379,355	1,707,685	48,850	38,250	$35,898,000	$20,288,000	6,795,000	813,379	51.225
1872	22,084,083	2,539,783	120,108	94,070	39,469,459	20,527,600	6,539,103	952,056	61,195
1873	22,880,921	2,660,962	170,652	129,015	40,456,593	28,252,100	9,879,455	1,167,379	70,507
1874	21,667,386	2,401,261	191 933	144,944	40,103,045	30,498,000	10,910,303	935,488	86,494
1875	20,643,509	2,023,733	375,517	290,863	41,745,147	34,043,910	8,787,506	910,843	81,753
5 years.	104,655,254	11,233,424	907,060	697,142	$197,662,244	$133,607,510	41,911,367	4,779,141	351,174
1876	19,000 000	1,868,961	526,996	412,481	$14,328,501	$41,606,672	8,968,906	977,233	61,911
1877	21,323,000	2,066,594	660,587	432,169	45,300,000	46,075,000	13,135,671	960,982	29,685
1878	18,600,000	2,301,215	732,226	650,398	41,000,000	40,000,000	15,163,462	1,123,093	17,404
1879	27,711,250	2,741,853	928,972	683,964	32,539,920	38,623,812	19,741,661	1,414,182	39,583
1880	24,848,477	3,835,191	1,203,173	967,592	33,522,182	40,005,364	26,032,421	1,975,602	48,502
5 years.	111,482,727	12,813,814	3,950,954	3,046,584	$196,690,603	$206,210,848	83,042,121	6,451,092	197,085

—Compiled from Annual Address, W. P. Shinn, American Institute Mining Engineers.

WESTERN SCENERY—GREEN RIVER STATION—COLORADO RIVER.

—FROM J. W. POWELL'S REPORT.

THE ORIGIN AND HISTORY OF COAL.

THE rocks of the earth, known as the "Coal Measures," consist of a series of beds of sandstones, shales, limestones, fireclays, iron-ores, and coals, in manifold alternations. The beds of coal are now universally held by men of science to have been formed from the decomposition of vegetable matter—the leaves and stems of ancient plants and trees which grew, and died, and became decomposed and mineralized on the spot where the coal is now found; and the associated beds of rocky strata to have been derived from the sediments of the water which flowed over the carbonaceous accumulations during the subsidence of the land. Several other theories have been advanced, accounting for the origin of coal—as that it is of animal origin, or that it was formed from petroleum. Bischoff, and other eminent geologists, held that the carbonaceous matter was an accumulation of vegetable detritus, which had been drifted by rivers into bays and estuaries, as the vast rafts of dead floating trees now accumulate in the Lower Mississippi; but careful examinations of the original coal plants found in the floor of the coal, first brought to notice by Sir William Logan, in 1840, during a survey of the South Wales coal field, have confirmed the theory that the vegetation grew on the spot where the coal is now buried. During the coal formation period, in the history of the earth, vast marshes of swampy plains skirted the ocean, or perhaps formed low islands near the shore. Upon these marshes there grew a profuse and luxuriant vegetation, consisting of numerous beautiful and various plants, differing in size from small mosses to stately trees, which, year after year, dropped their leaves and fruit, and in time, died themselves. New forests arose and died in succession, growth and decay going on through many slowly-moving centuries, until a mingled mass of vegetable tissue was accumulated, like the pulpy mass of a peat bog of the present day. At length, through the agency of subterranean movements, the area of the coal marsh became depressed with much uniformity, the land slowly and gradually sank, and the waters of the ocean flowed in over the carbonaceous accumulation, bringing along mud and sand and other sedimentary materials, which settled at the bottom. As the sinking process continued, the ocean currents brought in more detritus, covering the older depositions, which, becoming compressed by the accumulating weight, solidified, forming into sandstones, shales, etc., according to the nature of the materials. The buried peat bog also became greatly compressed by the accumulated weight of this detritus, the original plants and peaty tissue matting together and becoming hard and compact, while a portion of the gases escaped in the forms of carbureted hydrogen and carbonic acid by slow distillation and putrefactive fermentation.

The subsidence period was in time arrested, and was followed by a long period of rest, when the waters of the ocean becoming filled up, there was formed a new subaereal surface. A growth of vegetation covered this new plain, as in the former case. Generations of forests again succeeded each other, and again the vast marsh accumulated matter capable of forming a second seam of coal. Then followed another downward movement of the land, and another burial of the coal vegetation by the detritus of the water. The set of processes thus described was repeated in the formation of every seam of coal and its associated beds of strata; the periods of elevation were longer or shorter according to the amount of vegetable matter which accumulated on the marsh; and the periods of subsidence were longer or shorter according to the amount of strata which accumulated between the different beds of coal. Many geological writers maintain that during the Carboniferous era, the atmosphere of the earth was intensely hot, and was also saturated with vapor, and charged with undue proportions of carbonic acid gas which had been liberated from the interior of the earth through the agency of volcanic eruptions; these conditions being claimed as essential to the production of the coal vegetation. But as coal is found in newer formations than the Carboniferous era—the coal of China belonging to the Triassic, and that of the Pacific Coast to the Cretaceous formations—and as coal is doubtless forming now in many places of the earth, it may be fairly assumed that the climate of the Carboniferous age was not unlike the climate of the present age, although, perhaps, more mild and equable; only the plants and animals were different. Instead of one peculiar coal-bearing age, all ages perhaps, as well deserve to be called carboniferous. Sir Charles Lyell, in his "Principles of Geology," writing of the formations of the Delta of the Mississippi, mentions instances of whole forests of strata sunk as they grew, and covered, to a depth of several hundred feet, with an accumulation of mud and sand and vegetable soil in alternating beds, in the same manner as the coal marshes were covered up in the primeval ages. The sunken country of New Madrid a water space of nearly 80 miles long and 30 miles wide, caused by the earthquake of 1811–12, was filled, as late as the year 1846, with dead trees, some standing erect in the water, as they grew, others fallen down, and lying in dense masses over the bottom, and along the shore. He mentions another case of a tract of land, at the mouth of the river Indus, larger than the Lake of Geneva, which was converted into an inland sea in the year 1819, by an earthquake shock, while an adjoining tract, 50 miles in length, and nearly 16 miles wide, was raised by the same shock, ten feet above the level of the alluvial plain. The coal strata are full of the remains of animal and vegetable life. Nearly a thousand different coal plants have been described by the geologists. Beneath every seam of coal there is generally a stratum of fire-clay—the original land surface upon which the coal plants grew, in which rootlets, stumps of trees, stems and dark filaments are found. Sometimes the remains of trees, embedded as they grew in the underclay, and standing up through the coal and the roof above, and then abruptly stopping—the upper part having rotted and fallen off—are met with. In the year 1844, at the Parkfield colliery, near Wolverhampton, in England, the workmen mined into a quarter of an acre of coal, which was filled with stumps of trees, standing as they grew; the trunks, flattened by the pressure of the superincumbent strata, were converted into coal, but were identified. The trees were found scattered in all directions, having evidently been snapped off by a storm or an inflow of the water, during the sinking of the land, or by an earthquake shock. The roof above the coal is often charged with the remains of ferns, flattened trunks of trees, pieces of bark, branches and leaves, crossing each other in promiscuous profusion.

Of the numerous forms of vegetable matter, from which coal is derived, a great bulk of the coal appears to have been formed from trees allied to the club mosses, ferns and rushes of the present day—more particularly in the lower beds or coal. The casts of the sigillariæ, known by their fluted and symmetrically scarred bark, often lie full length, as they fell in the mud, immediately above the coal, and can be traced for fifty and sixty feet along the working places of the miners. The gigantic lepidodendrons, allied to our modern club mosses, which in the coal era attained a height of forty feet, lie stretched full length, alongside of the sigillariæ. Calamites (the representatives of our rushes) with jointed and striated stems, meet the eye in nearly every mine, and often measure thirty feet in length. The fossil remains of fishes, marine shells and amphibian reptiles are also found interspersed in the roof shales. One hundred and fifty species of fishes, many of them of immense size as compared with the fishes of the present day, have been discovered in the coal and its associated strata, and the teeth, scales and spines of fishes are frequently found imbedded in the same manner. The tracks of the reptiles, formed as they walked along the soft and muddy sediment of the ancient shore, ripple marks, and the impression of rain drops, have also been seen in the roof shales of some mines.

Some of the coal fields of the world contain strata of immense thickness. At Lundly, in Wales, the coal measures are known to be fully ten thousand feet thick, and to contain forty-two different seams of coal, the total thickness of which measures one hundred and fifty feet. The coal strata of Nova Scotia, at the Joggins, are fifteen thousand feet thick, and include seventy-six different seams of coal, one of which measures thirty-seven feet in thickness, and another twenty-two feet. The coal field of Saarbrucken, on the left bank of the Rhine, in Prussia, has the enormous depth of twenty thousand feet. It has been estimated by eminent geologists that it would require a period of 150,000 years to accumulate matter to form sixty feet of thickness of coal, an amount far exceeded in many coal fields of the world. In this calculation, no account is taken of the different periods of subsidence of the land, when the associated strata were deposited. As the sinking process was slow and gradual, and as fifty feet of strata intervene, on an average, between the different seams of coal, it may be reasonably assumed that an equal period of time was required in building up these strata as occurred in the formation of the carbonaceous matter which formed the coal. Beroldingen first suggested the theory that the coal beds of the present age, were the peat bogs of the primeval ages, converted from peat into brown coal, and then into true coal; and this view is now accepted by every intelligent geologist. The progressive steps from peat to anthracite, are thus described by Dr. Newberry, the eminent geologist of Ohio:

"Coal is now considered, by all good chemists and geologists, as of organic origin, and it may be easily demonstrated that it has been derived from the decomposition of vegetable tissue. As we find it in the earth, it forms one of a series of carbonaceous minerals which represent the different stages in a progressive change from vegetable tissue as found in the living plant. In peat and lignite, we witness the first step in the formation of coal. Peat is bituminized vegetation, generally mosses and other herbaceous plants, which, under favorable circumstances, accumulate in marshes, hence called peat bogs. Lignite is the product of a similar change effected in woody tissue; and because it retains in a greater or less degree the form and structure of wood, it has received the name it bears. Peat is the product of the present period, and lignites are found in deposits of recent geological age. In the older formations, these carbonaceous accumulations, still further changed, are bituminous coal.

"The changes which vegetable tissue has suffered in passing through these various stages, are not only physical but chemical. They have been carefully studied by several eminent chemists, and have been so fully explained that they may be comprehended by any intelligent person. The rationale of this process may be seen at a glance, by reference to the following formula, taken from Bischoff's Chemical Geology:

	WOOD.	LOSS	PEAT.	LOSS.	LIGNITE.	LOSS.	BITUMIN'S COAL.
Carbon . . .	49.1	21.50	27.6	18.65	30.45	12.35	18.10
Hydrogen	6.3	3 50	2 8	3.25	3.05	1.85	1.20
Oxygen . . .	44.6	29.10	15.5	24.40	20.20	18.13	2.07

"This is the condition in which we find most of the beds of peat and lignite that accumulated in the Carboniferous age, millions of years ago, and which, deeply buried, have been subjected to slow and general distillation, resulting in the different varieties of bituminous coal. Where exposed to peculiar influences, as to heat from volcanic eruptions, or from the elevation of mountain chains where all the strata are metamorphosed, the volatile constituents of bituminous coal are partially or perfectly driven off, giving us, first, semi-bituminous coal, then anthracite, and finally graphite. The process by which graphite and anthracite are formed from ordinary bituminous coal, is indicated in the succeeding formula:

	BITUMINOUS COAL.	LOSS.	ANTHRACITE.	LOSS.	GRAPHITE.
Carbon . . .	18.10	3.57	14.55	1.42	13.11
Hydrogen .	1.20	0.93	0.27	0 14	0.30
Oxygen . . .	2.07	1.32	0.65	0.65	0.00

From the above tables it will be seen that the change from wood tissue to peat or lignite, and from these to bituminous, thence to anthracite coal and plumbago, consists in the evolution of a portion of the carbon, hydrogen and oxygen, leaving a constantly increasing percentage of carbon behind, until, ultimately, the resulting mineral consists of a portion of the original carbon of the plant, with all its earthy matter. That portion of the original substance which is lost in the progressive change escapes in the form of some hydro-carbon, as water, carbureted hydrogen, carbonic acid, petroleum, etc. The escape of these volatile compounds we see in the gases bubbling up in marshes where vegetable matter is undergoing decomposition, in the gases generated in our coal mines, and in the oil springs, which always flow from strata charged with bituminous matter. By the application of heat, and with proper management, we can manufacture any of these mineral fuels from vegetable fibre, at will. This has been done repeatedly, and although we cannot accurately reproduce the conditions under which these changes are effected in nature's laboratory, we can so closely imitate them as to demonstrate their character.

It would require from eight to ten feet of thickness of the loosely matted peaty tissue of the coal marshes to form one foot of coal; and as some coal seams are thirty and forty feet thick, in several of the coal fields of the world, an enormous bulk of vegetable matter must have accumulated for the production of these thick seams. The thickest peat bogs of the present day seldom exceed thirty or forty feet. The coal marshes of the primeval world, on being opened up to serve the purposes of man, present several-distinct varieties of coal. The coals of the Carboniferous age, called true coals, in contradistinction to the lignites or brown coals of more recent geological ages, are classed under the general heads of bituminous and anthracite. The bituminous coals are divided into different species, and show great diversity, both in their physical and chemical properties, and they are known by different names, according to their qualities and chief properties, such as "dry-burning coals," "caking coals," "gas coals," "cannel coals," etc. Bituminous coals are of all shades of color, from deep black to greyish black, and they exhibit in their structure some well marked peculiarities.

The dry-burning variety usually possesses a laminated structure, the fracture or cleavage of the coal being horizontal, and the seam is often intersected with partings or cutters, which cross each other every foot or two, like latitude and longitude lines, giving the masses, as they come from the miner's pick, the appearance of squares, or blocks, hence they are called block coals. Such coals do not cake nor swell when burning, and for this reason they are especially adapted for smelting iron in a raw state. In the blast furnace they retain their shape until they fall to ashes. They are generally very hard and compact, and bear transportation better than any caking species of bituminous coals. Caking coals melt and fuse together in the act of combustion. This property forbids their use in the furnace, as they form a hollow fire, and they require to be converted into coke before being applied to the reduction of ores. The slack or small coal is of nearly equal value, when in a pure state, with the round coal, the abundance of bituminous matter in the coal causing the whole to agglutinate in masses when exposed to a moderate heat. Cannel coal is nearly always formed in thin seams, and the deposits generally occupy but limited areas. It contains a large percentage of hydrogen, and burns with a bright, clear flame, making a very pleasant parlor fire. Cannel is the richest gas coal obtainable, the gas possessing brighter illuminating powers than that of the more common varieties. This coal has a dull lustre and is in color between a velvet and greyish-black; it breaks with a flat, conchoidal fracture, and it is very compact and fine in the grain. It will scarcely soil the fingers in handling it, and it makes very little dust in the mine. The remains of shells, fishes and amphibious animals are very often found imbedded in the beds of cannel coal, whence it is thought that the carbonaceous matter from which it derived was deposited in lagoons of open water in the condition of muck or mud, similar to the muck swamps of the present day. The specific gravity of bituminous coals is from 1.25 to 1.4. They generally contain from 55 to 80 per cent. of carbon, and from 8 to 22 per cent. of oxygen, hydrogen and nitrogen, with variable proportions of earthy matter.

Anthracite is a black, heavy coal, having a conchoidal fracture, and containing from 80 to 95 per cent. of carbon, and a small per cent. of hydrogen, oxygen and nitrogen. This coal kindles with difficulty, but when once fairly ignited, it burns with an intense heat, emitting neither smoke nor flame. It occupies much less extensive areas than the bituminous species.

Anthracite coal was originally bituminous, the change having been affected through the agency of heat, which drove off the bituminous matter, as the gases are now driven off from bituminous coal in the production of common street gas. The anthracite coal fields of Pennsylvania form part of the great Allegheny coal field. During the upheaval of the Allegheny Mountains, which occurred after the close of the Carboniferous age, the heat which attended the elevation of the mountains, acted on the coal and drove out the gaseous matters. Anthracite exists in South Wales, and in France, Russia, and Saxony; and everywhere it is found occupying abrupt flexures of the strata, the result of gradual and irresistible forces. So abrupt are these flexures in the anthracite region of Pennsylvania, that the coal strata are found occupying in many places, nearly perpendicular positions, and in some cases reverse dips. The specific gravity of anthracite is from 1.3 to 1.75. Semi-bituminous coal is, as its name implies, intermediate between bituminous and anthracite. It contains little bituminous matter and a large percentage of carbon, and is highly prized for the generation of steam and the manufacture of iron. This coal burns freely, producing an intense heat when exposed to the action of a strong blast. Like anthracite, semi-bituminous coal has been subjected to the action of heat, though in a less degree, during the folding of the strata. The coal is less debitumenized, because, during the metamorphic processs, the gaseous materials had not the same opportunity to escape; the strata, though folded, are nowhere fractured. The lignites, or brown coals, belong to the geological formations of more recent age than the true coals of the Carboniferous period. They exhibit in their structure, plain and unmistakable traces of their vegetable origin. These coals burn with a clear flame, but give off a highly bituminous smell. They decompose very rapidly when exposed to the action of the atmosphere, and for this reason are unfitted for distant transportation. The coals of China and of our Pacific Coast belong to this class; and they exist over large areas on the Continent of Europe. Some of the better sorts approach the true coals in character.

The coal fields of the world generally exist in the shape of elliptical basins. Some of the basins are nearly round; but in most cases they possess much greater length than breadth. The greatest thickness of strata, and, consequently, the greatest number of beds of a field, exist at the center or trough. From this point the strata are inclined, or pitch upward in all directions, the upper coals cropping out first and the lower ones stretching across the whole surface of the coal marsh. The original shape of many fields has been greatly changed by faults in the form of "slip dykes" and "dislocations" of the strata. These faults traverse the coal field for miles, and are the result of violent mechanical convulsions, by which the strata in one part of the field are thrown up on one side of the dislocation. The change of level caused by such faults ranges from a few inches, to hundreds of feet; and it frequently happens in the operation of sinking for coal, that the seam is reached by a shaft at the depth of three hundred feet, while on the opposite side of the fault, the same seam is found a thousand or twelve hundred feet deep. These dislocations are very common in the British coal fields. They sometimes divide the basin into subordinate basins, presenting great barriers to the successful prosecution of underground operations. But they come as friends as well as enemies, for they are true flood-gates, damming back the waters of the mine. Their line of direction of these slip-dikes is not always the same, and they sometimes cross each other. The change of level caused by a slip-dike in one of the Scottish coal fields, is stated by Mr. Robert Bald, the eminent coal viewer of Scotland, to be no less than 1,230 feet, and the coal field is divided by this and another slip, on the north side of the basin, into three subordinate basins. The great dislocation throws out the whole of the coal strata for nearly a mile, when, by reason of the natural inclination of the rocks, the missing materials again appear as the outcrop of one of the subordinate fields. Another dike in Lanarkshire, causes a change of level of the coal rocks, of the enormous distance of 2,700 feet.

The change of level caused by slip-dikes is upward or downward, according to the side from which they are approached by the miner; and when forming an acute angle with the floor of the mine, the coal strata are thrown down; when the angle is obtuse, they are thrown up. Sometimes, however, the face of the dike is perfectly vertical, forming a right angle with the pavement; in which case it is very difficult to undermine whether it is an upthrow or downthrow. These dikes are not always upthrows or downthrows, for the strata are sometimes only pierced by them without change of level. In these examples they are known as trap-dikes, the intrusive matter being the lava which flowed in during the rents of the strata. In approaching such faults the coal is frequently found burnt like coke. Besides dikes of the character noticed above, there are a number of other faults encountered in mining, which are known by various names, such as "troubles," "horsebacks," "nips," "clay-veins," "wants," etc. Troubles are generally meant to denote irregularities in the coal, as where a seam has an irregular floor, and is subject to sudden thinning, or where part of the coal is so soft as to resemble the gob waste of the mine. Horseback is an Americanism, and in this country, is now very generally applied to every trouble of the mine, though originally meant to designate a fault in the floor of the coal, which resembles the shape of a horse's back. Sometimes irregular layers of sandstone or shale appear in the body of the coal; and it also frequently happens that a foreign mass of sandstone will be found usurping the place of the coal. This latter fault is very common in some mines, and is, doubtless, due to currents of water, in rapid motion, having carried sand across the old coal bog, which, by constant friction, has removed the coal, and finally settled down in its place. In the coal fields of the United States, although there are an abundance of faults of a local character, there is seldom met any slip dike; and such dislocations of the strata, wherever encountered, seldom exceed a few feet of upthrow or downthrow; though in the coal strata of North Carolina, which are subject to many troubles, some of the dikes are known to cause twenty or thirty feet of change of level. The various beds of coal in the coal fields of the world generally bear a parallel relation to each other. This fact, though general, is by no means universal, for there are some well known cases where the beds diverge or approximate each other, according to the line of direction in which they are followed; and sometimes, also, the seams split up into two or more parts, by the introduction of shale bands, which, though thin at first, continue to increase in thickness until two or more independent seams are formed. The great thick coal of Billston, Dudley and Wolverhampton, in England, which forms a mass of solid coal, from twenty-four to thirty-six feet in thickness, splits up in one part of the coal field into nine different beds; and the mammoth vein of the anthracite region, also splits up into several seams. Some well marked cases of the splitting of the seams also occur in the coal strata of Ohio.

"Coal," says Dr. Newberry, "is entitled to be considered as the mainspring of our civilization. By the power developed in its combustion, all the wheels of industry are kept in motion, commerce is carried with rapidity and certainty over all portions of the earth's surface, the useful metals are brought from the deep caves in which they have hidden themselves, and are purified and wrought to serve the purposes of man. By coal, night is, in one sense, converted into day, winter into summer, and the life of man, measured by its fruits, greatly prolonged. Wealth with all its comforts, the luxuries and triumphs it brings, is its gift. Though black, sooty, and often repulsive in its aspects it is the embodiment of a power more potent than that attributed to the genii in oriental tales. Its possession is, therefore, the highest material boon that can be craved by a community or nation. Coal is also not without its poetry. It has been formed under the stimulus of the sunshine of long past ages, and the light and power it holds are nothing else than such sunshine stored in the black casket, to wait the coming, and serve the purposes, of man. In the process of formation, it composed the tissues of those strange trees that lifted up their scaled trunks, and waved their feathery foliage over the marshy shores of the carboniferous continent, where not only no man was, but gigantic salamanders and mail-clad fishes were the monarchs of the animated world." In the early ages of the world, the products of the forest were sufficient to supply the wants of mankind, but as the race increased in numbers, and its wants began to multiply, attention was turned to the mineral fuels of the earth. The peculiar appearance of a coal bed, exposed in the flanks of a hill, or laid bare by the action of water along the banks of a stream, would doubtless attract the attention of the earliest inhabitants of a country, and accident or experiment would reveal its combustible properties. We have no knowledge of the people who first discovered the existence and uses of coal, but the history of coal mining can be traced back to a period long before the commencement of the Christran era.

The first time coal is expressly mentioned in the works of ancient authors, occurs in the writings of Theophrastus, the pupil of Aristotle, who lived nearly three hundred years before Christ. In his book on Stones, chapter XXVIII, this author remarks: "Those substances that are called coals, and are broken for use, are earthy; they kindle, however, and burn like wood coals. These are found in Lyguria, where there is amber, and in Elis, on the way to Olympus, over the mountains. They are used by smiths." Pliny also speaks of a black substance, as available for medicinal and ornamental purposes. Frequent allusions are made to coals of fire in the Scriptures; but they doubtless have reference to charcoal. The Chinese are known to have used coal from the very earliest times, and to have extracted the inflammable gases from this mineral for illuminating purposes. The coal fields of Great Britain appear to have been the first opened in Europe. The primeval Britons, those savage and roving clans who inhabited the island at the time of its invasion by Julius Cæsar, a people possessed of perceptive faculties of a high order, were doubtless acquainted with the existence and properties of coal. They could only mine it along its outcrop, where it exposed itself in full view to the naked eye, and their tools would be of the very rudest kind, composed partly of wood and stone, since they had no knowledge of the use of iron. In a coal mine in Monmouthshire, in Wales, there was found, some years ago, a flint axe sticking in the coal; and near Stanley, in Derbyshire, the miners in holing through into some old workings, found tools formed out of solid oak, without any iron whatever. The Romans, while in Britain, were well acquainted with the existence of the coal mines, and carried on mining operations to a considerable extent. Cinder beds yet exist among the ruins of several Roman stations, in which Roman coins, and Roman inscriptions have been found. The Ardley main coal of Lancashire, which crops out along the banks of the river Douglas, has been mined along that stream, for over a hundred yards in one direction, in the form of polygonal rooms, altogether different from any British manner of mining, the symmetry and regularity of plan resembling the tesselated pavements of Roman villas. Coal is mentioned for the first time in English history, in the year 1180, when the Bishop of Durham granted some lands to a collier, to mine coal for the use of a blacksmith, at Counden, in the county of Durham. During the reign of Henry III, that monarch, in the year 1239, granted a charter to the people of New-Castle-on-Tyne, conferring upon them the privilege of mining coal; and in 1240 coal appears to have been shipped to London. In 1280, the coal trade of New Castle had consumed considerable importance. By the beginning of the next century, the use of coal had become so general in London that the citizens became alarmed for their health, believing the coal smoke induced disease of the lungs and chest, and they petitioned Parliament to prohibit the burning of coal as an intolerable nuisance. Accordingly, the Lords and Commons, in Parliament assembled, complained to the King (Edward I) in behalf of the citizens of London, and humbly petitioned him to prohibit the use of coal, as a public nuisance; and the King issued a proclamation forbidding the burning of coal in London, and its suburbs, and commanded all persons to make their fires of wood, except blacksmiths, "to avoid the sulphurous smoke and savour of the firing." But the proclamation of the King appears to have been generally disregarded, and on a second complaint from Parliament, a royal commission was appointed, with strict orders to punish all delinquents by fines, and to destroy all furnaces and kilns which burned coal. The self-interest of the manufacturing establishments, and the necessities of the common people, however, appear to have been more potent than both royal proclamations and arbitrary commissions, for coal not only continued to be used, but within twenty years afterward, it is said to have found its way to the royal palace itself.

Coal was mined in Scotland during the 12th century. At this time, we have reliable accounts of grants being made to mine coal. In the year 1189, the Earl of Winchester made a grant to the monks of the Abbey of Newbattle to work coal; and in the year 1294, a mining grant was executed in favor of the Abbot of Dumferline, to open a coal "heugh." In 1322, Robert Bruce, the Hero King of Scotland, granted to Henry Cissor the lands of Kilbaberton for mining purposes. The coal mines of the Lothians and Fife, appear to have been the first opened. Both Agricola and Camden mention that in their days there were abandoned pits in Scotland, filled with water; and Æneas Silvius, afterward Pope Pius the II. who traveled through Britain about the middle of the 15th century, relates that in Scotland the beggars were in the habit of receiving as an alms, at the church doors, pieces of coal, which they burn instead of wood, of which their country was destitute. The coal mines of Wales would seem to have been opened about the same time as those of Scotland and England. We have authentic accounts that coal was mined and used during the reign of Edward I.

The first systems of mining consisted in "stripping" the coal, that is, in uncovering the bed and quarrying it out in open day. After all the crop coal was mined which could be reached in this primitive manner, drifting into the hill, by following the lead or strike of the seam, was resorted to. If the coal dipped, it could not be followed far, owing to the accumulating waters; but if the seam were level-free, and the waters of the mine discharged themselves by gravitation, the subterranean excavations were pushed boldly forward. The first tools of the miners, the pick and shovel, were made of wood, and then of stone. As civilization advanced, and the arts and sciences began to be understood, improvements were made in mining implements, and the working tools of the coal hewer were made of iron, and pointed with steel. The common pick for undermining and shearing the sides of the coal seams has been in use in British mining since the days of William the Conqueror, retaining nearly its original shape and structure.

The coal, placed in sacks, was carried from the working faces to the mouth of the drift on the backs of the miners. Then wheelbarrows were invented, upon which the coal was wheeled out to-day, and the terms barrow-man and barrow-way are still in use in many British mining districts. In ancient workings, where the coal dipped under water, day-levels were frequently cut through the solid rocks, to discharge the water. Some of these levels were not more than eighteen inches wide, and they were cut with remarkable smoothness and accuracy. In time, shallow pits were sunk, generally beside some running stream, the water of which was utilized for hoisting the coal through the shaft, and then escaping from the mines by means of a day-level.

Although coal is now regarded, not alone as the source and mainstay of the national prosperity of England, but even of modern civilization itself, it was necessity rather than choice, which led to its application, not only as a household fuel, but to even industrial purposes. We have seen that during the reign of Edward the First, it was banished from the city of London as an intolerable nuisance. Even as late as the year 1661, more than three and a half centuries afterwards, a memorial was sent to the Crown by Sir Kenelm Digby, remonstrating against the use of coal, of which the following is an extract: "This coal flies abroad, fouling the clothes that are exposed a-drying on the hedges, and in the spring time besoils all the leaves so that there is nothing free from its contamination; and it is for this that the bleachers about Haarlem prohibit by an express law (as I am told) the use of coals for seven miles about town. Being thus incorporated with the very air which ministers to the necessary respiration of our lungs, the inhabitants of London, and such as frequent it, find it in all their expectorations: the spittle and other excrements which proceed from them being, for the most part of a blackish and fuliginous color; besides the acrimonious soot produces another sad effect by rendering the people obnoxious to inflammations, and comes in time to exculcerate the lungs, when a mischief is produced, so incurable that it carries away multitudes by languishing and deep consumptions, as the bills of mortality do quickly inform." British writers of this period lamented to see manufactures arise which made use of coal as a necessity in their establishments. In Stowe's annals, by Homes, published in 1632, we are told the nice dames of London would not come into any house or room where coal was burned, nor willingly eat of food which was cooked by a coal fire.

Until the beginning of the 17th century, coal was mainly used for household purposes, and in blacksmith forges, and by brewers, dyers, and other artificers who required a strong fire. It was not till the discovery of steam, and its practical application to industrial purposes, that the coal trade began to assume real importance. This mighty power, dependent upon coal, like Samson upon his hair, for strength, at once opened up a multitude of uses for coal. Then came the manufacture of gas from coal, and the discovery of the hot blast in the smelting of iron; and finally, the steamboat and railroad locomotive, which made the use of coal an indispensable article of modern civilization, and almost as important an element as water. Before the application of steam by Newcomen, for raising the waters of the mine, the subterranean excavations were limited to drift mining, or to comparatively shallow and dry shaft workings. The machinery in use for hoisting water from pits, previous to the middle of the 18th century, consisted of chain pumps, barrels, and sometimes ox-skins, operated by horse power. The horse and gin, which is often now employed for raising material in the first stages of sinking shafts, was used for hoisting coal. The Germans were the first to employ rails and cars for moving the coal from the working faces to the bottom of the mine. Agricola, writing in 1550, mentions the form of the wagon then in use. It was rectangular in shape, bound with iron, and was mounted on four small wheels. The manner of working the coal in those early days, was simple and rude. All the coal was removed as the workings progressed forward, except pillars of just sufficient size and strength for the immediate support of the superincumbent rocks. As a result, most of the mines were lost by the creep of the floor, or by the pillars crushing, before the excavations were pushed to the limits of the field sought to be won. John Carr, of Sheffield, England, introduced wooden rails in British mines in the year 1775. Gunpowder was long discovered and employed for warlike purposes, before the miner thought of its assistance in breaking out the rock or coal.

Before the introduction of railways and cars in British mines, the coal was generally carried from the working faces to the bottom, and in the large coal mines to the top, of the pit on the backs of bearers. These bearers were often women and half grown girls, and in England were clothed in the same garb as the men. In the Scottish coal mines, the coal was carried in wicker cribs, fitted on the backs of the bearers. The cribs were held in place by leather straps passing around the forehead. In some mines, as many as two hundred female bearers were working at once, and the coal was carried to the top of the shaft by long winding stairways. An ordinary load of one of these female bearers consisted of one hundred and seventy pounds. Robert Bald, the eminent coal viewer of Scotland, has estimated the day's work of the female bearers of that country, as equal to carrying a hundred weight from the level of the sea to the top of Ben Lomond. The powers of endurance of some of these bearers, and the loads they carried, would scarcely find credence in these modern days. A Scottish song, written by a miner on a bearer, his cotemporary in the mines, thus alludes to her prowess:

> "She could carry on her back what wad harry a naggy,—
> For trained to the coal heugh was Meg Kilbeggie."

This slavish practice was not confined to Great Britain, but prevailed in equal extent in the coal mines of Continental Europe, and to this day women work in the mines of Belgium. In the mines of St. Etienne, in France, the female bearers were compelled to carry a certain number of loads of coal up the winding stairway of the shaft as a day's work. Barefooted, and supported by a staff, these poor creatures toiled harder than galley slaves. The shameful practice of employing delicate females in the coal mines of Great Britain, continued until the year 1842, when an act of the Legislature, based upon the report of a commission appointed by Parliament to inquire into the nature and results of female labor in the coal pits, was passed, which abolished a system replete with poverty, and shame and demoralization, at the very thought of which the sensitive mind revolts with horror. The same law also prohibited the employment of boys under ten years of age from working in the mines. Of the coal fields of Continental Europe, the mines of Zwickau, in Saxony, were working in the 14th century, and it is claimed that mining operations can be traced back as far as the 10th century. In the year 1348, the metal workers of Zwickau were forbidden to use coal in their works, owing to the supposed deleterious character of the smoke.

The working of coal in Belgium, is traced back to the 12th century, at which time we have authentic accounts of mining operations, at Plenevaux, near Liege; and not long afterward we learn of the mines of Charleroi being worked. Coal was used in the manufacture of arms in this country from very early times—some historians asserting, even before the invasion of the Romans under Cæsar. The Belgian miners have a tradition that the existence and use of coal were revealed to an old blacksmith, a poor but worthy man, named Houillos, by an angel from Heaven. The blacksmith, who lived in the village of Plenevaux, was one day sitting in his shop brooding over his hard lot (for he was so poor that his family was nearly reduced to starvation), when an aged man (the angel in disguise), with a grey beard, came into the shop and entered into conversation with Houillos. The blacksmith told of his poverty and of the necessities of his family, remarking that if charcoal was not so dear he could do well enough. The good old man was moved to pity. "My friend," said he, "go over to that mountain and you will find veins of black earth which will make a stronger heat in the forge than charcoal." Houillos repaired to the spot, and digging into the hill side, found the black stones, some of which he carried back to his forge; and so great a heat was produced, that he actually forged a horse shoe at a single heat. Overjoyed with the discovery, Houillos communicated the tidings to all his neighbors and all his fellow-craftsmen. A grateful posterity has conferred his name upon the mineral—*houllis* being the French for coal. The miners of Belgium delight to tell the story of Houillos, the ancient miner of Plenevaux. We have no authentic account of mining in France till the 14th century. The history of the introduction of coal in Paris was similar to its introduction in London. It was condemned, and its use forbidden in the city, because of the noxious sulphurous vapors which it was supposed to give off in the act of combustion, and the iron merchants were prohibited from using it in their shops, on pain of fine and imprisonment. As late as the year 1769, when the first shipments of coal were made from New Castle to Paris, it was accused of polluting the air, of causing disease of the chest and lungs, and of even impairing the beauty and delicacy of the female complexion. The matter was appealed to the Academy of Science and Medicine, which decided in favor of the coal; but popular clamor would not be appeased, and for several years the hated English mineral was the subject of much bitter invective.

The first discovery of coal in America was made by a Catholic priest, Father Hennepin, in the year 1669, in what is now the State of Illinois. His Journal, published in 1698, contained a map illustrating his travels, and he points out a coal mine on the Illinois river, where a bed of coal was exposed to view along the banks of that stream. The Richmond coal field, of Virginia, was first developed in this country, coal having been mined as early as 1750. In 1775, and during the progress of the war of independence, the coal from the mines near Richmond was employed in the manufacture of shot and shell for the patriot army. In 1789, coal was shipped from Richmond to Philadelphia, New York and Boston. The city of Pittsburg was laid out in 1664, and twenty years afterward privilege was granted by Wm. Penn, to mine coal in the hills fronting the river. Bituminous coal was first mined in the United States, in any systematic manner, in the Pittsburg coal region; for although the coal of the Richmond coal field was used, and even shipped to the markets of the east, before any attention was paid to the Pittsburg coal, the early efforts of mining in the Richmond basin consisted not in underground mining, but in quarrying the coal. The existence of the anthracite deposits of Pennsylvania was known as early as 1766, in which year a specimen of the coal of the Wyoming region was shipped to England. In 1768, this coal was first used by two blacksmiths by the name of Gore, who were originally from New England, but had settled in the Wyoming valley. They found the coal exposed in open day, on the flanks of the mountains, and applied it in their forges in the place of charcoal, with flattering success. The coal of the Lehigh region was discovered by a hunter named Philip Ginter, in the year 1791, while returning home from a hunting expedition. He had heard of the coal of the Wyoming valley, and was always looking well about in the hope of discovering coal. He took some of it home and showed it to his neighbors, and pieces of it were sent to Philadelphia for the opinion of more competent judges.

For many years anthracite coal was used for no other purpose than the blacksmith's forge. Being very difficult of ignition it was believed it could only be employed to advantage while under the action of a strong blast. In 1808, Judge Jesse Fell, of Wilkesbarre, conceived the idea of burning anthracite in a common parlor grate. Before going to the expense of building an iron grate, he resolved to make the experiment in one constructed of wood. The effort was crowned with complete success; and the Judge, himself a blacksmith, at once commenced the work of fashioning an iron grate. Henceforth, he enjoyed his evenings before a glowing fire of anthracite coal. The success attending the Judge's experiment was a matter of wonder to all his neighbors, who, for many days and weeks, thronged from far and near to witness the burning of a stone coal parlor fire. Before this time, a number of efforts had been made in Philadelphia to use the stone coal of the mountains, but without success. In 1803, the Lehigh Coal-Mine Company, among whose members was the celebrated Robert Morris, shipped six barges of coal from the Lehigh region to Philadelphia, four of which were lost by the way, and the remaining two, after much difficulty, were disposed of to the authorities to be used as fuel for one of the city engines. But the coal could not be made to burn; it was pronounced "black rocks" instead of coal, and was broken up into gravel and thrown upon the side walks. Five years elapsed before another effort was made to introduce the Lehigh coal in the eastern cities, and again it was a failure. In the year 1814, five barges were loaded at the mines, two of which reached Philadelphia in safety, and the coal found ready sale at $21 a ton, for by this time the secret of burning anthracite coal had been discovered, and the foundation of the anthracite coal trade had been laid.

—Compiled from "The Coal-Mines by Andrew Roy."

THE EARLIEST ATTEMPT TO SECURE A DISCOVERER'S RIGHTS.

As being of great historical interest to the mining men of America, we reprint here, in its entirety, a little volume that Mr. Israel W. Morris, of Philadelphia, was fortunate enough to chance upon while exploring an old book stall. It presents the earliest attempt to secure to the discoverer in America his rights to a mining claim of which we have any knowledge. Its quaint pages of one hundred and eighty-three years ago contain also a remarkable prediction about the abounding mineral wealth of this continent, and of which the earnest author could hardly have known much even in his most mad dreams. The following is the book:

THE GOLDEN TREASURY:
OR, THE
COMPLEAT MINOR.
BEING
Royal Institutions, or Proposals
FOR
ARTICLES
To Establish and Confirm
Laws, Liberties & Customs
OF
SILVER & GOLD MINES,
TO ALL

The KING'S Subjects, in such Parts of *AFRICA* and *AMERICA*, which are Now (or Shall be Annexed to, and Dependant on the CROWN of *England*.

With *Rules, Laws* and *Methods* of Mining, and Getting of *Precious Stones;* The Working and Making of *Salt-Peter;* And also, The Digging and Getting of *Lead, Tin, Copper,* and *Quick-Silver-Oars,* in Any or Either of those Countries; Whereby *Navigation,* and *Trade,* with the Subject's Interest and Riches, together with the CROWN'S Revenues, would be greatly Encreased in a little Time.

Most Humbly Offered to the Consideration of the King's most Excellent Majesty, & *this Present* Parliament.

LONDON, Printed for the Author, and sold by *J. Marshal* at the *Bible* in *Grace-church-street,* 1699.

TO THE
KING'S
MOST
Excellent Majesty;
Together, with the Present
PARLIAMENT
Assembled this Thirteenth Day
of *February,* 1699.

Great CÆSAR, and SENATORS,

In all Humility, most Humbly I inform You

There is nothing more Certain and True, Than that there are many extraordinary Rich Veyns, Mines, *and* Mineral Countries, *in some Parts of* America, *which are now Annexed to, and Dependant on the* Crown *of* England; (*the Experience and Truth of which, nothing but want of Skill in* Mineral Affairs, *and Incredulity can or will deny*); *which* Veyns *and* Mines, *if they was Sought for, and Set to Work, by any that understands them, would undoubtedly, in a little Time, prove as* Rich *as any the* Spaniards *have in* Peru, *or on the* North *Side of the Æquinox, in* New-Spain; *and, in a few Years, would produce and raise great Quantities of* Silver, Gold, Copper, *and other Valuable Things, to the Great Content and Satisfaction of the* English; *provided there was any Regular* Laws, Rules, *and* Methods *Settled, for Working and Carrying on the said* Mines; *by which* Laws, *the* Enterprisers, *or* Undertakers *thereof, might Enjoy and Secure their Rights, Interests, and Properties therein, to Them, their Heirs, and Assigns, after they have been at the Cost and Charges of Finding and Discovering the said* Mines. *But as the Royalties thereof stand, at present,* (*in their respective and separate Grants from the* Crown) *to a few* Proprietors, *who* formerly *hath not, at present doth not, nor* hereafter, *in all Probability, will not use any effectual Ways and Means to Work and Discover the same; whereby this excellent* Undertaking *hath hitherto been Neglected and Slighted, and is yet rendered Impracticable to all* Englishmen; *and so will remain to* Posterity; *by which many* Rich Veyns *and* Mines *have* been, are, & will be *of no Benefit; but continue Void, and utterly Lost, unless some further Care be taken, than yet hath been, for Settling and Methodizing the same: The evil Circumstances of which, hath* been, is, *and* will be, *if not remedied, an unvaluable Loss to the* English *Nation, in Neglecting to give all due Encouragement to improve this Honourable* Enterprise; *which would greatly increase the Revenues of the* Crown, *and advance the* English *Nation's Interest, to an unspeakable Degree, in a little time. Therefore that the* King's most excellent Majesty, *in his Princely Wisdom, together with this Present* Parliament, *would be Graciously Pleased to take it into Consideration, and amend this Mischief, by making the following* Articles, (*or sum such other, as the Government shall approve off*) *for Standing* Laws, *and* Customs, *to be Observed and Practised by all the* KING'S *Subjects in* America; *whereby the* Enterprize *would become National to the* English *Posterity, and every Free-Born Subject have Liberty to Seek, Find, and Enjoy the Fruit of his Labours; Paying to the* CROWN, *the* Duties *and* Reservations *here-after mentioned, is the sole Desire and earnest Request of,*

Your most Humble,

Most Dutiful, and most

Obedient Petitioner,

Thom. Houghton.

ROYAL INSTITUTIONS.

Article I.

That it is the Right and Prerogative of the CROWN, to Elect and Choose an Officer, and Officers for the Management of the *Royal Treasures,* when and where Occasion doth or shall require, to take the Care and Charge of the KING'S Part, in all *Royal Mines;* and also in all Mines of *Base Metal,* where the Royalties yet remain annexed to the Crown; Which Officer, and Officers, shall be *Sworn* to do Right and Justice, as much as in Him or Them lieth, (according to the best of his or their Skill and Knowledge) between his Soveraign Majesty the KING, and the *Miner*, *Maintainer*, or *Venturer*; and also, between *Miner* and *Miner*, and *Miner* and *Maintainer* of such Mines; and shall either Himself, or by his or their Lawful Deputy or Deputies, duly Execute, and faithfully put in Practice, amongst the *Miners* and *Adventurers*, and all other of the KING's Subjects, these ARTICLES, as Rules, Laws, and Customs, fit to be kept and observed, in all parts of *Africa*, *America*, or the *West-India Islands*, where any *Silver* or *Gold Mines*, or any other *Mines* of *Tin*, *Lead*, *Copper*, *Quick Silver*, *Precious Stones*, and *Salt-Petre*, shall be Found, Dug, Made, and Discovered hereafter; which Officer shall be called the *Bar-Master*; and shall remain Overseer and Supervisor of the *Royal Mines*, and other Mines of *Base Metal*, for the KING'S Part, during his Majesty's Pleasure.

Article II.

THAT all or any of the *KING's* Subjects, of what Degree, Quality, or Estate soever they be, shall have full Power, & free Liberty to Dig, Delve, Work, Mine, and Break up Ground in any of the Countries afore-said, to seek for *Silver*, *Gold*, *Lead*, *Tin*, *Copper*, *Quick Silver*, *Precious Stones*, and *Salt-Petre*, in any Part or Place whatsoever, Houses, Orchards, Gardens, and Enclosures of Sugarworks excepted, upon the Terms and Conditions following: That is to say, He or they who findeth them, or any of them, shall pay to the *KING's* Officer, for the Use of the *King*, in Oars ready drest, and cleansed from the Earth, Stone, and Rubbish, made fit for Smelting, Melting, and Refining; of all *Gold* and *Silver Oars*, one Sixth Part; And of all *Lead*, *Tin*, *Copper*, *Quick-Silver-Oars*, and *Precious Stones*, one Twelfth Part; And of all *Salt-Petre*, every Twelfth Tunn: For Payment of which Sixth and Twelfth Parts, as afore-said, every *Miner*, *Maintainer*, or any of the *KING's* Subjects, shall have free Liberty to Dig, Work, & Break up Grounds in any of the Countries afore-said; except in such Places, as is before excepted.

Article III.

THAT all Rakes or Veyns of *Silver* or *Gold*, *Lead*, *Tin*, *Copper*, and *Quick-Silver*, and all Pipes and Flat-Works of *Precious Stones* or *Salt-Petre*, shall, in three Days Time next after they, or any of them are found, he possest with one pair of Stowes or more, by the Owners or first Finders thereof; and Notice shall be given, or sent to the *KING's* Officer, by word of Mouth, or Writing, concerning the same, within three Months Time next after such Veyn or Veyns, Rake or Rakes, Pipe or Pipes, Flat-Work or Flat-Works are Found and Discovered; and, for want of such Officer, to the Minister of the Parish, or the next Magistrate, or Justice of the Peace, or Governour of the Place, where such Mines are Found, who shall immediately go or send his Deputy to the said Mine, Rake, Veyn, Pipe, or Flat-Work, and shall there measure out as many Meers* of Ground, as the *Owner* or *Owners* thereof have Stowes set in quiet Possession; which Meers of Ground he shall deliver to the first *Finder*, or *Owners* thereof, and shall Register that Veyn, Rake, Pipe or Flat-Work, by such Name, as the *Owners* think fit to give it; the *Miner*, *Owner*, or *Finder* thereof Paying to the *Bar-Master*, or his Deputy, Ten Shillings for every Meer of Ground he or they shall so Measure out and Register; each Meer of Ground containing Twenty Nine Yards of Ground in Length: Upon every of which Meer of Ground, a pair of Stowes shall stand to keep Possession, as aforesaid, within which Length of Ground, no Person or Persons shall presume to Work, Dig, or Break up Ground, in Order to get Oar therein, without the Leave and Consent of the *Owner*, or first *Finder* thereof, whether *Gold*, or any other Metal whatsoever.

*A little more than one-sixth of an acre.

Article IV.

THAT it is, and shall be, Lawful for any Person to Cross, Stow, and take Possession of either of the Extreams or Ends of all Rakes, Veyns Pipes and Flat-Works so found, where the Right and Possession of the next *Owner* expires, either at the Measuring out of the first Meers of Ground, or before; and he who shall first break Ground by the Making of a Cross or Crosses, and shall Own and Prove himself to be the first Taker at the Finder, or to him or them that Holdeth and Enjoyeth the next Possession, and shall set on one pair of Stowes or more, within Three Days Time next after the Making of such Cross or Crosses, or breaking of Ground, shall be Judged and Concluded to have the Right, Interest, and Possession of the next Ten Meers of Gronnd in the same Rake, Veyn, Pipe, or Flat-work, there-unto adjoyning, at whither End or Side soever it is, or shall be; provided he or they shall and do set on the other Nine pair of Stowes, within Three Days Time next after the Making of such Cross or Crosses; and shall Pay the *Bar-Master*, or his Deputy, Ten Shillings for Registering and Measuring out each Meer of Gronnd; at which Time, Stakes shall be driven down, or Marks made to determine and show the End of the same. But if he or they, who have made such Cross or Crosses, and Broken Ground, Neglect or Refuse to set on One Pair of Stowes or more, where such Cross or Crosses was made, within Three Days Time next after the Making thereof; that *then* it shall be *free & lawful* for any other Person to Cross, Take, and Set on Stowes, and Possess those Ten Meers of Ground, and shall Hold and Enjoy the same to himself, or his Assigns, giving the *Bar-Master*, or his Deputy, Notice thereof, and Paying for Registering and Measuring these Meers of Ground, as afore-said. And thus every one shall be served, sooner or later, in the same Rake, Veyn, Pipe or Flat-Work, whether it be *Silver*, *Gold*, *Lead*, *Tin*, *Copper*, *Quick-Silver*, *Precious Stones*, or *Salt-Petre*, according to his or their Antiquity of Crossing, or Breaking of Ground, and Setting on of Stowes, as is afore-said.

Article V.

THAT after the Ground is Possest with Stowes, Measured, Marked out, and Registered, if any Man's Stowes be Stol'n off, and taken away by any Malicious Person, or by any Indirect Way or Means shall be Carried or Taken from the Places where they or any of them Stood, That it shall not be Lawful for any Person or Persons to Set his or their Stowes, or Possess the same Ground, or to Work therein, or in any Part of it, for three Months Time next after; and at the End of the three Months, he or they who desires to be *Owners* and *Possessors* of the same, shall go or send to the *Bar-Master*, or his Deputy, or to the Minister of the Parish, or to some other Person, as afore-said, and acquaint him or them therewith; where-upon the Officer or Person, so acquainted, shall Write or send to the late *Owner* or *Owners* thereof, to whom the Right of those Meers of Ground did belong, or to some of his or their Agents; and shall give them Notice, That unless he or they set on New Stowes upon those Meers of Ground, and Dig or Work in some Part of it, within three Months Time next after such Notice given, That his or their Right in and to those Ten Meers of Ground will be given away: But if the *Bar-Master*, or other *Officer*, knows not how or where to Write or Send to such *Owner* or *Owners*, nor any of their Agents, to give him or them Notice thereof, Then the *Bar-Master*, or his Deputy, shall go to that Ground, and shall take Three or Four Persons along with him, and shall there make open PROCLAMATION, upon the Mine, some Time of the Day, between the Hours of Eight of the Clock in the Morning, and Two in the Afternoon, in the hearing of such Persons as go along with him, That unless the late *Owner*, or *Owners* thereof, shall set on new Stowes, and make Workman-ship in some Part of those Meers of Ground, within Three Months Time next after such PROCLAMATION, so that the Mine may be set forwards, and wrought for the Publick Good of the *KING*, and his Subjects: That for such Neglect, those Ten Meers of Ground in that Rake, Veyn, Pipe, or Flat-Work, will be given away to others, and his or their Names, that was late in Possession, will be raced out of the Register, and new *Owners* put into Possession, and their Names Registered: And this PROCLAMATION shall determine the Right and Interest thereof. And furthermore, Every Person and Persons whatsoever, having Possest and Stowed up the Ground as afore-said, whether it be Rake, Veyn, Pipe, or Flat-Work, shall do and perform some actual Work, by Digging and Mining, in some Part of that Ground, in Twelve Months Time next after it is so Stowed and Possest, as afore-said; or else it is, and shall be, Lawful to and for the *Bar-Master*, or the *KING's* Officer, to throw off those Stowes, so set on, and to set on the Stows of any other Person that shall desire that ground; to the End, That the Mines may not lye Waste and Neglected; but that the *KING*, and the Publick, may receive the Benefit thereof.

ARTICLE VI.

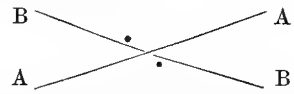
THAT no Person or Persons, Society or Societies of Men' shall take up or Possess above Forty Meers of Ground together, in any Rake, Veyn, or Pipe-Work, without leaving an Interval, or Space of Ten Meers of Ground at least, for other Adventurers; for the Reason of Giving all the *KING's* Subjects Encouragement to Venture, and to set the Field or Mine more fully at work, for the Publick Good. But in all Flat-Works of *Gold*, or any of the before-mentioned *Metals, Minerals, Stones*, or *Salts*, every Man shall have as many Meers of Ground, as he or they have sett-on Stowes, being Twenty Nine Yards Square, upon the Superficies of the Ground, for every Pair of Stowes; and for every Man successively, sooner or later, according to his or their Taking, Stowing, and Working the same, as afore-said.

ARTICLE VII.

THAT all *Miners* and *Adventurers*, shall have the Timber of the Countrey, (where the Grounds are not enclosed) for the use of their Mines, to Work and Uphold the Same, and to Smelt and Refine their Oars with, or to do and perform any other Service or Business, their Occasions shall require, in and about the Mines; And Liberty to Dress, Wash, and Cleanse their Oars from the Earth, and Rubbish, whether they be *Silver, Gold, Copper*, or any other *Metal, Stones, or Salt*, as before-mentioned, in the most fit and convenient Places they can find; and shall Build, and set up Smelting Mills, or Melting and Refining Houses for the same; and shall have Ways, with free Egress and Regress, to Pass and Repass, to and from the Mines, with any Carriages; and the Benefit of the Water, where-ever they shall find it. And when the Oars shall be Cleansed from the Earth, and Rubbish, and made fit for Melting and Refining, before any of the Oar is Removed, Conveyed, and Carried away from the Ground, where it is got, to Smelt, or Refine, or any other Ways, to be disposed off by the *Owners, Diggers*, or *Getters* of the same; The *KING's* Officer, or his Deputy, or some such Person, as is before-mentioned, shall be sent for, to Measure or Weigh the same. And when the *Bar-Master*, or his Deputy, hath taken the Sixth Part of all *Gold*, and *Silver Oars*, and the Twelfth Part of all *Copper, Lead, Tin*, and *Quick-Silver Oars*, and the like for *Precious Stones*, and *Salt-Petre*, as afore-said, for the Use of the *KING*; Then the *Miner*, or *Maintainer*, shall have Liberty to Sell and Dispose of the Rest, to his or their best Advantage; or to Smelt and Refine the same, as he or they that Owns them think fit; And after it is made into *Copper, Lead*, or *Tin*, shall and may (if he or they please) Smoke off the *Base Metal*, or Refine their Oars, before they are Melted, by *Quick-Silver*, or *Corrosive-Waters*, or any other Way, to the best of his or their Advantage, according as his or their Skill and Judgement shall direct them, either in Oars, or in Metal, as he or they think fit.

ARTICLE VIII.

THAT if it shall so happen, that Two Veyns of *Silver, Gold, Copper*, or any other Metal, shall run or go along One by the Side of Another, and shall be parted by a Rither or Rock of Stone Three Foot Thick, or More; That then they shall be Held and Accounted for Two Rakes or Veyns; and he or they that Found the First Veyn, shall Hold and Enjoy that in his or their own Right; for each Pair of Stowes, a Meer of Ground, as is before-said: And so likewise shall he or they that Found and Discovered the other Veyn or Rake, so running near, and going along by the Side of the Veyn first Found, according to his or their Crossing, Taking, and Possessing of the same with Stowes, one Meer of Ground for each Pair of Stowes; and so every Man, sooner or later, according to his or their Taking and Stowing. But if these Two Rakes or Veyns run One into Another, and continue so, or go so near together, that the Rither or Rock, which parts them, may be got, without Blasting and Blowing down of the same Rock with Gunpowder; Then they shall be Taken, Held, and Accounted for one Veyn; and he or they that was the first *Finders*, or *Owners* of the Veyn first Found, shall Enjoy the same, so long as they continue thus together: But if these two Rakes or Veyns, or any other Rake or Veyn, Intersect and Cross one another Diametrically, as thus, X or obliquely, in this manner,



He that first comes to, and finds the Place, or Point of Intersection, shall Hold and Enjoy the same: That is to say, He shall Hold and Enjoy his own Veyn, as A.——————A. in his own Right, and Three Foot of either Side into the Veyn B.——————B., as far as the Black Spots . . beyond which, being Three Foot, of either Side, from the Point of Intersection, towards B.——————B., he shall not Work, upon the Pain of Forfeiting the double Value of the Oar got therein, without any Cost or Charges to the Wronged Person, if that Veyn or Rake B.——————B. belong to any other Person or Persons; and this point of Intersection shall be called the P, to distinguish it: But if the Veyn B.——————B. be a New Veyn, and no other Person in Possession of it; Then it is, and shall be Lawful for the *Finder* thereof to Take and Possess it, and Hold it in his own Right. And if any Person shall Work upon the Front and Forefield of another Man's Rake or Veyn, and shall be thought and judged to Work in the same Veyn that another Man, at some Distance, had first in Work, and was Possest of; Then the Person that thinks himself Wronged, shall apply himself to the *Bar-Master*, or his Deputy, and desire him to keep an Account of all the Oar got therein; and before the *Getters*, or *Owners* thereof, shall carry it, or any of it away, or shall Smelt, Melt, or Refine any of the same into *Silver, Gold*, or any other Metal, he or they shall give Bond to the *Owners* of the first Veyn, That if by Workmanship, in Length of Time, these Two Places proves to be one and the same Veyn, to return the full value of the Oar got therein, to the *Owners* or *Finders* of the first Veyn, without Stopping or Deducting any Cost or Charges for Getting the same; and if he or they refuse to give Bond, then the Oar shall be Stopt, and Seized for the Use of the first *Owners*, by the *Bar-Master*, or his Deputy till further Workmanship shall make the Truth appear, whether they be one and the same Veyn or no; and to whether of them, the Place in Question and Dispute, doth appertain and belong.

ARTICLE IX.

THAT whereas it is most Natural and Customary, for *Gold* to lye in the Earth in Flat-Work; therefore, when any *Gold, Silver, Copper*, or the Oars of any other Metal, shall be found to lye in Flat-Work, he or they who first Findeth the same, and Crosseth, Breaketh Ground, and Sets on Stowes within Three Days Time next after such Flat-Work is Found, shall have as many Meers of Ground in that Flat-Work, as he or they shall Set on Stowes in Three Days Time next Ensuing the Finding, Crossing, and Taking thereof each Meer of Ground containing Twenty Nine Yards of Ground Square, upon the Superficies; within which Length and Compass of Ground, no other Person or Persons shall presume to Dig, Work, or Carry the same away, without the Leave and Consent of the first *Finder*, or *Owners* thereof. But if any other Person or Persons, shall find any other Veyn or Veyns, Rake or Rakes, that shall sink Perpendicular or Hadeing, within the Limits or Compass of that Ground so Taken, Possest, and Stowed up for Flat-Work, as afore-said; That then it is, and shall be Lawful to and for the first *Finders*, or *Owners* of those Rakes, and Veyns, to Hold, Work, and Enjoy the same, & all the *Product* thereof that shall be got within the Compass and Bounds of those Rakes or Veyns, without any Disturbance or Hindrence from or by the *Owners* or *Masters* of the Flat-Works; because such Rakes and Veyns lye in the earth after another Manner, and Nature, quite different, to Flat-Works, and are Separate Things; And so (successively) every one in the same Rakes or Veyns, according to his or their Taking, and Possessing with Stowes, sooner or later, shall be served, Hold and Enjoy the Meers of Ground so Taken, and Possest, in those Rakes and Veyns. And if there be no Veyns or Rakes Found within that Compass of Ground, so Taken and Possest for Flat-Work, but the Flat-Work shall continue, and extend it self, bearing *Gold*, or the Oars of any other Metal, further, and beyond the Limits of the Ground so Possest with Stowes, as afore-said, for Flat-Works; That then the first and next *Taker*, *Possessor*, and *Stower* of the next adjoyning Ground, shall Hold and Enjoy as many Meers of Ground, each Meer containing Twenty Nine Yards of Square Ground upon the Superficies, as he or they have Taken, and Set on Stowes for the same Flat-Work, within the Time afore-said; and so, successively, every other Person or Persons shall be served, sooner or later, according to his or their Taking, Possessing, and Stowing up of the same Flat-Work; be it in *Gold Mines*, or in Seams and Beds of *Salt-Petre*, or *Precious Stones* lying in the Earth, Soyl, or Rocks, in Flat-Works, as afore-said; or any other Metal and Oars, lying in the same manner whatsoever.

Article X.

That where any Oars shall be got, made, and run into *Copper*, *Lead*, *Tin*, or *Quick-Silver*, all and every Part of those Metals, that shall be used and spent in the Countrey, where they are got, shall Pay no other Duty to the *KING*, but only that before-mentioned; for the Reason of giving the Inhabitants, and Adventurers, all the Encouragement, that may be, to Work the Mines, and to Carry on the Field. But if the *Finders*, *Getters*, or *Owners* thereof, or any other Person, shall have a mind, and finds it for his or their Benefit and Advantage, to Transport and Ship them, or any of them, from the Countries where they are got, to other Places beyond the Seas, he or they that Ship them, shall Pay for every Tunn of *Copper* so Shipt, Twenty Shillings to the *KING's* Office, for the Use of the *KING*; and the same Sum of Twenty Shillings the Tunn, for *Salt-Petre*, and *Tin*; and Five Pounds for every Tunn of *Quick-Silver* so Shipt off, and Transported from the Countries where they are got: For the Payment of which Duties, and the Twelfth Part or Caract of all *Precious Stones*, as afore-said, All *Diggers*, *Finders*, *Owners*, *Buyers*, *Adventurers*, or *Dealers* therein, or in any of them, shall have free Liberty to Sell, Ship, and Transport them to any Part or Place whatsoever, to the best of his or their Advantage.

The End of the Articles.

All which Methods, Rules, and Articles, that they, and every of them, may be Enacted, Established, and Confirmed by the King's most Excellent Majesty, and this present Parliament, now Assembled, as LAWS and CUSTOMS, hereafter to be Practiced, Used, and Observed by all the Subjects of the Crown of England, in all Parts of Africa, and America, for the Discovering, Working, and Carrying on any of the Mines before mentioned, when and where they, or any of them, shall be Found, is the most Humble Petition and Request of a well-Wisher to the Nation's Interest,

T. H.

POSTSCRIPT.

TO THE
LORDS
Spiritual and Temporal,
Together with the
COMMONS,
Assembled in this present
Parliament.

Gentlemen,

It is Worth your Thoughts & Considerations, to Enquire into the Reasons and Causes, Why no *English King*, *Prince*, *Noble-Man*, *Merchant*, or any other *Person* of Heroick Spirit, should not, in all this Time, since *America* hath been Discovered, endeavour to be Master of *Silver* and *Gold Mines*, as well as the *Spaniards*; there being in many Places of *America*, now in the Hands of the *English*, as Rich, and as Plentiful *Veyns* and *Mines to be Found*, as any the *Spaniards* have in *Peru*, or *New-Spain.* But one Reason of this Misfortune, I believe to be this; He that hath had Substance, to have undertaken this Enterprise, hath wanted Skill, and durst not Trust another *with a small Stock out of Sight*, nor would not go himself with such as had Judgement therein: Or, He that hath had Skill, hath wanted Money, and Encouragement, to Manage and Carry on this Affair, and so could not undertake it, for want of a Stock; and as yet, no Person hath Petitioned any King or Prince, about it: However, it is plain, and too true, the Mines have been Neglected, which one would think, since all the *Kings*, *Princes*, *Grandees*, and *Persons of Estate*, in *Europe*, have known, That for 150 Years last past, the *Spaniards* have imported at *Cales*, from Ten to Forty Millions a Year in *Silver* and *Gold*, besides many *Precious Stones*, and other *Rich Commodities*, of great Value. The Knowledge of which, one would imagine, should have strongly induced some other *Prince*, or *Heroick Spirited Men*, to have used all their Endeavours to have Found and Discovered such Mines; and have given them sufficient Cause to have pursued the same, by sending such Persons about this Affair, as well Understandeth such Things: But the chief Reason and Mischief, that these Mines have layn so long Neglected, is, Because a few Proprietors (as is before recited in the Preface,) having, together with the Land, got Grants from the Crown, of the Royalties, where Mines, and Mineral Countries are; and not using any effectual means to Discover the Mines themselves, at their Charge, the Enterprise hath remained intricate, and no ways feasable to Others, by Reason of those Grants; all other Persons being Prohibited to engage therein. For to what purpose shall a Man spend his Time, Labour, and Money, to Enrich Others. by Seeking for That, which, when he hath found, neither He, nor his Heirs, shall Enjoy, nor any part thereof: *To Engage in this, would be perfect Madness.* This is the chief Reason, why the *English* are not Masters of *Silver* and *Gold Mines*, as well as the *Spaniards*; and not the want of such Mines, being within the *English* Teretories and Dominions; for if this *Sore* was once *Cured*, The *English* would have a *Plate*-Fleet, in a few

Years, Arrive in *England*, as well as the *Flota* doth in *Spain*. How great the Loss of which hath been, and is, and how Acceptable and Profitable the Discovering of such Mines, and an arrival of a *Plate*-Fleet Yearly in *England*. would be, I leave every one to Judge, that knows the Use and Service of *Silver* and *Gold*: And the Cause and Causes, why there are no such Mines Wrought in *America*, but what are Wrought by the *Spaniards*, are only the Reasons afore-said; concerning which, I hope, I have said sufficient; and that some better Care will be taken, for the Future, whereby all those Grants, relating to the Mines in *America*, may be Null'd, Revok'd, and made Void, (only in such Clauses as concern Mines,) by the *King's Most Excellent Majesty*, and the Prudence of this Present *Parliament*; and that the *KING* hereafter may remain sole Lord of the Field, and Royalties, in all Parts of *Africa* and *America*, that are now, or shall be, Annexed to the CROWN of *England*, *&c.* The *Indians*, both on the *South* and *North* Side the *Æquinoctial*, had Found the Mines, and Wrought in them (after their Fashion) for above Three Hundred Years before the *Spaniards* came there; or else most of the Mines had layn Undiscovered to this Day, by Reason of the *Spaniards* Laziness; for the *Indians* of *Peru*, having Lived some Hundreds of Years in a civiliz'd Government, before the *Spaniards* Arrival, had Wrought the Mines, and got great Quantities of *Silver* and *Gold*, although they were in no proper way of Working them, nor had any Iron or Steeled Tools, fit for the Service of the Mines; but only Tools of Copper, which they Valued more than *Silver* or *Gold*, in regard the Tools and Utensils of Copper were most serviceable for their Domestick Affairs, and all other Occasions, in their Times: So that, for many years wherever the *Spaniards* came, unless they Found Vessels of *Silver* and *Gold* in the *Indians* Houses, or Wore about them, at their Ears, Lips, Necks, or Noses; or was conducted, by the *Indians*, to the Mines, and Places, where the *Silver* and *Gold* had been got, The best and Richest Mines, the *Spaniards* now have, lay Void, and for a long Time Unwrought; being no more taken Notice of, than some Mineral Countries now are by the *English*, in several Parts of *America*. And the best Method (for Gathering and Taking up *Gold*,) most of the *Spaniards* had, for many Years, was only to Cleanse and Scower up the small Rivers and Brooks of the Country, falling from the Mountains; from the Sands whereof, they Gathered much *Gold*, without the *Experience* of Digging, Mining, and Sinking of Shafts, to seek for Veyns and Rakes; The Knowledge of which hath not been many Years Understood, and Practised by them; nor is yet Understood, Used, and Practised to that Heighth, and to such Advantage, as it might be. So that, in many Places, which are now in Possession of the *English*, there was never any Shafts Sunk, and put down, either by the *English* or the *Spaniards*; their chief Objects, and Places of Tryal, being only the Surface of the Earth, with the Brooks and Rivers, as afore-said. And therefore it remains, without Contradiction, there is all the probable Signs and Symptomes of Rich Veyns to be had, and Found, for Digging and Seeking for. And to this Day, the best Method and Way that is known, Practised, and Used by the *Spaniards* and *Indians*, for Gathering and Taking up *Gold*, in Flat-Work, is as followeth: The *Spaniards* set their *Indian* and *Negro* Slaves out a *Parcel* of Ground, Forty or Fifty Yards Square, more or less as the *Patroon* or *Master* thinks fit; which Ground, the *Indians* and Slaves Dig up as Deep as they find any *Gold* in it; and as they Dig it, throw it into Wheel-Barrows; which being done, their other Slaves run it away to the next River, or Running Brook, and there lays it down, and Returns for more; and in this Manner they Labour, till their Days Work is done, in Digging and carrying of Earth. At the River, or Running Brook, there are also several other *Indian* Women, Boys, Girls, or Slaves, at Work, having Bowls, or small Treays with Handles; where a *Negro* Boy or Girl, having first broken and beaten the Lumps of Earth small, where, by Reason of the Heat, it immediately dryes; which when it is dry, they put about an *English* Peck of that small Earth, so beaten and dryed, into one of those Treays, as afore-said, at a Time; and then the Woman shakes and dances it about in the Water, turning the Bowl or Treay about and about, till the Water hath Washt away all the Earth, and Rubbish; and what *Gold* is in it, sinks, and remains at the Bottom; which not being fully Cleansed from the Earth, is put into a Bowl that stands by, to undergo a second and a third Cleansing. And in this Manner, the Women, Boys, and Girls, renew filling of their Treays and Bowls, with that Earth, till their Days Work is done; and so daily gather more or less *Gold*, according as it happens, and as that Flat-Work is more or less Plentiful of *Gold*; Pursuing this Method in Digging, Carrying, and Washing, as long as that Earth hath any *Gold* in it worth their Labour; and then they remove to another Place. After this Way, they Work out all their Earth and Land, that lies near Rivers, or Running-Brooks, that hath *Gold* in it; but where the *Gold* lies at a great Distance from any Running Water, they are obliged to let all alone, or else to lose the greatest Part of the *Gold* that is small; for in such Places that are remote from the Water, (as on the Tops and Plains of the *Mountains*, where there is generally the most plentiful Store of *Gold*) the best Ways they Use or Understand to gather it there, are these: They Dig the Earth, Dry it, then Beat it small, and Sift it; which done, they Spread or Strow it thin upon the Ground, and there it lies, till the next Showers of Rain Wash it; and then they pick out what *Gold* they can; which being done, they draw the Earth up and down with Coal Rakes, or turn it with Shovels, and spread it thin again, and let it lye till other Rains wash it, and so pick it over again; which Operation, being twice or thrice Repeated, and having taken what *Gold* they can out this Way, they then shovel all the Earth together upon Heaps; and if there be no Pools or standing Waters near, they make Ponds or Pools, which when the Rain-Water hath filled, they carry that Earth, so laid upon Heaps, thither, and wash it, with their Treays and Bowls, in those Pools, as afore-said: And by this means they get some more *Gold*, although most of the fine and small *Gold* is quite lost, because the Water of those standing Pools soon grows dirty and muddy, and thereby rendered unfit to separate the fine dust *Gold* from the Earth, for want of clear running-Waters; which Error and Defect, might easily be amended, and all the *Gold*, though never so small, preserved, if they understood the way of *Husbing*, and using long Buddles, and Landers: As much *Gold* might be taken up in a Month, by the same Number of Hands, as they now take up in Seven Years: But, whether this be a proper Place, and a fit Time, to Shew and Describe the Way of *Husbing*, and Using these Buddles and Landers, I know not, till I find what Reception and Countenance these ARTICLES will meet with. And if the Design of this Book meets with Encouragement, I will Publish a Book, Entitled, *The Royal Miner*; (in which, the whole Method and Progress of Digging, Working, and Carrying on of Mines, from the first Beginning, or Breaking of Ground, to the Melting, Refining, and Making the Oars into Metal, shall be clearly Taught and Described; together with all the Work-Tools, Instruments, and Materials Used in and about the Mines: As also, what Incidents, or Accidents, Prejudicial, or Profitable, hath, doth, and may attend the same, as far as Art, or Nature, hath Discovered these things to Humane Reason: In all which, (I may say, without Boasting,) I have had long Experience, and am as capable to Acquaint Posterity with, as any Person extant, having for Six and Twenty Years past, been universally concerned in Mines, in all, or most of the Mineral Countries of *England*, not only as a *Partner*, *Master*, or *Owner* of them; but in the Practick Part of their Workman-ship, from the Beginning, to the End:) In which Book, I will describe the Method of these Buddles and Landers, for *Husbing*, and the most proper Way of taking up, and gathering of *Gold*, with many Useful and Beneficial Directions and Instructions, in and about the Mines, and Mineral Countries of *England*, and other Places, shall be fully set out and described. In the Interim, If this small Book should fall into the Hands of any Detractors, who, through Ignorance or Envy, shall exclaim against any thing herein mentioned, or hereby intended; I shall only give such Persons this Modest Reproof, *Quis nist mentis inops oblitum respuat auram?* and he may well be reckoned a weak Man, if not a Fool, that will censure, slight, or condemn anything, in which he never acquired sufficient Knowledge to be a competent and fit Judge.

GENTLEMEN,

I would not have You, or any of You, think, or believe that *Gold* and *Silver*, or the Oars of any other Metals, lyes in the Earth, in such Plenty, or in such a Manner, as to discover themselves to every vulgar or unskillful Eye; however, it is certain, There is great Plenty, and many Rich Veyns to be Found in the *English* Territories; & for what I have mentioned before, concerning a *Plate-Fleet* coming Yearly into *England*, if Liberty, and fit Encouragement, be given, I will Undertake to Effect and Perform it. And, if any of You desires further Information in this Affair, I am ready, to Acquaint You with it, when You Command me; and to Shew You *how, where* and by *what Ways* and Means the same may be Effected; so that, if Liberty and Encouragement may be given, I doubt not, but to have Five Hundred *Miners* at Work, in Two Years Time; by which, with some *Negroes*, and other Persons, that I will Cause to be brought to them, in Two Years Time more, I question not, but to make the Mines flourish to a greater Degree, than I shall now Speak of. To Conclude; All that I seek herein, is, That the *King's most Excellent Majesty*, and this *August Assembly* of *Parliament*, would be Graciously Pleased, (if in their great Wisdom, it may be thought fit,) to take away, and remove all those Obstructions, which hitherto have Ruined this Honourable Enterprize; and that for the Future, they would Settle and Confirm either the afore-going ARTICLES, or some other Fundamental LAWS and CUSTOMS, for the Mines before-mentioned; whereby all Free-Born Subjects of the CROWN of *England*, may have Liberty, and full Power of Using their Endeavours, to improve their own Interests, together with the Revenues of the CROWN: Which is the most Humble Desire, and Petition, of a *Well-Wisher* to his KING, and Countrey,

Thom. Houghton.

FINIS.

PART II.

UNFAMILIAR MINING REGIONS OF THE UNITED STATES—MINOR BEDS OF TREASURE—MINERAL LANDS OF THE SOUTH, EAST AND NORTH.

THE uninitiated in American mining interests have very little knowledge about the resources of this continent if they suppose them to exist only in California and the far West.

In Part II, of the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES, it is our intention to draw the eyes of the reader to some of our mineral belts that are not so well known as the great underground treasure vaults of the Pacific States, and to mining interests in the Dominion of Canada and the Republic of Mexico. The mineral veins of the Southern, Southwestern, Middle, Eastern, and Northern States; and of our neighboring countries represent a great many million dollars of American capital, and produce an amount of metallic wealth that has a precise influence upon the market. Much of the territory upon the Atlantic sea-board that undoubtedly contains valuable mineral deposits has never even been explored; as the constant discoveries yearly testify. The silver mines of Nevada and Colorado were old stories when it occurred to a keen-sighted ne'er-do-weel to have some sparkling rocks found near Newburyport, Massachusetts, analyzed. The mines of Maine were myths for twenty years after California became the gold field of the world. To the resources of some other States and regions it is our purpose to call attention here, in the desire of spreading wider some valuable information that seems in spite of its value, to travel but slowly.

THE MINES AND MINERALS OF ARKANSAS.

HIS Excellency, Governor T. J. Churchill, of Arkansas, has kindly had prepared for this work by Mr. George W. Dale, of Little Rock, a careful and competent mining expert, the following concise account of the mines and mineral prospects of the State of Arkansas. Mr. Dale deals thus with his subject:

The oldest mine in the state is situated in Pulaski county, eight miles north-east of Little Rock. It is known as the Kellogg mine, and was discovered about forty years ago. Lead, copper, pyrites and zinc blende are found in this mine. Assays of galena, by Dr. D. D. Owen, run as high as 339 ounces to the ton of ore. The country rock is shaly, talcose schist, much contorted, intersected with dykes of red and gray feldspathic quartz. It is supposed that a mineral belt runs from the Kellogg mine in a south-westerly direction through the counties of Pulaski, Saline, Montgomery, Garland, Hot Springs, Polk, Pike, and Sevier, to the Bella mine, which was discovered about thirty-five years ago, and was developed, to some extent, by making an open cut some sixteen feet deep. The lead found in this mine gives about 30 ounces of silver to the ton of ore. Since the late war considerable prospecting has been done in several counties of Arkansas. In Montgomery, the Silver City mines are located. At this camp a miner's district is organized, and considerable prospecting has been accomplished. A stamp mill and reduction works have been established, and ore raised, but the result, so far, has been a loss to those engaged in the business. This results from lack of capital, and want of skill in working the mines, and in manipulating the ores. The minerals found at this place are the same as at the Kellogg. Assays of ore are reported as running several hundred ounces of silver to the ton. The country rock at this camp is, as at the Kellogg, talcose shale, intersected by quartz and trap dykes. The shales, as at the Kellogg mines, are underlaid by the sub-carboniferous limestone. In the same condition is the entire mineral belt running across the state from the Kellogg to the western border. The strata of this mineral belt is much tilted, ranging from 10 to 90°; the tilt is north; the strike, east and west.

In Polk county some prospecting has been done in the last few years, resulting in the discovery of manganese (Pyrolusite) of fine quality. These lands were recently purchased from the government by some northern capitalists. Iron, copper, zinc, lead, and graphite abound. Some gold has been found. But little work has yet been done, and that of the most unskilled kind. I regard Polk as one of the best mineral-bearing counties in the state. Large bodies of antimony are found in Pike and Sevier counties. A few years ago reduction works were erected; the ore was abundant, and of high grade (sulphuret), but from the want of skill in the manipulation, and lack of judgment in the erection of a suitable furnace, the enterprise resulted in failure, and consequent loss to the stockholders. The company is, I understand, about to resume operations, and it is to be hoped with better success. In Pike, large deposits of gypsum are found. At Royston's Bluff, on Little Missouri river, there is a deposit of gypsum, highly crystallized, and of the finest quality. Salt-water is obtained in this district. Works were at one time established for the manufacture of salt, but this was long since discontinued, In Garland county, lead, copper, and the celebrated novaculite hone-stone are found. The latter is extensively used throughout the world. There is also an excellent quality of tripoli. It only needs thorough enterprise to wring a fortune from it. In Hot Springs county, lead, copper, magnetic iron, buhr stone and novaculite are found. Saline county ranks among the first in the state in point of mineral wealth. In this county are found iron, copper, lead, argentiferous galena and nickel. The country rock is talcose slate, intersected by mineral-bearing quartz ledges, and by numerous trap dykes of basaltic formation. Limestone is found, mostly blue in color, veined with white quartz and calcspar. The most extensive deposit of steatite (soap-stone) and serpentine known in the Mississippi Valley is located in this county. This deposit is destined, at no distant day, to be of vast importance. The lead, copper, and carbonates of iron all carry more or less silver. Some of them are of high grades, and I have no doubt but the time will come when valuable mines will be opened up in the belt herein described. Gold has been found in small quantities. Novaculite, roofing slate and porcelain clay of excellent quality, are found in great abundance.

Having spoken of the Kellogg mine, I will return to Pulaski county. The strike of the metallic veins of the entire mineral belt of South Arkansas, (as was originally discovered at the Kellogg mine) is uniformly east and west or nearly so. Three miles south of Little Rock, is what is called Fourche mountain. This so-called mountain is a low ridge running east and west about seven miles; and two miles north and south. It consists of a fine quality of syenite, of gray and blue colors, intersected by dykes of quartz and of magnetic iron. In the hands of men of enterprise, skill, and capital, this deposit of valuable material could be made immensely profitable. No county in the state is, probably, possessed of more mineral wealth than this. Iron, copper, argentiferous galena, cobalt, nickel, and manganese (Pyrolusite) abound. A mine of the last-named mineral—a true fissure vein, of immense proportions,—lies twelve miles west of Little Rock, and seven miles from the Iron mountain R. R. From what is known of the character and quality of the vein, I regard it as one of the most valuable deposits of the kind to be found on the Continent. Gold has been found in this country, but not in quantity, promising profitable results. The foregoing described district is timbered with the various kinds of oak, hickory, ash, gum, and pitch-pine, all of excellent quality. Much of this land is public, subject to sale for cash, or to homestead entry, or to location and purchase under the mineral laws of the United States.

The coal field has its eastern terminus in White county, about thirty miles north-east of Little Rock, and is confined to a narrow belt along the Arkansas river valley and near to the foot-hills of the Boston mountain, which extends from White river, opposite to Batesville, in Independence county, thence in a westerly direction, far into the Indian territory. The main bodies of the workable coal are found in Pope, Johnson, and Sebastian counties. The veins range from three to four feet in thickness, and are from thirty to eighty feet below the surface. The coal is semi-anthracite. The principal mines worked are the Ouita, in Pope county; the Spadra, Horsehead, and Coal Hill, in Johnson county. Some are worked in Sebastian county, near the city of Fort Smith, for local consumption. The vein gets thicker as it goes west, and, as before stated, penetrates far into the Indian territory, where, at McAlister, on the Missouri, Kansas, and Texas R. R., there is a valuable mine opened, from which northern Texas receives a large portion of the coal used in that part of the state. Within the immediate vicinity of some of the Arkansas coal mines, and on the line of the Little Rock and Fort Smith R. R., as also, on and near the banks of the Arkansas river, are large bodies of valuable iron ore. These deposits are well deserving the attention of the iron masters of the country. At the mouth of Shoal creek, in Logan county, and on the south bank of the Arkansas, is the most extensive deposit of micaceous fire clay I have ever found anywhere. This clay is favorably located, both for the purpose of manufacturing, and for shipping. It is owned by one of our resident capitalists; one who is interested in mines in Old and New Mexico; and although he owns, in this deposit of clay, that of greater value than mines of gold and silver, he gives up this land to the production of cotton in preference to working up the clay into fire-proof materials. At this place there is also a vein of good coal three feet in thickness.

The mineral belt of north Arkansas includes the counties of Lawrence, Sharp, Independence, Izard, Marion, Pearcy, Boone, Newton, Madison and Carroll. The mineral-bearing rocks of this belt are of lower Silurian date. In Lawrence county, calamine (carbonate of zinc) is found, in large quantities. Many years ago reduction works were erected at the town of Calamine in that county, and a large amount of zinc was smelted, but in consequence of lack of sufficient capital, work was suspended. Lead and iron ores of good quality are found. In Independence county, iron and manganese are found. The manganese mines are being developed. The mineral is the variety known as Psilomelane, very hard, and strikes fire to a steel. It is found in clay fissures, in the lower carboniferous limestone. In Sharp county, zinc ore has been found, but no mines opened. Iron is there and in sufficient quantities to attract the notice of iron men. Izard county shows some iron, lead and manganese.

Some specimens of copper have been found; no mines have yet been opened. Buhr stone is found in that county, and is pronounced by those professing to be judges, equally as good as the French buhr. Marion county is one of the great mineral counties of the state. Lead has been mined successfully in a number of localities. Not having cheap transportation facilities, work has been, in a great measure, discontinued. Marion has copper and zinc; the latter in large quantities; also marble of very fine quality. Searcy county, located mostly in the Boston mountains, contains many valuable minerals, among which may be mentioned lead, zinc, and black marble. Boone county is destined, at no distant day, to become one of the most noted localities in the world for its vast deposits of zinc ores. Very fine marble is found. Newton county is the most mountainous county in the state. It has valuable deposits of zinc, also lead and marble. Madison county, in the Boston mountains, has lead, iron and coal. A mine of the latter has been recently opened, and is said to be of good quality. Marble is found.

Carroll county, in point of mineral wealth, including its beautiful pink-colored marble, is destined to, and, in fact, does stand, first in the list of counties in north Arkansas. And not alone for its rich deposits of lead, zinc, and iron, but for its celebrated medicinal waters, at the city of Eureka Springs, it is becoming famous throughout the Union. These springs are situated in the northwest part of Carroll. Although not yet three years since their discovery, there is a city around these springs of about ten thousand inhabitants. In conclusion, I will say that what Arkansas most needs is capital and brains. When we have acquired these, we need have no fears for the future success of our mining interests.

THE ZINC DEPOSITS OF SOUTHERN MISSOURI.

THE lead-mining industry of Missouri, as of other parts of the Mississippi basin, appears to have been paralyzed by the shock of competition with the mines of the States and Territories further west. It is difficult for establishments working galena ores, too poor in silver to pay for extracting it, to compete with the producers of the argentiferous carbonates of Utah and Colorado, who look upon their lead as a by-product of little value, and are satisfied if it pays the charges of transportation, or the loss in smelting for silver. But simultaneously with this depression in the lead-mining of the Mississippi States, the development of new zinc deposits has caused a notable revival in the mining of zinc ores. The zinc-bearing territory in Southwest Missouri appears to be very extensive; that is to say, zinc ores have been mined quite recently at various points throughout a district extending from the eastern edge of Kansas, west of Joplin, to a line some 50 miles east of Springfield. Many of these openings, however, have already been abandoned. The deposits were superficial and limited, or the quality was unsatisfactory, or transportation was too dear, etc. The ores were carbonate and hydrous silicate of zinc. Further north and northeast, discoveries of zinc ore are also reported, but no developments have yet been made. These northern deposits, like those of Southeast Missouri, are said to be in Silurian rocks, and therefore belong to a different horizon from those of the Southwest, which are pronounced sub-Carboniferous. This difference in age of the inclosing rocks does not necessarily prove a similar difference in age of the deposits, since all that can be predicated upon a determination of the period to which the country rock belongs is the limit, back of which the beginning of the deposit is not to be placed. In other words, an ore-deposit in Silurian rocks must be Silurian or post-Silurian in age, and its formation may have taken place much more recently than that of the country rock. The sub-Carboniferous and the Silurian rocks of Missouri may, therefore, be traversed by deposits of some one age posterior to both.

The sub-Carboniferous limestone of the Southwest lies nearly horizontal, and is characterized by flinty segregations, sometimes solid, sometimes brittle, and much fissured. The limestone is occasionally shaly. The ore-deposits, irregular in shape and distribution, occur in this formation. Those which have proved most productive hitherto have been associated with lead ores; but their superior productiveness is probably due to the circumstance that previous mining operations, having lead for their object, had laid bare large amounts of zinc ore, ready for cheap extraction. It was a fortunate thing that the mines first opened at Joplin yielded rich blende, in large pure masses, associated with galena. For some years they worked for lead. When a solid body of blende was reached the miners called it a "bar," and excavated—or, as the Western men would say, "gophered"—around it to save the expense of blasting it out. When the value of this ore was subsequently recognized, large quantities could be obtained from these bars, so rich as to need no concentration before shipment. Under less favorable conditions the development of the industry in this district would have been slow. Most of these bars appear now to have been exhausted. The zinc ore now brought into market comes mostly from deposits in the brittle flint rock, the fissures of which it fills. The whole mass extracted in mining must be crushed and jigged. Galena is sometimes present and sometimes very scarce. Little is known of the extent of these deposits. They appear to be limited in height, width, and length, abutting against barren rock. At some points the zinc ore impregnates or interlaminates shales instead of flint. Iron sulphide is plentiful in a few mines only. Some of the ore consists of a skeleton of silica, as porous as a sponge, the pores of which are filled with blende; and all forms of transition are observed, from this to solid flint-rock, with disseminated specks of blende. This the miners call "iron-jack," their name for blende being "black-jack."

Next to the blende deposits of Joplin, the most important are the silicate mines at Granby. Here, also, the zinc ores were first exposed in large quantities by the mining of lead, and the earliest productiveness has considerably fallen off through the exhaustion of these reserves. The deposits of Granby seem to lie all in one horizon—either in one stratum of limestone, or in a group of several strata a few feet apart. The layers of ore-bearing rock are separated by barren layers. Other deposits, again, resemble fissure-veins for considerable distances; but the local expression "run" designates most of them aptly. There is no foretelling how they will pitch or branch or turn. At many of the mines the ore is broken by hand with the so-called buck-hammer on the anvil consisting of a hard rock, and is then dressed in Cornish jigs of the most ancient fashion, operated by hand with a pole. Stone-breakers and crushers are, however, coming into use, and several well-arranged concentrating works of large capacity have been built. The attempt to build up a smelting industry on the spot, instead of shipping the ore out of the district, has not yet borne fruit. If, as now seems probable, the ore supply is to be for the most part the aggregate of many small and short-lived operations, scattered over a large area, the proper place for smelting-works is not at the locality of any one of these mines, but at the centres of transportation, where cheap freight and cheap fuel will command the whole field.

—Compiled from a paper by Rossiter W. Raymond, M. E., Ph. D., Transactions American Institute of Mining Engineers.

THE SOUTHEAST MISSOURI LEAD DISTRICT.

THE lead district of Southeast Missouri covers an area of over 3000 square miles, including Maries County on the west, Jefferson on the east, Franklin on the north, and part of Madison on the south, or parts of ten counties. A general section of the rocks of the southeast part of this region would be about as follows, numbering from the top:

1. Sandstone (the second of Missouri geologists), ...	20 feet.
2. Chert beds—beds of passage below, ...	125 "
3. Magnesian limestone, chert, and quartzite,	100 to 300 "
4. Lower magnesian limestone, ...	100 to 150 "
5. Gritstone and lingula beds, . . .	50 "
6. Ozark marble beds, ...	. 5 to 20 "
7. Sandstone and conglomerate, .	. 5 to 90 "
8. Porphyry, } Archæan	
9. Granite, }	

The thickness is approximate, for it is not possible to obtain the correct thickness of the various beds. No. 1 may be seen as detached outliers or loose masses of a hard sandstone or quartzite, and is found on the hilltops in the southern part of Madison County, in like topographical position in Reynolds County and the western part of Washington County. No. 2 consists of alternations of chert, clay, and quartzite. It is the formation which contains most of the limonite deposits of Central and Southern Missouri. In Reynolds County shafts have penetrated it 75 feet. Outcrops there and in Madison would indicate it to be at least 125 feet thick. Fossils obtained in various places prove it clearly to be of the age of the calciferous sandrock of the New York system, and No. 1 and 2 may also be referred to the age of the second sandstone of Missouri. No. 3 consist chiefly of thick beds of ash, drab and flesh-colored magnesian limestone, both coarse and fine-grained. These beds, where they occur, in Washington, Jefferson, and the southern part of Madison Counties, contain a good deal of quartz in drusy cavities. In Washington County the limestones are beautifully ramified by a system of connected drusy cavities generally lined with minute quartz crystals arranged in botryoidal and mammillary forms, and called "mineral blossom" by the miners. This is the bed-bearing rock of Washington County, but in the southern part of Madison it does not appear to be galeniferous. It is also undoubtedly the equivalent of the lead bearing rock of Central Missouri, and is known in Missouri geology as the third magnesian limestone. In Washington County it is from 200 to 300 feet or more thick, but in Madison probably not over 100. No fossils have been obtained from it in these counties. I would here remark that the line of division between Nos. 3 and 4 is not well defined. It may yet be proved that they belong to the same group. No. 4 consists of either dark ash or flesh-colored dolomitic limestone, generally occurring in thick beds. On Mine La Motte tract, this limestone, with the underlying gritstone beds, is 80 feet thick. At St. Jo Mine, St. Francois County, it has been proved to be not less than 200 feet thick. At the lead mines it soon becomes brown upon exposure.

At Mine La Motte a thin band of blue shale is found which abounds in a *Lingula* (*Linguella*) *Lamborni*, which is regarded as a Potsdam fossil by palæontologists. Near Fredrickstown the lower limestone beds contain this fossil, together with *Scolithus Orthoceras*, and a *Pleurotomaria.* This is the lead-bearing rock of Mine La Motte, Fox Mines, Avon Mines and St. Jo. No. 5 is a close-grained, even-bedded silicious dolomite, sometimes having drusy cavities lined with dolomite. The various beds seem to be chiefly formed of rounded quartz grains disseminated in a compact dolomitic paste. Its greatest thickness amounts to 23 feet, but is even sometimes wanting. No. 6, the marble beds, are not always present; for in the northern part of Madison county No. 5 rests directly on No. 7. These beds consist generally of fine-grained, even-bedded, magnesian limestone, of gray, red, flesh-colored, buff, or mottled white, with red, buff, or drab, the colors sometimes quite beautiful. It admits of a high polish and is quite handsome. The lowest unaltered sedimentary rock of southeast Missouri is a sandstone, generally coarse-grained, although we do find it of fine grain. It also occurs as a conglomerate, formed chiefly of porphyritic pebbles. Its chief outcrop is in the southern part of St. Francois and northern part of Madison counties, especially on the Mine La Motte tract, where we find it directly reposing unaltered on the porphyry, and farther westward on granite. Its greatest thickness is 80 or 90 feet, but it is often much thinner. The occurrence of any ore in it is very rare, and only at one place have I heard of a little galena being found. With regard to the age of these rocks we would call No. 7 (the sandstone) Potsdam. If *Lingula* (*Lingulella*) *Lamborni* is restricted to the Potsdam group, and the *Scolithus*, also occurring in the same bed with the *Lingula*, we should, without hesitation, regard the rocks as Potsdam, but if these fossils are also found in the calciferous group, we should prefer to assign all our rocks above the lower sandstone, to No. 1, inclusive, as calciferous, for there has thus far been found no well-marked line of division between Nos. 3 and 4, and the late Dr. Shumard stated in his reports that No. 3 (the third magnesian limestone) undoubtedly contained calciferous fossils. The oldest rocks of southeast Missouri are the porphyries and granites. We know that the porphyries are older than the above-named rocks, because we have found the lowest sandstone resting unaltered on them, and also upon the granite. We also have found the lowest magnesian limestones resting on this sandstone, and also unaltered upon the porphyry. We therefore have a correct succession of rocks. Our data, thus far, is not sufficient to establish the age of granites, or whether they are older than the porphyries, but we incline to the belief that they are. Our porphyries, though, are exactly similar to those of Massachusetts and New Brunswick, which are considered Huronian. We, therefore, feel correct in calling ours Huronian. Our granites may be Laurentian.

Ores of the above.—The ores of No. 4 and 5 include those of lead, copper, nickel, and cobalt. The oldest worked mines are those of Mine La Motte, where lead was mined soon after the year 1720. At intervals, these mines have been much worked during the present century. The ore occurs disseminated in horizontal limestone beds, throughout an average vertical thickness of 7½ feet. The cap-rock and bed-rock are of like composition, but contain very little ore. In one portion of the mines, copper ore (chalcopyrite) is quite abundant, and is intimately associated with galena. At another place we find nickel and cobalt quite abundant. This mine having been formerly particularly described, we pass on to others, simply mentioning that at the Avon and Fox Mines the ore occurs very similarly, and that the formation is of the same geological age. At the Fox Mines much of the galena is found in drusy cavities, associated with pyrites, calcite, and dolomite. But it is of the St. Jo Mines that we wish more particularly to speak. As we have stated before, the rocks are similar to those of Mine La Motte, but the ores are only lead and copper. The rock here is a dense ash-blue magnesian limestone, reposing in nearly horizontal strata. The St. Jo Company at present have two working shafts of 80 and a 100 feet depth, the ore-bearing rocks being the lower 25 feet arranged in tolerably uniform layers of two to four feet in thickness. No vertical veins were observed, but the mineral will sometimes follow vertical cracks. At one place, solid layers of galena, of about three inches in thickness, are intercalated with the limestone beds every few feet; but the ore is generally disseminated in the limestone. In the upper beds, bands of chalcopyrite are of frequent occurrence. A vertical section at one place shows.

1. Several feet of magnesian limestone, occurring in even beds, and containing a small percentage of disseminated galena.
2. 6 feet of magnesian limestone—no galena observed.
3. 3 inches—sheet of galena.
4. 2½ feet of limestone.
5. 3 feet of limestone, with a good percentage of galena.
6. 4 feet—nearly all galena—with a very little limestone.

The Deslodge Shaft.—Just adjoining the St. Jo Lead Company's land, and only a few hundred feet northeast, the Missouri Lead Mining and Smelting Company have sunk a shaft 120 feet, and bored 84 feet further, passing through rich galeniferous limestone. A section recorded by the company reports passing through limestone with disseminated galena as follows:

Galena at . .	33½		feet from eurface.
" "	46		" " "
" "	78		" " "
" very rich at	78	to 80	" " "
" at	81		" " "
" a little from	83	to 97	" " "
" richly disseminated, . .	103	to 104	" " "
" sparsely disseminated,	104	to 114	" " "
" a good percentage, . . .	114	to 116	" " "
" a very little to	117		" " "
" s good percentage, from .	117	to 127	" " "
" dieseminated, from .	120	to 138	" " "
" very rich. from	138	to 140	" " "
" disseminated, from . . .	140.6	to 140.9	" " "
" fair, dieseminated, from . .	140.9	to 141.3	" " "
" very rich percentage, from	141.3	to 142	" " "
" disseminated, from .	142	to 151 6	" " "
" very rich, from	151.6	to 152.3	" " "
" good, dieseminated, from .	152.3	to 154	" " "
" lean, from	154	to 155.6	" " "
" rich, disseminated, from . .	155.6	to 156.6	" " "
" lean, disseminated, from . . .	156.6	to 157	" " "
" very rich, disseminated from	157	to 158	" " "
" good, disseminated, from .	158	to 159	" " "
" lean, disseminated, from	159	to 161.3	" " "
" rich, disseminated, from .	161.3	to 164	" " "
" a little ore, from . .	164.5	to 165	" " "
" very rich from . .	165	to 167	" " "
" mineral, from	167	to 175	" " "
" lean, from	179	to 182	" " "
" dieseminated, from	184	to 194	" " "
" very rich from . .	194	to 197	" " "
" some mineral, from . .	197	to 204	" " "

The limestones here lie about horizontal, and it is impossible at present to estimate the probable extent of the galena, but it is undoubtedly very great. The galena at St. Jo, as at other mines in the lower limestone, is coarsely granular, and cubes are of rare occurrence, but in small drusy cavities very nice crystals of a secondary form are often found. Iron pyrites, dolomite, and calcite abound at the Fox Mines. Calcite and dolomite are of general occurrence; barytes, if at all seen, is very rare. With regard to the origin of the galena in these mines, we would give as our theory that the limestones were first formed in deep seas. That after and during a long period of subsequent time, the galena, in a state of solution, replaced a portion of the limestone beds which had previously been softened by acids. We would not hazard the opinion that the process of replacement was recent, but rather believe it to have taken place in some remote period of time, and probably before the deposition of the galena among the more recent formations of Southeast Missouri; also, that its formation must have continued through a long period of time, for the galena did not replace the limestone in the different beds at the same time, nor is it certain that the process was in progress in different beds at the same time.

Ores in No. 3, or the Third Magnesian Limestone.—Some of the mines of St. François County, for instance the Vallé Mines, and all of those of Washington and Crawford Counties, occur in these rocks.

The ore occurs either—

1st. In caves or openings.

2d. In leads or lodes.

Cave Openings.—Although there may be a slight difference in the form or shape of the deposits, still I believe that all the galena ores of this formation, excepting the "*leads*," may come under this head, nor am I certain that the vertical leads should be separated. The limestones are often bisected by vertical cracks or fissures, crossed by others. These are sometimes narrow, but are often widened out, probably caused by breaking off and disintegration of masses of limestone. The ore and its associated minerals are limited by "runs" and "openings." The "run" is a widening of the opening, and must not be confounded with the runs of Southwest Missouri. It is limited above and below by solid limestone, which cuts it off from other runs below, sometimes only separated by a few feet, but at other times much more. These runs may therefore be considered as occupying a part of the same crevice, and shut off from each other by closing up of the walls.

At Prairie Diggings, on "Old Mines" tract, we entered a run of 7 feet wide and 55 feet depth, extending in a nearly northern direction as far as explored for several hundred feet. Other short runs or cave openings meet the main run, but generally terminate within a few feet. Others, extending further, develop into similar openings to the main run. These "runs" or "openings" are filled with masses of decomposed magnesian limestone, barytes, iron pyrites, galena, and calcite, sometimes confusedly arranged, but often in regular broken horizontal layers, the galena generally preserving a nearly horizontal position in its arrangement, and when disseminated, it is found occupying nearly the same horizontal line. The galena is sometimes inclosed by bands of pyrites, and at other times associated with a gangue of barytes, the latter apparently of more recent age.

A vertical section in the main run at one place shows—

1. Cap-rock of magnesian limestone.
2. 1 inch of barytes and galena.
3. 10 inches decomposing magnesian limestone.
4. Streak of iron pyrites.
5. 4 inches of barytes and galena.
6. Streak of iron pyrites.
7. 2-feet mass of barytes, boulders of softened limestone, galena, and streaks of iron pyrites.
8. Bed-rock of magnesian limestone.

At "New Diggings," near Potosi, the galena occurs in a similar association with barytes and pyrites.

The ore at Mineral Point occurs in a very similar manner and in irregular-shaped openings. A vertical section in a shaft displays—

1. Clay and chert.
2. Limestone.
3. Red clay, barytes, and a little galena.
4. 10 inches barytes, in nearly horizontal bands with galena.
5. 5 inches magnesian limestone.
6. Thin seam of barytes and galena.
7. Quartz in drusy cavities and mammillary forms, with some galena attached to the quartz.

The mode of occurrence of ores at New Ishmael, on Palmer tract, is very similar to the last, and to the others just above named. At Mineral Point are interesting exhibitions of replacement of galena by barytes, proven by right angular galeniferous lines traversing barytes. At the Palmer Mines are beautiful forms of calamine crystallized on galena, sometimes entirely enveloping large cubes. The galena at the Palmer Mines also shows drusy cavities, with pretty crystals of cerussite and sometimes also anglesite. The cerussite is sometimes covered by hairlike crystals of barytes. At Mammoth Mines, in Jefferson County, beautiful specimens can be obtained crystallized in the following genetic succession on magnesian limestone: 1. Quartz in minute botryoidal forms; 2. Iron pyrites; 3. Blende; 4. Barytes; 5. Calcite. The Sandy Mines occur in what is known as the second magnesian limestone, a group of rocks lying next above our sandstone, which we have spoken of in the first part of this article, but as they occur similarly to other lead deposits we have to speak of, we here insert a brief account of them. At these mines we find a nearly vertical fissure, varying from a knife-edge to 15 inches wide; the wall-rock is magnesian limestone. The fissure is filled with a gangue of barytes with galena, and has been worked with variable success for many years. The course of the main fissure varies but little from a north and south line, and has been traced for several miles. Parallel to this, and but a few hundred feet apart are two other fissures, also galeniferous. Of a similar character is the Jones Mine, owned by the Kansas City Mining and Smelting Company, 15 miles southeast from Versailles, Morgan County. At this place the vein varies in width from 4 to 18 inches, and includes a gangue of barytes in vertical sheets, crystallized at their junction, and bearing galena near its southern exposed portion. It can be traced for three-quarters of a mile north and south. The vein can be easily traced out, but only near its southern exposure is galena found. In Benton County we find a similar fissure vein, and bearing nearly the same magnetic course, which has also been traced for three-quarters of a mile. Its minerals are iron pyrites, galena, and blende. These "leads," or "fissure veins," originate in cracks in the rock, probably all owing to the same prime cause, and to the same cause as that which created the place for the "run" on Old Mines tract, and the "runs" or "leads" near Potosi, and the Virginia Mines in Franklin County.

Compiled from a paper by Prof. G. C. Broadhead, Transactions Am. Institute Mining Engineers.

THE BRAZOS COAL FIELD OF TEXAS.

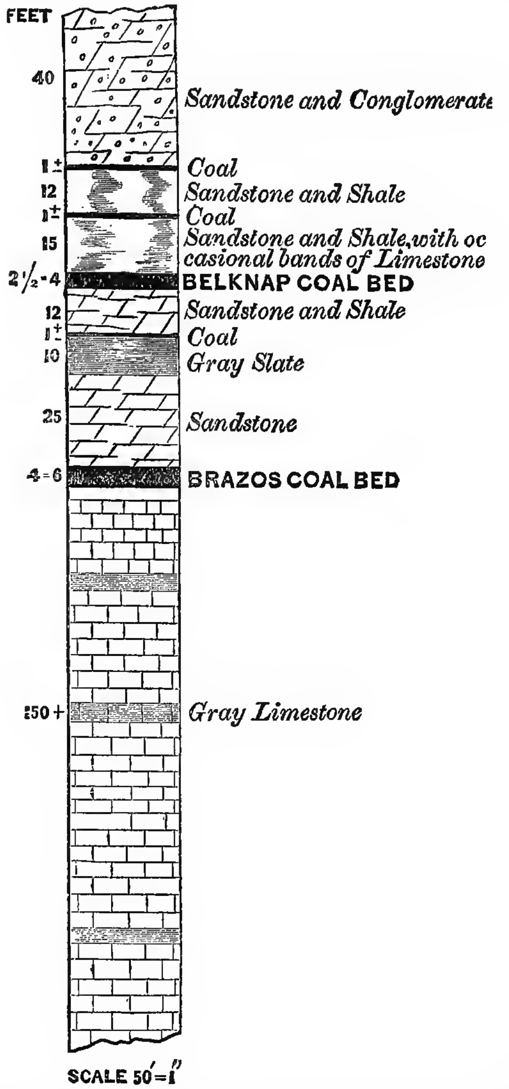
VERY little is known of the economical value of the coal beds of the State of Texas. The first authentic statement in regard to their occurrence is that contained in the reports of the United States Explorations for the Pacific Railroad, near the 32d parallel of latitude, published in 1853–55. Professor William P. Blake reports, "that a number of seams of bituminous coal, varying in thickness from two to four feet, have been opened along the Brazos river, in Young county, about one hundred and fifty miles west of Fort Worth." Dr. Shumard also states, "that the characteristic fossil forms of the Carboniferous Era have been found with this coal, and considers the age of the formation established. Fossils obtained from the carboniferous limestone remove all doubt of the age of these deposits." The demand for coal in this section of the country is great, and a fuel which in our Eastern markets might be considered of inferior quality, would here find a ready sale. It must be remembered that the market value of a coal does not depend upon its absolute purity, but upon its actual value in heat units which it is capable of producing. A poor coal which can be cheaply mined near the consumer, is infinitely more remunerative to a mining company than a superior coal, whose cost to the consumer is greatly increased by high mining charges and railroad freights. The value of the Texan coals does not depend upon their purity but upon their low first cost and nearness to a market.

A glance at a geological map of the United States, will show that the Brazos coal field is the extreme southwestern extension of what may be called the Missourian, Fourth, or Western bituminous coal basin. This basin spreads over the southwestern part of Iowa, Western Missouri, and Eastern Kansas, eastern part of the Indian Territory, Western and Central Arkansas, and ends in Northern Texas. Professor C. H. Hitchcock, in the report of the ninth census, estimates the area of the basin, which is the largest in the United States, as 84,000 square miles. The area embraced within the State of Texas, according to A. R. Roessler, is 6,000 square miles. Professor B. F. Shumard estimates the thickness of the measures at 300 feet.*

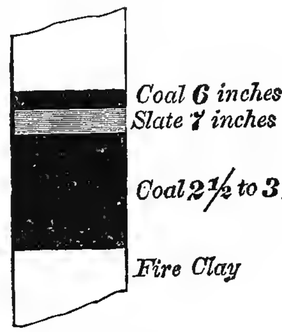
The official geological reports of the several States all claim that the Missourian coal field is continuous from Iowa to Texas. My knowledge of the main features of the field is too general to add much corroborative testimony. From the dissimilarity of the coal at McAllister, in Indian Territory to that found in the vicinity of Fort Belknap, Texas, many of the local geologists deny the statement that the basins in the Territory and State are connected. The principal ground upon which the objection is made, is that along the Red River carboniferous strata are not found, and that the coals in the two localities are entirely different. When it is remembered that the Red River rocks belong to a newer and overlying formation to the coal measures, there seems to be but little doubt that the coal strata must pass considerably below the bed of the Red River and connect the otherwise severed fields. The mere fact that the Texan coals, so far as at present known, are so very much inferior to the coal which is being mined at McAllister amounts to nothing. I have examined the coal bed in the mine at McAllister, and the coal bed in the drifts at Fort Belknap, over two hundred and five miles distant, and have found less difference than exists in Pennsylvania between beds of the coal-measures in localities only a few miles apart. We know nothing yet as to the relative position in the measures of the Belknap and McAllister beds, so that their great difference in quality cannot establish the fact of a break between the two basins. The area in which my examinations were principally made, lies in the northern part of Stephens county, along the Clear Fork of the Brazos river, and in the southern part of Young county. There are but two beds which may possibly prove to be commercial. The upper bed I have called the

* This is very much in excess of the thickness which I determined between Crystal Falls, Port Belknap, and Graham. Professor Shumard does not state the exact position in the basin at which his measurement was made.

Belknap bed, because it has been opened for a great many years in the vicinity of old Fort Belknap, and the lower bed the *Brazos*, since as yet it has only been found in the tributary waters of the Brazos River. Besides these two beds there are a number of associated coal seams, which have never been found of a workable thickness. The vertical interval containing the coal beds is less than 100 feet in thickness, and lies between a sandstone and conglomerate, and a hard gray limestone. A general section of the strata, compiled from measurements made in the vicinity of Crystal Falls, Stephens county, and Fort Belknap, Young county, is as follows:

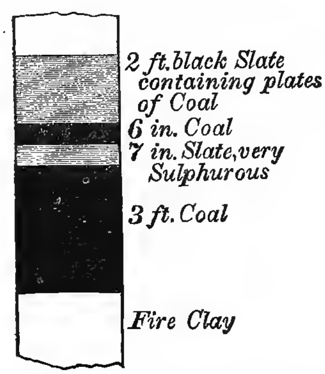


The sandstone and conglomerate at the top of the section immediately underlies most of the prairie flat between Crystal Falls and Fort Belknap. The sandstone is a comparatively soft, friable, and ferruginous stone. The conglomerate beds have no marked persistency; the rock itself bears no resemblance to the carboniferous conglomerate so familiar to geologists in the Eastern States. It is quite soft, very ferruginous, and the pebbles are small, often quite irregular in shape, and are generally formed from sandstone, which at times is very calcareous. Below this sandstone and conglomerate is a group of strata, 85 feet thick, composed of sandstones, shales, slates, fire-clays, and coal-beds, and below these coal-measures occurs a hard, gray limestone, the total thickness of which is unknown. I have measured 150 feet in the valley of the Brazos river. This succession of the strata is not unlike that to be found in many localities where the carboniferous rocks are found in the Middle States. It seems to point clearly to the conclusion that the top sandstone and conglomerate is the representative of the carboniferous conglomerate or Millstone Grit, that the limestone is the subcarboniferous or Mountain limestone, known generally throughout the Mississippi Valley as the St. Louis or Chester limestone, and that the included coal-measures are really subconglomerate.* The upper, or Belknap coal-bed, has been most extensively prospected. It covers a large extent of territory, especially in Stephens and Young counties, as is proved further on. The bed usually consists of two benches, or layers of coal, as shown in the section.



The upper bench of coal is usually about 6 inches thick, while the lower varies from 2½ to 3 feet thick. The two benches are separated by 7 inches, more or less, of black slate or clay, containing a great deal of sulphur in the form of iron pyrites or sulphide of iron. The coal itself is poor, bony, and extremely sulphurous. The bed is always overlaid by a very ferruginous sandstone or conglomerate. From the unvarying character of this rock it seems quite probable that the territory underlaid by the coal-bed is coextensive with the area underlaid by the sandstone, the latter being easily recognized wherever it occurs. The bed was found to outcrop in the following localities:

1. The Belknap coal-bed may be seen about three-quarters of a mile southwest of Crystal Falls, at an elevation of 1115 feet, the barometric elevation of Widow Nash's house in Crystal Falls being assumed at 1100 feet above ocean level.† At this point the following section is exposed:



Where this coal is seen there is only from 5 to 15 feet of cover. When a coal-bed contains a large amount of sulphur, and occurs under so little cover as at this point, little

* In many places in Northwestern Pennsylvania and West Virginia sections have been constructed which compare in many respects with the Brazos section. In the former locality no Mountain limestone has been found, but coal occurs under the base of the Pottsville or carboniferous conglomerate No. XII; in the Virginias the same section exists, and in addition the Mountain (locally called Lewisburg) limestone is boldly developed.

† The elevations given in this paper were determined by a Hicks's aneroid barometer. No opportunity was afforded of determining the elevation of Crystal Falls instrumentally.

can be judged of what its actual condition and character would be when drifted on under good solid cover, which would prevent the infiltration of surface-water. About 300 feet south of this point the Belknap bed outcrops again at about the same elevation. At this latter out-crop a fire-clay bed is observed immediately under the coal. This is an invariable accompaniment of our bituminous coal-beds, and doubtless will always be found under the Belknap bed.

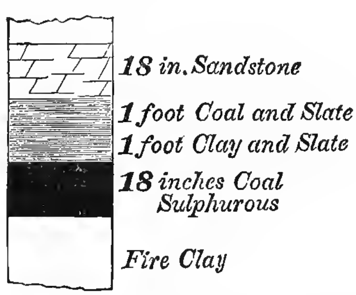
On account of the imperfect character of the diggings the fire-clay is not always observed where the coal-bed is seen to outcrop. Below the fire-clay at this last locality occurs a hard, iron sandstone, which is immediately underlaid by an outcrop, indicating a coal-bed about 1 foot thick. This bed is about 12 feet below the bottom of the Belknap bed. A number of small coal-beds, such as this last, are seen in a number of localities either above or below the Belknap bed. I do not think they will ever prove workable.

2. The next place where the Belknap bed was visited was at the O'Neill opening, about 600 feet southeast of the first outcrop mentioned. The character and thickness of the bed is the same as at the former outcrop; the elevation of the opening is 1100 feet. The coal bed has been drifted on for 200 feet, more or less, and proves no better under 15 or 20 feet of sandstone cover than on the outcrop. The bed is overlaid by a hard ferruginous sandstone. Three hundred feet northeast of the mouth of the drift there is 40 feet of cover to the coal-bed, and a quarter of a mile north of the opening the prairie flat is 1185 feet high, showing 80 feet of cover to the bed.

3. The same bed outcrops on the Walker tract to the south of Samuel Sloan's house, and about three-quarters of a mile, a little north of east of the O'Neill opening. The elevation of the bed at this point is 1105 feet, and 35 feet above the level of the Clear Fork, which flows at the foot of the hill immediately below the outcrop.

4. I found another outcrop of the same bed in the bank of the creek, about 450 feet southeast of the last mentioned. The elevation of this outcrop is 1110 feet. This last locality is about half a mile north of Crystal Falls.

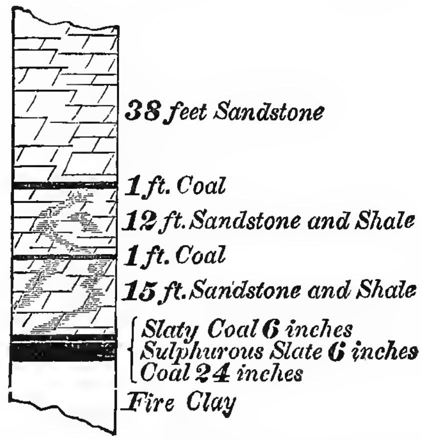
5. The next outcrop visited was found on the east bank of the Clear Fork, about a quarter of a mile north of the above outcrop, and in the northwestern corner of the J. T. Pinkney tract. This is known as the Ballard opening. The following section is exposed:



The coal is rather hard and bright, but has the unvariable character of the Belknap bed in being very slaty and very sulphurous. The elevation of the coal at this opening is 1080 feet, and about ten feet above the Clear Fork.

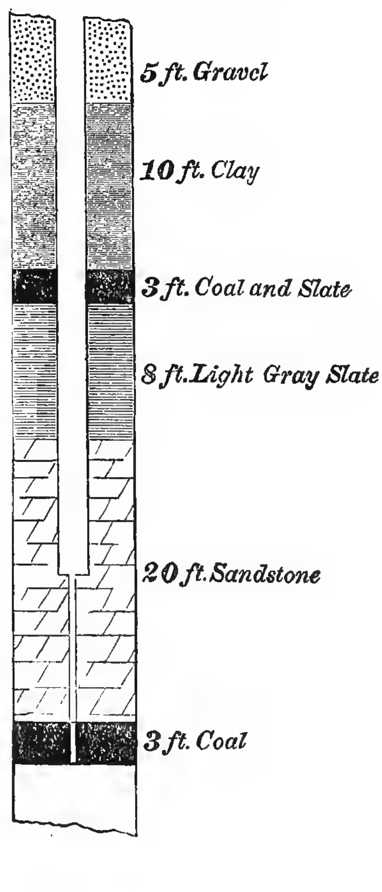
6. On Coal Creek, in the southeastern corner of section 3 of the railroad lands, the Belknap bed is exposed, showing from 2½ to 3 feet of coal. The bed is here immediately overlaid by 18 inches of highly sulphurous black slate, above which occurs 15 feet of hard, shaly iron sandstone. The same bed has been found at several other points along the creek.

7. The Belknap bed outcrops around the base of Coal Mountain, seven miles southwest of Crystal Falls, and between Hubbard and Gonzales creeks. The elevation of the coal is 1135 feet, and of the top of the mountain 1200 feet. The following section is observed:



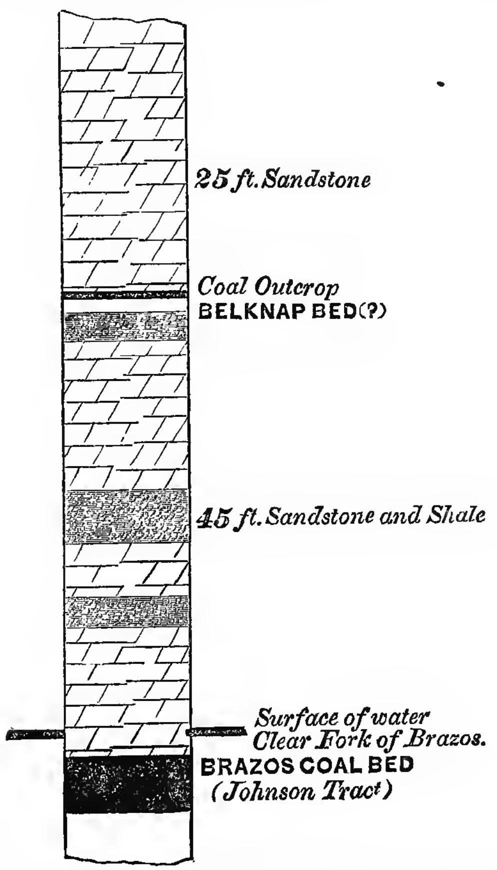
The coal has been hauled from the mountain to Breckenridge for blacksmith use. It is very sulphurous and very slaty. At the junction of Sandy and Hubbard creeks, northwest of Coal Mountain, and at an elevation of 1105 feet, a coal has been worked in the bed of the creek below water level. The coal from this bed has been mined and used by the blacksmiths; it is said to be purer and to burn much better than the coal from the Belknap bed. The bed was under water when I visited it, so that I could not see the coal. This bed occurs at a lower level than that at the foot of Coal Mountain. I should judge it to be a lower coal and very probably the representative of the Brazos coal-bed. Its thickness is very uncertain; it was variously reported to me to be from 1 to 6 feet thick.

8. On Mr. P. F. Pascall's farm, two and a half miles southwest of Crystal Falls, a well has recently been dug, and I was fortunate enough to obtain a record from the well-digger. The well was dug 39 feet deep, and a drill-hole ten feet deep was sunk below the bottom of the well. The following is a section of the well:

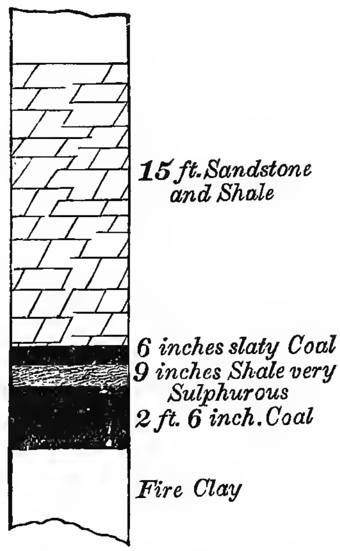


The elevation at the top of the well is about 1125 feet. The elevation of the first coal is 1107 feet, and of the second coal 1079 feet. I believe the lower coal-bed which was pierced by the drill is the Brazos coal-bed. The upper coal, which is found associated with black slate, is very possibly the thin coal which is shown in the general section underneath the Belknap coal-bed. I am inclined to put this construction upon the well record from an examination of the rock exposures and topography in the immediate vicinity of the Pascall farm.

The most important outcrop visited in Stephens County was that of the Brazos coal-seam in the bed of the Clear Fork of the Brazos River in the eastern part of the Johnson tract, four and a half miles northwest of Crystal Falls. The coal lies 3 to 4 feet under the surface of the water in the bed of the creek, and is variously reported to be from 5 to 7 feet thick. The coal has been worked by prying large cubical blocks apart by a long crowbar and raising the blocks on to rafts by divers or tongs. The elevation of the top of the coal is 1075 feet. Forty-five feet above the top of the coal in the creek, which I have named the Brazos bed, and on the south side of the stream, is seen an imperfect outcrop of a coal which is probably the representative of the Belknap bed. The following is the section:



A hard massive gray limestone is found in the bed of the Clear Fork at Crystal Falls; in fact, it is the limestone which forms the natural fall of 4 feet 10 inches which has given a name to the place. This limestone underlies the Brazos coal-bed and is probably the base of the coal measures. The top of the limestone is only exposed in the northern part of Stephens County. By glancing over the elevations of the Belknap bed in the vicinity of Crystal Falls we see that the bed is nearly horizontal. The lowest point where it was found was at the Ballard opening on the Pinkney tract. The Brazos coal-bed if it has an extended area should be found at Crystal Falls above the level of the creek, as the limestone in the creek occurs below the coal. The area under which we might expect to find the Belknap and Brazos coals is very great. I found the limestone which occurs under the latter coal but a short distance west of Weatherford. The top of the limestone is not reached until we approach the Brazos River in Northern Palo Pinto County. Here the sandstone which is found over the Belknap coal-bed shows itself in the tops of the hills from 100 to 200 feet above the bottom of the valleys. If the coal-beds should be found on these hills the area would be too limited to make a development profitable. In Eastern Stephens County the sandstone is found more universally underlying the surface. Going south from Crystal Falls to Breckenridge the topography resembles very much that in the eastern part of the county. The limestone for the most part is below the surface, and the topographical features are formed by the sandstone. From Crystal Falls to Belknap, I found the sandstone generally beneath the surface until we descended into the valley of the Brazos River, about three miles southwest of Fort Belknap. There is no evidence against the existence of both the Belknap and Brazos coal-beds under most of the plateau between Crystal Falls and Belknap. The Belknap coal has been opened on several places on Whiskey Run, one and a half miles northwest of the settlement. About half a mile from the mouth of the run the following section is exposed:



The bottom of the coal-bed is 45 feet vertically below the town and 50 feet above the bottom of the Brazos River. An indication of a coal-bed 8 or 9 feet above the Belknap bed is seen on Whiskey Run. It is possibly the same coal that was found above the Belknap bed in the vicinity of Crystal Falls. A coal-bed has been opened at one time on the Brazos River near the mouth of Whiskey Run and 30 to 35 feet vertically below the Belknap bed. I did not see this bed exposed. It was reported to be two to three feet thick and of better quality than the upper bed. I was informed by the blacksmith at Fort Belknap that he had picked blocks of coal out of the bed of the river which had come from this lower coal-bed, which may prove to be the Brazos. The elevation of the Belknap bed at Fort Belknap is about the same as it is at Crystal Falls, so that the coal-strata lie very nearly horizontal between the two places. The Belknap bed is opened two and a half miles from the mouth of a small stream which empties into Salt Creek nine miles north of Graham. The coal is 2½ feet in thickness and has all the characteristics of the Belknap bed. Most of the territory lying between Belknap and Graham, and Graham and Crystal Falls, is underlaid by the Belknap and Brazos coal-beds. Whether they will ever prove to be workable commercial coal-beds in all this territory can only be determined by actual tests and openings made on the beds. The Brazos coal-field extends south to the Colorado River. There are many conflicting reports as to its boundaries. I gathered no facts outside of the immediate territory examined, so that I am not prepared to express an opinion as to its definite limits. Coal has been reported to have been found in El Paso and Presidio counties along the Rio Grande, but nothing has been authentically stated as to the extent of the areas or the value of the beds. Tertiary lignites, or lignitic coals, are said to exist in the following counties: Rush, Harrison, Cass, Grayson, Bastrop, Fayette, Caldwell, and Guadalupe.

Résumé.—The Brazos coal-field is the southwestern limit of the Missourian or Fourth bituminous coal basin of the United States. The coal-measures of Stephens and Young counties belong to the Carboniferous Age. The coal-strata proper are 85 feet thick, and are included between an upper sandstone and conglomerate, representative of the Millstone Grit or Pottsville conglomerate, No. XII of the Pennsylvania series, and a lower gray limestone representative of the Mountain limestone or Chester and St. Louis limestone of the Mississippi Valley. The coal-strata contain two coal-beds of workable thickness. The upper bed, namedBelknap, ranges from 2½ to 4 feet, and the lower, named Brazos, from 4 to 6 feet. The coals are high in ash and sulphur, but have never been thoroughly tested. The Brazos bed underlies a great area, and will no doubt prove to be a valuable commercial coal in some localities.

—*Compiled from a paper by Charles A. Ashburner, Transactions American Institute of Mining Engineers.*

ALABAMA COAL AND IRON.

A REFERENCE to the geological map of Alabama shows the coal measures of that State to form three distinct fields. The Coosa, or most easterly, contains about one hundred square miles; the Cahaba, or middle field, which is also the most southern true coal in the United States, contains about 230 square miles; and the Warrior field, which contains in the State of Alabama some 5000 square miles, is the southern extremity of the great carboniferous deposit, which extends through Pennsylvania, West Virginia, Kentucky, Tennessee, and Georgia. But very little has yet been done towards developing those coal fields, partly owing to the absence of all commercial manufacturing enterprise in the South under slavery, and partly owing to the want of capital and disturbed condition of the South since the war. During the past three or four years I have devoted a large part of my time to the examination of the coal and iron ores of this range, and particularly to the coal in the Warrior and Cahaba fields, and the iron ores which are found in such abundance in their vicinity. My surveys and examinations have been directed especially to the Cahaba field, which, from its geographical position as the most southern coal in the State, and the most accessible by water communication, counting the Alabama River as the only available stream at present, and on account of its presenting the greatest variety and, I believe, the best quality of coal feasibly accessible, will, undoubtedly, be the centre of a large industry, and must, in the near future, become one of the principal coal-producing districts of America. Under the stimulus of State aid a number of railroads have been built in Alabama within the last six years, and the prospectuses and reports of these have invariably counted on a large part of their profits coming from carrying coal and iron; but strangely enough, none of the roads built where alone they would make the development of the coal-fields possible; so we have to-day the somewhat peculiar phenomenon of a market at the iron ore deposits, in the cities of the South, and in the Gulf and export trades, calling for an amount of coal the carriage of which would in itself make a railroad profitable; a coal-field in which we know there exists an abundance of coal of excellent quality in large veins; and on each side of the field, railroads which have become bankrupt, because, through some strange design, they have avoided the very source from which not only their own prosperity, but also that of the entire State must come. Most of these roads appear to have been designed rather with the view of obtaining the State grants than of developing the greal natural resources of this favored country, for they have avoided where possible, crossing the coal-fields, or encouraging, till recently, by modern freight charges the establishment of mining industries. Under these circumstances, and in the absence of anything deserving the name of a geological survey of the State, we can scarcely be surprised at the almost complete ignorance that prevails concerning the quality of the Alabama coals, and the number, thickness and position of the coal-beds. No developments of any value have been made in the Coosa field, beyond proving the fact of the existence of several workable beds of coal, which were exploited some years ago for the supply of the blacksmiths in the vicinity. The Coosa River could be made navigable only by a large expenditure of money, building locks and dams, and the coal-basin is not crossed by any railroad. The Selma, Rome and Dalton Railroad passes near the southern edge of this field, and the South and North Alabama road follows up the limestone valley, which lies between this and the Cahaba field.

At the base of the coal-measures in Alabama, as in other portions of this country, we find a series of hard, coarse-grained, and heavy-bedded sandstones. They do not however, resemble the conglomerate we find at the base of our anthracite coal-measures, nor are they even as coarse as the sandstones which lie below the West Virginia coals on the Sewall Mountains and the New River, but they have the same effect on the topography of the country; for, being much harder than the rocks immediately containing the coal-beds, they form a well-defined ridge, running in an almost straight northeast and southwest line, as the western limit of the Cahaba field. The dip of these rocks does not usually exceed twelve degrees, and is frequently less than ten. Crossing the field in the direction of the dip (*i. e.*, southeast),and limiting our remarks to the southern portion of the field, where the measures are regular and the width of the greatest field (about twelve miles), we note that the inclination of the measures increases from six to ten degrees on the western limit to twelve or fifteen degrees on the Cahaba River, in the vicinity of the Lilly Shoals, and from that to the eastern limit of the field, the dip increases much more rapidly, though still with tolerable regularity, till along the eastern edge of the field the rocks are dipping from forty-five to seventy-five degrees, or even vertical in a few places, the dip being constantly in the southeasterly direction. The Cahaba coal-field is limited on its southern and eastern sides by a fault which cuts off the coal-measures, and brings to the surface, on a level with the highest coal-beds of the field, silurian rocks, which belong fully 7000 to 8000 feet below them. The vertical displacement of this enormous throw, or fault, must therefore be but little less than 10,000 feet, or nearly two miles. I know of no other such fault in any part of the world. The Silurian rocks, which have also a steep southeast dip, are for the most part limestones, metamorphosed by the action of the agents which caused this great rupture of the earth's crust, and cherts, which evidently have replaced limestones, and are, in many places, pseudomorphs of calc spar, and contain occasionally characteristic silurian fossils, orthoceratites, etc. In hardness, these rocks do not vary greatly from the softer sandstones, and coarse and loose pebbly conglomerates which here constitute the higher coal-measures, and we do not, therefore, find any very marked ridge along the southern and eastern sides of the field as we do on the west, and as we would find were this field really a true trough-shaped basin, instead of being a monoclinal basin as it is. This very remarkable feature exerts a notable influence on the economic value of the field. In the first place we have here a very much greater thickness of measures than exists anywhere along the eastern side, and probably in any part of the great Warrior field, which is a true trough-shaped basin, with a very moderate inclination of the measures. The greater inclination of the Cahaba beds causes them to outcrop within a limited area, and as we have here a greater total thickness of measures, so have we a greater number of coal-beds, and, consequently, a greater variety of coals than, I believe, exists in any part of the Warrior or Coosa fields. It is true, however, that there is more coal which can be worked *above water level* in the Warrior field than in the Cahaba, though, since in either case the hills rarely rise more than 150 to 200 feet above the levels of the creeks, no very large amount of coal will be obtained level free. From the topographical features of the county, a railroad crossing the southern portion of the Cahaba field would be graded at a considerable elevation above the streams, the coal would have to be raised either in shafts or on planes to the level of the railroads; there would, therefore, be the less inducement for opening mines on the lowest water level, except, of course, drainage levels. The small inclination of the beds would make it necessary to open all the lower beds by means of vertical shafts, which would be located with reference to shipping facilities on the railways. The surface of field is very broken, valleys being cut in every direction, it is therefore an exceedingly difficult country in which to select the most desirable route for a road; not that there are insurmountable, or even very great obstacles to the construction of a road with moderate grades and good alignment across the southern portion of the field, but, because the road should be built with the special object of developing the coal mining interests, and should run irrespective of minor difficulties, in that portion of the field where the largest beds and the best qualities of coal are accessible at moderate depths, and where the regularity of the measures gives promise of freedom from those faults and disturbances which are so serious a drawback and source of expense in practical mining operations. These are considerations which appear to have been overlooked in the location of all the Alabama railroads. The surface of these coal-fields is nearly everywhere covered by a virgin forest of yellow pine, oak, chestnut, and other valuable timber. The soil is light, and not suitable for agricultural purposes, except in the river and creek bottoms, which are of very limited area. The climate is exceedingly healthy, except in the bottoms, where, at certain seasons of the year, ague is prevalent.

Number and Thickness of the Coal-beds.—The coal-measures of the Alabama fields consist of a series of sandstones, conglomerates, and shales, among which we find some ten or twelve veins of workable thickness, *i. e.*, from two feet (average thickness of clean coal) upwards, besides a number of smaller beds, several of which are from 15 to 18 inches in thickness. These ten or twelve workable beds are distributed in two series or groups, as we find in all our coal-fields, notably in West Virginia, Ohio, and Pennsylvania. The lower group contains seven or eight workable beds, varying in average thickness from 3′ 0″ to 7′ 0″ of clean coal, and making an aggregate thickness of workable coal in the beds thus far proved of from 30 to 35 feet, while the upper, or Montevallo, series, which occupies but a very small area along the eastern side of the field, contains some three or four workable beds, giving an aggregate thickness of about 12 feet, making the total thickness of coal in the field, in beds of workable size, at from 40 to 50 feet. The enormous thickness of measures which exists between the lower beds of the lower series and the beds in the Montevallo, or upper, group, renders the lower coals so deep as to be forever inaccessible where we have the upper beds, hence the *maximum available thickness* of coal as yet proved in any portion of the field will not exceed 30 to 35 feet; while, if we take the area of the Cahaba field at 230 square miles, the average thickness of workable coal over the entire field would probably scarcely attain 15 feet; for in a great part of the field along the western side, where the measures are nearly horizontal (5°—10°) there are but two workable beds. This estimate, so much lower than we have been accustomed to see stated in reports and newspaper articles, is probably not very different from the thickness which the same method of estimating would give for any of our other bituminous coal-fields. Without describing in detail the peculiarities of the different veins, which would be out of place in a general paper of this kind, though of very great importance in determining on the establishment of mines, I may say that the veins of the Cahaba coal-field are generally free from shale partings, that is, they form generally a single bench of coal, and in that respect will be found better adapted for clean mining than most of the beds of the Warrior field, where some of the larger veins have got a number of shale bands running through them. The thickness of the largest bed as yet proved in the Cahaba field is about 9′ 0″, but where examined, two feet of these nine formed a shale band, leaving the coal in two divisions of about 5′ 6″ and 1′ 6″; where, unfortunately, the thick bench comes on the top, the probability, therefore, is that the lower bench will be abandoned. Another vein worked to some extent during the war is represented to have a thickness of 7′ 0″ of clean coal. The good quality of the coal from this place is quite evident, for there still remain at the pit-head several hundred tons of it in large lumps, which have resisted very successfully the action of the atmosphere for some eight years now, having been all that time exposed to the sun and rain of a warm climate; and it is still so serviceable a fuel that many of the farmers send for miles to get it for their winter supply. The sections, one across the southern or widest portion of the field, the other across the basin, on the line of the South and North Alabama Railroad, will give the general features of this field, and show the remarkable fault which limits the coal-field on the south and east. The South and North Alabama Railroad section shows also one of those peculiar contortions in the rocks which we frequently find in the coal-fields; it is very well defined at this point, and has the effect of greatly interfering with mining operations, for such complications are the results of a crushing of the measures which makes the coal faulty and not unfrequently sulphury, even at some distance from the anticlinal and synclinal axes. In general, we may remark that wherever the disturbance of the measures is so great as to leave the beds standing at a high angle, say 60° to 80°, or vertical, we almost invariably find the veins are subject to great irregularity, both in the thickness and hardness of the coal; they are, in short, "faulty," and this is as true in the anthracite as in the bituminous fields. The rolls which we find in the narrow compressed part of the field where the South and North Alabama Railroad crosses, disappear, or at least, so diminish in importance in the southern portion of the field that they cannot be designated as anticlinals, for they do not divide the field into separate basins. On the "Four Mile Creek" section, to which I refer, these rolls barely change the degree of dip over a very limited distance from, say, twenty degrees to horizontal or nearly so. Undoubtedly they will exert an influence on mining operations, even though they are not of such magnitude as to divide the field into different troughs or synclinal basins. Their position in the field, especially in that portion of it where the most desirable coals are accessible, has received much attention in my examination, but to name these points without reference to elaborate maps would be of little interest.

The following are the workable beds proved on or near the line of the South and North Alabama Railroad. I place them in their order of superposition, commencing with the highest, the thickness being the average of clean coal where examined:

No. 9. Thickness,	4′ 0″	No. 4. Thickness,	3′ 6″
" 8. "	3′ 6″	" 3. "	3′ 3″
" 7. "	2′ 0″	" 2. "	4′ 0″
" 6. "	2′ 0″	" 1. "	3′ 6″
" 5. "	2′ 6″	Aggregate thickness,	28′ 3″

It is true that at this point the measures are compressed and these veins may become thicker as we get some distance away from the line of greatest disturbance, as we find in the southern portion of the field where the beds are much larger, being but little disturbed. The developments thus far made are not sufficient to enable us to identify the beds in different parts of the field, but I give an approximate section of the measures in the "Four Mile Creek," as follows:

Four veins Montevallo group, aggregate	12′ 0″	IV. Vein,	8′ 6′
VIII. Vein,	3′ 6″	III. "	3′ 6″
VII. "	7′ 0″	II. "	4′ 0″
VI. "	4′ 0″	I. "	4′ 0″
V. "	3′ 6″	Total,	50′ 0″

There are, probably, other workable beds not yet known. We can assume the thickness of coal in the southern portion of the field at 35′ 0″ to 40′ 0″ in the lower group, and about twelve feet in the upper group. The great fault which limits this coal-field on the east has left none of the upper groups of coals, and, probably, not even the two highest veins of the lower group, on the line of the South and North Alabama Railroad. While our data are not sufficient to identify the several beds in different parts of the field, yet the dimensions of the veins I have above given are from openings made mostly during the war, when the needs of the Confederate Government caused it to make extensive surveys and examinations of the field (the notes of these were, unfortunately, destroyed during the latter part of the war), and to open mines in a number of places. The fact is therefore fully proven that Alabama possesses an abundant supply of coal in easily accessible beds of good workable thickness. I have made careful examinations of the quality of the coal of all the workable beds from which it was possible to obtain satisfactory samples for analyses. I was unable in most cases to procure such large amounts of the coals as would have been desirable; for the only manner in which to obtain samples whose analysis will give the average quality of a bed is by taking a large number of freshly mined average specimens from the different divisions of the vein and crushing and mixing them previous to taking the samples for analysis. In some cases it was impossible to do this, so that, though care was taken to get what appeared average pieces, it is possible the run of the bed would not equal the analysis I have given. As a means of comparison with coals from other fields, the results will probably be satisfactory, for in most cases samples for analysis are taken in the same manner as were these, and the published results consequently indicate almost invari- culm-banks, exposed to the rain, and under conditions the most favorable for decomposition, being mixed with shales containing a large amount of iron pyrites, which in decomposing generate a very high temperature in the whole mass, is yet found to burn well, almost as well as that freshly mined, while large lump coal has been used in our blast-furnaces after an exposure of twelve years, and no perceptible difference in its quality could be noticed. It is, nevertheless, quite certain that most varieties of bituminous coal deteriorate very rapidly, and to an extent but little appreciated. These important results should be born in mind not only in providing for the storage of coal, but also in selecting samples for analysis. The following table gives the composition from some seven different beds. For obvious reasons the numbers of the samples do not indicate the number of the bed as given in the previous table, and while generally in ascending order, they do not commence with the lowest bed of the field. These analyses, made with much care, will be found of value and interest, and though only a part of those I have made, they may be taken as representing fairly the quality of the Cahaba coals.

Cahaba Coals.

	NUMBER OF SAMPLES.										Mean of ten analyses of Cahaba coals. from 8 veins.	Mean of 14 analyses of Indiana coals. Cox.	Mean of 6 analyses of Ohio coal Newberry
	1	2	3	4	5	6	7	8	9	10			
Specific gravity	1.22	1.29	1.29	1.38	1 29	1.28	1.12	1.28	1.25	1.35	1.26	1.24	1.266
Moisture	1 66	1.58	1.91	1.93	2.05	2.13	2.54	1.78	2.14	2.13	1.98	5.2	4.54
Vol. combustible matter	33.28	32.60	32.65	32.84	33.47	30.86	29.44	30.60	31.92	27.03	31.47	34.8	34.61
Fixed carbon	63.04	62.62	63.91	59.64	62.20	64.54	66.81	66.58	63.68	66.22	63.92	57.6	58.68
Ash	2.02	3.20	1.53	5.59	2.28	2.47	1.21	1.09	2.26	4.62	2.63	2.6	2.17
Sulphur											1.06		.87
Total	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.			
Sulphur as sulphate	.097	.223	.071	1.001	.118	.320	.073	.085		.114			
Sulphur as sulphuret of Iron	.428	.727	.550	2.779	.523	1.160	.455	.479		.388			
Sulphur in coke			Not determined.				.214	.223					

For comparison—Sulphur in Connellsville coke, Pa., .55 to .70.

ably a quality of coal superior to the average production of the mines. It is also essential that the coal be freshly mined, for experiments have been made that show the deterioration which coal undergoes by even a very limited exposure to the atmosphere is quite considerable. For example:

According to Dr. Richter, the *weather waste* of a coal depends on its ability to absorb oxygen, converting the hydrocarbons into water and carbonic acid. Grundman found that coal exposed for nine months to the atmosphere lost 50 per cent. of its value as a fuel. He states that the decomposition takes place in the middle of a heap the same as on the surface, and it reached its maximum about the *third* or *fourth* week; and one-half the oxygen was absorbed during the first fourteen days. He also found that a coal poor in oxygen absorbs it most rapidly, and that the presence of moisture is an important condition. Coal which made, when freshly mined, a good compact coke, after eleven days' exposure either would not coke at all or it made an inferior coke. For gas purposes the coal is also greatly injured by the loss of its volatile hydrocarbons. Varrentrapp, of Brunswick, found in his experiments that oxidation of the coal takes place even at common temperature, where moisture is present. Coal exposed to a temperature of 284° Fahr. for three months lost all its hydrocarbons, a fact which shows that the conversion of bituminous into anthracite was not necessarily accompanied by a high temperature. "He found also that the weather waste in some cases amounted to 33 per cent., and in one instance the gas-yielding quality decreased 45 per cent., and the heating power 47 per cent., while the same coal under cover lost in the same time but 24 per cent. for gas purposes, and 12 per cent for fuel." The harder varieties of bituminous coal, such for example as the cannel and splint coals of West Virginia, Ohio, and Indiana, do not appear to lose much by exposure to the atmosphere, except it be in heaps of slack where the conditions are favorable to the generation of a high temperature. Anthracite appears to be still less affected by exposure, for the fine coal which has lain for the past twenty years in our

The above table shows that the Cahaba coals are of remarkably fine quality, being chiefly distinguished for their dryness, small amount of ash, and large amount of fixed carbon. We note particularly (as a subject worthy of further attention, and on which I desire to have the experience of other members) the regular increase, with but little exception, of the amount of moisture in the coal as we go from the lower to the higher veins; it would appear that, possibly, with a sufficient number of analyses of freshly mined coal, we might be able to determine the relative height in the series of the several veins of any given field by this test alone. I believe it has been asserted that the quantity of oxygen in the coals of a given basin varies directly with the geological height of the vein. Unfortunately I was not enabled to apply this test, but it is a matter of great interest if by careful analyses we can determine the relative ages of coal-beds of the same field, and possibly even of different fields. Some of the above coals make an excellent coke suitable for blast-furnace use, and as some of them are dry-burning coals that do not coke, they would probably work raw in the furnace. Judging from the analysis alone, we would be inclined to consider all of the Cahabas as drier-burning coals than those of Indiana or Ohio, while in reality the opposite is the case. The block coals of Ohio and Indiana, so largely used raw in the furnaces of the Mahoning Valley, do not coke in burning, while the Cahaba coals do, though the former contain about 3 per cent. more of volatile combustible matter, and nearly 6 per cent. less fixed carbon than the latter. It is noticeable that these Indiana and Ohio coals, ranked among the best furnace fuels we have in this country, contain on an average $2\frac{1}{2}$ to 3 per cent. more moisture than the Alabama coals; in fact, the analysis would indicate that the Cahaba coal is a better fuel, and altogether an exceptionally pure coal. It has been fully proved as a steam generator and is highly esteemed, and the coke from several of the veins was used very successfully in the smelting of iron for the cannon foundry of the Confederate States, at Selma, during the war. It may be found that it will be desirable in the case of a few of the good coking seams to crush and wash the coal before coking, and this will be more necessary in the Warrior field than in the Cahaba, the veins proved in the former containing more soft shale partings which, in the mining will break up and cannot be separated from the coal. The coals of the Warrior field appear also to be softer and more friable in general, than those mined on the Cahaba. The property which makes one coal coke or melt in burning, and another burn without change of form, is not to be determined by their composition alone, for we find coals almost identical in chemical composition, as are these Cahaba coals, and yet one cokes well, making a hard, compact, silvery coke, and another burns without change of form. It appears to me probable, that in non-coking coals the carbon is in thin layers, which are separated by exceedingly thin leaves of a carbon which has partially lost its volatile constituents. We not unfrequently find in the partings between successive layers of both bituminous and anthracite coal, layers of charcoal, mineral charcoal, if we may so call it. And again, we know that on heating a piece of the hardest anthracite with the most perfect conchoidal fracture, we can readily distinguish under the microscope the original bedding planes of the coal, and can usually even divide the piece into leaves. Now, where these leaves are separated by thin layers of what we may call oxidized coal—that is, coal which, from exposure, or other cause when being deposited, has lost a portion of its volatile constituents, bringing it to the condition of this mineral charcoal, it is probable the coal would not melt or coke in burning even where the amount of coal in the partings is so small that it would not change noticeably the composition of the entire vein, while where the bed was deposited in a continuous manner or without these partings of non-coking carbon we would have a coking coal. The Cahaba coals contain a small amount of sulphur principally in the form of sulphuret of iron. I have determined separately the amount contained as sulphate of lime, alumina, etc., since in that condition it is not supposed to exercise the injurious influence in the blast-furnace which it does when occurring as sulphuret of iron. The quantity of sulphur contained in these coals varies considerably, but the best veins are sufficiently free from it to be suitable for use raw in the blast-furnace, where the nature of the coal in other respects will allow of this. In all cases they are so free from sulphur as to produce coke of great purity.

The cost of mining in the Cahaba and Warrior fields will vary for the different veins, according to their thickness, the amount of shales interbedded in the coal, the nature of the roof of the vein, the locations of the veins, and other conditions of a practical nature, which will require careful consideration for each special case. For a large output the cost should not exceed $1.75 per ton in the railroad wagons. including in this, interest and wear and tear of improvements, but not royalties, for where the land can be bought at from $3 to $10 per acre, it is not necessary to count royalty or sinking-fund for the property, the increase in the value of the surface much more than covering the first cost of the land. I had intended to give in this paper some particulars as to the great iron ore deposits which are found in the immediate vicinity of the coal-fields of Alabama, but I shall not at present take up that subject further than to say that the limonite or brown hematite deposits are of the most wonderful extent and richness. I have never seen deposits of this kind of ore in any other part of the world to equal them. The ore can be mined at a cost of about $1 per ton, and will yield in the furnace, when roasted (in which process it loses about 12 per cent. moisture), from 50 to 60 per cent. metallic iron. From the very nature of their origin—depositions from ferruginous springs—these limonite deposits are of irregular and uncertain extent, and require a careful study in each particular case. The red or fossil ores being in regular stratified beds are easier studied. They occur to the west, south, and southeast of the Cahaba coal-field, and extend in an unbroken line through many hundred miles. These beds are from 10 to 30 feet in thickness in the vicinity of that part of the coal-field which I have examined, but in many places the ore is "lean," seldom yielding over 40 per cent. in the furnace, even from the better portion of the bed. These ores are somewhat silicious, and their treatment alone in the charcoal furnaces of that region has been attended with considerable difficulty; most of the furnaces now use a mixture of limonite and red ore, and produce an excellent quality of pig-iron. The charcoal iron manufactured from the limonites alone stands at the very head of our American iron, "Shelby" and "Bibb" ranking with the famous Salesbury car-wheel iron of Connecticut. The Blackband ore of the coal-measures is found from 16 to 20 inches thick in the Warrior field, and forms a continuous bed within a short distance of, and between two of the best coal-veins of the field. It is of fine quality, yielding in the assay about 34 per cent. of iron and 12 per cent. carbonaceous matter, and 1.35 per cent. manganese. There has been but very little magnetic ore iron yet found in Alabama; that which occurs near the Coosa, on the line of the Selma, Rome and Dalton Railroad, is quite silicious, and contains, also, an injurious amount of phosphorus. Indeed, all the Alabama ores contain more or less of that bugbear of our iron and steel producers, though we have the analysis of ores from a few deposits of limonites, where the quantity of phosphorus is so small that it would probably permit of their use in the manufacture of Bessemer metal. Without going into any detailed estimate of the cost of producing pig-iron in Alabama, I may say that there is no other place in America in which coke iron can be produced so cheaply as in well-selected locations in the vicinity of the Cahaba and Warrior coal-fields. For a large production, we may put this cost of pig-iron at $12 to $13 per ton, and this includes interest on capital, etc., etc. This iron can be delivered in New York at an additional charge of about $10 per ton. Under these circumstances, it is scarcely necessary for me to add that Alabama is destined, at no distant day, to take a prominent place among our producers of iron. With the very large home market for her coals, among the furnaces, factories, cities, railroads, and steamboats, and a very large foreign market, in which they could compete with advantage were the mines developed on a large scale, and the enterprise carried on with sufficient capital to insure certainty in the supply, there can be no doubt that Alabama will, before many years have passed, contribute to the coal production of the United States a quota proportionate to the enormous extent and richness of her fields.

—Compiled from a paper by R. P. Rothwell, M. E., Transactions American Institute of Mining Engineers.

AURIFEROUS SLATE DEPOSITS OF THE SOUTHERN MINING REGION.

CAN the auriferous slate deposits of the Southern mining region ever be successfully worked? is a question that has been often asked by persons seeking investments in Southern mines. Those who have had the opportunity of exploring the region mentioned above, will readily recall to mind numerous localities, to which their attention was directed by would-be miners, as "rich and desirable properties," in which there were but few quartz *seams* running in every direction through fine-grained talcose slate. Most of the gold in such formations was always found disseminated through the slate, and but a small percentage contained in the quartz. Such are the deposits discussed here. Of course there are many excellent quartz mines in the South that are paying the owners good profits, and many more that are not being worked for obvious reasons. But it is out of the question to suppose that these slate deposits can be practically worked by the same methods adopted for extracting the ore from well-defined and prominent quartz veins. It is true that in many instances these slate formations are quite rich in gold, but this is not uniformly the case, and, as there is no chance of sorting the ore, handling so much crude and dead stuff in the ordinary way of mining and milling would be ruinous. These formations in the South, as a general thing, are found so thoroughly decomposed, as to render it not at all difficult to spade the slate, and pulverize the whole mass between the fingers. These formations are sometimes several hundred feet in width, extending to unknown depth, and varying in length from a few hundred feet to several miles. In fact, in every respect, except as to composition and location, they bear a striking resemblance to the ordinary gravel deposit.

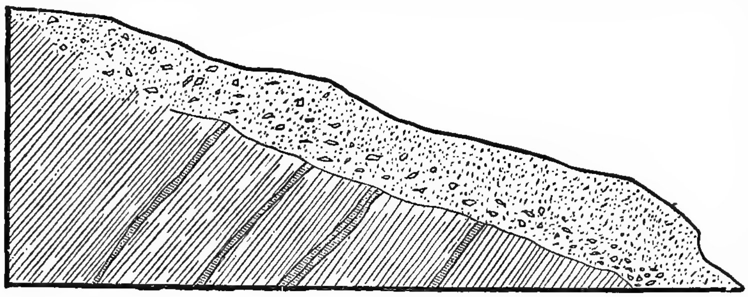
Now, why cannot these slate formations be worked by water, somewhat in the same way as ore is concentrated in gravel beds? This plan has, in part, been adopted by N. H. Hand & Co., in working a property located near the Pigeon Roost region, Lumpkin County, Ga. The idea seems to have suggested itself from the surrounding circumstances. It is well known that for a number of years this company have been supplying their mines with water from a well-constructed ditch over 26 miles in length, and by means of this ready agent they have successfully worked the slate vein mentioned above. Before N. H. Hand & Co. took possession, the property was very thoroughly tested by the old plan of driving shafts and extracting the ore by means of picks and shovels. Very expensive and elaborate machinery was employed, but without success, and the property was eventually abandoned with considerable loss to the company. When the present owners, therefore, took possession, the past history of the mine contained but little to encourage them in the prosecution of the enterprise. There was no regularly defined vein of quartz, but simply a large mass of fine-grained talcose slate, throughout the length and breadth of which good pannings of gold were obtained. A twenty-five stamp battery, run by water, was erected one-half mile from the mine, at the lowest point accessible. On a high hill in the neighborhood of the mine a large reservoir was supplied with water from the ditch mentioned above, and by means of a "Little Giant," in connection with this reservoir, playing under a pressure of 150 feet head, the vein of decomposed slate and quartz was driven through riffle-boxes towards the mill. The inclination of these boxes was sufficient to carry everything in the nature of ore into the mill-house, and the force of the water being broken there by mechanical means, only the finely pulverized slate and floating mud were permitted to pass away and settle wherever opportunities were presented in the various gulches. It was of course necessary at times to break up by means of hammers, or otherwise, any large boulders that were washed down from the vein before permitting them to enter the riffle-boxes. But these were of such rare occurrence that two to four men were all that were necessary to supply the mill with ore. The net profits yielded by this mine per week in 1879, under the above treatment, were $800. The unused water power of the Southern gold belt is immense, and if companies could be formed to build the proper water ditches to reach these at present worthless properties, there would be a wonderful revolution and revival in the mining interests.

From the geological reports of Georgia it is found that there are 180 prominent streams in the gold belt of that state, that furnish in the aggregate 26,000 cubic feet of water per second, the capacity of each stream varying from 2 cubic feet upward as high as 3000 cubic feet per second. This amount of water would give, with an assumed head of 100 feet, 285,640 theoretical horse-power, or 190,426 available horse-power. Again, 26,000 cubic feet per second would be equivalent to 1,560,000 cubic feet per minute, and this volume of water confined in a ditch would supply about 700,000 miner's inches. North Carolina and Alabama are not behind Georgia in the supply of water, and the most of this vast power is running unused to sea. Custom mills should be built at intervals throughout the region, and this water utilized for not only washing down and concentrating the ore, but also transporting it, if possible, to the mill ready for crushing and amalgamating. Upon actual experiment in Georgia, it has been found that by such treatment ore can be profitably handled that yields but 75 cents per ton. Last year the manager of Finley Mine stated that where the ore could be reached by the water, he had succeeded in mining and crushing at a cost of but 28 cents per ton. This was the case, however, where the water was made not only the mining but the transporting agent as well. The climate is delightful the year round, and seldom are the streams so locked up with ice as to suspend all mining operations. Railroads are running within a few miles of the farthest point of the mining region. Provisions are cheap, and in great abundance. Labor is to be had in sufficient amount, ranging in value from 50 cents per day for ordinary hands to $1.50 per day for mechanics. The forests are also in their original beauty and abundance, and there is, of course, no lack of wood for building and fuel purposes. So, in summing up, it would not be far from right to assert that, with all these advantages, the same class of ore that is now cast aside as worthless on the Rocky Mountain slopes, could be profitably worked in North Carolina, Georgia, and Alabama.

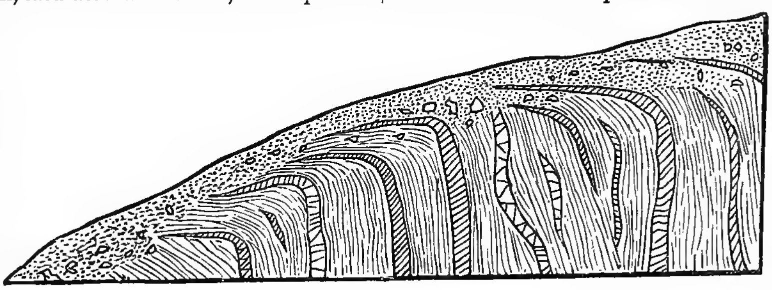
—*Compiled from a paper by P. H. Mell Jr., M. D. Ph. D., Transactions American Institute of Mining Engineers.*

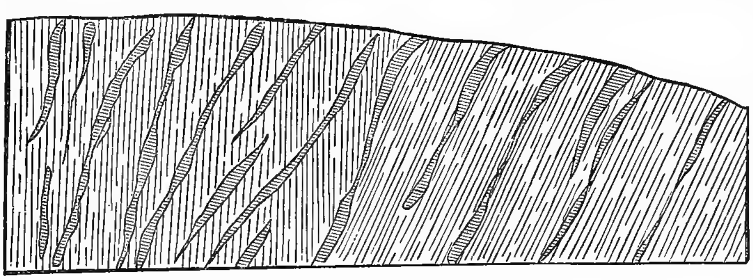
THE GOLD GRAVELS OF NORTH CAROLINA —THEIR STRUCTURE AND ORIGIN.

WHEN Agassiz and his party of geologists commenced their exploration of the interior of Brazil and the Amazon region, one of the first and, to the last, one of the most novel and striking phenomena which met them everywhere was the great depth of decomposed or partially decayed rock *in situ*, which mantles, and for the most part conceals, the underlying strata. The same facts strike all geological observers from the North who happen to penetrate the middle and southern latitudes of the Atlantic States. In North Carolina, *e. g.*, the entire middle and western regions, outside of the Quaternary clays, sands, and gravels of the East, —that is, all that portion of the State occupied by the Archæan and Mesozoic rocks,—show everywhere this peculiarity, so new to those accustomed to glaciated surfaces. Not only do the hills and slopes, the mountain chains and spurs, present everywhere to the eye this superficial covering, but even the more level tracts and the valleys. The railroad cuts give very good exposures of this covering, and furnish, everywhere, abundant opportunities for the study of its structure and history. Some of the more obtrusive facts are these: the thickness of this covering varies from a few feet to 30 or 40, and often 60 and 75, and even 100 feet, and bears an obvious relation to the character of the underlying rock, being least where this is most refractory, and *vice versa;* the rock is generally nearest the surface in the crests of the hills. The upper portion of this earthy envelope for several feet beneath the soil is homogeneous and structureless; but lines of structure soon make their appearance, becoming more pronounced with the depth. These lines of structure are commonly coincident with bands and ribbons of differently colored earths, which, on closer inspection, show differences in their materials also, these differences becoming more and more strongly marked as they are traced downward, until they pass by insensible gradations into the solid rock beneath. The obvious and necessary conclusion from these observations gives itself, viz., that the rocks of the region are and have long been undergoing a slow chemical decomposition and disintegration from the action of atmospheric forces, this decay being too rapid, however, to be overtaken by the abrasive and transporting power of these same agencies. So far the general and obvious facts are plain to be read by the man that runs. A little closer inspection reveals another set of facts. It is easily discovered that these mantles of earth and half-decayed rocks are not strictly *in situ*, but have been subjected to some sort and degree of movement, and that the materials have undergone at least a partial rearrangement in certain situations and under certain conditions. In general on the summits of the hills there has been no change, but descending the slope, however gentle, a tendency to a sorting and arrangement of materials appears, and this becomes more observable with the distance. At first the fragments of quartz and other hard rocks are sharply angular, and are distributed equally and irregularly through the mass, or in lines corresponding to the bedding of the rocks. Descending a few rods the rock fragments have "settled" somewhat; they are found more thickly strewn towards the bottom, and are less angular. Descending still further all the coarser fragments are found accumulated in a layer of cobbles or pebbles, with only the interstices filled with earth and gravel. Combining sections of this covering taken from different points, from the hilltop to the bottom of the slope, which commonly terminates in a ravine or valley, or the bed of a stream, we have the appearance shown in Figure 1. The obvious interpretation of these facts is that there has been a movement or flux of the earthy mass in the direction of the slope. And this notion is confirmed by an occasional observation which is represented in Figure 2. The difficulty at once arises how to account for a flow of such materials with such results. The ordinary action of flowing water is, of course, excluded. The mere action of gravitation will not account for the phenomena,—slipping or sliding down hill. This, doubtless, often happens on very steep declivities, but such cases are quite exceptional and are easily distinguished. The movements we are considering have taken place at every degree of inclination, from one degree and less upwards, and occasionally on a level, *or even up hill.*



After puzzling over these phenomena for half a dozen years, and wondering that there is no explanation in the books, or even any discussion of the subject or note of the facts, not even in Gerkie's *Great Ice Age*, it occurred to me that the only possible solution must be sought in the action of frost. The alternate freezing and thawing of such a mass of earth must needs produce just the effects we have been considering. The earth, saturated with water, in the process of consolidation under the action of cold would, of course, expand just as if it were all water, and in thawing there would be a slight movement of the parts and particles of the mass *inter se*, and of course a settling of the heavier fragments; in other words, the movement would be the same in kind (though not in amount) as that of a glacier. These masses may be considered earth glaciers, and I have ventured to denominate this group of phenomena, and these peculiar superficial accumulations, *frost drift*. Now the ordinary glacial phenomena are wanting in North Carolina, with, perhaps, the exception of a few morainal ridges in the gorges of the higher mountains. But during the glacial period, of course, the cold must have been intense enough to account for the depth and extent of action which the theory of *frost drift* supposes. I was led to these results from the particular study of the gold deposits of the State. They have all been formed in this way. There are probably five hundred square miles of gold drifts in North Carolina. They are found through a range of four hundred miles east and west, from the lower waters of the Roanoke, near Weldon, to the extreme western border, the county of Cherokee, and they belong to all the different subdivisions of the Archæan rocks of the State. The two most extensive deposits are found in the middle region, on the Yadkin and Catawba rivers, among the low ranges and spurs of the mountains. The schistose and slaty rocks, highly inclined and much contorted and dislocated, are in many places penetrated by innumerable small veins and seams of gold-bearing quartz. (See Fig. 3.) In the disintegration and breaking down of these rocks, and the movements of the debris in the manner described, it is evident that the gold particles, with the heavier crystalline minerals, will be found accumulated near the bottom of the drifts, on or near the surface of the bed-rock, or "slate," as the miners call it. The gold mining of modern times began sixty years ago in this region from the accidental discovery of a twenty-eight pound nugget by a boy in one of the streams of Carolina. Most of the simple and effective appliances now in use everywhere for the separation of gold from such deposits—the long tom, the sluice, the riffle-box, etc. — were devised and used in this region, and were carried hence to California when, twenty-five years later the trained miners of this region emigrated in a body to that newer and richer field. Since that emigration there has been but little placer mining done in North Carolina. Still this sort of mining has never entirely ceased, and in some sections, and by a few families, it has been followed continuously to the present. The richest deposits within the reach of water have been worked over, but there are large areas still untouched, because inaccessible to water without considerable outlay for ditching, canalling, and fluming, to which neither the capital nor the enterprise of the region is equal. Possibly at no distant day foreign capital will open up an industry that once more will draw the gaze of the world to the gold fields of California.





—*Compiled from a paper by W. C. Kerr, State Geologist of North Carolina, Transactions American Institute of Mining Engineers.*

THE JENKS CORUNDUM MINE, MACON COUNTY, N. C.

THE mine is situated upon the Culsagee Fork of the Tennessee River, in Macon County, North Carolina, a few miles from Franklin. The most practicable route by which it can at present be visited is by wagon (or preferably on horseback) from Seneca City, S. C., a station on the Charlotte and Atlanta Air Line Railroad. The itinerary is as follows: to Walhalla,* nine miles; Walhalla to Highlands, twenty-nine miles; Highlands to Culsagee, fourteen miles. By passing the night at or near Highlands, the mine can be reached and examined and the return to Highlands made on the second day; and the round trip, if performed in the saddle, can be completed in three days from Seneca City. It is not easy, with due regard to steed and rider, to do it in less time. The rough and precipitous mountain roads do not permit rapid travel; and the journey is at best a fatiguing one. But its slight

* A branch or cross railroad is in operation as far as Walhalla; but the single daily train runs at an hour not convenient for this expedition; and Seneca City is probably the best starting-point. At all events, I obtained there an excellent mount for the trip.

hardships are overpaid by the stimulating effect of the climate and the great beauty of the scenery, both of which are destined to become more widely known than at present, to seekers for health and pleasure. Indeed the town of Highlands, already named, is almost entirely made up of northern immigrants, attracted by these advantages and by the inducement of cheap land for agriculture and stock-raising. The Culsagee or Sugartown fork of the Tennessee traverses the belt of ancient crystalline schists on the west flank of the Blue Ridge. This belt abounds in valuable minerals. Among those of the non-metallic class may be mentioned graphite, soapstone, serpentine, asbestos, and mica. The latter has been mined to considerable extent since 1870; and in some of the most productive localities* the curious discovery has been made that mica was mined here on a large scale not less than three centuries ago. The occurrence of mica utensils and ornaments in the mounds of the Northwest, and of mica cut into corresponding forms in the *dêbris* of these ancient workings, leaves, according to Prof. Kerr, no doubt that these workings were contemporary with the ancient copper-mining excavations of Lake Superior, and that their product was conveyed to the West by the operations of a prehistoric commerce, the existence of which is thus for the first time made known.

Mr. Jenks, in a paper before the Society of Arts of the Massachusetts Institute of Technology (December, 1876), has suggested that the ancient Egyptians may have used corundum, on account of its superior hardness, to execute their inscriptions in porphyry. However this may be, there is, so far as I am aware, no evidence to show that the mineral and its uses were known to the former inhabitants of this country; nor do their mounds or other relics present specimens of workmanship requiring its employment. Its discovery in North Carolina is not, therefore, like the opening of the mica mines, merely the renewal of an earlier industry.

"This mountain tract of Laurentian rocks," says Prof. Kerr, "contains between 3000 and 4000 square miles of surface," the aggregate area of these rocks in the whole State being, according to the same authority, more than 20,000 square miles, or nearly half the territory of North Carolina. Along the middle of the belt now specially under consideration, a discontinuous line of outcrops appears at intervals from Cane Creek in Mitchell County through the intervening counties of North Carolina into Union County, Georgia, and perhaps still further south. These are called, in the State Geological Report, dikes of chrysolite or dunite.† Mr. Smith, who seems to have made the most extended examination, thus far, of the rocks of this belt, says the chrysolite bears decided marks of its eruptive origin, and cites in proof its crystalline structure, the disseminated octahedral crystals of magnetite and chrome iron which it contains, and the circumstance that although it is laminated, the strike of its laminæ seldom conforms to the strike of the inclosing rocks. "It cannot, therefore," he says, "be regarded as a regular interpolation, nor as an intercalation with the inclosing beds." It would be presumptuous to dispute, on the strength of a hasty examination of a single locality, an opinion so positively expressed; yet I should not be surprised if future careful study of all the localities should show these chrysolite beds to be intercalated members of the formation in which they occur. Prof. Kerr, who speaks of them as dikes (and also as ledges and masses) without definitely pronouncing them to be eruptive, says they are more or less distinctly granular, and constitute in fact a chrysolitic sandstone of a yellowish to dull or dark olive-green color. The composition, as analyzed by Dr. Genth and Mr. Chatard, of specimens from Webster and Culsagee, N. C., is as follows:

	GENTH (Webster).	CHATARD (Culsagee).
Silica,	41.89	41.58
Alumina,	trace	0.14
Protoxide of iron,	7.39	7.49
Nickel oxide,	0.35	0.34
Magnesia,	49 13	49.28
Lime,	0.06	0.11
Loss by heating,	0.82	1 72
Chromic iron, etc.,	0.58	——
	100.22	100.66

* Near Bakerville, for instance. See the Report of 1875, of Prof. W. C. Kerr, State Geologist, p. 300.

† See two papers by Rev. C. D. Smith, of Franklin, N. C., in the Appendix to the State Report of 1875.

Prof. Shepard, in the *American Journal of Science* for August, 1872, and Dr. Genth, in No. 1 of the Contributions from the Laboratory of the University of Pennsylvania, have discussed the mineral species associated with this chrysolite. They comprise corundum, chlorite (ripidolite, jefferisite), talc, chalcedony, hornblende (actinolite, asbestos), damourite, tourmaline, etc. In view of this paragenesis, it is noteworthy that Dr. Genth's analysis of the chrysolite shows so little alumina. Whether the chrysolite be eruptive or not, the veins of chlorite which it contains are plainly of secondary origin, and the presence of crystallized alumina in them as corundum cannot well be explained as a result of fusion. Whether this alumina has been segregated from the constituents of the (now chrysolitic) wall-rock, or deposited as an original member of the series of strata, or brought in by percolation in solution and precipitated by slow reactions, it is not easy to determine. The absence of potassa and soda from the analysis above quoted may have significance in this connection, since the exchange of these bases for alumina would leave them in solution, while the latter was precipitated as hydrate or (carbonic acid being present) as a basic carbonate.

Dr. Genth's conclusions from the chemical analysis of the associated minerals are stated as follows: That, at the great period when the chromiferous chrysolite beds (in part subsequently altered into serpentine, etc.) were deposited, a large quantity of alumina was separated, which formed beds of corundum; that this corundum has subsequently been acted upon and thus been changed into various minerals, such as spinel, fibrolite, cyanite, and perhaps some varieties of felspar, also into tourmaline, damourite, chlorite, and margarite; that a part of the products of the alteration of corundum still exists in the form of large beds of mica (damourite) and chlorite slates or schists; and that another part has been further altered and converted into other minerals and rocks, such as pyrophyllite, paragonite, beauxite, lazulite, etc. Dr. Genth frankly declares his inability to explain the manner of these transformations, and says that we have at present no facts upon which a tenable theory could be built. Taking the case of chlorite as an example, we find that some of the specimens from the Culsagee mine are apparently pseudomorphs after corundum, with central nuclei of the unaltered mineral. Others contain distinct, perfect and brilliant crystals of corundum. Dr. Genth is forced to conclude that in the latter case there has apparently been a recrystallization of corundum, since, as he says, the crystals "appear to have formed *after* a great portion of the original corundum had changed into chlorite, as if there had been an excess of alumina ready for combination, which, not finding a supply of the requisite amount of silicic acid and basis, had again crystallized as corundum." It is difficult to conceive of the precipitation and crystallization of anhydrous alumina. One would rather suppose the original deposit to have been a hydrate, such as diaspore or beauxite. Dr. T. Sterry Hunt says* of the latter mineral, "By intense heat this substance (beauxite) is converted into crystalline corundum resembling emery in its physical characters; but the presence of grains of corundum in the hydrated mineral seems to show that the transformation may take place at ordinary temperature." Dr. Genth thinks that all the specimens he has examined present no instance in which corundum could have been eliminated under such circumstances from the hydrate. On the contrary, he says, the presence of grains of corundum in the beauxite proves pretty conclusively that the latter is itself the result of hydration, and that the grains which have been found are remnants not yet converted. As to diaspore, it occurs, according to Prof. J. Lawrence Smith,† very intimately mixed with corundum; but Prof. Smith observed that all the corundum which he had examined contained from 0.68 to 3.74 per cent. of water even when careful examination showed the absence of diaspore or other definite hydrate of alumina. Dr. Genth suggests that the distribution may be so minute that even microscopic observation would fail to show it. But in any case, the presence of water in the corundum might be regarded as a sign either of commencing hydration or of closing dehydration. The problem is therefore still unsolved.

* Sill. Jour. (2) xxxii, 288, quoted by Dr. Genth.

† Sill. Jour. (2.) x, 355 and xi, 53, quoted by Dr. Genth.

Dr. Genth's view, which is strongly supported by many of the specimens examined, rather favors the probability that large masses of pure corundum will be found by deeper working upon those veins or strata in which, near the surface, the corundum appears in nodules, inclosures and "remainders" only. In this view, the "veins" of chlorite, etc., are local alterations of the original belt of corundum, and possibly that belt might be exposed in a less extensively altered, or wholly unaltered, condition by explorations beneath the surface zone. On the other hand, a hypothesis which makes the corundum part of a fissure-filling, or the result of segregation from the country rock, gives no special ground, so far as I know, for the expectation of larger masses at greater depth. So far as the chemical aspects of the problem are concerned, nothing can at present be added to the work of such experts as Genth, Hunt, and Lawrence Smith. In visiting the locality at Culsagee, I hoped to contribute to the discussion the result of a thorough examination of the outcrops and underground exposures of the different strata, embracing a study of the mineral paragenesis more satisfactory than those hitherto based upon hand-specimens. My intention was, however, completely frustrated by the present condition of the various openings, which would have taken days of labor to clear of the rubbish impeding a careful examination. My own observations, therefore, leave me in uncertainty; but it is fair to say that they revealed nothing absolutely inconsistent with Dr. Genth's view. The beds of corundum which, according to that view, were originally separated before deposition, must have been several in number at this locality, and their deposition must have alternated pretty sharply with that of the chrysolite. But this fact, although it favors the notion of a subsequent segregation during metamorphosis, is not fatal to Dr. Genth's idea.

Mr. Jenks, whose superintendence of mining operations gave him opportunities for continuous study of the facts, says that sometimes the corundum and sometimes the chlorite appeared to be the matrix. The purest corundum, if I am not mistaken, was usually found in nuclei; but one of the veins, more frequently than the others, produced it in crystals. It would be unwarrantable assumption, in view of the circumstances, to attempt to add weight to either side of the theoretical discussion by the expression of a private judgment. It is only for the sake of frankness that I say, that while the particular evidences either favor or do not disprove Dr. Genth's theory, the general analogies of chemical geology seem to me to be the other way. The dike or mass of chrysolite exposed at the Jenks mine constitutes a somewhat barren ridge, through which five parallel veins of chlorite run longitudinally, having a N. E. and S. W. course, and a dip of about 45° N. W. These veins vary from a few inches to several feet in width. Exact measurements were not practicable at the time of my visit, by reason of the *débris* which had caved into the accessible workings since active operations were suspended in 1873. The veins have been explored by several shafts, tunnels, and open cuts, besides a large amount of surface costeaning, executed for the purpose of ascertaining their number and position. The net result of these operations has been to demonstrate the existence of these five definite zones, in which corundum may be sought with confidence, and to show with a certain degree of probability, that the different veins have individual characteristics, one of them being apparently most likely to yield the gems, another the massive laminated, another the granular, opaque corundum, etc. Concerning the gems, I need hardly say that, being well aware of the repeated scrutiny to which every exposed part of the deposit has been subjected, not only by the workmen during the operations of the mine, but by numerous visitors since, I wasted no time in hunting on the ground for rubies or sapphires. But the specimens from this mine in many cabinets of the United States and Europe, from the great (opaque) ruby and sapphire crystal, weighing 312 pounds, now in the Shepard collection at Amherst College, to the superb crystals in the possession of a collector in Philadelphia, place it beyond doubt that the conditions controlling the formation of all the corundum gems have been present in various parts of this deposit. These gems are nine in number, including, besides the well-known ruby and sapphire, the asteria, corundum emerald, corundum amethyst, girasol, chatoyant, and white or colorless sapphire. They differ from each other in coloring matter only, and from the common corundum in transparency and in the absence of cleavages which would interfere with the work of the lapidary. Strictly speaking, like all other gems, they possess crystalline cleavage. Even the diamond must be handled with much care in cutting, lest it be split and ruined. But the requisite degree of firmness may coexist with this property. The corundum gems heretofore known to commerce have always been found, in India, Ceylon, Bactria, the Ural, China, etc., as pebbles, rounded by long attrition in gravel. It has been of course inferred that they were crystals, torn from their original matrix, though, like the matrix of the diamond, this has been unknown. But it now seems more likely that these pebbles are the dense nuclei of larger crystaline masses, the more laminated, granular or cleavable parts of which have been rubbed away. At least, this is shown to be a possible origin by the discovery in the Jenks mine of transparent nodules of corundum in a matrix of the same material. Mr. Jenks says that specimens, more or less perfect, of all the nine varieties have been obtained from the mines.

On the other hand, if Dr. Genth's conclusions are accepted, it seems likely that the original bed of corundum would be opaque, and that the pure, transparent and variously colored gems would more probably result from recrystallizations, such as he suggests in the passage already quoted. This notion receives some confirmation from the circumstance reported to me, that one of the veins at Culsagee has produced more gems than the others, while it contains apparently fewer large masses. Although the buildings and works at this mine are out of repair, it would not be difficult or expensive to resume operations. The value of the material in the arts, its superiority to ordinary emery, and the great demand for it, which could easily be revived and maintained, are matters beyond doubt. The facts were sufficiently established, a few years ago, when corundum from Chester County, Pa., was put into market. To the great regret of manufacturers, that source of supply became, at least temporarily, exhausted. I am informed that further explorations are making or to be made in that locality, with a view of discovering other pockets of mineral. Meanwhile, the product from there, together with that already taken from Culsagee, has "broken the ice;" and there is no doubt of a ready sale for the material, when delivered in suitable form and purity.

To secure these conditions, the product of the mine must be crushed and subjected to mechanical dressing, which will remove the associated minerals, except a small remainder of chromic iron. The proportion of this in the Culsagee corundum is fortunately trifling. I understand from Mr. Jenks that he has been able to dress his crude material up to 98 per cent. of pure alumina. If the works which I saw were able to do this, the problem of mechanical dressing cannot be very difficult. A small and rude stamp-mill with a few launders, comprised the whole apparatus. A supply of water both for power and for concentration was obtained by means of a ditch and reservoir. Perhaps operations on a larger scale would require steam-power. But the veins are narrow; mining is slow work; and even for a very profitable business, at the present price of corundum, a large product would not be required, even if it could be obtained. Mr. Jenks says that, without the aid of better machinery, and without improvements in transportation or favorable contracts with teamsters and railroads, based on a steady business, he can mine and dress a ton of prepared corundum for $40, send it to the railroad for $20, and deliver it in Philadelphia for $20 more, or $80 in all. Each of these items can, I believe, be greatly reduced. But the material is said to be easily worth in market $160 per ton, several tons having been sold at much higher figures. Without vouching for these estimates from personal knowledge, I feel safe in saying that they indicate a very favorable prospect for the enterprise. The only remaining question of vital importance is that of competition. The chrysolite belt is, as I have shown, an extensive one; and corundum has been found in it at numerous points. Whether at some future time, perhaps under the stimulus of the success achieved in a pioneer enterprise, rival mines, more favorably located as to transportation, may not be opened, it is of course impossible to predict. I have taken some pains to investigate as to the other localities heretofore reported, and have to acknowledge my obligations to Rev,

C. D. Smith, of Franklin, N. C., the original discoverer and tracer of the chrysolite belt, for his cordial reply to the inquiries I addressed to him on the subject. Putting together what information could be obtained from all quarters, I am led to conclude that the Culsagee mine is the only one, so far, which has passed through the laborious and expensive stage of preliminary explorations, and definitely exposed the corundum-bearing deposits *in situ*. Moreover, those other localities hitherto discovered, which seem most promising as to mineral, are about as badly off as Culsagee with regard to transportation.

—*Compiled from a paper by R. W. Raymond, M. E. Ph. D., Transactions American Institute of Mining Engineers.*

THE DISCOVERY OF EMERALDS IN NORTH CAROLINA.

THAT emeralds have been found in the United States, has been doubted. The press has stated "the discovery of emeralds needed confirmation." It is my pleasure to show you convincing proof of the existence in our country of this rare and beautiful gem. Since, what the impetus was that started the search for emeralds in North Carolina would be of interest, I will give you the story, gathered as it is from a year's residence on the spot where the discovery was made. Sixteen years ago the site of the North Carolina emerald mine was covered with a dense primitive forest. Less than ten years ago the locality was mineralogically a blank, nothing was known to exist there having any special interest or value. This new mineral region (and I state this from my own experience in collecting) has produced lately some of the most remarkable and beautiful specimens of emerald, spodumene, beryl, rutile, monazite and quartz thus far discovered in the United States.

To be brief, I will say, that in a few localities in Alexander county, crystals would be found of the common opaque beryl; but occasionally a semi-transparent prism, having a decided grass-green color, much resembling the famous crystals from Siberia, so familiar to mineralogists, would be found and offered for sale in the neighboring towns. Those came to have the name among the farmers of "green rocks" and "green bolts." From the fact of their selling for more than anything else they found these green crystals became the ultimatum of their searchings.

Among other curious names for minerals were "Denicks" quartz crystals, "Black Bolts" for prisms of tourmaline, "Red Metal" for rutile crystals, and "Needle Rock" for the beautiful sagenite, or Arrows-of-love-stone. Suffice it to say that in a period of about six years, there were found loose in the surface soil, on three plantations in this county, a small number of beryls having a color verging distinctly upon the true emerald tint, none of which crystals, however, were deep-colored or transparent enough for use as gems. That such indications could receive only passing notice from collectors, is really inexplicable. A very natural conclusion would have been that where these pale emeralds were found loose in the soil, darker and purer ones would be found by mining for them. Such inducements as the following were held out to the farmers to search for these "green bolts." A visiting collector had offered the munificent sum of *one dollar* to farmers who should find a crystal as long as his finger, which must, to merit the dollar, be *dark green*, pure, transparent, and with perfect terminal planes and prismatic faces! Such is the history of the emeralds found in Alexander county, before I commenced systematic mining for them.

The location of the mine was obtained in the following manner. A corps of workmen was employed to dig a series of deep ditches in directions that would cut the strata at different angles. The site chosen for work was on the spot where at least half a dozen pale emeralds had been found. This location was shown to me by the farmer who had discovered the specimens while plowing. Not knowing then their manner of occurrence, I expected in this way to strike a vein bearing them. Five weeks were spent (in July and August, 1880,) before any success was met with; and then, at a depth of eight feet, was discovered a "blind vein" (so called because it had no outcrop), having very small emeralds. In this vein, or pocket, as it proved to be later, and outnumbering the emeralds fifty to one, was also found the new emerald-green mineral which was such a surprise to the scientific world, and which was destined to answer the same purposes as did the gem I sought. I refer to the spodumene-emerald, now known as Hiddenite. You must pardon this digression, but the search for emeralds is so interwoven with my discovery of emerald-green spodumene that I cannot tell the story of one without the other. The two minerals occur intimately associated, and while mining for the one the other is constantly found. This "blind vein" yielded very handsomely of the new mineral, but very sparingly of emeralds, and the few found were too small to be useful as gems, though their color was very good. A tunnel, for the purpose of drainage, 261 feet long, mostly through rock, was cut to this vein, and a shaft sunk down upon it. At this time the work on this vein has reached a depth of 36 feet, at which point it proved its pocket nature by pinching out—closing together. Thus far, twelve of these pockets have been found within an area of forty feet square, carrying emeralds, four of which pockets contained also the spodumene-emerald. All these veins maintain nearly the same character of dip, thickness, length and associations. Other pockets were found that yielded Quartz, Rutile, Monazite, and Mica crystals of great beauty. Others yet, whose walls were covered with finely crystalized Dolomite, Calcite, Apatite (transparent and pellucid) Rutile, Pyrite, Quartz and Mica. In one instance, a small pocket that contained two beautiful emerald crystals, had its walls covered with large crystals of Albite. Another pocket contained only Mica crystals and one small pellucid colorless beryl that had both ends brilliantly terminated with many planes. I mention the above associations, that you may learn the diversity in these pockets, although they are so near together.

In the rock-mining, and while prospecting on the surface, the sign of a vein is the presence of small streaks of massive quartz, or of mica, in a counter direction to the strike of the country-rock, either of which lead to open pockets not many feet off. The gems have thus far been found loosely attached to the rock. Not over nine emeralds have been found at any one time. Mineralogists have a great treat in store for them, when deep rock-mining is accomplished here. Then the gems will be found firmly attached, and they will shine with all their primitive crystalline beauty. The largest emerald found in this mine is 8½ inches long, and weighs nearly nine ounces. It was one of nine fine crystals contained in a single pocket; their color was excellent, and they were transparent, though somewhat flawed. The locality is situated about 35 miles, air-line measure, S. E. from the "Blue Ridge" mountains. The contour of the country is low rolling, and its altitude is about 1200 feet. The soils are chiefly red gravelly clays, of not much fertility. The prevailing rock is gneiss, with more of a feldspathic than a micaceous character; the trend of the strata is N. N. W. and S. S. E. with a dip nearly vertical. The gems and crystals occur in open pockets of very limited extent, these are cross fractures or fissures in the rock. These fissures are usually nearly perpendicular.

To a foreign geologist, entering the South Atlantic States for the first time, a hundred miles or more from the coast, the most striking and novel feature of the geology is the great depth of earth that everywhere mantles and conceals the rocks. This is readily discovered to be, for the most part, merely the result of the decomposition *in situ* of the exposed edges of the underlying strata. The vertical and highly inclined bedding lines or strata, are distinctly traceable by the eye, through this superficial earth covering, and are seen to pass by insensible gradations into the undecayed rock beneath. At this locality, the unaltered rock is found at a depth of twenty-six feet, and is of unusual hardness, especially where it walls the gem-bearing pockets. Thus far the gems have been found in a narrow belt running N. E. and S. W., and scattered over a distance of three miles. In this belt, signs of cross-fissures are very abundant, and it is a very common thing to find crystals of quartz, rutile, tourmaline, etc., etc., perfectly preserved, scattered over the surface.

A peculiar feature pertains to most of the emeralds and beryls from this region. They appear as though filed across the prismatic faces. The basal plane is also often pitted with minute depressed hexagonal pyramids, that lie with their edges parallel to one another, and to the edge of the di-hexagonal prism. Rarely, though, crystals are found with perfectly smooth and brilliant faces. The emerald color is often focused on the surface, and fades gradually to a colorless central core, which feature is of exceeding interest when the genesis of the mineral is considered. The emeralds have been found of richer color, and less flawed, as the mine gets deeper. In regard to the commercial value of the emeralds thus far found, I will frankly state that the majority of the crystals have little value for gem purposes; but as cabinet specimens they are unprecedented, and as such have a market value ranging from $25 to $1,000 each. From the largest crystals, stones of over one carat weight could be cut, that would be marketable as gems; but as scientific specimens, the crystals in their entirety would have greater value. Certainly no better signs could be wished for than these specimens, to prove the existence at this locality of dark-colored crystals, pure enough for cutting into valuable gems. This region has a great future as a gem-producing district. Mining skill and capital are the only essentials needed to insure success. It may be interesting to note that the entire expense of the work at this locality has been more than repaid by the sales of the gems (Hiddenites) discovered.

—Compiled from a paper by Wm. Earl Hidden, Transactions New York Academy of Sciences.

THE MINERAL RESOURCES OF SOUTH-WESTERN VIRGINIA.

THE region to which this paper calls attention, though limited in area, is remarkable for the quantity and purity of its mineral deposits, and in these respects it would be difficult to find its equal anywhere.

Iron Ores.—The red and brown hematites, pipe ore, and semi-magnetites, from which is made in charcoal furnaces the highest quality of iron for car wheels, extend through the counties of Giles, Montgomery, Pulaski, Wythe, Smythe, Washington, Bland, Tazewell, Russell, Scott, Lee, Floyd, Carroll, and Grayson, Virginia, and run over into Ashe County, North Carolina. One locality of semi-magnetite, in the centre of the great Giles county basin, has in sight, by actual measurement, 50,000 tons of ore, which, according to Prof. Fesquet, contains 69.74 per cent. of iron and no phosphorus. In the great brown-ore belt, which passes through the counties of Montgomery, Pulaski, Wythe, Smythe, and Washington, there is an extraordinary deposit of more than a million tons. A small section of this very long vein on Cripple Creek, in the county of Wythe, yields an ore which, analyzed by Mr. James Aumann, gave the following results. Metallic iron, 58.15; water, 12.96; alumina, 2.32; silica, 1.09; phosphorus, none. At one point towards the western end of Red Land Mountain, in Pulaski county, New River section, there is a body of ore in this belt which will yield, to a depth of 150 feet, over 8,000,000 tons, and the deposit extends far below the 150 feet measured at the upper part. Again, at Rich Hill, near the mouth of Reed Island Creek, these veins show extraordinary surface development, giving an ore of very great purity. At numerous places, also, in the counties of Giles, Bland, Tazewell, Russell, Scott, Wise, and Lee, these brown and red iron ores are exposed in such vast quantities as to baffle both description and measurement. That of Chestnut Flat, in Giles county, back or west of the Angel's Rest Mountain, is an easily reducible ore, blood-red when crushed, of which there are fully 300,000 tons in sight. Its analysis is as follows:

Sesquioxide of iron,	89.55
Oxide of manganese,	0.20
Silica,	2.58
Alumina,	1.11
Lime,	0.20
Magnesia,	0 15
Sulphuric acid,	0.37
Phosphoric acid,	0 30
Water, hygroscopic,	1.25
Water combined,	4.10

Among other known localities may be mentioned Round Mountain, Nye's Cove, Newberry's, and other places in Bland County; Whitely's Ridge, Kent's Ridge, and numerous other places in Tazewell County; Kent's Ridge, Copper Ridge, Clinch River, in Russell County; Copper Ridge, Mocasin Ridge, Big Ridge, Newman's Ridge, Powell's Mountain, Boatwright's, in Scott County; the neighborhood of Big Stone Gap, in Wise County; Bale's or Bowling Green Forge, Waldin's Ridge, Poor Valley Ridge, in Lee County. The strictly fossil ores are found in continuous veins in Walker's Mountain, Gap Mountain, Clinch Mountain, Round Mountain, Wolf Creek Mountain, Pearis's Mountain, Buckhorn, East River Mountain, Peters's Mountain, Paint Lick Mountain, Salt Pond, Butte, Newman's Ridge, Powell's Mountain Waldin's Ridge, and Poor Valley Ridge, in the counties of Giles Montgomery, Bland, Pulaski, Russell, Scott, Wise, and Lee. Of these localities, the best fossil ores I have seen came from the Clinch Mountain, in the line between Washington and Russell counties; Poor Valley Ridge, near Pennington's Gap, in Lee County; Boon's Path, the same county; East River Mountain, Giles County, and one or two points in Wolf Creek Mountain, Pearis's Mountain, and Round Mountain, in Bland County.

The Giles and Bland fossil ores assayed, according to H. Dickinson, of Norwood, Mass., as follows:

Sesquioxide of Iron,	58.12
Oxide of manganese,	0.06
Alumina,	4.67
Lime,	0.20
Magnesia,	0.41
Potassa and Soda,	0.40
Silica,	32.74
Sulphuric acid,	0.00
Phosphoric acid.	0.75
Water, hygroscopic,	0.60
Water, combined,	0.96
Organic matter.	0.84

Other ores from the fossil belt in East River Mountain gave Prof. Fesquet 50.36 per cent. of metallic iron. The true magnetites are principally found in the more ancient rocks (Laurentian) in the counties of Floyd, Carroll, and Grayson, Virginia, and in Ashe County, North Carolina, in veins varying between 3 and 30 feet. One well-defined vein at Ballou's, on New River, in Ashe County, N. C., is 30 feet in thickness by 150 feet elevation above water in the river, the dip varying between 28 and 60 degrees. For a length of 300 feet it is very accessible to the river, and shows 1,800,000 tons of ore that yields, according to Mr. John Fulton, 0.031 per cent. of phosphorus. Another portion of the vein holds 0.026 per cent. of phosphorus, by the analysis of Mr. F. P. Dewey. These veins, of which three in the locality just named, are almost continuous through Ashe County, North Carolina, and Grayson, Carroll, and Floyd counties, Virginia, will yield so vast an amount altogether that they can scarcely be ranked as second to any known deposits. Floyd County, at the Toncray Mines, gives fine magnetite, somewhat south of the general direction of the above veins. The semi-magnetites are found in the counties of Giles, Montgomery, Carroll, Wythe, Smythe, and Washington. Many of them contain, according to the analyses of Messrs. Booth and Garrett: Metallic iron, 55,690, Phosphorus, 0.028. Their quantity is not yet so fully determined as the true magnetites and peroxides. They occur usually as semi-magnetic red ores.

The Lead and Zinc Ores.—These ores are confined principally to the counties of Wythe, Pulaski, Montgomery, Smythe and Washington, and one or two localities in Bland, Russell, and Scott counties. While occurring in large quantities in Pulaski and Montgomery, their greatest development seems, from all explorations to the present, to be in Wythe County, from near Reed Island Creek to the southwest, along New River and up the waters of Cripple Creek. The ores undoubtedly belong in the rocks of No. 2. It is an error to place these measures in the upper part of the Trenton limestones, as it is understood some persons have done.

The extraordinary quantities of carbonate, oxide, silicate, and sulphide of zinc, and sulphide of lead, at different points in Wythe County, suggest the idea of a very large continuous deposit. Perhaps the following measures, taken on Painter's Branch, known originally as the Kitchen's, Noble's, and Painter's mines, may not be uninteresting: Dip of measures 30 degrees northwest, measured with the clinometer in a deep shaft, as well as other places. Beginning on the floor or southeast wall of the main measure, we have 144 feet of heavy blend-bearing strata; then 36 feet of dolomite, with occasional spots of zinc and lead; 36 feet iron sulphuret and oxide; 90 feet dolomitic rock, containing large veins and deposits of zinc and lead sulphuret, one of which is 18 feet thick; 180 feet of iron, zinc, and barytes, heavily disseminated in the rock; then toward the northern or hanging wall an indefinite amount of dolomite, more or less charged with barytes. The hill, along the crest of which these measures were taken, is 75 to 100 feet above the water in the small creek flowing near. This series of rocks trends through the country for many miles in a general direction N. 70° E. At the Wythe lead and zinc mines, on New River, the great pressure apparently exerted from the southeast throughout this whole region of country, in folding the earth's surface, has met with such resistance as to cause a partial fusion of the various strata holding the lead and zinc. Hence the whole body of the rocks is more crystalline in structure, and has less of that appearance of stratification which is so apparent at other points. Here the measures from which this ancient lead company has, under one form or another, for more than 100 years taken its ores, are forty feet in thickness between walls of dolomite, with a dip of 70° in the main drift, which is reached with a tunnel 1600 feet in length. Numerous excavations over this hill show other deposits of lead of good dimensions, as well as large bodies of zinc ores of high grade. The Bertha mine now shows a face of silico-carbonate and oxide of about 180 feet by a depth of 20 feet, with the ore still below. Numerous shafts in this and adjoining hills show the continuity of the beds from which the recently erected smelting works on the Atlantic, Mississippi, and Ohio Railroad, at Martin's Station, derive their ores. On the headwaters of Walker's Creek, in Bland County, there are lead and zinc ores, as well as in other localities to the northeast and southwest.

Copper.—The three great lodes of copper which are known to exist in the section under consideration, pass through the counties of Floyd, Carroll, and Grayson, Virginia, and continue on through Alleghany, Ashe, and Watauga counties, North Carolina. There is another—the native lode—confined to Carroll County, Virginia. This lode differs from the rest in being apparently injected from below, and is associated with tremolite and hornblendic trap, having a trend from N.W. to S.E., while the direction of the first-named lodes is N.E. to S.W. The first three are distinguished as the Northern or Iron Lode (having its greatest development in Carroll County), the Middle or Peach Bottom Lode, and the Southern or Ore Knob Lode. The middle lode shows best at the Peach Bottom Mine in Alleghany County, and at Elk Knob, in Watauga County, North Carolina, while the southern has its finest development at Ore Knob, Ashe County, North Carolina, and at Toncray Mine, Floyd County, Virginia. The Ore Knob Mine has given sulphuret ores from a vertical vein, 18 feet thick, averaging 25 per cent. of copper, at a depth of about 300 feet from the surface. This ore is being converted into ingot copper at the mine, by the extensive plant of the Ore Knob Copper Company. At the Toncray Mine, on this lode, the better grades of ores have been exposed in a vein 30 feet thick, but dipping S.E about 45 degrees, and having on its northern wall 4 feet of excellent magnetite. On the northern lode, at some points in Carroll County, can be found a thickness of fully 150 feet. At one point, where it gives this measure, a shaft sunk into its central portion shows sulphuret ores which will average 5 per cent. of copper for 30 feet in width, while the remainder of the 150 feet on either side gives only 1.70 per cent. of copper. This great lode is marked by extensive beds of gossan, forming most abundant and useful hematite ores. It may be as well to say that throughout this copper belt there are numerous other minerals, both interesting and highly valuable,—specular ores, mica, feldspar, asbestos, and gold and silver, as at Cowles's, Gap Creek, in Ashe County, North Carolina; gold being also found on Bush Creek, and Little River, in Floyd and Montgomery counties, Virginia, and silver in the ores at Peach Bottom Mine, and at the Clifton opening, near Old Town, on the northern lode. To these, also, may be added nickel, cobalt, antimony, and arsenic.

Coal.—Southwestern Virginia holds a very large area of the southern portion of the great Kanawha Coal Basin proper; the counties of Tazewell, Russell, Scott, Buchanan, Wise, and Lee, participate in it; while in the counties of Montgomery, Pulaski, Wythe, Smythe, and Bland are found the coals which belong more strictly to the protocarboniferous series, and are designated generally as the Upper New River series. The former may be considered as belonging nearer the great Carboniferous, from the regularity and continuity of both the coal and the accompanying rocks. The latter have, also, been found to run for miles through the counties named with surprising regularity; so much so as to baffle those gentlemen who, basing their opinions on the unreliability of corresponding measures in Pennsylvania, ventured to predict the same character for the Virginia beds. Daddow was one of the first to recognize that these measures were of a highly valuable nature; and recent developments have fully proved his conclusions. Witness the operations of the Altoona Coal Company at Martin's, in Pulaski County; of the Blacksburg Company, and numerous others, in Montgomery County; of Colonel Boyd, and Joseph Crockett, in Wythe County, and others, in different localities. It is undeniably true that much of this area has been badly injured by the convulsions to which this part of the earth's crust has been subjected; but there are large areas which have been preserved in almost their original regularity, or, if disturbed, only to the advantage of the miner. These veins vary in thickness, being 22 feet at Altoona, 8 feet in Montgomery, 5 feet in Wythe, and less at other points, generally with a uniform pitch of 30 and 42 degrees in different parts, except where there are well-defined basins, as in Pulaski, and the lower part of Wythe and Montgomery counties. These dips then apply mainly to the outcrops, while the central portions lie nearly flat.

The southeastern portion of the Great Kanawha Basin, which we have just mentioned as being confined to the counties of Tazewell, Russell, Scott, Buchanan, Wise, and Lee, cannot be overestimated as a mineral producing region. These counties hold the most valuable bituminous coal veins, accessible to the miner, and close to the ores which they are intended to reduce, in the country. Within seventy-five miles of vast quantities of the iron, copper, lead, and zinc ores are found horizontal veins of fine bituminous and block coals, measuring 11 feet, 8 feet, 5½ feet, and 4 feet, running for miles reliably through the extended area above mentioned. It is true that a part of the extreme southeastern edge of this area is somewhat broken up by a double fault; but immediately back of this begin the flat dips and reliable measures above alluded to. There is, also, in Southwestern Virginia the largest and most valuable virgin forest in the United States, comprising poplar, cherry, walnut, oak, hickory, white pine, hemlock, and locust. In conclusion may be added, as of interest to iron manufacturers, the following analysis, made by Mr. Dickinson, of a limestone from the Lower Helderberg group at the base of Flat Top Mountain, Dismal Creek, Giles County:

Lime	49.42
Magnesia	2·04
Protoxide of iron	1.53
Oxide of manganese	0.15
Alumina	0.48
Silica	2.94
Sulphuric acid	0.02
Phosphoric acid	0.04
Carbonic acid	42.00
Water	0.60
Organic matter	0·78

During 1868 zine ore was mined at the Uuion Lead Mines, and shipped to Trenton, N. J., and to the Lehigh Zinc Works at Bethlehem, Pa. It was sold at the mouth of the shaft at $6 a ton, and the average cost of raising it was $3.50 a ton. At this time the cost of pumping the water alone at the Friedensville mines amounted to $6 to the ton of ore. About 2500 tons of zinc ore were raised that year. Double this amount might have been produced but for the short-sighted policy of the proprietors, who would not make the necessary outlay for the improvement of the dressing machinery.

The Union Lead Mines have produced since 1838 12,167 tons of pig lead (2,000 pounds), charcoal being used for reduction. Before the war the cost of production was 2.4 to 3.1 cents per pound, during the war as high as 12 cents (gold), and since the war up to 1869 5 cents per pound. If these mines had been in the hands of a vigorous company four times this amount of lead could have been produced.

As much as 745 tons have been raised in one year, but the necessary exploration being neglected this production could not be maintained. A tunnel 1100 feet in length, which cost $32,000, is now used only as a tram road, connecting with an old shaft which is used as a shot tower, when it might be the main avenue of large and productive mines.

The iron resources of the western part of the State are especially remarkable, both for the quantity and quality, as well as for the variety of the ores which occur there, and also for the manner in which they occur, which renders their mining so extremely easy. Commencing at the Maryland line the whole belt of country which lies between the Blue Ridge and the Allegheny Mountains may be said to be ferriferous. On the eastern side of the Blue Ridge the Archæan ores are found, which are followed on the western slope by the ores of the Potsdam period, greatly developed, then the Clinton and Oriskany groups. Incidentally deposits are found in other formations, as in the Trenton limestone, or as it is there called the Valley limestone, and also in the Hamilton shales. These last are pockety, while the others are regular geological beds. Independently of these are the magnetic belts of the James River in the southwestern part of the State. It is astonishing that so little attention has been called to the mineral wealth of the State of Virginia. There seems to have been a theory that the Oriskany sandstone, which is the great ore-bearing formation of the State, was too rich in silica to be worked. This finds expression in the *Geologists' Travelling Handbook*, in which it is distinctly asserted that the Oriskany formation contains no ores that can be utilized for the manufacture of iron. Shortly beyond the Maryland line the great Shenandoah Valley is cut in two, in the direction of its length, by the Massanutten Mountains, and in their valleys the Potsdam ores are worked on the western flanks of the Blue Ridge, while the Clinton and Oriskany ores are worked on both slopes of the Massanutten Mountains. Not far from Staunton these mountains abruptly terminate, and the valley opens for several miles the whole width between the two ranges. Commencing at Buffalo Gap, the ores reappear on the western flanks of Little North Mountain. The Clinton ores outcrop occasionally, and in some places, as at Clifton Forge, are well developed, in three beds about one foot each in thickness, and have been mined to a considerable extent. The Oriskany is, however, the formation which usually appears in force. It has been folded on itself and afterwards eroded, so that for a distance of more than fifty miles, it crops several times at short intervals high up on the hillside, in beds of from twelve to twenty feet in thickness, and in a few localities even thicker. Very little work is done on the Potsdam beds. In the Massanutten Mountains the most prominent ore is that of the Shenandoah Iron Works, where a small charcoal blast furnace is being worked. The only other furnaces at work, at the present time, are those at Longdale and Quinnimont, though an eighty-ton furnace is being constructed at Low Moor.

The coals of West Virginia are remarkably pure and free from sulphur, and are as low as two per cent. in ash. Analysis of the cokes, shows them to contain rarely more than six per cent of ash, which is a much lower average than that of the Connellsville coke. These averages of the coals and ores are given of over one hundred samples, which were very carefully analyzed. The Virginia iron deposits justify the erection of a very large number of furnaces. Very few of the ores are suitable for making Bessemer pig, but for other purposes the ores are of good quality and rich; the coke is excellent, and remarkably free from ash, sulphur, and phosphorus, while good limestone and plenty of water can be had in abundance.

—*Compiled from a paper by C. R. Boyd, M. E. Transactions American Institute of Mining Engineers.*

MAGNETIC IRON ORES OF NEW JERSEY.

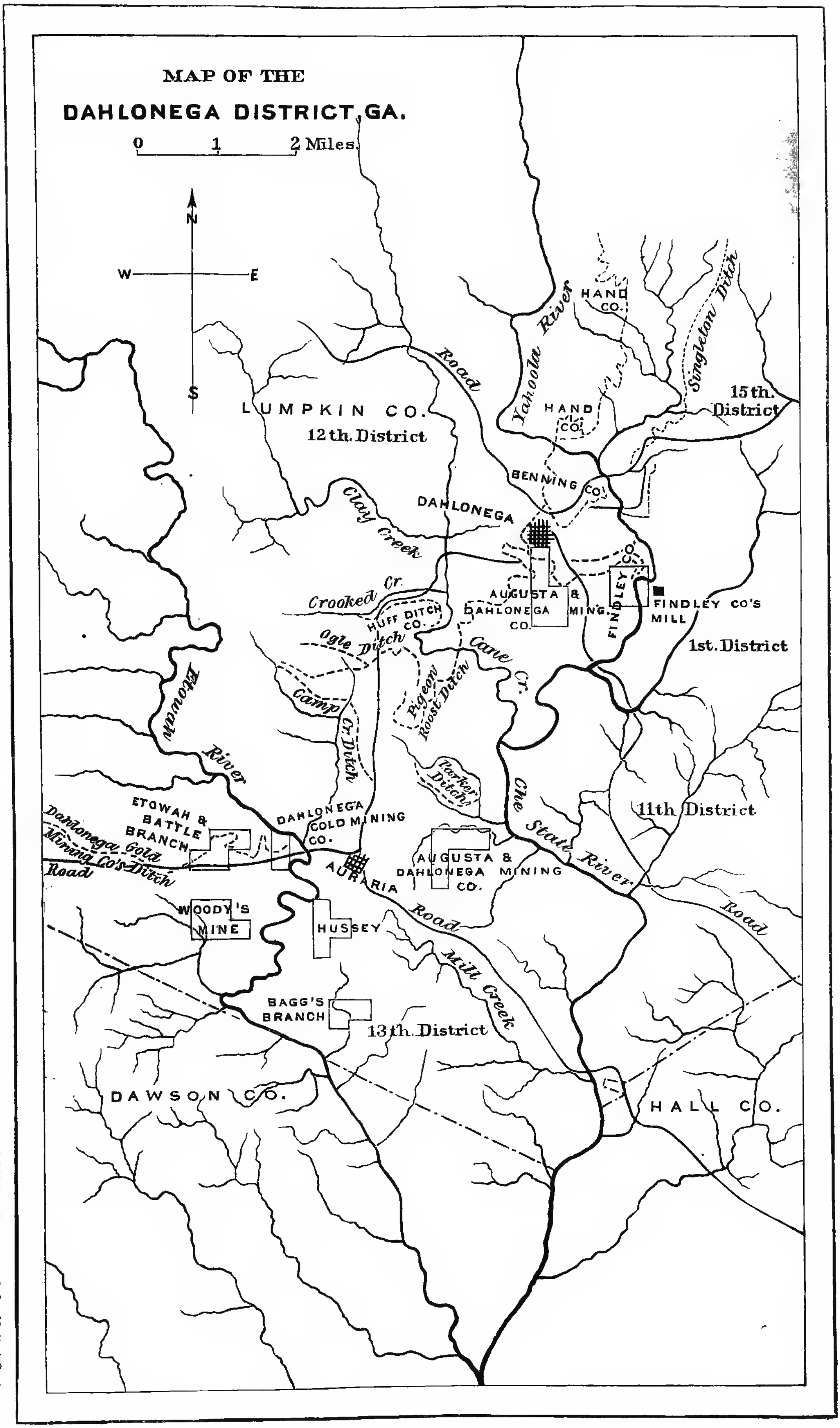
THE magnetic iron ores of New Jersey are found in the northern part of the State, in the Highland Mountain range, which runs from the New York line on the northeast, to the Delaware River, near Easton, at the southwest. The same range continues across Orange county to the Hudson river, and towards the southwest it is known in Pennsylvania as the South Mountain. It is, more properly, an elevated table-land, quite deeply furrowed by several narrow, longitudinal valleys, and shorter cross-valleys, or gaps. The ridges, or lines of elevation, as well as the lower valleys, conform in their general direction very closely to the general trend of the whole belt or table-land, that is, from the northeast to the southwest. This also agrees with the prevailing strike of the rocks. This great uniformity in the altitudes of the hills and ridges, and the direction of the lines of depression corresponding to the strike of the strata, point to original table-land, which, through the long action of denuding agents, has been quite deeply eroded, giving rise to the present surface configuration, so that some of the former and uniform features have been partially obliterated. The very few cross-valleys or depressions are much more irregular in their course, and serve as outlets through which the drainage is carried, either into the Kittatinny Valley on the northwest, or to the broad red shale and sandstone plane bounding the highlands on the southeast. The area of this highland region in New Jersey is about nine hundred square miles. Its average elevation above the ocean is about one thousand feet. Except the valleys toward the northwestern border, as the Wallkill, Musconetcong, Pohatcong, and German, which contain magnesian limestone and Hudson River slate, this whole range consists of crystalline rocks, mainly gneiss, granite, syenite, and limestone, covered in many places by drift and alluvial beds. These rocks resemble closely those of the Laurentian formation of Canada, both in their structure and in their mineralogical characters. Stratification is nearly everywhere plain, indicating a sedimentary origin and subsequent metamorphism. In the Geological Survey reports of the States they have been described as belonging to the "Azoic Formation." It is in this series of crystalline, metamorphic rocks, that the magnetic iron ores occur. The extent of this outcrop and the iron mines and localities at which ore in workable amounts has been obtained, are both indicated upon the geological maps of the State survey, one of which has recently been published. This map shows the mines as in lines nearly parallel to one another, and having the same direction as that of the whole belt or range. In some instances they are so close as almost to form a continuous line, as the Mount Hope, Allen, Baker, Richards, Mount Pleasant, and others, near Dover, in Morris County. Others appear in sort of *en échelon* arrangement.

This occurrence in lines, or what may be more properly termed ranges, is so well known that miners and those searching for ore speak of veins continuing for miles, and of certain mines belonging to certain veins. Large and productive mines, as the Hibernia, Mount Hope, Dickerson, Ogden, and Kishpaugh, with others, give names to such lines. The complete breaks in veins worked, and the absence of any indications of continuity, show that these popular theories are not yet substantiated by the facts, although, if by the terms lines or veins, or, better, ranges, series of ore beds whose several lines of strike or axes run closely parallel to one another, are meant, then they have a foundation in truth. In the "Geology of New Jersey," published in 1868, the mines then opened were grouped in such lines, and these were called ranges. The map accompanying that report, as well as the one just issued by the State Survey, shows these lines and the intervening barren belts. A comparison of these two maps confirms in some degree this theory of ranges, or what would be better termed, ore-belts, inasmuch as the hundred or more new mines and ore outcrops opened since 1868, and represented on the latter map, are nearly all either on old and well-known lines or what must be considered as new ones. These discoveries have shortened the gaps and widened the ranges. Thus the new mines near Chester, and those along the eastern base of Copperas Mountain, all in Morris County, have filled in wide blanks, and greatly extended what were but faintly indicated as ranges or belts of ore. The numerous openings quite recently made on Marble, Scotts, and Jenny Jump Mountains, in Warren County, constitute a new and marked line. In this the manganiferous character of the ore throughout its whole length seems to give additional evidence in proof of such a relation. An order of arrangement or division into such lines or belts, based upon lithological and mineralogical characters, has not been possible, but it is hoped that further studies will develop the existence of such characteristic features which will confirm the indications from the geographical distribution. The last map also shows groups of mines, between which very little ore has been found. One of the best known and largest of these groups is near Dover, Morris County, and a map of this district was published in 1868. Northeast of this there is an interval of several miles, extending almost to Ringwood, in which there are no working mines, and comparatively but few localities where ore is known to exist. But the newly opened Board, Ward, Green Pond, Pardee, and Splitrock mines show that the lines of ore are beginning to be traced into this hitherto barren district, and point to future discoveries which will connect the Ringwood and Sterling groups with the Morris County lines. A lack of cheap and ready transportation has prevented the thorough examination of this part of the State, or the development of any localities which were promising. The extended workings in the older mines are also doing much to prove the great length, and probably continuity, of some of these veins. Thus the long line from Mount Hope to the Dickerson mine, a distance of seven miles, has been so opened as to show an almost uninterrupted bed or vein of ore, or a series of veins parallel to each other, and all within a very narrow belt; and all of the facts of geographical distribution, as well as the arguments which could be drawn from the probable mode of origin of this ore, tend to support this theory of lines or ranges, or better, perhaps, belts of ore.

Magnetite, as a mineral, is very common in the crystalline rocks of the Highlands, occurring more frequently than any other mineral, excepting the ordinary constituents of the gneissic rocks, viz., quartz, feldspar, mica, and hornblende. And so widely is it distributed that it is impossible to find many strata in succession where it is entirely wanting. It appears as one of the constituent minerals of these beds, either wholly or in part replacing their more common components, or it is added to these, and in each case occurs in thin layers or laminæ alternating with them, or it is irregularly distributed through the rock mass. The unstratified granitic and syenitic rocks, as well as the bedded gneisses, also often contain magnetite. In these, however, it occurs in larger and more irregular crystalline masses or bunches, and does not appear to be so properly a constituent of the whole, but rather as foreign to it. The same mode of replacement is sometimes seen in these as in the stratified rocks. In both these classes it enters into the composition in all proportions, increasing in amount until the whole is sufficiently rich to be considered as an ore of iron. Between rock entirely free from magnetite and the richest ore there is an endless gradation, making it impossible to fix any other line of demarcation between them other than that of the minimum percentage for the profitable extraction of the iron. Three modes of occurrence have been assigned to this mineral, two of which are in the rock, as one of its constituents either in irregular bunches or in a granular form, and the third in seams or strata, when it is called ore. But these distinctions are not fixed, and therefore it is better to consider it as one of the more common minerals of these gneissic and granite rocks, and in places forming the whole mass, or else so much of it as to be workable, and then to be called an ore. Rock containing from twenty to forty per cent. of metallic iron, the most of which is in the form of magnetite, has been found in many places, and some of these have been explored to a considerable extent in searching for richer ores. The granitic and syenitic rocks containing magnetite are generally found to cut the beds of gneiss, and are, geologically, huge ore-bearing dikes. The most common mineral aggregation is feldspar, quartz, magnetite, and hornblende, or mica, although in some cases both the latter enter into the composition. Such rock is worked at a few points, but these operations are not yet worthy of the designation of mines. And, in fact, the great irregularity and the varying percentage of iron in it does not make it a desirable ore. Gneiss containing magnetite in quantity sufficient to render it workable, has been opened and mined at several localities. Perhaps it would be called lean ore. One of the most extensive outcrops of such ore is near the Pequest mine, in what is known as the Henry tunnel, about two miles north of Oxford Furnace. Here there is a breadth of twelve feet or more, in which the beds are highly impregnated with magnetite, while those on each side are free from it. Extensive drifting and sinking have exposed several hundred feet of these beds on the line of strike, and shown an increase in the percentage of iron going from the surface to the lowest levels. Near Hackettstown, in Warren County, there are several localities of such ore-bearing rock, but nearly all of them are failures as mines. The Scrub Oak mine, near Dover, the Combs mine, near Walnut Grove, have large portions of their veins so mixed with rock that they may be classed with the above localities of ore-bearing gneiss. And all the lean ores of the State may be considered as gradations in the series from rock to what is conventionally termed ore.

While it is impossible to separate these lean ores from the rock upon any decisive or marked distinctions or differences, the richer ores are to be considered as a distinct mode of occurrence, as these differ from the lean ores and rock in their simplicity of composition, being made up of fewer elements, and these predominating to the exclusion of all others. Assuming this as another mode in which the magnetite occurs, the geological features of these *seams* or *strata* may claim our attention. They are often called *veins* because of their highly inclined or almost vertical position, and hence resemblance to true veins. Their irregular form has helped to strengthen this opinion of them. But as they show well-marked planes of stratification and also lamination, both parallel to the beds of gneiss which inclose them on the sides, and have strike, dip, and pitch, and are folded, bent, contorted, and broken, just as stratified rock, they must be called beds, and be classed among the sedimentary rocks. The irregularities in their extent, thickness, and the presence of included masses of rock, known as horses, are phenomena common to the gneiss and them, and therefore these cannot serve as an argument for calling them veins. Lenticular masses of micaceo-hornblendic gneiss, lying in feldspathic and quartzose beds, or the converse, are quite common, nor do the strata of these rocks run on unchanged in character. But they thin out or grow thicker, or change in mineral composition just as these veins are seen to *pinch out* or swell into thick *shoots*, or be replaced more or less gradually by rock. The similarity in these respects between these ore masses and the surrounding stratified rocks proves them to be beds and of contemporaneous origin. Imbedded in the gneissic strata of this highland belt or region, these iron-ore beds or veins (so called) have the same general strike or dip in common with them. The prevailing direction of the first is towards the northeast, varying, however, within the quadrant from north to east. In most cases it is between the north and northeast. From these there are several exceptions, as at Oxford Furnace, where the veins run north 25° west; the Connet mine, a few miles west of Morristown, where it is also northwest and southeast. While these lines of strike have a general straight bearing, they exhibit short irregularities and deflections, often varying from side to side, or zigzagged by faults or offsets. The rocks of this formation, as observed in hundreds of places, show the same prevailing straight lines as are seen in the longer openings for ore. Bends or foldings are very rare. One of the most remarkable of these is on Mine Hill, Franklin, Sussex County, although this occurs in a zinc vein or bed, and not in iron ore. Here there is quite a sudden bend, so that the vein returns almost to its original course—which is the usual northeast and southwest one. In the iron mines of the State, the Waterloo or Brookfield mine, about five miles north of Hackettstown, in Warren County, shows a curving strike—turning from northeast and southwest to north and south. Further opening may find as complete a bend here as is to be seen on Mine Hill. But the best example of such folding is at Durham, Pa., where the iron-ore vein, as followed in the mining operations, coincides in its course very nearly with the contour line of the Mine Hill, running around in a semicircle on the western side of this elevation.

The dip of these ore-beds being at right angles to the line of strike has, of course, the same degree of uniformity in direction, and that is towards the southeast, or more generally towards the east-southeast. In some localities the strata are in a vertical position or inclined towards the northwest, and the dip is in that direction. But this has been observed in a few mines only, and in some of these, deeper working has



—Drawn and Engraved for the Mines, Miners and Mining Interests of the United States.

found the vein below assuming the prevailing southeast dip, indicating the existence of a fold, of which the *vein* opened is a segment, or a bending over near the surface caused by some powerful force acting subsequently to the elevating and folding agents. The Beach Glenn and Davenports' mines, in Morris County, offer illustrations of northwest dips. The rock outcrops show a number of such directions, but they are comparatively few in number, when the thousand or more observed southeast dips are considered. In the Connet mine (mentioned above) the dip is towards the southwest. At Durham it is radiating towards a central axial line of what is considered as a fold, and in, towards the centre of the hill. In the Hurd mine, as also at the zinc mine, Franklin, the two legs of the synclinals show dips at different angles towards the southeast, one of these, at Hurdtown, being almost vertical, while the other is quite steep. In the large openings of the Ford and Scofield mines there is no dip, the beds standing vertical. The term *pitch* is used to designate the descent or inclination of the ore-bed or *shoots* of ore towards the northeast—or in line of strike. If we should conceive of the line of strike as broken and depressed so as to descend towards the northeast, we should get a good example of this *pitch* of *shoot*. This inclination has been observed in the rock as well as in the ore. It is so commonly observed in mining these magnetic ores as to be expected everywhere, and miners speak of the ore *pitching* or *shooting*, and their working has constant reference to such a structure in both ore and inclosing rocks. In nearly all cases the pitch is towards the northeast. It is beautifully exhibited in the Cannon mine, at Ringwood, where it amounts to 45° inclination from a horizontal line. The long slope of the Hurd mine, in Morris County, and the thick swells alternating with intervening *pinchers*, or barren ground, at Mount Hope, show this same structural phenomenon.

These *shoots* of ore, however named, are best described as "irregular, lenticular masses of ore imbedded in the gneiss, their longest diameters coinciding with the strike and pitch of the rock," which in nearly all cases is towards the northeast, and their dip conforming to that of the same surrounding rocky *case*, and generally at a high angle towards the southeast. They vary greatly in their dimensions, sometimes thinning out or *pinching*, when followed on the line of the strike, or on that of the dip, to a thin sheet or seam of ore and occasionally ending wedge-like in rock. Sometimes they split up into several small veins or *fingers* which are dovetailed, as it were, in with the rock, and so gradually pinch out. Quite often there is a sort of flattened kernel or core of rock inclosed in the shoots of ore, but generally these *horses*, or what are called such, are interpenetrating masses of rock from the outside *country rock*. Extensive mining operations and explorations have shown some of these shoots to be connected with others, forming a series of these lenticular masses, or if not actually united by ore, associated and arranged on closely parallel planes, if not in the same axial plane. Following the plane of the dip downwards, the *pinches* between the shoots are nearly everywhere continuous sheets of ore, and these are not often greater in breath than the shoots. That is, the distance from shoot to shoot measured across the pinch is not often greater than the breadth of the former. But quite frequently these shoots are entirely separate from one another, rock intervening in the same plane, or they are in different planes or geological horizons. Nearly all of our New Jersey mines work on more than one shoot, since the extraction of the ore from near the surface is easier and more economical than following a single shoot downwards. Their length is unknown. In the Hurd mine the slope is nearly 900 feet long descending on the *bottom rock* and there are no signs of exhaustion. In the Weldon mine (near the Hurd mine) there are two shoots side by side, but not exactly parallel, nearing each other as they pitch down, and now separated by about twelve feet of gneiss rock. These may come together and prove to be leaders from one large shoot. In most of our iron mines the ore is bounded by well defined walls or strata of rock from which the ore comes off *clean* in mining, but very frequently there is no such plain boundaries or sudden transitions from magnetite to gneiss, but a very gentle gradation of ore into rock, and in these cases the mining goes only so far as the richness of the beds in iron makes it profitable to remove them. Following the *shoots* downwards, the same gradual replacement has been observed until the whole was too lean to work, or altogether free from ore; but this feature is not so common as that of the gradation or deplacement towards the side of the shoots or the walls. Occasionally the shoot is said to run out, that is, there is a sudden change from ore to rock; some of these, however, may be faults rather than shoots changed into mineral composition.

The thinning out of the shoots towards the edges, or at right angles to the line of pitch, or towards what may be called the lines of pinch, which run parallel to the lines of *swell* or axes of these shoots, has originated the terms cap-rock and bottom rock. The former makes the arched or double-pitched roof of the mine, while the latter constitutes the trough-like floor or bottom. These peculiar features are very finely exhibited in the Hurd mine, Hurdtown, Morris county, where the extraction of the ore, following the conformation of the shoot, has left the *cap-rock* overhead and the *bottom rock* below, on which the long slope runs down to the bottom of the mine. In the Cannon mine, at Ringwood, the same capping rock appears in the heading or northeast side of the large opening, and the track runs down on the bottom rock towards the northeast. Here the pitch is nearly twice as great as in the Hurd mine and the shoot as worked is much broader, being nearly of the same size both ways. And here there may be said to be *four* walls that surround the ore. Sometimes miners speak of these top and bottom rocks as walls. But generally there is a narrow vein or sheet of ore left both at the top and in the bottom; and these may gradually run out entirely, or they may connect with other shoots of ore lying in the same plane of dip as that of the shoot worked. And this is true in nearly every case; the exceptions being considered as not yet fully demonstrated as such, since the mining operations generally cease when the vein pinches up so as to become unprofitable for the removal of its ore.

The extent of these *shoots* of ore is exceedingly varying, and our mines are not yet deep enough to show their maximum length. The width and thickness, or the lateral dimensions, are soon ascertained, the former scarcely ever exceeding one hundred feet, from *cap* to *bottom rock*, or from *pinch* to *pinch*; and the latter varying from an inch to eighty feet; but more often less than thirty—they may average five to twenty feet. These figures always include some rock, or *horses*. The oldest and deepest of our mines, as the Blue mine, at Ringwood, the Mount Hope, Swedes, Dickerson, and Hurd mines, are all steadily going down, increasing the length of their slopes, and they are apparently as inexhaustible as ever, and promise to continue so, at least as far as our present appliances for hoisting ore and water can allow of the economical extraction of ore from them Such are some of the more general and essential features that characterize the iron-ore beds of the state. Lying imbeded in, and being contemporaneous in origin with, the gneissoid rocks of this Azoic formation, these ore beds or *veins* have been subject to the same disturbing forces which have elevated, folded, wrinkled, and broken all the strata belonging to it, and which have given to it its present structure. These forces, so manifold and acting through so long a period of time, and probably at wide intervals, have so destroyed any degree of uniformity which once may have existed, that it is often difficult, and sometimes impossible, to recognize amidst this chaos any order of structure whatever. The beds of ore and rock have been squeezed into close folds, so that they now stand on edge, and through these agencies have come the strike and dip. Other forces acting on lines traversing the veins at all angles, have variously dislocated and further disturbed the strata, giving rise to frequent *faults* or *offsets*, and what are called *cross-slides*—phenomena seen in both the veins and in the rock strata of this formation. In some instances the veins have been displaced one hundred feet while in others the ore-mass has been broken apart, but not pushed aside, so as to interrupt its course. The planes of these dislocations traversing the veins in all directions, the dip and strike are sometimes both altered. These faults are common, and can be seen in nearly all the mines; sometimes so frequent as to cut the vein into short segments, giving it a zigzag course. The most remarkable faults or offsets are seen in the Mount Hope mines, where five veins are all displaced over a hundred feet; in the Hurd mine, where the displacement has been in a vertical plane and the original long and continuous shoot appears as two distinct masses, the upper of which has been worked out. Other examples are in the Byram and the Mount Pleasant mines, near Dover. Generally a thin seam of ore mixed with rock connects the vein on corresponding sides of the fault, and this serves often as a guide to find the vein beyond the break or offset. Miners have several so-called rules about offsets, but these are not universal, and there is no general law in the direction of the throw or displacement. Occasionally one fault is crossed by another—increasing the irregularity in the course of the vein.

From these numerous faultings, discovered in mining operations, we learn something of the extent to which these strata have been disturbed since their original deposition, and probably all subsequent to their elevation and compression into folds. More thorough surveys of the surface and more extended mining may yet enable the geologist and miner to trace out these lines of fracture, and learn how much they, together with the general effects of elevation and folding of the whole formation, have contributed towards the grouping of the iron-ore as we find it, and this knowledge may direct both our mining and our searches for ore. The facts already obtained point to a system, and the successful pursuit of the ore in its crooked and broken course in some of the largest mines is the best evidence of the accuracy of the laws of structure as now understood. They also show most forcibly, and illustrate most beautifully, the intimate and necessary relations of mining and the principles of geology, and show that the two ought never to be disassociated.

—Compiled from a paper by J. C. Smock. Transactions American Institute Institute of Mining Engineers.

THE SALISBURY (CONN.) IRON MINES AND WORKS.

THE three principal mines from which the celebrated Salisbury iron ores are obtained are called respectively the "Old Hill," "Davis," and "Chatfield ore beds, and are situated in the town of Salisbury, Litchfield County, Conn., on the eastern slope of the Tocconuc range of hills. The Old Hill Ore Bed is a tract of land of 100 acres, originally granted by the General Court in October, 1731, to be laid out by Daniel Bissell of Windsor. It was soon after surveyed and located by Ezekiel Ashley and John Pell. The descendants of Ashley are still proprietors in the mine. The supply of ore has been very abundant, and for many years was easily obtained, but latterly the cost of raising has been greatly increased. Up to about 1840 the average yield was estimated to be about 4500 tons per annum. The production has gradually increased until the average yield at present is estimated at 15,000 tons annually. The largest production in any one year was about 20,000 tons. The proprietors of this mine were incorporated many years ago under the style of "The Salisbury Ore Bed Proprietors." The Davis Ore Bed, named after an early owner, was originally called Hendricks Ore Bed, and was owned before the organization of the town of Salisbury by Thomas Lamb, one of the first settlers in the town. Ore was mined in this bed as early as 1730 or 1731, and was taken by Lamb to supply his forge at Lime Rock. It was in early days transported in leathern bags on horses. This mine has been worked almost constantly since first opened, showing an increased production. The average yearly yield at present is estimated to be about 15,000 tons. The property has passed through several ownerships; the proprietors are now incorporated under the name of Forbes Ore Bed Company. The Chatfield Ore Bed was originally owned by Philip Chatfield, from whom it takes its name, and was opened soon after the other beds were. It has been steadily worked since first opened, showing also an increased production. Its annual yield at present is estimated to be 12,000 tons. Notwithstanding these mines have been so long and so constantly worked, the supply of ore is still abundant and apparently inexhaustible. There has been no special effort to increase the production, as these ores are not in the market, and it is only desired to raise a sufficient supply for the furnaces in the immediate vicinity of the mines. The ores are all of the brown hematite variety, and of the same general character, yielding about forty-five per cent. of iron. The process of raising the ore and making it ready for the furnaces has been much improved within the past twenty years; it is crushed and washed by machinery before leaving the mines. The ore is raised entirely by open mining, and beds are now worked at a depth of from 75 to 100 feet. In addition to the mines mentioned above, the Barnum-Richardson Company is working mines at Amenia and at Mount Riga, both on the New York and Harlem Railroad, just over the New York State line, and on the western slope of the Tocconuc Hills. These mines produce ores very similar in character and value to those already described.

The first forge in this vicinity was erected in Lime Rock by Thomas Lamb, as early as 1734. He took his ore from the Hendricks (now Davis) Ore Bed. Several different parties succeeded to the ownership; among those who occupied it longest, and operated it most successfully, were Messrs. Canfield & Robbins. They operated a forge and blast-furnace on this site for many years, and also had a forge and blast-furnace (built by Leman Bradley in 1812) on the Housatonic River, just below the Canaan Falls, using at both places Salisbury ores. The Lime Rock property came into possession of its present owner in 1863, and in 1864 a new blast furnace was erected, which has been in operation up to the present time. About the year 1748 a forge was erected in the present village of Lakeville (then called Furnace Village), and in 1762 John Haseltine, Samuel Forbes, and Ethan Allen purchased the property, and built a blast furnace. This is supposed to be the first blast furnace built in the State. This property in 1768 came into the possession of Richard Smith, of Boston, who, being a Loyalist, returned to England upon the breaking out of the war. The State took possession of the works, and appointed Col. Joshua Porter their agent in its management, and upon orders of the Governor and Council large quantities of cannon, shot, and shell were made during the Revolutionary War for the General Government. John Jay and Gouverneur Morris were often there superintending the casting and proving of the guns, and at this time the Salisbury iron gained a celebrity which it has never lost for superior strength and general quality. The cannon were intended chiefly for the navy, and after the war the navy, to a considerable extent, was supplied with guns from the same iron. The ship of Commodore Truxton, the *Constellation*, and the celebrated *Constitution*, "Old Ironsides," were supplied with Salisbury cannon. The furnace was afterwards owned and operated for many years by Messrs. Holley & Coffing, who also operated a forge and furnace at Mount Riga. The forge on Mount Riga was built about the year 1781 by Abner or Peter Woodin. Daniel Ball succeeded, and the works were for many years known as Ball's Forge. Seth King and John Kelsey commenced building a furnace there about 1806, but were not able to complete it, and in 1810 it came into possession of Messrs. Holley & Coffing, who the same year finished it, and for many years carried on an extensive business. Pig iron, anchors, screws, and various kinds of manufactured iron were made there. These works and those at Lakeville were abandoned many years ago, and the property at Mount Riga, including the water privilege, which is very valuable and one of the finest in the State, is now owned by the Millerton Iron Company, Irondale, N. Y. There were also built at East Canaan two blast furnaces for the manufacture of pig iron from Salisbury ores, one about 1840 by Samuel Forbes, and one about 1847, by John A. Beckley. The first foundry for the melting of pig iron was built at Lime Rock about the year 1830, and soon after came under control of Milo Barnum, who was the founder of the present Barnum-Richardson Company. He associated in the business Leonard Richardson, and within a few years his son, William H. Barnum, was taken into the partnership.

The foundry business was carried on in a small way in connection with the store; their productions consisted chiefly of clock and sash weights, plow castings and other small work. The business gradually increased until about 1840, when they began the manufacture of railroad work, the first of which was chairs for the Boston & Albany Railroad, then building from Springfield to Albany; the castings were transported by teams to Springfield and to

Chatham, a distance of about fifty miles. The great tensile strength and natural chilling qualities of the Salisbury iron proved it of great value in the manufacture of cast chilled car-wheels, which naturally followed in a few years the making of smaller railroad castings. The iron early obtained, and has since held, the reputation of being the best known for this purpose. In 1858 the company obtained possession of the Beckley furnace at East Canaan, and in 1862 purchased the Forbes furnace at the same place. They also, about this time, purchased the foundry at 64 South Jefferson Street, Chicago, and organized a joint stock company under the name of the Barnum-Richardson Manufacturing Company, for the continuance of the foundry business. In May, 1864, the Barnum-Richardson Company, a joint stock company was organized with William H. Barnum as president and general manager. It has since largely increased its works by building, and by acquiring further interests in mining and furnace companies. A third and improved furnace was built at East Canaan in 1872; in 1870 a second foundry was erected at Lime Rock. A new wheel foundry was built in Chicago in 1873. The foundries at Chicago use the Salisbury iron, and have a capacity in the two shops of 300 wheels per day. The company uses, at its Lime Rock works, Salisbury iron also, and have a capacity of 200 wheels per day.

In 1840, there were in this vicinity four blast furnaces in operation, each using an average of 600 bushels of charcoal and producing three tons of pig iron per day. There are now seven blast furnaces owned by the company, of which William H. Barnum is president and general manager. They use each an average of 1200 bushels of charcoal, and produce eleven tons of iron per day. The new furnace at East Canaan at its last blast made an average of eighty tons of iron per week, this being the most advantageous blast known to have been made in a charcoal furnace of this size. The seven furnaces are located within a radius of eight miles from Lime Rock, and are situated as follows: three at East Canaan, one at Lime Rock, one at Sharon Valley, one at Cornwall Bridge, and one at Huntsville. In connection with the latter furnace there is a car-wheel foundry at Jersey City, having a capacity of 150 wheels per day, and using the iron exclusively from this furnace. The Salisbury pig iron shows an average tensile strength of about 30,000 lbs. to the square inch, and, besides being valuable for ordnance and railroad purposes, it is extensively supplied for malleable and machinery uses. The wheels made at the Barnum-Richardson Works have been largely used in the United States, Canada, and foreign countries, particularly in South America. The opening of the Connecticut Western Railroad has brought these mines and furnaces within easier access of each other, and has also enabled the furnace companies to procure a portion of their supply of charcoal from a distance, most of it being brought from Vermont.

—Compiled from a paper by A. L. Holley, C. E., Transactions American Institute of Mining Engineers.

THE IRON ORE AND ANTHRACITE COAL OF RHODE ISLAND AND MASSACHUSETTS.

THE existence of iron ore and anthracite coal in the neighborhood of Providence, R. I., has long been known, chiefly as a geological fact; that these materials, so near to each other and to tide-water, are of such a good quality and are present in such large quantity, as to have seriously raised the question of establishing blast furnaces there, was a surprising fact to me; and I have thought that the few notes I have lately gathered on the subject would be of interest. The coalfield referred to has an area of above 400 square miles, and is found throughout the belt of transition rocks extending from Newport Neck to Mansfield, Massachusetts. It underlies the cities of Providence and Newport, and the towns of Middletown, Portsmouth, Jamestown, Warwick, Barrington, Cranston, North Providence, Cumberland, Bristol, Warren, East Providence in Rhode Island, and Seekonk, Attleboro, Wrentham, and Mansfield, in Massachusetts. The amount of coal is not estimated, but very roughly stated at "hundreds of millions of tons" in a report of "The Rhode Island Society for the Encouragement of Domestic Industry." Professor Ridgway, in a memorial to the General Assembly in 1868, states that the field is a large but shallow one, made up of a cluster of beautiful coal basins, being identical with the lower coal series of the anthracite basin of Pennsylvania. The coal on the edges of the field has been not only broken up, but altered, by heat and pressure, such as the Pennsylvania field seems to have escaped; but Professor Ridgway states that it is regular and undisturbed, and less altered, in other parts. Still later—in 1875—a hole was sunk a little over 700 feet, at a point in Massachusetts some five miles from Providence, in the centre of the basin, and a bed of coal nine feet thick was found at this depth. Its quality, judging from the core brought up, was superior to the coal previously worked. All this coal has a red ash, and burns with great freedom and with a fuller blaze than other anthracite. The ash is quite fusible, so that a moderate blast is required. Some time ago, Mr. Samuel L. Crocker, of the Taunton Copper Company, stated that, for about twelve years, he had used 10,000 tons annually of this coal from the Portsmouth mine, in various manufacturing establishments and for domestic purposes, and that, for steam and all ordinary purposes, it was quite as good as Pennsylvania anthracite; while, for smelting copper ores, it was the best mineral fuel. More recently, the Taunton Copper Company have acquired this mine, and are now raising their own coal. The main shaft measures 1400 feet on the incline, and the gangways aggregate a length of 3½ miles. Another mine at Cranston, from which some thousands of tons were formerly shipped, has recently been reopened with a capacity of 100 tons per day. Most of the workings have been on the outcrop, where, as before stated, the coal is broken and altered. But the alteration seems to have pretty well freed the coal from sulphur, and has also given it free-burning qualities. Prof. Jackson's analysis of the Portsmouth coal is as follows:

Water and volatile matter	10.00
Fixed carbon	84.50
Ash of dark red color	5.50

Prof. Shaler's analysis of Cranston coal (1876) is as follows:

Volatile matter expelled at red heat	3.55
Fixed carbon	82.25
Ash	5.65
Hygroscopic moisture	8.55
	100.00
Sulphur	0.026
Specific gravity	1.839

The magnetic iron ore deposit at Cumberland, three miles from Woonsocket, and twelve from Providence, is the most valuable in the State. The "Cumberland Iron Hill" is a mass of ore 500 feet long, 150 feet wide, and 104 feet high, and is estimated to contain over a million tons above natural drainage. Probably a very much larger quantity lies below ground. The ore is not rich in iron—it averages 35 per cent.—but it is extremely free from sulphur and phosphorus, the latter element, as lately determined at the Bethlehem Iron Works, being but 0.026 per cent. The Bethlehem analysis gives the iron in one specimen as 30.86 per cent., and in another at 33 per cent., and the silica as 25.5 per cent. Dr. Chilton's analysis is as follows:

Per- and protoxide of iron	58.50
Oxide of manganese	2.10
Oxide of titanium	3.66
Alumina and silica	26.33
Magnesia	6.80
Lime	0.65
Water and loss	1.96
	100.00
Metallic iron	42.58

Such an ore mined by open quarrying with natural drainage, and almost on tidewater, would seem to be of some value for the steel manufacture. There are also hematite deposits, the largest being at Cranston, five miles from Providence. The analysis of this ore by Prof. Willis in 1870 is as follows:

Volatile matter,	14.950
Peroxide of iron	76.285
Protoxide of iron	trace
Silica,	4.810
Alumina,	2.100
Sulphuric acid (0.047 sulphur),	0.118
Phosphoric acid (0.199 phosphorus),	0.453
Peroxide of manganese,	0.080
Lime,	0.500
Magnesia,	0.410
Loss,	0.200
	99.936
Metallic iron,	53.40
Metallic iron in calcined ore,	63.60

The manufacture of iron in Rhode Island is not exactly a new subject, since it commenced in 1703. Many cannon were cast here from these ores for use in the Revolutionary War and in the war of 1812. The charcoal iron manufacture closed in this State in 1834, when anthracite iron began to be introduced. The authorities of the time pronounced the iron of very superior quality. The Cumberland and Cranston ores were mixed in equal quantities. It has been estimated that pig iron can be produced in this region at less than $16 per ton, which is no doubt true, seeing that ore, coal and limestone are adjacent and easily mined, provided the coal turns out to be a good blast-furnace fuel. I do not learn that experiments have been made in this direction. But whether iron is produced here or not there is already a largely growing development of coal mining, and it seems probable that ore of this quality, so near tidewater, may find a profitable market.

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THE SILVER MINES OF NEWBURYPORT.

THE first pit was opened in May, 1874. In August I made a visit to this pit, which was six feet wide in the north-west direction, twelve feet long north, 80° east, and six feet deep. About four tons of galena carrying gray copper siderite, and quartz, had been taken from this pit. The lumps were all of them evidently float specimens and varied from eight to twelve inches in thickness and showed very distinct indications of crevice or vein structure. The indications at the bottom of this pit were such as to remove all questions of salting. Three specimens were assayed, with the following results: No. 1, a coarse-grained galena, very rich in lead, yielded $63.13 of silver per ton of 2240 lbs. No. 2 was a fine-grained galena, and seemed to represent the standard ore of the mine. This gave 50 per cent. of lead and $84.26 in silver per ton. No. 3 was a nearly pure piece of gray copper not quite perfectly freed from quartz and galena; this sample yielded $1422 in silver per ton, also $145.12 in gold, and 27 per cent. of copper. The first discovery of ore in *in situ* was made about October 10th, 1874, when a crevice filled with a deposit an inch thick of galena was discovered some 40 feet due north of the first pit. This had a strike of about north 80° east. 6 feet to the north of this and parallel to it a six-inch crevice of galena was discovered. The parties who were operating the deposit then went about 20 feet, hoping to find a wider vein. The ore deposit as here found had widened out to a thickness of three feet at ten below the sod, and at a distance of 22 feet below the surface of the galena vein measured six feet thick. A hole was drilled dry through this mass perpendicular to the plane of the vein, and the drillings saved, thoroughly sampled, and assayed, yielding

52 per cent. lead at 6 cts. per lb.,	$69.84	per ton 2240 lbs.
1736 per cent. silver at $1.29 per oz. Troy,	72.87	" " "
0017 per cent. gold at $20.60. per oz. Troy	11.43	" " "
	$154 14	

This gives the gross value of a ton of the ore. A considable percentage will be lost in the working owing to the presence of antimony in the gray copper. Another valuation of the ore was made upon a larger scale at the Institute of Technology in Boston. A lump weighing 500 lbs. one foot thick was broken into three pieces, one of which, weighing 145 lbs., was treated. This when crushed and sorted by hand yielded 92 lbs. of smelting ore, *i. e.*, a tolerably rich galena, and one which would probably pass as No. 1 ore in most of the mining districts of the United States. While making the meltings a very considerable loss was experienced from fume. The yield was 30 lbs. of crude ingot lead or 746 lbs. to the ton of 2240 lbs. This crude lead after being refined with zinc, was again refined, and the rich portion cupelled. The lead was recovered from the cupel bottom, and there was obtained in actual marketable condition, 23 lbs. refined lead; 436.32 grains of silver; and 4.19 grains of gold. From this it appears that a ton of picked ore contains, in condition to be actually extracted and put in the market, as follows:

560 lbs. lead at 6 cts. per lb.,	$33.60
22 oz. silver at $1.30 per oz.,	28 60
101.8 grains gold at $20.60 per oz.,	4.37
	$66.57

Also a ton of crude ingot lead as produced by smelting yields:

1710 lbs. lead at 6 cents per lb.,	$102.60
74 oz. silver at $1.30,	96.20
341 grains gold at $20.60 per oz.,	14.63
	$213.43

It must be remembered that the losses in the above work are far greater than would actually take place where the ore was worked on a large scale and with experienced workmen. In reporting on the mine, the long ton, 2240 lbs., was used at the special request of the former owner, Dr. Kelley. The above figures are copied directly from that report. The Chipman shaft was sunk on the thick outcrop of galena just described. I am inclined to think that this mass was what is often known as a chimney of thickening up of the vein. A thickness of six feet of solid ore with a parting on each side has nowhere else been found in this mine. At a depth of 30 feet on the Chipman shaft a level 90 feet long has been driven to the southwest to the limit of the property. The ore has been stoped out up to the surface to a distance of 30 feet from the shaft, and I am told that the ore deposit was from 10 inches to 16 inches thick at all parts of the stoping ground of 30 feet square. The remaining portion of this 30 feet level which has not been stoped, *i. e.*, the 60 feet lying beyond the first 30 feet from the shaft, now carries a very fine display of ore, there being along the roof of the level about 12 to 15 inches thick of solid ore. The vein at one point on this level has been faulted with a throw of about six feet to the northwest. The deposit appears to be unchanged in character beyond the fault. At a depth between 50 and 60 feet below the surface of the vein, which so far has been vertical, leaves the shaft with a decided dip to the southeast. A level has been driven in a southerly direction at 100 feet depth, but when I last heard from the mine this level had not yet reached the vein though it was 20 feet from the shaft. Some gray copper, however, was beginning to appear at the end of this level, and a carefully selected and cleaned specimen of this was essayed at the Institute of Technology, and yielded as a mean of five essays:

12.186 per cent. silver, or $4583.93 per ton of 2000 lbs.
.004 per cent. gold, or $26.69 per ton of 2000 lbs.

The Chipman Mine is well equiped with a well-lined shaft, a fine hoisting engine, cage, cars, and pump, all of which have been put in by the superintendent, Mr. C. G. Paterson. In September, 1875, the mine was yielding regularly about 1½ tons of No. 1 ore, and 2 tons of No. 2 ore, and about 3 tons of No. 3 ore per day. No. 1 is fine smelting ore; No. 2 is a low grade of smelting ore; No. 3 requires crushing and washing. No. 1 ore, I am told, will sell outright for $100 per ton in New York. The Boynton shaft lies about 150 feet from the Chipman shaft in a direction south 80° west. The work of prospecting has not been carried on so extensively nor systematically here as in the Chipman Mine. The shaft apparently follows down the same ore streak, though it is not quite so thick on the average as in the Chipman Mine. I have visited a number of other openings, but have nowhere else seen an indication strong enough to give any great hope of the discovery of a mine. In many places the rusty streak of yellow ochre is followed with as much enthusiasm as in California, but it does not seem to be the fashion to pan this yellow dirt; this may, perhaps, be due to the fact that when it is panned it does not yield the color of gold which the California pay dirt does. The diamond drill has been used in the vicinity of Newburyport to some extent for prospecting. It seems a little odd that it should have been chosen for this purpose. A vertical hole is scarcely adapted to prospect among vertical veins which are liable at any moment to swerve away from the drill-core. A furnace has been erected in the vicinity of the Chipman Mine. This furnace is built on a slope of about 30°, and is intended to be continuous in its action, receiving the ore at the top of the slope, roasting it on the slope, and smelting with reduction to lead at the foot of the slope.

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THE ROCK FORMATIONS OF MAINE.

UNFORTUNATELY but little is known of the geological ages of the rocks of the greater part of Maine. There are thousands of square miles in the northern part of the State that are as yet wholly unexplored. Undoubtedly the rocks of the northwestern portion of the State are Laurentian in character. Of the explored and settled portions, we have of the Palæozoic age, the lower Silurian, the upper Silurian and the Devonian. No positive evidence has been afforded us of the existence of any part of the Carboniferous system. Many of our rocks have been referred to the Cambrian or Huronian system. Our rocks have hitherto received so little attention from geologists that there is necessarily a great deal of uncertainty regarding the true classification of them. The coast line from Grand Manan to the Isle of Shoals, although but three hundred miles in a straight line, owing to the numerous indentures, islands, capes, bays and rivers, actually measures more than twenty-five hundred miles of exposed rocks, affording magnificent and almost unlimited facilities for the examination of their formations. It is doubtful if anywhere in the known world is exhibited such a variety of rocks. Prominent among them may be seen granites of all grades and varieties, gneiss, sienite, protogine, porphyry, eurite, felsite, quartz, conglomerates, limestones, serpentine, steatite, hornstone, jasper, trap of all kinds, mica, hornblende, talcose; and argillaceous schists; clay and calciferous slates; pyritiferous and plumbaginous schists; fossiliferous and sandstone rocks. Many of the rocks on the coast of Maine are metalliferous; those of Hancock county especially. Another feature exceptionally prominent in Hancock county, and contiguous to the mines, is the great number of trapdykes and veins. Deer Isle, Sedgwick, Mount Desert, Sullivan and Gouldsboro, present numerous examples of these traps; also in Hampden, Hancock, Ellsworth, Blue Hill, Long Island, Machias, Lubec, Dexter and many other places. Much of the trap is porphyritic, more especially at Sedgwick, Deer Isle and Brooksville. That these trap-dykes and veins have some intimate connection with, or relation to, the ore veins about Hancock county is apparent from the fact that they are much more numerous in the vicinity of ore-bearing lodes. There is a very striking resemblance between the Maine metal-bearing belts and those of the Old World; and in reading descriptions of those of Cornwall, Wales, Derbyshire, North Germany and Spain, one cannot but notice the similarity. The rocks of Maine more nearly resemble those of the Old World than they do those of the Pacific coast. Mineral veins and beds in each separate portion of the earth certainly appear to follow one another in nearly the same relative order as to age, in so far as they are the gradual result of similar geological events. There can be no doubt that all true ore beds were originally formed by mechanical or chemical precipitation from water. Their conditions may have been much changed afterwards by the action of chemical or heat agencies. They exhibit certain lines of polarity. Magnetism or electricity seems to have something to do with the formation of ore veins, but exactly how or in what manner we are unable to determine at the present day.

It has been asserted that ore veins are more commonly found in mountainous regions than in plains; that they appear to be more frequent in the older rocks and formations than in the very recent ones. Hence it would appear that Maine is particularly well adapted to bear valuable deposits of ores. That the north and northwestern portions of the State are very much broken, and present an appearance altogether different from that of the south-western and eastern portions is true. This difference in appearance is easily accounted for by the fact that the northern portions of the State, being much more elevated, escaped the action of the drift matter which must have swept along the coast with great power, denuding and wearing down the surface, filling up valleys and ravines, and leaving comparatively a level track. We have positive evidence that this was the case in the fact that the surface of the denuded rocks shows numerous striæ or drift marks. If the surface of the rocks of the coast was laid bare, they would all present a polished or *striated* appearance. The discoveries of minerals and ores seem to have been confined principally to the coast line. No particular exploration has been made of the more northerly or mountainous regions. It is not anticipated that any rich discoveries of silver ores will be made in that section; if anything, gold will be discovered. Of the mining belts thus far explored in Maine, the more prominent ones are the Lubec and Trescott belts; the Gouldsboro and Sullivan, Sedgwick and Deer Isle belt; the Blue Hill copper belt; the Dexter, Corinna and St. Albans belt; and the Acton, Newfield and Parsonsfield belt.

The Lubec Mining Belt.—This has been the longest known of any in the State. Explorations for lead were commenced here many years ago, and considerable work has been done at different times, which has resulted in the development of a number of veins of argentiferous galenas. Considerable ore has been shipped from these mines at various times, and the result has been satisfactory. Several shafts and a number of drifts have been opened and a great deal of money has been expended, mostly (if reports are true), under a misguided management, the greater part having been devoted to expensive machinery and buildings. There is no question but these properties are valuable. Recent examinations by a prominent expert have shown this to be a fact. The mineral belt of which the Lubec mines are but a part, undoubtedly extends through Campobello Island, Lubec and Trescott. Numerous veins of galena have been found in Trescott, one of which is exceedingly promising. The rocks which appear upon this belt are argillaceous and calcareous slates. Trap dykes are exceedingly numerous; some of them are composed of green stone, others are porphyritic. Calcite is quite frequent and forms part of the gangue of the veins. Few impressions of shells are found, probably the same as those of Perry. The ore consists of lead, zinc and copper, on the surface. The galena is argentiferous, carrying silver in the proportion of from twenty to ninety ounces to the ton. Below seventy-five feet in depth, the ores rapidly change, becoming much softer, containing more lead and silver, and less zinc and copper. This belt probably extends up through St. George in New Brunswick. Several veins of ore have been opened in that section, the character of which is precisely similar to those of Lubec. Magnificent specimens of copper pyrites have been shown from Campobello Island, assaying twenty-four per cent. of metallic copper. This whole region is undoubtedly very rich in metallic deposits.

The Gouldsboro and Sullivan Mining Belt.—Coming west from Lubec to Gouldsboro one will cross a number of metalliferous belts, most of them, however, unexplored as yet. The above named belt or district has been quite extensively prospected, resulting in the opening of a number of good mines. It extends from Gouldsboro through the towns of Sullivan and Hancock to Franklin, in a north-westerly direction some twenty miles or more. The Cherryfield district should not be omitted in mentioning these metalliferous belts. It is probably somewhat similar to the Gouldsboro. The country rocks are syenites, quartzites and schists. Several exceedingly long and broad bands of quartz extend through the towns of Cherryfield and Harrington. A little free gold is occasionally found in this quartz, but not in sufficient quantity, probably, to pay for working.

At Gouldsboro there have been discovered some exceedingly large and well defined veins of galena, on which are located the Gouldsboro and Home, also the Soule and Guptill silver mining companies. These mines are very productive and rich. The Gouldsboro is the oldest, and consequently much farther advanced than the others. The ore taken from this mine consists of a mixture of galena, zinc, copper and iron pyrites, with occasional specks of gray copper. The ore runs from ten to four hundred ounces in silver to the ton. Some of the galena concentrates which I have assayed, run four hundred and eight ounces to the ton. The gangue of the ore vein is quartz; the wall of the rocks are formed of a peculiar kind of material composed of hornblende, quartz and lime. The Home mine produces exceedingly massive galena, carrying from forty to sixty ounces of silver. The vein is of great width and length. The gangue and the wall rock are similar to the Gouldsboro. One peculiarity of the country rock in the vicinity of these mines, is that it all contains lime. At the Soule and Guptill mine are found distinct veins of calcspar; this is considered a good indication for the whole district. Coming west from the Gouldsboro mines the rock changes into a slaty quartzite. At Sullivan it comes into contact with granite on the north. Along the shore of the Sullivan river, and running nearly parallel with it, is located the famous Sullivan lode. The course of the vein is from north-west to south-east. The strike being the same as the country rock, it dips towards the granite and will probably come in contact with it, inside of the depth of one thousand feet. This vein was discovered by Mr. Messer, in May, 1877. It crops out along the shore of the river, showing eight or ten inches of quartz, containing silver-sulphuret, galena, and iron pyrites. Mr. Frances Worcester caused a shaft to be sunk some eight or ten feet, and strange to say, he encountered specimens of native silver in the form of threads and flakes. Specimens of these were forwarded to the State Assayer. Having never seen any thing of the kind from the State before, he was exceedingly astonished and could not believe it,until he visited the mine and made a personal examination. The following spring a company was formed composed of Boston men, who commenced work at once, and has proceeded uninteruptedly ever since.

The discovery of the Sullivan lode marks an era in the history of mining in Maine, and deserves special mention. The Sullivan Company, although laughed at by many, and encouraged by none, except two or three experts who examined the property, with commendable energy, enterprise and perseverance, pushed their work forward until they have actually proved, despite all opposition, that the lode or vein is one of exceeding great richness. The success attending the working of this mine was unquestionably the cause of starting all other mines in this and adjoining districts. On the Sullivan vein proper, are located the Wankeag, Sullivan, Pine Tree and Milton mining companies. Further up the river, on the Hancock side, on the same range, are located the Robert Emmet and Hancock silver mining companies. These mines, although probably not located on any part of the Sullivan vein, are within the Sullivan belt. The Robert Emmet and Hancock mines both produce ores which carry considerable gold and some copper, while that of the Sullivan vein contains but little of either. Coming back again to the Sullivan side, we have the Ashley, Milbrook and Tugwassa mines, located below and a little to the eastward of the Sullivan veins. The Ashley and Millbrook are both located on what is claimed to be a broken or dislocated portion of the Sullivan vein, which, if the claim be not true, must have some close relationship to it, since the ore taken from the Millbrook at the depth of ninety feet, is of the same character as that of the Sullivan vein proper. There has been considerable disturbance of some portions of the Sullivan lode by the intrusion of trap dykes and porphyry, which may have caused a deflection or splitting up of the vein. The country rock in which the Sullivan vein is found, is a slaty quartzite, somewhat talcose, and in some places calcareous and occasionally porphyritic. At the Milton mine, the rock somewhat resembles the Comstock, porphyry being distinctly calciferous. A brief description of some of the characteristic features of the Sullivan mine will answer for all the others on or near this lode. The Sullivan company have one shaft one hundred and ninety feet in depth, following the dip of the ore vein, in which can be seen the ore vein, gradually widening from ten inches at the top to nine feet at the bottom of the shaft. Both the walls, foot and hanging, are clearly defined, and are separated from the slate by a distinct seam of clay nearly two inches in thickness. The vein matter is made up of alternate layers of different grades and varieties of ores, some of the streaks being exceedingly rich in silver compounds. The predominating ore is a black sulphuret of silver. Splendid specimens of native silver may be obtained; also argentite, stromeyerite, pyrargyrite, stephanite, and cerargyrite. In fact, almost every ore of silver is represented in this mine. The proportion of lead in the ore is very small. There is considerable iron, some arsenic and a little zinc. A fair average of the first-class ore from this mine will be about one hundred ounces. All the mines in this section are provided with first-class steam machinery. Many discoveries of ore have been made on all the adjacent and surrounding lands about Sullivan. Mount Desert, Hancock Neck, Iron Bound Island, Little Duck Island, Petit Manan Point and many other places have all contributed their share of new discoveries. At Petit Manan Point is located the Petit Manan Mining Company. On the eastern side of Hancock Neck is located the Grant Mining Company.

The Blue Hill Copper Belt.—Proceeding west from the Sullivan belt twenty-two miles, we come to the justly celebrated Blue Hill copper belt. Blue Hill is situated at the head of Blue Hill Bay, in the county of Hancock, and is of easy access by rail or steamer from any direction. This copper belt is about four miles long and one-half mile wide. It is entirely a distinct belt of itself, and has no resemblance to the adjoining parallel belts. It will be seen from the following description that it resembles the copper belts of Falun, Sweden, also the Carpathian belts, and the Chilian deposits. The copper belt proper undoubtedly belongs to the Huronian series. Blue Hill mountain is composed of coarse, eruptive granite; the same may also be found both sides of the belt, and even in some instances breaking through the gneiss and quartzite which form the larger part of the country rock of the metalliferous section of this belt. The richest copper ore seems to be confined to a soft granular quartzite. The whole belt is pyritiferous, even to the extreme boundary lines. The whole deposit is clearly stratified, and appears to be an immense fissure vein, the whole mass of which is impregnated with cupriferous ores, and in fact it bears a great resemblance to, and is almost identical with, many of the great copper belts of the world, and as might be expected, indeed as has already been proved, is of almost uniform richness throughout the whole length. The strike of the rock is almost east and west; the dip varies greatly, mostly inclining, however, to the south. The ores lie in parallel alternate bands, in width varying from one inch to many feet. These, according to well known laws that have application to beds or deposits of this nature, must continue to yield ore to great depths. There are no faults or cross veins. No possibility can exist of losing or exhausting the ore strata in depth. A portion of one of the richest bands uncovered two hundred feet wide, on the property of the Douglass copper mining company, present the following characteristics, which will apply equally well to all the others. Commencing on the southern side, is found a thin band containing galena and zinc blende, some of the former being exceedingly rich in silver. A thin clay selvage separates the galena from a granular quartz band of rich purple copper, often containing black oxide and native copper. Then comes a rich band of yellow copper pyrites; next a wide band of "mundic;" next alternating strata of yellow pyrites and "mundic," with thin seams of purple ore, until it verges into the gneiss on the northern side. Ores can be taken out in large quantities, ranging from two to thirty per cent.; a fair average of the larger portion would be twelve per cent.

The following named ores may be found at this place: Red copper oxide (quite common); chalcocite, or copper glance (occasionally); bornite, often called erubescite; purple copper and peacock ore (very common); chalcopyrite, or yellow pyrites (predominates); tennantite (rarely); tetrahedrite, or gray copper (occasionally); malachite (in small nodules); azurite (rarely); chrysocolla (rarely); pyrrhotite (common); mispickel (frequently); molybdenite (occasionally); galenite, stibnite and zinc blende (quite common).

The Blue Hill copper belt presents many advantages, amongst which may be mentioned: first, its nearness to tide water, less than two miles. Ores may be landed in Baltimore or New York, from the wharf, at a price not exceeding two dollars per ton for shipment. Second, the facilities for raising the ore, no deep shafts being required, as it can be, and is worked from the surface; hence, no great amount of capital is necessary in developing. Third, the fine quality of the ore, the large quantity, and the ease in dressing and making it ready for the market. The smelters who have received the ore shipped from this region are greatly pleased with the way it works, the ore being one of great purity, containing no admixture of arsenic, lime, magnesia, or anything of the sort that will in any way interfere with the process of smelting. It is a simple mixture of quartz with the sulphurets of iron and copper, and makes a most excellent flux for reducing other more refractory ores. A fair average of the constituent parts is presented by the following analysis, made from ore taken from one of the mines:

Copper,	10.34 per cent.
Silica,	34.50 " "
Iron,	23.28 " "
Sulphur,	31.78 " "
Zinc,	10 " "
	100

It also contained gold at the rate of five pennyweights, and silver five and one-half ounces to the ton. These mines are under able and efficient management. All the modern and improved steam machinery is brought into requisition to assist in the working of them. Plenty of manganese is found in this vicinity, and the whole region seems to be unusually prolific in minerals and ores. All the mining and geological experts who have examined this belt, are unanimous in their reports of the value of the mines.

The Sedgwick and Deer Isle Belt.—Passing south from the Blue Hill copper belt, we cross a series of slaty rocks bearing some quartz and somewhat metalliferous. Reaching the coast line, the rocks become porphyritic, and are penetrated by numerous trap-dykes. In the town of Sedgwick, on what is termed Byard's Point, is found one large silver-bearing vein and several smaller ones; on the large vein is located the Edgemoggin company. At the depth of sixty-five feet, native silver was found, and the ore possesses many characteristics of the Sullivan ore. The vein is very strong and well defined. The hanging wall is as smooth as a marble floor, and is within five degrees of the vertical. Deer Isle is exactly opposite Byard's Point. Here there have been discovered a number of veins, some of which look exceedingly well. The Deer Isle silver mining company is located on a very strong vein near Dunham's Point. Their exploitations show a sulphuret ore vein, composed of heavy spar, calcite, fluor-spar, and quartz, carrying sulphurets of lead, zinc, iron, silver, and copper. The formation belongs to the same as that of the Edgemoggin mine. Serpentine, asbestos, jasper, quartz, apatite, and several other rarer minerals are found in close proximity to the Deer Isle mine. The Isle of Haut and Vinal Haven probably should both be included in the Sedgwick and Deer Isle belt. Both these islands are prolific in ores. At Vinal Haven nickeliferous pyrites is found in great abundance. Should nickel ever again become in great demand in this country, here is a deposit of unlimited extent that can be worked inexpensively, and would probably be a source of large revenue. There are dozens of smaller islands in the vicinity of Vinal Haven, from which many discoveries have been reported.

The Metalliferous Slate Belt of Penobscot and Piscataquis Counties.—This enormous slate belt is metalliferous in many places. It takes in nearly the whole of Penobscot and Piscataquis counties. It is very irregular in shape, being about seventy miles wide in the broadest part and is over one hundred and twenty miles in length. If a line be drawn from the lower part of Moosehead Lake down to New Portland; thence through Anson and Norridgewock to Waterville and Winslow; from there in a direct line to the north part of Bucksport; thence along the north-western part of Washington county to Princeton; thence across the Patten by the Twin Lakes in a direct line to the foot of Moosehead Lake; forming a section in the centre of the state, the outlines of which are very similar in figure to that of the state itself. Much of the slate of this area is of the clay variety, valuable in some portions as a roofing slate and worked as such. In the north-eastern part it is often more properly a fine-grained sandstone, associated with layers of clay slate. It is, also, in some parts slightly micaceous and often contains lime. Occasionally granite penetrates through the slate. Trap, greenstone, and quartz veins are frequent. Two sections of this slate belt are certainly metalliferous; possibly the whole of it may be. The eastern metalliferous part extends from Hampden and Carmel, up through Lowell, Passadumkeag, Enfield, Howland, and certainly as far north as Lee. The characteristics of this eastern metalliferous bearing belt may be summed up as follows. The veins occur in green-stone or an epidotic variety of quartz, mixed with occasional bunches of calcspar. The ore on the surface is always arsenical and antimonial. The ore is sparse but very rich, gray copper being always associated with it. Several mines are being operated on this belt, notably among them the Hampden, Harrington and McKusick. The Hampden mine has a shaft down on one of the green-stone veins from which specimens have been taken assaying over seven hundred dollars to the ton. The western metalliferous section of this great slate belt extends through the towns (commencing at the southern limit) of Newport, Corinna, and St. Albans, and probably as far west as Athens, also northerly through Dexter, Garland, and Parkman, to Guilford. The slate through this section is somewhat talcose, occasionally micaceous. The ore veins through this region are very pockety. Large boulders of galena are found in various places, especially in the towns of Dexter, Corinna, and St. Albans, where many prospecting shafts have been sunk. The galena is remarkably fine, and carries silver in fair proportions. It contains a slight admixture of antimony, and has a peculiar appearance that easily distinguishes it from galenas from other portions of the State. The slate is very friable and easy decomposed. Much of the quartz was originally heavily charged with arsenical sulphurets; this has decomposed on the surface, and considerable gold is found amongst the quartz that has probably been set free from this decomposition. It has been claimed that nuggets of free gold and also of silver have been found in Corinna and St. Albans. Several mines are now in operation in Dexter, Corinna, and St. Albans. So much float ore is indicative of good veins somewhere.

The Acton Mining Belt.—Leaving the St. Albans and Corinna belt, and passing south-westerly, we cross wide bands of ancient gneiss and granites, all so far as known, non-metalliferous. Proceeding west of Acton, in the county of York, we encounter another metalliferous belt, very narrow, but of considerable length, which we denominate the Acton mineral belt. This is from two to four miles in width, and probably about twenty miles in length. The formation is regular, and consists of shally mica schists and slates, enclosed on each side by irregular patches of granite, and also capped by the same on the hills. The explored part, where the mines are situated, is in the towns of Acton and Lebanon, some three or four miles from East Lebanon station, on the Portland & Rochester railroad.

The strike of the rock is southeast-south ten degrees, and the dip thirty-two degrees towards the south-west. Numerous parallel bands or veins of quartz, many of them metalliferous, run through the belt. The uniformity of the strike and dip is something remarkable. Scarcely a break or dislocation occurs within the mineral portion of the belt. The ore veins first show themselves at the edge of a marsh, at the upper end of the belt. Here they divide and run parallel about seventy feet apart, the entire length of the belt, cropping out occasionally along the first mile and a half of the belt, but finally becoming lost in the drift and soil at the lower end. Numerous cross-cuts and prospecting shafts have been put down along on the veins, and in no case has the thickness of the quartz been found to be less than four feet, and in every case more or less ore is present. Narrow veins of trap run along the eastern side of both these veins, and commonly form the foot walls. The ores consist mainly of argentiferous galenas, both fine and coarse grained; some zinc, arsenical iron and copper are also present in the surface ores, but not to any great extent. One notable fact is that the arsenical iron is argentiferous, often containing silver in the proportion of twenty ounces to the ton. In some places in the veins are found decomposed ores, oxides and carbonates of lead. These run in some cases very high in silver. The gangue of the ore is pure quartz; there is no admixture whatever of any lime or alumina minerals. This is a great advantage in concentrating the ores, since it renders the operation one of great simplicity. Almost any good form of jig, buddle or table, after the ores are crushed and screened, will answer for concentrating, and the product cannot fail to be very rich, and will command a high price in the market. The surface ores from the Acton veins run from twenty to one hundred and twenty-five dollars to the ton. Several companies have been formed for working these veins. The Acton silver mining company have a valuable section of land, through which both of the veins pass. Adjoining the Acton silver mining company on the south, is the Silver Wave mining company. The ore vein shows here a thickness of some twelve feet. The future of this mining section is very promising. The fact that so much good ore lies on the surface and the many advantages surrounding the working of the same seem to indicate that the working of these mines may be made to pay from the start.

The Wakefield and Parsonsfield Belt.—The State of Maine can lay claim to but half of this belt, as it passes in a south-easterly direction down into New Hampshire. This is eminently a quartz and gneissic belt. Immense veins of quartz crop out from East Wakefield, clear up through to Woodstock and Milton Plantation in Oxford county; possibly it may extend much further. The croppings are confined more particularly to the elevated portions, the hills and mountains. The quartz carries considerable gold in some places; it occurs very irregularly, however. There are also many veins of argentiferous galenas. The Lone Star mine in Milton Plantation is located on one of these. The Mineral Hill mining company is located on another at East Wakefield, just across the State line. The exploitations of the last named company reveal a true fissure vein. Considerable depth will have to be attained by the mines, on these quartz veins, before fine ore will be reached, owing to the high elevation of the country rock which carries the veins. This mining belt is either quite wide, or else there is a series of these elevated quartz veins, since ores of the same description have been found in nearly all of the towns surrounding Wakefield, also at Gilead, Newry, Andover, and Phillips.

The Gold Fields of Maine.—For years reports have come to us of the existence of Gold in the north-western part of the State. Hunters and men engaged in lumbering in the vicinity of the Rangely lakes have brought to us numerous samples of gold dust and nuggets. One hunter has for years, in his semi-annual visits to Portland to dispose of his fur, brought with him from one to four ounces of clean gold, which he reports has gathered on the streams running into the Rangely lakes. Quartz has also been brought us from the same locality, containing free gold. This quartz must have been broken from the ledges; consequently there is a strong possibility, not to say probability, that gold exists there *in situ*. Gold has also been washed from the black sand found in Sandy river, running through Philips, Madrid, and New Sharon, also from Carritunk stream, Dead river, Seven Mile brook, and many of the small tributaries near the head waters of the Kennebec. Gold has been found in the quartz at Bingham, Moscow, and New Portland in Somerset county. It is also reported from many of the ranges between the Rangely and Moosehead lakes. As near as we can ascertain from a careful arrangement of all the facts in connection with the gold discoveries of these sections, there must be gold in the quartz on the west side of the Rangely lakes. This quartz probably follows the range of mountains, including Mt. Abram and Mt. Biglow, through to the foot of Moosehead lake. The valley of the Chaudiere (in Canada), has been very productive in alluvial gold for many years. At one time, it was thought that the Sandy River gold was a part of the washings from the Chaudiere, but this is not true. The range of mountains previously referred to would have most effectually cut off the sources of supply from the Chaudiere to the Sandy river valley. The gold found on the Sandy river and contiguous streams, owes its parentage to the quartz rock west of the Rangely lakes. The rocks of this region are mostly azoic, and contain numerous veins of quartz. No explorations or exploitations of any consequence have ever been made in these regions. The gold coming from the vicinity of the Rangeley lakes is very fine and pure. The quartz is very similar to that which yields the gold in the southern States.

Another gold region probably exists in the north-eastern part of the State, in the region of the head waters of the St. John river. The rock there is talcose schist, similar to the gold bearing schists of New Hampshire and Canada. This is a region, however, of which we possess but little knowledge, and that derived from sources that may be unreliable. Free gold has been found in small quantities in many of the towns of Maine; it has been found in Baileyville and Barine, near the New Brunswick line in Washington county; also in Cherryfield, Columbia and Harrington, towns in the same county. Small specimens have been found in Pittston, Corinna and St. Albans. In York county at Saco (in the slate quarry), and also at Waterboro. Some of the silver ores in the State are auriferous, notably those found at Blue Hill and Hampden. Nearly all of the arsenical, copper, and iron pyrites of the State are auriferous, but they do not contain gold in sufficient quantity to render the extraction of it alone profitable. It may, however, be worked to advantage in ores containing other metals, where the saving of the gold would be but an accessory part of the operation. In prospecting for gold, there is one fact which should be kept in mind, that auriferous ore does not always contain gold coarse enough to be visible to the naked eye. Fully two-thirds of all the gold quartz that is now worked, contains gold in such a fine state of division that it is wholly undiscernible to the eye, even when assisted by a powerful lens; hence, in prospecting for gold, simple panning or examination by a lens is not sufficient. Chemical tests should always be brought into requisition before the case is decided.

Other Minerals and Metals found in Maine.—The mineral wealth of Maine does not consist alone in her mines of gold, silver, and copper. There are other metals and minerals which, if not valuable in the same sense as these, are quite as valuable in their way as *economic* productions. The demands now made upon science to produce from the minerals of the earth materials which are to be used in the arts and consumed in the daily routine of commercial transactions are unlimited. Should this daily production cease, even for a moment, the wheels of business would cease to revolve. Nature's laboratory, ample as it is, can but keep pace with the steady and growing demands upon it. For years the granites, the slates, and the limestones of Maine have been quarried and sent to every part of the known world. Some of the most magnificent works of modern engineering attribute their strength and durability to the beautiful and time-enduring granite of Maine. Thousands of fine dwellings and magnificent blocks are protected from the elements by the slates drawn from the inexhaustible quarries of Maine; while the inside walls are covered with mortar made from the best lime rock in existence, which also came from the State of Maine. Glazing for pottery ware is made from Maine feldspar; sand paper is made from the crushed quartz of Maine; iron and steel are refined by the use of Maine manganese; the good housewife polishes her culinary utensils with polishing powder made from Maine tripoli, and buildings are protected by the use of mineral paints made from Maine decomposed iron ores.

One other subject remains to be spoken of, that is the manufacture of sulphur and sulphuric acid from the iron pyrites, of which Maine has almost inexhaustable beds.

This is an industry that has long been established in France. Germany, and England, all of their sulphuric acid being now produced from the combustion of iron pyrites. We are at this very moment importing sulphur and saltpetre to make our sulphuric acid, when we have a ready and convenient supply of the necessary materials almost at our very door. Maine, with her immense beds of these pyrites, might produce sulphuric acid to supply the demands of the whole United States. Most of these pyrites are cupriferous, and manufacture of salts of copper metal might be profitably carried on in connection with that of sulphuric acid. Alums can be manufactured from Maine shales. The State has good horn-stone that might be manufactured into scythe-stones and whet-stones. Emery is found in many parts of the state suitable for cutting and polishing steel. Tin has been found in many localities of the State. We have good reason to believe that it may yet be found in profitable quantities. The Blue Hill region is especially adapted for it. Zinc ores occur in abundance associated with the ores of lead, and will be profitable as a by-product. Arsenic might be made in large quantities from the immense deposits of arsenical iron which exist thereabouts. Antimony also occurs; there is a very large deposit of it at Vanceboro, which has been worked to some extent. The region round about Gardiner, on the Kennebec, promises well for Graphites, and many fine specimens have been shown from that locality. Many people still persist in their determination that coal must exist in Maine in quantity. Near and about the mouth of the Kennebec river are found small, thin seams of pyriteriferous, bituminous coal; these veins have no extent, neither do they lead to any deposits of value. Iron, nickel, and cobalt exist in almost unlimited quantities. Splendid mica, sufficiently large for industrial purposes, is found in the ancient gneiss which forms part of the rock formation of the State. In fact the mineral resources of Maine include about all of the earthy productions. Maine is also rich in the precious gems; tourmaline, emeralds, and garnets have been found, many of which have been cut and polished, and found purchasers in the market for precious stones.

Ore Veins.—It is a well known fact, and an allusion to it may perhaps be unnecessary, that surface ores from nearly all mines of the globe are refractory and compound mixtures of the various chemical elements, the base metals largely predominating over the more precious. It is expected, and is, indeed, usually found to be true that on going down to the lower depths the base metals give way to the more precious ones. Not only has experience demonstrated this, but the theory now accepted by scientific men of the mineralization of ore veins is chiefly in accordance with it. The old and now thoroughly irrational theory of vein formations was that of *ejection* or projection of fused mineral matter through a cavity or fissure in the rock. The idea is almost completely erroneous, and is now supplanted by that of Professor Dana, which may be given in a few words: "The fissures occupied by veins are simply cavities penetrating the rocks more or less deeply down to regions of great heat, but not to those of fused rock. During the metamorphic changes, such cavities, as soon as formed, would begin to receive mineral solutions or vapors from the rocks adjoining. The rocks may contain sufficient moisture to carry on this system of infiltration if there were no other source, and this moisture and any vapors present would move towards the open spaces. The mineral matters thus carried to the fissure would there become concreted and commence the formation of the vein. These materials from the adjoining rock may be taken directly from it by simple solution, or be derived by a decomposition of some of its constituents." Von Cotta, in his excellent work on ore deposits, says: "There can be no doubt that all true ore beds were originally formed by chemical or mechanical precipitation from water. The formation of fissures, as well as their filling, is continuous. Metalliferous veins, which from their nature were formed at a great depth, could first attain the surface only by means of a great, and consequently very long continued, decomposition and erosion of the rocks covering them." Speaking of the length and depth of ore veins, he says: "Up to the present time it has never been proved that a lode has been followed to its end; that is, to where the fissure actually ceased. Most of the stated cases concerning the wedging out of veins, or their becoming sterile with increased depth, rest on the fact that ores are generally distributed in the veins. As long as the fissures exist there remains a possibility of their widening out and containing ore." Von Cotta considers it safe to assert that "ore veins will certainly be as deep as they are long." Under the new and rational theory of vein formation, the much abused iron pyrites or sulphuret of iron plays an important part. Le Conte considers it "the parent or the great carrier of all the other metals." Its presence in an ore vein is significant of strength and permanency. This being the case, there are in the State of Maine, all the characteristics of valuable veins, so far as sulphuret of iron is concerned; for it is doubtful if anywhere in the known world are to be found such extensive deposits of this material. It is allowed, and, indeed, already proved, that there are in Maine many true fissure veins, well mineralized, of great length and thickness. Why, then, may they not have great *depth?* The exploitations carried on in the State have proved beyond the shadow of a doubt, that the veins do actually improve both in quality and quantity with depth. If any additional proof is needed of the permanency of the Maine veins it will remain with the future, since time alone can give it. There is no silver mining region in the world that has given out. Mexican mines, worked by the Aztecs before the conquest of Cortez, are still as profitable as ever. The old Spanish mines opened long before Hannibal's time, are still worked with enormous profits. The South American mines have constantly yielded their wealth for more than three hundred years and are as productive as ever. Mines in Hungary that were worked by the Romans before the time of Christ, still yield an abundance of ore.

Maine Ores.—It has been said that the ores from the Maine mines are refractory; this is true in part, but not wholly so. The ores of Blue Hill are much sought after by the smelters, on account of being so easily reduced. This, then, is a refutation of part of the charge. There are no very deep mines in the state as yet, and the silver ores mined thus far are most essentially *surface* ores, and consequently contain many refractory elements. In some individual cases the ores have been found to be very refractory, while in others, on the contrary, they have been found to be easily reduced. On the whole I think it is safe to say that the ores of the state are not more refractory than those from other mining countries. More time is required for the development of the mines and erection of mills than most people suppose, and people must wait patiently for the completion of the work before they can expect great results. Now the question naturally presents itself, are the ores rich enough in the precious metals to pay for working? The quantity is, in most cases, pronounced large enough, the facilities for working are allowed to be unsurpassed, and the ores can be mined at a price far less than those of regions unsettled, mountainous, and far from navigation, as most mining centers are. So the whole matter naturally rests upon the question of richness.

Now an assay made from time to time of picked samples from an ore vein cannot give anything like a correct idea of the average value of the vein. It does prove that the mine contains rich ore perhaps, but not by any means that it is a rich mine; consequently the practical miner has little or no confidence at all in reported assays, but always makes his own selections of ore for assay, usually choosing samples of the best and poorest. And even then, when thinking he has made a judicious and fair selection, he may cheat himself, for it has been proved on many occasions that in making selections from ore piles we are mightily prone to take samples a little better than the average. The only way to ascertain the true value of a vein is to conduct a regular systematic course of assays on cross sections of the vein taken every few feet in depth and the *whole* of it to be assayed, no samples taken, but the whole mass crushed and assayed carefully; or when a large pile of ore has accumulated on the dump, it can be crushed coarsely and cut down in quarters until an average sample is secured for assay. Either of these methods will give good, fair, average results, and are about the only means that will lead to that much desired end. We give here a table of average assays for Maine Minerals.

Table of Assays.—Ores of the State of Maine.

Location.	Name of mine.	Kind of ore.	Depth.	Silver in ounces	Gold in P W	Lead per ct	Cop'r per ct
Acton	Dirigo	Galena	80 ft.	22.31	2.10	31.82	
"	"	"	80 ft.	84.96	trace	35.20	
"	Acton	"	surf.	21.70	3.00	72.20	
"	"	Sulph'ts	"	10.84	2.57	15.70	
"	"	Galena	"	21.70		56.10	
"	"	Arsenic'l	"	32.97	11.97	42.67	
"	"	Galena	"	45.20		68.20	
Blue Hill	Douglas	"	10 ft.	56.23	14.57	47.00	
"	"	Antimo'l	25 ft.	72.00	36.00		
"	"	Pyrites	50 ft.	5.50	5.00		22.50
"	"	Purple	10 ft.	9.50	8 00		16.25
"	Atlantic	Pyrites	surf.	4.50	6.00		18.90
"	"	"	"	10.00	2.45		12.83
"	Blue Hill	"	"	9.20	4.50		13.48
Corinna	Corinna	Galena	"	52.60	2.00	61.50	
Cherryfield		Gold qtz.	"	3.63	17.49		
"	Cherryfield	Galena	12 ft.	48.55	traces	35.25	
Deer Isle	Deer Isle	Sulph'ts	surf.	12.00	6.20		
"	"	"	24 ft.	35.20	23.33		
"	"	"	22 ft.	8.00	29.11		
Gouldsboro	Gouldsboro	Galena	surf.	115.00	trace		
"	"	Sulph'ts	"	44.50	"	30.00	7.50
"	"	Gal. Con.	20 ft.	403.20	"	78.92	
Hampden	Dunton	Galena	20 ft.	35.68	5.83	35.00	
"	"	Antimo'l	20 ft.	246.40	14.57		32.00
Hancock	Hancock	Sulph'ts	16 ft.	32.20	14.00		
"	"	Concen'd	40 ft.	179.87	17 60		
Lubec	Lubec	Galena	20 ft.	28.14	20.00	22.00	11.10
"	"	"	14 ft.	16.60	trace	38.69	3.00
Lowell	Shorey	Sulph'ts	8 ft.	18.25	2.50	-	
"	"	"	6 ft.	11.60	14.60		
Lincolnville		Galena	surf.	56.62	trace	62.50	
Pittston	Manhattan	Quartz	"	6.00	6.30		
Sullivan	Sullivan	Galena	"	32.62	trace	38.00	
"	"	"	10 ft.	79.74	14.00		
"	"	"	12 ft.	85.05	trace		
"	"	Sulph'ts	16 ft.	111.79	"		
"	"	"	20 ft.	121.21	5.40	10.00	
"	"	"	30 ft.	67.86	14.00	8.00	
"	"	Antimo'l	50 ft.	7,370.35	18.00		
"	"	Sulph'ts	75 ft.	220.00	7.50		
Sedgwick	Edgemog'n	Galena	surf.	19.60	trace	20.00	
"	"	"	12 ft.	51.00	9.69	28.00	
"	"	"	24 ft.	226.44	traces	24.00	
"	"	"	34 ft.	56.00	15 05	25.00	
St. Albans		"	6 ft.	14.08	trace		
"		"	15 ft.	62.20	1.80	82.50	
Trescott		"	6 ft.	31.87	trace	38.00	6.50
Wakefield, N.H.	Miner'l Hill	"	surf.	16.00	3.00	45.00	
" "	"	"	40 ft.	46.51	trace	55.00	
" "	"		55 ft.	34.68	14.40	42.00	

It needs but a glance at the assays given in this table to convince the most skeptical that Maine ores do contain value. It will be seen that this list contains only what might be termed surface ores. What may be discovered at a greater depth, yet remains to be seen. In reducing silver ores, they are divided into two classes, viz.: "smelting" and "milling" ores. Ores that contain twenty per cent. (or more), of lead, are usually smelted directly; ores containing a lesser amount of lead are "milled"; in the latter case, if the silver is in the form of native chlorides, etc., it is treated without roasting; but where there is a mixture of several sulphides, such as zinc, antimony, arsenic and copper, they require to be treated by roasting and chloridizing, and subsequent treatment by amalgamation. Wet or chemical processes for silver ores are rapidly superseding other methods, and will probably soon take the place of smelting. Many of the ores are too quartzose to admit direct treatment; by this is meant the particles of ore are disseminated all through the quartz gangue, not concentrated at any one point. Such ores, although giving low assays, owing to the large amount of quartz present, are really very valuable, from the fact that they can be easily concentrated by machinery designed expressly for that purpose. For instance, take a galena ore in quartz, one-tenth of which is ore, and nine-tenths quartz, by separating the ore from the quartz, the expense of handling so much bulk is dispensed with, and ore is obtained in a concentrated form and can be sent direct to the smelter, who will pay a good price for it. Without this treatment, such ores would be valueless. It has been demonstrated that ores of this kind, when the mine is in a fair location, which contain at the rate of ten dollars per ton, in silver, will pay for mining, concentrating and reducing. This same method is applicable to copper ores as well, and the process of concentration may be seen in actual work at Blue Hill, where a large quantity of copper ores are separated daily from the quartz gangue.

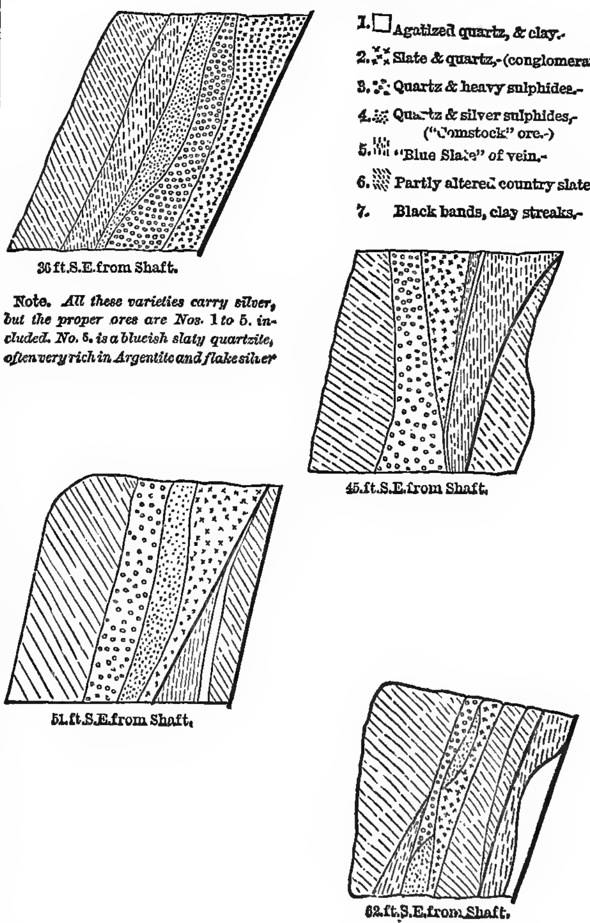
—*Compiled from F. L. Bartlett's "Mines of Maine."*

THE MINING DISTRICT AT SULLIVAN, MAINE.

If New England were located in some distant and almost inaccessible region, there is no doubt that its mineral resources would have been ere this well developed and generally acknowledged, but laboring under the disadvantage of nearness, it has been neglected. Its surface, moreover, is not cut up by mountains and cañons, and the remnants of many of the old ridges are extensively covered by glacial drift. The Sullivan Mining District extends from the town of Franklin, through Hancock, Sullivan, and Gouldsborough, from northwest to southeast, about sixteen miles. A general idea of this locality may be gathered from the map accompanying, which we demonstrate Fig. 1.

Sullivan is situated at the head of Frenchman's Bay, ten miles north from Bar Harbor, Mount Desert, twelve miles from Ellsworth, and thirty-seven miles from Bangor. It may be reached in summer by steamer, via Rockland and Bar Harbor, and has good hotel accommodations. A daily mail stage connects with Ellsworth and Bangor at all times

Figures 2 to 5.
Sections of Vein, Sullivan Mine, 85 ft. level.
Down River Drift.
Scale, 6 feet to an inch. Views looking S. E.



of the year. The staple production of Sullivan is granite, of which unlimited quantities of very fine quality may easily be obtained. At first impression a stranger would say that no other rock existed there, but further examination discloses the fact that the region has more slate than granite, and that along or near the line of their contact are most of the mineral veins of the district. The lithological characteristics of the surface are shown on the map. The slates of the region are quartzitic, of unknown age, undoubtedly very ancient, and referred to the latter Laurentian—the limbo to which most of the doubtful New England rocks are consigned. Through these have been thrust the immense mass of granite and its allied rocks, from which action has proceeded the formation of the principal mineral deposits.

The first discovery of silver ores here was made by Mr. A. A. Messer, in May, 1877. They were discovered below high-water mark, on the shore of the bay, at the site now occupied by the shaft of the "Sullivan" mine. The vein, when found, showed about ten inches of quartz, carrying pyrites, galena, and traces of brittle silver (stephanite). A coffer dam was built and shaft commenced. The first native silver threads were found about ten feet down. The vein was uncovered in several other places, also below high-water mark, proving that the showing at the shaft location was the poorest yet found. Seventy-five feet from the shaft, southeasterly, the quartz is four feet wide at three feet below the beach, and the lowest assay I have known from this is over $200 per ton in silver. The ore is principally stephanite. Proceeding with the shaft, at about thirty feet depth, the vein, composed of quartz, with more or less slate highly im-

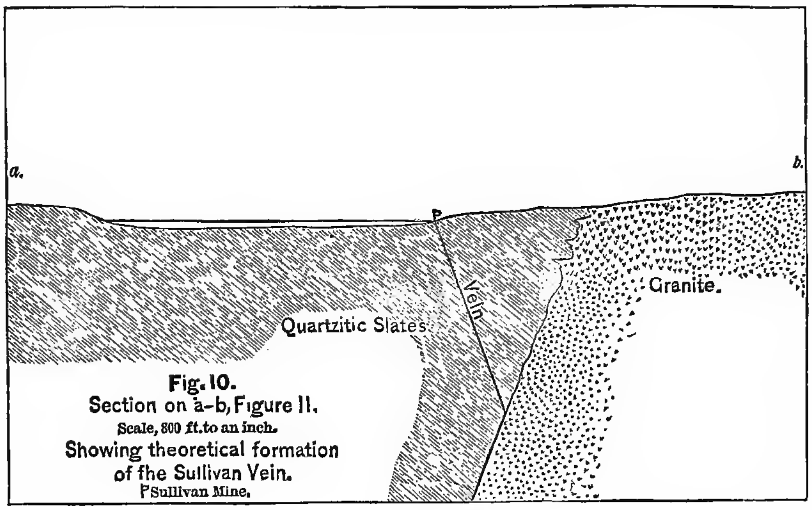
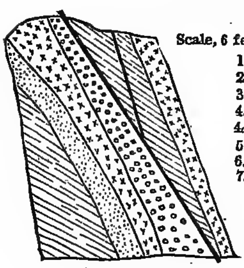


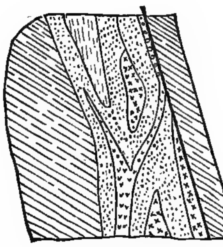
Fig. 10.
Section on a-b, Figure 11.
Scale, 800 ft. to an inch.
Showing theoretical formation of the Sullivan Vein.
P Sullivan Mine.

Figures 6 to 9.
Sections of Vein, Sullivan Mine, 85 ft. level.
Up River Drift.
Scale, 6 feet to an inch. Views looking N. W.

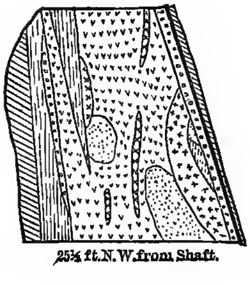
1. Agatized quartz, &c.
2. Conglomerate.
3. Quartz and heavy sulphides.
4. Quartz and silver sulphides.
4a. Semi-crystalline quartz and grey silver ore.
5. Blue slate of vein.
6. Partly altered country slates.
7. Black bands, clay streaks.



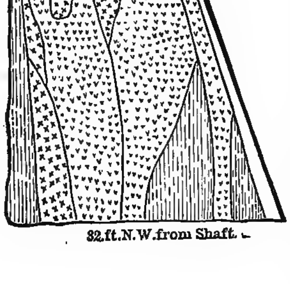
10½ ft. N. W. from Shaft.



17½ ft. N. W. from Shaft.



25½ ft. N. W. from Shaft.



32 ft. N. W. from Shaft.

pregnated with sulphides, was found to be four feet wide. Drifts have been run southeast from the 75 feet level, and northwest from the 85 feet level. Sections showing the formation of the vein, and to some extent the nature of the ore, are given in Figures 2 to 9 inclusive. The ore is essentially silver, sulphides and native, in quartz and slaty gangues, with slight amounts of iron, zinc, etc., as sulphides, and also galena.

Of the silver minerals, stromeyerite is most plentiful, stephanite next, argentite (silver glance), common, native silver in flakes very plenty, threads frequent, lumps occasional.

Ruby silver is exceedingly rare; antimonial silver has been found. The occasional yellow copper sulphide met with has a peculiar lustre and runs very rich in silver. As stated above, the course of the vein is from northwest to southeast, with the strike of the slate running parallel to the line of contact of the granite. The vein is in the slate, dipping at an angle of 70° from the horizon, northeasterly, toward the granite, which it probably reaches in less than a thousand feet. The slate also dips toward the granite at this place about 37° from horizontal, although at some other places not more than 12°. (See sketch, Fig. 10.)

At the contact of the slate and granite, the latter often penetrates the bedding of the slate, in known instances nearly 200 feet. The granite is much cut up by dikes of black trap, which also run into the slate, faulting the vein in several places. A sketch of dikes and faults is shown in the map. (Fig. 11).

The geological sequence of the formations appears to be, commencing with the oldest: Quartzite slates. Granite, and silver vein in slate. Trap. Quartz veins in granite and syenite. The general line of fissure of the Sullivan vein, passing northwest under the bay about three miles, strikes the shore at the Cline shaft, shown in section in Fig. 12. Here, owing to some local disturbances, the vein is deflected more westerly and cuts directly across the slates, by which action it has been split up into no less than nine veins, dipping to meet within four hundred feet of the surface. The shaft is sunk on No. 3 vein, this appearing to be the main branch, and has reached the junction of No. 4 at about 60 feet from the surface, as shown. The ore here is copper pyrites, galena, etc., at the surface assaying well for silver, and appears to carry gold and silver in form of tellurides at a depth of 60 feet. Average assays about $20 per ton.

Returning to the Sullivan mine, and passing southeast a few hundred feet, we come to the Stimson shaft, which struck the vein, well developed, at a depth of 64 feet. About five hundred feet further southeast the vein is faulted by a large dike of black trap. Beyond this it continues in a direction more easterly, and is accompanied for a portion of its length in the next 700 feet, by a heavy quartzitic band,

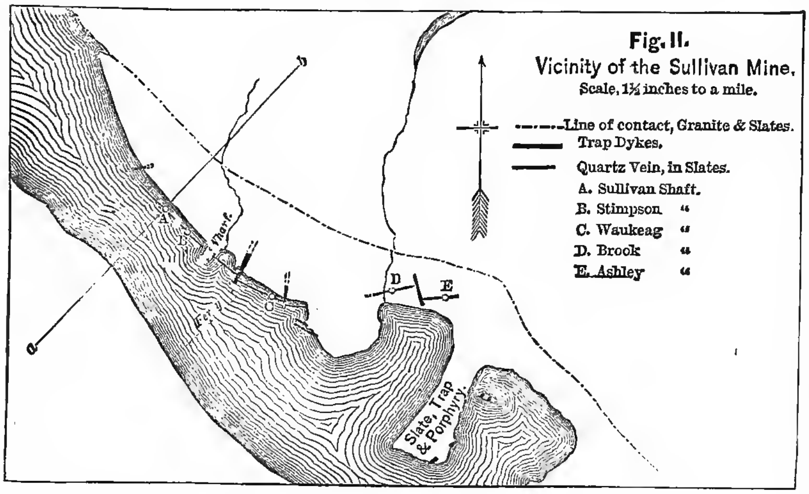


Fig. 11.
Vicinity of the Sullivan Mine.
Scale, 1½ inches to a mile.

nearly 25 feet wide, carrying arsenical iron. This iron gives a show of gold, and in some cases gives an assay for silver. The vein proper is highly decomposed. The sketch (Fig. 13, see p. 141), gives a section across this formation, about 650 feet beyond the large dike, easterly. The vein

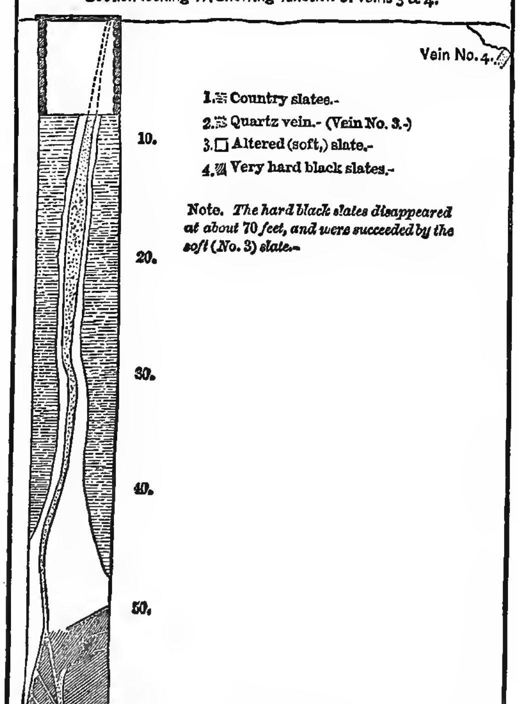


Fig. 12.
Cline Shaft, Hancock, Maine.
Scale, 16 ft. to an inch.
Section looking W. Showing junction of veins 3 & 4.

beyond this is faulted and deflected, and next worked at the Brook shaft, so called, about half a mile east, and also at the Ashley shaft, some hundreds of yards from the Brook. Fig. 14 (see p. 141), gives an idea of the formations at these two shafts, their height being referred to high-tide level. In the Brook shaft some telluride ore has occurred, but not enough in quantity to enable the mineral to be identified. It carries both gold and silver. In the Ashley the same occurred, sparingly, and sulphides carrying $25 to $30 per ton in gold and silver have been found at the present bottom of shaft. No further developments have been made on this vein and its connections, but some nine miles southeast, in Gouldsborough, two veins have been struck in the syenite, which bid fair to become of value. "G" on the map (Fig. 1), the "Young" mining property, is a galena vein, with strike northwesterly and southeasterly, or about parallel with the Sullivan vein. "H" is made up of galena and copper sulphides, the surface ore assaying quite rich in silver. The strike is nearly north and south. Both these veins dip nearly perpendicularly. Less than a year sufficed to demonstrate the existence of strong fissure veins in this district, carrying high-grade ores, and to give every assurance of their permanency and value. As has been stated, the level surface of the country, covered with drift gravel, makes prospecting a slow matter, and there is no reason why there should not exist many mineral deposits in the Sullivan district as good or better than those already discovered.

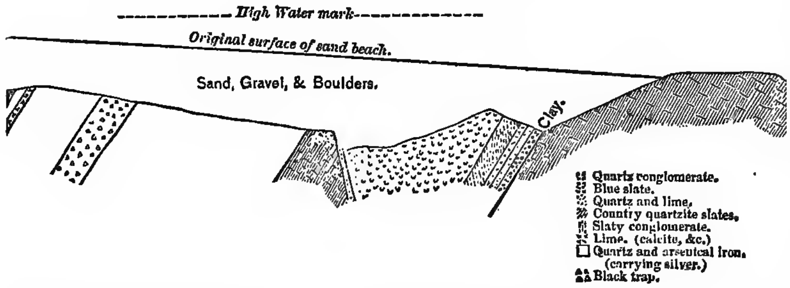
—*Compiled from a paper by C. W. Kempton, M. E., Transactions American Institute of Mining Engineers.*

GOLD IN NEWFOUNDLAND.

THE discoveries of gold made in Newfoundland during 1880, have aroused considerable interest in the colony. The following report on the auriferous district by the official geologist, Sir Alexander Murray, indicates a possibility of the island becoming as celebrated for its mines as it had been for its fisheries. Sir Alexander says: "Reports having been circulated for some time past that gold had been discovered in quartz veins in the regions near Brigus, of Conception Bay, I considered it my duty to make a personal examination of the ground, and to have portions of the veins tested by blasting, under my own immediate supervision. These rumors of the presence of the precious metal, have naturally had the effect of inducing people to make applications at the Surveyor General's office for licenses of search over the supposed auriferous area. I proceeded to Brigus on Monday, September 27, and on the afternoon of the same day visited the locality where, according to report, gold had been found. Here I selected and marked out a series of spots upon the quartz for trial, and on the following day, which proved to be a rainy one and unfit for experimenting, I inspected another area, about two miles southwest of the former place, and nearly in the strike of the quartz-bearing strata, where I found the rocks, with their reticulations of quartz veins, to be nearly identical in all respects. This latter place is known locally as Fox Hill, and from it sundry specimens of gold are said to have been taken, one of which is in my possession. The place where I finally determined to try the first blast is situated near the so-called Brigus Lookout, about equidistant from two peaks, each a triangulation point of the Admiralty surveyors, the heights above the sea being marked on the chart respectively 408 and 413 feet.

By the first blast from two to three cubic feet of rock was removed, all of which was carefully broken up, washed, and examined, which operation finally resulted in the display of ten or twelve distinct "sights" of gold. In one fragment, largely charged with dark green chlorite, the gold shows itself in three places distinctly, while many small specks are perceptible by means of a good lens. The fracture of a fragment of milky-white and translucent quartz, which was broken off the large pieces, revealed two large patches of gold, both of which, together, if removed from the matrix, would probably produce about a pennyweight of the metal; while several small masses or nuggets were found adhering to the small broken fragments of quartz at the bottom of the pail in which the rock was washed, the largest of which contained about ten or twelve grains of gold. From some specimens, in which no gold was perceptible to the naked eye, which I had selected for analysis, I found among the dust at the bottom of the bag in which it was carried a small

Formations at Waukeag Property,
Sullivan, Maine.
Scale, 16 feet to an inch. Section looking S. E.



nugget weighing three grains. A second shot was tried on the same lead, a few yards distant from the first, but, owing to our imperfect implements, it failed to blow out more than a few pounds of rock, in which no gold was perceptible. In the specimen I procured from Fox Hill the metal occurs thickly in the minutest specks, scarcely, if at all, perceptible to the naked eye, but readily recognized under the lens,

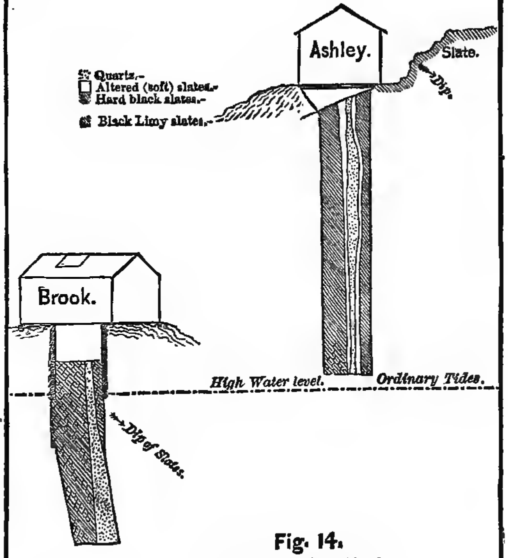


Fig. 14.
Brook & Ashley Shafts.
Sullivan, Maine.
Scale. 32 feet to an inch.
View looking N. W.

where it chiefly surrounds a small patch of chlorite. The rock formation, intersected by these auriferous quartz veins, is of Huronian or intermediate age, or of the group of strata next below the Aspidella slates of St. Johns. The group consists chiefly of greenish, fine-grained felsite slates, which, judging by the weathering of the exposed surfaces, are also magnesian and ferruginous. The cleavage is exactly coincident with the bedding, and the slates occasionally split into very fine laminæ, but frequently into strong, stout slabs, which are used to a considerable extent at Brigus for paving, for hearth stones, and for building foundations and walls. A dip taken on the beds just in front of the place where the gold was found was north 56° west by compass, or north 88° west from the true meridian, or of inclination 45°. Parallel joins intersect the strata bearing south 80° west magnetic, or north 68° west true. By the side of the road at Brigus the dip on some strong slabby beds was found to be north 42° west magnetic, or north 74° west true, or of inclination 40°.

A rough and hummocky belt of country, from three-quarters to one mile wide, which forms the nucleus of the peninsula, between Bay de Grase and Brigus Harbor, is thickly intersected by reticulating quartz veins, varying in thickness from less than an inch to upward of a foot, which often appear to ramify from a central base or great mass of quartz, often extending over many square yards, and usually forming low, isolated hummocks or hills. The general run of the belt is as nearly as possible northeast and southwest from the true meridian, having been traced in a southwest direction from Brigus Lookout as far as Fox Hill, and, as I am informed can be traced several miles more in the same direction.

Thus, although many of the veins, both small and large, may be seen for considerable distances to run exactly parallel with the bedding, the network of the whole mass runs obliquely to the strike of the beds, which are also minutely intersected by the smaller veins, crossing and reticulating in all directions. I nowhere observed anything to indicate a true fissure vein, and consider these with gold, as altogether veins of segregation. The resemblance in general character of the strata with their included auriferous quartz veins in New Foundland, to those of Nova Scotia, must strike any one who has visited the two countries with the purpose of studying their geological features, and I venture to say that the description given of the latter country by Dr. J. W. Dawson, might in many respects equally apply to the former, although, according to that author, the auriferous country of Nova Scotia is supposed to be of Lower Silurian age, while that of Newfoundland is undoubtedly unconformably below the Primordial Group, which, with abundant characteristic fossils, skirts the shores of Conception Bay. Without presuming to offer an opinion as regards the age of the Nova Scotian strata, the fact of the resemblance is suggestive. Chlorate is profusely disseminated through the quartz veins, filling up cracks and drusy cavities, and it was observed that the visible gold was always in or near a patch of chlorate. Some specimens which were produced at the place of trial, presented small cubes of galena, minute cubical iron pyrites, and, in a few instances, small crystals of sulphate of copper, together with specks or grains of gold.

That a large area of country in the regions referred to is auriferous there can scarcely be a doubt, although nothing short of actual mining and practical experience can possibly prove what the valne of the product may be, or whether the prospects of obtaining a remunerative return for the necessary outlay are favorable or otherwise. The specimens which have been obtained, although an unquestionable evidence of the presence of the precious metal, cannot by any means be taken as indicative of a certain average yield; indeed, to quote the words of Dr. Dawson, from his "Acadian Geology," page 626, "It is not easy from mere inspection of the veinstone to predict as to its value, since the gold is usually invisible to the eye." And again, at the following page, when treating of the characteristics of the Waverly Mine, he says: "Visible gold is rare in this vein at present, the greater part being in a minutely disseminated and invisible state." An analysis of quartz collected, in which gold is imperceptible to the naked eye, may aid in revealing some evidence of its constancy, and may throw some light upon the possible average of superficial contents over certain areas surrounded by similar circumstances; but it may be safely predicted that the irregularities of the distribution so conspicuously displayed by the veins on the surface, will extend beneath it, and that it will be mainly on the stronger and more persistent bands, where intercalated with the strata, that mining will extend to any considerable depth. The indications of gold in this country, then, are sufficiently favorable to merit a fair trial, and there are good reasons to hope and expect that ample capital applied to skilled and judicious labor, may be found remunerative to future adventurers, while a new industry will be added to give employment to the laboring population of the island, and possibly bring this despised and but little known country into more prominence and consideration abroad than it has hitherto enjoyed.

—*Compiled from the Scientific American.*

THE NICKEL ORES OF ORFORD; QUEBEC, CANADA.

IN September last I had my attention called by Mr. R. G. Leckie to a deposit of nickel in the township of Orford, province of Quebec. In many ways it has proved to be a subject of great interest. As this ore is, as far as I can learn, entirely new in mineralogy and metallurgy, it has seemed to me that it would be a matter of interest to have, in a short paper, the peculiarities I have met with in studying it. This deposit of nickel was first described by Dr. T. Sterry Hunt, in the *Geology of Canada*, 1863, p. 738, in the following terms: "The general diffusion of nickel throughout the magnesian rocks of the Quebec group has been already noticed. It has, however, never been met with in any considerable quantities in these rocks, although workable deposits of its ores may reasonably be looked for in some parts of their distribution. On the sixth lot of the twelfth range of Orford, the sulphuret of nickel (millerite) is met with in small grains and crystals, diseminated through a mixture of green chrome-garnet, with calc-spar, and through the adjacent rock. Explorations were made at this place a year or two since in the hope of obtaining copper, which was supposed to be indicated by the brilliant green of the garnet; and lead, small quantities of which are found in the vicinity. The ore of nickel is sparingly disseminated in small grains through the garnet and calcareous spar, and the masses submitted to analysis did not yield more than one per cent. of nickel. It is, perhaps, doubtful whether this small quantity could be extracted with profit." On page 497 is the following:

"It (the garnet)forms granular masses, or is disseminated with millerite in a white crystalline calcite. The largest crystals are found in druses in the massive portions, but do not exceed a line in diameter, and are dodecahedrons with their edges replaced.

". . . . . . This garnet resembles closely the *ouvarvovite* from the Urals.

"This beautiful garnet, if obtained in sufficiently large crystals, would constitute a gem equal in beauty to the emerald."

My first visit to the mine occupied several days. We were encamped on an island in Brompton Lake. A half mile distant lay the nickel mine, on the side of a hill. On this deposit there are two shafts being sunk, 180 feet apart. The hanging wall is a magnesian limestone; the percentage of magnesia is, however, small. The width of this has not yet been determined, but on the surface other smaller veins and branches of the spar and garnet are visible. The foot-wall, a dark-colored serpentine, is very clearly defined. At a considerable distance south of No. 1 shaft the line of strike is cut at right angles by a sharply defined band of clay slate. The vein has now pretty much the same characters as before described in the *Geology of Canada*, viz., green chrome-garnet, calcite, and millerite; besides these, small particles of chromite are found. There is no trace of copper or cobalt present, possibly a trace of arsenic, though I have not thoroughly established that yet. The hanging wall contains nickel in small grains.

The following analysis gives a fair idea of the composition of the vein:

Calcite and millerite	50.40 per cent.
Black specks (chromite)	6.87 "
Chrome garnet	42.73 "
	100.00

No. 2 shaft was started on the vein in decomposed spar and pyroxene, carrying occasionally small masses of chrome-garnet. The vein here is fully as wide as in No. 1 shaft. The pyroxene (analyzed by Dr. Hunt) has the following composition:

Silica	47.15
Alumina	3.45
Oxide of iron	8·73
Oxide of magnesium	24.55
Oxide of calcium	11.35
Water	5.83
	101.06

—*Dana's Mineralogy*, p. 221.

The chrome-garnet is the beautiful green crystal, a rhombic dodecahedron of the isometric system. It remains absolutely untouched in hot, strong aqua regia. I am still in hopes of finding crystals in some of the many druses which occur in the vein, large enough to show their beauty to the naked eye. The specimens which I have will require a glass to bring out the crystals. In the ore near the surface, which only was accessible at the time the *Geology of Canada*, quoted above, was written, the millerite occurred in grains as there described, but as the shafts have gone down, the crystals have increased in size, till now we have the large ones, which show the characteristic needles very plainly. Sometimes these occur in clusters of needles, placed side by side as it were, forming a flat plate. It (the millerite) varies in color greatly according to the depth. In the samples shown from No. 2 shaft, there appear two distinct, differently colored metallic sulphides, and this was the case with specimens from No. 1 before it got below the decomposed spar. At first it was supposed that magnetic iron pyrites or other sulphides might be present, but the analyses go to prove it all to be millerite. At first I had grave doubts about the practicability of treating the ore, owing to the infusibility of the chrome-garnet; at the least I expected to have to add fluxes, but the results have proved quite the contrary. The first experiments were made in a Siemens furnace. A black-lead crucible full of the ore was placed on the bank of the furnace, while making low steel. Looking at it fifteen or twenty minutes later, I was surprised to find it liquid. It was poured into a mold, and a good button obtained, which was more ductile than the pieces shown, and had the yellow color to a greater degree when polished. The next experiment was to run 508 pounds of the ore through a blast furnace. Through the courtesy of Prof. Richards, of the Massachusetts Institute of Technology, I was allowed to use the blast furnace of his laboratory. It is about one foot square by four feet high, and uses gas coke as fuel. I am largely indebted to the great facilities offered by Prof. Richards for the results I have obtained. Ten minutes after the ore was charged into the furnace, slag appeared at the tap-hole. The whole charge was run through in 2½ hours; 145 pounds of coke being used, making about 3.5 of ore to 1 of coke; and 8 pounds of matte or alloy were obtained, containing

Iron	71.84 per cent.
Nickel	22.70 "
	94.54

The ore treated was a very lean lot from near the surface, probably containing not over one half of one per cent. of nickel. The slag had a mere trace of nickel. As to the further treatment of this product, I am not prepared now to make any report. *Prima facie*, it would seem that the problem was a simpler one than most nickel manufacturers have to face, since there is no copper or cobalt present; but not finding it spoken of in the books on metallurgy, I have been obliged to investigate as I have gone along, and my progress has consequently been slow. At some future time I hope to give the results of the present investigations, and at the same time to be able to report some progress in extracting the chromium in some merchantable condition. Inasmuch as the slag produced must contain somewhere about 6 per cent. of sesquioxide of chromium, it becomes extremely valuable, provided it can be extracted easily, but while some slags produced yield it up with great readiness, others yield it up with great difficulty. As to the per cent. of nickel which this ore carries, and which will determine its money value, it is not easy at present to speak with any certainty. At the bottom of No. 1 shaft, pieces taken to be average ones for three-quarters the width, show between three and four per cent. nickel. Specimens from No. 2 look equally rich. What is to be the average yield after the mine is opened up it is impossible to say.

Compiled from a paper by W. E. C. Eustis, A. B., S. B.; Transactions American Institute of Mining Engineers.

THE GOLD-BEARING MISPICKEL VEINS OF MARMORA, ONTARIO, CANADA.

ABOUT thirty miles north of the city of Belleville (which is situated on a branch of Lake Ontario), and in the township of Marmora, Ontario, there is found a belt of gold-bearing quartz veins, which present geological, mineralogical, and economic features of great interest to the profession. The district in which these veins are found is characterized as rolling country, with low rounded hills of syenitic granite, overlain on the flanks of the hills by Silurian limestones, which lie in nearly horizontal beds, and in some places are so fine in texture as to afford lithographic stone of a fair quality. The gold-bearing veins run north and south through this belt of syenitic granite, and are quartz-filled true fissures, with micaceous or talcoid slates forming the walls of and horses in the veins. This talcose, slaty rock is evidently the product of the chemical decomposition of the syenite along the fissures, the quartz being segregated from the country rock into the veins, and the hornblende of the syenite furnishing the magnesia of the talcoid slates. The veins, besides quartz, contain also, as gangue, crystallized calc-spar, and occasionally crystallized black mica. The ore scattered through this gangue, in heavy bands in some places and in detached, well-formed crystals at other points, is an arsenical sulphuret of iron (mispickel), having a composition of about 55 per cent. of iron and 25 per cent. of sulphur. This mispickel contains the greater part of the gold for which the mines are worked, but free gold is also found scattered through the quartz in small leaves and grains, and it is also found, showing freely at times, in the mispickel itself. The tests which have been made of these veins and their ores have so thoroughly established the facts of the continuity of the veins, both in length and depth, and the economic value of the ores, that the interest which would naturally be taken in so promising a prospect as this was, even before development, has now deepened into the substantial form of an interest in a great industrial enterprise.

Gold was first discovered in this district in 1865 as free gold in quartz and mispickel, and sporadic attempts have since been made at two or three points to treat the ores, chiefly by raw amalgamation. As might have been anticipated from the nature of the ore, but a very small proportion of the gold was saved in this way, while the expense of treatment in the small and primitive mills adopted was great and the loss of quicksilver heavy. There was neither experience nor technical knowledge available at the time, and no sufficient capital to put up suitable works or to develop the mines; hence they have lain idle all these years without a single serious effort to work them on an economical basis. Nevertheless, many tests of the ores were made, some on quite an extensive scale, in reduction works in the United States and England, and the results were invariably satisfactory. By far the most extensive and the only systematic tests of these veins and their ores have been made upon the properties combined under the ownership of the Canada Consolidated Gold Mining Company. From these tests some four or five parallel veins have been proved to exist in a belt of 500 or 600 feet in width, running through the property of this company for a length of over three-quarters of a mile, while the main vein has been opened on adjoining properties, making a total proved length of this great fissure of about three miles on the vein, a fact which, next to actual sinking, may be considered the best proof of the continuance in depths of the veins. Three of these veins have been proved on this property by costean pits and shafts sunk at short intervals along their outcrops, to depths varying from 15 to 150 feet. In this manner, the east or main vein has been thoroughly explored over a length of about 800 feet by shafts of from 40 to 150 feet in depth; these have in every case, been in pay-ore all the way; their lowest points are now in as good ore as has been found on the property; and they have shown this vein to have a thickness exceeding 20 feet in many places, and averaging probably 8 or 10 feet, while the middle and west veins, though smaller, have still apparently a thickness of three feet and upward. As each foot of thickness for a length of 700 feet and a depth of 150 feet will yield about 10,000 tons of ore, the estimate which counts as technically in sight, in this small part of this vein alone, from 60,000 to 75,000 tons of ore, must be considered very moderate. These estimates and some much higher have been made by a number of experts of large experience.

Perhaps the question of greatest interest is the average gold contents of the ore; and as this has been determined in a very thorough manner under my own supervision, I shall enter somewhat into the detail of the work, as showing what is considered essential in determining with safety the average value of gold ore and of a mine. Some three or four thousand tons of ore have been mined upon this property, and of this about a half has been milled or treated in a variety of ways, and the remainder is now on the dumps. The first tests of these ores were made from samples selected by various experts who had from time to time examined the property. Some of the results were as follows: Twenty assays, made at the laboratory of the Geological Survey of Canada, of samples from the Marmora mines, gave an average of 1.6367 ounces of gold, equal to $33.81 per ton of 2,000 pounds. Twelve of these samples were from the Gatling mines, and gave an average of 1.9107 ounces of gold, or $39.47 per ton. Professor E. J. Chapman, of the University College, Toronto, says: "I have made assays of its ores from time to time, and I have never failed to obtain from any sample (mispickel), as a minimum value, at least $50 per ton." "The following results were obtained from samples collected very carefully with a view to obtain the average amount of precious metal held by the undressed ore: No. 1, or East Vein—Gold, 73.50; silver, ¼ ounce. No. 3, or Middle Vein—Gold, $69.86; silver, ¼ ounce. O'Neil Shaft, middle vein—Gold, $60.26; silver, ¼ ounce. On a former occasion, I obtained from a small sample of the Gatling ore $112, and from pure mispickel $156 per ton." Mr. James Douglas, Jr., Mining Engineer: "A sample taken as fairly as possible from the ore-piles on the Gatling Company's property, the five acre lot, and the Hawkeye lot gives me in gold 1 oz. 5 dwts., value, $25.84 per ton of 2000 pounds." Professor W. T. Rickard, of London, says: "I took samples from the various shafts and opening on each claim, and ground them together. . . . I picked out a large quantity of pure mispickel, crushed and sampled, and assayed the same. . . . I deducted the estimated amount of quartz, associated with the mispickel, and then allowed 50 per cent. for depreciation in the quality of the mispickel. The following results were obtained by careful assay:

"*Hawkeye ore* from three shafts mixed mispickel—Gold, $753,48; silver, $15.71. Total, $769.19. "*Gatling five-acre lot.*—From one shaft quartz—Gold, $200.93; silver, $3.14. Total, $204.07 per ton. "*Gatling Company.*—From three shafts, mixed mispickel—Gold, $351.63; silver, $21.91. Total, $373.54. "*Gatling Company.*—O'Neil Shaft, third vein—Gold, $376.64; silver, $7.35. Total, $384.49. "*Tuttle Property.*—Surface quartz—Gold, $125.48; silver, $4.70. Total, $130.18.

"*Average*—First-class quartz and pure mispickel	$372 29
Deduct 4-5 ton for gangue in bulk, leaving	74 46
" ½ ton for inferior mispickel, leaving	37 23
" for loss in reduction $7 23, leaving	30 00
Or net yield of ore in treatment $30 per ton.	

F. W. Dahne, Esq., who dressed a lot of this ore sent to Swansea, says: "The ore I treated contained, before dressing, 2½ ounces of gold to the ton (2240 pounds)." Captain Benjamin Plummer, who examined these mines for Messrs. John Taylor & Sons, of London, carefully sampled the ores from the different openings, and had his samples assayed by Professor Chapman, of University College, Toronto, who obtained the following as the average of a number of assays, gold counted at $20.66 per ounce troy:

Samples No. 19, Gold $38.65 per ton of 2000 pounds.
" No. E, " 24.87 " "
" No. F, " 36.60 " "
" No. G, " 24.74 " "
Average, $31.21.

The amount of silver in these samples never exceeded ¼ ounce per ton.

Two barrels of average ore treated at Balbach's works, in Newark, N. J., yielded:

From East Vein.—Gold, $23.76; silver, $4.07. Total, $27.83 per ton of 2000 pounds. *From O'Neil Shaft.*—Gold, $25.62; silver, $4.39. Total, $30.01 per ton. Four barrels of ore sent to Messrs. Richardson & Co., Swansea, yielded as follows (assays being reduced to dollars per ton of 2000 pounds): *Tuttle Shaft.*—Gold, $93; silver, $7 per ton (2000 pounds). *Gatling Company's Deep Shaft.*—Gold, $37.21; silver, $20 per ton (2000 pounds). *Gatling Company's A Shaft.*—Gold, $23.15; silver, $18 per ton (2000 pounds). *Gatling Company's O'Neil Shaft.*—Gold, $23.15; silver, $100 per ton (2000 pounds). The report for a large lot of ore from the O'Neil shaft, subsequently sent to the same Swansea parties, was as follows: For 19.8 tons: Gold, $23.15; silver, $0.50 per ton of 2000 pounds. For 9.9 tons: Gold, $27.90; silver, $0.75 per ton of 2000 pounds. For 4.4. tons: Gold, $55.81; silver, $0.50 per ton of 2000 pounds. Analyses of pure mispickel, made by Thomas Thomas and J. Hernaman James, Assayers in Swansea, to Messrs. Richardson & Co., were as follows (the gold being reduced to dollars in a ton of 2000 pounds at $20.67 per ounce):

	SMALL CRYSTALLIZATION.	LARGE CRYSTALLIZATION.
Peroxide of iron	54.00	56.00
Silica	0.51	0.03
Sulphur	19.03	18.13
Arsenic	25.70	23.00
Nickel	trace.	trace.
Silver (per ton of 2000 pounds)	trace.	$6.50
Gold (per ton of 2000 pounds)	$306.95	$2920.67

Mr. E. W. Harmon, in 1876, tested the ores from these properties in the interest of Boston parties, who had a patent process for treating sulphuret ores. The following are the results obtained by Mr. Harmon from average samples selected by himself, per ton of 2000 pounds:

No. 1. East Vein Gatling Company, gold, $123.84; No. 2. East Vein Gatling Company, gold, $37.84; No. 3, East Vein Gatling Company, gold, $37.84; No. 4, East Vein Gatling Company, gold, $75.68; No. 5, Middle Vein Gatling Company, gold, $48.16; No. 6, Middle Vein Gatling Compay, gold, $116.96; No. 7, West Vein Gatling Company, gold, $41.28; No. 8, West Vein Gatling Company, gold, $120.40; No. 9, Sample from all of foregoing, $61.92; No. 10, Gatling South, $41.28; No. 11, Gatling five acres, $550.-40; No. 12, Gatling five acres, $595 12; No. 13, Gatling five acres, $37.84; No. 14 Williams mine, tailings, $34.40; No. 15, Gatling Company—Shaft, free gold, $440.32; No. 16, Gatling roasted steely ore, amalgamated, $48.16; No. 17, Gatling rich pyrites, raw treatment, $1265.92; No. 18, 1 pound average material from first test by a stirring (almalgamating) process, $52.46. 18.7 tons of ore from the several shafts of the Gatling Company's mines were then treated by the same parties, the process being roasting and almalgamating; the roasting was very imperfect, being effected in a revolving cylinder only 3 feet diameter and 12 feet long, heated from the outside, and with a strong draught of air forced through it by a blower. The consequence was, that the fine-dust contained much gold, and the roasted ore carried 6 per cent. of sulphur. The following were the assays of lots of from two to three tons each:

No. 1, Ore, $30.90, Tailings, $30.30; No. 2, Ore, $41.20, Tailings, $6.67; No. 3, Ore, 65.23, Tailings, $6.87; No. 4, Ore, $41.20, Tailings, $6.87; No. 5, Ore, $51.50; Tailings, $8,58; No. 6, Ore, $44.71, Tailings, $12.94. Average gold in 18.7 tons was $35.46 per ton, counting gold at $20 per ounce. Gold actually saved was $25.32 per ton, or 71 per cent. of assay value, while there was still in the bottoms in flue-dust returnable for retreatment, obtainable gold that would have made the yield $27.31 per ton, or 77 per cent.; and tailings were extremely rich, and could easily have yielded on shaking tables or belts gold enough to have made the actual yield $30 or $31 per ton. Captain Thomas Couch, Mine Superintendent, in his examination of these mines, in February, 1880, carefully sampled the several mines, taking one and two ton samples of the ore just as it came from each of the shafts and levels, without sorting. The results were as follows:

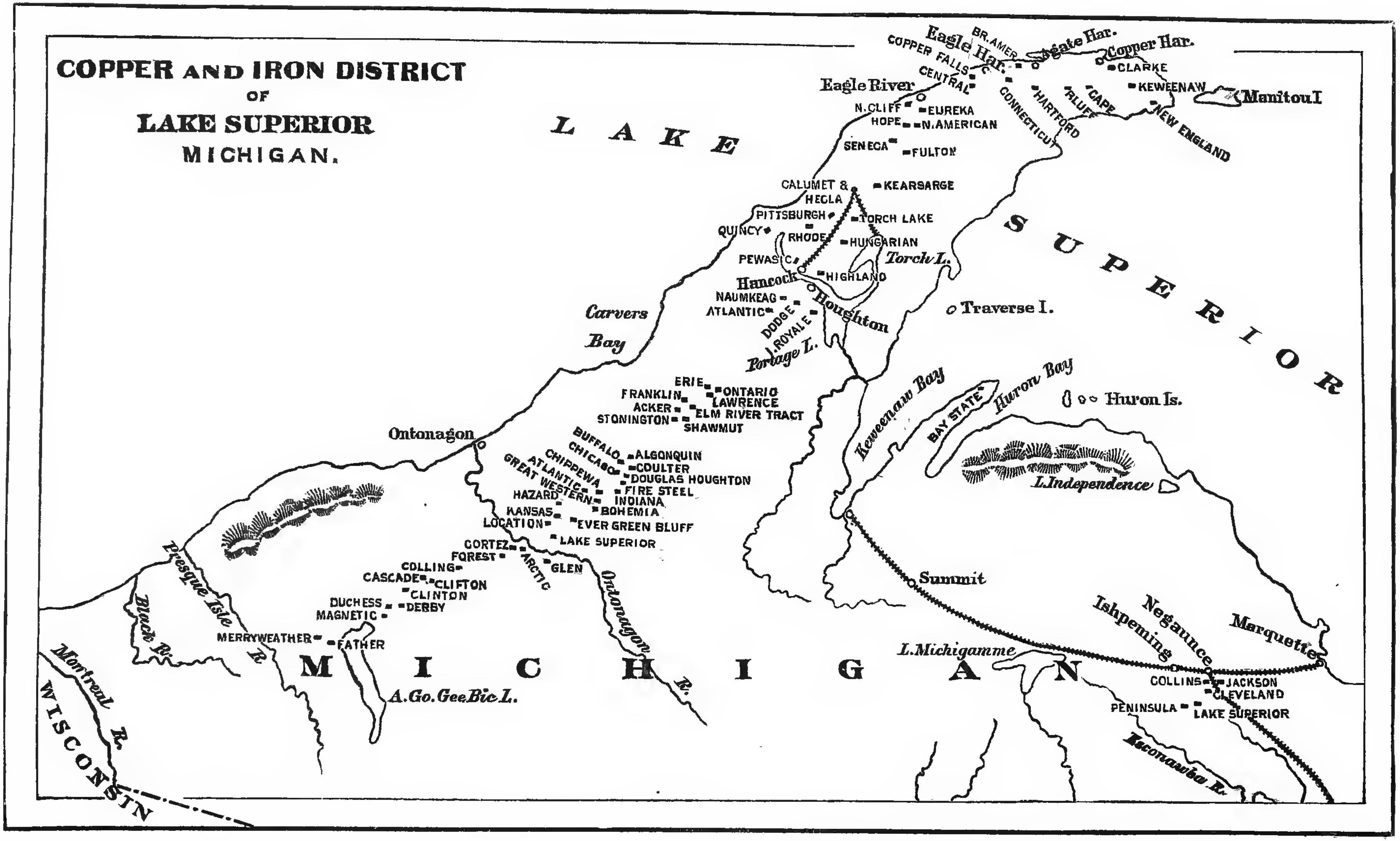
	Gold.	Silver.
Tuttle shaft, 2 tons,	$26.46 per ton.	1.28 ounces.
Deep shaft levels, 2 tons,	16.33 "	.79 "
Middle vein, 2 tons,	32.65 "	1.58 "
N. Hawkeye shaft,	7.85 "	.38 "
S. Hawkeye shaft,	7.44 "	.36 "
Concentrates (Tuttle shaft),	137.48 "	6.65 "
" (Levels deep shaft),	65.00 "	3.14 "
" (Middle vein),	107.48 "	5.20 "
"	129.19 "	6.25 "

Assayed by W. E. Gifford, 54 Pine Street, New York.

Mr. R. H. Stretch, Mining Engineer, sampled the mines by taking one-ton lots of the ore just as it came from the several shafts and levels, without sorting, and the result of his assays was as follows: Deep shaft, bottom, $21.50 per ton; N. level, $9.00 per ton; S. level, $7.50 per ton; a shaft (3 samplings), $17.92 per ton; Tuttle shaft, $19.00 per ton; average after parting; gold, $13.06 per ton.

By far the most exhaustive tests of these ores were made under my own direction. Having secured a working bond upon these properties, I carried on mining and milling operations with a force of eighty or ninety men during nearly four months. During this time, seven shafts were worked upon and attained depths of from forty to one hundred and ten feet; and two levels of forty feet each in length were driven. Three of these shafts, namely, the Tuttle, the A shaft, the deep shaft, and two levels were those upon which the most work was performed, and it is to the ore from these that the following remarks are confined. These openings proved a length along the main vein of about 700 feet. The ore extracted, *without any sorting whatever*, was taken to the mill; it was then weighed and crushed for the greater part in five-ton lots, every twentieth shovelful as it came from the Blake crusher being laid aside for a sample. The samples of five-ton lots were crushed fine, quartered down as usual, and assayed; thus, one hundred and eight lots, nearly all representing five tons of ore, were assayed separately, while fifty-one tons from the Tuttle shaft were sampled in the same careful manner in one lot by Mr. Thomas Macfarlane, of the Wyandotte Silver Smelting Company. The assays of these several samples are given in the following table. It will be noted that the richer five-ton lots were obtained by selecting the heavier sulphurets from the remainder of the ore in the ore-house so as to demonstrate the effect of rough hand-sorting; the low assays were therefore of second-class ore; the whole number of assays gives, however, the average yield of the ore just as it comes from the mine without sorting. The higher assay numbers (last assays made) were, in general, from ore mined nearest the surface, and which accordingly was found at the centre of the dump. Nearly one-half the dump was milled, and the last milled came from the centre of the dump.

NOTE.—The proportions of gold and silver in the assay buttons were obtained by parting 89 buttons in one operation. It was found the average was 68 per cent. gold, 32 silver. The following table gives only the gold, or 68 per cent. of the weight of the button.



—Drawn and Engraved for the Mines, Miners and Mining Interests of the United States.

*Record of Assays of Canada Consolidated Gold Mining Company's Ores, mostly from the Gatling Mine—*108 *samples, mostly* 5 *tons each, representing a total of* 512 *tons of* 2000 *pounds.*

1	$33 04	28	$6 33	55	$9 84	82	10 90
2	14 06	29	8 08	56	42 18	83	11 07
3	9 84	30	25 31	57	28 12	84	9 49
4	18 98	31	7 03	58	27 06	85	7 38
5	43 94	32	33 74	59	14 76	86	4 57
6	15 11	33	7 38	60	39 37	87	5 98
7	11 60	34	7 38	61	11 25	88	82 34
8	10 55	35	6 50	62	9 84	89	7 03
9	14 76	36	12 65	63	23 20	90	7 73
10	8 44	37	16 17	64	16 17	91	5 62
11	11 69	38	9 84	65	9 49	02	33 94
12	8 79	39	18 28	66	8 44	93	32 34
13	9 84	40	21 79	67	12 65	94	15 47
14	9 14	41	14 76	68	10 72	95	6 33
15	7 73	42	7 03	69	10 99	96	9 49
16	11 25	43	10 55	70	6 33	97	17 58
17	16 17	44	7 73	71	5 27	98	17 58
18	14 06	45	4 92	72	8 44	99	9 14
19	7 38	46	9 14	73	9 84	100	5 45
20	11 25	47	53 43	74	5 62	101	12 83
21	9 49	48	5 02	75	7 38	102	13 36
22	7 03	49	5 62	76	12 48	103	4 92
23	9 14	50	5 62	77	11 07	104	15 11
24	8 79	51	17 58	78	5 98	105	6 62
25	11 25	52	13 71	79	9 03	106	28 12
26	8 44	53	18 08	80	10 90	107	11 95
27	18 28	54	8 44	81	8 26	108	7 03

Average 108 samples, 515 tons Gatling ore, assayed by A. Thies, $13.37 gold per ton.
Check assays, by Prof. Richards, of Boston, and Gifford, of New York, $14.75.
Average value Gatling ore, East vein, $14.06 per ton.
Average samples, aggregating 63 tons Tuttle shaft, East vein, $24 88.
Average samples, aggregating 12 tons, Middle vein, $30.82.

Allowing the proper proportion of ore-reserve to each of these shafts, the average assay value of the ore in reserves I find to be $18.65 in gold per ton.

From these most exhaustive tests, the average gold contents of the ore were determined with great accuracy. Perhaps the most interesting and certainly one of the most important and valuable facts developed was the very remarkable uniformity of the gold yield of the ore. In only three instances – even of second-class ore after the richer ore had been roughly picked out—was less than five dollars per ton in gold found, and the highest assay of a five-ton lot was $53.43 per ton. Samples of a few hundred pounds have been found to run as high as $150 per ton, and hand samples very much higher; but these were not considered as safe guides in valuing a mine, and were therefore rejected as exceptional.

When I first commenced testing these mines, I was met with a vast array of *dicta* concerning the difficulties to be encountered in roasting, in amalgamating, or otherwise getting the gold out of arsenical sulphurets of iron. It is fair to add, however, that these difficulties were always reported by *persons who had not themselves worked such ores*, but had "always understood" they existed. No satisfactory record of tests actually made with such ores being on record, so far as I knew, I determined to make history myself; and though in some particulars we have still very much to learn, the facts which were established may be of use to the profession, and I gladly communicate them. As there could be no possible question about the facility of concentrating mispickel, with a specific gravity of about 6 or 6½, from quartz and calc-spar, with a specific gravity of about 2½, we did not consider it necessary to build concentrating works to test that point; and as there was no concentrator except a centre-discharge buddle taking all the ore as it came from the battery (with forty-mesh screens) without sizing, it was no matter of surprise that at times one-half of the gold was lost in the operation. That, however, was not so much a consideration with us as to determine points upon which knowledge was not obtainable. The ores were sampled in the manner mentioned above before going through the battery. After concentration, the concentrates from some two or three hundred tons were roasted in a muffle furnace, those from nearly six hundred tons in a reverberatory, and those from several hundred tons in a revolving cylinder. The results in all cases showed that these arsenical sulphurets roast with the greatest facility, and in much less time than simple pyrites, owing probably to the fact that the arsenic is volatilized at a much lower heat than the sulphur, and in escaping it leaves the ore in a measure porous, and therefore in suitable condition for oxidizing the sulphur. The consumption of fuel was far greater in the reverberatory and muffle furnaces than in the revolving cylinder, where indeed one cord a day would roast ten tons of ore. There was no comparison, either, in the cost of labor in these different systems (in the revolving cylinder it was about 50 cents per ton), and our results give a very decided advantage to the automatic continuous cylinder in the uniformity of the roast. It was found that ore which took one hour and three-quarters to pass through the cylinder was thoroughly roasted, so far, at least, as was necessary for amalgamation. The chief objection to the cylinder was in the amount of flue-dust made, and that in a somewhat less degree is also the objection to any hand-rabbled furnace. The arsenic fumes are very dense, and when aided by a rapid current of air, they easily carry over dust and gold.

The question is not at all one of roasting the ore, for arsenical sulphurets roast much more easily, more quickly, and sinter less than simple sulphurets; but the important question—the only practical difficulty found in the treatment of these ores—is that of preventing a loss of extremely fine gold, which is mechanically carried over with flue-dust and arsenic fumes. The cause of loss, though it will probably always exist to a greater or less extent, does not appear by any means insuperable; but our tests have thoroughly convinced us that, both on the score of expense and loss in flue-dust, no hand-rabbled furnace is admissible. The automatic continuous revolving furnace, known in the Western States as the White & Howell furnace, and in England as the Oxland, is entirely satisfactory so far as expense is concerned; but without special precautions, it will make too much flue-dust. By taking out most of the shelves, or leaving only sufficient to turn over and not lift the ore (which when hot, runs like quicksand), the greater part of the loss which we encountered would, no doubt, be avoided. There are other modifications in the revolving cylinder which have suggested themselves; but as they have not been tried, they need not be mentioned here. In Philadelphia, a revolving hearth, with fixed rabbles, and with a preheating furnace forming the flue from the revolving hearth, has worked well, and undoubtedly made less dust than the cylinder. Of course, some of the gold which escapes is recovered by the re-treatment of the flue-dust; but there would be still a loss, which should, and in a great measure undoubtedly can, be avoided.

The roasted ore was found to amalgamate with the greatest possible facility, 80 and even 85 per cent. of the gold contained in the roasted ore being obtained in regular work and with a very slight loss of mercury. There is no flouring of the mercury, and the gold is bright and very readily amalgamated. Some of the roasted ore was treated by chlorination under pressure (Mears's process), and practically nearly the full fire-assay was obtained. Even including the loss in flue dust in roasting in the revolving hearth, an ore which assayed less than $14 per ton *yielded, net in the bullion,* 91 *per cent. of the fire-assay;* so that it is thought that by care in roasting, from 93 to 95 per cent. of the gold in the concentrates can be regularly obtained. That the loss in concentrating will be very small, can be understood when it is considered that the concentration will not be made close. It is proposed to crush the ore in rock-breakers to from ½ to 1 inch size, screen in revolving screens which will size into say ¼ to ½ inch and ½ to 1 inch, which would then be jigged, the richer ore going to rolls, and thence directly to the roasting furnace without concentration, and the poorer going to other rolls, where it is crushed, and then jigged. It is thought that from ½ to ⅔ of the sulphurets, and consequently of the gold, will be obtained in the coarse jigging, and will suffer no loss in concentration. Works have been built for the Canada Consolidated Gold Mining Company capable of treating from 100 tons to 125 tons a day.

Without going into the cost of mining and milling these ores I may say that a number of experts, taking from the books the figures of cost of such work as has already been done at the mines, have estimated at from $3 to $3.50 per ton of ore, as it comes from the mines, the entire cost of mining and milling. This cost is made up about as follows: Mining, per ton of ore as mined, $1.75; concentrating, 50 cents; roasting, 20=60 cents per ton concentrates; chlorinating, 50=$2 per ton roasted concentrates; contingencies, 55 cents;—$3.50 per ton. Labor is paid $1 to

$1.25 per day; wood, $1.25 per cord; water-power will partly drive machinery. Supplies of all kinds are extremely abundant and cheap. The ore carries as an average between $18 and $19 per ton in gold, and assuming a net yield in bullion of only 80 per cent., the net profit on the treatment of these ores is estimated at from $10 to $12 per ton.

—*Compiled from a paper by R. P. Rothwell, M. E., Ph. D., Transactions American Institute of Mining Engineers.*

THE MASS COPPER OF THE LAKE SUPERIOR MINES, AND THE METHOD OF MINING IT.

THE occurrence of enormous masses of pure copper has given the mining district of Lake Superior world-wide reputation. The first masses brought from there excited great attention, and directed the notice of the mining world to the few particular mines from which they were taken. It may not now be generally known that nearly all the veins which are worked, and which cut across the trap ridge, contain mass copper, and that large masses are continually being raised from them. The largest continuous mass which has been taken out was probably that from the Minnesota, in 1857, which is variously stated as weighing 420 tons and 470 tons. Its length was about 45 feet, its breadth or height 22 feet, and its greatest thickness 8 feet. All such masses are very irregular and ragged in their form and thickness, thinning out generally from a foot to a few inches, and straggling through the vein until they connect with other large masses. This was the character of a mass found in the Phœnix Mine, one of the oldest on the lake, which mass altogether weighed some 600 tons. But this was really a series of masses more or less connected by strings of metal, yet no one large part of it weighed, singly, over 200 tons. A similar series of masses, weighing about 600 tons, was extracted from the Minnesota. Some of the Phœnix masses were four to five feet thick of solid copper. The Cliff Mine has yielded masses weighing from 100 to 150 tons in one piece. One of 40 tons was taken out in 1879, besides numerous blocks weighing from 1 to 8 tons. This mine and the Central are now yielding mass copper in abundance. It is, of course, impossible to pick, or drill, or to break out such huge masses of solid metal when they are found, by drifting upon the course of the vein. The method of extraction is as follows: The miner picks out or excavates a narrow passage or chamber upon one side of the mass, laying it bare as far as possible over its whole surface. It is usually firmly held by its close union with the vein-stuff, or by its irregular projections above, below, and at the end. If it cannot then be dislodged by levers, the excavation of a chamber is commenced behind the mass, and this excavation is made large enough to receive from 5 to 20 or more kegs of powder. In one instance, the Cliff Mine, a charge of 21 kegs of powder threw down 200 tons of copper. Bags of sand are used for tamping, and the drift is closed up by a barricade of refuse and loose dirt. After such a blast the drift is, of course, charged with foul air, and it cannot safely be entered for hours afterwards. If entered too soon, men lose all strength in their limbs, and fall down.

The huge masses of copper dislodged in this way are too large to be handled and got to the surface. They have to be cut up. The copper-cutters are called in, and the mass is marked off into squares or blocks of suitable size. Copper-cutting is a distinct art, and requires considerable skill and experience. Ordinary miners, however skilful they may be, cannot cut up copper without long training.

The tools used are simply narrow chisels and striking hammers. The chisels are shaped like the parting-tool of turners. They are made of flat bars of half-inch steel, about two inches wide, and eighteen inches long. They are chamfered each way like a cold chisel, to form the cutting edge. This edge is made a little longer than the thickness of the bar. The cutter holds the chisel, and two men strike it. A thin slice or chip of copper is in this way cut out in a narrow channel across the mass of copper. The operation is repeated until the narrow cut, but little over half an inch wide, has been carried through the mass. The chips cut out in this way are long, narrow strips of copper, only about half as long as the groove from which they are taken, the metal being condensed and thickened by the force of the blow. This work is necessarily slow and tedious, and it costs twelve dollars ($12) per square foot by contract. At this price the cutters make $2 per day. It is inconvenient to handle masses weighing over six tons. Such masses when hoisted are landed upon very strong platform trucks, and are then dumped in the rock-house upon a large pile of dry pine logs. When a considerable number of masses have accumulated, the logs are fired, and the whole pile is heated to redness, for the purpose of loosening the very considerable quantities of vein-stone which are inclosed in the ragged cavities. This vein-stone consists chiefly of calcite, and after cooling off it is so much softened, that the greater portion can be knocked out by pounding upon the copper. The masses are then marked, numbered, and recorded, and are shipped to the smelting works, where they are melted down in reverberatories.

—*Compiled from a paper by Prof. Wm. P. Blake, Transactions American Institute of Mining Engineers.*

NOTES ON THE TREATMENT OF MERCURY IN NORTH CALIFORNIA.

THE ores of mercury of North California are composed of metallic mercury and cinnabar. They are found in serpentine, and are very often associated with chalcedony, in masses more or less irregular, often concentrated enough, however, to furnish ores yielding from three to ten per cent., and sometimes richer. This deposit makes its appearance in Vallejo where it has been worked. North of there the mines are more developed. Most of the quicksilver mines, however are situated in Sonoma and Napa Counties. On its outcrop the serpentine rocks have become decomposed, and have often been washed away to a considerable depth, so that in many cases in their neighborhood, what is apparently nothing but ordinary dirt, will frequently contain from two to three per cent. of metallic mercury, with but a trace of cinnabar, in which case, as at the Sonoma mine, it is made up into adobes and distilled. Such material does not require to be mixed with dirt to be made into adobes. Very often, also, the outcrop of the rock, where it is not decomposed, is filled with metallic mercury, so that by striking a pick into it, as at the Rattlesnake mine, a pound or more of mercury at a time will sometimes spurt out. Such rock as this is found in several localities in every stage of impregnation, and usually makes very rich ore. There is generally, however, very little of it, and it is found only in the first workings; the ore in depth is always cinnabar. At the Rattlesnake mine near Pine Flat, where large quantities of metallic mercury are found, the rock contains so much petroleum that it has been necessary to make special arrangements to burn the carbides of hydrogen, since the distillation of the petroleum causes an extra quantity of poor soot to be formed in the condensation-chambers. At the Geysers the ore is associated with large quantities of sulphur and gypsum, so that in a hand specimen there is often more sulphur than cinnabar, which is a serious impediment to working, especially for the modern style of furnace with iron condensers, and causes so much soot to be formed that it has been known to penetrate as far as the blower, and to so completely clog it as to prevent its revolution.

The ore coming from the mine is more or less hand-picked. In one or two cases attempts have been made to treat the poorest, and especially the very fine ores, mechanically as at the California works. The apparatus used for the purpose is very rude, and the treatment does not seem to be very successful, as there is visibly a considerable loss in the tailings. Usually the fine ore is not concentrated; it is taken as it comes from the mine, mixed with dirt and made up into adobes, which have no regular size or weight, and treated in the furnace. The processes by which the ore is treated are, first, the process by precipitation; second, by roasting. The precipitation is done in retorts with lime, and consists of oxidizing the sulphur by means of an excess of air, and so producing sulphate of lime and free mercury. The roasting is done either in retorts, or in other furnaces which are not continuous, and in several styles of continuous furnaces. The reaction consists in volatilizing the sulphur and oxidizing it so as to produce free mercury and sulphuric acid, which, with the moisture of the fuel and ore is condensed and allowed to run to waste. The furnaces which are not continuous are a modification of the old Idria furnace, which is used at Knoxville and at New Almaden in South California. Those which are continuous are the Luckhart, which is used at Sonoma, and which was being built at the Rattlesnake mine and elsewhere; and the Knox furnace, which is in very successful operation at the Redington, Manhattan, and the California mines, and elsewhere. There are a number of other varieties of furnaces, none of which, however, I saw. To these processes should be added the process of distillation, if the metallic mercury of the outcrops were found in sufficient quantities to warrant the ore being treated alone. This, however, has never been the case, and the small quantities that are found are charged in the furnace with the other ores, either as rock ore or as adobes. Very little effort is made to sort the ore, and this generally consists in a rough attempt at hand-picking. No assays of any kind are made. The furnace manager, or miner, judges by the eye that the ore contains one, two, three, ten, or twenty-five per cent., as the case may be, and hence there is little faith to be placed in the statement of many of the advocates of different kinds of furnaces, that their furnace yields such and such a percentage of the assay value. The mercury produced is put up in iron flasks, which contain 76½ lbs. each, with an iron screw for a cork, and shipped. Irregular flasks, as they are called, contain less or more.

Method of Distillation.—At the American Mine, near Pine Flat, all the ore is crushed fine in an ordinary California stamp-mill, with a battery of ten stamps, which is run at a high velocity. It is then mixed with lime, and treated in retorts. The average yield of the ore is said to be two per cent. There are twelve retorts 9 feet long, 2 feet wide, and 18 inches high in the middle. They are made of cast iron, and are D-shaped like the ordinary gas retort, and are arranged in benches of three, the centre one being the highest, so that there are four fireplaces to the twelve retorts. The charge consists of 150 lbs. of crushed ore, to which ten per cent. of quicklime is added. This charge is introduced into the muffle in an iron spoon 6 feet long, 9 inches wide, and 6 inches deep. This is carried by three men, one taking the end, which has an iron handle 2 feet long, with a crossbar of wood of the same length. The middle is supported on an iron bar, curved in the middle to fit the shape of the spoon, with handles projecting 18 inches from the sides, and is carried by two men. This spoon is introduced into the muffle and shoved to its end. It is drawn out by short jerks, so as to leave the charge in the retort. The doors of the retort are then fastened by means of thumb-screws, and luted with wood ashes, and fired during four hours, when the charge is withdrawn. Not over 500 lbs. per retort is treated in twelve hours. The condensation pipes are in the back of the retort. A pipe, about 18 inches long, connects each retort with a vertical pipe about 5 inches long, which connects with a horizontal pipe 6 inches in diameter, placed in a water-tank at a lower level than the front of the furnace, and which receives the pipes of all the retorts. Every six retorts are so arranged that they discharge their condensed mercury through a siphon pipe. The soot is treated with lime as is usual. These works are new and carefully built. It is surprising to see works upon which no expense seems to have been spared, apparently put up to treat such very small quantities at a time of very lean ore by such a system; not even the *possible* economy of the retort system seems to have been taken into account. There did not seem to be sufficient care taken with the condensation apparatus, for the air for some distance from the works was filled with mercurial vapors; and though the workmen wore wet sponges over their mouths and noses, most of them were more or less salivated. I did not visit the mines; but any mine which would justify such carefully erected works with stamp-mills, would certainly justify the erection of other and less wasteful furnaces.

Method of Roasting.—The method by roasting is the one which is the most extensively used, and all the different varieties of furnaces are adapted to it. Those most in use are retorts, and the modified Idria furnace of the non-continuous varieties, the Luckhart and the Knox furnace of the continuous ones.

Non-Continuous Furnaces.—At the Missouri mine, near Pine Flat, the average yield of the ore is from one-half to 2 per cent. of mercury. The cinnabar is irregularly scattered through a chalcedony found in very irregular masses in serpentine; the large pieces are crushed in a Blake's crusher to about 1 cubic inch in size. There are two benches of retorts, one containing two retorts and holding 250 pounds of charge at a time, and the other containing three retorts and holding 350 pounds, so that the small retorts treat 1000 and the large ones 2100 pounds in twenty-four hours. The large retorts have been in use but a short time, and have consequently produced but little. The retorts are D-shaped, and are here 9 feet long, 12 inches high, and 18 inches wide on the bottom; they are charged every twelve hours by means of a shovel. At the Lost Ledge mine the same company have three retorts which are only five feet in length, and have a capacity of 500 pounds, or 160 pounds each; they are charged every four hours, and consequently treat 3000 pounds of ore in twenty-four hours. It takes three-quarters of an hour at the Missouri mine to discharge and charge the large retorts, and half an hour for the small ones, so that, as there is not much difference in the wear and tear, the large size retorts are the most advantageous. They are never filled full, as there would be danger that the pressure of the discharging vapors might force an exit through the luted joints. When the furnace is ready to be discharged the men cover their mouths and noses with wet sponges, tied on with bandages, and then remove the cover of the retorts. When they are about to be removed a little fan placed on the condensing pipes is set in motion to cause an aspiration through the retorts, so that no mercurial fumes escape. When the fumes cease to be dense the charge is drawn out of the retort with long hoes on to the floor in front of the furnace. The discharged ore is at a cherry-red heat, and, as it is not entirely free from mercury, a considerable quantity of fumes are given off so that the precaution of using the bandage over the mouth and nose is indispensable. After the ore has all been raked out, it is carried as quickly as possible a short distance from the furnace and extinguished with water, a new charge being put in in the meantime. This is an exceedingly bad system, as the workmen are constantly exposed to fumes, more especially when water is scarce, since small quantities at a time thrown on the very hot ore seem to increase the quantity of fumes. The men, however, seem to know this, and take the necessary precautions, as none of them were salivated. The product of the small retorts varies from 3½ to 70 pounds of mercury in twenty-four hours. The large ones yield from 10 to 100 pounds.

As the two benches of retorts are at some distance, each bench requires one man per shift of twelve hours, who is paid $3.75 a day. They burn 3½ cords of wood in twenty-four hours. Wood costs $6 per cord, and labor $64 per month with board. Each retort is connected by a short joint, with a horizontal pipe leading to the condenser, which must be large enough to insure of its not being clogged by the soot. This pipe is of cast iron, and is 30 feet long and 6 inches in diameter. The pipes leading from the retorts, in the latest and best construction, come from the back, where there is plenty of room and they are not in the way, so that they can be large. Formerly they were made to come from the front, where they were in the way of the workmen, and were constantly in danger of being damaged by the charge lying against them as it was drawn from the furnace. The condensing apparatus consists of two cast-iron boxes 3 feet by 2, and 2 feet high, turned down into cast-iron tanks, with inclined bottoms, which are covered with water. From the bottom of these tanks a wrought-iron pipe, curved in the shape of an S, is placed, with the arms sufficiently long to counterbalance the pressure of the water, so that the mercury flows from it continuously. The mercury commences to flow two and one-half hours after the charge is put in. Between the two cast-iron boxes, which are connected with each other, and on the main pipe, a small fan-blower is placed, and is made to suck out the vapors from the retorts, or when the condenser is to be cleaned into an exterior pipe. The fan is inclosed in a box 18 inches square, into which there is an opening 1 foot in diameter, closed with a hydraulic packing. The pipes and condensers are cleaned once a week.

In the small furnace 140 pounds of soot and mercury together are collected; this is put in a sheet-iron-pan, 8 feet long, 3 feet wide, 6 inches deep, inclined about 25°, which is not fixed, but is moved from place to place as convenience may require. The soot is placed at its upper end, and is worked with a hoe for a quarter of an hour, to separate the free mercury. Three to five pounds of unslaked lime without water are then stirred into it. As the soot is already damp, the lime soon commences to slack; it is left until it slacks entirely. No one goes near it for one-half or three-quarters of an hour, on account of the vapors arising from it. It is then worked with a hoe for three hours. About one barrel of lime, which costs $3 the barrel, is used per week for treating the soot. The mercury as it collects runs into the lower part of the pan, and is taken out with a ladle and put into flasks. The residue, which has twice the bulk which the soot originally had, is added to the next charge of the retorts, in addition to the charge of ore. Such a charge will produce about 10 pounds more mercury than usual. From 140 pounds of soot, 120 pounds of mercury are obtained directly, and about 10 pounds more from soot charged in the furnace. The large furnaces were run 10 days; 200 pounds were taken from the first condensers and pipes, and from 12 to 14 out of the second condenser. When there is only a small amount of soot to be treated, a small cast-iron sink 3 feet by 18 inches is used, the drain-hole being placed over an enamelled vessel 1 foot in diameter, and 6 inches deep. This vessel is used because ordinary kitchen utensils answer perfectly well, and can be had much cheaper than special apparatus, which would work no better.

The expenses for twenty-four hours:

2 men at the retorts, ...	$6.50
3½ cords of wood, at $6, ...	21.00
Lime for soot, ...	.50
Crushing the ore two days, at $1.25	2.50

There does not seem to be any real economy in using this retort system. The yield is not greater, nor is the cost of repairs and running less, while the risk of salivation is greater. There is certainly an economy of first installation, and this seems to be the only reason why such furnaces are used. With the high prices of quicksilver which have ruled during 1873 and most of 1874, every place where ores could be found has been worked, and as all the deposits are irregular and uncertain, the owners of such mines have not felt themselves justified in going to any greater expense. I saw no well-developed property, nor any property which appeared to have any future which was worked with retorts, except in a few instances, where the retorts were put up to have a yield while other furnaces were being erected on the property developed, or where the mines were evidently being worked with too small a capital.

Modified Idria Furnace.—As an example of non-continuous working with shaft furnaces, I have selected the practice of the Redington mine, with the old Idria furnace, which is by far the largest mercury works in North California. But as everything relating to this variety of furnace, which is destined in a few years to disappear altogether, is of interest, I have added some details relating to the New Almaden furnace of the same type, which I visited shortly after, although they are south of San Francisco. Great attention is being paid to the question of condensation, which is, perhaps, even more important than that of the furnace. The two questions are, however, intimately connected, and are engaging the most serious study of all persons interested in the metallurgy of mercury.

At Knoxville, the Redington Quicksilver Company treat the ores from the Redington mine, which they own, in both the modified Idria furnaces, of which they have two, and also in the Knox furnaces, of which there are two working, and two in the course of construction; besides these, two others are to be built. The furnaces are situated at the mines and within a few feet of the ore shaft. The mine produces 700 to 800 tons of cinnabar per week. The ore occurs in a sand-rock, in serpentine. Much pure cinnabar is found, and a considerable quantity of high grade ore, but the average yield of the whole mine is about 3 per cent. Metacinnabarite is found in considerable quantities in these mines. Epsomite, resulting from the decomposition of the serpentine, also occurs here in very large quantities, in acicular crystals over a foot long. The ore is largely associated with pyrites. About one-tenth of the ore comes from the open cut made in the side of the hill. From the mine the ore is thrown upon screens placed one over the other; the upper screen is made of round iron bars 1½ inches in diameter, placed 2 inches apart at the top, and 2¼ at the bottom. The screen itself is 5 feet wide at the top, 5 feet 6 inches at the bottom, and is eight feet long. Whatever passes over this screen only, is hand-picked. What passes through falls upon strong iron-wire screen of ¾-inch mesh. What goes over the second screen goes directly to the furnace, and is charged with the hand-picked ore; what passes through is treated as fine ore; all the large pieces are broken by hand. Before the Knox furnace was introduced, the ore was dressed by hand up to 5 per cent.

All the fine ore is mixed with dirt and made into adobes, which are sun-dried and stored, for use in the modified Idria furnaces exclusively. There is no generally adopted size for the adobes. They are made in roughly constructed wooden frames, made by the workmen, which wear out rapidly. The usual sizes are 9 x 4 x 4 inches. When dry such adobes weigh 12 pounds. They are sometimes made 12 x 5 x 5 inches, which is a very large size. Such adobes weigh 18 pounds. The smaller size is the one most generally used. Seven men, at $2 per day, can make 6000 adobes. Each man can mould one thousand, but the six men require one man to loosen and moisten the dirt, and to mix the ore with it. Making the adobes costs, therefore, $2.33 the thousand. The cost of the adobes delivered at the furnace, ready for charging, including making, carting and storing, is $5 the thousand. The modified Idria furnaces (Fig. 1) are built one on each side of the condensers, which are at right angles to them. Each of these furnaces is capable of treating 100 tons of ore with 4000 to 5000 adobes per week. They are built of a porous sandstone, which is found a short distance from the works. Each furnace has a double fire-place, B, 20 inches in width, 17 feet long, and 15 feet high, from the spring of the arch of the fireplace. The total inside height of the fireplace compartment is 20 feet. It has on the ore-chamber side a brick screen pierced with fourteen openings, the size of one brick, and two bricks apart, across the furnace, and fourteen openings in height, also two bricks apart. The fireplace wall has been repaired once in seven years. It is made of red brick, and is glazed by the heat. The ore chamber, C, is 13 feet by 10, and 20 feet high. Its walls are 4 feet thick. There are two ore discharge openings, 32 by 20 inches, on each side, at the bottom, which are four feet above the ground. The car for discharging the furnace runs under a swinging apron of cast iron, and the ore which has been treated is raked out over it. The fireplace and condenser walls are each mere screens of brickwork filled with holes, which are the starting-points of the flues, made in the charge. As the condenser side is constantly exposed to the acid vapors, it is the one most rapidly worn. It has been renewed twice in five years. It is now strengthened with an abutment. From constant use the inside walls round the ore-chamber have become worn away, making its present size somewhat larger than it originally was. Beyond the ore-chamber each furnace has two sandstone condensers, D, which are 4 feet wide, 13 feet long, and 20 feet high, in which very little material ever collects, never more than two flasks of mercury a week.

In the drawing, Fig. 1, these furnace condensers are connected with the main condensing chambers, A, by the flues, E, which are supported upon arches, and which enter the top of the first chamber of the main condenser, A. The length of the flue between the furnace and the main condenser is 8 feet and the furnaces are so arranged that each one may work independently into the condenser, the connection being cut off at will. The total length of each furnace, including the fireplace, ore-chamber, and two condensing chambers, is 36 feet, its total width is 17 feet, total outside height 24 feet. The main condensers, A, consist of a series of twelve chambers, each of which is 4 feet wide, 20 feet long, and 20 feet high on the inside, contained in a structure at right angles to the furnaces, and which is common to both of them. Each one of these compartments has an iron door on each side on a level with the bottom of the chamber. The inside walls of the condensers are 1 foot thick, the outside 18 inches. They are braced on the outside with wooden beams 8 x 10 inches, which are tied with ⅝-inches round iron rods. These rods must be carefully watched, as they are likely to become corroded through, and allow the wall to fall, and thereby cause serious accident.

The walls of these chambers are soon saturated with mercury, and become soft from the effects of the acid vapors. The stones are found corroded for a depth of six inches, and some of the interior walls have been corroded entirely through. Whenever they have been repaired with brick, it is found to be quite hard and to resist much better than the stone. The relation of the condensing surface of the condensers to that of the charging compartment is much too small. The relation of the condensing volume to the volume of the furnace should be at least as 24 to 1. In this furnace, however, it is not more than one-half of that amount. This would make the chambers only large enough for one furnace. That the condensing capacity is not sufficient, is evident, from the fact that metallic mercury has supersaturated the stones, and still exudes in globules from the walls even after repeated cleaning. The flue leading to the chimney is also built of cut stone, and is 250 feet long. It is oval, 4 feet in the highest diameter inside, with walls 2 feet thick. It lies against the side hill. The chimney is built of stone, with walls 3 feet thick. It is conical, 5 feet in diameter at the base, and 50 feet high.

The furnace is charged by a windlass from above. The ore is let down in iron buckets 3 feet in diameter, and 30 inches high. The adobes are let down in iron cages that hold 150 adobes, which weigh about a ton. This cage is 3 feet by 30 inches, and 2½ feet high. The charging compartment is lined with adobes 2 to 5 thick, piled close, but not crowded. Inside of this the ore is placed in pieces from about the size of an egg to twice the size of the fist, in layers of four, 18 to 24 inches in thickness, then four to five channels the size of an adobe are built over the ore. Their number depends on the size of the ore, five for fine ore, and four for coarse. These channels start in the opening of the fireplace screen, and end in the opening towards the condensation-chamber. They answer the purpose of flues, and are necessary not only to provide a draft and to allow of the heat coming in contact with the ore, but also to prevent the charge from packing together. The poor soot, or that which has been worked, is charged on top of every layer of ore. A new layer of ore is then put in, and so on, until the chamber is nearly full. A layer of fine ore and poor soot is placed near the top, and this is covered over with clay and straw. The compartments are closed with cast-iron pans, which are filled with water, the joints between the pans and against the masonry being made tight with ashes or cement. These pans are 10½ feet long, 4½ feet wide, 5 inches deep. The cold water flows constantly from an inch pipe into the pan nearest the fireplace. A spout from every pan carries the water to the next pan, so that they are always full. Each pan is provided with two eyes at the sides for their removal when it is necessary to recharge the furnace. One furnace is charged on Monday, and is fired Monday night, and is kept burning until Thursday morning. During this time two cords of wood are burned to each furnace. The sulphur, to a great extent, answers for fuel, for there is always an excess of sulphur in the shape of pyrites in the ore. The other furnace is charged on Tuesday, and is fired Tuesday evening, and kept burning until Friday. One furnace will thus be cooling on Saturday and Sunday, and the other on Sunday and Monday. A little mercury commences to run in D on Tuesday, and in the 1st, 2d, and 3d compartments of the main condenser. It runs most freely Wednesday and Thursday. By Thursday the mercury condenses quite in the end of the condenser, but only in very small quantities; 150, sometimes 200, flasks are collected from both furnaces during the week; most of it comes from the 5th and 6th condensers. On Wednesday it commences in the 5th and 6th, and runs from here continually until the furnace is discharged. The most of the mercury is obtained when the furnace is cooling down. When the draft is good and the ore moderately rich the yield will not be less than 200 flasks a week.

The bottoms of the condensing chambers were originally built inclined towards the centre, as is shown in the lower part, Fig. 2, with the intention of having all the mercury in all the condensers run out through a common opening made for the purpose, but the openings in the partition walls of the condensing-chambers very soon became clogged, and so much mercury was absorbed in the masonry that this was shortly abandoned. The present disposition is iron pans, sloping from the centre toward the outside, as is shown in the upper part, Fig. 2, which are placed three feet above the furnace bottom of the old construction, which has not been altered, so that there is a space of considerable size under the bottom of the pans. The pans are made in three pieces, which overlap each other. This is especially necessary, as when the walls get old and fall, the whole pan would then be liable to be broken. Tiles placed upon the top of the pans to protect them, have been used with good effect. The castings with this protection have lasted already four years, and are seemingly perfect. The cast iron without the tiles lasts only two years, at which time it is corroded by the sulphuric acid, which condenses from the furnace.

On Saturday the iron doors at the bottom of the condensation chambers are taken off, and a workman with a long hoe collects the soot on the pan, and that from the walls, about two feet above the bottom of the pan; what is higher up on the wall is left to collect there until it falls of its own weight. Seventy-five to 100 bushels of soot are collected in buckets every week from the bottom of the condensing chambers, which yields from five to twenty flasks of mercury. This soot is a mechanical mixture composed of ordinary soot, condensed from the smoke of the fuel, ashes, dust, and dirt, carried over from the ore, volatilized cinnabar, and sublimated mercury in very fine globules. It is usually taken from the condenser damp, owing to the condensation of steam from the moisture in the fuel and ore, and the acid vapors. This soot is removed in buckets, fourteen inches in diameter at the bottom, thirty at the top, and thirty-three inches high. Two such buckets, filled one foot high, are taken from each side of the condenser. Sometimes as many as eight, and sometimes not as many, are taken. It takes two men two days to clean out and work the soot from all the five condensers in an ordinary working of the furnace. The amount collected is very variable. When, for any reason, such as a stoppage for repairs, the furnace cools, a large quantity of soot becomes detached at the time the furnace is lit. The amount of mercury collected from the soot varies from five to twenty flasks a week. The flue leading to the chimney is cleaned once in two or three weeks; about one bushel of soot is taken from it. This is not kept separate, but is mixed with that taken from the condensers. It takes ten men one day to charge each furnace, and six men one day to discharge it. The six men are paid about $85 per month and board, making about $1.90 a day. There is a fireman and one man to clean and repair the flasks and fill them. They work during the day only. Each shift of twelve hours has its own foreman. This does not include the men working up the soot. When the draft is not good a fire is placed at the foot of the chimney, which is fifty feet high, to increase the draft. The draft depends for the most part upon the way the furnace has been charged, but is sometimes due to the direction of the wind. This draft furnace is oftenest used when the furnace has been allowed to get cool. Not a cord of wood per month is required for this purpose. In winter, fall, and spring there is no trace of mercury in the flue, but when the weather is hot it collects inside, near the top of the chimney, which is provided with a ladder in order to make any observations on the escape of gases at the top which may be desirable. When the furnace is out of repair in very hot summer weather, it is apparent that some mercury escapes. The joints of the furnace are made so tight that no accident arises from salivation except through the carelessness of the men. As soon as the workmen experience any sensitiveness about the mouth they are instructed to go to the office, and are there furnished with a mouth-wash, consisting of two parts of cinchona, one part tincture of myrrh, and three parts water, but no case of real salivation, except from the carelessness of the men, has occurred in a great many years.

Twice in a year a general clean-up is made. This is done by putting iron pipes, twenty-four inches in diameter in compartment D, and three in the flues leading to the chimneys, both to hasten the cooling and ventilate them while they are being cleaned. The walls of the condensers are cleaned by scraping. On account of the dust arising from the falling soot, it is necessary, when this work is done, for the men to wear a wet sponge over the mouth and nose, which is covered with a thin cloth, tied behind the head. At this work the men relieve each other every fifteen minutes. After scraping, the walls are thoroughly washed. It takes eight men two days to scrape and wash the walls, flues, and condensers. The soot so detached contains a large amount of mercury. From such a general clean-up as many as one hundred flasks have been collected. The soot in the first condenser is often six inches thick in concretions. It is here hard and solid, but in the other condensers it is soft and light. The light soot upon the walls is of very variable thickness, but is rarely less than one to two inches thick. It sometimes reaches as high as six inches after a long run without cleaning. When there is very rich soot it may often be as thick as six inches on the bottom of the iron pan. The soot is richest in the fourth, fifth, and sixth condensers, but it is always very evenly distributed. In all the compartments in the space below the iron pans, a hard concrete, consisting of hardened soot and mercury in globules, is found.

The furnaces with the condensers cost originally between $100,000 and $125,000; they have been built eight years, and have been repaired three times, parts of six partition walls having fallen down at the flue end. At the furnace end the wall is good. The walls after having been scraped and washed every day for a month still showed mercury in globules all over them, a few hours after they became exposed to the heat of the sun. All the stone taken out of the condensation-chambers during repairs is carefully preserved and is treated as very rich ore. The first time that the furnace was charged the ore was picked. At the top of the charge, over the rich ore, 6 to 7 feet of rich soot were put in, but the heat did not reach it. The charge being unusually rich, should have yielded five hundred flasks of mercury, but all but nine flasks of it were absorbed by the walls. This furnace has been definitely abandoned at Knoxville. The masonry has been altered into Livermore's inclined continuous furnace, which is adapted to treat fine ores, and since its introduction, in the earlier part of 1875, no adobes are made. The cost of altering the furnace was only $1200.

Average cost per week of reducing 1 ton of ore in the modified Idria furnace, at the Redington mine, furnaces Nos. 1 and 2, in 1874:

5½ cords of wood at $5, ...	$27.50
36 days, furnaceman, fireman, and his assistant, .	86.00
20 days, laborers charging furnace, ...	38,60
12 days, laborers discharging furnace, ...	23.15
8 days, laborers working soot, .	14.55
8 days fireman, ...	14.55
9000 adobes at $5 per thousand, ...	45.00
Total charge of 200 tons cost, ...	$249.35
Average cost per ton for reduction, ...	$1.25

New Almaden Works.—At New Almaden, the Quicksilver Mining Company have six furnaces of the modified Idria type, built of brick, which produced in the year 1874, 11,042 flasks of 76½ pounds each, or 920 flasks per month. Four of these have a capacity of 50 tons, one a capacity of 70, and one 100 tons of ore a week. They run a week, so that each furnace makes four charges a month. Each furnace has from sixteen to twenty-two brick condensing-chambers, the numbers varying with its ore capacity. The bottom of the chambers inclines from the centre toward the doors. The floor is built of brick, and is covered with cement. Besides the brick condensers, each furnace has four or five wooden condensers, which are 26 feet long, 14 feet wide, 20 feet high, divided into six compartments of equal size. As the result of the addition of these wooden chambers, one of the flues, which formerly yielded in the general clean-up from 60 to 100 flasks of mercury, yielded in the year 1873 only two flasks, and the largest part of this was found near the outlet from the condensers, and no signs of metal were found further on. It is the present intention to cut up the blocks of brick condensers by taking down the outside wall of one or more compartments, and making the dividing walls the exterior walls of the new structure. The former condensers will thus be divided into three or more separate buildings. A much larger radiating surface being exposed in this way, it is expected that the condensation will be much more perfect. Adobes 10 x 4½ x 4½ inches in size, made of the fine ore mixed with dirt, are placed over the floor of the ore-chamber, one adobe thick the entire height of the sides; ore is then put 2½ to 3 feet in thickness, then a layer of adobes, in which five flues from one side to the other of the furnace are made, and then ore, and so on to the top. The top is covered with a layer of adobes, and then a layer of straw two or three inches thick, and then ordinary clay and mud, to make it even with the top, and over this ashes. Any cracks that may occur are filled in with ashes. When the furnace is filled, one-third of the charge will be adobes; sometimes the furnace is run on adobes alone. It takes six men one day to charge the furnace. It takes one man part of twelve hours to keep up the fire. It takes four men one day to discharge it. The charging is done by the company, as it must be carefully done, but the discharging, as it requires no supervision, is done by contract. The fire is kept up ninety-six hours, and during this time eighteen cords of wood are burned for 100 tons of ore. The wood costs from four to six dollars a cord. The ore is discharged twelve hours after the fire is drawn; twenty-four hours afterwards the soot is taken out.

The mercury commences to condense fourteen to sixteen hours after the furnace is lit. If the ore is very rich it sometimes commences to condense in eight hours. It appears first in condenser No. 1. In Nos. 1, 2, 3, 4, and 5, it runs for ten hours; after this it runs in Nos. 3, 4, 5, 6, 7. It appears in No. 7 on the second day, after which it ceases to run in the first four condensers, but continues to run in all the others. The greater part collects in Nos. 9, 10, and 11. Before the fire is drawn, half of all the mercury is condensed, which is in about forty hours, gradually diminishing until it ceases to condense. A small amount of mercury still runs, however, the flow being kept up by the dripping from the walls. From the bottom of each of the condensers there are small pipes leading into an outside trough, to allow any mercury that forms to run immediately into the gutter, from which it is discharged into the reception basin. The iron doors which close the entrance to the brick condensers have been given up, except for the first four or five chambers, and are now replaced by ordinary glass window-frames 3 x 3 feet, with six panes of glass. It is found that there is a material difference in the condensation since they have been adopted. The condensers made of wood and glass, which were patented in May, 1874, are in successful operation here. They are certainly much cheaper, and it would seem a much better condenser, and less likely to get out of repair than the iron ones used elsewhere. This kind of condenser requires no water, and is, therefore, applicable everywhere. The want of water in many places in California is often a serious drawback to the working of the ores. Four such condensers are at work at New Almaden. Each one has a volume of 2640 cubic feet, and 1196 square feet of condensing surface, or altogether 10,560 cubic feet volume, and 4784 square feet of surface. They cost only $1500, which is the smallest cost for any such amount of condensing surface known. If they work as well as they promise they will take the place at least of half the iron or brick condensers. The soot is collected in the same way as at Knoxville. That collected from four charges gave 18 flasks of mercury. The same four charges produced 474 flasks. The soot condenses in all the condensers from No. 4 on; the most of it collects in 10, 12, and 14, or about in the middle. On an average about a lime-barrelful per week is collected from each condenser. One man does the whole cleaning up. The soot was formerly on an inclined plane, and stirred and slightly rubbed with a wooden hoe. A certain quantity of quicksilver separated and ran out into a vessel prepared for it, but left a very large quantity still remaining in the soot, which was afterwards treated with lime. This method, which is in general use and takes a great deal of time, has been given up here. The soot is now put into a hemispherical boiler about 3 feet in diameter; it is mixed with boiling water from a vertical boiler, used for this purpose only. About half of the bulk of soot is added in wood-ashes, and the whole thoroughly stirred with an iron hoe for three-quarters of an hour, when the separation is complete. It is then allowed to remain an hour and settle, and during this time another boiler is worked. The mercury collects in the bottom of the vessel, and flows out of a siphon-shaped pipe, so that only the pure mercury is discharged. The water is drawn off afterwards, and the soot remaining behind is thrown into a heap, and when dry is placed upon the top of the furnace near the flue where the flame passes, as it still contains some sulphur. It is claimed that all the mercury in the soot is separated in this way and with much less labor than by the former method. This process was patented October 4th, 1873.

It takes one man, working ten hours, four to five days to work the soot of six furnaces. The fuel used here is wood, or ordinary charcoal made from oak, or a mixture of charcoal and coke. It requires 75 lbs. of coke and charcoal mixed to 3000 lbs. of ore and adobes, or equal quantities in bulk. This furnace, as used here and at Knoxville, must be considered as a very great improvement on the old Idria furnaces, as there are no arches in the ore-chamber which are likely to break down without warning.

The method of charging large and small ores and arranging air-channels by means of adobes prevents the charge from packing, and gives all the space which is required for the circulation of the air and heat, and allows of using a poorer ore than could be otherwise used. The labor of making the adobes, which is, however, only $5 the thousand, must be regarded as a necessary expense, as the furnace could not be run without them; as the expense of making the air-channels of large pieces of ore would be too great, and there would be no certainty that they would last if so made. The adobes, however, do not change their form, and the air-channels once made remain as they were made in the charge. The making of adobes is, however, one of the expenses to be avoided in the furnace of the future, and the most careful attention now being given to the construction of furnaces which will allow of the fine ore being treated as it comes from the screens. Although this furnace, with its expensive, cumbersome method of condensation, is a great improvement on the old Idria furnace, it is destined to disappear, and in a few years will probably be cited as one of the curiosities of metallurgical history.

Continuous Furnaces.—The continuous furnaces in use are all of them shaft furnaces, which do not differ essentially in the principles of their construction, though there are wide differences of detail, which are more or less essential. The California practice is essentially different from that of other countries, in that all of these furnaces are provided with fans placed beyond the condensing apparatus, which not only do away with the necessity of high chimneys, but give such an absolute control of the draft that there is no fear of the fumes escaping. The draft is always toward the interior of the furnace, so that even if an aperture in the furnace or the condensing apparatus should remain open, no fumes escape, and consequently cases of salivation are very rare. As the velocity of the fan can always be changed, the draft can be regulated at will to suit either the working of the furnace, or the irregularities of the weather. The furnace is of less consequence than the condensation apparatus, though its aim should always be to extract the metal at the lowest possible temperature, and to require the least possible preparation of the ore. It is consequently on the condensation apparatus rather than on the furnace that the greatest number of experiments have been made; providing that the furnaces are continuous, the one which has the best condensation apparatus will be the best. There are a number of these furnaces used in California, all of which I believe are patented. I saw, however, but two of them, the Luckhart and the Knox, working.

Luckhart Furnace.—The Luckhart furnace is, in all respects, similar to the Swedish furnace for roasting iron ores. It consists of a shaft with a fire-box, with openings in the two sides only, which goes through the furnace from one side to the other. It is covered with a cast-iron roof slanting from the centre towards both sides of the furnace, so that the charge is divided as it passes down, and the heat is also divided as it passes up. The sides of the furnace are pierced with holes to observe what is passing in its interior, and to watch the progress of the charge. The discharge door is sufficiently far below the grate to insure the ore remaining long enough in the furnace to have all of its volatile contents distilled, and to be sufficiently cool to be discharged with perfect safety into an open wagon at the bottom. By this system, which is common to all the continuous furnaces, the inconveniences arising from the discharge of hot ore not entirely worked are avoided. The Luckhart furnace used at the Sonoma mine, is capable of treating 15 to 18 tons of ore and adobes a day. The richest ore treated has not contained over 10 per cent. The serpentine containing the mercury crops out near the furnace, and is very much decomposed. The rock is soft and crumbly, and where it is exposed to the weather, its débris has been washed away so that the soil for some distance from the outcrop is composed of its detritus, more or less mixed with free mercury, and a very little undecomposed cinnabar. Where the rock has been mined so as to reach the undecomposed parts of it, it is found to contain in the upper portions more or less free mercury mixed with the cinnabar, but nine-tenths of all the ore treated consist of dirt taken from the surface of the ground, which is made into adobes by Chinamen. The adobes contain from one-quarter to one-half per cent. The rock does not contain more than one and a half per cent. The adobes are made by mixing the earth with water to a thick paste, and then putting it into wooden moulds 5 by 4½ inches, and 4 inches high. The thick mud is simply placed in a frame containing 8 of these moulds, patted with a shovel, the wooden frame drawn up, and the adobes left to dry in the sun; it takes about two days to dry them. When ready for use, they weigh about eight pounds each, and are a little larger than an ordinary brick. One Chinaman can make a thousand in a day. The men are paid $1.25, and find themselves It takes two Chinamen, at $1.25, to pick as much dirt as six men can use for making adobes. The furnace is charged by means of a circular hopper 22 inches in diameter, and 26 deep; 5 to 6 of these hoppers full make a charge, and 5 such charges make a ton. The hopper is covered over with a hydraulic cover for safety, but even when it is off, the draft is so strong that there is no discharge of mercurial vapors from the top of the furnace, as I assured myself by removing the cover and having the charge withdrawn below the hopper. The furnace consumes one and a half cords of wood a day, which comprises all the fuel used in the works. The wood is usually oak, and is worth $3 a cord. About 15 tons of ore a day are treated. Most of the ore is discharged from the bottom of the furnace black, some of the last of a discharge is occasionally red-hot; it is drawn about every hour and a quarter into iron wagons, which hold about half a ton. There are 7 men engaged in making adobes, and there is one Chinaman and one engineer on each shift of twelve hours at the furnace; the Chinaman is paid $1.50, and finds himself, the engineer is paid $65 a month. The engineer helps the Chinaman, who draws the charge and dumps it, and charges the furnace and puts in the fuel. In addition to the two helpers, there is one man engaged continually in chopping wood. The total cost of treating the ore is one dollar per ton.

The condensing apparatus consists of three sheet-iron cylinders five feet apart, which are 14 feet high, six feet in diameter. The vapors pass from the furnace through a pipe about 20 feet long, in at the top, and out at the bottom of the condenser. A blower is placed just beyond the last condenser, which is three feet in diameter, and makes 100 to 120 revolutions a minute. If there is much fine stuff not made into adobes charged into the furnace, it must be run faster. The engine used is twelve horse-power, but six would answer for a single furnace. Just beyond it is a wooden box, six feet high, 12 feet long, and eight feet wide, into which the blower discharges. This box has a partition in the centre, which goes to within two feet of the bottom, to break the current. From this box there is a flue two feet square, and 100 feet long, ending in a wooden chimney 20 feet high. Around the top of the condensing cylinders there is a lead pipe one inch in diameter, pierced with small holes about three inches apart. When there is a plenty of water it is allowed to flow continuously from this pipe, and discharges itself over the outside of the cylinder, thus cooling it. When there is a lack of water it is allowed to flow only over the last condenser. The pipes which connect the cylinders have in their interior a partition about two feet long, and on them a considerable amount of soot collects. The bottom of the cylinders incline towards the centre, and from here a pipe leads to an iron kettle on the outside two feet in diameter, which is kept constantly full of water. A large quantity of soot collects on the sides of the condensing apparatus. A little of it constantly falls, and is washed out into the iron basin by the condensed moisture, which is but slightly acid, as there is but little cinnabar in the ore. About one flask of mercury a day is collected from the first two condensers. About one-half of this comes from the second. From the third about a flask a month is collected. The cylinders are provided with doors, and the furnace is stopped once in three weeks to clean out the soot, which is collected in kettles. About ten flasks of mercury will collect from the soot after some stirring; the rest is put into an iron pan, nine feet by three, with a gutter in the centre. The pan is set at an angle of 20°, and gently heated to about 120° F.; it is then mixed with lime or ashes and stirred. The mercury flows readily from it, and about 70 per cent. of its mercury contents is collected in this way. The rest is made into adobes and treated in the furnace. The more or less acid water which is constantly flowing into the basin outside of the condenser, as it runs off carries away some light mercury and soot. This is conducted to a wooden tank, 12 feet long, six feet wide, and four feet deep, where it collects and gives a product which contains considerable mercury, which is treated as soot. The soot comes from the basins, the wooden tanks, and sometimes a very little is taken from the blower cylinders. This soot gets poorer as it is further from the furnace. The richest contains 60 per cent. of mercury and the poorest about 3. The product of the works is about 25 to 50 flasks of mercury a month. The condensation at these works seemed nearly perfect. The manager stated to me that he had exposed a $20 gold piece for six weeks from the top of the wooden chimney, and that he not only found it there at the end of that time, but entirely unaffected by mercury. There is so little sulphur in the ore that the sheet iron does not seem to have been acted upon to any great extent. With this system of high cylinders with a bottom converging towards the centre, there seems to be but little opportunity for the action of the acid, and with a thick cast-iron bottom there seems to be no reason why it should not answer quite well. It would seem, however, that a few large compartments could not give as good results as a greater number of smaller ones, as a perfect condensation requires a maximum of surface, and does not depend so directly upon volume, though the amount of soot and mercury collected in the wooden box and in the last condenser here seem to show that in this case, at least, owing probably to the very small product of the furnace, the condensation was quite perfect.

Knox Furnace.—At Knoxville, beside the Idria furnaces, there were, in August, 1874, at the Redington mine, two Knox furnaces in the course of construction, and two in work, which treated 25 tons of ore each in twenty-four hours, and have been running since January, 1874. During the years 1874 and 1875, two other furnaces have been constructed, making six in all, which treat together from 900 to 1000 tons of ore a week. Before the use of these Knox furnaces, and while the modified Idria furnaces were the only ones in use at these works, all the ore had to be dressed up to five per cent. Now ore yielding not more than 1 to 1½ per cent., as it comes from the mine, is treated, and Mr. Knox claims that he can treat profitably ore containing not more than ½ per cent. A furnace about to be constructed is to be adapted to treat fine ore exclusively, and it is expected, if this furnace works successfully, to give up making adobes altogether and treat the fine ore here, and if the modified Idria furnaces are still retained, to treat in them only the large and medium-sized ores.

The Knox furnace (Figs. 1, 3, 4 and 5) is a shaft furnace with a fireplace upon the side. The total height of the furnace is 39 feet. The bottom of the fireplace is 17 feet 6 inches from the bottom of the furnace, so that the fire itself is about in the middle of the shaft. The furnace is rectangular in shape. At the top it is two feet square; it continues for two feet at this size, and then widens out on one side, until at the depth of four feet it attains the width of seven feet. While in the other direction it continues straight for a depth of ten feet, and then increases gradually until it becomes seven feet at the fireplace. At this point there are two chambers, Z and Z′, Fig. 5, arranged in the masonry, on one side for the fireplace, and on the other, the space for the introduction of the pipe U′, which carries off the fumes. At this point, which is 17 feet 6 inches from the top, there commence a series of six retreating arches, which support the masonry of the furnace, four of which retreat two feet six inches on either side. The two others which are above are much smaller, and reach to within three feet of the top of the furnace. At the fireplace the furnace is seven feet square. The shaft continues to the bottom on the fireplace side of the same size. On the other side it contracts equally upon both sides, so that at the bottom, X Y, where the ore discharges, the width is only two feet. The fireplace follows the retreating arches with a width of 36 inches to the top of the second arch, and then diminishes to 30 at the top of the third, and continues so to within 3 ft. 6 in. of the top of the furnace. Between each of these arches, on both sides of the furnace, there are openings six inches wide, and the whole width of the arch. The aspiration of the blower draws the flame from the fireplace Z to the chamber Z′ on the opposite side. The heat of the fireplace is always sufficient to keep it at a dull-red. This construction of the fireplace is far too complicated. These retreating arches are liable to be worn by the ore, though not very rapidly, but are quite rapidly affected by the fire and the gases. Exactly the same effect might be brought about by the much simpler construction of having the fireplace entirely outside of the furnace. As originally constructed the furnace was quite different. It was 24x42 inches at the top, and continued for two feet at this size and then gradually widened by a curve upon one side until at a depth of seven feet from top it was seven feet six inches wide; it continued to the bottom of the fireplace at this width, and then gradually diminished until it was two feet at the discharge. On the other side, at a depth of two feet from the top, it widened to three feet, and continued at this width to the top of the arch, then followed the retreating arches down to the bottom of the fireplace, where it was seven feet, and continued at this size to the discharge. There were only three openings between the arches, and it was found that this was insufficient, and the two small arches above were introduced to increase the heat and attack the ore higher up. The fireplace is so arranged that it receives air which enters at the bottom of the furnace and passes round it through a series of channels Y, so that before entering the fireplace, it is heated by the walls of the furnace, and thus effects a small saving in fuel, so that the furnace may be said to be in some respects a hot-air furnace. The masonry of the furnace was formerly made six feet thick, and it is now made eight feet. It is braced by ten large wooden beams, which are held together by iron bolts, and as the furnace is double, are strengthened by three uprights of the same size, also clamped together by bolts which pass entirely through the masonry furnace. By the enlargement of the furnace in the centre the ore as it comes to the point where it is to receive the highest temperature is made suddenly to spread out, so that each particle of it comes in contact with heat, and is in no danger of fusing. The flames are made to traverse through the six openings between the arches, which are six inches in height, to the chamber on the opposite side of the furnace, into which all the fumes are carried by the draft.

The cubic contents of the furnace are calculated in such a way as to be capable of containing about 75 tons of ore, but as only one ton of treated ore is drawn from the bottom of the furnace every hour its capacity is 24 tons in twenty-four hours, so that every ton of ore will remain in the furnace at least three days. When, however, the proportion of very fine ore becomes large, or when the ore is wet, the amount that can be treated in twenty-four hours will be reduced to 12 to 16 tons per day. In the case of a large quantity of fine ore it is proposed to remedy this to some extent by charging wood in small pieces with the ore. This serves to

some extent the purpose of keeping the ore open, so as to allow free passage to the heat through the ore, and at the same time creates a source of heat within the charge, so that it will be partially dried, and not pack as it comes down in front of the fireplace. The chamber for the outlet of the vapor is underlaid with a very heavy cast-iron plate, in order to prevent any possible condensation or absorption of the vapor at that point. The pipe U′ for the outlet of gas is made of cast-iron, is 18 inches in diameter, sixteen feet in height, as it enters the condensation-chambers U. It projects two feet from the furnace before it turns down; at the elbow there is a man-hole for cleaning the pipe. Just above the outlet pipe a cast-iron door is arranged, so as to observe what is passing in the interior of the furnace on the side. Two of the furnaces were built in one structure on account of economy in constructing and running them. They are charged with two-thirds to three-quarters medium, and one half to one quarter of fine ore. Adobes are never used in these furnaces.

The charge is introduced by means of an automatic iron wagon, which contains 18 cubic feet of ore, which is equivalent to about a ton when it is moderately heaped. If the ore is very light, however, the amount contained may be somewhat less than this. When the capacity of the furnace is given in tons, that number of carloads is intended to be expressed. The wagon runs upon rails, and is shoved by the charger to the top of the furnace, where the rim of the wagon first strikes a lever attached to a wire rope, which supports the cover of the furnace, which throws off the cover, then a projection on the body of the wagon throws it to one side. The workman then pulls out a pin in the wagon, which discharges the ore into the furnace. As soon as the ore is discharged the weight of the furnace top and lever drives the car back, when the cover drops and closes the furnace. The weight of the charge holds the wagon in place only long enough for the car to empty itself. The workman shoves the empty car back far enough to be out of the way, covers the furnace top with ashes, and prepares a new charge.

There are fifteen men breaking and sorting the ore, but one man does the whole charging for both furnaces. The fuel used here and at the Manhattan works is the most ordinary oak brush, which is cut by the company and brought one-quarter of a mile. It costs about $4 a load, which is supposed to be equal to about a cord of good wood. The reason for the use of brushwood is, that during the summer an unlimited supply of it can be had at a short distance from the furnace, both at the Manhattan works and at Knoxville. It is much more easily cut and carried than wood, and it is a cheap fuel in the summer. As this supply fails in the winter, and teaming is more difficult, wood is used at this season. A sheet-iron trough, 3 feet long and 2 feet square, is hung before the fireplace door. This trough is made to fit the fireplace door, which is counterbalanced and rises vertically. The brush is cut to the length of the trough and is packed into it with a pitchfork, the fireplace door is then raised, and the brush shoved in with the fork. This brush is used green, immediately after cutting. It flames very readily and makes a quick hot fire. It is charged about every half hour. It takes 2½ cords of good wood to do the work of the furnace in twenty-four hours, or two loads of brush, which are considered as weighing one ton. The wood is a mixture of white and live oak, and costs $5 a cord delivered at the furnace. A ton of the brushwood costs $5, and is sufficient to treat about 24 tons of ore. The fireman draws the ore that has been treated and takes care of the furnace. The charge is drawn from a long narrow door X in the lower part of the furnace, 15 feet below the level of the fireplace and on the side next to it. The door is raised by a tackle, and is counterpoised. The discharge is effected by means of a hoe and a rake, attached to handles 12 to 14 feet in length made of inch pipe. The discharging car is of iron, and is half the length of the door. It is rolled to one side of the opening and stopped with the handle of the rake, so as to be exactly opposite the end of the door. The ore, which is black, though not cold, is drawn into it from one side of the charging door until the wagon is half full, it is then rolled to the other side and filled from there. By the time the car is full the red-hot ore appears. The car holds one ton of fully treated ore. One load is drawn every hour from each furnace. The furnace is charged above as soon as the charge is drawn. It is done by the same men who also attend to the fire.

Each furnace requires two men and an aid per shift, so that a single furnace requires six men to treat 24 tons in 24 hours. A double furnace requires only 8 men, who treat 5 tons in 24 hours. To run four furnaces, standing as in Plate VIII, requires 10 men to treat 100 tons in 24 hours. It therefore requires one day's labor to treat 4 tons, 6 tons, or 10 tons in 24 hours, showing a gain of twice and a half on all the labor by increasing the number of furnaces to four. One engine and boiler will do all the work of four furnaces, and three or four cords of wood is sufficient both to burn the ore and to keep up steam to run the blowers.

The draft in the furnace is produced by four Root's blowers, E, F, G, H, placed at the extremity of the condensing-chambers. The bottoms of the condensers U are inclined at an angle of from 15° to 20°. They are joined, as is shown in the drawings, at the top by means of curved iron pipes U′. There are sixteen to each furnace as at present constructed. It is proposed, however, to have four sets of eleven, two sets of ten, and six out of line, making twenty-two in all, or eighteen for each, when the four furnaces are finished. These condensers are 8 feet long, 2 feet 6 inches wide, and 5 feet high at one end and 6 feet at the other. They are set on wooden frames on a cement floor. The first condenser of the series nearest the furnace is set 30 inches, and the last one 37 inches above the ground. Commencing with the next series, the first one farthest from the furnace is 40 inches, and the last one of this series, nearest to the furnace, is 47 inches above the ground. They are made out of three castings, for greater ease of transportation and repair. The top piece is 30 inches in depth all round, is clamped to a projection of the bottom part. The top is made in a shape of a pan, and holds water to the depth of 2 inches. When there is plenty of water it is made to discharge over the top, so as to run down the sides of the condensers, but when water is scarce it simply rests upon the top. At the Manhattan works, which were the first that used the Knox furnace, the condensers are only half the height of those used elsewhere. They have been in constant use for five years, and are nearly worn out, though they may last six months or a year longer. The ore here does not contain much sulphur. These condensers will be replaced by others like those in use here. A very small amount of weak and impure sulphuric acid water commences to condense in the third condenser, but is very abundant in the eighth, and condenses through all the rest. It corrodes the iron-work more or less rapidly. As this action takes place chiefly on the bottom of the condenser, it is cast separate and made several inches thick. As it has been found that the action of the acid water is much less rapid when it is in contact with a small quantity of air, it is allowed to collect for about two inches in the bottom of the last eight condensers, and at this height is discharged from a wooden spout into the mercury trough, and runs to the settling vats M, which are 6 by 10 feet in size and 4 feet deep. A very small amount of mercury is carried off by these streams and collects in this tank. The very small amount so collected shows that the condensation is very nearly perfect. Mercury commences to collect in the first to the eighth condenser, and is discharged at once into a conduit by a small opening in the bottom of the manhole door. It is collected in the iron pots K, which contain about an inch of water, to prevent the mercury from spattering as it falls into the pot. The iron pipe leading from the trough into the mercury pot is shaped like a goose-neck, so that the acid water runs off above and the mercury collects clear. It is bottled from these pots in the bottling-pot J. From the end of each set of condensers a wooden box, E′, F′, G′, H′, 1500 feet long and 30 inches square, carries the fumes and smoke away from the furnace. The boards of which it is made are clamped against a wooden frame, on the inside by wooden clamps, on the outside so that it can be taken apart at any time. If nails were used they would very quickly corrode, and the flue, if not clamped, would be likely to fall to pieces at any moment. 300 feet from the furnace, on these long flues, there is a chimney, I, which descends about 15 feet high and 4 feet square. This chimney is filled with large stones, and water is made to flow over them from a pipe connecting with the reservoir S. This reduces the volume of smoke, which in this way, is made quite cool at this point. 1000 feet from this point the four conduits are united into one, and is continued to the top of the hill, half a mile off. No mercury and no mercurial soot is found in any part of this conduit, or in the flues leading to it. The object of it is to carry away the smoke, which in the winter time collects in and around the furnace and annoys the men. It is quite common to see the sickly cattle of the neighborhood collect near the end of this conduit and remain there for half a day at a time, so that they have to be driven from it. The engines, W, which do the work of the two blowers are fifteen horse-power, and are to be used to saw all the wood. It takes 1½ cords of wood for the engines in twenty-four hours. Nothing like fifteen horse-power is required for these blowers, and only four will be required when the six furnaces are built. All the condensers are cleaned once a week. This is done in the intervals between the charging and discharging by taking off the manhole door and cleaning down the sides with a hoe, but without scraping them. It takes two or three minutes to take out the soot from each condenser. The soot is caught in an iron soot-bucket, which is 2 feet by 3 feet, and 18 inches deep, and is carried on a truck. The soot from the first eight condensers only is rich enough to treat; that collected from the others is too poor to work, and is put back into the furnace. The draft into the condensers is so strong that there is no danger that mercurial vapors will escape, if not more than one condenser is open at a time; so that to prevent any possible accident they are opened one by one. After one or two have been cleaned the soot is worked up, and then the others are cleaned. By doing the work in this way times can be selected when the furnace is neither charging or discharging. The quantity of soot which is produced is very variable, and depends entirely upon how thoroughly the condensers are cooled, whether the fire is slow or quick, upon the speed of the blower, and also to some extent upon the changes of the weather, so that the quantity deposited in each condenser will vary at different times. The same is true of the acid water; and it sometimes happens that when the blower is run at the usual speed, and everything else in the furnace is in the normal condition, but the water has given out, that no acid water will be deposited in the first six or eight condensers, the heat, which is usually absorbed by the evaporation of the water, being so great that they remain perfectly dry.

It takes from Monday to Friday to clean out and work up all the soot, which is worked in the usual way with lime on an inclined plane. On Saturday the conduit and spouts, which get filled with mud, are cleaned, and the flasks are filled with mercury collected during the week. In a charge which gives 150 flasks per week, 40 flasks come from the soot. The works are so arranged that two furnaces may be run with one blower, or through one set of condensers; and this may become necessary when one of the blowers, or one set of the condensers, have to be repaired. It is more difficult to keep the heat up under such circumstances, and a smaller charge has to be put into each furnace. The diminution of capacity will amount to from four to five car-loads of ore in twenty-four hours. The two furnaces, B and C, will generally treat 50 tons of assorted ore in a day. They have been run without repairs since January, 1874, and have produced from 600 to 900 flasks a month, the variation depending upon the richness of the ore. It is the intention to make the trial of distilling all the soot in a retort, P. The retort is built, but the trial had not at the time of my visit been made. At the Manhattan works the soot is worked up in a retort to which a Liebig condenser, like Q, 10 feet long, is attached. The condensing pipe is large enough to hold a barrel of water at one time. The experiment is being made here of working the soot mechanically. It is mixed with lime and is put into an iron rocker, which has several motions, and in which a rake works backwards and forwards. A very large part of the mercury in the soot is collected in this way by machine labor without necessarily having any one to tend it. The rocker is run by the steam-engine of the works. This machine is not yet perfected. Working as it did at the time of my visit, some of the mercury separated is afterwards floured. This is a serious imperfection, but is is expected will be shortly overcome The best men in the works at Knoxville are always selected for the Knox furnace. They work twelve hours, and are paid $40 for 30 days and board. If the men have families and occupy the company's cottages they are allowed $20, as a commutation for board, but they pay $7½ per month for rent.

California Works.—The California Quicksilver Works also use the Knox furnace. They treat their own ores and produce 26 flasks of 76½ pounds of mercury a week. All the ore passes over a coarse screen, so as to separate the large pieces from the fine and small, which are separated by other screens in the same shute. The larger pieces are broken by hand. The fine ore which is rich enough is made into adobes. One man mixes his dirt and makes 900 a day. The poor fine ore is dressed by hand gigs, and six men treat 10 tons, and reduce it to one-eighth of its former capacity. The enriched ore contains about five per cent. of mercury, but a considerable quantity of cinnabar is lost in the tailings, and it is doubtful whether the dressed ore pays for the labor expended upon it. The men are paid $40 and board, which equals $2 a day. The attempt was made here to treat the soot in the arched chamber Z opposite the fireplace, but the gases of the furnace contained so much free oxygen at this point, that the result was the formation of a large quantity of sulphate of mercury, and the attempt was abandoned. The works have been managed with so little care that the condensing-chambers, which have been used only 18 months, are so corroded that they will have to be taken out. Long stalactites of acid sulphate of iron are hanging from them in every direction, and the walls in some cases have been entirely eaten through, or are so thin that they could be easily pushed through with the finger. It is the intention to replace the last eight condensers by brick chambers, 8 by 10, and 4½ feet high, with three partitions. When the iron condensers are in good repair the soot is found in from the third to the sixth, but now they are leaking it is found in from the first to the third. The soot is drawn every week from the first six condensers; beyond the six they are cleaned only once in three months. The soot collected in the first six condensers is about six ordinary sugar barrels per week. The quantity depends upon the sulphur in the ore, its dampness, and other causes.

Good oak wood is $4½ per cord. About two cords in twenty-four hours are burned in the furnace. Brushwood is not as cheap as other wood here, and is consequently not used. There are five men in twenty-four hours about the furnace. At night the fireman and engineer alone run it. In discharging the furnace the engineer fills the wagon while the furnaceman draws the charge down. In the daytime there is a superintendent of the work, besides one man making adobes. The miners are required to deliver the ore broken and sorted. There are 100 men working in the mines. The miners are paid $45 a month. The works have been run constantly for 18 months without repairs, and have not stopped more than three weeks during the whole of this time for any cause. The first Knox furnaces constructed cost between $35,000 and $40,000 each. They were built when wages were high, and labor was difficult to get. The furnaces since constructed have cost about $25,000 each. There are 170,000 brick in the furnace beside the stone, but nearly half the cost of construction is for iron work. Below is a statement of the cost, at the Redington mine, of treating the ore in the modified Idria furnace and the Knox furnace.

Cost per ton of reducing ore in the modified Idria furnaces, Nos. 1 and 2, at the Redington mine, Napa County, California, in 1874, taking one week's run both furnaces:

5½ cords wood, at $5,	$27 50
36 days. Furnace foreman and his assistant,	86 00
20 " Laborers chargiog furnace,	38 60
12 " Laborers discharging furnace,	23 15
8 " Laborers working soot,	14 55
8 " Firemen,	14 55
9000 adobes, at $5 per thousand,	45 00
Total charge of 200 tons ore in these two furnaces cost,	$249 35
Average cost per ton for reduction,	1 25

Cost per ton of reducing ore in the Knox furnace at the Redington mine, furnaces Nos. 3 and 4, taking one week's run of both furnaces:

42 days' labor, engineer, fireman, soot men, etc.,	$81 06
17½ cords wood, at $5,	87 50
1 gallon oil for lamps,	75
1 gallon lard oil for engine,	1 20
Total cost of one week's run,	$170 51
Average cost per day for reducing 50 tons,	24 36
Average cost per ton,	50

The difference between $1.25, which is the cost of treatment in the modified Idria furnace, and $0.50 the cost of treatment in the Knox furnace, is sufficiently great not only to warrant the use of much poorer ore in the latter furnace, but to call seriously into discussion whether it is not worth while to abandon the old style of furnaces altogether. Below is given an estimate of the principal items of expense of building *one* Knox & Osborn quicksilver furnace, in October, 1874:

50 to 75 M red brick.	
12 M fire brick.	
Stone for foundation, walls, etc.	
1 cast iron lintel weight,	3000 lbs.
1 cast iron draw-door frame, weight,	650 "
1 set draw plates, cast iron, weight,	3500 "
18 cast-iron condensers, complete, weight each,	6500 "
1 fire-door and frame, weight,	650 "
1 flue-chamber plate and door, weight	1000 "
6 braces, weight,	3000 "
1 blower-box, weight,	2500 "
2 pots, etc., weight,	500 "
1 set grate-bars, weight,	1200 "
1 blower,	$500 "
Blower pipes,	50
1 retort and condenser,	500
1000 feet wooden flues, cost per running foot,	1
1 engine, with pulleys and shafting, 8 x 12 cylinder.	
2 boilers (12 x 3).	
35 square timbers, 12 inches by 12 inches, and 21 feet long.	
60 round iron rods, 1¼ inch diameter, 23 feet long, 10-inch washers on both ends.	
2 cars, railroad tracks, etc.	

It takes six or eight masons, with their helpers, between three and four months, to build one of these furnaces. The cost might be made less by making more than one-half of the condensers of wood. They might answer even nearer the furnace, if there was a certainty of always having a large supply of water, so that they could be kept constantly wet.

Cost of labor would be about,	$5,000
Cost of building the furnaces 3 and 4, and condensers now in use,	60,000

Below is given Knox & Osborn's estimated cost of a quicksilver furnace, with a capacity of 75 tons, or to work 24 tons every twenty-four hours:

Cast iron in furnaces, 17,000 lbs., at 6 cts. per lb.,		$1,020.00
Cast iron in condensers, 91,000 lbs., at 6 cts. per lb.,		5,496.00
Work, planing and fitting,	$90.00	
1 conical charging car,	150.00	
1 discharging car,	125.00	
1 Knox patent suction blower,	400.00	
2 boxes borings to caulk condensers,	10.00	
3 iron kettles, 120 gallons each,	100 00	
Forging bolt ends, and nuts and screwing,	70.00	
		945.00
Gross amount of foundry bill,		$7,461.00
20,000 feet of lumber, at $20 per M,	400.00	
80,000 red brick, at $10 per M,	800.00	
7000 firebrick, at $60 per M,	420.00	
4000 lbs. wrought iron, at $5 per M,	200.00	
1 set blocks and fall (watch tackle) 6 inches,	10.00	
2 iron sheaves, 1¼ x 6 inches,	5.00	
4 iron side pulleys,	2.00	
40 feet chain ¼-inch wire,	2 00	
10 kegs nails and spikes, at $50 per keg,	45.00	
		1,884.00
Labor, erecting furnace,		$2,000.00
Boiler and engine, four horse-power,		800 00
		$12,145.00

In this estimate nothing is included for grading site, drayage, freight, hauling brick, sand, clay, rock, and timber, to the furnace; nor for the sheds to cover the structures. As the different sized furnaces would require about the same amount, as an approximation, we may say, that $3000 would cover an extreme case, and $1500 would suffice for a very favorable one. In a position where water for a four horse-power can be had, a saving in the first cost is effected, and a greater saving in the current expenses of running. There are two sizes of this furnace, a half size, or 12-ton furnace, which easily treats 15 tons, and has, when crowded, worked 17 tons. The full size, or 24-ton furnace, crowded in the same way, will work 30 to 34 tons.

The cost of the half size furnace is about,	$9,000
The cost of the three-quarter size furnace is about,	14,000

Both these sizes have been built within the year 1874, and they are giving perfect satisfaction.

The following is the estimated cost of running or operating the Knox & Osborn furnace, at the Manhattan works, per day of twenty-four hours, when run by steam power:

For an average ore for 24 hours, 1¼ cords of wood (oak), at $4.50 per cord,*	$5.63
2 men on each watch of twelve hours, or 4 men, $50 per month, and board, $2·53 per day,	10 12
Oil for light and engine,	50
Cost per day for reducing 24 tons of ore,	$16.25
Cost per ton,	$67\frac{7}{10}$

With regard to these systems of working it may be said that the advantage of the retort system is its economy of installation. It does not appear that there is any gain in yield, though this is claimed for it, while the expenses for fuel and labor are necessarily maximum, of the amount which can be treated at any given time must be considered as a minimum. The cost of repair is also a maximum, since the iron of the retort is rapidly attacked by the sulphur of the ore, which destroys them, so that a larger number of them must always be kept on hand. The danger of accidents from salivation is at a maximum, even when the precaution of using a blower, as at the Missouri mine, is taken, and there seems to be no good reason why such furnaces should not go out of use altogether. There is evidently a limit beyond which the speed of the blowers, which are so characteristic of California practice, cannot be increased. Not only is a large surface necessary to a perfect condensation, but a certain amount of time is quite as indispensable to cool the volatilized material, in order to have it condense. If, therefore, the condensing surface be a maximum, but the velocity of the current too great, it is evident that there will be a loss of mercury, which will be exhausted out of the condensers by the rapidity of the current. The proper speed of the blower will vary at different times, and with the obstruction caused to the passage of the air, by the kind of condensers used, and by the character of the ore charged in the furnace. It is evident that in a given furnace, the ore may be charged so fine, that it will pack in such a way, that no speed of the blower will draw the furnace's gases through it, or so large that a few revolutions per minute will be all that will be required. Between these two extremes there is a mean, which can only be determined by the judgment of the person in charge of the furnace, and it is often precisely this judgment and skill, which may or may not have been acquired by long experience with a process, which makes an inferior process give good results in one place, and the want of it which makes a good process fail in another. Such examples occur throughout the whole range of metallurgical industry, and not in the metallurgy of mercury only.

The objections to masonry condensers are generally the penetrating power of the mercury, which is so great that it not only impregnates the vertical stone or brick walls of the chambers, but infiltrates into the ground to such an extent that on taking up the foundations of some old furnaces at New Almaden, about the year 1863, mercury was found to have penetrated through the foundation, and the clay beneath it to the bed rock a depth of 25 to 30 feet, and over 2000 flasks were recovered in a single year from the foundations of two furnaces. This loss is now prevented by building the condensing chambers upon double arches, into which plates of iron are built so as to cut off the flow of mercury, and turn it inwards towards an iron basin into which it may be seen to fall in intermittent streams every few minutes. At the time of my visit to New Almaden a large shaft had been dug beside one of the furnaces, and at the depth of 30 feet, it was still profitable to wash the dirt in order to collect the mercury from it. In 1874 sufficient mercury was obtained from the brick ore-chamber, and three condensing-chambers of a furnace, and from the dirt around the structure, to more than pay for the new shaft furnace and condensers. For the construction of condensers pricks, though porous, are much preferable to and I think less porous than the sandstone used in the old Idria furnaces at

* Of this one cord would fire the furnace, one-quarter the boiler. Ores rich in sulphur will not require over one-half cord of wood in twenty-four hours.

the Redington Works. Whenever repairs in the condensers at Knoxville have been made with brick, they have stood while the sandstone next to the bricks has been worn away. It is evident that what is required is some substance that will be impervious to mercury. Bricks, however, are not so. Every brick or piece of sandstone taken out of a condenser must be considered and treated as a very rich ore of mercury, or whenever broken myriads of globules of metallic mercury are seen scattered through it. Iron is better than brick, in that it does not absorb mercury, but it is rapidly corroded by the sulphuric acid which condenses. Wood is much cheaper, but cannot be used near the furnace on account of the heat. At a certain distance from it, it is more or less rapidly acted on by the condensing sulphuric acid. It seems perfectly practicable to make such a combination of wood and glass that will stand at a certain distance from the fireplace, and by placing the condensers made of brick near the furnace, and cutting them up into smaller structures so that they shall not retain the heat, or substituting iron condensers with water cooling arrangements, for them to arrange a good condensing apparatus. By using, for instance, the Knox condensers together with the wood and glass arrangement recently patented at Almaden, it would seem that a much better condenser would be made than any now in use.* In any case a few large compartments are not so effective as the same volume distributed among a large number of small ones. What is required to effect a perfect condensation is surface more than volume, and more especially sudden and frequent changes of the direction of the current of volatilized material. With a furnace having only a natural draft this was impracticable, but with a furnace working by an exhaust fan, where obstacles can be introduced within certain limits, it is only necessary to increase the speed of the fan to get the necessary draft. There is, however, evidently a limit of obstruction which cannot be overstepped. There seems to be a very decided advantage in using an artificial fuel when it can be had; European experience has pronounced decidedly in favor of it. At New Almaden a series of experiments were made during the years 1873-4 with coke and charcoal, and a mixture of both, but at the time of my visit no definite conclusion had been arrived at. It would seem even advantageous under certain circumstances to mix a certain amount of fuel with the ore, especially when large amounts of fine ore not made into adobes must be charged. It is evident that the fuel which contains the least amount of moisture, if it is not friable, will prevent the formation of a certain quantity of soot, and as artificial fuels generally contain less moisture than natural ones, there would probably be less acid condensed if they were used. There are places, however, where the cost of making the artificial fuel would more than counterbalance the advantage gained.

Every system in use, and some which are not, have their supporters. When the date of the discovery of these deposits in California is taken into consideration, it must be confessed that more rapid strides have been made in the metallurgy of quicksilver there than in Europe. There is, however, much to be done. So little is known of what is done, and the prices of the metal have been subjected to such great fluctuations, that except in the case of the wealthy companies, there has been but little encouragement to experiment. The price of quicksilver in San Francisco in August, 1874, was $1.75 per pound. It is now 75 cents, and has been in former years as low as 35 cents. Such prices as these, if they should rule again, would compel almost all the small works to stop. The general feeling is that every advantage must be taken of the present. Under such circumstances the small works must wait to benefit by the experiments and experience of the larger ones, if they are not entirely ruined by the fluctuations in value before they have the opportunity.

—Compiled from a paper by Prof. T. Egleston, Transactions American Institute of Mining Engineers.

* While this paper is going through the press, Mr. C. E. Livermore, of the Redington mine, writes that they have commenced to use six or eight wooden condensers to each furnace. They are made of seasoned red wood 1¼ inches thick, and of the same size and shape as the iron ones. They are found to last at least equally as well, and are far cheaper.

THE GOLD BLUFFS AND GOLD BEACHES ON THE NORTH PACIFIC COAST.

MORE than thirty-one years have now elapsed since the first discovery of gold in the beach sands on this coast. This occurred at Gold Bluff in 1850, and led to the excitement which the following spring carried a great many people to that point. Although the most of these adventurers were disappointed in their expectations, the existence of gold in considerable quantities at that locality was not altogether a myth. The precious metal was there, but it existed in a form and under conditions that made it impossible for these people to gather it with profit. So, after a few fruitless attempts at working these deposits, the business was abandoned, the most of these Argonauts returning to San Francisco, whence they came, a few having made their way farther up the coast, or crossing the mountains to the mines on Trinity River, then just beginning to be heard of. The trouble with these beach deposits was this: The gold which the surf threw up and exposed to view at one time was covered with masses of harren sand or swept wholly away at another, its stay being to brief to permit the waiting crowd, ill equipped for the purpose, to secure more than an infinitesimal portion of it at any one time. Then, but little of the gold that the sands contained, could, by reason of its fineness and its being coated with some greasy or gaseous substance, be saved. And so Gold Bluff was, for the time being, pretty much deserted, and its name afterward classed with the traditionary humbugs of which there were all too many at that day. But there were those who entertained the belief that where there was so much gold, means could be devised for saving at least sufficient to make the collecting of it remunerative. Of these hopeful ones enough remained to form several small companies who pursued here the business of gold gathering with tolerably good results, these parties having stopped at the original Gold Bluff, and secured there some of the best paying portions of the beach.

In course of time, however, the whole of the beach lying in front of this bluff, some eight miles in extent, fell into the hands of two companies, the one composed of two members, Greenbaum & Chapman, and the other by some six or eight persons, all practical miners. These companies adopted the plan of gathering at low tide the richest portions of the sand, and packing it on animals up beyond the reach of high water, and there washing it in sluices. As each of them owned four miles of beach it seldom happened that they failed to find after a heavy surf, with a favorable wind, some rich sand at one point or another along this stretch of beach, and having grown expert at detecting these deposits when present, and being withal well provided with the means for securing and removing them, these companies made the business pay handsomely. But the locality being remote and difficult of approach, vessels of any kind rarely ever touching and making no regular landings there, only at long intervals have we been able to hear much about the operations of these companies, little exact information on the subject having, in fact, ever reached the public ear. From Mr. Allen Heald, of Oakland, who is familiar with this class of deposits, and who, not long since, visited Gold Bluff, traversing the beach thence north, we have some recent and accurate information from this isolated but interesting section of our gold fields. Touching the history and operations of the two companies mentioned, it seems that they or their successors are still the only parties extensively engaged in gathering and washing the auriferous sands at or near the old Gold Bluff. The Greenbaum Company still consists of the two members who originally composed it. The shares of the other company having been bought up by Richard Furnald and Solomon Hall, this property was afterwards sold to Adson Adams, the real estate millionaire, of Oakland, Mr. Heald having examined the ground and negotiated the sale on behalf of Mr. Adams, who is now its sole owner. Each of these estates yields on an average about $40,000 per year, of which something like 65 per cent. consists of net profits. As Mr. Adams paid but $50,000 for his purchase, he naturally considers the bargain a good one. He has since been offered $100,000 for the mine, but declined to sell at any such figure, believing it a good legacy to leave to its children. Not only so—he finds the locality a pleasant summer resort, and is, at this time, sojourning at Gold Bluff with his family.

The manner of conducting the business of gold gathering at this point is as follows: After a heavy surf the superintendent of the mine rides along the beach as the tide begins to ebb and carefully notes the condition of the sand, watching for evidence of gold having been thrown up by the waves. If he discovers that fresh deposits have been made he signals the muleteers to that effect, who then rush down their animals and pack out as much of the auriferous sand as possible before the tide again comes in and puts a stop to their work, covering up perhaps the rich streak with a heavy layer of barren sand or possibly sweeping it away altogether. It is a singular circumstance that when the surf comes square on the beach the gold brought up by it is covered under several feet of this barren sand, and that only when the surf strikes the beach at some other angle, is the gold left on the surface where it can be seen and readily gathered. After being so collected, this rich sand is washed in sluices, small streams of water having been brought in for the purpose. For saving the gold only copper silvered plates are used in the sluices, which are usually run with a light head of water.

On the border of a small lagoon on the Greenbaum ground, a short distance back from the beach, occurs a large body of low-grade sand. This is run out on cars and washed in an old-fashioned "Jenny Lind" tom, being a sluice of one box widened out and supplied with a screen at the lower end. At one time it was thought that this gold was brought up out of the ocean, an opinion that some people still entertain. But this is clearly a mistake. It came from the bluff in the rear, which is made up of alternating strata of clay, gravel, and sandstone, the gravel strata, three or four in number, being all more or less auriferous. The action of the waves has broken down this bluff, which varies from 100 to 500 feet in height, and released the gold; the latter having afterwards been by the same agency carried seaward at least as far as low water mark. After a very heavy surf breaking down, as sometimes happens, a portion of the bluff, the beach below is sensibly enriched, the gold by this new addition being rendered somewhat coarser than before. This fact has suggested the utility of employing powder for breaking down and disintegrating these banks, an agent that will, no doubt, some day be used for that purpose. While the sand along this beach must under such steady and long-continued working, necessarily suffer a gradual impoverishment, this latter has not, as yet, proceeded far enough here to sensibly affect practical results, a fact due, it may be presumed, to the great width of the beach at this point and to the replenishment which the stock of workable material is constantly receiving from the caving down of the banks above. Farther north, where these favorable conditions did not exist, the gold-bearing beaches have been so nearly exhausted, that hardly any work is now being done, where from fifteen to twenty-five years ago, thousands of men made good wages. That the sand, which is constantly covered by the sea, is not very rich has been proven by the trials made on it some years ago with steam dredgers, none of which found gold enough in it to warrant a continuance of these operations. Each of the companies above mentioned employ from ten to twelve men and about eighteen pack-animals the year round. Operations are kept up with but little interruption, the men being engaged a good part of the time, either in gathering sand or washing it. What time they are not so employed is devoted to cultivating a patch of land in the neighborhood, on which the companies raise some fruit, hay, and vegetables for their own use. Adjoining the Adams claim, which covers the upper or northern half of the beach, a small company is washing these sands by the hydraulic method, using a limited amount of water under a pressure of eighty or ninety feet. From this point north, clear into Oregon, a distance of thirty to forty miles, very little in this line of mining is being done, though this was at one time along miles and miles of the beach in the vicinity of Whisky Run and the Coquille rivers, an active and profitable industry. Here and there a small company is still to be seen reworking the sands that have already been washed, in some instances several times over, and always with remunerative results, the first one or two washings having generally paid very large wages. From Mr. Heald, who is himself a successful miner, we learn that the present has been a prosperous year with hydraulic miners along both the Trinity and Klamath rivers, notwithstanding the water season there, as elsewhere throughout California, has been a very short one. Owing to its freedom from the vexatious *dêbris* question and to the presence of good conditions generally, that region of country is strongly attracting the attention of capitalists and others inclined to invest in this branch of mining. Besides great quantities of good gravel, the Klamath country is especially well situated as regards water, which is not only abundant but can be brought upon the mines at small cost and under great pressure, the mountains, the sources of the supplying streams, rising to a great height directly over the mines. That but little trouble is encountered there from high-rim rock or cemented gravel, may be inferred from the fact that no bank blasting has ever been practiced nor has a single bedrock tunnel of any length ever been driven in Klamath county; and this, notwithstanding hydraulic mining has been carried on there extensively and successfully for many years. For these and other reasons it costs comparatively little to open up and run a mine of this kind anywhere in this northern region.

—*Compiled from "The Mining and Scientific Press."*

TIN MINING AND THE CALIFORNIA ORES OF TIN.

THE importations of tin in bars, blocks and pigs into San Francisco have trebled within four years. From 556,752 pounds, valued at $83,870, in the year 1876–77, they have increased to 1,315,104 pounds, valued at $248,256, for the year ending June 30, 1881. This does not include the tin plate imported. The large increase is due to the fruit and salmon canning business. When it is considered that what is used on the Pacific Coast is only a small portion of the total quantity employed in the entire country, one will be better able to comprehend the importance of the tin trade, and to understand that if tin mines were discovered in the United States they would prove a profitable investment. At present all the tin used comes from Cornwall, Banca, and New South Wales. The tin mines of Cornwall are connected with the earliest history of England. The Phœnicians imported tin from the white Island, the name given in their time to Great Britain. Under the Saxon dominion the Cornish tin mines were neglected, but when the Normans came they were vigorously developed. During the reign of John, the Jews got hold of them and worked them to their own profit. For over two centuries they continued to yield largely, when a lode was discovered in Bohemia by a Cornish tin miner who had been banished from England, but the yield from it was never at any time very great. About the middle of the last century discoveries were made at Banca, one of the islands in the Malay Archipelago, belonging to the Dutch, which promised to seriously interfere with the Cornish trade.

Destructive competition was avoided by the action of the British Government, which interfered to prevent too rapid development of the Banca mines. The consequence was that the supply was never at any time greater than the demand, and both countries continued to sell the products of their two mines at paying prices. The yield of the Cornwall mines at the beginning of the present century was under 2,500 tons. It now exceeds 18,000 tons a year. The yearly yield of the Banca mines is in the neighborhood of 10,000 tons. Since the latter development tin has been discovered in New South Wales, Australia. The yield of these mines is about 8,000 tons yearly. The total tin supply of the world is from these three sources, the quantity obtained from other countries being of small moment. The Australian discoveries broke the English prices, and from £150 ($750) a ton, Cornish tin has sold as low as £60 ($300) a ton. An understanding between the two countries was eventually arrived at, and at present the average wholesale price of tin is about $500 a ton, or from twenty-four cents to twenty-five cents a pound. Taking the world's requirement at 40,000 tons, the total value of tin used, at the above rates, is $20,000,000. The American importation represents over $6,000,000 of this amount.

Discoveries of tin have from time to time been made in the Southern part of California, notably in the Temescal Range of mountains about thirty miles from Riverside, and close to the San Bernardino county lines. The first of any note was made in 1860, and caused considerable excitement. The tin found was pronounced of good quality, and was said to exist in large quantities. It came principally from what is known as the Cajaica mine. A fuller examination of the lode was not satisfactory, the evidence being that it was not of any great extent. The increased demand for tin on this coast, and the high prices maintained, have been the means of again directing attention to the tin lodes of Southern California, with more satisfactory results. One reason of previous disappointment was due to the finding of a dark colored glossular garnet, quite common in the Temescal region, the crystals of which resemble the tin ores of Cornwall. Cornish and Australian miners have been frequently deceived by this mineral. A party of them that had worked in the Australian tin mines, and who were passing through San Francisco, visited the Temescal Range. On seeing a dark colored stone in the river beds, they immediately said that stream tin existed there in large quantities. They were, however, mistaken. Although closely resembling in appearance the stream tin ore of New South Wales, the Temescal specimens contained no tin at all. There is no stream tin in the Temescal mines as far as known, but it has been determined that there are considerable quantities of tin ore in lodes.

A peculiarity of the ore is that it does not look like tin ore. Clever assayers have been frequently deceived with it. Some years ago some of the ore was forwarded East for assay. The person, to whom it was sent, well competent to judge of tin ore, returned the specimens saying that the sender of them must have made some mistake, that the ore sent was not tin ore, and could not possibly contain tin. They were again sent to him with the request to assay them, and not to mind whether they had the appearance of tin or not. He did so, and changed his opinion. Following upon this a company was formed to work them. A sufficient amount of capital was subscribed by the shareholders to make further investigations. When prepared to go seriously to work the Company found that there was a difficulty in the way of obtaining a perfect title to the land. It formed part of one of the old original Spanish grants, with a floating title, and it was decided to abandon all further enterprise until the title to it was definitely obtained. In the opinion of some persons this fact has been determined, but not to the entire satisfaction of capitalists. It is still before Judge Sawyer of the United States Circuit Court in San Francisco. A letter lately received at the State Mining Bureau of California states that when a clear and settled title to the land in which the mines are situated can be obtained, all the money necessary to work and develop them will be immediately forthcoming. The prospects of obtaining such a title are said to be promising. The samples of tin ore obtained from the Temescal district gave thirty per cent. of oxide of tin under assay. If ore assaying that percentage exists in large quantities the value of the mines could hardly be overestimated. The sole matter of doubt appears to be the extent of the deposits. Investigations have never been pushed sufficiently far to determine that point. Experience in respect to the deposits in other counties teaches that wherever tin has been found in one locality it has led to the discovery of other deposits in the neighborhood. An important point is to know how to prospect for it. A simple and good way is to pulverize the ore in a mortar or any other vessel that will answer the purpose. Then wash it out in a pan or a horn spoon in the same way gold is prospected for. Dry the residue in the sun. Then again pulverize it as fine as possible. Fuse it with cyanide of potassium on charcoal before a blow pipe, and if the ore contains any deposit a button of metallic tin will be obtained. The miner will in course of time become familiar with the appearance of ore containing tin, and will be able to pronounce upon it at sight in the same way as would an expert Cornish miner. A peculiarity of tin mines, as was shown in the celebrated Dolcoath mine, is that they may at first be worked as a tin, then as a copper mine, copper deposits underlying the tin ore, and finally at greater depth as a tin mine again. The Coneto tin mines near Durango, Mexico, on the Pacific slope of the Rocky Mountains, although comparatively unknown are said to contain immense deposits of tin ore. They have been worked for many years past, but are still only partially developed. This is owing to the cost of bringing the tin down on mules' backs. If railroad communication existed and capital were put in to develop them, it is believed, from what has already been accomplished, that they would yield as largely as any tin mines in the world. At the State Mining Bureau of California, there can be seen specimens of the Durango and Temescal ores. There are also specimens of tin ores from Cornwall, Bohemia and Australia. The cause why so little has been done to determine the extent and value of the tin ore deposits of Temescal is due to a prejudice arising from a misconception of the existing geological relations of the Pacific coast. The ore has been judged at the Cornwall standard, and failing to correspond to the English ore in appearance, has been condemned. Tin ore yielding thirty per cent. of oxide of tin under assay, will give ninety-five per cent. under concentration, equal to about seventy-five per cent. of pure tin. There are over five hundred tin claims located in the Temescal Range. Of this number thirty-three are known to contain tin, but only one, the Cajaica, has been opened. An analysis of Temescal tin ore, made by F. A. Genth of Philadelphia, gave the following results:

Silicic acid	9.82
Tungstic	.22
Stannic (oxide of tin)	76.15
Oxide of copper	.27
Oxides of iron, manganese, lime and alumina	13.54
Total	100.00

—*San Francisco Bulletin.*

PART III.

GEOLOGY OF PROMINENT MINING CAMPS—THE DISTRIBUTION OF IRON ORES—THE COMSTOCK LODE AND THE SUTRO TUNNEL —FOREIGN FACTS OF MINING INTEREST.

THE study of geology in all its branches is fascinating at all times, more particularly however in the mining regions, where the skilful eye of the man of science enables him at a glance to gain the key to the region under observation, and to profit where the unlearned can see nothing but rocks. In Part III, THE MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES, we have therefore introduced some information concerning two important mining regions. We have also in this Part embodied a mass of information of more than general interest, on many subjects connected with the metallic wealth of this country. Also, we have compiled for a place in Part III, some papers on European topics including some statistics upon the iron trade of Great Britain. Some statistics of foreign bullion product are also printed, which do not strictly pertain to the mining interests of the United States in 1882. Possibly this Part should have been headed Miscellaneous, rather than the titles bestowed, as the articles are such as did not admit of classification under any other head, nor belong appropriately with the other divisions of this volume.

THE GEOLOGY AND VEINS OF TOMBSTONE, ARIZONA.

THE mining district and the town of Tombstone are situated in Cochise County, Arizona Territory, at the northwest end of the Mule Pass range of mountains, in longitude 110°, and latitude about 31° 40′ N., upon the right bank of the San Pedro River, from which the town is distant 9 miles east. It is also 24 miles south of Benson Station on the Southern Pacific Railroad of Arizona, and about 40 miles north of the Mexican line. Its altitude above the sea is 4,600 feet. The Dragoon Mountains rise across a valley to the northeast, and the Huachuca range similarly upon the southwest. The country is open, without timber, and the surface, where the mines are opened is, in general, gently rolling and accessible to wagons by natural roads.

The first locations were made in the year 1878 by the Scheffelin brothers and Richard Gird, the latter being well known among the pioneers of Arizona as a surveyor and miner who contributed largely to our knowledge of the geography of the territory in early days, when the dreaded Apache dominated the region. There are now, probably, over one thousand locations or claims in the district, and upward of 2,500 inhabitants. The output of the precious metals, gold and silver, up to the first of January, 1882, aggregates $7,359,200, and over $3,000,000 have been disbursed in dividends. This product is distributed among the following-named mines and mills:

Production of Tombstone Mines and Mills.

Tombstone Mill and Mining Company,	$2,704,936.33
Contention Consolidated,	2,703,144.39
Grand Central,	1,050,875.30
Head Centre,	191,520.52
Vizina,	526,716.98
Ingersoll,	15,000.00
Sunset,	15,000.00
Corbin Mill,	40,000.00
Boston Mill,	112,007.83

Dividends.

Tombstone Mill and Mining Company,	$1,100,000.00
Contention Consolidated,	1,375,000.00
Grand Central,	600,000.00
Vizina,	80,000.00

This will suffice to show the importance of the locality for mining, and to indicate at the same time the principal claims.

Geology of the District.—In going from the railroad at Benson to the mines, the traveler rises from the post-pliocene deposits along the San Pedro to a granite plateau. The rock is gray and highly crystalline, and is apparently eruptive. It weathers in places into gigantic rounded blocks and masses lying one upon another, as if piled there by some titanic force, rather than by the gentle and gradual effects of irresistible decay. This rock extends to within a mile or two of Tombstone, where stratified formations occur, overlying the granite. These stratified beds consist of quartzites, limestones and shales, with frequent repetitions in an ascending series several thousand feet thick, but all conformable and dipping generally at a low angle from 20° to 45° to the eastward. The fossils which have been found in the middle and upper beds, consisting chiefly of *Productus* and cyathophylloid corals, show them to be *Paleozoic*, and probably lower carboniferous. The lower strata are probably older. A small shell, like *Lingula*, occurs in the shales of the Contention mines.

In addition to the stratified formations, we find intrusive porphyritic dykes cutting through the strata indiscriminately, nearly at right angles, and trending approximately north and south, or a little east of north. This is the direction of the general rift or breaking of the country and of the mineral veins. In the central portion of the district, covering the claims known as the Toughnut, Good Enough, Way-Up, Vizina and others, erosion has exposed the outcropping edges of many strata of limestone shales and "quartzites." Both the shale and so-called quartzite beds are of deep-sea origin, being very fine and compact in texture, with scarcely any signs of granular structure. The latter, particularly, is flint-like and very hard, and is more exactly described as a novaculite or honestone. In places, it passes insensibly into limestone. It is, no doubt, largely organic in its origin, and is a very fine sediment, totally different from the typical quartzites, with granular structure, found in the higher parts of the series of strata. It evidently, in forming, accumulated slowly, beyond the influence of currents, at the sea bottom. An abundance of iron pyrites in fine crystalline grains, disseminated through the layers of this rock, gives evidence of its organic origin in part, at least This rock has special importance from the fact that the miners in the Toughnut and Good Enough claims find it *below* the chief ore-bearing limestone. It is regularly and evenly stratified for a thickness of about 140 feet, and rests upon a thickly-bedded dolomitic limestone below. The beds above it consist of dark, black or blue limestones, and of thick beds of dark argillaceous shale, alternating with black siliceous shales for nearly half a mile to the eastward.

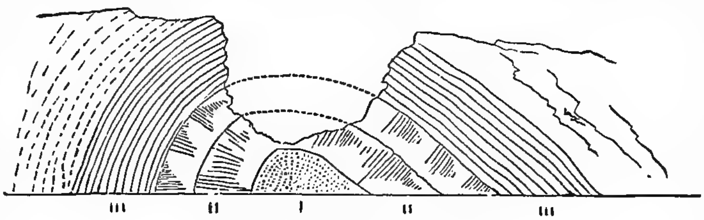
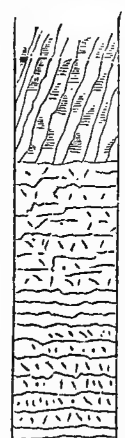


Fig. 1.—Anticlinal Fold. Toughnut.

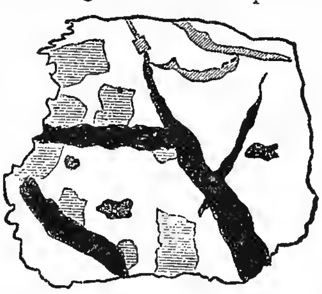
I. Novaculite—under the limestone.
II. Limestone—bending over the novaculite.
III. Shales—bending over the limestone.

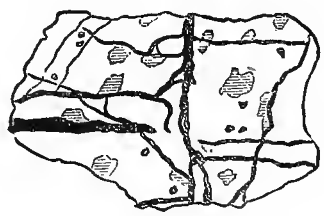
The black limestones above the novaculite are the chief depositories of the bedded masses of rich silver ore, as will be presently shown. The whole series of beds in this central part of the district is thrown into folds, being regularly plicated in a series of wave-like flexures, the steepest and sharpest folds being on the northwest of the Toughnut and Good Enough claims, facing the granite region in that direction. These folds may be traced, but with difficulty, upon the surface, but are best seen in the cross-cuts of the mines and along the drifts. In the open cut upon the Toughnut there is a good exposure of some of the beds at the crest of an anticlinal fold presenting an appearance in section, along a northeast and southwest cut, nearly as shown in the annexed drawing. This little section is along the upper level known as the "adit." It is directly below the place on the surface where ore was found cropping out, mixed with soil and vein-stuff. At another place, upon the western end of the Good Enough, we find a series of plications up and down at about the angles shown, and with rich ore lying in the folds. These folds are not large, covering only a few hundred feet in extent, but are beautifully regular and well-defined. As we pass up the hill, rising higher in the series of strata to the eastward, the dip becomes more regular, and coarse-grained quartzites, in thicker beds, take the place of the finer-grained deposits. All the formations named have not only been uplifted as described, but have been much broken and faulted, either at the time of uplift, or at long periods later. This is shown by the number of fissures and lines of fault, as well as by the outcrop of dikes of porphyry, and the dissimilarity of the stratified beds on each side of them, and the disjointed outcrops of the limestone beds.



The Contention Mine.—The chief fissure and ore-bearing vein of the district traverses the Grand Central and the Contention claims. These claims were located in a north and south direction, upon the somewhat obscure croppings of a dike of dioritic porphyry carrying ore in through and alongside of it. This location was made by Messrs. White & Parsons. The croppings were not remarkably well defined, consisting of the porphyry and a confused mixture of porphyry, chert and quartz, with masses of porous quartzite alongside; none of these rocks rising high above the soil. There was, however, a considerable discoloration of the soil by iron rust along the line, and a little digging revealed good ore near the surface. The harder parts of the dike were the most prominent, and its direction governed the direction of location of the claim. This dike varies in width from a few feet to 50 feet or 70 feet, and dips to the westward at an angle of from 55° to 65°. It cuts indiscriminately through shales, quartzites, and limestones, and is evidently of igneous origin. The contact, however, with the abutting edges of the disrupted beds is not always marked by any great change in their appearance or composition, though in places there is obscure metamorphism, impregnations of silica, and some modifications of structure. The dike itself has a distinct vertical lamination or structure through most of its substance, and is more or less penetrated by veinlets of quartz. In some portions it is highly crystalline and nearly barren, and in others, consists chiefly of a feldspathic base, in which the feldspar crystals are obscure. It passes into a felsite, which, in the decomposed portions of the dike, and when slaty in structure, might be mistaken for the partly decayed shales or quartzites. Large portions of the dike are so penetrated by quartz as to consist largely of it, and might be called quartz, although close examination will show the presence of feldspar.

The accompanying cross-section of the chief part of the dike, taken on the first level of the Head Centre mine, upon the Contention lode, will convey a better idea than can be given in words. It shows the vertical structure and the general distribution of quartz in vertical seams or layers, and in one place a vugg or cavity, in which there are distinct





quartz crystals. In general, however, combs of quartz crystals are wanting; the quartz being in an amorphous, sub-vitreous state, or in the form of chert. A fragment ground down to a plane surface showed very plainly the lamellar arrangement of this quartz with the intermediate spaces filled with feldspar. This lamination is typical of the vertical structure of the dike. Another fragment, with less quartz, taken at a distance of about two feet from the first consists chiefly of a felsite base, with obscure crystals of feldspar sparingly distributed. Examination shows it to be penetrated irregularly by veinlets of quartz, as shown by the accompanying sketches from ground and polished surface.

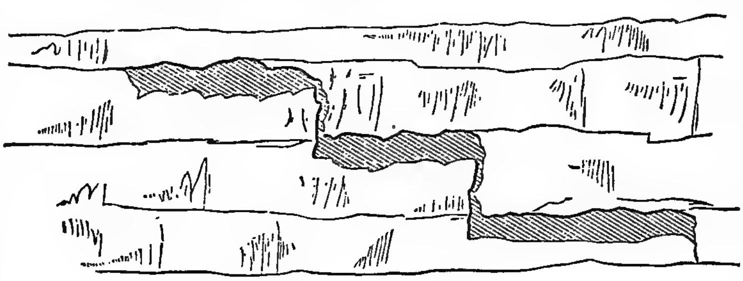
There is also a considerable amount of mineralization of the dike by iron pyrites disseminated irregularly in its substance in cubical crystals, most of which have dissolved out and left the cavities only to indicate their former presence, making in some places a spongy mass of porphyry or of quartz. Although the mine has been worked to a depth of 600 feet, and there are some 12 to 15 miles of drifts, levels and winzes in the Contention and adjoining mines, the undecomposed ores below the water-line have not yet been reached and mined, and all the ores above are in the decomposed and oxidized condition common to surface ores. A large part of the ore is highly charged with red oxide of iron, to such an extent that the clothing of the miners becomes saturated with the rouge-like powder, and the tailings at the mills are blood-red. There has been an extensive decomposition of the porphyry, especially along the upper 300 feet of the dike, resulting in the formation of quantities of white-clay kaolin, sometimes perfectly snow-white and pure, but generally more or less mixed with red oxide of iron. This kaolinization extends in places to the adjoining shales, and there are some white, clay-like interstratified beds which may, on further examination, be found to be altered felsitic offshoots from the dike. It is not yet possible to say what the exact nature of the ore below the water-level will be found to be. The only metallic contents so far found, with the exception of the pyrites and some galenite and lead carbonate, are gold and silver in a comparatively free state; part of the gold, if not all, being free, and the silver occurring chiefly as chloride, or horn silver (with probably some iodide), in crusts and films, also occurring in minute crystals upon cleavage surfaces. The average value of silver and gold in the ores worked last year was about $70 per ton. The gold has of late increased from 20 to 25 per cent. of the value of the product, the rest being silver.

Gold in Porphyry.—One very interesting fact is the occurrence of free metallic gold together with chloride of silver, in the midst of the porphyritic rocks, at a distance of many feet from the portions of the porphyry-carrying quartz in veins, and disseminated. This gold is found chiefly in a portion of the rock apparently dioritic, containing finely disseminated hornblende. In decomposing, this porphyry becomes steatitic, and in places appears to be changing to serpentine. The gold is found in thin sub-crystalline flakes and scales, chiefly in and along thin seams and cracks in the mass of the rock, as if it had been infiltrated and deposited from solution. This is probably the fact, and the magnesian nature of the rock has no doubt exerted an important influence in its deposition. Free gold is also found in quartz in the usual manner of association; but even in such specimens the crystalline feldspar of the dike is found.

Metallization of the Dike.—The time and manner of the metallization of the dike may be considered as open questions, for a solution of which we must wait until the mining extends below the permanent water-level of the formation. It seems most probable that the rock, at the time of its intrusion, was pyritous, and the strata adjoining it no doubt were. It is not impossible that there may have been a concentration of the precious metals in the dike from the surrounding beds, the result of the decay and change of the pyrites diffused in the strata. On the other hand, we may suppose that the dike has been the source of the silver and gold we find in and about it.

In either case, the vertical laminated or stratiform structure parallel with the walls has been an important factor in the distribution of the metals, and in the changes and modifications of the original condition of the dike. We may readily conceive of such vertical planes of structure affording planes or lines of least resistance to vertical movements, while the abutting ends of the strata, in contact with the walls of the dike, would offer great resistance by friction. The condition of the dike along a great part of its course seems to sustain and verify this hypothesis. There has evidently been considerable movement of parts of the dike upon itself, resulting in the formation of heavy clay seams and brecciated layers of porphyry and quartz, sometimes occupying a medial position along the dike, sometimes at one side or the other, and again along the line of contact with the country rocks. Such seams and brecciated ground are sometimes wanting, and the structure and condition of the dike remain unchanged. The whole of the dike with the adjoining strata has been subjected to extensive movements and displacements, shown not only by breaks of continuity, but by the brecciated cross-courses and seams traversing both the igneous and stratified formations. One of these faults resulting in a throw of the northern portion of the Contention lode 150 feet to the west, and partly outside of the west side-line of the claim, has recently led to expensive litigation. The faulting seam or break has been drifted upon between the two ends of the disjointed dike. It consists of a heavy breccia of fragments of the adjoining strata, together with a strong clay wall, marking the plane of greatest movement and slip. Its direction is southwest and northeast.

In addition to the lateral movement, there have been extensive vertical displacements, and it is probable that the lateral shifting may be referred to them. It would be premature to attempt an exact description of the numerous faults and mechanical changes to which the dike has been subjected. They require further study and surveys. Mr. Isaac E. James, so long and well known upon the Comstock lode as an accomplished mine engineer, is now in charge, and has the subject under investigation. We owe the first determination of the nature and position of many of the vertical faults and throws to his careful observation and surveys. Without now entering into precise descriptions of particular displacements, it will suffice to give a sketch indicative of what has occurred, producing such a confused recurrence of ore upon certain levels of the mine as to lead at once to the supposition that there were several dikes of porphyry and ore over a breadth of five or six hundred feet. The movement appears to have been from the west eastward and downward, the top of the dike being carried off in successive blocks by the sliding of masses of the stratified formations partly upon the planes of deposition of the beds, these dipping eastward and affording surfaces of easy movement; and partly upon steeper planes of fracture, generally dipping eastward, partly as shown in the outline sketch section, which may be taken as typical. This disruption of the dike, with its attendant fracturing and brecciation of the country-rock, accompanied by the movement of the dike upon itself, and the formation of heavy clay seams, has provided favorable places for the accumulation of ore. It is generally found in the softer and most broken portions of the dike, coincident, no doubt, with the regions of greatest original metallization and subsequent movement, attended by clay seams. Such clay seams, with the accompanying ore, have by some been considered as marking the limits of a second or subsequently formed vein, following the dike and independent of it. This theory, formed under the inspiration of the necessity of narrowing down the vein and throwing it as far west as possible, in order to secure a greater length of it upon the Head Centre ground, would be more defensible, if in the stopes any vein structure referable to a later deposition could be found. Instead of the fragments of broken porphyry, shale and quartz being cemented together by quartz, they are loosely aggregated, and show clearly that the formation is due to mechanical force and attrition. The clay seams are also not certain boundaries of the ore; it occurs on both sides of clay seams. The clay cannot, therefore, be taken as separating ore from waste. The seams, moreover, are not continuous, but give out, and in some parts of the dike are absent.



The only place upon the lode where water has been reached is upon the Sulphuret claim. At this point, the lode intersects strata of limestone, and there is a bedded layer of ore following the stratification and connected with the dike. This ore is chiefly galena and iron pyrites. Very little has yet been taken out. So also in the Head Centre ground, at a higher level, where the dike intersects limestone, a bedded or interstratified layer of ore occurs. But the best examples of bedded deposits in the district are in the Toughnut and Good Enough claims before referred to.

Bedded Ore Deposits.—These also are associated with dikes and vertical fissures nearly parallel with the Contention lode. One of the longest and best defined is the West Side lode, which may be traced for about two miles until it passes into the underlying granite. Its northern prolongation appears to cut across the Toughnut claim, and to connect with the vertical fissure and quartz croppings at the discovery-shaft on the Good Enough. A second line of fissure cuts across the anticlinal line of the formations at the open cut on the Toughnut, and across the whole breadth of the Good Enough into the Way-Up claim beyond. This has been followed on ore from the open cut to the Way-Up, and is connected with the chief lateral bedded deposits. A lode has also been followed in the same general direction from the claim called the Defense, across the Toughnut into the Good Enough. This lode is marked by very heavy croppings of quartz and flinty boulders lying above the limestone on the surface. In the fissure extending into the Way-Up claim, the ore was found in layers and bunches following the plane of the vein, extending upward and downward along its course in nearly vertical shoots or ore-bodies, but breaking off into the adjoining strata in flat bed-like layers, particularly where the vein intersects the lower limestone resting on the noviculite beds. These bedded offshoots from the vein are often of considerable lateral extent, following the planes of stratification on each side. We cannot yet state with confidence what the exact origin of these bedded deposits is. They may be due to the decomposition of nodular masses, but they are generally deposited in the limestone as if by replacement. They may be regarded as filling irregular cavernous spaces eroded from the strata by metalliferous solutions, and without any regular boundaries. These bedded masses do not have a symmetrical arrangement of the ore, except such as may be referred to stratification or deposition by gravity. It is to be observed that these beds occupy the limestones rather than the siliceous or argillaceous strata, as we might expect from the greater solubility of the limestone. Inasmuch as these limestone strata are folded and turned up in different directions, the intersection of the limestone with the vertical plane of the vein is an irregular line. At such intersections, the walls of the fissure are corroded away, and are obliterated or are farther apart than where the fissure cuts the siliceous beds, the shales, or the quartzites. In this respect the formations are similar to many abroad. Moissenet represents bodies or shoots of ore corresponding in their pitch to the intersection of strata with the plane of a vein. Wallace describes a series of strata in the north of England, consisting of limestone and shales traversed by lodes productive in the limestone, but poor when passing through shales. Other examples might be cited. In extent, the bedded masses of the Good Enough and Toughnut claims have been much greater than the ore-bodies of the vertical fissures, and it may be said that the greater part of the productions have been from the beds or flats. They extend irregularly between the two fissures a distance of about 400 feet, measured diagonally along the dip. It is noteworthy that they follow the stratification, and then suddenly break across it vertically, following a crack or break of the bedding, and then expand again horizontally for some distance to another dropping down by a series of steps from one layer to another in and between the limestones. The ores found in these bedded deposits in the limestones are much more plumbiferous than the ore of the feldspathic dikes. Galenite, blende, and iron pyrites are abundant in masses, which, within the reach of oxidizing agencies, are largely converted into oxides and carbonates. Bedded ores of this nature are also found in the limestone of the Blue Monday claim contiguous to the vertical fissures in the western prolongation of the West Side lode, or vertical ore-bearing fissure. This contiguity of the bedded deposits of the camp to the vertical fissures and dikes, and the occurrence of bedded ores where the dikes intersect limestone strata, lead me to the opinion that the metallization of the district is due to the igneous intrusions, and that these are the true lodes, or "leads," that may be followed with confidence in the search for ores.

—A paper by Professor Wm. P. Blake, Transactions American Institute of Mining Engineers.

GEOLOGY AND MINING INDUSTRY OF LEADVILLE, COLORADO.

THE present city of Leadville is situated in the county of Lake, State of Colorado, on the western flank of the Mosquito or Park Range, and on the eastern slopes of the valley of the Arkansas, near its head. Its exact position is in longitude 106° 17′ west from Greenwich and 39° 15′ north latitude, and its mean elevation above sea-level is 10,150 feet, taken at the court-house, in the center of the city. In this latitude the Rocky Mountain chain is made up of three main and more or less parallel uplifts; the Colorado or Front Range, the Mosquito or Park Range, and the Sawatch Range. The first rises immediately from the Great Plains, and to the traveler from the East, who has just passed over 500 weary miles of unincidented and practically level country, represents at first view the whole Rocky Mountain system. It is a broad, somewhat irregular chain, whose more prominent peaks rise to a height of over 14,000 feet above sea-level, and whose flanks are deeply scored by the tortuous ravines or cañons cut by streams flowing out to join the Platte and Arkansas Rivers. Beyond this range lies the mountain valley known as the South Park, a broad, basin-like depression, sloping gently to the southward, having an elevation of 8,000 to 10,000 feet above sea-level. The next mountain uplift, which forms the western border of the South Park, is the Mosquito Range, a narrow and abrupt ridge having a trend nearly north and south, and whose prominent peaks also rise above 14,000 feet, the average height of its crest being nearly 13,000 feet above sea-level. It is characterized in general by long, easy slopes on the east toward the Park, and broken, abrupt slopes, which are nearly perpendicular walls near its crest, on the west toward the Arkansas Valley, while either flank is deeply scored by amphitheaters and deep gorges or cañons of glacial origin. The Arkansas Valley is a meridional depression, about 60 miles in length by 16 in width, bordered by the sharp peaks of the Mosquito Range on the east, and by the equally high but broader mountain mass of the Sawatch Range on the west. This valley is not only remarkable as presenting some of the grandest mountain scenery to be found in the Rocky Mountains, but also on account of the great mineral wealth found along its borders, and the scientific interest of its geological structure. To the upper 20 miles alone will attention be especially directed here.

At about this distance from its head the foot-hills of the bordering ranges close together, confining the present bed of the stream within a narrow rocky cañon, a few miles above the town of Granite. Above this cañon the valley widens out in broad grassy meadow-lands, on each side of which flat table-like terraces rise for several miles, with a gentle, almost imperceptible slope to the foot of the more rugged mountain spurs. Such topography suggests at once to the thoughtful observer that this portion of the valley was once a mountain lake, and, as will be seen later on, the present investigation proves this to have been the case. On the upper edge of one of these gently sloping terraces, between Big Evans and California Gulches, and at the base of Carbonate Hill, the extremity of a western spur of the Mosquito Range, is situated the city of Leadville.

Discovery.—The history of the discovery and development of the mineral wealth of Leadville, which well illustrates the uncertainties and vicissitudes attendant upon a life of search for the precious metals in these wild regions, can be here but briefly touched upon. Among the hundreds of weary gold-seekers whom the so-called Pike's Peak rush brought to Colorado in the fall of 1859, only to find themselves the victims of exaggerated and chimerical stories, a few undaunted spirits pushed still further on into the recesses of the then unknown mountain regions. Gold was first discovered in the same year on Tarryall Creek, at the head of the South Park, and early in the spring of 1860 two parties of prospectors, pushing westward still, stumbled almost simultaneously upon rich diggings in California Gulch, near the present site of Leadville. The news of the discovery spread with wonderful rapidity, considering the difficulties of travel and sparseness of population in those early days, and eager miners flocked rapidly in. Large amounts of gold-dust were obtained from this gulch, and the town which was built along its banks, known as Oro City, is somewhat freely estimated to have had within a year 10,000 inhabitants. A similar generosity of estimate, so readily accorded to bygone times of which accurate information is not attainable, places the aggregate production of the gulch in gold-dust at ten millions, while more conservative and better grounded opinions would give it a maximum of $3,000,000. At all events the richer placers were soon exhausted, and the population of the ephemeral city of Oro gradually decreased, the thousands having dwindled within three or four years to hundreds. At that day miners had gained most of their experience in the gold fields of California, and to them silver ores were comparatively unknown and worthless. Some prospecting was done for the gold veins from the croppings of which the gold of the placer diggings was originally derived, and resulted in the discovery of several gold mines, such as the Printer Boy, Five-Twenty, and a few others, whose working gave a fitful gleam of renewed prosperity to the camp, but of whose actual yield no accurate data are attainable. Few, if any, however, suspected the value of the so-called "heavy rock," fragments of ironstained carbonate of lead, which obstructed their sluices, being too dense to be carried down by the force of water alone, and which had to be thrown out by hand. Although many now claim to have known of the existence of the rich argentiferous lead ores of Leadville in earlier days, its practical discovery is apparently due to Mr. A. B. Wood, an educated and experienced miner and metallurgist, who first came to this region in 1874, and at once recognized the mineralogical character of the miners' worthless "heavy rock." In 1875 the titles acquired by the gulch-miners under local laws had lapsed by limitation, and Messrs. Wood and W. H. Stevens located, under United States laws, the claims which now belong to the Iron-Silver Mining Company, covering, with remarkable accuracy, when it is remembered that at that day little or nothing was known of the geological structure of the region, the croppings of the ore-bearing stratum over a distance of more than a mile. The first practical test of the value of the ore was made by Mr. A. R. Meyer, a graduate of the Freiberg Mining Academy, and agent for the Saint Louis Smelting and Refining Company, who shipped a small lot to Saint Louis in the fall of 1876.

Development.—Active prospecting over the whole region may be said to have commenced in the spring of 1877, and the development of rich and productive mines from that time on advanced with a rapidity that is truly marvelous. This can be more easily comprehended by a comparative statement of the economical conditions of Leadville in the spring of 1877, and at this same period in 1880, after a lapse of three years. At the former time the nucleus of the present city, known as the town of Agassiz, consisted of a few log cabins, relics of the palmy days of gulch-mining, scattered along the edge of California Gulch with an estimated population of less than 200 persons; its business houses consisted of a ten-by-twelve grocery and two small saloons. Three of the now productive mines had been discovered, but were still scarcely more than mere surface scratchings. A single lead furnace was planned, but not as yet erected. Communication was had with the outside world by stage or wagon, either across the crests of two high ranges to Denver, or by an almost equally difficult road to Colorado Springs. The latter date finds a broad, populous, admirably situated city, of 15,000 inhabitants, with 28 miles of streets, in part lit by gas, and furnished with hydrants and over five miles of water-pipes. It has thirteen schools, with an average attendance of 1,100 pupils; five churches, and three public hospitals, supported by charitable contributions; an opera house and numerous smaller theaters; six banks, and block after block of business stores, many substantially constructed of brick or stone. Its assessable property is estimated at $30,000,000, and $1,400,000 were expended during the year 1880 in new buildings and improvements. To support this population are over thirty producing mines, with innumerable smaller mines and prospects, which are either producing small amounts of ore or give promise of so doing in a comparatively short time. Ten large smelting works are in active operation reducing the ore of these mines, and the value of the aggregate annual production of the district in gold, silver, and lead amounts to $15,000,000. Two lines of narrow-gauge railway connect it with the East, the one by way of Denver, across the Mosquito and Front Ranges, the other following down the valley of the Arkansas to Pueblo, and these find ample remuneration, even over the heavy grades which the mountainous nature of the region traversed necessitates, in the business its mines afford.

General Geology of the Mosquito Range.—The area now occupied by the Mosquito Range and the Upper Arkansas Valley was once the littoral region of an Archæan continent or island, whose area is approximately expressed by the Archæan exposures of the Sawatch Range. The Rocky Mountain chain or eastern member of the Cordilleran system, in this latitude consists of a series of Archæan islands or continents which have never been entirely submerged. Some superficial geological observers have reasoned, from the fact that the later sedimentary beds are here generally found resting on the flanks of the Archæan masses, and dipping away from them often at high angles, that these strata once arched entirely over the Archæan masses in anticlinal folds. Were this the case, however, wherever the edges of folded strata were exposed around the eroded crest of the anticlinal, beds of invariably the same geological horizon would be found resting directly on the Archæan, and their angle of dip should be sufficiently steep to carry the strata, in an ideal reconstruction of the original arch, entirely over the present mountain masses. In point of fact, however, along the flanks of the Archæan of the Colorado Range Carboniferous, Triassic, and even Cretaceous beds are found at different points directly abutting against the crystalline schists; and, with few exceptions, the angle of inclination of the sedimentary beds is far too low to carry them up to any considerable height, even on the present surface of the mountains, which must have been considerably planed down by long periods of erosion and abrasion. The sedimentary deposits of the Mosquito Range were, as above stated, originally deposited, in the Paleozoic seas, along the shores of the Sawatch island, and have been lifted to their present position by dynamic forces, which have resulted in a series of sharp folds and longitudinal faults, in which the upward movement has been almost invariably on the east of the fault line. There is every reason to suppose that, like the Archæan masses of the Colorado range, the Sawatch island was never entirely submerged. But the fact that in the limited region studied absolutely the same bed, with one single exception, is found resting upon the Archæan rocks, shows, that the bottom of the ocean in which they were deposited had a comparatively smooth and regular surface, and that no steep cliffs existed along the immediate shore line, as in the Colorado Range, or that if they did exist within this area, they, together with their bordering sediments, have been entirely removed by subsequent erosion. The dynamic movements which resulted in the elevation of Mosquito Range, and produced its present complicated structure, can be most readily explained on the generally received contraction theory, as the result of tangential pressure exerted upon the upper portion of the earth's crust in a direction approximately at right angles to the shore line, or radial to the center of the Sawatch island. The primal effect of such pressure exerted against a comparatively unyielding mass of crystalline rocks would be to compress the series of conformable sedimentary beds into longitudinal folds, whose principal axis would be at right angles to the direction of pressure. In the region under consideration the pressure would act from the east westward. The upper beds being relatively more plastic than those beneath, the pushing force would tend to produce anticlinal folds having a gentle slope to the eastward and a steep or approximately vertical inclination on the west.

That sedimentary beds, even though formed of apparently rigid and unyielding material, may, under favorable conditions of pressure, be flexible and plastic, is abundantly proved by observation in nature. Such plasticity must, however, have a limit, and when such limit is reached the tension produced by pressure will result in a fracture of the beds and a vertical displacement, or faulting. After the deposition of the sedimentary beds in the area under consideration, there occurred, during Secondary times, an intrusion of igneous or eruptive rocks, which spread themselves out in sheets between the strata, and became, as it were, an integral part of the sedimentary formation. It was after the eruption and consolidation of these masses of igneous rock that the dynamic movements in question occurred. Sedimentary strata are comparatively thin sheets of homogeneous and coherent material, whose plasticity, other things being equal, would be proportionate to the average thinness of the beds. An augmentation of the aggregate number of stratification planes in a given thickness would increase the possible movement of each on the other along such planes, and, as in the familiar illustration of folding a number of sheets of paper, the sharpness and number of folds into which, under given conditions of pressure, they could be compressed without fracturing. The igneous rocks, however, which were spread out in irregular and comparatively thick masses, having no bedded structure, but fracturing with equal ease in any direction, would render the whole series more rigid, and favor the production of faults rather than folds. Such is the case in this region, where the action of faulting and displacement is predominant over that of folding, and particularly prominent in those portions where there is the greatest concentration of eruptive rocks, as in the district immediately adjoining Leadville.

Archæan Rocks.—All the sedimentary rocks found within this area belong, geologically, to the Archæan, Paleozoic, or Quaternary eras. The Archæan rocks are, as well as the present limited data enable us to determine, the very oldest of the crystalline rocks, and may be considered as the Rocky Mountain equivalent of the Laurentian of Eastern geologists. They consist here of granites, gneisses, and amphibolites.

Granites.—The granites are, in most cases, distinctly stratified and of undoubted sedimentary origin. In other cases the evidence is less clear and at times they even have characteristics of eruptive granites. In composition they belong to the normal type of granite, viz., those which consist of quartz, two feldspars, biotite, and muscovite. They are generally very coarse-grained and contain large twin crystals of orthoclase porphyritically distributed. In color they are gray or red, the latter tint being more prominent in the coarse-grained varieties; but in some instances fine-grained, deep-red granites, not unlike the famous Aberdeen granites, occur. There is sometimes a foliated structure approaching that of gneiss, especially where found immediately adjoining sedimentary rocks. Within the mass of normal granite occur large, irregular, vein-like white masses of secondary origin, corresponding to the German definition of pegmatite. They consist of large, inter-grown crystals of white orthoclase, microcline, and quartz, with irregular masses of muscovite.

Gneiss.—Among gneisses the mica-gneiss is the prevailing type; hornblende gneiss, which is so frequent in other Archæan masses to the north, being comparatively rare. Their composition is similar to that of granites. In structure, however, they present a great variety of forms, from the normal gneiss structure, with fine, even grain and constant composition in the different layers, to a coarse-grained porphyritical structure, containing large twin crystals of orthoclase and approaching that of the coarse-grained granites.

Amphibolites.—The amphibolites are of less frequent occurrence than either of the previously-mentioned rocks, and occur interstratified with them in layers of varying thickness, and sometimes in large lenticular bodies. Under this name are included hornblende rocks of less marked schistose structure than is common in normal gneisses or schists. They consist mainly of quartz, two feldspars, and hornblende, with not infrequent biotite.

Paleozoic Formations.—Among Paleozoic formations beds of the Cambrian, Silurian, and Carboniferous groups have been recognized, although, owing to the difficulty of obtaining distinct fossils in such a highly metamorphosed region, the limits of the two first mentioned have not been definitely fixed. The question of the existence or absence of Devonian beds is one upon which too little evidence has been gathered for a definite decision. Such as it is, it is purely of a negative character, viz., that no undoubted Devonian forms have yet been found in the Rocky Mountains, and that in the area under survey a slight, though not unquestionable, evidence of non-conformity by erosion exists between the horizons of the Carboniferous and Silurian periods. A comprehensive idea of the relative thickness and general character of these beds will be given by the subjoined table of the average section obtained in Mosquito Range, to which is added, for purposes of comparison, a typical section of corresponding beds in the Wahsatch Range,* and a section of the same in the region of the Lower Colorado, made by Mr. C. D. Walcott.†

Mosquito section; 4,050–5,600 feet; possible unconformity by erosion.

Carboniferous 3,700 ft. to 4,000 ft.	Upper Coal measure limestones	1000 to 1500	Blue and drab limestones and dolomites, with red sandstones and shales. Mud shales at top.
	Weber grits	2500	Coarse white sandstones, passing into conglomerates and siliceous and highly micaceous shales, with occasional beds of black argillite and blue dolomitic limestone.
	Weber shales		Calcareous and carbonaceous shales, with quartzite.
	Blue limestone	200	Compact, heavy-bedded, dark-blue dolomitic limestone. Siliceous concretions at top, in form of black chert.
Silurian 200 ft.	Parting quartzite	40	White quartzite.
	White limestone	160	Light-gray siliceous dolomitic limestone, with white chert concretions.
Cambrian 200 ft.	Lower quartzite	150 to 200	White quartzite, passing into calcareous and argillaceous shales above.

Kanab (Colorado River) section; 5,000 feet; unconformities by erosion.

Permian 855 ft.	Upper Permian	710	Gypsiferous and arenaceous shales and marls, with impure shaly limestone at base.
	Lower Permian	115	Same as above, with more massive limestone.
Carboniferous 3,260 ft.	Upper Aubrey	835	Massive cherty limestone, with gypsiferous arenaceous bed, passing down into calciferous sandrock.
	Lower Aubrey	1,455	Friable, reddish sandstone, passing down into more massive and compact sandstone below. A few fillets of impure limestone intercalated.
	Red Wall limestone	970	Arenaceous and cherty limestone 235 feet, with massive limestone beneath. Cherty layers coincident with bedding near base.
Devonian 100 ft.	Devonian	100	Sandstone and impure limestone.
Cambrian 785 ft.	Tonto Group	235	Massive mottled limestone, with 50 feet sandstone at base.
		550+	Thin-bedded, mottled limestone in massive layers. Green arenaceous and micaceous shales 100 feet at the base.

* Geological Exploration of the 40th parallel.

† American Journal of Science, September, 1880, page 222.

Wahsatch section; 30,000 feet; conformable.

Permian . . . . . 650 ft.	Permian	650	Clays, marls, and limestones, shallow.
Carboniferous 15,000 ft.	Upper Coal-measure limestone.	2,000	Blue and drab limestones, passing into sandstones.
	Weber quartzite .	6,000	Compact sandstone and quartzite, often reddish; intercalations of lime, argillites, and conglomerate.
Waverley.	Wahsatch limestone.	7,000	Heavy-bedded blue and gray limestone, with siliceous admixture, especially near the top.
Devonian . . . . 2,400 ft.	Ogden quartzite . . .	1,000	Pure quartzite, with conglomerate.
Silurian . . . . . . 1,000 ft.	Ute limestone . . .	1,000	Compact, or shaly siliceous limestone.
Cambrian . . . . . 12,000 ft.	Cambrian	12,000	Siliceous schists and quartzite.

NOTE.—Planes of unconformity by erosion denoted by double dividing lines.

Cambrian.—*Lower quartzites.*—The beds assigned provisorily to this horizon, are prevailingly quartzites; to them, therefore, the local name of Lower quartzites has been given. Their average thickness is about 150 feet, of which the lower 100 feet are composed of evenly-bedded white saccharoidal quartzites, while the upper 50 feet are shaly in character and more or less calcareous, passing by almost imperceptible transition into the siliceous limestone above. At the base a thickness of a foot or more is conglomeritic and stained with oxide of iron. Above this is a heavy white quartzite of remarkably uniform and persistent character, from 40 to 100 feet in thickness, always very readily distinguished as a white line in the numerous sections afforded by the cañon walls of the range. Primordial fossils belonging to the Potsdam epoch were found in the shaly beds above this quartzite. In its upper portion also occurs a remarkably persistent stratum, about a foot in thickness, of siliceous limestone, to which the local name Red Cast bed has been given, from the red concretions resembling casts of fossils which are constantly found in it. The siliceous dolomites near the dividing line between this and the overlying series contain local developments of serpentine, resulting from metamorphic action, which range in color from a dark, beautifully veined verd-antique green to a homogeneous mass of yellow tint resembling beeswax, not only in color but in texture.

Silurian.—*White limestone.*—The beds of this horizon, to which the above local name has been given from their prevailing light color as distinguished from the formation immediately succeeding, consist in the main of light-drab dolomites, containing, besides the normal proportion of lime and magnesia, from 10 per cent. upwards of silica. They are thinly bedded, compact rather than crystalline, often with conchoidal fracture, and only rarely of absolutely white color. Their characteristic feature is the occurrence in certain beds of concretions of white, semi-transparent hornstone or chert. Their average thickness is about 150 to 160 feet.

Parting quartzite.—Above the White limestone occurs a remarkably persistent bed of rather variable thickness, to which the local name of Parting quartzite has been given, and which, in the absence of any direct geological evidence, has been included in the Silurian group. It has an average thickness of from 10 to 40 feet, and is not to be distinguished lithologically from the numerous white quartzites found at other horizons. It is, however, of geological importance as determining the dividing line between the Silurian and Carboniferous groups. The fossil evidence obtained as to the age of the above formation is rather meager, being confined to a few Niagara forms found near its base, and to forms of the Trenton and Calciferous epochs contained in float fragments which probably came from this horizon.

Carboniferous.—*Blue limestone.*—The beds included under this local name, and which, from the fact that they form the ore-bearing rocks *par excellence* of the region, it is most important to be able to trace accurately, are fortunately marked by persistent and characteristic features. They have an average thickness of 150 to 200 feet. Their composition, which is remarkably regular, is that of normal dolomite, containing a very small percentage of silica. In color they are of a deep grayish blue, often nearly black above, while some of the lower beds are lighter, approaching the drab, and, where locally bleached, difficult to distinguish lithologically from the underlying White limestone. The upper bed is well marked by characteristic concretions of black chert, frequently hollow in the center, and often containing within their mass distinct casts of fossils. The typical rock is generally granular or coarsely crystalline, and has a characteristic ribbed structure produced by irregular lines and spots of white crystalline dolomite, resulting from the dissolving out and redeposition of this material. The principal characteristics, therefore, which distinguish the ore-bearing limestone from the underlying White limestone are, first, its color; second, its composition, the latter being invariably more siliceous; third, its texture, which is generally crystalline, while the latter is more frequently compact; fourth, the chert secretions, which in the former are always black and in the latter light colored or white; to which may be added the fact that the Blue limestone is generally more heavily bedded than the White. The fossils obtained, which were comparatively abundant in the upper beds, contain, among prevailing Coal-measure forms, some which belong to the Lower or Sub-carboniferous of the East.

Weber grits.—The rocks included under this head form a series of relatively great thickness and of prevailing siliceous composition. At their base, immediately above the Blue limestone, occurs a series of shales and quartzites of very variable thickness and composition. The thickness may be roughly estimated at 150 feet. The quartzites are not to be distinguished from other quartzites of the region, while the shales are sometimes green, more frequently black, and highly carbonaceous argillites which are generally impregnated with pyrites, and contain at times beds of impure anthracite coal. Locally there are developments of impure dolomite, which, as well as the shales, are often very rich in coal-measure fossils. The Weber grits proper, which have an average thickness of about 2,500 feet, consist of coarse white sandstones, passing into conglomerates, containing pebbles of Archæan rocks, most frequently white or pinkish quartz. They have a varying admixture of finely-disseminated carbonaceous material, which at times gives them an almost black color. Besides the sandstone there are abundant schists, generally siliceous, and always rich in brilliant white mica. At irregular intervals through the horizon are found beds of compact black argillite, sometimes calcareous, and about the middle of the series two persistent beds of blue-gray dolomite, from ten to fifty feet in thickness.

Upper Coal-measure Limestone—Less favorable opportunities were offered for studying this group than either of the preceding, and its limits are therefore less definitely determined. It consists mainly of calcareous beds, alternating with coarse reddish sandstones and quartzites, more or less micaceous, and sometimes passing into mica-schists. Its lower limit is drawn at the base of the first important limestone bed above the siliceous series of the Weber grits. This limestone, locally called the Robinson limestone, from the fact that it forms the ore-bearing horizon of an important mine of that name in the Ten-mile district, is noticeable from the fact that it is the only true limestone observed among the calcareous beds of the region; the others are all practically dolomites of varying purity. As developed in this mine it is of a drab color and of peculiarly compact texture, resembling a lithographic stone. These textural characteristics are apparently not persistent, however, not having been recognized in other portions of the region. Several beds of blue-gray limestone, and one of a very fossiliferous black limestone, were observed on the western flanks of Mount Silverheels, and in the upper horizons of the Ten-mile district were found mud shales, recalling the Permo-Carboniferous beds of the Wahsatch. No fossils other than coal-measure forms were found, however. The red sandstones of this group are distinguished from the overlying Triassic rocks by a deeper color, approaching a Venetian red, whereas in the latter it is rather a light brick-red.

Quaternary.—The Quaternary formations are the *Lake Beds* and the *Recent* formations, including drift and moraines. The former were deposited in the bed of a fresh-water lake at the head of the Arkansas during the intermediate flood period of the Glacial epoch. The material of which they are composed is therefore not essentially different from that of the moraine material, but it is distinguished from it by its bedded structure. These beds consist at times of fragments, more or less rounded, of various rocks which make up the range, frequently with calcareous cement, and at other times of a mixture of clays resulting from the decomposition of porphyry, and of decomposed granite, and still again of earthy marls. In the recent beds are included not only the later alluvial deposits, where these are accumulated in sufficient depth to obscure the underlying rock, but also moraines and rearranged moraine material, for which the local name of "Wash" has been preserved.

The Paleozoic rocks described above have an aggregate thickness of between 4,000 and 5,000 feet. In the seas in which they were deposited, however, a continuous sedimentation went on through the successive Triassic, Jurassic, and Cretaceous periods, it being at the close of the latter that the dynamic movements took place which resulted in the folding and fracturing which raised the Mosquito Range to its present position. From data available their thickness may be estimated at not less than 7,000 feet. Probably the greater part, if not the whole, of these sediments were already accumulated at the bottom of the ocean before the intrusion of the Secondary eruptive rocks now found in the region, and which will be next described. An explanation of their exceptionally crystalline structure may therefore be found in the fact that they solidified under the pressure of a thickness of at least 10,000 feet of superincumbent beds.

Eruptive or Igneous Rocks.—The eruptive rocks of the district are mostly of Mesozoic age, and belong to the general types of porphyries* and diorites, or those in which monoclinic or triclinic feldspars are relatively predominant. Of Tertiary eruptive rocks, which are closely allied to the products of modern volcanoes, the only representatives are andesites, which occur at Buffalo Peaks, and rhyolite of the crystalline variety classed by Richthofen as Nevadite.

White or Leadville Porphyry—Constitutes the most distinct and well-characterized variety of the porphyries. It is a white, homogeneous-looking rock, composed of quartz and feldspar, of even, granular texture, in which the porphyritical ingredients, which are accidental rather than essential, are small rectangular crystals of white feldspar, occasional double pyramids of quartz, and fresh, hexagonal plates of biotite, or black mica. More frequent than either of the above are aggregations of fine leaflets of muscovite, or white mica, which are a secondary product resulting from the decomposition of feldspar. The rock is always in a more or less advanced state of decomposition, which is first shown by the opaqueness of its feldspars and the development of spots of muscovite, and in its extreme stage in the neighborhood of the ore deposits results in a general softening of the mass, due to the kaolinization of the feldspar. Among the miners of Leadville it is known also as "Block Porphyry," on account of its tendency to split up into angular blocks; and also as "Forest Rock," from the deposition of dendritic oxide of manganese on the surfaces of such fragments. Its composition is that of normal quartz porphyry, containing about 70 per cent. of silica.

Other Porphyries.—All the other forms of porphyry found, which, though presenting a number of varieties in the field, have essentially the same general composition, both mineralogical and chemical. They consist generally of quartz, two feldspars, and biotite; hornblende occurring as an essential ingredient in only one variety. The crystalline ingredients are easily distinguishable by the eye, and there is, therefore, no danger of confounding them in the field with White porphyry. This crystalline structure, on the other hand is often so far developed that they are not readily distinguishable by the untechnical eye from granites; as such, indeed, they are generally classed by the miner. A careful examination, however, readily reveals their structural difference, which is that in them the larger crystals are enclosed in a finer-grained groundmass, whereas between the crystals of granite there is no such intervening and apparently structureless material.

Lincoln porphyry.—The principal subdivision of this group has been called Lincoln porphyry, from the fact that it is typically developed in the mountain mass around Mount Lincoln. It consists of quartz, orthoclase and plagioclase feldspars, and biotite. Its most striking peculiarity is the frequent occurrence of large crystals of rather glassy-looking orthoclase feldspar about one inch in length. The quartz, which occurs in double pyramids, appears to have a rounded outline, and frequently a delicate rose tint. The mica is found in hexagonal plates, generally decomposed and of greenish color. Although the type-rock does not occur in the immediate vicinity of Leadville, a variety known as *Gray porphyry*, which does not differ in its essential constituents, and occupies generally the same stratigraphical position, is a prominent feature in the geology of that region. It has a prevailing dark greenish-gray color, due to the alteration of the constituents of its groundmass; but when found in the mines, where it is more thoroughly decomposed, it is quite white, and only to be distinguished from the White porphyry by the traces left of outlines of former crystalline ingredients. The large feldspars are often finely developed, but the groundmass is relatively more prominent than in the Lincoln porphyry proper. The specimens analyzed yielded 66 per cent. of silica for the Lincoln porphyry and 68 for the Gray.

Sacramento porphyry.—The second important variety of quartz porphyry receives its name from the locality of its typical occurrence, which is at the head of the Sacramento Gulches. At first glance it does not differ from the Lincoln porphyry, except in the absence of the large feldspar crystals. It contains the same large rosy quartz-grains, two feldspars and biotite, but is distinguished from it by carrying hornblende also. It is in general comparatively fresh, and perhaps more likely to be confounded with granite than even the Lincoln porphyry. This rock does not occur on the surface within the Leadville region, although the

*In the absence of any universally accepted classification and definition of eruptive rocks of Secondary age, it seems important to state here the system adopted and the reasons therefor. To the use of the term porphyry, as applied to a type of rocks of definite age and composition, the very valid objection may be brought that in its original acceptation it simply defined a certain type of structure, viz., that of a fine-grained or amorphous groundmass containing larger crystals porphyritically imbedded. On the other hand, the custom of applying this term to orthoclastic porphyritic rocks of Secondary age has become so firmly established by long-continued usage that it would seem unwise to abandon the present use of the term until a satisfactory substitute were found which would be received by all lithologists. The normal quartz-porphyry is a porphyritic compound of quartz, prevailing orthoclase, and some plagioclase feldspar, with mica or hornblende, in which the groundmass contains more or less isotropic amorphous material. A granite-porphyry, on the other hand, is a porphyritic rock of similar composition in which the groundmass contains only crystalline and no amorphous material. It is distinguished from granite, structurally, by the fact that it has a porphyritic rather than an evenly crystalline texture, but, like granite, it contains microscopically only fluid and no glassy inclusions. The rocks described above are, however, essentially crystalline as viewed under the microscope, though certain specimens contain a limited amount of amorphous material, and glassy inclusions are found in them, but less frequently than fluid inclusions. Strictly defined, therefore, they cannot be considered as granite-porphyries, though frequently indistinguishable from them in the hand-specimen. Rosenbusch has proposed (*Rosenbusch, Mass. Gesteine*, pp. 85-87) to separate all such rocks from the quartz or felsite-porphyries, and call them micro-granites. To call the rocks in question micro-granites, however, would be to add a new and somewhat ambiguous term to the already sufficiently confused lithological nomenclature, without gaining thereby in clearness of definition, since although they approach granite in microscopical structure, they are widely divergent from it in geological habitus. It has been judged best therefore, to preserve the term quartz-porphyry, which is sanctioned by local usage, and of which they form the extreme crystalline type.

variety next to be described, which occupies a nearly equivalent stratigraphical position there, may be allied to it.

Pyritiferous porphyry.—This rock, which forms an extremely important mass in the Leadville region, is found in such a universally decomposed condition that its original constituents cannot definitely be determined. It is generally of a white color, with grayish-green or pinkish tints, comparatively fine-grained, with no traces of the large crystals. In it can be distinguished small grains of white feldspar, quartz, biotite which is generally altered to a chloritic substance, and pyrite. The latter ingredient, from which it derives its name, is found abundantly scattered through the rock in crystals, often so fine as to be indistinguishable by the naked eye. They occur at times within the crystals of quartz and biotite, and are hence supposed to be an original constituent of the rock. They are frequently concentrated along cleavage planes, sometimes associated with finely disseminated crystals of galena. Pyritiferous porphyry is readily distinguished from the White porphyry by its crystalline constituents. It differs from the Sacramento and Gray porphyries by a relatively small amount of plagioclase feldspar, and from the former by the absence of hornblende. Its most strikingly distinctive feature is the amount of pyrites which it contains, which is estimated to constitute, on the average, 4 per cent. of its mass. Besides the above-mentioned varieties are the Silverheels, the Mosquito, and the Green porphyries, only the former of which is found in any considerable mass. The others are generally fine-grained, of a greenish tinge, and present no important typical features, having approximately the same ultimate composition as those already mentioned.

Dioritic Rocks.—*Diorite.* Of the rocks in which plagioclase feldspar is the characteristic ingredient the crystalline type or diorite, which is the structural equivalent of granite, is of comparatively rare occurrence.

Porphyrite.—Its porphyritic variety, known as porphyrite, is, however, extremely well developed in the region, so that an excellent opportunity was afforded for its study. As the rocks themselves do not occur in the Leadville region, nor have any economic bearing, no further mention of them need be made here.

Rock Formations—Distribution.—The superficial distribution of the various sedimentary formations, or the relative area covered by their outcrops, being a function of, or dependent upon, erosion, are intimately connected with the existing topographical structure of the region. Were erosion the only factor to be considered, the Archæan rocks would be found exposed continuously on the west side of a line, approximately representing the old shore line, and in the deeper drainage valleys and anticlinal axes of the eastern side. The displacements of the numerous faults which run through the region have, however, considerably modified this normal distribution. In point of fact, the central portion in the latitude of Leadville is mainly covered by the outcrops of Paleozoic sedimentary beds and intruded masses of porphyry; the Archæan exposure being confined to deep glacial amphitheatres near the crest of the range, and to minor masses which represent the eroded crests of anticlinal folds. In the northern portion of the area, Archæan rocks are exposed along the main crest of the range, and in the deep cañon valleys and glacial amphitheaters of the streams which flow into the Platte; the Paleozoic beds being found only on the easterly sloping flanks of the included spurs. On the western side of the range, owing to the displacement of the great Mosquito Fault, the area adjoining the valley of the East Fork of the Arkansas is covered by beds of the Weber grits formation, while a bordering fringe of outcrops of Lower Quartzite, and White and Blue Limestone beds is found on the northern and eastern rim of Tennessee Park. The western limit of the Paleozoic beds is a line running southeasterly from the forks of the Arkansas to the crest of the range at Weston's Pass, and southward along the crest approximately in a north and south line. West of this line are found only the granites and schists of the Archæan, and irregular dikes and intruded masses of porphyry. In the area included between this line and the crest of the range are triangular zones of easterly-dipping sedimentary beds, in some cases forming a continuous series from the Cambrian to the Upper Coal-measures, cut off abruptly by fault lines, and succeeded again on the east by Archæan exposures. On the west of the crest the Paleozoic beds slope regularly back beneath the floor of the South Park, the Archæan rocks being found only in the deeper hollows at the head of the streams. Beyond the limits of the map the outcrops of the more resisting beds of Mesozoic age form parallel ridges, running across South Park from north to south.

Eruptive—*Distribution.*—The most striking fact connected with the distribution of the Secondary eruptive rocks is that an east and west line drawn through Leadville represents very closely the limit of the two main varieties of porphyry recognized above. South of a line drawn through Empire and Horseshoe Gulches, the White porphyry is absolutely the only one which has been found within the limits of our exploration, while it is practically wanting north of the line through Evans and Mosquito Gulches, the only exceptions being dikes of comparatively insignificant size, and not absolutely identical in structure.

Mode of Occurrence.—In their mode of occurrence the type feature is that of intrusive masses, which are developed on a scale of unprecedented magnitude, and follow certain horizons with remarkable regularity. These inter-bedded sheets are found to have a maximum thickness at certain points, or along certain lines, and to become thinner in proportion to their distance from such central point, which is probably near a vent or channel through which they were erupted. This form resembles the structure of the intrusive masses of the Henry Mountains, which have received from Mr. G. K. Gilbert the name of *Laccolites.* Nor is the resemblance confined to external structure, but extends also to internal texture and mineralogical composition. It is probable that this mode of occurrence of eruptive rocks, viz., as intrusive masses, which originally did not reach the surface, but were forced up to a certain horizon and then spread out between the beds, is far more common than has hitherto been suspected by geologists. It is difficult to conceive of the conditions under which a fused mass could pry open strata to a width of 1,000 feet or more, overcoming the weight of 10,000 feet of superincumbent rocks, and spread itself out in a continuous sheet between the beds to a distance of ten miles from the point or line of eruption. That they did exist, however, can be clearly demonstrated in this region, thanks to the intense action of folding and faulting, and the enormous amount of erosion which has taken place since such eruption, and afforded exceptional opportunities for a study of their form and extent.

Intrusive Masses.—The main sheet of White porphyry which lies upon the surface of the Blue limestone had its principal vent at the head of Four Mile Creek, where it can be seen breaking through the underlying beds, and forming the main mass of a hill 2,000 feet high. The gradually thinning outcrops of this sheet can be traced southward continuously along the east slopes of the range nearly to Buffalo Peaks, and back again on the west side from Weston's Pass to Empire Gulch. The continuity of the outcrop on an east and west line is broken by faulting and erosion, but wherever the Blue limestone is found this sheet occurs, with some unimportant exceptions, directly above it, following all its undulations. Of less uniform extent are sheets of White porphyry at lower horizons, generally between the Blue and White limestone, whose principal development is in the vicinity of Leadville. One important mass can also be seen on the south wall of Horseshoe Creek, breaking up across Weber grits beds and then spreading out between the strata.

Intrusive masses of the other porphyries are found developed on an even greater scale than those of the White porphyry. Although no single sheet has been traced over so great an area as in the case of the former, they have a much greater vertical distribution, extending up to the Jurassic and possibly even into Cretaceous beds. In one single section over fifteen sheets, many several hundred feet thick, were counted between the Blue limestone and the top of the Carboniferous. The great aggregate thickness of beds thus added to the conformable Paleozoic sediments must have given them in their original position an arched form, which is now seen in a very marked change in the strike of outcrops, where there has been the greatest accumulation of intrusive masses, as on the line of Mount Silverheels on the east, and of Sheep and Jack Mountains in Ten-Mile District on the west of the range. In many cases quite thin sheets show most remarkable uniformity of thickness and position over comparatively large areas; for instance, along the walls of Mosquito Cañon a twenty-foot bed of porphyrite, occurring between the Blue and White limestone, can be traced continuously several miles. While these intrusive sheets follow by preference one definite plane, they not infrequently change their horizon, crossing an intervening bed; in one case also a second sheet is seen to have forced itself horizontally through the mass of an already interbedded sheet.

Dikes.—While by far the greater mass of igneous rocks occurs in the form of intrusive beds, the dike form is by no means uncommon, although the normal dike with regular parallel walls, generally figured in text-books, is seldom seen; on the other hand, large masses, of no regular form and apparently quite independent of stratification lines, which are intermediate between the normal dike and the intrusive sheet, are quite common. Dikes are generally found in the crystalline or Archæan rocks, and may be best observed in the glacial amphitheaters. They are generally narrow sheets from 20 to 50 feet in thickness, and of no great longitudinal extent. A not uncommon form is the "interrupted dike," a succession of outcrops of porphyry or porphyrite on the same general line, separated by short intervals of the enclosing rock mass. These may be projecting points of one main sheet, or independent chimneys, the former seeming more probable from their close proximity and identical composition. Dikes within dikes are found as well as intrusive sheets within intrusive sheets. Dikes are also found extending up through the crystalline rocks into the overlying Paleozoic beds; wherever observed on cañon walls they were found to end abruptly at a definite, although not always the same, horizon. Opportunities for actually tracing the dike as the feeding-channel of an intrusive sheet were comparatively rare.

Relative age.—The evidence as to the relative age of the different varieties of porphyry, though generally satisfactory, offers some apparent contradictions; these may, however, be explained on the supposition that the eruption of any one variety was not strictly confined to a single definitely marked period, but was intermittent. In other words, after a main eruptive mass had consolidated and been succeeded by eruptions of other rocks or from different magmas, a renewed activity took place in the magma of the first rock, which resulted in later intrusions of less magnitude. Thus the White porphyry is definitely the oldest of the Secondary rocks. The great mass of the Sacramento porphyry, whose main vent apparently adjoined that of the former, between the head of Little Sacramento and Big Evans Gulches, contains caught-up portions of the White porphyry and of the Weber grits. The main sheet of Gray porphyry in the Leadville region occurs above, sometimes replacing the White porphyry, while other intrusive masses of this rock are found cutting across both White porphyry and the sedimentary strata which enclose it. It is also significant that the White porphyry is the most thoroughly crystalline of all the Secondary eruptive rocks, and generally occupies a lower geological horizon. On the other hand, dikes of White porphyry have been found cutting across interbedded masses of Lincoln porphyry, which seems to be the equivalent in age and position of the Gray.

Contact phenomena.—There is a notable absence in the region of strongly marked contact phenomena in the sedimentary beds, that is, changes which have resulted from the contact of a fused mass, such as a baking or vitrification. The changes which are found in them near intrusive masses are evidently rather the result of the action of percolating waters. Within the eruptive rocks themselves the usual phenomena observed near the outer surface of cooling masses are found here along their contact with the enclosing rock, viz., a finer grain and different relative distribution of mineral constitutents as contrasted with the average character of the rock, and a tendency to development of laminated structure at the actual contact. Angular fragments of the enclosing rock are, morever, so abundant at times along the contact as to form a regular breccia.

Glacial phenomena.—Of the forces of erosion and abrasion which have removed an aggregate thickness of about 10,000 feet of sedimentary beds, together with an unknown amount of eruptive rocks, from a great portion of the area examined, only the latter phases, viz., those which have acted during and since the Glacial period, come directly under observation. As already stated, the present investigations afford evidence of the existence during the Glacial period of two epochs of maximum cold, separated by one of higher temperature. In its general bearing this fact presents no novelty, but is merely confirmatory of observations already made by American, as well as European geologists, who have arrived at the same conclusion by reasoning from different classes of phenomena, astronomical as well as terrestrial. The warmer intervening period here was, owing to the melting of enormous ice masses and great precipitation, one of great floods, which caused a rapid degradation, as well as the removal of existing detritus, and where, as at the head of the Arkansas Valley, conditions were favorable to the formation of a lake, by the damming up of the waters, the coarse detrital material was deposited in regular beds, of relatively great thickness at its bottom. While, therefore, the actual outlines, as here given, might be modified by more complete data, the information obtained is quite sufficient to establish the following important facts:

I. *That the present moraines have been deposited over the Lake beds;* consequently that the glaciers by which they were formed existed *after* the deposition of the latter and the draining of the lake in which they were deposited.

II. *That since the latter epoch there has been an elevation of the mountain mass, relatively to the adjoining valley, amounting in one place to over* 1,000 *feet.* This is proved by the existence of Lake beds at an elevation, on the spurs adjoining Iowa Gulch, of 11,000 feet; by the angle at which they now stand on the ridges adjoining the Arkansas Valley, and by the fact that where they are nearly horizontal, in the center of the basin, they have an average level of less than 10,000 feet.

Valleys.—In studying the configuration of the present surface the valleys may be separated into three classes as regards their age and manner of formation:

I. Glacial valleys.
II. Valleys of erosion.
III. Surface valleys.

The first, which owe their main outline to the carving of glaciers, have in cross-section a characteristic U outline, head in a glacial amphitheater, and have a comparatively straight course. This original form is always more or less modified by the same action which has formed the other two kinds of valleys. To this class belong all the large cañons or valleys on the east side of the range, and the East Fork of Arkansas, Evans, Iowa, and Empire Gulches on the west. The second class, formed exclusively by the action of running water, which has cut through surface accumulations into the hard rock mass, have a V shape; that is, the sides are proportionately less steep, and the bottom narrower than the former, while their course is generally tortuous, being affected by the unequal resistance offered by different positions or textures of rocks. They also want the amphitheater-shaped head. The third class are also valleys of erosion, but cut out of surface accumulations, such as drift or Lake beds, which have not yet become solid rock. They are in consequence relatively wide and shallow, and have a straighter course than the second class. The most striking difference between these and ordinary valleys of erosion is seen on a geological map, where the outline of outcrops crossing the latter would have a re-entering angle in the direction of the dip, whereas the former would cause no divergence in the course of such outlines. This class would be anywhere of more recent origin than the other two, and in this region the second class is younger than the first. As instances of surface valleys may be mentioned, Little Evans, Georgia, and Thompson's Gulches. The former drains the amphitheater on the south face of Prospect Mountain, being separated from Big Evans Valley only by a moraine ridge formed by the glacier of the second epoch. It is thus proved that the amphitheaters were carved out by the earlier set of glaciers, since that from the Prospect Mountain amphitheater was originally a branch of the main glacier from the Evans amphitheater, and it was the moraine of the second Evans glacier which, being placed across the mouth of the Prospect Mountain amphitheater, necessitated its seeking a new outlet for its waters. That at one time ice must have filled the amphitheaters to their brim, and been in places over 2,000 feet thick, is proved by their configuration and the position of erratic blocks.

Ore Deposits.—A brief outline having thus been given of the geological structure of the region, it will be next in order to show the general characteristics of its ore deposits, and give a brief résumé of the conclusions which have been arrived at with regard to their origin and mode of formation.

Classification.—To a scientific description of natural objects, the most valuable aid is a rational and universally accepted system of classification. The first obstacle one encounters in attempting a description of mineral deposits is the absence of such a classification. A rational system should take account, not only of the present outward form of the deposits, but also of its origin and manner of formation. Mining geology in the United States has hereto found its principal discussion in the courts of law; and the authority there generally accepted is the classical though now somewhat antiquated work of B. von Cotta. This book, which is a most excellent compilation of what was known about the ore deposits of the world twenty-five or thirty years since, though containing many previously unrecorded observations, presents no claims as a work of original scientific investigation; and the classification adopted by Von Cotta takes account only of the external form of the deposits. It divides them into four classes of veins or lodes:

1. Ordinary. (*Gewöhnliche-gänge.*)
2. Bedded. (*Lager-gänge.*)
3. Contact. (*Contact-gänge*)
4. Lenticular. (*Lenticular-gänge.*)

The terms most current among mining men, which are probably derived in great measure from the above seem to be:

True fissure veins.
Contact veins or deposits.
Pipe or rake veins.

Blanket Veins or Deposits.—The first are popularly supposed to be the most valuable, since they occupy, in general, a nearly vertical position, and may extend indefinitely in depth. The term blanket deposit, on the other hand, which is probably derived from the *mantas* of the Spanish miners, seems to be generally applied in rather a derogatory sense to any horizontal sheet of ore. The last, whose proper definition has given rise to some discussion, is derived from local usage in a small district in the north of England, where valuable lead deposits are found in the Carboniferous or mountain limestone. According to Mr. Westgarth Foster this local usage classes as *Rake veins* fissures analogous to the faults in the Coal-measures, but which contain lead ore. When these are wide above and gradually contract below they become *Gash* veins. Pipe veins, on the other hand, are irregular deposits in the limestone, in shape like the cavern so often found there. When these occupy a nearly horizontal position between the strata they become *Flats*, or *flat* veins. Since Von Cotta's time the most important general treatises on mineral deposits are those of Joh. Grimm, of Pribram, and of Dr. A. von Groddeck, of Clausthal, which includes not only the ores of metals, but all minerals useful in the arts, such as coal and salt. Grimm's classification is very thorough, and takes account of the origin of the deposits, but is too complicated for general application. Von Groddeck divides all mineral deposits into four general classes:

1st. Bedded deposits (*geschichteten Lagerstätten*), including those which have been deposited at the bottoms of seas or oceans, whether mechanically, or as chemical precipitates—coal, gypsum, salt, etc.

2nd. Massive deposits (*massigen Lagerstätten*), a rather ill-defined division, including large masses of metallic minerals impregnating a particular rock.

3rd. Deposits filling pre-existing cavities (*Hohlraums-füllungen*), which include all veins or deposits, whatever their shape, whose vein-material is essentially different from the enclosing rock.

4th. Metamorphic deposits (*metamorphische Lagerstätten,*) including those which result from a more or less complete metamorphism of the rock itself by metallic combinations.

In the last edition of Johnson's Encyclopædia Prof. R. Pumpelly, in his article on ore deposits, proposes the following six divisions, in which the first two are based on the texture or mineralogical composition of the enclosing rock, and the three following considered as due chiefly to pre-existing open cavities or fissures:

I. *Disseminated concentrations.*
  1. Impregnations. Fallbands.
II. *Aggregated concentrations.*
  1. Lenticular aggregations.
  2. Irregular masses.
  3. Reticulated veins.
  4. Contact deposits.
III. *Cave deposits.*
IV. *Gash veins.*
V. *Fissure veins.*
VI. *Surface deposits.*
  1. Residuary deposits.
  2. Stream deposits.
  3. Lake and bog deposits.

Under gash veins Pumpelly would include those fissures which are limited to a certain bed or rock mass, while his fissure veins extend across different rock masses, without any definite limit. A discussion of the above systems of classification, which have been quoted simply as aids in the subjoined description, would exceed the limits of the present abstract. That the difference of origin and manner of formation should be a more important factor in the classification of ore deposits than has been the case hitherto is generally admitted, but, owing to the fact that the definite determination of such origin requires more laborious and expensive investigations, especially from a chemical point of view, than geologists are in general able or willing to make, trustworthy data are as yet too meager to form a basis for a general classification from this standpoint. The utmost that can be claimed by this memoir is to contribute to the general store of knowledge reliable facts in regard to an important group of ore deposits, and to point out the bearing of those facts upon the generally received theories of ore deposition, and the modifications which they may suggest in present classifications. The earlier geologists devoted much speculation to the subject of the origin of metallic minerals in ore deposits, and arrayed themselves on the side respectively of the Neptunists or Plutonists, according as they believed them to have been brought to their present position by descending or ascending currents, whether gaseous or liquid. As pure theory has been gradually modified by the results of actual investigation, the upholders of the two opposing schools have come to concede, in this, as in other questions of general bearing in geology, an element of truth even in the views of their opponents. Only extremists maintain that any series of geological phenomena admit of but one explanation, or are due to one universal immediate cause. It is generally agreed that subterranean waters, however deep-seated their apparent source, came originally from the surface. It is moreover proved that no rocks are absolutely impermeable to water, but as on the earth's surface, so within its solid crust, there is a constant circulation either through capillary pores, where it is not readily visible, or through the larger and more apparent channels formed by joints, cleavage planes, faults, dikes, and stratification lines, the direction taken by such waters varying with different local conditions. In the case, therefore, of ore deposits which are derived from aqueous solutions circulating within the earth's crust, a class which is constantly augmented by scientific investigation, the question as to the immediate source of the metals in the solutions from which they were deposited, whether above or below the present position, is one which must be determined independently in each individual case, and to which no general answer can probably ever be given.

Leadville Deposits.—The present investigation has proved of the ore deposits of Leadville and vicinity as regards their origin—

I. *That they have been derived from aqueous solutions.*
II. *That these solutions came from above.*
III. *That they derived their metallic contents from the neighboring eruptive rocks.*
IV. *That in their original form they were deposited not later than the Cretaceous epoch.*

And as regards their mode of formation—

I. *That the metals were deposited from their solutions mainly as sulphides.*
II. *That the process of deposition of the vein-material was*

a chemical interchange, or actual replacement of the rock-mass in which they were deposited.

III. *That the mineral solutions or ore-currents concentrated along natural water channels and followed by preference the bedding planes at a certain geological horizon; but that they also penetrated the mass of the adjoining rocks through cross-joints and cleavage planes.*

And with regard to distribution—

I. *That the main mass of argentiferous lead ores is found in calcareo-magnesian rocks;*

II. *That the siliceous rocks, porphyries, and crystalline rocks contain proportionately more gold and copper.*

As regards classification it is more difficult to make a definite statement. Von Groddeck's term "metamorphic deposits" would include all the deposits of the district, with the possible exception of certain veins in the Archæan which have not as yet been sufficiently developed for thorough investigation. These veins would, in any event, come under the popular definition of true fissure veins, even though they should prove to be metamorphic, or the result of the alternation of country rock in place. Those not in the crystalline rocks would, in the main, come under the popular definition of contact veins, but they not infrequently pass directly into pipe veins, as in England; while, on the other hand, the fissure veins, which some have considered true fissures, correspond to the English pipe or rake veins. They would, however, be excluded from Pumpelly's class of gash veins, inasmuch as they do not fill pre-existing fissures. There is no evidence that the deposits in limestone were made in pre-existing cavities; on the contrary, the caves, which are not infrequently found, are plainly due to the action of surface waters, and are sometimes hollowed out of ore bodies as well as of limestone. When ore is found in them it is through the accident that surface waters have followed or crossed a previous ore-channel. Moreover, the thickness of the original limestone bed, or the distance between the enclosing strata, is found to be proportionately reduced if the amount of replacement has been exceptionally great.

Secondary Deposition.—As in the deposition of minerals from percolating waters the process is a practically continuous one, and by changes in the character of the waters, minerals already deposited may be redissolved and deposited again in another place or form, the statement that a mineral is in its original form or position may be only relatively true. The action of surface waters, that is, those which have penetrated the rock masses directly from the surface during recent geological time, is, however, one that can be readily traced by the preponderance of combinations of oxygen and chlorine with the metals of an ore deposit in those portions which are near the present surface. To such combinations, therefore, the term secondary may be safely restricted in speaking of our deposits. The deposits of the Leadville region are peculiarly exposed to the action of surface waters; first, because of the relatively great precipitation; and, second, because of the geological structure, the numerous faults and displacements bringing the ore-bearing horizon near the surface in a great number of points, and erosion having largely removed from above them the more impermeable sedimentary beds, and left a covering of relatively permeable porphyry. This is more especially the case in the immediate vicinity of Leadville, the value of whose ores is greatly enhanced by the predominance in them of oxides and chlorides. It may also be observed, in considering the distribution of minerals, as shown by present developments, that the proportion of secondary products is less in the higher altitudes, where the waters are imprisoned by frost during a comparatively larger portion of the year.

Composition.—The prevailing and by far the most important ore, from an economical point of view, is argentiferous galena, and its secondary products, cerussite or carbonate of lead, and kerargyrite or chloride of silver. Lead is also found as anglesite or sulphate, as pyromorphite or phosphate, and occasionally as oxide in the form of litharge or more rarely minium. Silver frequently occurs as chloro-bromide, less frequently as chloro-iodide, occasionally as sulphuret, and very rarely in the native state. Chemical investigation has failed to detect sufficient regularity in the proportions of chlorine, bromine, and iodine combined with the silver to justify the determination of distinct mineral species. Gold occurs in the native state, generally in extremely small flakes or leaflets. It is also said to have been found in the filiform state in galena.

As accessory minerals, are:

Zinc blende, and silicate of zinc or calamine.

Arsenic, probably as sulphide and as arseniate of iron.

Antimony, probably as sulphide.

Molybdenum, in the form of wulfenite, and locally copper, as carbonate or silicate.

Bismuth as sulphide, and its secondary product, a double-carbonate.

Tin has been detected in furnace products.

Iron occurs as an ore, though in the Leadville deposits it may be considered as an essential part of the gangue or matrix in which the valuable ore is found. In the former case it occurs in considerable bodies, as pyrite or sulphide, and anhydrous oxide, or red hematite with a little magnetite.

Gangue. — The other components of the ore deposits, which may be considered as gangue, although this term is perhaps more strictly applicable to non-metallic minerals, are: Silica, either as chert, or a granular cavernous quartz, and chemically or mechanically combined hydrous oxides of iron and manganese. A great variety of clays or hydrous silicates of alumina, generally very impure, and charged with oxide of iron and manganese, the extreme of purity being white normal kaolin, containing at times sulphuric acid in appreciable amount. Sulphate of baryta, or heavy spar. Carbonate of iron, pyrite, and sulphate of lime, are comparatively rare in the deposits of Leadville itself. The miner's term, "Chinese talc," has been preserved for a substance which is found with singular persistence along the main ore-channel, or at the dividing plane between the White porphyry and underlying limestone or vein material, and also at times within the body of the deposit. It is composed of silicate and a varying amount of sulphate of alumina, to which no definite composition can be assigned. It is compact, semi-translucent, generally white, and very soft and easily cut by the finger-nail. It is very hygroscopic; hardens and becomes opaque on exposure to the air.

Paragenesis.—The metals were all brought in as sulphides. The evidence of this is found in the fact that they form the interior or unaltered kernels of masses of lead ore, that sulphurets already increase in proportion as the more unaltered portion of the deposits is reached, and in the fact that a basic sulphate of alumina is left as the result of the action of sulphurous waters on porphyry along the main ore-channel. The silver was without doubt originally contained in the galena, and where now found as chloride free from lead is a secondary deposition. While the sulphide of lead was undoubtedly deposited as such, it seems more likely that an actual chemical interchange took place between the sulphide of iron and the carbonates of lime and magnesia, the latter being carried away as soluble sulphates, and the former deposited either as carbonate, or directly as oxide. As regards the relative age of lead and iron, it is difficult to determine definitely whether galena was originally deposited in the dolomite, and the process of replacement of the latter by oxide of iron went on around it later, or whether the two were deposited at practically the same time, as sulphides, the pyrites being in so much greater amount as practically to enclose the galena, so that, being thus first exposed to oxidizing action, and perhaps also more susceptible to it, they are now completely oxidized, while the galena is only partially so. That the replacement of dolomite by oxides of iron and manganese has been going on in comparatively recent times is quite evident.

With regard to the immediate source from which the vein materials were derived, chemical examinations of the various rocks of the region made on specimens taken from portions at a distance from ore deposits, and in a comparatively unaltered condition, show that while the sedimentary and crystalline rocks contain no precious metals, appreciable amounts of gold, silver, lead, and baryta may generally be found in the eruptive rocks. An idea of the amount of material available in these rocks may be obtained from the following estimate of the possible contents of a single variety of porphyry of the Leadville district, the Pyritiferous porphyry. The figures are deduced from the superficial area of its outcrop, as shown on the map, its probable thickness, and the average percentage of metals contained in it, deduced from chemical examination of eleven specimens taken from different parts. They are, in round numbers, 250,000,000 ounces of silver, 9,000,000 tons of galena, and 100,000,000 tons of limonite, which represent fairly the average proportions of each in Leadville ores as a whole. As regards the agents of secondary deposition, chloride was found in the surface waters, and also in all the dolomites and limestones; traces of bromine were also detected in the latter. Phosphoric acid is found in the White porphyry, and in comparatively large amount in the Lingula shales which overlie the Blue limestone. Carbonic acid, as is well known, exists everywhere in the air and water; it is chemically combined in lime and magnesian rocks, and mechanically in siliceous rocks.

Distribution.—The principal ore-deposits of the region are found at or near the contact of the Blue limestone with the overlying porphyry.

The contact of the main sheet of White porphyry has, whenever it has been examined, shown evidence of the passage of ore-currents, and in the region of Leadville, although not every inch, or every foot even, yields an appreciable quantity of silver, no considerable area has yet been examined without finding bodies of valuable ore. The ore is, however, by no means confined to the surface of the limestone, but often extends into its mass, pinching out however in depth; sometimes the bodies thus developed show no visible connection with the surface, but it is evident that they originally came from it. While for some as yet unexplained reason the horizon of the Blue limestone was exceptionally favorable to the deposition and concentration of ore, valuable deposits are occasionally found elsewhere, generally along bedding planes or contact surfaces, less frequently on jointing planes. The deposits in crystalline rocks, which are popularly supposed to be true fissure veins, have, as before stated, been but little studied. A brief mention of a few of the best known mines will, perhaps, give a better idea of the geological distribution of ores than any general statement. On the east side of the range the Monte Cristo deposits, which occur on the east flank of Quandary Peak, consist of galena impregnating one of the upper quartzite beds of the Cambrian horizon. The Phillips mine, in Buckskin Gulch, is a concentration of gold-bearing pyrites along a bedding plane of the Cambrian quartzite, in the neighborhood of a dike or intrusive mass of quartz porphyry. The Criterion mine, now deserted, had large renticular bodies of ore replacing this quartzite, adjoining which are natural caverns hollowed out of such bodies by surface waters, while the ore channels extend up into the White limestone above. The Orphan Boy, in Musquito Gulch, is also apparently an impregnation or replacement of quartzite beds of this horizon. In the massive of Mounts Lincoln and Bross the Blue limestone has been the scene of the most extensive ore deposition. Here it is overlaid by a sheet of Lincoln porphyry, while innumerable dikes and cross-bodies of other porphyries exist, which could not be accurately traced out in the limited time that could be given to this region. The ore bodies of the Russia, Moose, and other mines extend irregularly from the surface into the mass of the limestone, while in the Dolly Varden mine, on Mount Bross, the ore is found in that portion of the limestone which immediately adjoins a vertical dike of White porphyry. In the Sacramento mine, on the spur between Sacramento and Four-mile Gulches, rich galena and carbonates are found in irregular bodies in the Blue limestone; the Sacramento porphyry, which originally overlaid it, has been largely removed by erosion, and the connection with the contact surface, if it existed, is not to be seen. On the main crest of the range the Peerless, Badger, New York, and other mines find their ore at or near the contact of the Blue limestone and White porphyry. West of the crest, the Dyer mine, near the head of Iowa Gulch, has long been worked on rich bodies of galena, associated with some copper, which occur in the White limestone. The Colorado Prince and Miner Boy have a gash vein carrying gold in the Lower quartzite. The Black Prince has veins of sulphurets extending up into the White limestone. The Dania, J. B. Grant, and other shafts on Yankee Hill have found small bodies of iron on the White limestone contact. The Great Hope found the Parting quartzite impregnated with gold to such an extent that it could be profitably worked. The Ocean is said to have obtained gold from the lower quartzite and the Nevada tunnel has found ore bodies, possibly belonging to a similar horizon, though, as it is on a fault line, it is difficult to say what was their original position. The Ready Cash gets gold ore from a vein in the granite, while above the horizon of the Blue Limestone, the Green Mountain, Ontario, Tiger, and others, have found ore in gash veins in the Pyritiferous porphyry and at its contact with the Weber grits. The most valuable ore bodies, however, are those which occur as a replacement of the Blue limestone. At times the original dolomite has been so largely removed that its geological position can only be recognized by the bounding beds. In the subjoined description, however, the horizon is spoken of by its geological name, whether it be represented by dolomite or a mass of iron-stained clay, granular quartz, or chert. The reader must also bear in mind that when outcrops are spoken of not the actual surface of the ground is referred to, but the surface of rock in place under the Wash or other superficial detritus. In a great portion of the shafts mentioned this rock is only reached after passing through a hundred feet or more of detrital matter.

Iron Hill Mines.—Of the three principal groups of mines those of Iron Hill present the simplest type, both in geological structure and in the character of their ore deposits. It is that of a block of easterly-dipping beds, capped by porphyry, with a fault on its western side, by whose displacement these beds have been lifted over a thousand feet above their western continuation, and in which the ore deposition has taken place on the surface of the upper limestone bed, at its contact with the overlying porphyry. This simple type obtains only on the southern end of Iron Hill, and even then only in a somewhat modified form, the northern presenting, as will be seen later, the extreme of complication. The southern face of the hill has, by the erosion of the deep V-shaped valley of California Gulch, been left so steep that its surface is but thinly covered by detrital material, and east of the Iron fault, which is marked by slight depression, the outcrops of the succeeding beds can be readily traced up its slopes from the Lower quartzite, immediately overlying the granite, to the main sheet of White porphyry, which forms its summit. Besides this normal series of beds are two intruded masses of porphyry of later age, and allied to, though not absolutely identical with, the Gray porphyry. One occurs near the base of the Blue limestone, and has its greatest thickness at the fault line, thinning out to the eastward, and disappearing midway between it and the point where the Blue limestone reaches the bed of the gulch. The other has its greatest thickness at this point, where it cuts across the upper portion of the Blue limestone at so small an angle with its stratification planes that it forms the contact between it and the White porphyry for some distance up the slope on either side, and then passes up into the White porphyry, also gradually thinning out and disappearing. The average strike of the formation in this vicinity is a little west of north, and the beds dip to the eastward at an angle of about 12° at the outcrop, which shallows to 7° and even less under the summit of the hill.

Iron fault.—The average direction of the line of the Iron fault is a little east of north, but its course is very crooked, as proved by actual development in shafts and winzes in the Garden City, L. M., Lingula, Iron, and Codfish-Ball claims. It has an average inclination to the west of 65°, and its movement of displacement, though no shaft has yet reached the Blue limestone to the west of it, is probably more than one thousand feet. Were the Carbonate Hill beds carried back at the angle of dip thus far determined it would give a still greater thickness of White porphyry above the limestone immediately adjoining the fault, but such thickness cannot be calculated on, since there are good grounds for assuming that the dip shallows, and even that the beds basin up before reaching the fault.

Dome Hill.—South of California Gulch the structure is more complicated, and the opportunities for accurate study of the rock surface diminished by great depth of Wash and underlying Lake beds, on the ridge which separates it from Iowa Gulch. Its expression will be made clearer if the displacement is considered as a downward movement of the beds on the west of the fault, instead of an upward movement of those on the east, as is actually the case. The downward movement of the western block has, then, south of California Gulch, been distributed between the Iron fault proper, and a second fault further east, just below the Rock and Dome mines, which is connected with the former by a cross-fault following the bed of California Gulch from the Garden City shaft up to within 600 feet of the Montgomery quarry. Moreover, between these two faults is a third, running below the Robert Emmet tunnel, in the gulch, to connect with the Iron fault, and enclosing thus a wedge-shaped piece of ground, which has been lifted up and compressed into an anticlinal fold. As a result of the upward movement of this wedge-shaped piece of ground, Blue limestone is found outcropping on the south side of the gulch directly opposite the Lower quartzite on the Globe ground, and the Columbia, Ben Burb, and others, have been enabled to strike the contact comparatively near the surface; on its west side the beds dip steeply towards the Iron fault. It is probable that before reaching Iowa Gulch the Iron fault merges into the axis of a synclinal fold, in which case the normal continuation of the Iron fault might be considered to be formed by the California Gulch and Dome fault, since the latter becomes beyond Iowa Gulch the axis of an anticlinal fold, as does the northern extremity of the Iron fault. Moreover, evidence of a westerly dip in beds between the Dome and Iron faults is found in the relatively greater depth at which the Blue limestone was reached in the Coon Valley shaft near the latter than in those further east. This region is worthy of being systematically prospected, being within the principal ore-bearing area of the district.

Mineral deposits.—As shown by present developments the principal deposition of ore has taken place along the contact plane between the Blue limestone and overlying White porphyry, and extended to greater or less depth into the mass of the limestone; in several instances large deposits have been formed within the body of the limestone, being probably on the line of some natural cleavage plane or fissure, which caused a deviation of the ore-currents from their normal course.

Gangue.—The vein material or gangue consists of hydrated oxides of iron or manganese, silica, and clay. The iron varies from a hard, compact, more or less siliceous, brown hematite to a simple coloring matter of the clay. Manganese is found sometimes in fine needle-like crystals of pyrolusite, but mainly occurs in a black clayey mass, known to the miners as "black-iron." Silica occurs either as a blue-black chert, or as a granular, somewhat porous mass, hardly distinguishable from quartzite. Clay is found in greatly varying degrees of impurity, from a white kaolin down, and is a product of the decomposition of porphyry. It occurs either in place or as an infiltrated mass. Besides this should be mentioned the "Chinese talc" of the miners, found mainly at the actual contact.

Ore.—The ore is principally argentiferous galena and its secondary products, viz., carbonate of lead or cerussite, and chloride of silver; as accessory minerals, or those of less frequent occurrence, are sulphate of lead or anglesite, pyromorphite, minium, zinc blende, and calamine. Native sulphur is found in one instance as a result of the decomposition of galena, and native silver, from the reduction of the chloride.

Mine workings.—The principal mine workings may be divided into the following groups, commencing at the north: 1st, the main Iron mine workings, including the north Bull's-Eye; 2nd, the Silver Wave and Silver Cord workings, including south Bull's-Eye; 3rd, Lime and Smuggler workings. Beyond California Gulch: 1st, the La Plata workings; 2nd, the Rock and Dome workings.

Iron mine.—This group has an area of about 25 acres of underground workings, being the most considerable of any single mine in the district. They have been driven a distance of over 1,500 feet along the contact from the outcrop of the Blue limestone. Here the contact has been found productive over an unusually large area, the main ore body extending diagonally through the claims in a northeast direction from the croppings, with an average width of 200 feet. In this area the ore currents have penetrated irregularly into the body of the limestone, and ore bodies of 30 and 40 feet in thickness have been developed. It is found that the limestone, while keeping its general inclination to the eastward, is compressed into lateral folds which have produced a series of troughs and ridges within the mass. The relation of the distribution of rich ore bodies to these minor folds is not, however, as clear as in the deposits of Carbonate Hill. In the lower part of the mine, between the sixth and seventh levels, is a body of Gray porphyry, cutting up across the strata into the White porphyry, which would appear to have influenced a concentration of ore on its flanks. The developments here have been pushed already to a sufficient depth to show an increase in the proportion of sulphurets in the ore and a decrease in the tenor of silver, which would be naturally expected from diminished action of surface waters.

Silver Wave group.—In the Silver Wave group the contact surface has been found relatively unproductive, but large amounts of rich ore have been found in irregular lenticular bodies, standing nearly vertical, and extending downwards 60 to 100 feet from the surface of the limestone. That these are along water-channels is proved by the discovery of recent caves washed out of the ore bodies themselves, or immediately adjoining them, which have evidently been formed by the percolation of surface waters at a comparatively recent date. The general direction of these bodies is also northeast, but on a line convergent with that of the main Iron body.

Smuggler and Lime.—On the south end of Iron Hill, adjoining California Gulch, there is evidence of another zone where the limestone has been largely replaced by vein material, in which, however, present limited developments have disclosed no large bodies of very rich ore.

La Plata.—The La Plata mine has been developed by a tunnel run in near the contact, but with a direction a little west of that of the strike. As in the Silver Wave, but little rich ore has been found on the contact, but large lenticular bodies standing in a nearly vertical position have been found within the limestone extending to a depth of 100 feet below the tunnel level.

The Rock and Dome.—Near the mouth of the Rock tunnel once stood a huge outcrop of "hard carbonate" from which came the first silver ore that was discovered in the region. The main workings of these two mines are in a bonanza which is near the croppings, and which, like those on Iron Hill, has a general northeast direction. The ore in this body occurs mostly near the contact, extending at places to a considerable depth into the limestone. It is much more siliceous than that of the Iron mine. A second more or less parallel body, on a line with that of the La Plata body, may be looked for in the lower working of either mine.

Future explorations.—It is difficult to offer suggestions as to manner of exploration to those who so well understand the character of their deposits as do the managers of mines in this region. Practical experience has already proved to them that not only should the contact be thoroughly explored, but indications of ore bodies extending into the mass of the limestone should be carefully followed. They should also look for bodies of porphyry which may cross the formation, either as dikes or irregular sheets, since they are likely to be accompanied by a concentration of ore at no great distance; the Gray porphyry forms such bodies more commonly than the White. It is probably a fruitless task to search for valuable ore deposits below the horizon of the Blue limestone, although there is always a remote possibility of finding veins in the underlying granite. Ore indications on fault planes are also likely to prove deceptive; the evidence afforded by present developments goes to show that, while small fragments of ore are found which have probably fallen into the fissure, and a certain amount of secondary deposition from waters which have passed over the original deposits has taken place there, the ore to be obtained from them will at the best no more than pay the expenses of exploration.

To the west of the fault line, however, the contact undoubtedly exists below the porphyry and probably contains valuable bodies of ore, which, however, as present experience abundantly shows, are not continuous over the whole surface. In locating a shaft for such exploration the probable continuation of already existing bodies should be carefully calculated, taking into consideration the apparent lateral movement that would be caused by the fault-displacement. Directly opposite the Iron mine it may be calculated that at least a thousand feet of unproductive rock will have to be passed through; this thickness is probably less as one goes south, and the least depth will probably be found on Dome Hill, or beyond in Iowa Gulch, with the disadvantage in going south that the centre of ore developements as at present known is further removed.

North Iron Hill.—Explorations in the Adelaide-Argentine group of mines on the northern end of Iron Hill overlooking Stray Horse Gulch, have developed a geological structure of an intricate and complicated nature. Only a brief sketch of its main outlines will here be presented. Along a line running southeast from Fryer Hill toward Mount Sheridan, the sheet of White porphyry cuts across the Blue limestone, or splits into two bodies, there being on the northeast of this line one body of White porphyry above the Blue limestone, and one below, between it and the White limestone. On Iron Hill this cutting across occurs in the region under description, in which, morever, two minor sheets of White porphyry were forced in, the one in the middle of the Parting quartzite, the other in the body of the White limestone near its base; furthermore, two bodies of Gray porphyry were afterwards introduced, the main one into the mass of the White limestone above the lower sheet of White porphyry, and a smaller one above the Parting quartzite, between it and the offshoot from the main general sheet of White porphyry. In the movements of folding and displacement these beds were lifted by a fold and cut off by the Adelaide cross-fault, which runs diagonally from the Iron to the Mike fault. The whole upper part of the fold was then planed off by erosion, which entirely removed the portion of Blue limestone above the cross-cutting mass of White porphyry. During the period of ore deposition the currents followed the under surface of the porphyry body, and in these mines the main deposit of pay-ore has consequently been found at its contact with the Parting quartzite, although some replacement probably took place also along the basset edges of the Blue limestone. In the Argentine tunnel, which is driven in a direction nearly at right angles to the strike, the beds are found with a dip at first of 25° southeast, which shallows as one proceeds. One crosses in succession from the mouth inwards, or ascending in the geological scales;

1. Lower White porphyry.
2. White limestone.
3. Offshoot from Gray porphyry body.
4. White limestone.
5. Main Gray porphyry body.
6. White limestone.
7. Offshoot from Gray porphyry body.
8. White limestone.
9. Parting quartzite.
10. White porphyry.
11. Parting quartzite.
12. Ore horizon.
13. Blue limestone.
14. White porphyry (overlying).

The supposed contact of White porphyry over the basset edges of the Blue limestone is not seen, being above the tunnel level. The actual contact between the upper surface of the Blue limestone and White porphyry is barren in the tunnel, but has produced ore in the Hynes shaft on the Camp Bird claim to the south. The main ore body extends above the tunnel level, on the surface of the Parting quartzite, westward into the Camp Bird Claim, and east and south on the dip into the Adelaide claim. Small bodies of carbonate of lead were also found in the Adelaide ground, at the contact of a small body of Gray porphyry which does not cross the tunnel, and the main White porphyry. Moreover, besides the surface of the Parting quartzite, replacement is found to have gone on to a considerable extent in the White limestone also, without, however, developing much rich ore. In the Discovery tunnel of the Adelaide, on Stray Horse Gulch, a small body of Blue dolomite was found immediately over the Parting quartzite, which is apparently a portion of Blue limestone which had not been separated from the overlying rocks by the cross-cutting White porphyry. In such a complication of intrusive bodies the only maxim for the miner is, to follow all productive contacts so long as there are signs of ore or vein material.

Carbonate Hill Mines.—The geological structure of Carbonate Hill is very similar to that of Iron Hill, in that it is formed by a series of easterly-dipping beds, broken on the west by a line of fault or displacement. Outcrops are also exposed on its southern face by the erosion of California Gulch, but in a less complete series owing to its being shallower and proportionately wider, in consequence of which its bounding slopes, being less steep, are more thickly covered by surface *débris*. The fault is nearly parallel to that of Iron Hill, and, like it, merges into the axis of an anticlinal fold on the north. In the southern half of the hill, however, the movement of displacement is distributed in part to a secondary nearly parallel fault, a short distance to the west. Of the southern continuation of these faults less satisfactory data are available, but they are supposed to merge together before crossing California Gulch, and probably pass into an anticlinal fold under the Lake beds to the southwest like the Dome fault, the normal continuation of the Iron fault. As on Iron Hill, also, there is evidence of a basining up, as they approach the fault, of the beds of the relatively downthrown mass on the west; in other words, of a synclinal structure.

Formations.—The series of beds of which it is composed is essentially the same as that given in the Iron Hill section, but the distribution of the latter intrusions of Gray or Mottled porphyry differs somewhat in detail. Where these cross the beds, either as dikes or sheets, there is a noticeable enrichment of the ore bodies. One main sheet of Gray porphyry is found at or near the base of the Blue limestone, which apparently cuts up to a higher horizon in different portions of the hill. A second sheet is found in the White limestone in California Gulch, but as none of the underground workings have penetrated as yet to this depth, there is no evidence to show whether this is a distinct sheet or merely an offshoot from the main body.

Vein material.—The materials composing the ore deposits of Carbonate Hill are essentially the same as those of Iron Hill; they may perhaps be said to be less rich in bases of iron and manganese, and proportionately more in silica, therefore less favorable for the smelter, but this characteristic is rather one to be confided to individual mines, or parts of a mine, than in such a general way. Silica occurs less frequently as chert and more commonly as a very finely granular and somewhat porous quartz rock, than on either Iron or Fryer Hills. The ore is either galena or its secondary products, carbonate of lead and chloride of silver. In one instance native silver has been found. Exceptionally good opportunities are offered for observing the action of replacement, and the gradual passage from dolomite into earthy oxides of iron and manganese. The workings not yet having reached the great distance from the surface that they have on Iron Hill, no such definite evidence is found of decrease in the action of surface waters, producing oxidation and chlorination of the original deposits. The limit of the zone of oxidation would morever be expected to be further from the surface, on account of its lower altitude.

Mine workings.—The underground workings of Carbonate Hill may, for convenience of description, be divided into three groups. 1st. A southern, including the Carbonate, Little Giant, and Yankee Doodle claims to the east of the main fault and the Ætna and Glass-Pendery claims below or to the west of it. 2nd. A central group, including the Crescent, Catalpa, and Evening Star claims east of the fault, and the minor workings of the Lower Crescent, Catalpa No. 2, Lower Evening Star, Niles & Augusta, and Wild Cat west of it. 3rd. A northern group, consisting of the Morning Star, Waterloo, Henriette, Maid of Erin, and other claims above the fault line, and the Forsaken, Halfway House, and Lower Henriette below it.

Carbonate group.—In this group of claims, the principal developments have been made on what is practically one main body, running in a northeasterly direction from the outcrop in the Carbonate claim. A noticeable feature of the structure is a prominent fold in the limestone, which bends down sharply to the east, and rising again forms a narrow trough. This is best seen in the main Carbonate incline at about 350 feet from its mouth, and can be traced through the adjoining Little Giant and Yankee Doodle claims, running parallel to the ore body, of which its crest forms the southeastern limit. Approximately parallel to this, several minor folds or complications can be seen in the Carbonate workings. The ore body is narrower in the Yankee Doodle and Little Giant claims, but widens out as it approaches the surface in the Carbonate ground, having barren streaks corresponding to the minor folds mentioned. From the actual cropping of the southeastern portion of this body was taken the first ore discovered on Carbonate Hill. The region to the southeast of the fold has thus far proved barren of rich ore, but the explorations are hardly sufficient to warrant the conclusion that another bonanza does not exist in that direction. The influence of the fold as determining the deposition of ore may be ascribed to the compression of the beds produced by it, and the consequent partial arresting of ore currents, giving them time to deposit their metallic contents.

Carbonate fault.—The Carbonate fault runs nearly on the dividing line of the Carbonate and Ætna claims, cutting across the extreme southwest edge of the former and the northeast corner of the latter. It is well shown by a shaft sunk on this claim which has followed its plane; as thus developed, it stands with an inclination of about 60° west, shallowing somewhat in depth, and having a movement of displacement of only about 250 feet. Within the opening were found some fragments of ore, and the fault material was slightly impregnated with chloride of silver. The slickensides surfaces are smooth and clearly defined, and the beds on either side have the same angle and direction of dip. In the Ætna and Glass-Pendery claims the contact has thus far proved practically barren, the principal ore extracted having been obtained from lenticular bodies within the limestone, lying mostly within the former claim. Judging from the few points at which its level has been determined, the general surface of the limestone would appear to slope westward, although as before stated, at the actual fault line it dips east.

Pendery fault.—A short distance west of the Glass shaft a second fault, apparently nearly parallel and having the same angle of inclination with the Carbonate fault, cuts off the limestone, no explorations west of this line having reached below the White porphyry. It is to be regretted that the persistent refusal of the owners of the Glass-Pendery to permit an examination of their mine renders the data with regard to this fault, which has such an important bearing upon future explorations, less full than could have been desired. Its probable continuation has been traced, however, southward to a connection with the Carbonate fault, and northward through the Washburne and Saint Mary workings, where it appears to be a combination of minor folds and faults, and into a probable anticlinal fold north of the Niles & Augusta, and west of the Halfway House.

Evening Star group.—In the second group of mines the workings above the fault have developed a second bonanza or ore body, nearly parallel to the one already mentioned, and separated from it by a comparatively barren belt of ground. In the Crescent claim it is rather thin and spread out somewhat irregularly, but concentrates and becomes deeper in the Catalpa, reaching its maximum, both of breadth and thickness, in the Evening Star claim. In the upper portion of the latter the entire body of limestone has been replaced by vein material, a remarkably large proportion of which is pay ore; but to the eastward the ore currents have penetrated to less depth, and in the lower workings unreplaced dolomite is found, at times only separated from the overlying porphyry by a few inches of clay and "Chinese talc." The actual southeastern limit of the bonanza has not yet been reached, however, and present explorations, extensive though they are, cover such a comparatively small proportion of the possible area of ore bodies, and afford such meager data for generalization, that it is with extreme reluctance that I speak of even possibly barren ground. A fact worthy of mention here is the occurrence of a narrow dike of Gray porphyry, standing nearly vertical, and having a northeasterly direction, cutting across the ore horizon at the western edge of the bonanza. This may be an offshoot from the heavy sheet of Gray porphyry which has been proved by the lower workings of the mine to underlie the main ore body, and has probably influenced the great concentration of ore in this mine. A second fact worthy of note is the occurrence of ore in the White porphyry near the main shaft of the Evening Star mine. Such instances of the divergence of ore-currents into the mass of the overlying porphyry are extremely rare. In this case the deposit consists largely of pyromorphite and carbonate of lead, with a little sulphide, and forms the binding material of small angular blocks of porphyry. It is therefore in part certainly, and possibly altogether, of secondary origin. The ground west of the main or Carbonate fault in this central group has been comparatively little explored, as no considerable ore bodies have yet been developed in it. The fault itself has nowhere been cut by underground working, and its existence is only proved inferentially, both here and on the more northern portion of the hill, by the relative difference of level of the contact above and below its assumed line. Its displacement in the Crescent ground, where the workings on either side most nearly approach each other, viz., those of the Crescent incline and the Lower Crescent shaft, are not more than 170 feet. In the Catalpa pay ore is found to extend nearly to the surface above the fault line; its existence below has, however, not yet been thoroughly tested. In the Evening Star the new No. 5 shaft has been sunk through a body of iron into a remnant of unreplaced dolomite, and is probably in the lower half of the Blue limestone or ore-bearing horizon. The lower Evening Star shaft is said to have developed a small body of ore, which would not be more than 100 feet below the bottom of the former, but in calculating the amount of displacement it must be borne in mind that in one case the ore is near the bottom, in the other probably at the top of the Blue limestone horizon. In the Niles & Augusta ground, immediately adjoining the Evening Star on the west, there is evidence of a westerly dip in the formation, so that between the two would be the crest of the anticlinal fold into which the Pendery fault is supposed to merge.

Morning Star group.—The continuation of the Evening Star bonanza has been traced in a northeasterly direction through the upper workings of the Morning Star mine, but too little systematic exploration has been done to give a satisfactory idea of its outlines or limits. It apparently decreases in thickness, and the acid character of its gangue, which is a porous granular quartz containing very little or no iron, is very noticeable. Ore has been found on the same line in the workings of the upper Henriette claim, but the adjoining portions of the Waterloo and Henriette between this and the fault, in which ore bodies may be reasonably looked for, are as yet practically untouched. Ore has also been found on the dip in the Big Chief, indicating a possible widening out of the ore body in that direction. In the Lower Morning Star, but still above the line of the fault, is a singular combination of fault and fold, by which the ground opened by the lower shaft has been lifted up, relatively to that nearer the main shaft. There is here also a body of Gray porphyry, which is probably an offshoot from the lower main sheet of Gray porphyry cutting up across the strata. The descent of the strata to the east of this fault is evidently comparable to that in the sharp folds noticed in the Carbonate and Crescent inclines, and the actual faulting movement, so far as could be observed, was very slight. As in these, also, the ground for a certain distance beyond is comparatively barren.

Below the line of the main fault, whose existence here, as already stated, is only proved inferentially, important ore bodies have been developed, and the probable structure as revealed by their exploration is so complicated that its explanation is difficult. The Carbonate fault is supposed to pass between the Lower Morniug Star and Waterloo shafts, and extend northeasterly across Stray Horse Gulch (there being evidence of a slight displacement in the ridge beyond) in the direction of Upper Fryer Hill, where, in the Dunkin ground, it has passed into a flat anticlinal fold. To the northwest of this line is a flat synclinal fold, which would be a continuation of the synclinal of Fryer Hill. In the ground of the Forsaken, Half-way House, and Lower Henriette, where are at present the principal ore developments, a body of Gray porphyry has cut up across the Blue limestone into the overlying White porphyry, and on either side of this body the dolomite has been replaced by vein material rich in iron, and often carrying pay ore. The edges of the strata, which rise from the bottom of the synclinal toward the fault line, have been planed off by erosion, the overlying White porphyry being left only in the trough of the synclinal. The Lower Henriette and Half-way House shafts, then, have been sunk through a portion of this remaining White porphyry to contact, and their workings have followed an ore body on an eastern dip, over which lies, not the White porphyry, but the cross-cutting Gray porphyry. The new shafts sunk to the eastward, to meet these workings in depth, have passed first through an iron body, the replacement of the dolomite adjoining the Gray porphyry on the east, and through this Gray porphyry to the productive contact, now below, formerly on the west side of this sheet. This explanation is founded mainly on analogy drawn from observations in other parts of the district, since, at the time of visit, no body of unreplaced dolomite had yet been penetrated, from which the dip of the bedding planes could be actually determined. The Jolly shaft, below the Half-way House, finds ore at a lower horizon, and passes through a much greater depth of Wash. This greater depth of Wash denotes the edge of a former shore-line, which may be traced southward along the western flank of the hill, through the Forsaken, Niles & Augusta, Lower Crescent, Pendery, and Glass shafts. Above this line there is no accumulation of Wash, the rock surface being only covered by angular débris resulting from the disintegration of the rocks forming the actual surface above, and locally known as "slide." Wash, on the other hand, as already stated, consists of rounded fragments of rocks, a large proportion of which must have come from considerably greater elevations on the range, and have been brought down by glaciers.

Fryer Hill Mines.—The geological structure of Fryer Hill has always seemed a puzzle to Leadville miners, and with good reason, since the Blue limestone has here been almost entirely replaced by vein material, the only relics remaining, besides two considerable masses of unreplaced dolomite, being occasional blocks or boulders, and small irregular bodies of dolomitic sand scattered through the ore bodies. Moreover, the White porphyry, instead of confining itself to the horizon above the Blue limestone, as on Iron and Carbonate hills, has formed a second distinct body between this and the underlying White limestone, and forced itself into the mass of the Blue limestone, splitting it into two and sometimes three sheets, which, being replaced, form as many different bodies of iron or vein material. In addition to these are irregular bodies of Gray porphyry, evidently of later eruption, which have been intruded in different places, and an interrupted dike which traverses the whole hill in a direction East 18° South. Nevertheless, the structure and manner of ore deposition are here strictly analogous to those already described for Iron and Carbonate Hills, with the difference that the folding of the beds has been more complicated, the intrusion of porphyry bodies more extensive, and the replacement of limestone by vein material and ore more complete. The simplest expression of the structure is that of two parallel folds, the one a synclinal, the other an anticlinal, whose axes have a northeast and southwest direction. All the beds which are included in this folding partake also of the prevailing northeast dip of the region. When, therefore, the upper portion of the beds thus folded was planed off, as it was in Glacial times by the great glacier which flowed down Big Evans Gulch, the resulting outcrops have an S-curve, if one looks in a southeast direction, or at right angles to the direction of the axes of the folds. The apex of the upper re-entering curve of the S indicates the axis of the anticlinal fold, which, as has been already stated, is a continuation of the line of the main Carbonate fault, now become a fold, while the convex lower curve is the outcrop of the flat synclinal. In actual fact this simple structure is complicated by minor irregularities within the folds, so that the dip at any particular point may not always be found to have its normal direction.

Mine workings.—The general disposition of the principal mines, or rectangular blocks of ground which represent their claims, which is familiar to many from maps already published, is, proceeding eastward or up the ridge from its western edge, first, the various claims of the Chrysolite Company, and the New Discovery, then the Little Chief, Little Pittsburg, Amie, Climax, Dunkin, Matchless, Big Pittsburg, Hibernia, and R. E. Lee. The claims of the four first mentioned cover the outcrops of the lower portion of the S or synclinal fold, their side lines running nearly North and South, or North 10° West, while the triangular wedge of the Dives claim, belonging to the little Pittsburg, gives to the eastern side line of the latter a northeast direction parallel to the anticlinal axis. The Amie claim covers the intermediate arm of the S, the Dunkin and Climax the re-entering curve or apex of the anticlinal, and the Matchless, Dee, and Hibernia its rather irregular top.

White porphyry bodies.—Throughout all this area the existence of an overlying and underlying body of White porphyry, enclosing the main ore horizon, is well proved, the former having been, however, in great measure removed by erosion, and when found above the ore bodies, being very much decomposed. Intermediate bodies of White porphyry, splitting up the ore-bearing bed into several sheets, are also found. The most important of these are: 1st. In the western Crysolite working; here a second or horizon has been proved in the west drift from Roberts shaft second level, immediately under the Wash at Vulture No. 2 shaft, and in a winze sunk a short distance south of Vulture No. 1 shaft. In the two latter points it was further separated from the main ore body by a sheet of Gray porphyry within the White porphyry. The value and extent of this lower ore-body still remain to be proved; it may cover a considerable area, but it probably does not extend as far east as the Roberts shaft. 2nd. In the Amie, and extending somewhat irregularly into the Climax and Dunkin ground, are found two lower sheets of vein material in the Lower porphyry. The dividing porphyry in all these cases belongs probably to the Lower porphyry body rather than the upper.

White limestone.—The outcrops of the underlying White limestone have been proved on the west by Crysolite No. 6 shaft, and various outlying shafts of the Fairview, Kit Carson, and All Right claims; in Little Stray Horse Gulch on the south, by New Discovery No. 5 shaft, and those of the Gambetta, Big Pittsburg, Eudora, Little Daisy, and others; while the shafts Amie No. 2, Climax No. 5, and Dunkin No. 1, have sunk down to it through the overlying beds; likewise New Discovery No. 6, on Stray Horse ridge, which has passed through Gray porphyry, Lower Blue limestone, and Parting quartzite into the White limestone. The coming to the surface of these lower beds proves that the overlying ore-horizon has been eroded off, and cannot be looked for to the west and south, unless a distinct southwest dip is developed, which would bring down the Blue limestone on the other side of a fold under the Wash and Lake beds which form the present site of Leadville. The probabilities in favor of this supposition will be discussed elsewhere.

Ore in lower horizons.—The question, whether the White limestone and lower quartzite contain ore deposits of commercial value, is one of special moment to owners of claims in this region, since its affirmative answer would greatly enlarge the horizontal as well as vertical extent of possibly productive ground. While *a priori* there seems to be at present no valid reason why ore should not have been secreted in the White limestone, especially when, as here, it is directly overlain by a body of porphyry, the fact that the many points where it has been explored, have, with few unimportant exceptions, disclosed no ore deposits of value, renders it safer policy to assume a negative answer and confine explorations to the horizon of the Blue limestone, which is proved to have been more or less replaced by ore over its entire extent, until the labors of those who are leading the forlorn hope of exploring for unknown ore bodies in a vertical direction shall have met with some practical return.

Blue limestone horizon.—The valuable ore deposits of Fryer Hill, thus far developed, have been found either at the outcrops or comparatively near the surface; that is, with but little or no covering of rock-in-place, the maximum thickness of overlying White porphyry remaining being but 80 feet. The existing surface is formed of Wash which has an average depth of 75 to 100 feet, and at no point on the hill is there an actual outcrop of rock-in-place. It is a rather singular fact that the first discovery of ore by A. Rische, and his partner was made, by pure chance, at the point where the rock-surface and the surface of the Wash most nearly approach each other. This was at the No. 1 shaft of the little Pittsburg claim, where a boss of iron, a portion of an immense iron body very rich in silver, projected to within 30 feet of the actual surface of the ground. The outcrop of the ore-bearing stratum has an average width on the surface (meaning always the rock-surface under the Wash, not that of the hill) of from 100 to 150 feet. From the point of discovery in the Little Pittsburg it extends nearly due west through the Little Chief and New Discovery claims, bending to the Northward in the latter; through the Vulture claim at Silver No. 2 and Vulture No. 1, and then again to the northeast through Carboniferous No. 5, the cropping of the lower iron sheet, which is here split off from the main ore body, being found still further west in Vulture No. 2. Eastward from the same point it extends through the Amie ground a little south of Amie No 4, where it has not been much explored, to Climax No. 4, and then bends to the northeast through the Climax claim into the Dunkin. The outcrops thus outlined form a semi-circle, convex to the southwest, and a cord drawn through Carboniferous No. 5 and Amie No. 3 shafts in a southeast direction, would practically define the northern limit of present exploration. Within this area the oil-bearing material has a maximum thickness of about 90 feet, becoming in places extremely thin. Its definite limits, however, cannot always be determined; these are defined above by a thin bed of quartzite, the base of the Weber shales, and below by the Parting quartzite, which is here generally about 10 feet thick. These siliceous beds which would be less changed by the action of mineralizing solutions than the included limestone, afford when found a definite horizon, but are often not seen, being separated from the ore body by intervening masses of porphyry through which developments are not pushed; frequently they are merely loose quartz sand, only distinguishable from decomposed porphyry by a more gritty feel.

Vein Material.—The vein material of this ore body consists mainly of a hydrated oxide of iron, in which the iron is frequently replaced by its interchangeable base, manganese; with silica, either combined with the iron, or as chert; small irregular masses of sulphate of baryta, or heavy spar; and a mechanical admixture of clay, resulting from the infiltration of decomposed porphyry; with this are unreplaced dolomite masses, either in the form of fine blue sand, or as solid blocks of varying dimensions. The extreme form of the iron is a hard, compact, though generally somewhat cavernous hematite, or, when manganese prevails, a soft, black, clayey material, known as "black iron," often forming large masses, and generally barren of pay ore.

Ore.—Within this mass, which may be considered as a gangue, the pay ore occurs in its original state as argentiferous galena, the secondary products of which are carbonate of lead and chloride of silver, with a varying amount of bromide and iodide; as accessory minerals are anglesite, pyromorphite, and wulfenite. "Hard carbonates" are masses of more or less siliceous iron oxide, in which crystals of carbonate of lead fill cavities in the mass, and the chloride of silver occurs generally in leaflets of such minute size as not to be visible to the naked eye; under this head are also included the masses of unaltered galena, which are more likely to have escaped oxidation in a hard, comparatively impermeable mass. "Sand carbonates" are portions of the ore mass in which silica and iron are not present under conditions favorable to consolidating it into a compact form, and which consequently crumble into sand on removal. As exceptional occurrences are masses of pure, transparent horn silver, one of which in the Vulture claim weighed several hundred pounds.

Distribution of bonanzas.—The distribution of the bodies of pay ore, or bonanzas, is extremely irregular, as is their shape and size. Their vertical dimensions are often 30 or 40 feet, and have in one instance reached 80 feet, but this great thickness seldom extends over any large horizontal area, the lower limits of the pay ore streak generally rising and falling with great rapidity. In general the form of individual bodies is not unlike that of those found within the mass of the limestone in other parts of the region. The rich ore masses are more common in the upper portion of the ore-bearing stratum. In horizontal distribution the larger bonanzas form two longitudinal bodies, rudely parallel with a dike-like mass of Gray porphyry, which has evidently influenced their deposition. The northern of these is practically continuous from the Climax south-workings to the Crysolite west-workings; the southern extends from Little Pittsburg through New Discovery and Vulture, being connected with the former in the Little Chief ground, and again around the west end of the dike, near the outcrop in Vulture and Crysolite.

Gray porphyry dike.—The Gray porphyry dike is a somewhat irregular body about 30 feet in thickness, standing at an average inclination of 50° to the north. Its mass is so thoroughly decomposed that it is with difficulty distinguished from the White porphyry except where the large feldspar crystals still remain. Nevertheless, it has been traced continuously through the Crysolite, Little Chief, Little Pittsburg, and Amie workings, and found again on the same line in the Big Pittsburg, Hibernia, and Lee mines. As shown by the outcrops, it is what we call an interrupted dike. It is supposed to have acted as a dam, causing an interruption of the ore-currents; these currents having flowed from the northeast toward the southwest, the stagnation thus produced has influenced a first deposition on its northeast flank, leaving a barren portion immediately under its southwest side; but through the gaps above mentioned the currents passed slowly depositing as they went, and in the eddy beyond was formed a second accumulation of ore.

Dunkin mine.—In the Dunkin mine, and the adjoining workings of the Climax and Matchless, the richest ore masses have been found near the outcrops, and in these are the principal developments. In the north end of the lower level of the Dunkin, a considerable body of unreplaced Blue limestone has been cut, showing the characteristic markings of this formation. The southern lower workings in both Climax and Dunkin are below the ore-horizon. A slight fold at the south end of the Dunkin claim brings the iron body down again for a short distance in the Little Diamond.

Matchless mine.—The rich ore body developed in this ground adjoining the Dunkin has not yet been thoroughly explored, but probably connects with the upper part of the Lee body. In the southeast corner of the claim, as in the northern edge of the Big Pittsburg and Hibernia claims, work is being done upon a western continuation of the remarkable ore body of the Lee mine. This is the very lowest portion of the ore horizon, the Parting quartzite being found in considerable thickness immediately under the ore. As the formation dips a little north of east the full thickness of the body is found in the Lee ground; whereas on the bounding line of the Matchless and Big Pittsburg claims, there remains only a wedge-shaped remnant of the ore body, included between the actual rock surface and the lower bounding plane of the ore horizon, which is cut off on the south by the dike.

R. E. Lee mine.—The Lee ore body is on a direct line with the northern body in the mines first described, and like that bounded on the south by the Gray porphyry dike; it may therefore be considered an eastern continuation of that body, the intermediate portion on the crest of the fold having been planed off by erosion. It still remains to be proved by future exploration whether or not the ore sweeps around the eastern end of the dike, and another large body exists to the south, as in the western group. The existence of such body is rendered probable by the discovery in the Surprise and other claims on the south side of Little Stray Horse Gulch, of pay ore near the outcrop, which is, like that in the Big Pittsburg, near the base of the ore-bearing stratum. Mineralogically, the Lee body differs very essentially from those thus far described; its gangue is principally silica and clay, containing only sufficient iron to color the mass in places a bright red, and little or no manganese. The ore is in the form of chloride of silver and contains practically no lead, either in the form of galena or carbonate; it is also exceptionally rich. It is, therefore, a secondary product, being the redeposition and probable concentration of material resulting from the decomposition of another ore body, now removed by erosion. As it is followed in depth to the east and north, it will probably contain more lead and proportionately less silver.

Denver City body.—South of the above claims, the continuation of the ore stratum is next proved in Denver City, under a great depth of Wash and porphyry, and about 600 feet east of its probable outcrop. In this region the lower body of White porphyry is cutting diagonally across the ore-bearing stratum, which is now largely unreplaced dolomite, and splits it into two wedge-shaped masses, the upper one tapering off to the south, the lower one thinning to nothing on the north. The northern extremity of the latter is proved in the Stonewall Jackson, Pearson, Joe Bates, and other shafts, southward it stretches across the Stray Horse claim, on to Carbonate Hill, soon embracing the full thickness of the body. The upper body is proved southward in the Robert Emmett, Agassiz, Gone-abroad, Cyclops, Mahala, and Greenback shafts, in the latter of which it has thinned out to seven feet of dolomite, and is separated from the rest of the Blue limestone body, which crops on the west face of Carbonate Hill, by a probable thickness of over 600 feet of White porphyry.

Future explorations and ore prospects.—Within the actually developed area yet unopened ore bodies may still be looked for. Practical experience has already taught miners that no part of the ore-bearing stratum can be considered barren until it is proved so by systematic exploration. Systematic exploration means a definite system of drifts, cross-cuts, and winzes, controlled by accurate surveys in such a manner that the mine superintendent may know that no considerable block of ground has been left untouched, either by himself or his predecessors. The system of burrowing, so much in vogue in the early days of mining in this region, is especially reprehensible in such rich ore deposits. Future explorations in as yet untouched ground must be carried on in the direction of the dip, not of individual ore bodies, but of the ore-bearing stratum as a whole; that is to the north and east of present developments. The whole northern and eastern portions of the hills are as yet practically untouched ground, the Virginius and Little Sliver being the only important shafts which have penetrated the ore-horizon, besides the Buckeye, which is on its western outcrop. The reason for the non-exploration of this ground lies mainly in the fact that whenever the ore-bearing stratum has been reached, the volume of water pouring in was so great that it could not be controlled by the pumps used. The laws of hydrostatic pressure, and the fact that we are here on the lower rim of a synclinal basin or trough, across whose edges the drainage of both Big and Little Evans runs, amply account for the great volume of water found. It cannot be assumed that the ore bodies, as at present developed, will necessarily be found to extend continuously, or in equal richness to the north and east; indeed, the few developments as yet made have been in comparatively low-grade ore. Still the promise of ore is amply sufficient to justify the expenditure of a large amount of money in exploration. Under the present conditions of ownership of the ground, however, whoever puts in pumping machinery of power sufficient to lower the water-level in his own ground, will probably do the same thing for his neighbors. The exploration must, therefore, be accomplished by a combination of property owners, and the putting down of one or more large union shafts, provided with powerful machinery, such as are in use on the Comstock lode, from which explorations may be carried out into the grounds of all belonging to the combination. These shafts should be located so as to reach the ore-bearing stratum as nearly as possible at the lowest point at which it is expected to be worked. For definitely determining such point, it would be wise to obtain more accurate data than have been available in this work, by sinking additional exploring shafts. Judging from what is now known, a union shaft for the claims on the western half of Fryer Hill should be sunk along Big Evans Gulch, at the southern extremity of the dividing line between the Little Pittsburg and Amie claims; say at the Little Amie shaft. For the eastern portion of Fryer Hill and the claims in Little Stray Horse Park, the union shaft should be placed near the gulch about midway between the Tip-Top shaft and Lickscumdidrix bore-hole. There will always be the element of uncertainty in regard to the complete efficiency of this system of drainage that as yet unknown bodies of porphyry may cross the beds in such a way as to interfere with the regular circulation of water in the basin; but in spite of this uncertainty the experiment should be tried, since portions which were thus cut off from the benefits of the common pump might easily be connected with it by a drainage level.

Conclusions.—The most important facts of general bearing are;

I. *Sedimentary formations.*—That the Paleozoic and Mesozoic beds are a littoral deposit around the Sawatch Archæan island, and were consequently formed in comparatively shallow water.

II. *Intrusive bodies.*—The occurrence, on an enormous scale, of intrusive bodies of eruptive rock of Secondary or Mesozoic age, and of exceptionally crystalline structure, which are so regularly interstratified as to form an integral part of the sedimentary series, and yet which never reached the surface, but were spread out and consolidated before the great dynamic movement or mountain-building period at the close of the Cretaceous.

III. *Ore deposits.* —That the original ore depositions took place after the intrusion of the eruptive rocks and before the folding and faulting occasioned by the great dynamic movement.

IV. *Plication and faulting.*—That the plication and faulting which resulted from this dynamic movement were intimately connected with each other, the latter being, in most cases, a direct sequence of the former, when the limit of flexibility of the plicated masses had been reached.

V. *Duration of dynamic movement.*—That while the close of the Cretaceous is properly considered the mountain-building period of this region, being that in which the greater dynamic movements were initiated and their major effects produced, these movements have continued, though on a probably much smaller scale, to recent times, as evinced by the movement proved to have taken place in the Lake beds since the Glacial period. Evidence, though of less definite character, has also been obtained of movements since the opening of the Leadville mines.

Facts which bear directly upon the ore deposits have a more practical application, and will therefore interest a larger class of readers. The main conclusions may be briefly summarized as follows:

Formation of ore deposits.—The minerals contained in the principal ore deposits of the region were derived from circulating waters, which in their passage through the various bodies of eruptive rocks took up certain metals in solution, and, concentrating along bedding planes, by a metamorphic or pseudomorphic action of replacement, deposited these metals as sulphides along the contact or upper surface, and to greater or less depth below that surface, of beds generally of limestone or dolomite, but sometimes also of siliceous rocks.

VII. *Distribution of ore deposits.*—That in the region immediately about Leadville the principal deposition of silver-bearing minerals took place at the horizon of the lowest member of the Carboniferous group, the Blue limestone formation, commencing at its contact with the overlying White porphyry. But that, while this particular formation has been peculiarly susceptible to the action of ore currents in this region, it is not admissible to assume, as some have done, that in general the beds of any one geological epoch are more favorable than those of any other to the formation of this important type of silver-bearing deposits; since, although they are generally found in greatest abundance in calcareous beds of Paleozoic age, the horizon of such beds is by no means identical in the various mining districts in which they have been thus far developed.

VIII. *Dikes.*—That in this, as in many other mining districts, dikes of eruptive rock, cutting the ore-bearing formation transversely, seem to favor the concentration of rich ore bodies or bonanzas in their vicinity.

IX. *Faults.*—That on fault planes, on the other hand, no considerable ore bodies have been deposited, as might have been assumed *a priori* from the fact that their origin is later than that of the original ore deposits.

X. *Value of these deposits as compared with fissure veins.*—The superior estimation in which true fissure veins are held, as compared with this class of deposits, is, as far as valid scientific reasons go, largely a popular prejudice. While fissure-vein deposits may be more regular and continuous, the bonanzas in this class are generally larger and more easily worked; morever, I consider that additional and more definite evidence is required before it can be assumed as proven that fissure veins extend indefinitely in depth and are filled directly from below, and consequently see no reason why the area of ore deposition, other things being equal, should be greater in that class than in this. A rough comparison of the relative areas of ore deposition in the famous Comstock lode and in the Blue limestone of Leadville, which was once as continuous as the former, will illustrate my idea. The Comstock has been worked on a length of 20,000 feet and to a maximum depth of 3,000 feet or over an area of 60,000,000 square feet. In Leadville, if we take, as the limits within which the Blue limestone has been found productive, a square of which Fryer Hill, Little Ellen Hill, and Long & Derry Hill should be three of the corners, we have an area of over 225,000,000 square feet, or about four times as great as that of Comstock. Too small a portion of the latter area has yet been explored to attempt any comparison between the relative proportions of productive and unproductive ground in the two cases.

XI. *Legal aspect.*—From the point of view of legal ownership, however, there is an undoubted advantage in favor of the fissure vein, since the owner of a certain number of feet on the outcrop can, under the United States mining law, establish his title to that width as far as the vein extends. In the case of the Leadville deposits, on the other hand, late legal decisions made under the system of trial by jury have practically reversed the law, and given effect to the system of square locations, which, however much may be said in its favor, was certainly never intended by the legislators who made it.

XII. *Practical suggestions to prospectors.*—In general, deposits of this type are to be looked for in regions where sedimentary beds are found associated with numerous dikes and intrusive masses of Mesozoic or Secondary age. In such regions valuable deposits would be first sought in limestone beds, and in preference on their upper surface, or at the contact with overlying eruptive rocks or sedimentary beds of essentially different composition. It should also be borne in mind that limestone deposits are generally irregular in their distribution, and often found within the mass of the rock with relatively few surface indications to guide the explorer. In the region here treated of the Blue limestone is essentially the ore-bearing bed, and while, owing to the favoring condition of the presence of large masses of intrusive rock impregnated with precious metals, ore has locally been concentrated at other horizons, this particular bed offers the best promise to the prospector. Experience has shown, moreover, that ore deposition has been most active where the Blue limestone is overlain by White porphyry. In the area covered by this intrusive mass, exploration has not yet thoroughly tested the horizon; but within these limits it seems to be well proved that no considerable portion of it is altogether barren of useful metals. On the other hand it must be remembered that it is only bonanzas or exceptionally large concentrations of ore which yield a great remuneration to miners, and these are, in the nature of things, limited to comparatively small areas where conditions have been favorable to their concentration. Such portions can here be readily recognized by the presence of large amounts of vein material, either ferruginous or siliceous, replacing the dolomite. By the aid of the U. S. geological survey maps the prospector can therefore determine with approximate accuracy where the Blue limestone horizon has been removed by erosion and where it still exists, and in the latter portions, by the further aid of sections and descriptions herein, where it may be looked for under the surface, and at what probable depth it may be found. He should bear in mind that, it is sometimes bleached so as even to be confounded with porphyry, from which its effervescence with acids is then the only safe distinction, and that even the porphyry is sometimes so impregnated with carbonate of lime as to effervesce slightly. Also that the Parting quartzite is the formation which marks its base, but that in the decomposed state prevalent in the mines it is often to be distinguished from porphyry only by its gritty feel; that, if for any reason the Parting quartzite is not definitely distinguishable, the finding of White limestone beneath, with its characteristic secretions of white hornstone or chert, is an unmistakable evidence that he is below the horizon of the Blue limestone.

Area under Leadville.—The determination of the existence or non-existence of the Blue limestone beneath the city of Leadville, or the area immediately west of Carbonate and Fryer Hills, is of prime importance, for the reason that so many rich bonanzas have already been developed at that horizon on its eastern borders, which it is reasonable to suppose once extended farther west, and that thus far the richness of the horizon seems to increase with its distance from the crest of the range. The evidence gathered upon this point will therefore be given in considerable detail. It is sufficiently well proved by the general geological structure of the region that the Blue limestone originally extended to the west of Leadville, its probable limits being a line drawn from the mouth of the East Fork of the Arkansas in a southeast direction to a point just west of Weston's Pass. If, then, it has not been removed by erosion, it should still be found there, and the question resolves itself into the determination of the amount of erosion over the triangular area included between that line and the known outcrops, and the probable elevation or depth below the present surface at which the Blue limestone was left by the folding action and faulting of the Paleozic series. Of the amount of erosion, or its practical exponent, the depth of surface accumulations of Wash and Lake beds over the actual rock surface, no data are attainable, except along the eastern shore-line of the ancient lake, or the western edges of the present hills, where rock in place has been actually reached in a few shafts. As it may be reasonably assumed that this was a shelving shore, the only deduction to be drawn from the data thus afforded is that farther west the thickness of Wash and Lake beds is probably greater.

With regard to the depth below the present surface at which the Blue limestone was left by folding and faulting, it may be assumed from analogy with the structure of other similar areas in the region, which the few available facts confirm, that this area is occupied by a shallow synclinal fold, cut off in part on its eastern edge by a fault. If, then, the shore of the Glacial lake was not very much steeper than has been assumed in the sections, and there exists no anticlinal ridge within the basin, it is probable that a continuous sheet of Blue limestone still exists west of the present known outcrops, and probably at no point over a thousand feet below the present surface. The evidence obtained with regard to its form may be very briefly stated.

On the North.—The existence of the Cambrian quartzite dipping southeast at the mouth of the East Fork of the Arkansas, and of Blue limestone on the ridge north of this stream, proves a basining-up in that direction, and that outcrop of the Blue limestone on that side of the basin runs nearly parallel to the river, and one or two thousand feet south of it, with a shallow dip southeast.

East Side.—On the west slope of Prospect Mountain it comes to the surface, as already shown, in the Little Evans anticlinal. South of this the Oolite shaft cut the overlying Gray and White porphyries, and found Blue limestone dipping steeply west at about 165 feet. About 1,100 feet west of this the Sequa shaft and bore-hole was sunk 280 feet through porphyry without reaching the contact, proving the western dip to be continuous so far. Still further south, at the foot of Fairview Hill, a number of now abandoned shafts have struck the White limestone under only sixty to ninety feet of Wash, in one of which, the American Eagle, it is said that the beds dipped both east and west. This would be the axis of the Big Evans anticlinal fold. About 600 feet west of this shaft the Bob Ingersoll drill, after passing through 360 feet of Wash and lake beds, has been driven from 100 to 150 feet in White porphyry. This proves definitely a western dip here, since no considerable sheet of White porphyry is known to exist below the White limestone. Whether this is the one which occurs above or below the Blue limestone will be determined only when the underlying bed is reached. On Carbonate Hill, as stated in Chapter VIII, the downward movement was distributed between two faults, the amount of that in the westernmost, the Pendery fault not having been proved. The fact that the shafts which have been sunk through the Wash along the lower slopes of the hill have invariably struck White porphyry, is satisfactory evidence that the ore horizon is still below them, since in this region the only known sheet of White porphyry is that which overlies the Blue limestone. There is some evidence of a western dip, as there shown, but whether the formation descends to the westward in a regular slope or in a series of short folds or faults is yet to be proved. The former would be more favorable to future developments. The facts that the displacement of the Carbonate fault is so small and that the Pendery fault probably passes into a fold are presumptive evidence that immediately west of the latter line the depth of the Blue limestone below the present surface is not great, and that it probably increases toward California Gulch and decreases toward Stray Horse Gulch. On the south slope of Carbonate Hill the California Tunnel passes through White porphyry west of the fault, which here had an inclination of only 30° to the west, and a shaft and bore-hole near the bed of the gulch, opposite the Harrison smelter, has been sunk 200 feet also in White porphyry.

South side.—The main fault crosses California Gulch in a southwest direction, about 500 feet above the Gillespie & Ballou sampling works, and west of it the Blue limestone may probably exist for some distance further south. Theoretically, it should extend, if not eroded, as far as the convergence of the fault line with the western rim of the basin. Practically, as the Lake beds probably deepen rapidly in this direction, its actual extent is likely to remain a matter of pure speculation for some time to come.

West side.—The western limits of the basin are equally a matter of speculation. The outcrops of the Blue limestone, run just west of the city limits. Within the limits thus rudely outlined the probabilities of the existence of the ore horizon below the Wash and Lake beds seem sufficient to justify the expense of an experimental shaft. This expense must necessarily be great, from the thickness of loosely agglomerated material to be passed through, which will almost certainly admit an enormous amount of water, the drainage of the surrounding hill surface. It must therefore be undertaken with the intention of risking a large sum of money, and as its result, if favorable, will increase the value of property in the whole area, the risk should be shared proportionately among them, as far as possible. From a purely geological standpoint, the most conservative method of exploration would be to reach the Blue limestone horizon somewhere near the eastern rim of the basin, say on the lower slopes of Carbonate Hill, and follow it westward. Other influencing motives may probably make it advisable to sink the experimental shaft further out on the flat, and in this case some position on a north and south line through Capitol Hill, would be a safe location to choose. While there might be advantage in going still farther west, inasmuch as the nearer one approaches the actual outcrop the less will be the overlying porphyry that will have to be passed through, on the other hand, once that outcrop is passed, the shaft would reach only the comparatively barren Silurian, Cambrian, or Archæan; it is therefore advisable to keep within safe limits until more definite data as to the probable breadth of the basin can be obtained. Although the Blue limestone may extend half way to Malta, in a region so complicated by unexpected folds and faults the regular slope of the basin, which would give it that width, cannot safely be counted on.

Other unexplored areas.—Present developments show that on a line running eastward from Fryer Hill replacement action has been exceptionally active. The Blue limestone horizon along this line is therefore worthy of thorough exploration, first in the synclinal basin of Little Stray Horse Park, and again in the area between the Yankee Hill anticlinal and the Weston fault. In either portion, as it is covered by thick porphyry masses, it would be more economical to conduct the exploration from some common shaft, and only sink actual working shafts after the existence of valuable ore bodies had been definitely determined. In either of these basins the ore horizon extends northward beyond Big Evans Gulch and under Prospect Mountain, and may prove productive there, but it is relatively more difficult of access, and the few points at which it has been reached give less promise of widespread ore deposition than in other regions. Southeastward from the crest of Yankee Hill the Blue limestone horizon might be expected to be productive from the presence of the cross-cutting body of Gray porphyry; on the other hand it may be more difficult to trace, on account of the probably complicated geological structure. Under the Pyritiferous porphyry of Breece Hill it must exist, but at an as yet unknown depth. On the north slope of this hill the contact eastward from the Highland Chief mine has not yet been thoroughly explored, as prospectors in this region have been hopelessly confused by the complicated structure, and have sunk their shafts indiscriminately above and below it. On Little Ellen Hill it has been found productive, as already mentioned, but not explored in the valleys to the north and south. East of the Ball Mountain fault, again, the contact crosses South Evans Gulch, but has been opened at comparatively few points. The prospects of as yet undeveloped ore bodies under Fryer, Carbonate, and Iron Hills have already been discussed. South of California Gulch the extension of the line of the Iron fault probably coincides nearly with the axis of a synclinal basin, east and west of which the formations should rise. The generally shallow depth at which the Gray porphyry sheet between the White porphyry and Blue limestone was found, just west of the Dome fault, afforded an indication that the latter would be found here comparatively near the surface, and this indication has been confirmed by explorations since the completion of field work. East of the Dome fault the outcrop of the Blue limestone is found in the Nisi Prius and adjoining shafts in Iowa Gulch, and its southern continuation has thus far only been struck by the Hoodoo and Echo shafts at the head of Thompson Gulch, leaving a considerable extent entirely unprospected. Under Printer Boy Hill, east of the Pilot fault, the geological indications are favorable to the existence of ore bodies in the Blue limestone. Its outcrop on the Iowa Gulch side is clearly marked, but on the northern slope toward California Gulch it is obscured by surface débris, or slide, and when last visited was unprospected between the Lovejoy shaft and the Eclipse tunnel. East of this it extends at a depth as yet unprofitable for exploration, until cut off by the Ball Mountain fault; while on Long & Derry Hill it is cut off earlier by the Weston fault, and is wanting in the areas further east. The outcrop of Blue limestone can be traced from the western shoulder of Mount Zion northward, gradually descending the hill slope, crossing the mouth of No Name Gulch and Piny Creek to Taylor Hill, at which point the El Capitan mine has developed a valuable body of gold ore. Throughout this extent it is as yet but little prospected.

Metallurgical Notes.—The smelting of lead in Leadville, upon a careful and prolonged investigation, prompted Mr. A. Guyard, who had undertaken the subject for the Government, to the following conclusions:

1. That smelting in Leadville is a profitable operation, but that the aggregate smelting capacity of the working smelters is about equal to the present mining product of the camp.

2. That lead smelting, in Leadville, has, on the whole, been brought to a state of great perfection, with regard both to the plant adopted, which is constructed on the most approved principles, and to the manner in which fuel, fluxes, and ores are mixed for smelting, giving slags which are remarkable for their fluidity, not too highly charged with either silver or lead (especially when it is remarked that the bullion produced is very rich); and from which bye-products, such as speises and mattes, are easily detached.

3. That the quantity of bye-products, other than lead fumes, resulting from smelting in Leadville, amounts to but little.

4. That the camp is provided with the necessary plant to work profitably such bye-products, which are generally rich in silver, and either completely neglected, or treated imperfectly and with a considerable loss of silver.

5. That the mode adopted at a great many smelters, of mixing and re-smelting with caustic lime the flue dust formed in considerable quantity, is the best that could have been devised, and that it would be advisable to substitute pure lime for the dolomitic lime used in Leadville for this operation.

6 That the numerous imperfections noticeable at various smelters are mostly intentional and based on economical grounds, and are not on ignorance, for smelting is conducted in Leadville by very clever superintendents and smelters.

7. That the smelting of lead ores, in presence of ironstone, has here been brought to a state of great practical perfection, and is carried on most successfully, from one year's end to the other, with the greatest regularity at a dozen smelters, and that superintendents of smelters do not hesitate to introduce in the charges sometimes very large quantities of galena, which are reduced with the greatest facility.

8. That owing to the peculiar nature of the Leadville

ores, and to the great altitude at which smelting is performed, which increase the volatility of lead compounds, attempts ought to be made to substitute caustic lime, free from magnesia, for the raw dolomite universally used in Leadville, in order to avoid as much as possible the formation of volatile lead compounds.

9. That *cœteris paribus*, dolomite forms as good a flux as calcitic limestone, so far as the actual working of the blast furnace is concerned, and that the fluidity of the slags thus formed is not only irreproachable but quite remarkable.

10. That besides the substances existing in large quantities in the camp, such as silica, sulphur, carbonic acid, lime, magnesia, alumina, oxides of iron and manganese, lead, silver, chlorine, and phosphoric acid, the following substances exist in small quantities: sulphuric acid, titanic acid, bromine, iodine, zinc, baryta, gold, nickel, molybdenum, arsenic, antimony, and copper; and that traces of the following substances may be detected: tin, bismuth, cobalt, iridium, selenium, tellurium, cadmium, and a new metal which has been imperfectly studied as yet, and which appears to be intermediate between the metals of the iron group and those of the lead group.

11. That ores of Leadville are either rich in lead and poor in silver, rich in silver and poor in lead, or equally rich in both silver and lead, and very variable in composition; but that by judicious admixtures of various ores, ore beds of sensibly the same composition are made at the smelters, which are needed to insure regularity in the smelting operations.

12. That the quantity of lead completely lost in the atmosphere is sensibly twice as large as the quantity of lead caught in the dust chambers generally used.

13. That the crude bullion extracted in the blast furnaces of Leadville by the process referred to in § 7, is of very fair quality, and that a little of its silver and some of its lead exist there in the state of sulphurets.

14. That mattes (both iron and lead mattes) which had hitherto been considered as entirely formed of sulphurets are crystallographic compounds of sulphurets of iron and lead, and crystallized magnetic oxide of iron. (This last observation, however, interferes in no way with the fact that in various smelting operations mattes entirely formed of sulphurets are produced.)

15. That slags cannot very well be compared with minerals, from which they differ essentially; that they contain minute quantities of carbonates which have escaped destruction, and small quantities of carbon or carburets, two products which hitherto had not been generally known to exist. That slags are formed of crystallographic compounds of silicates of iron, manganese, zinc, lead, lime, and magnesia, on the one hand, and on the other of a peculiar matte which is designated by the name of *calcium matte*, and which like its congeners is formed of a sulphuret (sulphuret of calcium) and magnetic oxide of iron, which can be isolated in the pure crystalline state.

16. That at least three distinct metallurgical kinds of speises, containing two distinct chemical arsenio-sulphurets of iron, are formed in lead smelting, and that they always contain small quantities of nickel and molybdenum entirely concentrated in them, showing that the metallurgy of molybdenum could be conducted jointly with that of lead, with ores containing only traces of molybdenum.

17. That a very curious and a hitherto unsuspected reaction takes place in the blast furnaces of Leadville, by means of which cobalt is completely separated from nickel (nickel being concentrated in speises and cobalt in the skimmings of the lead pots of blast furnaces), and showing that the metallurgy of both metals and their separation could be effected in lead furnaces by operating under conditions similar to those observed in Leadville.

18. That iron sows are a variety of speise and present a great analogy with the latter products.

19. That lead fumes are very complicated products, characterized in Leadville by the presence of no inconsiderable amount of chloro-bromoiodide of lead and phosphate of lead, and that they contain, contrary to the opinion formed in Leadville, but small quantities of arsenic and antimony.

20. That owing to that erroneous notion, the practice of roasting the dust in order to free it from arsenic and antimony, as adopted at one smelter, is a useless and costly one, which is unnecessary and ought not to be generalized in Leadville.

21. That accretions are products of sublimation, and that these products, which line the shaft of the furnaces and interfere seriously with a regular run, might be, to some extent, avoided, or made less troublesome, by a slight modification of the manner of charging the furnaces, and by the adoption of caustic lime, instead of raw limestone, in smelting.

22. That some accretions are characterized by the concentration, in sometimes large quantities, of metals such as tin, arsenic, antimony, and zinc, which exist but in small quantities in the ores.

23. That the charcoal used in smelting is of very good, and the coke of bad quality; but that the fuel obtained by mixing them contains 20 per cent. of ash, and that it requires a maximum amount of 32 to 33 parts of this fuel for 100 parts of ore, and 24 parts for 100 parts of charges to effect smelting; but that at several smelters these percentages are considerably lowered.

24. That for every 100 parts of carbon thrown in the furnaces with the smelting charges, only 52.25 parts reach the zone of combustion at the tuyeres, the balance being consumed chiefly by carbonic acid formed in the zone of combustion, involving, as is well known, an absorption of heat.

Compiled from an article by S. F. Emmons, C. E., Report of U. S. Geological Survey, 1881.

THE COMSTOCK MINES.

THE known limits of the lode cover a space of 22,546 feet, in a nearly due north and south direction (magnetic). At the time the existing mine maps were laid out, the variation of the needle in that locality was 16½ degrees east. The northern half of the lode has a direction a little more to the east than the magnetic meridian, and the southern half a strike which again is slightly more to the east than its neighbor. Great irregularities in the course occur locally, the strike varying in fact from north-east to north-west within short distances. Still the mean direction of the lode is almost coincident with the line of magnetic north. Upon this extensive seat of metalliferous deposition, the following mines have been opened, the list beginning at the northern end, and being divided into the Virginia, Gold Hill, and American Flat groups in accordance with the geological separation of the ore bodies. The names given these divisions are those of the towns which have been built upon them, and which rank in population in the order here given:

Virginia Group.

	Length of Claim.	
Utah	1,000	feet.
Sierra Nevada	3,550	"
*Union Consolidated	575	"
*Mexican	600	"
Ophir	675	"
California	600	"
Consolidated Virginia	710	"
*Best & Belcher	540	"
Gould & Curry	612½	"
Savage	771⅙	"
Hale & Norcross	400	"
Chollar	700	"
Potosi	700	"
Bullion	943⅜	"
*Exchequor	400	"
*Alpha	306	"
Imperial Consolidated	466	"
	13,549⅓	feet.

Gold Hill Group.

	Length of Claim.
*Challenge	90 feet.
*Confidence	130 "
Yellow Jacket	953¾ "
*Kentuck	93 11/12 "
Crown Point	541 7/12 "
Belcher	1,040 "
*Segregated Belcher	160 "
Overman	1,200 "
Caledonia	2,188 "
	6,397¼ feet.

American Flat Group.

	Length of Claim.
Maryland	900 feet.
Baltimore Consolidated	1,200 "
American Flat	500 "
	2,600 feet.

The mines above mentioned are followed by a number of others which from their position may have good reason to place themselves among the acknowledged mines of the Comstock Lode. The three series of mines occupy a total length on the lode of 22,546 feet, as follows:

In the Virginia Group	17 mines.	13,549 feet.
In the Gold Hill Group	9 "	6,397 "
In the American Flat Group	3 "	2,600 "
	29 mines.	22,546 feet.

The length of the claims now (1877) included in the lode is more than one thousand feet greater than it was in 1866, the additions having been made on the extreme southern end in the American Flat district. The division of the lode among the mining companies also is not now what it was when the table quoted by Mr. Hague ("Survey of the Fortieth Parallel," Vol. III., p. 99) was compiled by Mr. R. H. Stretch, State Mineralogist of Nevada. That contained the names of forty-six claims, many of which were less than a hundred feet long. Several of these have been consolidated within late years, and one company, the Chollar-Potosi, has divided its ground between two companies, the Chollar and the Potosi. A practical consolidation has been accomplished by working two or more mines through one shaft. Thus the Union, Mexican, and Ophir are all worked through the Ophir shaft; the Best and Belcher is managed by the Gould and Curry officers, and the Imperial and Empire shaft is a point from which the Exchequer, Alpha, Imperial, Challenge Consolidated, and Confidence claims, covering 1392 feet of ground, are all explored. The Kentuck is worked through the Crown Point shaft, and the Segregated Belcher through the Belcher. The number of working shafts distributed along the length of the lode in 1877 was twenty; to which must be added the air-shaft of the Belcher. Nine mines had no shaft, and some of them were among those of the first importance. This consolidation of interests is a favorite method of reducing the cost of exploration while the mine is in barren ground, and it can be and frequently is abandoned as soon as ore is reached. The great and increasing depth of the mines is no bar to this method of conducting the search for ore, because the energetic methods of mining practised on the Comstock allow the sinking of a deep shaft with extraordinary rapidity if the discovery of ore makes it advisable.

Mining began in the Comstock region in 1850, when gold was found by some Mormon emigrants in Gold Cañon, which leads from the immediate locality of the lode to the Carson River. The discovery was made near the Carson, and the work was confined to surface diggings. As these were pursued from one point to another, the Cañon was ascended until, in 1859, Gold Hill at the head of the Cañon was reached, and the surface claims were staked out close to and probably including, the croppings of the great ledge. During the same period Six-Mile Cañon, which runs from the northern part of the Comstock to the Carson, as Gold Cañon runs from the central part, was worked, and in the same year, 1859, the Comstock Lode was discovered by a pit sunk for a water-hole. This was on the ground of the Ophir mine. Milling the ore began in October of the same year; but progress was slow, and the amount of bullion taken out in 1860 is estimated at only $100,000. Since then the Comstock has become the greatest gold and silver mine in active operation in the world. It is extremely difficult to ascertain its true yield in the nineteen years of its history, and estimates vary from $300,000,000 to $350,000,000. During the earlier years very little effort was made to give accuracy to the statistics, and even the fuller data now obtainable must be regarded as a minimum, because they represent only that portion of the product which is extracted in the interest of the mine owners. In addition to this there are the battery slimes and the tailings, which are the property of the mills, and from which a large amount of bullion has been obtained. In the following table the annual product is given from the best sources at command. For the most part it covers only that portion of the product which is accounted for to the mine stockholders; but it includes also about $6,500,000 obtained from tailings and from mines that are not on the Comstock, though in its immediate neighborhood. This addition probably compensates nearly for the omissions due to imperfect records, and the benefit to stockholders from the Comstock lode has probably been not far from $290,000,000.

* Worked through the shaft of a neighboring mine.

			Gold and Silver.
1860*		$100,000	
1861*		2,000,000	
1862*		6,000,000	
1863*		12,400,000	
1864*		16,000,000	
1865*		16,000,000	
1866*		11,739,100	
1867*		13,738,618	
1868*		8,479,769	
1869*		7,405,678	
1870†		8,603,175	
Unclassified			$102,466,240
	Gold.	Silver.	
1871†	$4,077,027	$8,230,587	
1872†	6,310,035	6,611,943	
1873‡	10,493,796	11,037,023	
1874‡	12,579,825	11,881,000	
1875‡	11,739,873	14,402,350	
1876‡	18,002,906	20,570,078	
1877§	16,130,996	17,760,702	
1878§	9,357,040	9,694,940	
	$88,691,498	$98,278,623	
Total			186,970,121
1877‖ Unclassified		$901,790	
1878‖ "		825,054	
			1,725,844
			$291,162,205
From the mines in the Comstock region but not on the Comstock Lode, 1877 and 1878‖			$2,635,042

How much these figures should be increased to account for the bullion extracted from the battery slimes and tailings, is impossible to estimate with accuracy; but if an allowance of $5 per ton of ore is made on these two items, the above sum total would be increased by $32,500,000 and the entire product of the lode would be placed above $320,000,000. The quantity of ore extracted is even more doubtful than its value, for no record of it has been kept in earlier years. It consists of two general classes, the rich ore, obtained when the mines are in bonanza, and the low-grade ore, which is worked during the intermediate periods of comparative barrenness, The former ranges usually between $40 and $108 returned to the stockholders, and the latter between $20 and $35. A good authority on this subject estimates the average value of the Comstock ore in the past at $45 per ton of 2000 pounds, and this includes only the return to the companies. At this rate the above total of $201,161,205 represents about 6,500,000 tons of ore. To this must be added from two to ten per cent. for slimes, which vary quite as much in value. In the earlier years of this region, the slimes and tailings were not always worked over, and that was also for some of the mines the period of richest yield. Taking all these circumstances together, it is probable that the allowance above made of $5 per ton of ore mined would cover the amount actually extracted from the slimes and tailings. It is very much in excess of the quantities reported to the Controller of Nevada for taxation.

* From J. D. Hague's Report on Mining Industry of the Fortieth Parallel, 1870.

† From the Report of the U. S. Commissioner of Mining Statistics, 1871, corrected by data received from some mines.

‡ From Report of the U. S. Monetary Commission, 1877.

§ Reported by the mining companies with minor amounts taken from the Tax List.

‖ From State Tax List of Nevada.

The quantity of precious metals which has been allowed to run off with the exhausted tailings is unknown; but $40,000,000 is probably a minimum estimate for this item. Estimates of this kind are necessarily inexact. Summing up these estimates, we have for the gross contents of the lode as worked up to the end of 1878:

Ore extracted		6,560,000 tons.
	Per Ton.	Total.
Bullion from the ore	$44.80	$291,161,205
Bullion from tailings and slimes	5.00	32,500,000
Lost in tailings	6.20	40,300,000
Total estimated assay value of ore		$363,961,205

If the percentage yield in the mills were accurately known, it would of course be possible to determine the value of the ore from their returns. But this yield has varied constantly, increasing with the improvement in machinery and practice from sixty-five per cent. to seventy-two per cent. Seventy per cent. is probably a somewhat high average, and adding three per cent. for the amount extracted from tailings, which is also slightly in excess of the reported amount, we have a total yield of 73 per cent. from the ore. Therefore the $291,000,000 which has been obtained from the lode represents a mass of ore containing a little less than $399,000,000 worth of silver and gold. Adding to this sum $9,000,000 for the value of the slimes, or a little more than three per cent., we obtain a grand total of $408,000,000 for the original contents of the ore taken from the Comstock mines in twenty years, ending with the year 1878. These two methods of computation therefore give results that differ by no less than forty-five million dollars. Most of the bullion yield of the lode has been obtained from sixteen ore bodies or "bonanzas," and from low-grade ore which most of the mines continue to extract in large quantities after the rich quartz that furnish the rich ore, but is left in the mine until that has been removed. The bonanzas which have been found are as follows, beginning at the north end of the lode:

One in Sierra Nevada. Two in Ophir. One in Consolidated Virginia and California. One in Gould and Curry and Savage. One in Hale and Norcross. Two in Chollar-Potosi. One in the Imperial and adjacent mines. One in Yellow Jacket. One in Yellow Jacket, Kentuck, and Crown Point. One in Crown Point and Belcher. One in Belcher. One in Segregated Belcher. One in Overman. One in Caledonia.

The number of these bodies is variously given by authorities, the doubt not resting upon denial of reported ore discoveries, but being caused by the difficulty of distinguishing bonanzas which are enclosed in the same mass of quartz, and only separated by low-grade ore which may be mined out afterward. The subject is not important; and no pains have been taken to form a decided opinion upon it. The Justice lode, lying near and opposite the southern end of the Comstock, has also produced one large ore body. The great difference in the importance of the bonanzas is indicated by the fact that one of them, the last found and lying in Consolidated Virginia, California and Ophir ground, has produced no less than thirty-seven per cent. of the whole product of the lode, or $108,861,230. It is now too late to attempt an accurate summary of the interesting facts connected with these remarkable collections of ore. The published records have always been of doubtful value, and the fire which destroyed so many mine offices in Virginia, in 1875, swept away nearly all the original notes and maps which could supply means for their correction. The following table is therefore given merely as an approximation to the truth. It was compiled by the San Francisco *Chronicle* in August 1877, and its statistics are brought down to June 30th of that year. In some respects it is obviously incorrect. It gives the dimensions of the "great bonanzas" as 500 feet high, 700 feet long, and 90 feet wide; and every one of these figures could be successfully disputed as being too small. But a mass of that size would yield 31,500,000 cubic feet of quartz, which at thirteen cubic feet to the ton would weigh 2,423,000 tons; a quantity which is nearly twice as much as this ore body has supplied. Doubtless the other dimensions shown are equally inaccurate. Nevertheless the table may give to persons unaccustomed to mining some idea of the scale upon which the metalliferous depositions of the Comstock lode have been made. It is copied with no change except the insertion of the true yield to date from the California and Consolidated Virginia mines. The sum total, it will be observed, does not agree with that given above, a fact which illustrates the conflict of authorities on the question of yield; but is also partly accounted for by the yield from low-grade ore which is not included. The number of bonanzas named in this table is twenty, or four more than I have accounted for. The discrepancy is due to the fact that the *Chronicle* tabulates the returns from *mines* rather than from bonanzas, and one of the latter may stretch through two or three of the former.

Bonanza.	Date of Discovery.	Position.	Depth	Length.	Width.	Tons.	Average Yield.	Bullion.
Ophir, No. 1	1859	Surface.	200	200	40	109,166	$48 00	$5,210,000
Gould & Curry, Savage	1860	Surface.	400	900	30	777,783	39 70	30,881,397
Gold Hill	1863	Surface.	450	1000	30	1,037,412	25 39	26,340,762
Yellow Jacket, Kentuck, Crown Point	1864	100 feet.	350	500	35	418,051	32 02	13,389,068
Belcher	1864	Surface.	150	200	30	55,288	34 39	1,901,117
Chollar-Potosi	1865	Surface.	300	500	50	553,958	25 39	13,985,715
Overman	1866	Surface.	200	250	30	110.669	14 26	1,578,388
Seg. Belcher	1866	Surface.	80	50	20	4,961	20 49	101,453
Caledonia	1866	Surface.	100	100	25	16,613	12 89	212,761
Hale & Norcross	1866	400 feet.	350	350	35	313,270	24 97	7.822,233
Sierra Nevada	1868		200	300	40	111.497	7 89	883,108
Crown Point, Belcher	1871	900 feet.	500	600	60	1,374,528	42 40	58,110,240
Consol Virginia, California	1873	1100 feet.	300	700	90	1,090,360	93 55	104,007,652
Ophir, No. 2.	1874	1300 feet.	300	300	30	264,000	20 70	5,548,055
Justice	1874	200 feet.	500	400	10	112,964	21 38	2,395,974
Totals.						6,350,520	42 89	272,367,624

The proportion of silver and gold in the ore, is another point which suffers considerable obscurity from the want of accurate book-keeping, though it has lately been the subject of careful calculation. It varies in different ore bodies and in different parts of the same bonanza. In the Crown Point and Belcher, the Belcher, or southern end, was richer in gold than the other half of the mass. In the Consolidated Virginia & California, the California or northern end had the larger proportion of gold. In the latter case the ore bodies were absolutely distinct and occupied different quartz masses which were nowhere united together, though closely adjoining. The Consolidated Virginia had produced up to December 31st, 1878, $26,141,851\frac{9}{10}$ ounces, or 1101 tons, 861 pounds of bullion, and the California $10,000,770\frac{7}{10}$ ounces, or 615 tons, 524 pounds. The California bullion was worth $2.56 per ounce, and the Consolidated Virginia $2,246.

The profit and loss account of the mines is probably quite as difficult to arrive at as the dimensions and yield of the bonanzas. All the facts which have been attainable are shown in the following table which relates to those companies that were in existence April 1st, 1879, and gives an account of their capital stock, dividends and assessments, since the date of their incorporation:

NAME OF MINE.	Length of Claim.	Shares of Stock Number.	Value per Share.	Capital Stock.	Total Assessments.	Date of last Assessment.	Total Dividends.	Date of last Dividend.	Date of Incorporation.
VIRGINIA GROUP.	Feet.								
1. Utah	1.000	20,000	$100	$ 2,000,000	$ 780,000	February, 1879.	None	...	April 9, 1872.
2. Sierra Nevada	3,550	100,000	100	10,000,000	2,550,000	April, 1879,	$102,500	January 16, 1871.	...
3. Union Consolidated	575	100,000	100	10.000,000	460,000	April, 1879.	None.	...	January 23, 1865.
4. Mexican	600	100,800	100	10.080,000	221,760	May 15, 1878.	None.	...	1874.
5. Ophir	675	100,800	100	10,080,090	2,340,744	September 10,'78.	1,394 400	March 7,1864.	...
6. California	600	540,000	100	54,000,000	None.	...	30,240,000	January, 1879.	December 31, '73.
7. Consol. Virginia	710	540,000	100	54,000,000	474,600	June, 1873.	41.310,000	April, 1879.	June 7 ,1867.
8. Best & Belcher	540	100,800	100	10,080,000	438,592	April 16, 1878.	None.	...	...
9. Gould & Curry,	612½	108,000	100	10,080,000	2,945,600	March 1879.	3,826,800	October, 1870.	June 27, 1860.
10. Savage	771⅛	112,000	100	11,200,000	4,196,000	February, 1879.	4,460,000	June, 1869.	October 14, 1862.
11. Hale & Norcross	400	112,000	100	11,200,000	3,026,000	March, 1879.	1,598,000	April, 1871.	March 19, 1860.
12. Chollar	700	112,000	100	11,200,009	1,750,000	September, 1878.	3,080,000	February, 1871.	April, 1865.
13. Potosi	700	112,000	100	11.200,000	None.	...	...	...	...
14. Bullion	943¾	100,000	100	10,009,000	2,802,000	January 22, '70.	None.	...	...
15. Exchequer	400	100,000	100	10,000,000	380,000	January 17, '78.	None.	...	...
16. Alpha	406	30.00 0	100	3 000,000	240,000	March 21, 1878.	None.	...	...
17. Imperial Consol.	408	500,000	100	50,000,000	875,000	February, 1879.	None.	...	April 13, 1876.
Total	13,711½	2,888,400	...	$288,840,000	$23,480,206	...	$86,011,700	...	...
GOLD HILL GROUP.									
18. Challenge Consol	90	30,000	$100	$ 5,000,000	$ 10,000	November, 1878.	None.	...	November, 1873.
19. Confidence	130	24,960	100	2,496,000	256 320	April 10, 1878.	$ 78,000	May, 1865.	August 11, 1865.
20. Yellow Jacket	953¾	120,000	100	12,000,000	3,912,000	January, 1879.	2,184,000	August, 1871.	February 16, '63.
21. Kentuck	94	30,000	100	3,000,000	300,000	August 7, 1878.	1,252,000	March 10, 1870.	August 22, 1865.
22. Crown Point	541½	100,000	100	10,000,000	2,053,370	December, 1878.	11,898,000	January, 1875.	February 8, 1861.
23. Belcher	1,040	104,000	100	10,400,000	1,592,040	April 14, 1879.	15,397,200	April 10, 1876.	November 2, '68.
24. Segregated Belcher	160	6,400	100	1,020,000	244,800	April, 1876.	None.	...	July 18, 1865.
25. Overman	1,200	38,400	100	3,840,000	3,066,800	January, 1879.	None.	...	April, 1865.
26. Caledonia	2,188	100,000	100	10,000,000	1,645,000	April 11, 1879.	None.	...	May 2, 1871.
Total	6,397¼	573,760	...	$58,656,000	$13,080,690	...	$30,809,200	...	...
AMERICAN FLAT GROUP.									
27. Maryland	900	54,000	$100	$ 5,400,000	$ 54,000	May 9, 1877.	None.	...	March, 1875.
28. Baltimore Consol.	1,050	84,000	100	8,400,000	936,000	April 30, 1878.	None.	...	July 3, 1872.
29. American Flat	500	30,000	100	3,000,000	172,500	May 18, 1877.	None.	...	April, 1872.
Total	2,450	168,000	...	$16,800,000	$1,162,500	...	...	...	...

Summarized, the account stands as follows:

Number of Companies	29
Shares of Stock	3,630,160
Par value	$364,296,000
Total dividends	$116,820,900
Total Assessments	$37,623,886
Dividends less Assessments	$79,097,014

A large part of this assessment account has accrued during the last four years, which has been a period remarkable for the continuance of barren ground in all but five of the mines. The financial consequences of this misfortune have been increased by the depth of the workings, the flooding of two mines in the most favored part of the lode, the construction of new pumps of the heaviest and most expensive pattern, and the sinking of several new shafts designed to strike the lode at still greater depths. From all these causes combined, the assessments in Storey County in 1878 amounted to $8,561,600. This sum includes the levies of a large number of mines not on the Comstock lode, but the amount to be deducted on their account would be only a small portion of the whole.

In the third volume of Mr. Clarence King's report on the Fortieth Parallel Survey, Mr. James D. Hague, of San Francisco, has given a very thorough description of the methods of mining and the machines employed on the Comstock. That admirable treatise is still a trustworthy guide to the main features of the work and also to many details, most of the recent changes consisting in expansions of the former methods. In fact the plan followed, necessitated by the nature of the ground, has been quite uniform since the true eastward inclination of the lode was discovered. Since that time the works have differed more in magnitude than in plan. No attempt will be made here to repeat the information given by Mr. Hague, which will also be constantly referred to, and only a few of the additions to the mode of work will be described. The Comstock is an example of an inclined deposit which is reached by shafts sunk through the hanging wall. The extreme rapidity with which the ground is worked out necessitates the frequent removal of these shafts in the direction of the inclination, and to avoid the sinking of so many new and expensive openings a system of combined vertical and inclined works has been introduced. On account of the moderate dip (30 to 60 degrees) of the lode it is not practicable to work a large number of levels from a vertical shaft, and no attempt is made to do this. As soon as the vertical or "straight" shaft reaches the lode its further construction is abandoned, and an incline is opened usually on or near the foot wall, but not conforming closely to it. The vertical shafts have three or four compartments, disposed in a parallelogram, the only departure from this system being in the deep Forman shaft, which is L shaped. The inclines are mostly built for one track. From the incline a main drift is run north and south at those depths where it is desired to establish a level, and which are one hundred feet apart in promising ground, but may be three hundred feet apart in a barren zone. It is quite common now to maintain a practical uniformity in the position of these levels in neighboring mines, so that the main drift is frequently part of a gallery that may reach from one end of the actively worked ground to the other. While this is not true for every level, care is taken to make these connections at such distances as will secure good ventilation and the safety of the men in case of accident. The deepening of the mines frequently amounts to 150 feet vertical in a year, and this corresponds to about an equal advance eastward, and about one half more excavation, following the inclination of the lode. For this reason the depth which can be worked from one point is rather rapidly exhausted, and in the nineteen years during which the Comstock has been worked upon there have been three principal bases of operation, as follows: 1. Surface works, consisting of "diggings," tunnels, and shallow shafts or inclines. 2. A line of deeper shafts, but not often exceeding 500 or 600 feet in depth. 3. The first line of deep shafts sunk through the hanging wall and reaching the lode at the depth of about one thousand feet or more. The surface works were mostly operated about 1860–'62, the line of shallow shafts about 1862–'65, and the first line of deep shafts was begun in 1864 by the construction of the Bonner shaft of the Gould & Curry. All the other mines followed this example, and the entire line from the Mexican to the Overman was probably complete by 1869 or '70. The average life of these shafts has been somewhat more than ten years, and the mines have deepened in this time from about the 700 to the 2000 level, and in some cases a greater depth. None of these data are exact, but they illustrate fairly the rapidity with which the resources of the lode are exhausted.

Within the past two or three years all the principal mines have attained the 2000-foot level, and many have passed several hundred feet beyond it. The depth named requires a hoisting cable about 2500 feet long, and for every foot further an increased length of cable amounting to a foot and a half is necessary. Such extreme lengths require very powerful machinery, and increase the chances of accident. A barren zone in the lode has also been reached where the ore deposits are not numerous enough to require the use of so many shafts, the intervals in the present line being often less than 1000 feet. A new line considerably removed to the east has therefore been occupied, and several shafts are now under construction, most of which are designed to supply the wants of two or three mines. The Union Consolidated mine, which has been hitherto worked through the Ophir shaft, now has a new shaft nearly 1500 feet further east. The Gould & Curry mine have a new shaft, about 2300 feet east of the existing point of extraction. It is known as the Osbiston shaft, from the superintendent of the mine. The Savage, Hale & Norcross, and Chollar Potosi mines united in sinking a shaft known as the Requa shaft. It is about 3100 feet east of the lode croppings, and about 1700 feet east of the line occupied by the present shafts of those mines. South of this is the new Jacket or Taylor shaft, 2545 feet east of the present shaft. Finally, at the extreme southern end of the Gold Hill group of mines is located the important new Forman shaft, named after Mr. Forman, the superintendent, the fourth in the history of that mine, and the deepest mining work which has been projected in America, if not in the world. It is no less than 3100 feet east of the present shaft. At what depth it will strike the lode cannot be positively foretold, but it is expected to be 4500 feet in vertical depth. The Caledonia mine joins with the Forman in this great work. Of these new undertakings, the Requa, Forman and Osbiston shafts have four compartments each, and the Taylor has three. The Forman shaft is L-shaped, having three compartments 5 feet wide and 4½ feet, 4½ feet, and six feet long respectively. The pump shaft on the short arm is 6 by 7 feet.

Work upon the Comstock mines is unusually irregular, even for such irregular subjects of industrial operations as mines mostly are. The absence of a vein and the occurrence of large ore masses and perfectly barren ground in a succession that cannot be foretold, gives to mining in this lode the most extreme alternations of good and bad fortune. The ground in which lay the great bonanzas of the California and Consolidated Virginia mines yielded some ore above the 200 foot level, and then was practically barren down to the 1200 level. From the next four hundred feet of depth a million tons of very rich ore has been taken. Such vicissitudes necessarily induce irregularity in working, which is further increased by the differences which exist in the length of the various claims. It is matter of course that the progressive increase in depth should be less when a great ore body is removed, than when works of exploration are carried on in a barren and unpromising part of the lode. But the extraordinary vigor of operations in these mines somewhat counteracts this cause of fluctuations. When ore is at hand in large quantities the extraction is pushed with such speed that a deposit containing $150,000,000 worth of metal may be mostly removed within four years from the time of discovery; the whole work of laying out the levels and extracting the ore being done in this time. The Consolidated Virginia mine yielded 144,400 tons of ore in 1877, or 400 tons daily for 362 days; and the California had probably about the same yield from the neighboring ground. With such energetic management it is not strange to find the mines deepening at the rate of 100 feet a year, even when in bonanza.

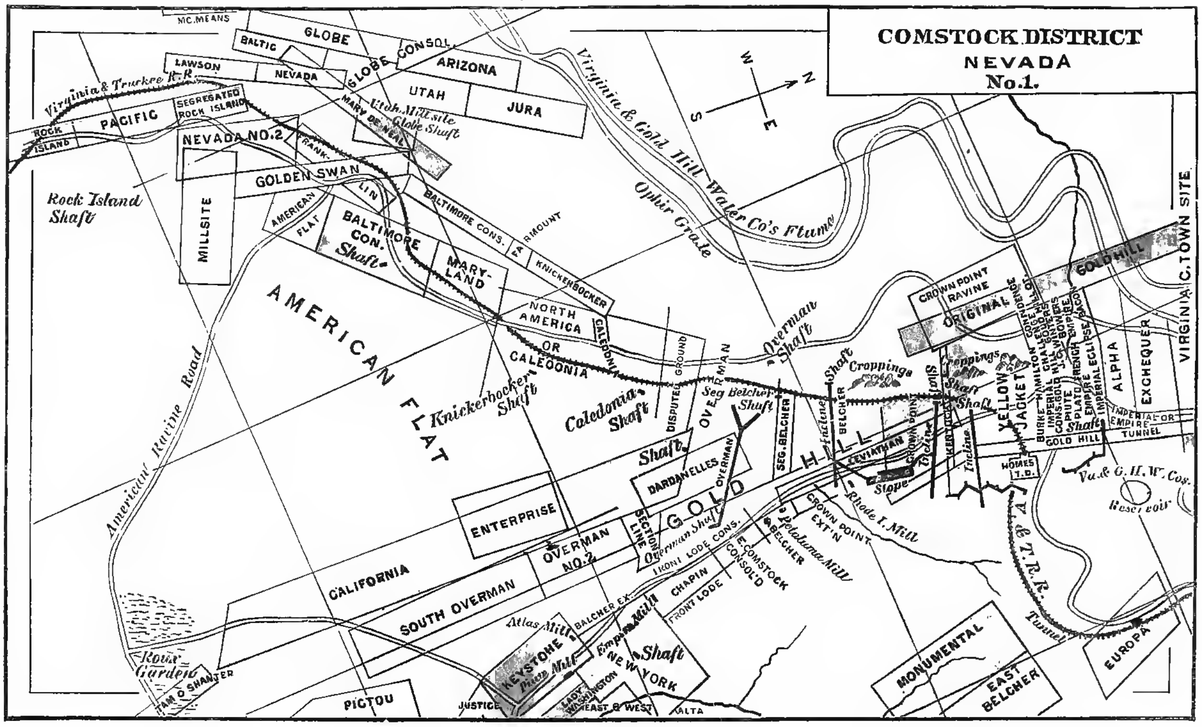
The New Jacket shaft, begun October 7th, 1876, was carried to the depth of 2250 feet in twenty-eight months, an average progress of 81½ feet per month. For some time the work was retarded by swelling ground; but pumps were not required for the first half or two-thirds of the sinking, the water being bailed out with the ore-skip. The work was not pressed with unusual vigor but carried on as steadily as the ground permitted. This rapid work is the result partly of high wages, admirable organization, and the lavish use of machinery. The administrative vigor which characterizes the management of these mines has made the employment of machinery for drilling a success wherever tried. The drifts are pushed forward at the rate of three to eight feet a day, and shafts at three to five feet. The higher rate is usually the result of machine-work; but hand-work also produces results that would be considered extremely rapid, even for machinery elsewhere.

Rapid progress is obtained here, as it is in most mining works, by the use of heavy powder charges and high-grade explosives. Picking and gadding are not much encouraged when the ground will blast well. For softer ground, where these modes of breaking down are advisable, shallow holes, three or four inches in depth, are sometimes made over the face of the header, and cartridges about an inch long, called "gophers," without tamping, are exploded in them. In ground which has been shattered in this way, excellent progress can be made by picking. Black powder is little used; nearly all the work being done with the nitro-glycerine compounds. Electricity is not used for firing, a fuse being inserted into the exploder. At the Sutro Tunnel the electrical mode of ignition was in use, and caused some very serious explosions. In spite of all precautions, the use of the electric exploder was found to be dangerous in the dry air of Nevada.

The high rate of progress is partly due to favorable ground. All the rocks encountered in the mines blast well, and the details of the work in excavation show that the rapid advance is obtained without resort to those strenuous efforts which are necessary in some other places. Comparing the Comstock drifts with the railroad tunnels, which seem to be the only rivals to them in swiftness of execution, it is immediately evident that decided differences exist in the details of work. In the tunnels, drill-holes of eight to eleven feet deep are common; but on the Comstock five feet is usually the maximum depth, even of machine-drill holes; and more frequently they are thirty to forty inches deep. Hand-worked holes vary from ten to thirty inches. This comparative shallowness is an inevitable consequence of the narrow quarters in which the machines work. All these details have come gradually into use, and though the mines have never enjoyed a common direction, the practice is essentially uniform throughout the district. While it is never safe to say that efficiency can go no further, it is probable that drilling and blasting are near their maximum of excellence in Comstock mining. These parts of the task involved in the extraction of subterranean rock have in fact reached a state of excellence that is much in advance of some other divisions of the labor. The removal of freshly blasted material is as slow here as it is in all single-track drifts, and greatly retards the progress. Probably one-half the time required for breaking down is spent in filling the rock into cars and running these to the shaft; and any means for hastening this work would be a valuable addition to the mining methods of the Comstock.

The cars used are now always made of iron; but the construction otherwise has not been changed from that which Mr. Hague described and illustrated. The load carried is still somewhat less than one ton, the large cars taking not more than 1800 or 1900 pounds. The disposition made of the car-load varies with the position of the level. When this runs out from a vertical shaft, the car is pushed upon a cage and hoisted; but when the level connects with the incline, the load is tipped into a shoot excavated over the incline. From this shoot the ore is loaded into the "giraffe," while the car returns for a new load, not leaving the level. This mode of extraction was barely introduced in Mr. Hague's day, but is now the prevalent one in the deep shafts. The name giraffe is given to the large car, holding twelve or fourteen tons, which runs in the incline. The principal innovations which have been made in the machinery of the mines since Mr. Hague's description was published in 1871 are:

1. Introduction of compound pumping-engines, with the Davey differential valve gear, modified by Mr. W. H. Patton. 2. Introduction of a direct-acting hoisting-engine, and increase of hoisting-speed to 1100 feet per minute. 3. Invention of the "skeet" by Mr. I. L. Requa, Superintendent of the Chollar-Potosi mine. This name is given to a large skip or ore-bucket, the use of which replaces the cage and avoids the necessity of hoisting the cars. Holding 4½ tons, it will raise more than a cage with four decks, and very much diminishes the dead weight to be lifted. It is self-dumping. This apparatus has been placed in the Requa, Taylor and other shafts, and if it approves itself upon extended trial, it may have an important effect upon Comstock mining and



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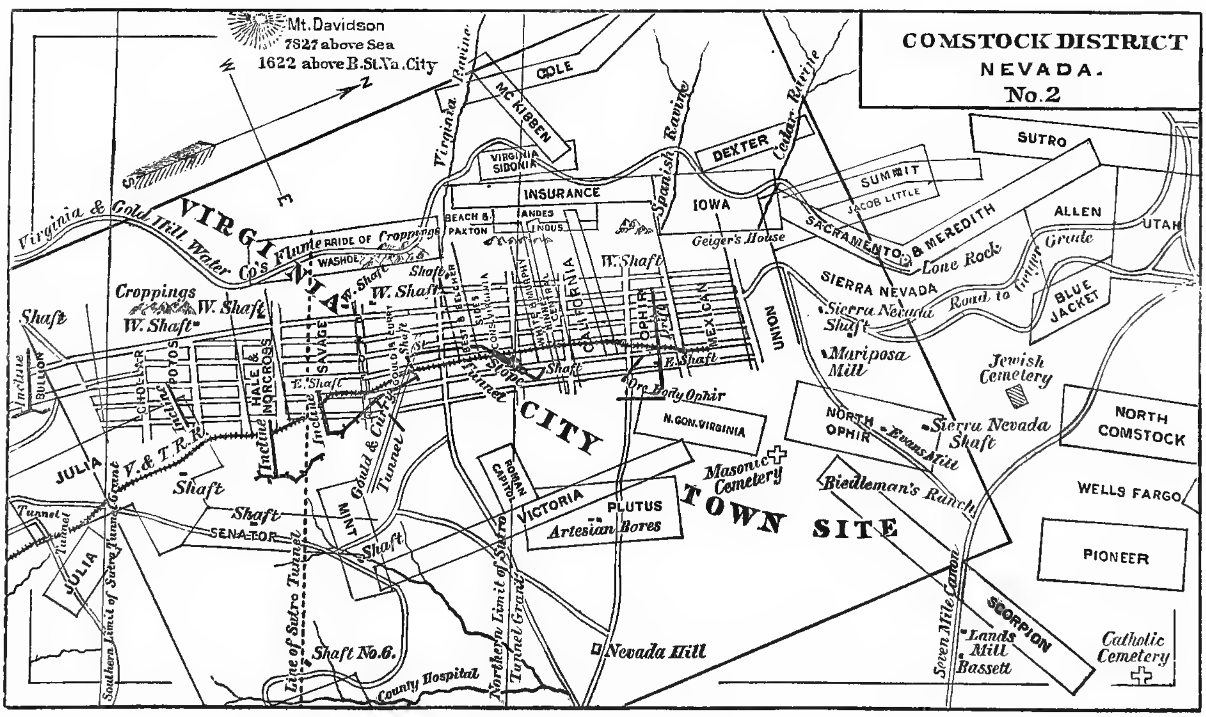

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play an excellent part in removing some of the difficulties of deep mining. 4. The use of galvanized iron air-pipes instead of the old red-wood boxes. Small as this detail is, no step can be taken in the management of ventilation in these mines without producing important results; and this has no doubt greatly improved the efficiency of the air supply. These points of distinctively engineering features will not be further touched upon; but there are others which concern the physics of the lode that will be described. They relate to ventilation and water supply.

Ventilation is secured by a combination of natural and artificial means; but underground the latter is mostly employed. Some also employ forced air-currents from the surface; but the apparatus is entirely inadequate to the supply of the large quantities of air required in these hot mines.

Brattices are sometimes found in main air-ways, and especially in the inclines; but the conditions of the ground are such that this mode of guiding air-currents is troublesome and costly in the vertical shafts. All the shafts on the lode lie in a hanging wall that has been undermined by extensive excavations, and even when this ground has settled to a firm condition, there is always local movement in the country rocks. The stratified condition and varied character of the material, the vast masses of soft clay or rock that decompose, swell, and flake away under the action of the atmosphere, with which this ground is filled, makes every opening insecure. Pressure and crushing are simply questions of time in every shaft, and the mode of timbering which has come into use, is designed to meet these peculiar exigencies. It consists of heavy timber frame work, unfastened and held together entirely by the pressure it sustains. This timbering is the invention of Mr. Phillip Deidesheimer. It allows considerable movement in the rock without losing its value as a safeguard, and this quality is so important that there is strong objection to placing stiff brattices, securely fastened, in the works. Air-currents from the surface, when forced, are therefore always sent down by pipes of galvanized sheet-iron eleven to twenty inches in diameter; and it is probably owing to these difficulties that the artificial ventilation of these mines is so unimportant. This remark does not apply to the local movement of air from one part of a mine to another. That is in use everywhere, and is accomplished by small engines which will be spoken of hereafter. Even the natural ventilation of these mines is remarkably small considering the vast heating powers of the hot rock, and the fact that even in summer an addition of from twenty to thirty degrees is made to the temperature of the air passing through the mines, while in winter the difference is greatly increased. In nearly all cases a shaft is exclusively down-cast, or up-cast, and the mines are divided into six down-cast and ten up-cast. In addition, the Gould & Curry had air-currents both ways in its shaft, and the Belcher has a special air-shaft for down-cast. On the 2d of July, 1877, the amount of air rising from eleven up-cast shafts (including the Gould & Curry), with its temperature, was as follows:

	Cubic Feet per Minute.	Temperature of Upcast Top of Shaft.
Utah	4,000	... degrees Fahr.
Sierra Nevada	7,700	76 " "
C. & C.	21,600	84 " "
Consolidated Virginia	48,750	89 " "
Gould & Curry	12,000	... " "
Savage	58,500	100 " "
Chollar-Potosi	18,000	77 " "
Bullion	10,080	89½ " "
Imperial Consolidated	28,800	95 " "
Belcher	52,000	89 " "
Overman	27,000	63 " "
Total cubic feet per minute	288,630	

This is probably to be considered as near a minimum quantity. A great difference is discernible in the ventilation of the mines on different days, due perhaps to the direction of the wind. This day (July 2d, 1877) was not a bad one, and the outside temperature, taken in the shaft-houses (and therefore in the shade) of those mines which were down-cast, averaged about 73 degrees F. from 10 A. M. to 4 P. M. The supply of air may be taken at eleven and a quarter tons or 300,000 cubic feet per minute, as the old Chollar and Kentuck shafts, both up-cast, were inaccessible. Probably 10,000 feet of this quantity is supplied by the numerous air compressing machines in use, and 30,000 feet by the blowers. The up-cast shafts had an aggregate suction of about 750 square feet, the area of which was diminished by an unknown quantity due to the presence of the cages at various stages of their paths. The minimum average velocity was therefore 400 feet per minute. Considering the straight course and excellent condition of the air-passages, and the short paths of most of the currents, this result cannot be regarded a very successful utilization of the great working powers of this extremely hot lode; but the causes of the deficiency, aside from the small section of the drifts as compared with those of coal mines, are not understood.

The velocities actually observed (with a Byram anemometer) varied from 200 to 900 feet per minute, the lower rate being obtained in those mines which have unusually long air-ways. The Savage, Bullion, Imperial, and Overman gave a velocity of 550 feet to 590 feet; the C. & C. 400; Consolidated Virginia, 620; and Belcher 900 feet per minute. Though ventilation is the life of all mines, the air-current is an especially beneficent visitor in the Comstock works. Nevada has a dry climate, and its atmosphere must have very high powers of hygroscopic absorption, which are further increased by the elevation of temperature which the air experiences in the mines. All of this is utilized, and the up-cast is so loaded with steam that it rises in a solid body of vapor thirty or forty feet above the shafts. The vaporization of this great amount of water must have a very marked effect in cooling down the drifts, aided as it is by the expansion of about 10,000 cubic feet per minute of air which has been compressed to one-fourth its usual volume, and the absorption of the heat which raises the whole current to a temperature of more than 90° F.

The unusual importance of the air-current in these mines is illustrated by the history of the 1850 level of the Bullion mine. This level was first opened from the Imperial shaft and attained a length of 1700 feet before any attempt to establish an air connection in the Bullion mine was made. The thermometer is reported to have ranged between 130° and 140° F., and work in the drift was extremely difficult and costly; but the State Mineralogist says that when a through current of air was established, the thermometer fell from 138° to 100° F. Here was an increase of thirty-eight degrees merely from the mode of working. At the time the observations given here were made, there were about 2700 men working underground in the mines in Virginia & Gold Hill. They worked in three "shifts" of eight hours each, and the allowance was therefore 300,000 cubic feet per minute to 900 men, or 330 cubic feet per man. This is very much in excess of the theoretical requirement, the amount required by law in the coal mines, where vast quantities of gas are discharged, not being above 100 cubic feet per man per minute. This quantity is itself a maximum designed to cover all possible contingencies, including the effective dilution of the coal gases. But the three times greater quantity which the Comstock mines receive is not sufficient to keep them cool nor to secure really comfortable conditions for them.

In another place it is shown that the heat of these rocks is probably due to the condensation of atmospheric water in the process of kaolinization, or transformation of the feldspathic rock to clay. By this action currents of gas, of which carbonic anhydride probably forms a principal part, are discharged, and take their way through the dry portions of the rock, conveying the heat produced to any opening by which they escape. It is probably to this agent in part that the nauseating effects which are sometimes felt even in the presence of a fair amount of ventilation are due. When the Sutro Tunnel reached the Savage works, in July, 1878, and a current of air was established through the tunnel into the mine, and thence 1600 feet upward to the surface, the air from the tunnel was said to be "sickening," though men had been working in it, with fair ventilation, and without unusual inconvenience for years. In this case the more vigorous movement of the air seems to have swept out the gas accumulated in the irregularities of the tunnel walls, and several days passed before the purity of the current was restored. The steaming atmosphere of the mines may contribute to the exhaustion which work in them induces; but whatever the causes, it is certain that the work is trying, and its severity is less dependent upon the temperature than upon deficient quantity of the air-current. This was constantly proved by leaving thermometers with the men who would not, without experimental proof, believe that the places which they sought for cooling off were sometimes hotter than those where they worked, and frequently had precisely the same temperature. It is true that an increase of a few degrees in the temperature of a drift will sometimes bring with it an exhaustion which is out of proportion to the heat change alone. This is explainable on the supposition that the increased heat is due to an unusual access of gas, and such places frequently become more comfortable after a few days. For this reason they are sometimes abandoned for a short time, "to cool off." It was invariably observed that while the men wanted constant change of air, they did not enjoy too strong a draft. They would complain if the fan engine was run too fast. On one occasion this fact was proved to me by the foreman of a mine, who quietly opened the throttle of the fan engine enough to speed it a little above its usual rate, though not to an excessive degree. My impression was that the change would be an improvement, for the drift to which the pipe led was probably 500 feet long, and quite hot. But in a few minutes one of the men came to the station and turned the valve back, saying it was "cold!" In this case the air at the fan had a temperature of 88° F., at the end of the air pipe 108° F., and in the drift about midway of its length 112° F. The latter was probably about the temperature of the atmosphere in which the men worked.

These conditions which are due to the character of the ground in which the mines are excavated, are supplemented by the requirements of vein mining. Labor is performed in narrow quarters, only a small portion of the lode material being moved in the work of exploration. Long stretches have to be excavated before a connection with a distant air-shaft can be established and a special mode of ventilation must be employed to supply the men working in these *culs de sac*, which are particularly subject to the peculiar conditions of the locality, for the reason that they are continually advancing into fresh ground. In these points which are removed from the line of the natural air-currents, ventilation is obtained by forced blast, and the machines which supply it are mostly placed below ground. They are ordinary upright engines of two to five horse power worked by compressed air at 60 pounds' pressure, supplied from the surface. Connected with each engine is a four-vane fan of simple construction, made in the shops of each company; and the air which these machines supply is taken to the end of the drift, or "header," by galvanized iron pipes eight or eleven inches in diameter. The engines are placed at some point in the main air-way, and take air of 75° to 95° F. temperature, the quantity being usually from 700 to 1000 cubic feet per minute to each fan. This may furnish three to seven men with air. Contrary to the usual practice in mining, the air is supplied by pressure instead of exhaustion; and this feature of Comstock engineering, which seems to be a matter of criticism to those who are not initiated in the peculiar requirements of work in these mines, is really one of the points most essential to the comfort of the men. The air-pipe terminates within twenty feet of them, and the current of fresh air is directed immediately upon their half-naked bodies, assisting in the rapid removal of the streams of perspiration which pour from them in quantities sufficient to soak their garments, fill their shoes, and even moisten the rock under their feet. The men drink copiously of ice-water, which is supplied without stint, and an allowance of three gallons per man is probably a minimum estimate for eight hours' work. All this is removed through the vigorous action of the skin, and the main condition for comfort to the men seems to be the quick removal of that part of the perspiration which is vaporized. If this hangs about the person, or if the vaporization is insufficient, there is a sense of suffocation; and this may take place either with deficient ventilation or even in a fair current of air if it is humid. Heat which increases the capacity of air for absorbing aqueous vapor may be in this way favorable to comfortable working, a fact which explains the relief so constantly obtained in a current of warm air. Throughout the mines it was observed that the men did not seek coolness, but quantity of air, and probably quality also, that is, capacity for absorbing moisture. For the latter reason, the air which is taken from a current having a temperature of 85° F., and is sent through a long pipe where it is heated to 100°, has its capacity for aqueous absorption increased so as to act with the highest efficiency when thrown upon the men. If the contrary method were used, and the air were drawn from the end of the drift through the pipe, as the managers are sometimes advised to do, the men would inevitably be put to great discomfort. Instead of a velocity of 100 feet per minute, the air would not have a greater movement than 40 feet per minute, and in passing through the drift it would pick up all the deleterious gases and all the moisture in its path. It would have no force of projection upon the men, and the constant exchange of atmosphere which is now obtained in the header would be lost. Without making radical and probably impracticable changes in the quantity of air supplied, there can be little doubt that the method of ventilation by exhaust fans would almost cause the closing of the mines. Still, the day is approaching when the present means of ventilation may be found insufficient, and a change of plan be necessary. It is probable that an intelligent study of the conditions under which personal comfort is secured will establish methods of ventilation that will allow the triumphant accomplishment of mining at depths of four and five thousand feet, even in these extraordinary natural furnaces. In another chapter it is shown that the most active centres of the heat are small and often can be avoided in planning the drifts, or confined by tight lagging, devices which may permit mining in much hotter ground than that of the existing levels. As the heat of the rock increases, the temperature and capacity for aqueous absorption of the air-current also increases, and the latter advantage can perhaps be heightened by drawing the air-currents direct from the surface. Thus in addition to improvement from increased care in management, the evil of increasing rock temperatures tends to correct itself by making the cooling and sustaining effects of the forced ventilation more vigorous. Of course there may be a point where the air will be too hot for the lungs to receive without injury; but the existing experience shows that a temperature of 123° and above this can be borne successfully, provided the action of the skin is properly maintained.

Pumping.—The country rock which encloses the Comstock is divided into distinctively wet and dry portions, arranged in a series of alternations parallel with the lode. The dry ground is in large excess over the wet, and it is so dry that the usual seepage, which takes place in all rocks, is quite insignificant. It is most often solid, but fissured portions are met with. Fissuring and decomposition are, however, the distinctive characteristics of the wet ground which occupies comparatively narrow bands, two or three hundred feet being probably a maximum thickness. Their vertical extent and their length are probably very great, for they pour out immense volumes of water, and for several years it was supposed that there must be large chambers in the rocks holding water, so great was the quantity yielded by some of the "water bonanzas." No such chambers have ever been encountered in the extensive explorations in the country rock, and there is no doubt that the seat of the aqueous stores is the soft and fissured seams which are constantly met with. The quantity of fluid which these shattered bands will hold is immense. Three years ago the Savage & Hale and Norcross mines were flooded by water, which entered on the 2200 foot level, and rose to about the 1750 level, flooding also the 2400 level which had been partly opened. The water therefore had a head of 450 feet, which must have been due entirely to hydrostatic pressure, and the freedom of movement within the seamy magazine is shown by the fact that here, as well as on other similar occasions, the miners had to fly for their lives, so rapid was the influx. New pumps, capable of throwing about 10,000,000 gallons per month to the surface, were immediately built for both mines, and have been working with great vigor ever since, but had not been able by the middle of December 1878 to reduce the water to a greater depth than 50 feet below the 2000 foot level, where it remained for several months longer. Great difficulties were experienced in the Savage by the breaking of the pump rod, and it is not probable that the pumps of the two mines have averaged more than three quarters of their full working capacity. Still that ratio would give for thirty months 450,000,000 gallons, or

1,800,000 tons, estimating the gallon at 8 pounds. This represents the quantity of water supplied by about three hundred feet of head. Two hundred feet remain to be overcome, and what amount of the fluid this represents cannot be foretold. The reduction of the water level is by no means very rapid nor uniformly continuous, and it is not possible to say how much the fissured water-bearing seam extends below the 2200 level. The Sutro Tunnel, which has been carried through to the 1640 foot level of the Savage mine, offers an opportunity for reducing the lift of the pumps, and increasing their size.

The third anniversary of its appearance (March, 1879) found this flood in full possession of the two mines, and the height was near still the 2000 foot level. Considering the depth at which it lies, and the character of the mines it has overcome, this "water bonanza" may fairly take position among the historic floods, which have defied the intelligence and determination of man. The Sutro Tunnel offers another example of the immense quantities of water which the rocks of this region locally contain. The quantity flowing from it has of course increased steadily with its progress, and now appears to be about 1,250,000 gallons a day, the tunnel being 20,489 feet long. Whenever wet ground was encountered the flow increased, reaching its highest point in October, 1876, when it was 24 miner's inches, or more than 4,000,000 gallons daily. This great work of engineering offers the best evidence of the banded nature of the water reservoirs. They have been repeatedly cut and passed in the tunnel, and always found to be soft and shattered seams of rock, and never vacant spaces. The next two or three years of experience in the tunnel will have great interest from its bearing upon the important question of what amount of atmospheric water reaches the tunnel level yearly. At present it is impossible to say how much of the floods which enter the mines is due to constant supply, and how much to the exhaustion of stores accumulated in the rocks. Upon the Comstock the impression is common that the current supplies from the atmosphere are very small, and it is in fact an ordinary occurrence for almost overwhelming floods to dwindle away to insignificant streams; but it is also true that some supplies are quite constant, as in the Ophir mine, which has pumped from its upper levels for years since they were worked out and abandoned, the lower levels meanwhile remaining remarkably dry.

It is noteworthy that while the country rocks contain these immense accumulations of water, the lode itself is tolerably free from them. Often it is quite dry, but sometimes contains a considerable amount of water, lying in the loose "sugar quartz" as in a sandstone bed. As a rule, these accumulations drain away rather rapidly, and are never so persistent as the great bodies from outside the lode. It is the country rock and not the lode that is distinctively the water-carrier, a fact which is probably due to the entrance of siliceous waters on the line of the lode, and the deposition of quartz in the crevices which elsewhere are free to store up water. It should be mentioned however, that a flow of water is looked upon as a favorable sign and promise of ore by the miners. Such indications of course depend upon position for their value, since floods of water have frequently been struck away from the lode, in points where there could be no sound expectation of ore. It is also possible that the value of water as a sign of ore, even within the just limits of the lode, has passed away as the mines have gained depth. In the upper portions the barren quartz was distinguished for its hardness and close structure, while the ore quartz was porous and loosely coherent. There was a well marked difference in the storing capacity of the two kinds of material, and water was no doubt often a true sign of the quartz that usually carried ore. But in the lower levels the strength of these distinctions is much diminished. Hard quartz is met with, but in proportion it is much diminished, and a flow of water in the lode is no longer a sign that a neighboring body of quartz is an ore carrier. The liability to overwhelming floods of water compels the mines to maintain pumps of the largest size, even though no extraordinary amount of water is encountered for years. They are all Cornish pumps, and the underground arrangements are still in the main what they were when Mr. Hague figured them in 1870, with exception of the size, which has been increased. Above ground great changes have taken place. The old cog gearing has given way to direct action in all the new pumps except that of the Jacket. Compounding, and the Davey differential cut-off, with a modification by a Mr. W. H. Patton, have been applied to all new constructions, and the Comstock now presents a line of powerful pumps constructed after the latest models. Beginning at the south end of the lode, we find the following new machines. The table also gives the number of strokes at which they were running in the autumn of 1877; but the maximum speed possible is about the same in all of them. This is lower on the Comstock than in cooler and drier mines. The difficulty of maintaining long pump-rods in a steaming atmosphere and over shifting rock surfaces, does not permit a higher speed than eight and a half strokes per minute.

	Pump.		Strokes per minute.	Hours of Daily run.
	Stroke.	Diameter.		
	feet.	inches		
Overman	8	14	1½ (registered).	24
Belcher	8	14	3½ (registered).	24
Yellow Jacket . .	10	14	. . . . . .	
Requa Shaft . . .	8	Two barrels, each 15 in.	. . . .	. .
Hale and Norcross	7½	13	6½ to 7½	24
Savage	7½	14 in. vertical shaft. 13 in. inclined "	6½ to 7½	24
Gould & Curry . .	7	14 & 12	4 to 4¼	24
C. & C. Shaft . . .	7	12	7 to 8	24

Six of these pumps, together with the old ones, were in the summer and fall of 1877 raising 350,000 to 400,000 tons of water monthly. The efficiency of the new form of pumping-engine is shown by the record of the Hale & Norcross pump for eight months, from October 1st, 1876. This mine being flooded, the pump was worked continuously.

Total Strokes	2,046.938
Strokes per Minute, including stops	5,85
Stoppages	9 days, 16 hours, 48 minutes.
Strokes per Minutes, excluding stops	6.119
Water pumped	84,436,192½ gallons.
Wood consumed	3,027 cords.
Cost	$41,721
Stroke of Pump (actual)	6 ft 5 in.
Gallons per Stroke	. . .41¼

The cost per gallon was not quite half a mill, 20.24 gallons costing one cent. The height of the lift varied as the water fell from a depth of 1670 feet to 1945 feet, the lowest point reached in this period. Probably the average lift was near 1800 feet. From October 1st, 1876, to March 1879, or in twenty-nine months, his pump made 7,432,054 strokes, and raised 306,572,228 gallons, at a cost of 8649 cords of wood, valued at $10.50 per cord. The stoppages amounted to 903 hours, 44 minutes. The Hale & Norcross, Savage and C. & C. pumps were working at their full capacity; the Belcher, Overman, and Gould & Curry pumps were working at reduced speed; the Requa, had no spear-rod, and the Jacket was not built in the fall of 1878. Three of the series were therefore run at their full capacity, three others at diminished speed, and two were idle. The total capacity of these new pumps may be taken at about twice the amount of water they were actually throwing at the time mentioned, or about 80,000,000 gallons, or 320,000 tons a month.

Of the old geared pumps there were six at work raising about one-third the water of the lode. This does not include either the number of pumps in idle mines or in those mines which, like the Julia, do not claim to be on the Comstock proper. The latter lie so near that lode as to drain the same rocks, and in any complete computation of drainage they should be accounted for. The spear-rods are always of Oregon pine, and vary from 11 to 14 inches in diameter. The extreme variation in quantity of water to be raised is not usually met by especial arrangements, but by slowing the engine or stopping it entirely for short intervals. Most mines increase the diameter of the pump cylinders in the upper part of the shaft, but not all. The Requa shaft has pump cylinders placed on each side of the rod, which in ordinary conditions of drainage are worked singly, but can be doubled on requirement. For single working, the successive cylinders on alternate sides of the rod are used. All the pumps on the Comstock are single acting; but the Alta mine at Devil's Gate has two spear-rods and pumps at both strokes, an arrangement which saves the use of balance-bobs. The cylinders of this engine also are compounded.

Though the cultivation of the soil requires artificial irrigation in this region, the vast quantity of mine waters are but little used for this purpose. Running into the gulches of Six-Mile Cañon and Gold Cañon, they serve to carry down the tailings from the mills where the ore is treated, and on their way are employed to operate a considerable number of blanket tables and pans for concentrating and treating the tailings. Finally they take their way to the Carson River, about seven miles distant by their route. Looking to the future, it is not improbable that the problem of deep mining will meet its greatest difficulty in drainage. The heat of the mines can be controlled sufficiently to afford even better conditions for work at great depths than have been enjoyed hitherto. But the deepest points of excavation are already 1000 feet below the Carson, the drainage area has greatly extended, and must now interfere seriously with the natural channels of relief to surface waters over wide districts. The extraordinary persistence of the Savage water and its return nearly to its highest level during a three months' rest of the pumps, after losing more than 2,000,000 tons by pumping, has not been explained. Still it is true that the resources of engineering have by no means been exhausted in the present mode of drainage, and the new shafts will undoubtedly offer great advantages in this respect over their predecessors.

— *From "The Comstock Lode by John A. Church, E. M. Ph. D."*

THE GEOLOGY OF THE COMSTOCK LODE AND THE WASHOE DISTRICT.

THE COMSTOCK LODE lies on the east slope of the Virginia Range, a northeasterly offshoot from the range of the Sierra Nevada. The region is a desert, supporting scarcely any vegetation besides the sage-brush. Portable water is found only in quantities too small to supply a settlement, and the town now depends for its supply on a point in the Sierra Nevada, thirty miles away. The mines were first opened in this inhospitable region in 1859, but have since been pushed with such vigor that their product is supposed seriously to have affected the silver market of the world. They have produced about $315,000,000 worth of bullion, of which $175,000,000 was silver (at the rate of one ounce equal to $1.2929). Of the total yield, $115,-871,000 has been disbursed in dividends. The last great ore body discovered yielded $111,707,609.39, of which $74,250,000 was paid in dividends. The number of men employed in the mines on June 1, 1880, was 2,770, and the sum annually disbursed in wages is now $4,550,000. The aggregate horse power of the machinery of the mines is 24,130. The total length of shafts and galleries exceeds 150 miles, and the greatest depth reached is above 3,000 feet. As has long been known, the COMSTOCK LODE presents scientific questions of an interest commensurate with its economical importance, and a number of famous geologists have written more or less fully on the subject. Besides numerous scattered papers, several important memoirs have been printed. Baron von Richthofen made an examination in 1865, the results of which were printed by the *Sutro Tunnel* Company, but were not published in the proper sense of the word. It is a very remarkable paper, and the portions relating to the geology are reproduced in this report almost in full. In 1867 Baron von Richthofen also published a paper entitled "A Natural System of Volcanic Rocks," as a memoir of the California Academy, in which the system proposed is avowedly based to a great extent on the geology of Washoe. At the date of these papers microscopical lithology was still in embryo, and Mr. Sorby's experiments were attracting attention as possibly promising important results. It is not wonderful, therefore, if the present inquiry, in which the microscope has been used as a field instrument, has led to different lithological results; while, so far as the structure and vein formation are concerned, the greater part of this geologist's views are confirmed in a remarkable manner. In 1867-'68, Mr. Clarence King, who was in charge of the exploration of the 40th parallel, made an examination of the lode, down to the 800-foot level.* He accepted von Richthofen's propylite, though stating a doubt whether it might not eventually prove identical with andesite. The quartzose rock of the district, which von Richthofen had determined as a pre-Tertiary quartz-porphyry, King regarded as quartz-propylite. The most prominent feature of this memoir is the graphic description of the vein phenomena from the surface down. In 1875, Prof. F. Zirkel examined the lithological collections of the 40th parallel.† Among the slides which he describes are thirty-three from the Washoe district. He confirmed the independence of propylite and quartz-propylite as lithological species, regarded the quartzose rock as dacite, corrected the determination of the granular diorite (it had been considered syenite), and added augite-andesite, rhyolite, and a strange variety of basalt to the list of rocks previously recognized. In 1877, Mr. J. A. Church, in connection with the United States Surveys West of the 100th Meridian, under Captain Wheeler, examined the workings down to the 2,000-foot level. Mr. Church accepted the lithology of his predecessors, with some exceptions a little difficult to follow, but though he mentions slides of the rocks, describes none. His memoir contains a number of ingenious hypotheses, prominent among which are the following:

That diorite was a thin flowing lava, and spread over the country in successive thin horizontal beds; That propylite and andesite were laid down in the same manner on the diorite, and the whole bedded mass was tilted or folded in such a way that the eruptive strata assumed their present position with an inclination of about 45°; That the ore was deposited by substitution for propylite, regulating the COMSTOCK to the class of Fahlbands; That the heat of the COMSTOCK is due to the kaolinizing action of surface waters on the feldspar of the country rock.

A topographical map of the district was published by the Expedition of the 40th Parallel, but a more detailed contour map, on a larger scale, was made in 1879, under orders of Captain Wheeler, by Mr. A. Karl.

Decomposition of Rocks.—The economical importance of the district, the obscure character of some points in its geology, and the great weight of the authorities whose investigations had already been published made it essential that the work done under the new United States Geological Survey should be supported by the strongest and most detailed evidence In laying down the various formations the microscope was in constant use, slides being ground as the occasion arose, and the results obtained from them finding immediate application in the extension of the work. The area in which the COMSTOCK lies is characterized by a wide-spread and profound decomposition of the rock masses, and a study of the lithology of the district resolves itself primarily into an investigation into decomposition. In spite of the most painstaking choice of specimens, there is not one in fifty of those collected underground which contains a particle of any of the characteristic bisilicates, secondary minerals replacing them throughout. Even the feldspars are rarely intact, and are sometimes wholly decomposed. When the steps of these processes of degeneration are once understood, it is comparatively easy to infer the original composition and structure of the rock. Some of the results obtained concerning the decomposition of the Washoe rocks are the following: Hornblende, augite, and mica generally pass into a chloritic mineral, which, so far as can be judged by any optical tests now known, is almost without exception the same, from whichever of the primary bisilicates it may have originated. This chlorite is generally green, but in especially compact masses appears greenish-brown under the microscope. It is strongly dichroitic, but, except in dense masses, appears nearly black between crossed Nicols. It is fibrous, often spherolitic, and invariably extinguishes light parallel to the direction of the fibres. It thus bears a considerable resemblance to fibrous green hornblende, but the cases are very rare, if they actually occur, in which a careful examination will not serve to discriminate between the minerals. This chlorite is decidedly soluble. It occurs in veinlets and diffused through the ground mass and through other minerals when these have become pervious through decomposition. It is especially striking as an infiltration in the feldspars, where, of course, it is readily visible. All the

* Exploration of the 40th Parallel, Vol. III.

† Exploration of the 40th Parallel, Vol. VI.

stages can be traced, from the first inconsiderable attack of the bisilicates, through rocks in which chlorite occurs wholly, or almost wholly, as admirable pseudomorphs after the bisilicates, and up to cases in which the secondary mineral is wholly diffused through the mass of other products of decomposition. Epidote is usually in Washoe a product of the decomposition of chlorite. Comparatively very few occurrences of epidote are explicable on the supposition that the mineral is the direct result of the decomposition of the primary basilicates; none are inexplicable on the supposition that chlorite represents an intermediate stage in the alteration, and hundreds of cases show beyond question epidote developing in chloritic masses, and sending characteristic denticles and fagot-like offshoots into the comparatively homogeneous chlorite. A considerable number of drawings, which are photographic in their fidelity, have been made, illustrating these processes. Epidote, too, appears to be soluble, but to a much slighter extent than chlorite. The veinlets of epidote are often, though probably not always, a result of the alteration of chlorite. No evidence has been obtained that feldspars are ever converted into epidote, and the dissemination of fresh hornblende particles in feldspars in any considerable number has not been observed. In many cases, on the other hand, it can be shown that feldspars have been impregnated with chlorite, from which epidote has afterwards developed. Chlorite does not always change to epidote, and appears often to be replaced by quartz and calcite. This is frequently visible in slides, which also show its alteration to epidote. No certain evidence of the alteration of epidote has been met with.

In the decomposition of the feldspars, the first stage appears to be the formation of calcite. This sometimes leaches out, leaving small irregular cavities, and these cavities are not infrequently filled with liquid, sometimes carrying a bubble, which is commonly stationary, but occasionally active. Thus secondary liquid inclusions are formed, which may mislead in the diagnosis of a rock. Primary liquid inclusions are either more or less perfect negative crystals or vesicular bodies. The vesicles often assume strange forms through pressure, such as are often observed in air-bubbles in the balsam of a slide, but their outlines are composed of smooth curves. The secondary fluid inclusions are bounded by jagged lines. Inclusions of this kind are never met with unaccompanied by other evidences of decomposition, and thus are abundant in the altered outer crust of andesite masses, the inner portions of which show none of them. There is every reason to suppose that the same secondary inclusions would form in older rocks, and similar occurrences have been noticed. Kaolin possesses so few characteristic optical properties that it is not identified with ease or certainty under the microscope. No kaolin has been identified in the Washoe rocks, and while it is by no means asserted that they contain none, it seems hardly possible that, had it formed a prominent constituent, it would have escaped observation. The presence of enormous masses of "clay" on the COMSTOCK does not prove the existence of much kaolin, for so-called clays are largely attrition mixtures. But of this later.

An increase of volume appears to accompany the decomposition of the Washoe rocks. This is perceptible where dense masses, such as the more compact andesites, are subjected to the process. Angular blocks are then converted into a series of concentric shells of comparatively soft matter, which approach the spheroidal shape more and more as the diameter diminishes. Often the nodule of undecomposed rock is found at the center, and such masses afford the very best opportunity for studying the macroscopical appearances resulting from degeneration. When the attacked mass is large, erosion often exposes the fresh core, which then, offering greater resistance, projects as a "cropping," or, if it has an elongated form, like a dike above the surrounding country; and as the tendency of the mere action of atmospheric agencies is to the production of ferric hydrate rather than chlorite from the bisilicates, the first impression which such a mass produces is that of an older and younger rock in conjunction. Nevertheless, sufficiently thorough examination will reveal a transition. When the rock is not solid, but brecciated or loose-grained, sufficient space seems often available to permit the requisite increase of volume without disintegration. Large and often prominent masses of very strongly cohesive decomposition-products derived from breccia are common in the district. The mineralogical character and the microscopical phenomena of decomposition seem to be identical in the different rocks. Those refined manifestations of physical character by which it is so often possible to discriminate between older and younger rocks, and between the various rock species when fresh, are nearly or quite obliterated by the decomposition process, which impresses its own character on the product.

Propylite.—The present investigation of the geology of the Washoe District has failed to establish the existence of propylite. Fnll proof of this responsible statement cannot of course be given in this summary of results. It consists in a process of exhaustive elimination. A study of each of the rocks of the districts, in all stages of decomposition, has led to the identification of all of them with other and previously recognized species. The reduction of rocks of originally different aspect to apparently uniform character by chlorite decomposition is strikingly evinced by a mere list of the species in the district, which have been grouped under the terms propylite and quartz-propylite. These are granular and diorite, porphyritic diorite, diabase, quartz-porphyry, hornblende-andesite, and augite-andesite. The peculiar "habitus" which is always referred to in descriptions of propylite appears to consist in the impellucidity of the feldspars, the green and fibrous character of the hornblende, the greenish color which often tinges feldspars and ground-mass, and a certain blending of the mineral ingredients. The impellucidity of the feldspars (which surprisingly alters the appearance of rocks originally containing transparent unisilicates) is due to incipient decomposition, especially, as it seems, to the extraction of calcite. The "green hornblendes" are simply pseudomorphs of chlorite after hornblendes or augite, as the case may be. Excepting the granular diorite, not one of the rocks from which propylite forms have ever been found in the Washoe District containing green hornblende, (barring uralite). The other characteristics are due to the diffusion of chlorite and the formation of epidote from it. The description of propylite as a species arose from the erroneous determination of chlorite as green hornblende—a very natural mistake before the microscope was brought to bear on the subject, since even with that instrument the same error may be committed if color and dichroism are exclusively relied upon as diagnostic tests. The microscopical characteristics of propylite are illusory. Finely disseminated hornblende in the ground-mass of a Washoe rock is very rare, and far rarer is the presence of particles of hornblende in feldspars. The propylites contain glass inclusions and primitive liquid inclusions, or not, according to the rocks from which they are derived. Base is rare in propylites; where it originally formed a constituent of the rock, it has for the most part undergone devitrification, and the writer does not hesitate to affirm that there is no proof yet known of the existence of a pre-andesitic Tertiary eruption in the United States. The term propylite should not be retained in the nomenclature of American geology even to express certain results of decomposition, for the equally loose term greenstone seems to cover the same ground and has priority.

The Rocks of the Washoe District.—The rocks occurring in the Washoe District are granite, metamorphic schists, slates, and limestones; eruptive diorite of three varieties; metamorphic diorite, quartz-porphyry, an older and a younger diabase, an older and a younger hornblende-andestite, augite-andesite, and basalt.* The report contains

* The signification attached to these names has varied somewhat as the science of lithology has progressed. Some of the main points of their definitions as here understood are as follows:

Granite, pre-Tertiary non-vitreous crystalline rock, of which the principal constituents are orthoclase, quartz, and mica or hornblende.

Diorite, pre-Tertiary non-vitreous crystalline rock, of which the main constituents are plagioclase and hornblende. It may or may not contain quartz.

Quartz-porphyry, pre-Tertiary glass-bearing porphyritic rock, of which the main constituents are orthoclase, quartz, and hornblende or mica.

Diabase, pre-Tertiary, more or less porphyritic rock, of which the main constituents are plagioclase and augite.

Andesite, Tertiary or post-Tertiary, glass-bearing, more or less porphyritic rock, of which the main constituents are plagioclase a discussion of each of these rocks, embracing a detailed description of about seventy-five slides well illustrated. Here they can be dismissed with a very few remarks.

Concerning the granite and basalt there has scarcely been a question. They are eminently characteristic occurrences. The metamorphic diorite sometimes resembles eruptive diorite, and has been taken both for diorite and granite; usually it bears some resemblance to augite, andesite or basalt, and has been determined microscopically as an unusual variety of the latter rock. It is composed essentially of oligoclase and hornblende. The hornblende was originally colorless, but through some change (perhaps absorption of water) it is in large part converted into an intensely green variety. The hornblende polarizes in unusually intense colors. The quartz-porphyry underlies both hornblende, andesite and diabase. The microscope, Thoulet's method of separation, and analysis show that the predominant feldspar is orthoclase. It is characterized by the association of liquid and glass inclusions usual in quartz-porphyry, to which also the ground-mass corresponds. In one locality, near the *Red Jacket*, the quartz is nearly suppressed, and the rock is excessively fine-grained. It is a felsitic modification of the ordinary variety. This rock, which Baron v. Richthofen determined correctly, has since been called quartz-propylite, dacite, and in its felsitic modification rhyolite. Most of the quartz-porphyry is greatly decomposed. The eruptive diorite is sometimes granular, sometimes porphyritic. In the porphyritic diorite mica sometimes predominates over hornblende. Quartz is irregularly disseminated through the rock. In the granular diorite the hornblende is sometimes green and fibrous, sometimes brown and solid. In some cases it can be shown that the latter variety of hornblende is altered to the former, and possibly this is ordinarily the case. Augite is not uncommon, and a part of the fibrous green hornblende is very likely uralite, but in the granular rock the outlines of the crystalline grains are rarely sufficiently regular to determine this point. In the porphyritic diorites the fresh hornblende is always brown. Even in this latter variety of the diorites well-developed feldspars are rare. The porphyritic diorites have for the most part been regarded as propylite, and some occurrences of the granular rock have been classed in the same way. Some of the fresher porphyritic diorites have been mistaken for andesites, the resemblance to which is sometimes strong. The older diabase is porphyritic. Almost the whole of this rock is in a very advanced stage of decomposition, and when fresh considerably resembles an augite-andesite, but its ground-mass is thoroughly crystalline; it contains no glass inclusions, but frequent fluid ones; the augites show both pinacoidal and prismatic cleavages, and a tendency to uralitic decomposition. It is also manifestly older than the other diabase. An important characteristic is the lath-like development of the porphyritic feldspars, for in cases of extreme decomposition of the bisilicates this characteristic at least serves to suggest whether the rock is dioritic or diabasitic. The older diabase has been considered as propylite or andesite, according to the stage of decomposition. The younger diabase ("black dike") is very highly crystalline and not porphyritic. It is bluish when fresh, but in course of a few hours turns to a smoky brown. It is identical with many of the diabases of the New England and the Middle States. The older hornblende-andesite and the augite-andesite where fresh are typical rocks macroscopically and microscopically. When decomposed they have been taken for propylite. The younger hornblende-andesite which overlies the augite-andesite is a cross-grained, soft, reddish or purplish rock, with large glassy feldspars. It has always been supposed to be trachyte; but, when endeavoring to determine the different species of feldspar under the microscope, the writer was unable to include any satisfactorily determinable orthoclases in the list. Dr. G. W. Hawes was kind enough to undertake the separation of the feldspars by Thoulet's method, and the analysis of the resultant feldspars. The specimen selected was the most trachytic in appearance, that of Mount Rose, but no feldspar whatever was found corresponding either physically or chemically to orthoclase. There is much reason to believe that trachyte occurs less often than had been supposed in the Great Basin area.

and hornblende, mica, or augite. The andesites in which augite is the characteristic bisilicate appear to be separate eruptions, while mica and hornblende replace one another to a variable extent in the same eruption. In the andesites feldspar predominates.

Basalt, Tertiary or post-Tertiary plagioclase augite rock, with predominant augite, usually characterized by the presence of olivine.

Structural Results of Faulting.—The evidence of faulting on the COMSTOCK is manifold, and has been recognized by all observers. The irregular openings in the vein, the presence of horses, the crushed condition of the quartz in many parts, the presence of slickensides and of rolled pebbles in the clays, are all conclusive on this point. Both to the east and west of the vein, too, the country rock shows a rude division into sheets, and along the partings between the plates evidences of movement are perceptible, decreasing in amount as the distance from the vein increases, according to some law not directly inferable. All the evidence points to a relative downward movement of the hanging wall.

The question of the character of the contact surface, whether it is a faulted surface or a continuation of a former exposure of the east front of Mount Davidson, is not to be settled by mere inspection. A cross-section to scale taken from Mr. King's maps shows immediately that while the dip of the lode is 45° or more, the maximum slope of Mount Davidson is about 30°. This fact, taken in connection with the character of the west wall when exposed, indicates that the surface is the result of faulting. A natural surface sloping for a long distance at an angle of above 40°, too, is very unusual. On the other hand, the coincidence between the contours of the west wall and those of the exposed surface has been notorious from the earliest days of mining on the lode, and it seems a less violent supposition that the steep flank of the mountain passes over into the still steeper wall of the vein than that the range has experienced an erosion modifying its angle 15° and more, and has still retained the details of its topography otherwise unaltered. It is plain that the elucidation of the faulting action on the COMSTOCK is a very important structural problem, and that it is most desirable to account quantitatively for the results, as well as to prove the existence of a notable dislocation. The most striking and wide-spread evidence of the faulting is the apparent relative movement on the contact surfaces between more or less regular sheets of the east and west country rocks for a long distance in both directions from the lode. Each sheet appears to have risen relatively to its eastern neighbor, and to have sunk as compared with the sheet adjoining it on the west. The consideration of a sheet or plate of rock under the influence of friction of a relatively opposite character on its two faces, therefore, forms the natural starting point for an examination of the observed conditions. It will be shown in the report, that if a country divided like the COMSTOCK area into parallel sheets experiences a dislocation on one of the partings under a compressive strain equal at each parting, a vertical cross-section will show a surface line represented by two logarithmic equations:

$$y = A\ (m^{-x} - 1) - x \tan \vartheta$$
$$y = A\ (1 - m^{x}) + x \tan \vartheta$$

in which A is one-half of the throw of the fault, and ϑ is the angle which the x-axis makes with the original surface. The y-axis coincides with the dip line of the parting on which the fault occurs, and the origin is at the cropping of the fault-fissure. The coördinates are rectangular. The correctness of this equation is confirmed by a very simple and satisfactory experiment. Fig. 1 shows a cross-section such as might result from a fault on the line Y A, supposing the original surface to have been level.

The discussion is also extended to the case in which the compressive strain is not uniform, but varies proportionally to the distance from the fault-plane. This case also results in a logarithmic equation of a more complex character. A discussion of the logarithmic equation as an expression of faulting action leads to some very interesting results, some of which are as follows: Where a fault of the class under discussion has occurred, and where the resulting surface has not been obscured by deep erosion, the original surface can be reconstructed or calculated, and the amount of dislocation determined. This is also true where more than one rock is involved. Where, as is nearly always the case, the movement on the fault-plane is equivalent to a rise of the foot wall; the hanging wall seen in cross-section will assume the form of a sharp wedge, and this wedge will be very likely to yield to the compressive strain, and break across. If the movement of the footwall on the fault-fissure were downward, a surface line would form, which is scarcely ever met with in nature, and the inference is that faults of this kind are of extreme rarity. This not only confirms the observations made in mines, but places the fact on a wide basis of observation. If a fault, accompanied by compressive strain. takes place on a fissure in otherwise solid rock, the walls are likely either to be distorted, if they are composed of flexible material, or to be fissured into parallel plates if the material is rigid. In the latter case the sheets of rock will also arrange themselves on logarithmic curves.

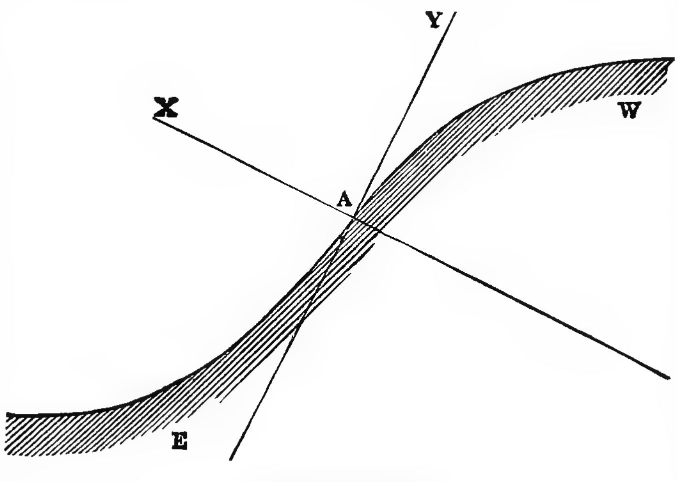


Fig. 1.—Fault Curve.

If the intersection of a fault fissure with the earth's surface is not a straight line, but is sinuous or broken the secondary fissures will be parallel to the original one, and in the resulting surface each inflection of the trace of the fissure on the original surface concave toward the lower country will be represented on the faulted surface by a ravine, and each inflection convex towards the lower country will result on the faulted surface in a ridge. This is illustrated in Fig. 2, which is a contour map of the country represented in Fig. 1, if the fault-fissure is supposed to have intersected the original surface on the undulating line A B. There is also a direct relation between the contours of the footwall of such a fissure and the surface contours. If the original surface was a horizontal plane, the surface contours will be identical with the footwall contours. A fault may be the result of a single extensive movement, or of successive slight movements in the same sense, with intervals of quiescence. It can be shown, with a high degree of probability, that the result of an intermittent dislocation will be sensibly the same as that of a continuous one.

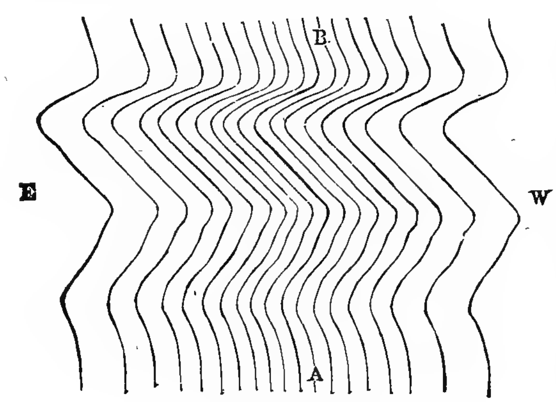


Fig. 2.—Faulted surface.

The theory, though worked out independently of the Comstock, applies to it with much precision. Equations can be given representing very closely the surface line of a cross-section, the amount of the fault can be determined, etc. It can be shown that the erosion since the beginning of the fault is very slight, that the cañons of the range were produced by faulting, and have been only slightly modified by erosion, whence the correspondence of the contours of the footwall with those of the surface. The east fissure is a result of the faulting, and the ore has been deposited since Washoe became a region of insignificant rainfall. The sheeted structure of the country is, in all probability, due to the fault. It is, of course, most unlikely that the Comstock is the only vein in which the deposition of ore is recent and has been accompanied by faulting, and some conclusions as to the occurrence of veins in such cases may be welcome to some of the readers of this paper. In a locality modified by faulting action under pressure the fact will appear in the parallelism of the exposed edges and faces of rock sheets. If erosion had not seriously modified the surface resulting from the faulting action, the logarithmic curve will be recognizable to the observer looking in the direction of the strike. The main cropping of the vein is to be sought at the point of inflection of the curve, which will be found nearly or exactly midway between the top and bottom of the hillside. One or more secondary vein-croppings should be looked for below the main cropping, and these, so far as yield is concerned (but not in regard to location of claim), may prove even more important than the main fissure. The dip of the vein will be to the same quarter as the slope of the surface, but of course greater in amount. The flatter the surface curve the smaller the angle of dip will be. The mean strike will be nearly or quite at right angles to the direction of the spurs and ravines of the faulted area. If, besides the movement of one or other wall in the azimuth of the dip, there has been a dislocation in the direction of the strike, chimneys will open, all of them on the same side of the different ravines. Surface evidences will often enable the prospector to determine on which side the chimneys are to be found. On the barren sides evidences of crushing and of closure of the fissure are probable. The fissure is more likely to have a constant dip (barring the secondary offshoots than a constant strike, but, of course, irregularities of dip, like those in a strike, will open chambers which may be productive. Offshoots into the hanging wall may occur at any depth, but none, except those near enough to the main cropping to reach the surface where it has a very considerable slope, are likely to be continuous. Finally it is shown that the law of land slips is also capable of expression by logarithmic equations, and that a large part of the details of the topography of grassy hills is formed in obedience to this law.

Occurrence and succession of rocks.—Granite occurs on the surface only in a very limited area near the Red Jacket mine, but it is certain that it has considerable underground development, for it has been struck at the Baltimore, the Rock Island, and by a tunnel to the southwest of the latter. The granite is overlaid by metamorphic rocks, which, however, are less metamorphosed close to it than at a distance from it, and the probabilities are that the sedimentary strata were laid down upon the massive rock. The sedimentary rocks are limestones, crystalline schists, and slate. They are badly broken and highly altered, and the search for fossils was not rewarded by success. The general geology of this part of the Great Basin, however, leaves little doubt that they are Mesozoic. A considerable area of metamorphics has been exposed in the southwest of the region by the erosion of the overlying eruptive masses. North and east of Silver City, however, the surface shows scarcely any metamorphics, while they play a large part in the underground occurrences as far as the Yellow Jacket. In the Gold Hill mines black slates form the footwall of the lode. They are intensely colored with graphite, and often very highly charged with pyrites.

They are frequently mistaken for "black dike," but a moment's inspection in a good light shows their sedimentary origin. The presence of such carbonaceous rocks at greater depths would explain the formation of hydrogen sulphide. There is also an obscure occurrence of metamorphic limestone in the Sierra Nevada mine between granular and micaceous diorite. It appears to be conformable to the face of the granular diorite. The metamorphics in and about Gold Hill appear both to overlie and to underlie diorite, and there is little doubt that sedimentary strata were present at the period of the diorite eruption.

Between the metamorphics and the quartz porphyry in the southwest portion of the area is a considerable extent of a black, crystalline rock, the relations of which are somewhat obscure. It has already been referred to as a metamorphic diorite. Cases of transition into distinctly metamorphic rocks no doubt occur, but none of an indubitable character were discovered. On the other hand, in some occurrences the rock is a distinct breccia, and bears a strong resemblance to augite-andesites or basalts. The point to which most weight has been given in determining its orgin is its association with the quartz-porphyry, and the distinctly metamorphic rocks. It appears to be exposed wherever the quartz-porphyry is eroded, and is frequently also associated with underlying metamorphics. Its resemblance to a volcanic rock, too, is greatest on its upper surface, and its analysis shows a composition which would be strange for an eruptive diorite. Besides the surface occurrences, it is found particularly well developed in the *Silver Hill* mine. The principal exposure of diorites is on the west of the lode through Virginia City, but there are several outlying occurrences about the *Forman Shaft*, and again far to the east at the *Lady Bryan* mine, which show that the underground development of the rock is a very extensive one. It forms the footwall of the lode from the *Yellow Jacket* north. The diorite is excessively uneven in its composition, and in almost any area of a hundred feet square several modifications are to be found. This fact, taken in connection with the microstructure of the rock, is pretty conclusive evidence that it has never reached a higher degree of fluidity than the plastic state. The varieties can be roughly classified as granular diorite, porphyritic-hornblendic diorite, and porphyritic-micaceous diorite. But intermediate varieties are of constant occurrence. There seems, nevertheless, to be a certain amount of order in the disposition of the different varieties. Mount Davidson, from Bullion Ravine to Spanish Ravine, is almost altogether granular on the west of the LODE, but to the north and south of these limits porphyritic forms prevail. In the neighborhood of the *Utah* mine mica becomes the predominant bisilicate, and the last variety is also the one which occurs in the neighborhood of the *Forman Shaft*. How this orderly disposition of the various diorites came about is a somewhat obscure question. The diabase appears but to a very trifling extent upon the surface, though it is by no means unlikely that an exposure of this rock occupied the position now covered by Virginia City. Underground it is extensively developed from the *Overman* to the *Sierra Nevada*, and from the lode to the *Combination Shaft*, as is seen in the cross-section on the *Sutro Tunnel* line. Its great importance is due to the fact that all the productive bodies of the COMSTOCK have been intimately associated with it, as, indeed, are many of the famous silver mines of the world. This diabase is of a rather unusual character, being more than commonly porphyritic, and containing comparatively little augite, a trifle less than twenty per cent. In appearance it is often not dissimilar to the andesites, but the resemblance does not extend to details. Almost the whole of this diabase is greatly decomposed, and has hitherto escaped recognition on that account.

Between the east country diabase and the west wall of the COMSTOCK occurs a thin dike, which has long been known as "black dike." It is only in the lower levels that fresh occurrences of this material have been met with. The "black dike" appears to be identical with the Mesozoic diabase of the Eastern States, from which it is scarcely distinguishable microscopically, or chemically. This younger diabase forms a remarkably microscopically thin and uniform dike, nowhere more than a few feet in thickness, extending from the *Savage* southward to the *Overman*, and the branching off to the southwest as far as the *Caledonia* shaft. This is the only dike in the district, in spite of the prevalence of eruptive rocks. Its presence shows that the fissure on which the COMSTOCK lode afterward formed was first opened in pre-Tertiary times, and its uniform thickness shows that its intrusion antedates any considerable dislocation on the contact. This inference receives strong confirmation from the evidence already explained that the faulting is a comparatively recent phenomenon. The occurrence of the two diabases also goes a long way toward demonstrating the nature of the fork in the vein, which has always been a mysterious point in the geology of the lode. The prolongation of the "black dike" beyond Gold Hill is toward American Flat, whereas the older diabase extends in the direction of Silver City. Much the larger part of the surface of the district is occupied by andesites, of which there are three varieties distinguishable both lithologically and geologically. These are a younger and a later hornblende-andesite, the latter of which has hitherto been considered a trachyte, and an augite-andesite intermediate in age. The older hornblende-andesite has in part long been recognized as such and is deceptive only when highly decomposed. It occupies a belt immediately east of the older diabase (see *Sutro Tunnel* section), a large area on the heights immediately west of the diorites, and a considerable area at and north of Silver City. The latter occurrence is noteworthy for the unusual size of the hornblendes, which are sometimes several inches in length. The augite-andesite occupies a second belt of country east of the lode and beyond the earlier hornblende-andesite, and is also extensively developed to the north and south of the diorite. The *Forman Shaft* penetrates 1,200 feet of this rock before passing into the hornblende-andesite. The reasons are given elsewhere for considering the rock heretofore regarded as trachyte to be an andesite. It is rough but soft, and its red and purple colors and large glassy feldspars made the mistake an easy one. The Flowery Range, the Sugar Loaf, Mount Emma, and Mount Rose, are all of this rock, which also occurs in two little patches close to the *Sierra Nevada* mine. These latter have been cut off from the quarry above the *Utah* by the erosion of Seven-Mile Cañon. The patches of rock near the *Combination Shaft* and the new *Yellow Jacket Shaft*, which have sometimes been regarded as trachyte, are merely decomposed older hornblende-andesite. The occurrence of basalt is exceedingly limited. It is a fine, fresh, and typical basalt, but there is no evidence of any direct connection between its eruption and the vein phenomena.

Chemistry.—The chemical history of the Comstock is no doubt a very complex one, nor are there by any means sufficient data to trace it in detail. All that can be attempted here is to show that the results observed might naturally follow from highly probable causes. The decomposition of the rocks shows three important features. The formation of pyrite from the bisilicates, the decomposition of the bisilicates into chlorite (which is in part further altered to epidote), and a partial change of the feldspar. The pyrite appears to have formed at the expense of the bisilicates. The really fresh rocks contain no pyrite, but minute crystals often occur in or attached to partially decomposed bisilicates. Sometimes distinct pseudomorphs of pyrite after augite or hornblende are visible, but this is not common because the average size of the pyrite crystals is about one-half that of their hosts. A macroscopical comparison, too, of series of rocks increasingly decomposed shows that the pyrite is to all appearances associated with the bisilicates, and in extreme cases replaces them with an entire correspondence of distribution, so that the cumulative evidence is all in one direction. It is well known that ferrous silicates in contact with waters charged with hydrogen sulphide produce pyrite. The transformation of the bisilicates into chlorite is not obscure in its general features, though its details are far from clear: like those of most similar decompositions chlorite is essentially a silicate of aluminium, iron, and magnesia. Chlorite contains nearly equal quantities of alumina and magnesia; whereas augite, for example, contains nearly four times as much of the protoxide base. If the amount of alumina is supposed to remain unchanged, the alteration must be accompanied by a separation of all the lime and of the greater part of the silica and the magnesia. The relations of the other bisilicates to chlorite are similar and their conversion to chlorite is a familiar fact, particularly in the neighborhood of silver ores. The triclinic feldspars of the Washoe District retain their striæ and optical properties in a recognizable form much longer than the bisilicates. Among the mine rocks it is very rarely that bisilicates occur undecomposed, but it is the exception when a slide of a tolerably hard rock does not show recognizable feldspars. When the feldspars are altered they are replaced by an aggregate of polarizing grains, which appear to be quartz and calcite with some opaque particles, but with no transparent amorphous material. Two generically distinct processes of decomposition of feldspar have hitherto been recognized. The one results in the formation of kaoline, or a less hydrous aluminium silicate. The other is characterized by the introduction of magnesia and a little water, and the separation of soda and lime. Everything seems to point to the latter change as the characteristic one in the Washoe District. Kaolin could hardly be present in large quantities without being recognized microscopically. The analyses of the clays, too, show that when allowance is made for the presence of hydrous chlorite there is not enough water to correspond with any large percentage of kaolin. In fact the analyses of the clays so exactly correspond to the composition of the firm rocks that the great masses of clay evidently represent only equal volumes of disintegrated rock. On the other hand, the magnesia, which plays a part in the alternative decomposition of plagioclase, is furnished by the conversion of the bisilicates to chlorite, the microscopical phenomena are just what might be expected, and the analyses correspond. On the whole, therefore, it appears improbable that there has been any large amount of kaolinization in the Washoe District. Epidote is very common on the surface, while under ground it seems rare and confined to the neighborhood of the fissure. The conversion of chlorite to epidote must be accompanied by a substitution of lime for magnesia, and by the conversion of ferrous to ferric oxide. It might very readily occur in the presence of solutions containing carbonic acid and free oxygen, or when surface waters mingled with waters rising from lower levels; for epidote is far less soluble than chlorite, and under these circumstances would form in obedience to the general law of precipitation. Its occurrence is usually compatible with this supposition, but it is not so decisive as to warrant a positive assertion that the conditions of its formation are those indicated.

As is well known, Prof. F. Sandberger has very ably maintained what is known as the lateral-secretion of ore deposits.* With a view to testing the probabilities of this theory, with reference to the Comstock, the rocks of the district have been essayed with all possible precaution. The rocks found to contain precious metals were also separated by Thoulet's method, and the precious metals traced to their mineralogical source. The results of this investigation show many interesting facts, among which are the following: The diabase shows noteworthy contents in the precious metals, most of which is found in the augite. The decomposed diabase contains about half as much of these metals as the fresh rock. The relative quantities of gold and silver in the fresh and decomposed diabase correspond fairly well with the known composition of the COMSTOCK bullion. The total exposure of diabase is sufficient to account for far more bullion than has been extracted from the mines.

The gangue on the COMSTOCK is almost exclusively quartz, though calcite also occurs in limited areas. The ore minerals elude investigation for the most part because they are so finely disseminated as merely to stain the quartz, but it is fairly certain that they are principally argentite, and native silver and gold, accompanied in some case by sulphuric antimonides, etc. The chloride has rarely been identified. Where ore is found in diorite, or in contact with it, it is usually of low grade, and its value is chiefly in gold. The notably productive ore bodies have been found in contact with diabase, and they have yielded by weight about twenty times as much silver as gold. It would perhaps be legitimate to infer from the chemical phenomena enumerated that waters charged with carbonic acid and hydrogen sulphide had played a considerable part on the COMSTOCK. This is not, however, a mere inference, for an advance boring on the 3,000′ level of the *Yellow Jacket* struck a powerful stream of water at 3,065 feet (in the west country), which was heavily charged with hydrogen sulphide and had a temperature of 170° F., and there is equal evidence of the presence of carbonic acid in the water of the lower levels. A spring on the 2,700′ level of the *Yellow Jacket*, which showed a temperature of above 150° F., was found to be depositing a sinter largely composed of carbonates. Baron v. Richthofen was of opinion that fluorine and chlorine had played a large part in the ore deposition on the COMSTOCK, and this the writer is not disposed to deny; but, on the other hand, it is plain that most of the phenomena are sufficiently accounted for on the supposition that the agents have been merely solutions of carbonic and hydrosulphuric acids. These reagents will attack the bisilicates and feldspars. The result would be carbonates and sulphides of metals, earths and alkalies, and free quartz; but quartz and the sulphides of the metals are soluble in solutions of carbonates and sulphides of the earths and alkalies, and the essential constituents of the ore might, therefore, readily be conveyed to openings in the vein where they would have been deposited on relief of pressure and diminution of temperature. Some of the physical conditions of the process will be elsewhere considered. It has been claimed that the ore and quartz have been deposited by substitution for masses of country rock. This hypothesis is exceedingly doubtful on chemical grounds, but there is also at least one insuperable physical objection to it. In all processes involving the solution of angular bodies, it is a matter of common observation that points and corners which expose a greater surface than planes are first attacked, consequently masses exposed to solution, substitution, weathering, and the like, always tend to spheroidal forms. Now, nothing is more common than to find masses of country rock included in the ore-bearing quartz. These masses are, in all cases which have come under the observation of the writer, angular fragments, in form precisely such as result from a fresh fracture; not a single instance has been observed in which a spheroidal rock was surrounded by more and more polyhedral concentric shells of quartz and ore.

Heat Phenomena of the Lode.—One of the famous peculiarities of the COMSTOCK LODE is the abnormally high temperature which prevails in and near it. This manifested itself in the upper levels, and has increased with the depth. The present workings are intensely hot. The water which flooded the lower levels of the Gold Hill mines during the past winter had a temperature of 170° F. This water will cook food, and will destroy the human epidermis, so that a partial immersion in it is certain death. The air in the lower levels more or less nearly approaches the temperature of the water, according to the amount of ventilation. The rapidity of the ventilation attained in the mines is something unknown elsewhere, yet deaths in ventilated workings from heat alone are common, and there are drifts which, without ventilation, the most seasoned miner cannot enter for a moment. Except where circulation of air is most rapid, and in localities not far removed from downcast shafts, the air is very nearly saturated with moisture. It is a serious question how far down it will be possible to push the mines in spite of the terrific heat.

The relation of the temperature to the depth from the surface is evidently one of great interest, but not entirely simple. If the rock were wholly uniform in character and unfissured the relation of temperature to depth would be wholly regular, and would be represented by a curvilinear focus. As the source of the heat was approached the rate at which the temperature rose would rapidly increase, and under the ideal conditions supposed, it would be possible to deduce the constants of the equation and to calculate the position of the source of heat. But unless the source of heat were so close to the surface that the errors introduced by the presence of fissures, the lack of homogeneity of the rock, and the percolation of surface water, were insignificant in comparison with the rate of increase of the temperature, such a calculation would not be possible. A careful record of temperature has been kept at three of the newer shafts to a depth of 2,000 feet. On plotting these records as ordinates and the depths as abscissæ no indication of regular curvature appears, being wholly obscured by the fluctuations due to the disturbing causes mentioned. In other words, there

* Berg und Huttenmansche Zeitung, vol. 39, 1880, 402 et ante.

is as yet nothing in the observations to show any but local divergences from a strict proportionality between depth and temperature. The source of heat must, consequently, lie at a very great distance from the surface as compared with the depth yet reached, and the curve is to be regarded as still sensibly coincident with its asymptote. In order to eliminate the fluctuations of temperature as far as possible, Mr. Reade and Dr. Barus have computed the observations made at the *Forman*, *Combination*, and *New Yellow Jacket* shafts by the method of least squares, and also, for comparison with them, the observations of Mr. J. A. Phillips at the *Rosebridge Colliery*. Here it is sufficient to state that the mean data for rock and water on the COMSTOCK result in the equation

$$t=53.7+0{\cdot}0327d$$

while the *Rosebridge Colliery* observations result in the equation

$$t=56+0.0150d$$

t representing degrees F., and d the depth from the surface in feet. Since no evidence of curvature can yet be traced in the locus representing the relations of temperature to depth, these equations may be expected to hold good for depths greatly exceeding the present, but if more than local variations occur at any depth they will be in the sense of a more rapid increase of temperature. Boiling water will probably be encountered on some parts of the COMSTOCK before the mines reach a depth of 5,000 feet, while the water of the *Rosebridge Colliery* will not boil before twice that depth is attained.

Two causes have been suggested in explanation of the high temperature of the COMSTOCK—the kaolinization of the feldspar contained in the country rock, and residual volcanic phenomena. The theory that kaolinization is the cause of the heat appears to rest upon two positive grounds—that the solidification of water liberates heat and that flooded drifts have been observed to grow hotter. It is also claimed in favor of the kaolinization hypothesis that there is no evidence of any other chemical action proceeding with sufficient activity to afford an explanation, and that the retention of igneous heat in the rocks is a sheer impossibility; while the hypothesis that the heat is conveyed from some deep-seated source to the mines by means of currents of heated water is characterized as somewhat violent and unnecessary. So far as the present writer is aware, there are no theoretical grounds upon which the heat involved in kaolinization can be estimated. The decomposition of feldspar into kaolin and other products (supposing kaolin to result from the decomposition of plagioclase) involves several processes, of which some are more likely to absorb than to liberate heat. But supposing an anhydrous aluminium silicate formed without loss of heat, the thermal results of its combination with waters are by no means certain. Were the water contained in kaolin not water of hydration, but chemically combined, it would be possible from known experiments to compute approximately the heat which would be produced. It will be shown in the report that the corresponding temperature would be so high as to be utterly at variance with known facts. The water is therefore the water of hydration. Of the heat involved in the hydration of salts we know that it is usually small, that it is sometimes negative, and that the different molecules of water combine with differing amounts of energy, but of the heat of hydration of kaolin we know nothing. With a view to testing the theory of kaolinization as far as possible, Dr. Barus, at the writer's request, undertook some very difficult experiments presently to be described. The result of these experiments, in a word, was that finely divided, almost fresh east country diabase, exposed to the temperature of boiling water and the action of saturated aqueous vapor for a week at a time, and for several weeks in succession, showed no rise of temperature perceptible with an apparatus delicate to the $\frac{1}{1000}$ of a degree C. It is by no means certain that kaolinization was affected by this experiment. The particles of rock were indeed coated with a white powdery substance, but in such small quantities that its nature could not be determined. It is still possible that when kaolinization occurs, heat is liberated. It is also possible that at temperatures above the boiling point and pressure greatly exceeding 760mm, feldspars are kaolinized; but it appears no longer reasonable to ascribe the heating of drifts, which are at nearly normal pressure, to the reaction on the rocks of water below the boiling point. The scene of active and heat-producing kaolinization, if it exists at all, must, therefore, be at remote depths. As was explained in a previous paragraph, the present examination has not resulted in tracing any considerable amount of kaolinization on the Comstock; while, had the heat of the lode been maintained ever since its formation at the expense of the feldspars, but little undecomposed feldspar could now remain. In short, while it cannot be demonstrated that the heat of the Comstock is not due to the prevalence, at unknown depths and pressures, of a chemical change of unknown thermal relations, the writer has failed to find any proof that the heat of the COMSTOCK is due to kaolinization.

Of the origin of the heat of solfataras not very much is known; yet, as they commonly occur either as an accompaniment of volcanic activity, or in regions characterized by the strongest evidences of past volcanic activity, it is usual and seems rational to connect them as cause and effect, or as different effects of a common cause. There seems to be no special opportunities on the Comstock for an elucidation of the whole theory of vulcanism, but considerable grounds for connecting the heat there manifested with that chain of phenomena. That solfataric action as commonly understood, once existed on the Comstock is certain. That the time at which the lode was charged with ore is not immeasurably removed from the present, appears to be demonstrated by the trifling character of the erosion which has since taken place. The water entering the bottom of the *New Yellow Jacket* shaft in the winter of 1880–'81, at a temperature of 170° F., was highly charged with hydrogen sulphide. The steamboat Springs, only a few miles west of the Comstock, lie in a north and south line like the Comstock, close to the contact of ancient massive rocks and andesites. Some of them are boiling hot, are charged with solfataric gases, and are now depositing cinnabar and silica as at the time of Mr. Phillips' visit many years ago. Finally, there is reason to suppose that the hot waters of the Comstock come from great depths. No meteorological station exists at Virginia City, but the rainfall is so small that the country is a sagebrush desert, and the precipitation is insufficient to account for the water met with on the lode. The main influx of water, and especially of hot water, is from the west wall, and when encountered it is found under a head often of several hundred feet. Between the Comstock and the main range of the Sierra Nevada, the whole country is covered by massive rocks, principally andesites, with occasionally croppings of granite. The general structure of the country, and the exposures of sedimentary rocks in the mines, lead to the supposition that the underlying strata dip eastward, and the inference is that the Comstock fissure tops water-ways leading from the crests of the great range. If the heat is conveyed to the lode by waters of great depths, the variations in temperature are readily explained. The distribution of the heated waters would be determined by the presence of cracks, fissures, and clamy-seams, and the uniformity of distribution of heat would further be disturbed, even at considerable distances from the surface, by the infiltration of surface water. One published observation, which is important in this connection, is that a large proportion of the rocks in the Virginia mines are dry. This is very true in the sense in which dry is used in mining, *i. e.*, there are many places where water does not drip from the walls; but the present examination has failed to reveal rocks which are not moist. Indeed the occurrence of really desiccated rock thousands of feet below the surface, near vast quantities of water, would disprove the generalization of the perviousness of rocks, which is one of the best established in geology. Unless, therefore, very strong proof to the contrary can be adduced, the conduction of heat on the Comstock must be considered as taking place in moist rock.

The Lode.—The detailed structure of the upper portion of the lode was minutely and graphically described by Mr. King, and Mr. Church has followed the vein phenomena down to the 2,000-foot level. Below this point only one very small ore-body has been found, and the position of the vein is marked only by barren quartz or by a mere clay seam. The old upper workings, and many of those visited by Mr.

Church, are now wholly inaccessible; and the present writer's task, so far as the mere description of the vein is concerned, is limited to showing what light is thrown on the recorded phenomena by the present investigation. The Comstock from the surface down is a remarkably regular fissure. This is shown by the close correspondence between the contours of the west wall and the lower levels with those of the surface near the lode, and when the presence of a large fault is taken into consideration, is also indicated by the closeness with which the east wall follows the west in many parts of the mines. A most important feature near the surface was the existence of the east fissures, or, so called, *Virginia* vein. This was referred by v. Richthofen to its proper cause, a fracture through the hanging wall, caused by faulting; and the present examination has shown how the edge of the east country came to assume a sharp wedge-like form, especially favorably for a formation of a cross fracture. Above the junction of the primary and secondary fissures both were largely occupied with quartz, but while the quartz of the main fissure carried but little metal, concentrations of ore or bonanzas were plentifully distributed through the east fissure. Below the junction of the two the east as well as the west wall became regular in dip, and both have continued so ever since. The secondary fissure and evidences of great fault extend from the lower portion of Gold Hill to the Sierra Nevada mine, as may be seen by reference to Mr. King's sections. Beyond these points the signs become less marked, and the dislocation has been distributed. The true vein is probably to be considered as limited to the contact between diabase and the underlying rocks. To the north of the Union shaft a considerable extent of this contact seems to be still unexplored. The fissure which has been followed on the Sierra Nevada upper levels appears to be wholly in diorites, though a small stringer of diabase also occurs here, and a similar one still further north, in the Utah mine, while the main contact between the diorite and the diabase swings off to the northeast in Union ground. So, too, to the south of the Overman there seem to be two fissures. While the main productive ground has been at or close to the diabase contact, ore has been found at many other points in the district. The gold quartz mines of Cedar Hill stand in such relation to the Comstock as proves, almost beyond a question, that they owe their existence to the same dynamical and chemical phenomena, modified only by the lithological character of their walls. The Occidental lode is evidently referable to the same causes which produced the Comstock, and it is probable that the numerous occurrences of ore on various contacts in the district (though they have seldom proved remunerative) have the same origin. It is possible that this may even be the case with the east and west veins in hornblende-andesite (at their croppings) which occur just north of Silver City. It is the combination of dynamical and lithological conditions, and of the chemical relations dependent upon the latter, which, taken together, separate what is unanimously conceded to be the Comstock Lode from the other ore-bearing formations of the district. From the surface down, the filling of the vein has consisted essentially of more or less metalliferous quartz, with here and there a little calcite, broken and decomposed rock, and clay. The presence of rock and clay is easily accounted for when the method of formation of the vein is considered. The great horses near the top were masses broken from the east country, but innumerable smaller fragments must have formed at the same time, filling or more or less obstructing the fissure. It is certain that openings formed in this way would have been held open to a greater or less extent, at least within moderate distances below the surface, but it is also certain that a large amount of the rock would have been triturated. When decomposition set in, conversion of the finely-divided rock into clay would have followed. The decomposition of all the fragments, too, would be likely to be more energetic on the fissure than elsewhere, on account of the activity of circulation. It may not be superfluous to repeat here that clays by no means necessarily contain any considerable percentage of kaolin. The quartz was found to a very large extent in a highly crushed condition, resembling nothing so much as ordinary commercial salt. Some doubt has been thrown on the manner in which this fine division has been produced, though it has ordinarily been assumed to be the result of crushing. Samples mounted in balsam and examined under the microscope show that the material is composed of fractured crystalline quartz. The edges and points of the spiculæ are sharp, and of course the crystalline character is perfectly evident in polarized light, while crystal faces as well as fractures are recognizable. Besides crushing, the only action which could have produced this state of division is some internal force such as tension produced by heat. That such is not the cause, however, is demonstrated by the fact that bunches of crystals of considerable size often occur, through each individual of which the same crack can be traced, showing a common and an external force. Small vugs must have formerly existed where these crystals occur. Taking into consideration the brittle character of this mineral it can readily be shown that there was force enough available during the dislocation of the country to effect its comminution. The eastern bodies are much more generally reduced to "sugar quartz," as it is commonly called, than the masses which lie near the west wall. This is as would be expected. As has been seen, there is good reason for believing that the decomposition of the east country has not been effected by surface waters. Granting this, it is almost necessary to suppose that at some depth or other there is a zone on the fissure which is closed water-tight; for were it otherwise the waters ascending from great depths would rise along the open fissure. Even at the levels already reached, the vein is in places only represented by a clay-seam, practically impervious to water, and as the liability to stoppage will certainly increase with the depth it is by no means an extravagant supposition that further down on some straight or sinuous line the fissure is impenetrable by water from one end to the other. As the east country is penetrated throughout by capillary fissures, of which those parallel to the lode probably possess great continuity, the heated waters entering the fissures below the stoppage would rise through the broken east country, but higher up would again tend towards the fissure as offering the path of least resistance.

The ore-bearing solutions must have taken the same course as those which decomposed the east country rock, and the vein must therefore have been filled through the east wall, even if the diabase is not regarded as the source of the metals. Had the vein been filled through the fissure from great depths, "comb-structure" must have been visible in the ore on both walls, for while "comb-structure" may not be incompatible with lateral secretion, it can hardly be maintained that minerals would crystallize out from ascending solutions otherwise than on the sides of the fissure and on included fragments. This structure is actually visible on the COMSTOCK, where narrow intervals between rock masses have induced such a method of deposition in miniature. On the other hand, a flow of mineralized solutions from the east country into the fissure would be exceedingly apt to interfere with the definiteness of the east wall, both mechanically and chemically. In point of fact, as is well known, although the east wall is well defined in some places, it is often ill defined and sometimes indistinguishable. At the intersection of the *Sutro Tunnel* with the *Savage* claim nothing could be more perfect than the east wall, but this also happens to be the only spot discovered where a considerable mass of diabase exists in an undecomposed condition. Unless, contrary to the conclusions to which this examination has led, a great mass of material has been eroded from the surface since the deposition of the ore, the ore-bearing solutions must have taken an upward course, since remunerative ore was comparatively well distributed in the first thousand feet of the lode. If precipitation was the result of the decrease of temperature and pressure, the tendency to precipitation must evidently have been greater near the surface. In this connection it is worthy of note that the character of the ores in portions of the croppings differed from that of those found at greater depths, being to a much larger extent galena, blende, and sulphur salts.

Collectively, the various observations made, if they are correct and the inferences from them sound, throw considerable light on the history of the lode. After the eruption of the diorite the first event of importance, so far as the vein is concerned, was the outburst of diabase, which involved a rupture and dislocation of the earlier diorite, leaving a smooth contact between the two rocks at an angle of about 43°. The contact was afterwards slightly opened to admit the younger diabase, or black dike. Eruptions of earlier hornblende-andesite and of augite-andesite afterwards occurred, which probably produced fractures and dislocation in the eastern portion of the diabase, but have left no traces of action on the COMSTOCK fissure. The country was subsequently so eroded as to reduce the surface of these four rocks to a gently sloping plane, with an inclination of a little more than two degrees to the west. After the commencement of the dry period (dry, that is to say, so far as this region was concerned) a great movement began, which may possibly have been a sinking of the hanging wall, but was more probably a rise of the foot wall. This dislocation involved an enormous friction, one result of which was a separation of the foot wall and the hanging wall for a long distance from the fissure into sheets parallel to it. A secondary effect of the same force was to form innumerable cracks in these sheets nearly perpendicular to their partings. The edge of the east country necessarily assumed the form of a wedge, and was broken completely through at a point a few hundred feet below that at which the primary fissure reached the surface. The total dislocation amounted to a little less than 3,000* feet, measured on the dip of the fissure; but the movement was not effected continuously. After the secondary east fissure had been opened, large masses of ore-bearing quartz were deposited by alkaline solutions of carbonates, sulphides, and silica flowing in from the east country. These were subsequently crushed by renewed movements of the walls. The nature of the ore-bearing solutions and of their contents no doubt varied from time to time. It is evident that currents following the same channels would gradually exhaust either the metalliferous minerals exposed to their action or the supply of the necessary alkaline solvent, and that a renewed movement would open up fresh material to attack. Pressure, too, if not temperature, may have varied from time to time. This necessary variation in the process of extraction sufficiently accounts for the great variety in the grade of the ore. Most of the ore-bodies which have hitherto been discovered are situated in the east fissure. From the very nature of the case this opening must have been exceedingly irregular. Above it lay only the shattered edge of the east country, approximately retaining its position only by gravity, while the mass of the east and west country were both in motion. The deposition of ore in this fissure was no doubt dependent upon the disposition of openings, and it appears to the writer a hopeless attempt to reduce to order, either *a posteriori* or *a priori*, the openings which may have been left in this fissure at different stages of the fault. In a very general way they would have been more likely to occur opposite ravines than opposite ridges. And in an equally general way such was the distribution of the ore-bodies in the east fissure. Two of the most important bonanzas have been found below the junction of the east fissure and the lode. One of them was in the *Crown Point* and *Belcher*, and the other was the famous body of the *California* and the *Consolidated Virginia*. The former appears to have been deposited in one of the ordinary lens-shaped openings which so frequently occur in all veins from a slight nonconformity of the walls. The latter appears to have had a somewhat different origin. A portion of the foot wall seems to have given way at this point, carrying a large amount of rock from the hanging wall with it, and the ore has been deposited in the space thus formed. Of course, the space referred to was not actually empty, but was filled with fragments, leaving considerable interstices between them. These fragments, however, after decomposition, acted as absorbents for the mineralized solutions, and became charged with argentiferous minerals. For the most part (with entire propriety) they have been mined and milled as ore.

No warning can be had of approach from above to a body of this character, because the attendant phenomena will be found below the ore, as in this case; and such bodies may occur at almost any point on a vein of which the hanging wall is like that of the COMSTOCK. Openings of a related character, however, may not improbably occur at the bottom of masses of broken and dislocated rock. An enormous volume of such material exists at the contact of the diabase and the diorite all the way from the *Gould & Curry* to the *Sierra Nevada;* and nothing would be less surprising than the discovery of one or more ore-bodies at the lower portion of this mass. Perhaps the quickest way to reach them, if they exist, would be to sink immediately to the lower portion of the mass, where they are most likely to be found. Attendant upon the ore-bodies, and to the east of them, though perhaps somewhat below them, there will probably be areas of the east country more heavily charged with pyrite than usual, as has been the case opposite former bodies. The flooding of the Gold Hill mines during the past winter unfortunately prevented an examination of their lower levels, and nothing can therefore be said as to their probabilities.

The Comstock is likely to be an ore-bearing vein as long as it continues to be the contact between a large body of diabase and the older rocks. Should a point be reached at which the diabase contracts to a narrow dike between diorite walls, the prospects will be less hopeful; but such a point, if it exists, may be many thousands of feet below the present workings. On the *Occidental* lode scarcely any work was done during the progress of this investigation, and no considerable examination could be made of it. Its croppings are laid down on the map mainly to exhibit their remarkable parallelism to the Comstock, and for the sake of consequent inferences as to the structure of the whole intervening country. That the *Occidental* lode dips to the east at an angle similar to that of the Comstock is certain, but whether the barren stringer cut by the *Sutro Tunnel* is really the *Occidental* lode is perhaps not unquestionable, nor are there any means known to the writer of settling this point until it has been more extensively explored.

Physical Investigations.—It is well known that Fox, Reich, and others made experiments of great interest upon the electrical phenomena of ore-bodies. Bernhard von Cotta earnestly recommended* that the experiments should be further pursued, as they seemed to him likely to lead to results of practical importance in the discovery of ore-bodies. If this recommendation has ever been followed out, no account of the investigation has been published. It was the writer's earnest desire to see the subject pursued, and Dr. Barus was invited to join the survey on account of his special fitness for this inquiry. All the plans and details of the electrical survey are due to Dr. Barus, the general scope of the work and the localities only being prescribed; and a résumé of his results is given below in his own words. Neither of the localities chosen were the best possible for the purpose. It was evidently necessary in such an inquiry to begin by the examination of the ore-bodies already exposed. At the date of the examination there was very little ore in sight on the Comstock. At the Eureka large bodies of ore were exposed, but being in an oxidized condition would be likely to give weaker currents than sulphides of similar quantity and distribution. These two localities, however, were the only ones practically available, and at the same time accessible through extensive workings. The results are nevertheless of great interest, and a considerable advance has been made towards a solution. It is one of the plans for the future to repeat these experiments under more favorable conditions. Dr. Barus also gives a summary of the experiments which he carried out on the subject of kaolinization, and which have been sufficiently alluded to in a foregoing paragraph.

On the Electrical Activity of Ore-Bodies.—The discovery of local electrical currents in metalliferous veins is due to Fox. The remarkable results contained in his original paper (1830) suggested a series of subsequent experiments made by Fox himself and Henwood in England, von Strombeck and Reich in Germany. In all of these, however, the results contained refer principally to the currents observed on joining with the prolonged terminals of a galvanometer two points lying at different distances apart on the same or different metalliferous veins. Special mention is due to a second paper of Reich (1844), insomuch as the author assumes that lode currents are hydroelectric, that contiguous ore-bodies (or different kinds of ore in the same body) and the country rock have the same relation to each other as the metals and liquid of an ordinary galvanic cell, and that therefore—this is his main point—currents must

* This is distributed both in east and west country. At and near the *Sutro Tunnel* section, any point on the hanging wall of the fissure was originally opposite a point about 1,500 feet higher up on the foot wall, the distance being measured on the dip.

* Erzlagerstaetten, part I, p. 233.

exist in the rock itself. It would follow herefrom that important practical inferences might be drawn from a careful study of the latter, and it was with this conviction that Reich made a number of experiments. Unfortunately he did not pursue his argument into its full consequence. After this, further study of the subject seems to have been altogether abandoned; at least a published account of an attempt to advance our knowledge in this direction, could not, without some pains be found. We can hardly suppose, however, that during this long interval of upwards of 37 years no experiment should have heen made. The matter is rather to be ascribed to the necessary non-concordance of interpretations made from purely qualitative results, with facts.

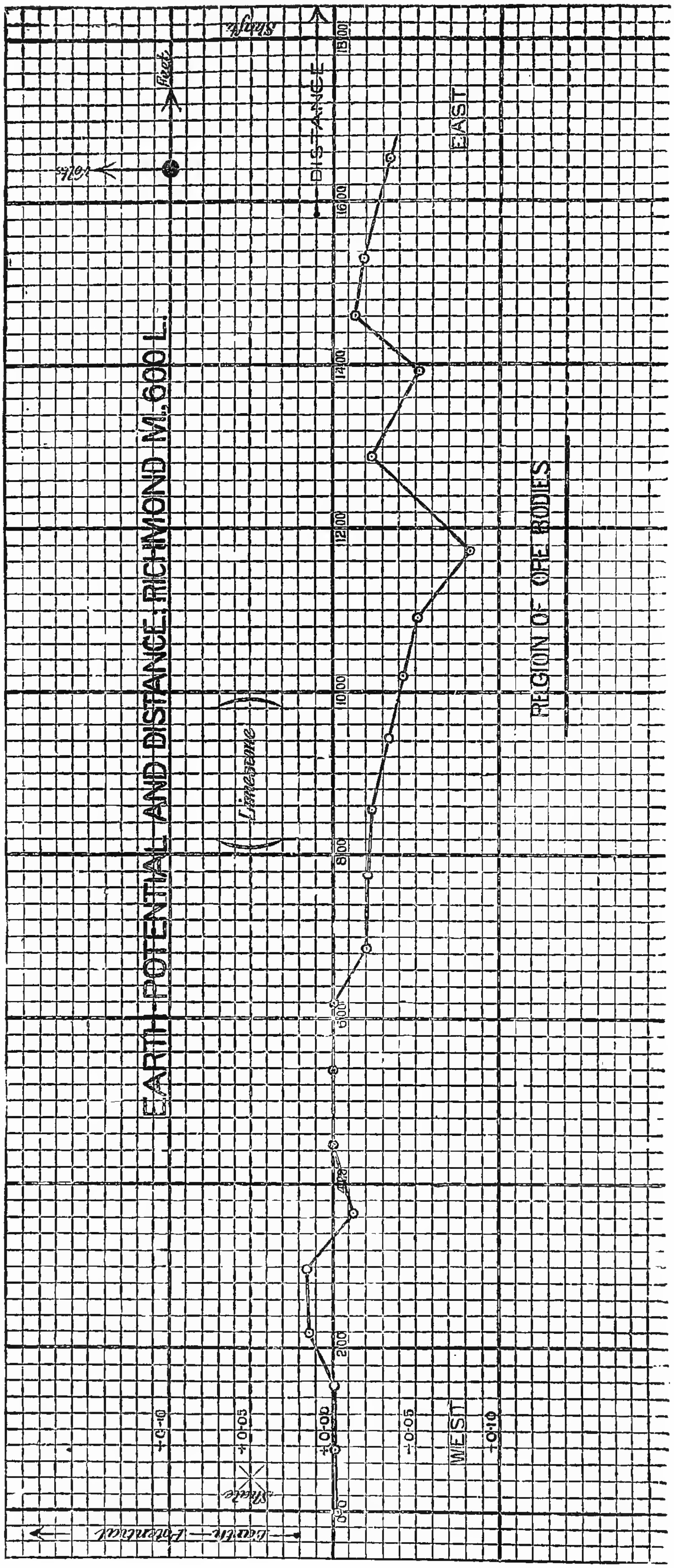
* * * * * * * * * *

The problem offered is not apparently a difficult one, and consists simply in determining the variation of earth-potential at as many points within and in the vicinity of the ore-body as may be desirable; or, in other words, of tracing the equipotential surfaces in their contour and position relative to it. We are, however, able *a priori*, to systematize the method of research. In the first place, the hypothesis that lode-currents, if present, are due to hydroelectric action is quite a safe and natural one. It is known that a number of ores—especially sulphides—possess metallic properties. The presence of two or more of these in the same ore-body is not an uncommon occurrence, and we are justified in anticipating electric action at their surfaces of contact. The currents thus generated have a very close analogy to those technically known as "*local currents*" in batteries, and which are due to impurities in the zinc.

In the second place, it is obvious that if currents are met with in a region of ore deposits, such currents, insomuch as electrical action has been going on for an indefinite period of time, must be *Constant*, both in intensity and direction. The equipotentials corresponding to this flow, will, therefore, have fixed and invariable positions relative to the ore body. Suppose, now, that from a point remote from the ore-body a line has been drawn towards it and prolonged beyond to about the same distance. It is not necessary for the present consideration that this line should actually pierce the deposit; only that certain of its parts are sufficiently near ore, and more so than its extreme points, and that it lies wholly within or upon the surface of the earth. Suppose, moreover, that the ores are so associated as to generate electrical currents. If, then, we commence at one end of our line and determine the values of earth-potential at consecutive, approximately equidistant points, it is obvious, insomuch as we pass *by* the seat of an electromotive force, or, in other words, *through* the field of sensible electrical action, that our progress from one extremity of the line to the other must be accompanied by a passage of the values of earth-potential corresponding, through a *maximum* or *minimum*, or both, or a number of such characteristic variations. In short, we may regard the earth-potential at any point as a fraction of the distance of this point from the assumed origin of our line. The assertion that this fraction will pass through a characteristic change of the kind specified is only another way of expressing that our line may be chosen so long, that in comparison with its extent, the field of sensible electrical action will be local, or its linear dimensions in the direction in question small. *Maxima* in a general sense are, therefore, to be regarded as criteria, and as indicating the part of the line nearest to the electrically active ore-body. This is about the idea underlying the experiments made in the bonanza mines on the Comstock Lode, Nevada, and in those of the Richmond Company, Eureka District, Nevada. Practically, since we possess no means of measuring potential absolutely, it will be sufficient to assume a value (zero) for one of the points of our series. The electromotive force between this and any of the other points is then the potential of the latter. In making the actual measurements, the simple problem above enunciated became quite complicated, because the small lode-electromotive forces were distorted by a number of errors, which in the aggregate might possibly produce an effect in the same order. On the Comstock, where the mines at the time were, without exception, working in very barren parts of the vein, no definite evidence of currents due to the lode itself was obtained. But even at Eureka, in spite of the enormous ore-bodies in sight, the range of variation of potential, corresponding to a distance of 2,000 feet, in the underground experiments very rarely reached 0.1 volt; whereas usually the variation lay within a few hundredths volt. These limits, in a case where we have to do with such disturbances as action between terminals, polarization, earth currents (normal). bad insulation of circuit at any point, difference of potential between liquids in contact, incidental effects due to masses of metal—machines, tracks, turn-tables, water and air pipes, etc.—distributed throughout the mine are to be considered as comprehending a rather dangerously small interval. This matter is to be attributed to the *earthy* character of the Eureka ores.

By way of example, the results obtained on the 600-foot level, west drift, Richmond mine, where the circumstances were particularly favorable, will be graphically given. The consecutive points tapped may be regarded as lying on a horizontal straight line, extending in an east-westerly direction. In the following figure, distance in *feet* is given as abscissa, the corresponding value of earth-potential in *volts*, as ordinate. The line of points lay completely *out of* the ore-bodies, the latter occupying positions above and to the south of it, at a mean distance of several hundred feet, and extending from east to west about as far as is indicated by the *heavy* black line below the curve. This line of electrical survey passes from shale, probably free from ore, at its westernmost extremity, into limestone, encountering therein a region of electric action to be attributed to the ore-bodies; but it does *not* pass through this region, local circumstances preventing. If we pass from west to east on the dotted prolongation of the heavy black line just mentioned, we shall find ore all along our path and finally get into the immense deposits of the Eureka Consolidated Mining Company. Contact with the earth was secured at the points tapped by means of a closed bag of beefgut, containing a solution of zinc sulphate into which a strip of amalgamated zinc, forming the terminus of the metallic circuit, had been introduced. The bag during the experiments was placed in a suitable cylindrical hole drilled in the rock and filled with water. These terminals were exchanged twice for each observation. It is to be especially borne in mind that with the exception of the first, in shale, the holes were in solid rock, in limestone throughout—a matter which has been indicated by the dotted line above the curve. The results for earth-potential, now to be given, are the means of two independent *sets* of observations, the second of which was made at an interval of 130 days after the first, and agreed fairly with it. A variety of methods of measurement were employed.

The irregular progress of curve is not due to such errors as might be supposed to result from the accidental condition of the holes in the rock. It was proved by using suitable terminal (bladders, otherwise like the above), which were allowed merely to *recline* against the walls of the drift, that the progress of the values of earth-potential in passing from hole to hole is *continuous*. It is safe to regard this curve as containing an unknown disturbing effect, superimposed on the larger electrical effect, due to the ore-body itself. In the experiments thus far made the variation of potential along a *single* line of electric survey only has been determined. It is obvious, however, that in order to derive the full benefits from such a method a number of these surveys must be co-ordinated. We should endeavor by passing toward and from the ore-body, in *all* directions, actually to determine the contours and position of the equipotential surfaces. It is not improbable that the interpretation of these results would give us clews for the economical exploitation of the mine, comparable in value to those of a purely geological character. Both should go hand in hand. Under ground, this general method of research is not always feasible, as it presupposes the mine to have been already widely exploited. On the surface of the earth, however, it may to some extent be applied. We here endeavor to obtain the traces of the equipotential surface on the former. Suppose, for instance, that the potential at every point of a given part (several square miles) of the earth's surface were known. Then let this surface be projected on a fixed horizontal ("X Y") plane, and the value of earth-potential corresponding to each of the points be constructed as "Z." In this way we will obtain a new (*potential*) surface, coextensive horizontally with the first. Terrestrial electrical action


EARTH POTENTIAL AND DISTANCE; RICHMOND M., 600 L.
DISTANCE
EAST
WEST
REGION OF ORE BODIES
Limestone
Shaft
Shaft
Earth Potential
0
200
400
600
800
1000
1200
1400
1600
1800
+0·05
+0·00
−0·05

would manifest itself upon our new surface *as a whole* and would not affect its regularity. *Local* action, on the other hand, would produce an effect local and circumscribed in comparison with the horizontal extent of the area under consideration. We should expect to find a *hillock* or *depression*, or both, or a number of these variegations in our imaginary potential surface. The experiments made cannot be said to have settled the question as to whether lode currents will or will not be of practical assistance to the prospector. Indeed, we cannot as yet even assert with full assurance that the currents obtained are due to the ore-bodies. We have simply observed a local electrical effect, sufficiently coincident in position with the ore-bodies themselves to warrant us to some extent in assuming that these contained the cause. They certainly, however, give high encouragement to further research in this direction.

On the Thermal Effect of Kaolinization.—Mr. Church has endeavored to account for the heat of the COMSTOCK Lode by assuming a *thermal* effect of kaolinization. This view is new and ingenious, but unfortunately purely speculative; for while, on the one hand, there is no direct evidence to support it, we have, on the other, to do with a process so complicated, so little understood, that there is abundant room for difference of opinion. To avoid ambiguity and vagueness, it will be well to give a *quantitative* signification to the effect in question at the outstart. We will define the thermal effect of kaolinization (abbreviated *T. E. K.*) as the quantity of heat generated by the action of aqueous vapor on the unit mass of the given feldspathic rock in the unit time. With this understanding, *T. E. K.* is then to be considered as a function of the percentage quantity of feldspar originally contained in, and the temperature of the given rock, as well as of the time during which the action has been going on. A *priori, T. E. K.* may be either positive, zero, or negative. The above theory having been enunciated in connection with the heat of the COMSTOCK, it became necessary to endeavor to see in how far its fundamental principle (*i. e., T.E. K. positive*) was in agreement with facts. In the second place however, such a research was desirable because of the intrinsic interest which attaches to it. Considered from a physical point of view, the question is quite a difficult one, and of a kind in which satisfactory results can only be reached by a process of gradual and laborious approximation. As *T. E. K.* will probably, even in the final experiments, escape detection, the problem may be more accurately said to consist in reducing the limits (respectively positive and negative) within which *T. E. K.* must lie to the smallest interval possible. Under all circumstances a mathematical analysis, based on some rational assumption of the dependence of *T. E. K.*, for a given rock, on time and temperature, and utilizing the limits just mentioned, will be the last resort. Our object, therefore, in making the qualitative experiments, briefly to be reviewed herewith, was more that of obtaining a precursory view of the difficulties which present themselves in actual practice than that of obtaining results of a decisive character. In processes of the kind before us, the action may usually be *accelerated* by increasing the temperature at which it takes place; provided, of course, the latter is not chosen so high as to interfere with the products of decomposition resulting in a normal case. The idea was, therefore, to act on the rock with steam at a temperature from the boiling point of water upward. But, with the primitive facilities at our disposal in Nevada, the experiments with superheated steam had to be abandoned. The apparatus in which the rock was subjected to the action of steam (Fig. 25) so closely resembles that usually employed for the determination of the "boiling point" of thermometers that but a brief description will be necessary.

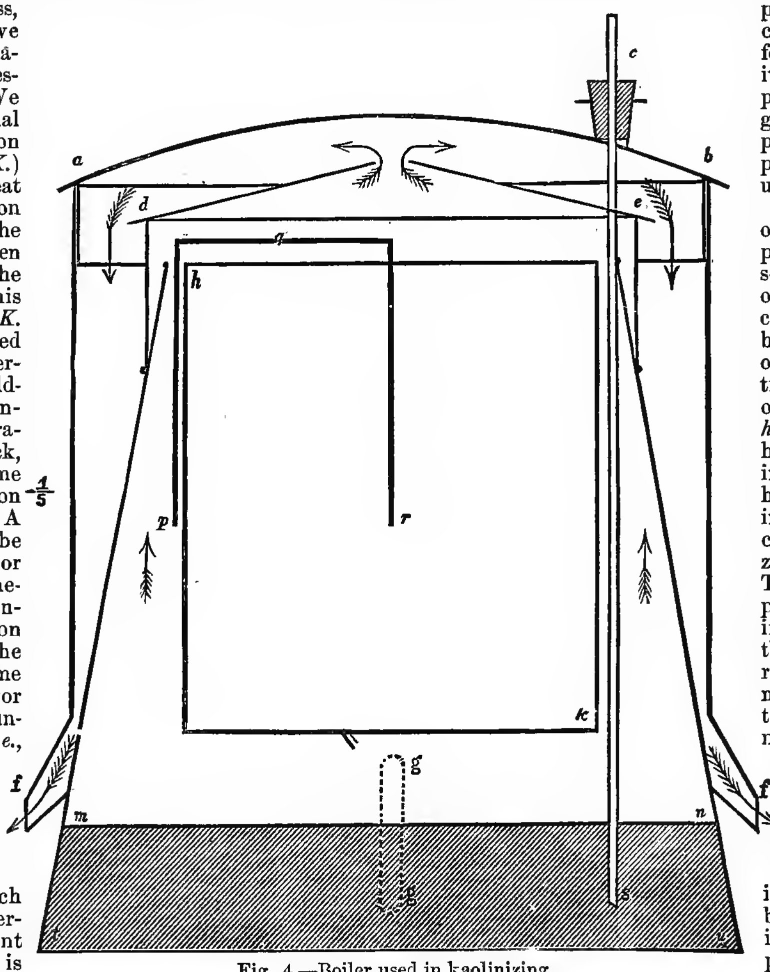


Fig. 4.—Boiler used in kaolinizing.

Steam is generated in the interior conical compartment *t d o e u*, the lid *d o e* of which is removable from water to the level *mn*, and passes through the hole *o* into the exterior compartment *fabf'*, jacketing the former, thence through the tubulures *f* and *f'* into the air. The lid *ab* can also be removed. The whole boiler is, moreover, covered with a thick ($\frac{3}{4}$–1) layer of cotton batting. In the interior compartment, finally, the cylindrical receptacle for the rock *hk*, open at its top, having a properly strengthened wire gauze bottom, and supported on a suitable tripod (not shown), is situated.

The rock to be acted on was crushed fine and packed into *hk* tightly, so that the atmosphere of steam enveloping it could reach the interior by a process of *diffusion* only, and that convective action from currents of steam passing through *hk* was not to be apprehended. The object was, in short, to allow the heat, possibly generated in the mass of rock in consequence of kaolinization, to accumulate. The difference of temperature between the interior of the rock and that of the steam surrounding it was determined by the aid of a thermopile, *p q r* (terminals omitted), consisting of three bismuth-platinum couples. The influence of fluctuations of the barometer—the increment of temperature of the junction *r*, in consequence, lagging behind that of *p*—may, in a long series of experiments (number of weeks), be eliminated mathematically. If *a* and *b* are constants, *e* the thermoelectromotive force corresponding to the temperatures *T* and *t* of the junctions *r* and *p*, respectively, we may put

$$T - t = \frac{e}{a + b\,(T + t)} = \frac{e}{a + 2\,b\,t},$$

since *b* is very small; *t* is calculable with sufficient approximation from the mean barometric height during the interval in which the experiments are made. Usually $2\,bt$ is negligible (correction): e was measured by a method of compensation; a and b frequently rechecked; but it is undesirable to go into the diverse details necessary in measurements of this kind here. The whole enabled the observer still to detect a variation of $T—t$ as small as $0.001°\,C$. The boiler was heated by two petroleum stoves (each containing two broad wicks), which could be replenished with oil, etc., without interfering to an appreciable extent with the flames. The water lost by evaporation was re-fed into the apparatus, drop by drop, through the tube *cs*, by means of a pneumatic arrangement (not shown) placed on the lid *ab*. A vertical glass tube, *gg*, the ends of which were in communication with the water and steam, respectively, of the interior compartment, indicated the height of the water-level. The whole aim was to make the process a *continuous* one, and had it not been for accidents the nearly constant source of heat and nearly constant water-level would have enabled us to keep up an ebullition of nearly constant intensity for an indefinite period of time. The rock used was earlier diabase from the hanging wall of the Lode collected in the main *Sutro Tunnel.* It had undergone only a trifling amount of decomposition. The experiments were continued during an interval of nearly *five* weeks, unfortunately with an accident between the first and second, and another between the second and third. On the average, three observations of $T—t$ were made during each twenty-four hours.

In order to derive a comprehensive view over the large number of data obtained it will be sufficient to assume the empirical relation,

$$T—t=\alpha+\beta\chi$$

where α and β are constants to be calculated by the method of least squares, χ the time in hours corresponding to any particular $T—t$, and dated from the commencement of the series of experiments to which the results belong. Under variation of α, an apparent thermal effect not due to kaolinization may be conveniently understood. For α a mean value of $—0.05°\,C$ was found. The interior of the rock was, therefore, invariably *colder* than the surrounding steam. It follows, also, that it is impossible, even after the lapse of a great interval of time, to heat so large a mass of material to an equal temperature throughout. The variation of α will add itself algebraically to β; and unless the *T. E. K.* produces a comparatively large result, will entirely vitiate the signification of the latter constant. β gives us nominally the rate of increase of the temperature of the interior of the rock in consequence of a *T. E. K.* Instead of reporting β, however, it will be more perspicuous to give the corresponding rate B referred to a *year* as the unit, viz:

$$B=376_5\beta.$$

For reasons which will appear in the report, the experimental material may be conveniently divided into two halves. In the first of these was found,

$$B=+1°.5\pm0°.1,$$

in the second,

$$B=—0°.9\pm0°.1.$$

Herefrom it appears that the variation of α alone was observed. The values of B are to be regarded as an *index* of the errors incident to the method in its present form, and it is moreover probable that the effect of kaolinization is negligible in comparison therewith. The limits set for the present article preclude a discussion of this abnormal behavior of B. It may be well to add, however, that the experiments made have suggested the following mode of attacking the question: A and B (Fig. 5) are two strong hermetically sealed receivers of metal similar in every respect and capable of withstanding great internal pressures. With the exception of the cavities α and β below, both are completely filled with the same quantity of finely pulverized feldspar, this material being tightly packed. Into α a little water has been introduced, so that the whole space A is at all temperatures thoroughly permeated with aqueous vapor. B, on the contrary, has before sealing been well *dried*, and the interstices between the granules of feldspar contain dry air only. A and B are placed in an appropriately jacketed elongated receiver, *TTT*, through which vapor at the boiling point of the liquid corresponding continually circulates.

A thermoelement can hardly be used with advantage here, as the couple chosen would either be insufficiently sensitive, or else give rise to too many experimental complications. A resistance thermometer* has therefore been substituted. The bridge adjustment, diagrammatically added, explains itself.

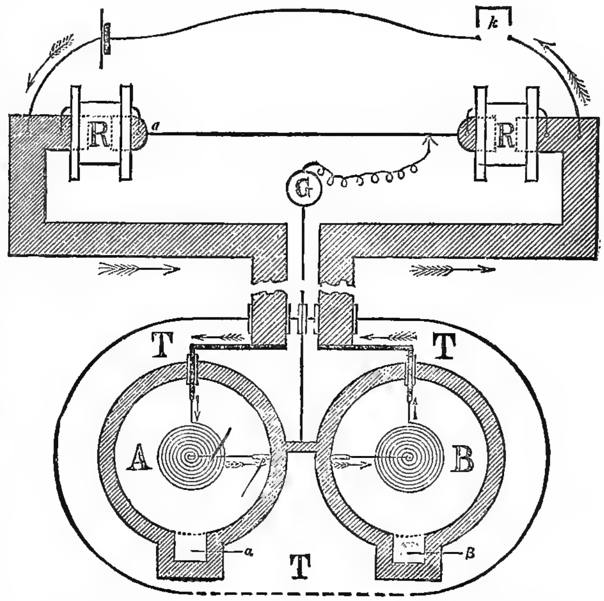


FIG. 5—Proposed apparatus for experiments on kaolinization.

The wire, *ab*, (for interpolation) had best be wrapped, after the ingenious manner of Kohlrausch, on a correspondingly grooved cylinder of serpentine, whence it projects outward much like the threads of a screw. In this way the apparatus becomes more compendious, and the whole may be easily so modified as to admit of complete submersion in an oil bath. R and R^1 are adjusted so as to correspond to the approximately equal resistance (fine platinum wire) in A and B, and the whole problem is reduced to a measurement of lengths, etc.

The method just described is advantageous in the following respects:

1. Both electric thermometers (respectively junctions of the thermoelement) are placed and heated under circumstances as nearly *identical* as practicable.

2. The thermometer is in very *intimate* contact with the pulverized feldspar.

3. *T. E. K.* may be studied in its relation to temperature. (*Confer* remarks above.) To this effect, the region *T T T* is to be heated consecutively with steam (100°C.), aniline vapor, 185°, etc.

4. A disposition by which CO_2 may be allowed to act on the rock simultaneously with aqueous vapor is easily made.

5. Although a change of mechanical state ("after action") of the spirals in A and B is of more serious consequence here, than in the case of a thermoelement, we have on the other hand the advantage of being able to examine each of them electrically, while the experiment is in progress.

—*Compiled from a paper by George F. Becker. Report of U. S. Geological Survey*, 1881.

* Confer remarkable results of Prof. S. P. Langley, Beibl. 3, 1881, p. 191; Chem. News, 43, 1881, p. 6 & 7; Am. Journal, March, 1881, p. 187. The problem which Professor Langley proposed to himself is, however, somewhat different from the one occurring here. It will be remembered, moreover, that the difficulty encountered in the present case is more that of obtaining a sufficiently *constant* temperature, than of measuring the same.

THE ORIGIN OF METALLIFEROUS DEPOSITS.

THERE are about sixty bodies which chemists call elements; the simplest forms of matter which they have been able to extract from the rocky crust of our earth, its waters, and its atmosphere. These substances are distributed in very unequal quantities, and in very different manners. As regards the frequency of these elements in nature, neglecting for the present those which constitute air and water, and confining ourselves to the solid matters of the earth's crust, there are a few which are exceedingly abundant, making up nine-tenths, if not ninety-five hundredths, of the rocks so far as known to us. The elements of which silica, alumina, lime, magnesia, potash, and soda are oxides, are very common, and occur almost everywhere. There are others which are much rarer, being found in comparatively small quantities. Many of these rarer elements are, however, of great importance in the economy of nature. Such are the common metals and other substances used in the arts, which occur in nature in quantities relatively very minute, but which have been collected by various agencies, and thus made available for the wants of man. It is chiefly of the well-known metals, iron, copper, silver, and gold, that I propose to speak here; but there are two other elements not classed among the metals, which I shall notice for the reason that their history is extremely important, and will, moreover, enable us to comprehend more clearly some points in that of the metals themselves. I speak of phosphorus and iodine.

You all know the essential part which the former of these, combined as phosphate of lime, plays in the animal economy, in the formation of bones; and how plants require for their proper growth and development a certain amount of phosphorus. Ordinary soils contain only a few thousandths of this element, yet there are agencies at work in nature which gather this diffused phosphorus together in beds of mineral phosphates and in veins of crystalline apatite, which are now sought to enrich impoverished soils. Iodine, an element of great value in medicine and in the art of photography, is widely distributed, but still rarer than phosphorus, yet it abounds in certain mineral waters, and is, moreover, accumulated in marine plants. These extract it from the waters of the sea, where iodine exists in such minute quantities as almost to elude our chemical tests.

There are probably no perfect separations in nature. We cannot, without great precautions, get any chemical element in a state of absolute purity, and we have reason to believe that even the rarest elements are everywhere diffused in infinitesimal quantities. The spectroscope, which we have lately learned to apply to the investigation alike of the chemistry of our own earth and that of other worlds once supposed to be beyond the chemist's ken, not only demonstrates the very wide diffusion of various chemical elements here on earth, but shows us that very many of them exist in the sun. If we accept, as most of us are now inclined to do, the nebular hypothesis, and admit that our earth was once, like the sun of to-day, an intensely heated vaporous mass; that it is, in fact, a cooled and condensed portion of that once great nebula of which the sun is also a part, we might expect to find all the elements now discovered in the sun distributed throughout this consolidated globe. We may speculate about the condensation of some of these before others, and their consequent accumulation in the inner parts of the earth, but the fact that we have all the elements of the solar envelope (together with many more) in the exterior portions of our planet, shows that there was, at least, but a very partial concentration and separation of these elements during the period of cooling and condensation. The superficial crust of the earth, from which all the rocks and minerals which we know have been generated, must have contained, diffused through it, from the earliest time, all the elements which we now meet with in our study of the earth, whether still diffused, or accumulated, as we often find the rarer elements, in particular veins or beds.

The question now before us is, how have these elements thus been brought together, and why is it that they are not all still widely and universally diffused? Why are the compounds of iron in beds by themselves, copper, silver, and gold gathered together in veins, and iodine concentrated in a few ores and certain mineral waters? That we may the better discern the direction in which we are to look for the solution of this problem, let us premise that all of these elements, in some of their combinations, are more or less soluble in water. There are, in fact, no such things in nature as absolutely insoluble bodies, but all, under certain conditions, are capable of being taken up by the water, and again deposited from it. The alchemists sought in vain for a universal solvent, but we now know that water, aided in some cases by heat, pressure, and the presence of certain widely distributed substances, such as carbonic acid and alkaline carbonates and sulphides, will dissolve the most insoluble bodies; so that it may after all be looked upon as the long-sought-for alkahest or universal menstruum.

Let us now compare the waters of rivers, seas, and subterranean springs, thus impregnated with various chemical elements, with the blood which circulates through our own bodies. The analysis of the blood shows it to contain albuminoids which go to form muscle, fat for the adipose tissues, phosphate of lime for the bones, fluorides for the enamel of the teeth, sulphur which enters largely into the composition of the hair and nails, soda which accumulates in the bile, and potash, which abounds in the flesh-fluid. All of these are dissolved in the blood, and the great problem for the chemical physiologist is to determine how the living organism gathers them from this complex fluid, depositing them here and there, and giving to each part its proper material. This selection is generally ascribed to a certain vital force, peculiar to the living body. I shall not here discuss the vexed question of the nature of the force which determines the assimilation from the blood of these various matters for the needs of the animal organism further than to say that modern investigations tend to show that it is only a subtler kind of chemistry, and that the study of the nature and relation of colloids and crystalloids, and of the phenomena of chemical diffusion, promises to subordinate all these obscure physiological processes to chemical and physical laws.

Let us now see how far the comparison which we have made between the earth and an animal organism will help us to understand the problem of the distribution of minerals in nature; how far water, the universal solvent, acting in accordance with known chemical and physical laws, will cause the separation of the mixed elements of the earth's crust, and their accumulation in veins and beds in the rocks. The subject is one of great importance to the geologist, who has to consider the genesis of the various rocks and ore-deposits, and the relations, which we are only beginning to understand, between certain metals and particular rocks, and between certain classes of ores and peculiar mineralogical and geological conditions. It is at the same time a vast one, and I can here only give you a few illustrations of the earth's crust, and of the laws of the terrestrial circulation, which I have compared to that of the blood distributing throughout the animal frame the elements necessary for its growth. The analogy is not altogether new, since a great French geologist, Elie de Beaumont, has already spoken of a terrestrial circulation in regard to certain elements in the earth's crust; though he has not, so far as I am aware, carried it out to the extent which I propose here in my attempt to explain some of the laws which have presided over the distribution of metals in the earth.

The chemist in his laboratory takes advantage of changes of temperature, and of the action of various solvents and precipitants, to separate in the humid way, one element from another; but to these agencies, in the economy of nature, are added others which we have not yet succeeded in imitating, and which are exerted only in growing animals and plants. I repeat it, I do not wish to say that these latter processes are different in kind from those which we command in our laboratories, but rather that these organisms control a far finer and more delicate chemical and physical apparatus than we have yet invented. Plants have the power of selecting from the media in which they live the elements necessary for their support. The growing oak and the grass alike assimilate from the air and water the carbon, hydrogen, nitrogen, and oxygen which build up their tissues, and at the same time take from the soil a portion of phosphorus, which, though minute, is in both cases essential to the vegetable growth. The acorn of the oak and the grass alike become the food of animals, and the gathered phosphates pass into their bones, which are nearly pure phosphate of lime. In like manner the phosphates from organic waste and decay find their way to the sea, and through the agency of marine vegetation become at last the bony skeleton of fishes. These are, in turn, the prey of carnivorous birds, whose exuviæ form on tropical islands beds of phosphatic guano. A history not dissimilar will explain the origin of beds of coprolites and other deposits of mineral phosphates. But again, these plants or these animals may perish in the sea and be buried in its ooze. The phosphates which they have gathered are not lost, but become fixed in an insoluble form in the clayey matter; and when in the revolutions of ages, these sea-muds, hardened to rock, become dry land, and crumble again to soil, the phosphates are there found ready for the wants of vegetation.

Most of what I have said of phosphates applies equally to the salts of potash, which are not less necessary to the growing plant. From the operation of these laws it results that neither of these elements is found in large quantities in the ocean. This great receptacle of the drainage from the land contains still smaller quantities of iodine; in fact, the traces of this element present in sea-water can scarcely be detected by our most delicate tests. Yet marine plants have the power of separating this iodine, and accumulating it in their tissues, so that the ashes of these plants are not only rich in phosphates and in potash-salts, but contain so much iodine that our supplies of this precious element are almost wholly derived from this source, and that the gathering and burning of sea-weed for the extraction of iodine is in some regions an important industry. When this marine vegetation decays, the iodine which it contains, appears, like the potash and phosphates, to pass into combinations with metals, earths, or earthy phosphates, which retain it in an insoluble state, and in certain cases yield it to percolating saline solutions, which thus give rise to springs rich in iodine.

In all of these processes the action of organic life is direct and assimilative, but there are others in which its agency, although indirect, is not less important. I can hardly conceive of an accumulation of iron, copper, lead, silver, or gold, in the production of which animal or vegetable life has not either directly or indirectly been necessary, and I shall begin to explain my meaning by the case of iron. This, you are aware, is one of the most widely diffused elements in nature; all soils, all plants contain it; and it is a necessary element in our blood. Clays and loams contain, however, at best, two or three hundredths of the metal, but so mixed with other matters that we could never make it available for the wants of this iron age of ours. How does it happen that we also find it gathered together in great beds of ore, which furnish an abundant supply of the metal? The chemist knows that the iron, as diffused in the rocks, exists chiefly in combination with oxygen, with which it forms two principal compounds: the first, or protoxide, which is readily soluble in water impregnated with carbonic acid or other feeble acids, and the second, or peroxide, which is insoluble in the same liquids. I do not here speak of the magnetic oxide, which may be looked upon as a compound of the other two, neutral and indifferent to most natural chemical agencies. The combinations of the first oxide are either colorless or bluish or greenish in tint, while the peroxide is reddish-brown, and is the substance known as iron-rust. Ordinary brick-clays are bluish in color, and contain combined iron in the state of protoxide, but when burned in a kiln they become reddish, because this oxide absorbs from the air a further proportion of oxygen, and is converted into peroxide. But there are clays which are white when burned, and are much prized for this reason. Many of these were once ferruginous clays, which have lost their iron by a process everywhere going on around us. If we dig a ditch in a moist soil which is covered with turf or with decaying vegetation, we may observe that the stagnant water which collects at the bottom soon becomes coated with a shining, iridescent scum, which looks somewhat like oil, but is really a compound of peroxide of iron. The water as it oozes from the soil is colorless but has an inky taste from dissolved protoxide of iron. When exposed to the air, however, this absorbs oxygen, and peroxide is formed, which is no longer soluble, but separates as a film on the surface of the water, and finally sinks to the bottom as a reddish ochre, or, under somewhat different conditions, becomes aggregated as a massive iron ore. A process identical in kind with this has been at work at the earth's surface ever since there were decaying organic matters, dissolving the iron from the porous rocks, clays, and sands, and gathering it together in beds of iron ore or iron ochre. It is not necessary that these rocks and soils should contain the iron in the state of protoxide, since these organic products (which are themselves dissolved in the water) are able to remove a portion of the oxygen from the insoluble peroxide, and convert it into the soluble protoxide of iron, being themselves in part oxidized and converted into carbonic acid in the process.

We find in rock formations of very different ages beds of sediments which have been deprived of iron by organic agencies, and near them will generally be found the accumulated iron. Go into any coal region, and you will see evidences that this process was at work when the coal-beds were forming. The soil in which the coal-plants grew has been deprived of its iron, and when burned turns white, as do most of the slaty beds from the coal-rocks. It is this ancient soil which constitutes the so-called fire-clays, prized for making fire-bricks, which, from the absence of both iron and alkalies, are very infusible. Interstratified with these we often find, in the form of ironstone, the separated metal; and thus from the same series of rocks may be obtained the fuel, the ore, and the fire-clay.

From what I have said it will be understood that great deposits of iron ore generally occur in the shape of beds; although waters holding the compounds of iron in solution have, in some cases, deposited them in fissures or openings in the rocks, thus forming true veins of ore, of which we shall speak further on. I wish now to insist upon the property which dead and decaying organic matters possess of reducing to protoxide, and rendering soluble, the insoluble peroxide of iron diffused through the rocks; and reciprocally the power which this peroxide has of oxidizing and consuming these same organic matters, which are thereby finally converted into carbonic acid and water. This last action, let me say in passing, is illustrated by the destructive action of rusting iron fastenings on moist wood, and the effect of iron-stains in impairing the strength of linen fibre. We see in the coal formation that the vegetable matter necessary for the production of the iron-ore beds was not wanting; but the question has been asked me, where are the evidences of the organic material which was required to produce the vast beds of iron ore found in the ancient crystalline rocks? I answer, that the organic matter was, in most cases, entirely consumed in producing these great results; and that it was the large proportion of iron diffused in the soils and waters of those early times, which not only rendered possible the accumulation of such great beds of ore, but oxidized and destroyed the organic matters which in later ages appear in coals, lignites, pyroschists, and bitumens. Some of the carbon of these early times is, however, still preserved in the form of graphite, and it would be possible to calculate how much carbonaceous material was consumed in the formation of the great iron-ore beds of the older rocks, and to determine of how much coal or lignite they are the equivalents.

In the course of ages, however, as a large proportion of the once diffused iron-oxide has become segregated in the form of beds of ore, and thus removed from the terrestrial circulation, the conditions have grown more favorable for the preservation of the carbonaceous products of vegetable life. The crystalline magnetic and specular oxides, which constitute a large proportion of the ores of this metal, are almost or altogether indifferent to the action of organic matter. When, however, these ores are reduced in our furnaces, and the resulting metal is exposed to the oxidizing action of a moist atmosphere, it is again converted into iron-rust, which is soluble in water holding organic matters, and may thus be made to enter once more into the terrestrial circulation. There is another form in which iron is frequently concentrated in nature, that of sulphide, and most frequently as the bisulphide, known as iron-pyrites. This substance is found both in the oldest and newest rocks, and, like the oxide of iron, is even to-day forming in certain waters, and in beds of mud and silt, where it sometimes takes a beautifully crystalline shape. What are the conditions in which the sulphide of iron is formed and deposited, instead of the oxide or carbonate of iron? Its production depends, like these on decaying organic matters. The sulphates of lime and magnesia, which abound in sea-water, and in many other natural waters, when exposed to the action of decaying plants or animals, out of contact of air, are like peroxide of iron, deoxidized, and are thereby converted into soluble sulphides; from which, if carbonic acid be present, sulphuretted hydrogen gas is set free. Such soluble sulphides, or sulphuretted hydrogen, are the reagents constantly employed in our laboratories to convert the soluble compounds of many of the common metals, such as iron, zinc, lead, copper, and silver, into sulphides, which are insoluble in water and in many acids, and are thus conveniently separated from a great many other bodies. Now, when in a water holding iron oxide, sulphates are also present, and the action of organic matter, deoxidizing the latter, furnishes the reagent necessary to convert the iron into a sulphide; which in some conditions, not well understood, contains two equivalents of sulphur for one of iron, and constitutes iron-pyrites. I may here say that I have found that the unstable protosulphide, which would naturally be first formed, may, under the influence of a persalt of iron, lose one-half of its combined iron; and that from this reaction a stable bisulphide results. This subject of the origin of iron-pyrites is still under investigation. The reducing action of organic matters upon soluble sulphates is well seen in the sulphuretted hydrogen which is evolved from the stagnant sea-water in the hold of a ship, and which coats silver exposed to it with a black film of sulphide of silver, and for the same reason discolors white-lead paint. The presence of sulphur in the exhalations from some other decaying matters is well known, and in all these cases a soluble compound of iron will act as a disinfectant, partly by fixing the sulphur as an insoluble sulphide. Silver coins brought from the ancient wreck of a treasure-ship in the Spanish Main were found to be deeply incrusted with sulphide of silver, formed in the ocean's depths by the process just explained, which is one that must go on wherever organic matters and sea-water are present, and atmospheric oxygen excluded.

The chemical history of iron is peculiar; since it requires reducing matters tó bring it into solution, and since it may be precipitated alike by oxidation, and by farther reduction, provided sulphates are present. The metals, copper, lead, and silver, on the contrary, form compounds more or less soluble in water, from which they are not precipitated by oxygen, but only by reducing agents, which may separate them in some cases in a metallic state, but more frequently as sulphides. The solubility of the salts and oxides of these metals in water is such that they are found in many mineral springs, in the waters that flow from certain mines, and in the ocean itself, the waters of which have been found to contain copper, silver, and lead. Why, then, do not these metals accumulate in the sea, as the salts of soda have done during long ages? The direct agency of organic life comes again into play, precisely as in the case of phosphorus, iodine, and potash. Marine plants, which absorb these from the sea-water, take up at the same time the metals just named, traces of all of which are found in the ashes of sea-weeds. Copper, moreover, is met with in notable quantities in the blood of many marine molluscous animals, to which it may be as necessary as iron is to our own bodies. Indeed, the blood of mau, and of the higher animals, appears never to be without traces of copper as well as of iron. In the open ocean the waters are constantly aerated, so that soluble sulphides are never formed, and the only way in which these dissolved metals can be removed and converted into sulphides is by fixing them in organisms, either vegetable or animal. These, by their decay in the mud of the bottom, or the lagoons of the shore, generate the sulphides which fix their contained metals in an insoluble form, and thus remove them from the terrestrial circulation. It is not, however, in all cases necessary to invoke the direct action of organisms to separate from water the dissolved metals. It often happens that the waters containing these, instead of finding their way to the ocean, flow into lakes or inclosed basins, as in the case of the drainage waters of an English copper mine, which have impregnated the turf of a neighboring bog to such an extent that its ashes have been found a profitable source of copper. Under certain conditions, not yet well understood, this metal is precipitated by organic matters in the metallic state, but if sulphates are present a sulphide is formed. Thus, in certain mesozoic schists in Bohemia, sulphide of copper is found incrusting the remains of fishes and in the sandstones of New Jersey we find it penetrating the stems of ancient trees. I have in my possession a portion of a small trunk, taken from the mud of a spring in Ontario, in which the yet undecayed wood of the centre is seen to be incrusted by hard metallic iron-pyrites. In like manner the old trees of the New Jersey sandstone became incrusted with copper-sulphide, which, as decay went on, in great part replaced the woody tissue. Similar deposits of sulphides of copper and of iron often took place in basins where the organic matter was present in such a condition or in such quantity as to be entirely decomposed, and to leave no trace of its form, unlike the examples just mentioned. In this way have been formed fahl-bands, and beds of pyrites and other ores. The fact that such deposits are associated with silver and with gold leads to the conclusion that these metals have obeyed the same laws as iron and copper. It is known that both persalts of iron and soluble sulphides have the power of rendering gold soluble, and its subsequent deposition in the metallic state is then easily understood.

I have endeavored by a few illustrations to show you by what processes some of the more common metals are dissolved and again separated from their solution in insoluble forms. It now remains to say something of the geological relations of ore deposits, which are naturally divided into two classes; the first including those which occur in beds, and have been formed contemporaneously with the inclosed earthy sediments. Such are the beds of iron ores, which often hold imbedded shells and other organic remains, and the copper-bearing strata, already mentioned, in which the metal must have been deposited during the decay of the animal or plant which it incrusts or replaces. But there are other ore deposits, evidently of more recent formation than the rocky strata which inclose them, which have resulted from a process of infiltration, filling up fissures with the ore, or diffusing it irregularly through the rock. It is not always easy to distinguish between the two classes of deposits. Thus a fissure may in some cases be formed and filled between two sundered beds, from which may result a vein that may be mistaken for an interposed stratum. Again, a bed may be so porous that infiltrating waters may diffuse through it a metallic ore or a metal, in such a manner as to leave it doubtful whether the process was contemporaneous with the disposition of the bed, or posterior to it. But I wish to speak of deposits which are evidently posterior, and occupy fissures in previously formed strata, constituting true veins. Whether produced by the great movements of the earth's crust, or by the local contraction of the rocks (and both of these causes have in different cases been in operation), such fissures sometimes extend to great lengths and depths; their arrangement and dimensions depending very much on the texture of the rocks which have been subject to fracture. When a bone in our bodies is broken, nature goes to work to repair the fractured part, and gradually brings to it bony matter, which fills up the little interval, and at length makes the severed parts one again. So, when there are fractures in the earth's crust, the circulating waters deposit in the openings mineral matters, which unite the broken portions, and thus make whole again the shattered rocks. Vein-stones are thus formed, and are the work of nature's conservative surgery.

Water, as we have seen, is a universal solvent, and the matters which it may bring and deposit in the fissures of the earth are very various. There is scarcely a spar or an ore to be met with in the stratified rocks that is not also found in some of these vein-stones, which are often very heterogeneous in composition. In certain veins we find the elements of limestone or of granite, and these often include the gems, such as amethyst, topaz, garnet, hyacinth, emerald, and sapphire; while others abound in native metals or in metallic oxides or sulphides. The nature of the materials thus deposited depends very much on conditions of temperature and of pressure, which affect the solvent power of the liquid, and still more upon the nature of the adjacent rocks and of the waters permeating them. The chemistry of mineral veins is very complicated. Many of these fissures penetrate to a depth of thousands of feet of the earth's crust, and along the channels thus opened the ascending heated subterranean waters may receive in their course various contributions from the overlying strata. From these additions, and from the diminished solubility resulting from a decrease of pressure, deposits of different minerals are formed upon the walls, and the slow changes in composition are often represented by successive layers of unlike substances. The power of these waters to dissolve and bring from the lower strata their contained metals and spars is probably due in great part to the alkaline carbonates and sulphides which these waters often hold in solution; but the chemical history of the deposition of the ores of iron, lead, copper, silver, tin, and gold, which are found in these veins, demands a lengthened study, and would furnish not less beautiful examples of nature's chemistry than those I have already laid before you. The process of filling veins has been going on from the earliest ages; we know of some which were formed before the Cambrian rocks were deposited, while others are still forming, as the observations of Phillips have shown us in Nevada, where hot springs rise to the surface and deposit silica, with metallic ores, which incrusts the walls of the fissures. These thermal waters show that the agencies which in past times gave rise to the rich mineral deposits of our Western regions, are still at work there. Let us now consider the beneficent results of the process of vein-making. The precious metals, such as silver, are so sparsely distributed, that even the beds rich in the products of decaying sea-weed, which we have supposed to be deposited from the ocean, would contain too little silver to be profitably extracted. But in the course of ages these sediments, deeply buried, are lixiviated by permeating solutions, which dissolve the silver diffused through a vast mass of rock, and subsequently deposit it in some fissure, it may be in strata far above, as a rich silver ore. This is nature's process of concentration.

We learn from the history which we have just sketched the important conclusion, that amid all the changes of the face of the globe the economy of nature has remained the same. We are apt, in explaining the appearances of the earth's crust, to refer the formation of ore-beds and veins to some distant and remote period, when conditions very unlike the present prevailed, when great convulsions took place, and mysterious forces were at work. Yet the same chemical and physical laws are now, as then, in operation; in one part dissolving the iron from the sediments and forming ore-beds, in another separating the rarer metals from the ocean's waters; while in still other regions the consolidated and buried sediments are permeated by heated waters, to which they give up their metallic matters, to be subsequently deposited in veins. These forces are always in operation, rearranging the chaotic admixture of elements which results from the constant change and decay around us. The laws which the first great cause imposed upon this material universe on the first day are still irresistibly at work fashioning its present order. One great design and purpose is seen to bind in necessary harmony the operations of the mineral with those of the vegetable and animal worlds, and to make all of these contribute to that terrestrial circulation which maintains the life of our mother earth.

While the phenomena of the material world have been looked upon as chemical and physical, it has been customary to speak of those of the organic world as vital. The tendency of modern investigation is, however, to regard the processes of animal and vegetable growth as themselves purely chemical and physical. That this is to a great extent true must be admitted, though I am not prepared to concede that we have in chemical and physical processes the whole secret of organic life. Still we are, in many respects, approximating the phenomena of the organic world to those of the mineral kingdom; and we at the same time learn that these so far interact and depend upon each other that we begin to see a certain truth underlying the notion of those old philosophers who extended to the mineral world the notion of a vital force; which led them to speak of the earth as a great living organism, and to look upon the various changes in its air, its waters, and its rocky depths, as processes belonging to the life of our planet. Since this lecture was delivered, I have seen the results of the researches of Sonstadt on the iodine in sea-water, which appear in the *Chemical News* for April 26, May 17, and May 24, 1871. According to him this element exists in sea-water, under ordinary conditions, as iodide of calcium, to the amount of about one part of the iodate in 250,000 parts of the water. This compound, by decaying organic matter (and by most other reducing agents), is changed to iodide, from which, apparently by the action of carbonic acid, iodine is set free, and may be separated by agitating the water with bisulphide of carbon. The iodine thus liberated from sea-water by the action of dead organic matters, however, slowly decomposes water in presence of carbonate of calcium, and is reconverted into iodate, the oxygen of the air probably intervening to complete the oxidation, since, according to Sonstadt, iodides are readily converted into iodates under these conditions. He finds that the insolubility of the iodides of silver and of copper is so great that by the use of salts of these metals iodine may be separated from sea-water without concentration, provided the iodate of calcium has first been reduced to iodide. By this property of iodine and its compounds to oxidize and be oxidized in turn, Sonstadt supposes them to perform the important function of consuming the products of organic decay, and so maintaining the salubrity of the ocean's waters. Their action would thus be very similar to that of the oxides of iron, as explained in the present lecture. Still more recently the same chemist has announced that the sea-water of the British coasts contains in solution besides silver an appreciable quantity of gold, estimated by him at about one grain to a ton of water. This is separated by the addition of chloride of barium, apparently as an aurate of baryta adhering to the precipitated sulphate, which yields by assay an alloy of about six parts of gold to four of copper. Other methods have been devised by him for separating these metals from their solution in sea-water. The agent which keeps the gold of the sea in a soluble and oxidized condition is, according to Sonstadt, the iodine liberated by the action already described.

The views maintained by Lieber, Wurtz, Genth, and Selwyn, as to the solution and redeposition of gold in modern alluvial deposits seem to be well grounded, and we are led to the conclusion that the circulation of this metal in nature is as easily effected as that of iron or of copper. The transfer of certain other elements, such as titanium, chrome, and tin, or at least their accumulation in concentrated forms, appears, on the contrary, to require conditions which are no longer operative at the surface of the earth. It should here be noticed that Prof. Henry Wurtz, of New York, in a paper read before the American Association for the Advancement of Science in 1868, expressed the opinion that the ocean-waters contained gold, and urged experiments for its detection. According to his calculations the total amount of gold hitherto extracted from the earth, and estimated at two thousand million dollars, would give only one dollar for two hundred and eighty million tons of sea-water, while from the experiments of Sonstadt it would appear that the same quantity of gold is actually contained in twenty five tons of water.

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THE ORES OF IRON; THEIR GEOGRAPHICAL DISTRIBUTION.

MENTION has been made by several observers that iron has been found in certain localities as native or pure iron. It is probable, however, that iron is never found of terrestrial origin in a pure state, and that in the instances referred to, the material was of meteoric derivation. In meteoric masses, nearly pure iron is not uncommon, but the iron of meteorites is usually associated with certain proportions of nickel, cobalt, and other elements, and sometimes considerable amounts of occluded hydrogen. Magnetite or the magnetic oxide (Fe_2O_3

$+FeO=Fe_3O_4$), is the richest of all the known ores of iron, and when perfectly pure contains 72.41 per cent. of iron, and 27.59 of oxygen, though commercially it rarely exceeds 55 to 60 per cent. of iron. It is found crystallized in octahedra, crystalline, massive, or as sand; color black; is magnetic, and some varieties possess polarity—the *loadstone*. The great deposits are in the Russian Altai and Ural Mountains, Sweden, Norway, and Lapland, and in North America. In America it is found solely in the metamorphic crystalline rocks—Archæan—the great deposits being in the Canadian highlands and the Alleghany Mountains from the St. Lawrence to Georgia. Besides these, other deposits of less present importance are found in Arkansas and at various points in the Archæan rocks of the Rocky Mountains. Certain deposits in all of these great iron regions are found to be contaminated by titanium in the form of the mineral menaccanite $(Ti.Fe)_2O_3$. In the Eastern United States, Canada, Tasmania, New Zealand, Japan, etc., a sand of magnetic oxide, often titaniferous, is found as the result of the destruction of large masses by wave action, in all of which places it has been used in the manufacture of iron. In Sussex County, New Jersey, there is found a unique deposit of magnetite—Franklinite—in which part of the protoxide of iron is replaced by protoxides of zinc and manganese, and part of the peroxide by peroxide of manganese. This mineral when pure contains about 65 per cent. of peroxide of iron, 12 per cent. of manganese oxide, and 20 per cent. of zinc oxide. It is a doubly valuable ore, first, for the production of zinc white, and secondly in the production of spiegeleisen. hematite, red hematite, specular iron, etc., (Fe_2O_3). When pure it contains 70 per cent. of iron and 30 per cent. of oxygen, though as used by the iron master it rarely surpasses 60 to 66 per cent. of metallic iron. It is distinguishable from the other ores of iron by its red streak; is found nearly black to brick-red in color, crystallized, crystalline, massive, fibrous, oölitic, botryoidal, ochrey, etc. The great deposits of this ore are crystallized on the island of Elba; massive and botryoidal in Lancashire, England, and certain places in Western Europe; massive and crystalline, Lake Superior, Pilot Knob, and Iron Mountain, etc., Missouri; oölitic in the stratified ore of the Clinton group of the Lower Silurian in the Eastern United States, the "dyestone" or "fossil ore."

Limonite, brown hematite, brown iron ore, hydrated peroxide, bog ore, pipe ore, etc., $(2Fe_2O_3,3HO)$, contains when pure 59.9 per cent. of iron and 14.4 per cent. of water. Under this ore may practically also be included the other peroxides of different degrees of hydration, *Göthite* and *Xanthrosiderite*, or yellow iron ore, which sometimes largely compose masses of limonite. Limonite is found nearly black in color to brown, yellowish-brown, or yellow, and is distinguished by its yellowish-brown streak. It occurs massive, botryoidal, stalactitic, granular (bog ore), ochreous, etc. In richness it varies greatly, but the ore as used rarely contains more than 45 to 50 per cent. of iron. Of all the ores of iron it is one of the most widely distributed. Usually it is found as surface deposits in basins or depressions, which are of very uncertain extent, and while there is scarcely a country or state that does not contain some deposits, as an ore, though valuable, it is of inferior importance. Sometimes it is found as the result of the oxidation of the outcrops of mineral veins containing iron (*gossans*) of the stratified carbonates or crystalline ores, and as deposits on the surface or in cavities, pockets, or fissures in the rocks from ferruginous springs or waters. In Sweden large quantities are found in the bottom of the lakes as grains of all sizes up to that of peas or beans, and is known as *lake ore.* Carbonates of the protoxide (FeO,CO_2) the different forms of which are: (*a*) *Spathic iron ore siderite* or *chalybite*, the crystallized carbonate of iron, when pure containing 48.22 per cent. of iron, crystallizing in rhombohedra. Though a very valuable ore of iron, it is of little importance in the United States, and is found in but small deposits in Roxbury, Conn., and Southern Vermont. In Carinthia and Westphalia in Europe, the spathic ore is of great importance and is the foundation of large industries. (*b*) The *clay ironstone* or argillaceous carbonate of iron, is the great ore of the coal measures, but is, however, found in considerable quantities in the cretaceous formation of both the East and West United States. It occurs as stratified deposits, though more commonly as rounded masses, *kidneys* or *nodules*, of all sizes, which are sometimes, however, so closely compacted as to form regular strata. In richness this clay ironstone contains commonly from 33 to 40 per cent. of iron.

It has been the principal ore used in Central England and Wales, and is also found in several of the European coal basins. While the carbonates of the coal measures are of considerable importance in the United States, they are greatly overshadowed in value by the richer and more abundant crystalline ore. Clay ironstone is also found granular and oölitic, as the oölitic ores of the Jurassic (Lias) in Germany and France, which are also of the same age and general character as the celebrated ore of the Cleveland Hills of Northeast England, where they are the foundation of an immense iron industry. When the argillaceous carbonate is associated with bituminous matter it forms (*c.*) *blackband* or bituminous clay ironstone, which is a bituminous shale impregnated with sufficient iron to render it valuable as an ore. Usually it contains from 25 to 50 per cent. of iron. It is the ore of the famous blackband iron district of Scotland, and is found to some extent also in Central England and Wales, also in some of the German coal basins. The United States contains deposits of little importance in the Triassic coal basin of North Carolina, in the metamorphic coal measures of Pottsville, Pa., and in the bituminous coal basin of West Virginia. The only deposits of value now known, however, are found in the coal measures of Eastern Ohio. Ores are rarely used which contain less than 25 per cent. of iron, and they may be roughly divided according to their richness into *poor ores*, those between 25 and 35 per cent.; *ordinary* or *average ores*, between 35 and 50 per cent.; and *rich ores*, those containing more than 50 per cent. of metallic iron. To show the *distribution* of the ores of iron, and the locations of the great iron producing regions of the world, the chief iron-making countries of the world may be passed rapidly and briefly in review.

ENGLAND.—It requires no argument to show that England's position, as one of the highest civilized countries, arises mainly from the extent of her manufactures and her commercial intercourse with the rest of the world, which are due almost exclusively to the great magnitude of her iron industries. Thus in 1871, of the total of 13,315,500 tons of pig iron made in the world, England produced about one-half, or 6,500,000 tons. Her facilities for iron manufactures are almost unsurpassed, for all the materials necessary, the iron ore, coal, etc., may be drawn from very limited areas, and often from the same mine, thus being in marked contrast with the condition in the United States where such long and expensive transportation is necessary. The districts of manufacture are five in number: the Scotch, Cleveland, West Coast, Central England, and South Wales.

1st. The *Scotch* region is limited by the extent of the Scotch coal measures, and is included in the shires of Fife, Lanark, Linlithgow, Stirling, and Ayr, extending across from the Frith of Forth to the Frith of Clyde. The ores are the blackband and clay ironstone of the coal measures, which are found in beds of limited extent and thickness, varying from a few inches to a couple of feet, but on an average only about ten inches. The amount of ore mined in 1872 was 3,270,000 tons. The fuel employed is the dry open-burning coal of the Scotch fields used raw in the furnace, similar in character to our own block coals of Ohio and Indiana. The pig iron produced is mainly for foundry use, and though not of first quality, has a reputation over all parts of the world for its exceeding uniformity and adaptability for foundry purposes, and is known by the familiar names of "Coltness," "Gartsherrie," etc.

2d. The *Cleveland* district, though the newest, ranks first in production and in the application of skill and boldness in the manufacture. It is situated on the northeast coast of England, around Middlesboro', in Durham, and the North Riding of Yorkshire. The ore used is an oölitic clay ironstone from the Jurassic formation, occurring in immense beds 12 to 17 feet in thickness, and containing about 35 per cent. of iron, with commonly 1 per cent. of phosphoric acid. The production of ore in 1872 was 5,539,000 tons. During the last few years, however, some ores have been imported for mixtures from Spain and Sweden. The fuel used is coke from the Durham coal-field, the coal of which approaches more nearly our typical coking coals than that of the other English coal areas.

3d. The *West Coast* district is one of the newest centres; but as the repository of the only ore used in Great Britain in making iron for the Bessemer steel process, is of great importance. It is located along the west coast of Cumberland and Lancashire, at Barrow, Workington, etc. The ore is a very pure red hematite found in pockets in the mountain limestone, and containing about 50 per cent. of iron. The ore is shipped largely to other parts of the country, Wales, Central England, etc., and in 1872 there were raised 1,769,000 tons.* The fuel employed is coke from the coals of the Cumberland coal-field, but principally from the Durham coal measures. The iron produced is specially adapted, from its purity, for making Bessemer steel, and large quantities are transported to Germany, France, and the United States for that purpose.

4th. The *Central* region of Staffordshire, Derbyshire, etc., including the famous towns of Birmingham, Derby, and Sheffield, though one of the oldest in the country, is being overshadowed by the newer districts. The ores worked for so many years are now becoming less abundant, and more difficult to mine. They are the argillaceous carbonate, and some black band of the coal measures, besides which brown hematites are imported from the adjoining country, Forest of Dean, etc. The fuel is the dry bituminous coal of the underlying coal formation, which is used both in the raw state and as coke.

5th. The *South Wales* region is embraced in the shires of Glanmorgan, Monmouth, and Brecknock, and is limited by the area of the Welsh coal-fields. The ores are similar in character to those of Staffordshire, besides which considerable quantities are brought from Cumberland, Ireland, Spain, etc. The fuel is the dry bituminous coal and anthracite of the region, and the iron produced is used chiefly for forge and mill purposes.

Sweden.—The ores of Sweden are specular, some brown hematite and bog ore, but principally magnetite. The character and geological position of the latter is peculiarly similar to that of the magnetites of the Eastern United States and Canada, though they are generally more free from sulphur and phosphorus. While abundantly provided with iron ores, and producing a large amount of iron celebrated for its excellent qualities, Sweden has made but little advance in her production, because of the absence of ready means of communication, but more especially from the want of an abundant supply of fuel, the only fuel being charcoal, and the quantity of this is fast becoming reduced, though its production is controlled by law. The principal deposits of magnetite in Sweden are in the southern part, around Lake Wenern, and in the counties of Wermland, Westmanland, and Dalecarlia. The mines of Dannemora, north of Upsala, also produce large quantities of iron, which is made into the celebrated brand of that name. There are also large deposits of magnetite in North Sweden and Lapland, and in Arendal in Norway. The chief product is wrought iron made from the pig iron almost exclusively in low fires, holding the first rank in all countries of Europe. Considerable amounts of cast iron and steel are also produced, and some quantities of ore are now being sent to the coal-fields of England and Northern Europe.

Russia.—Russia contains immense and almost inexhaustible deposits of iron ore, principally magnetite, with some hematite. While producing iron of the highest grades, her advance in the manufacture is retarded, like Sweden, by the want of mineral fuel; and though in some of the governments coal is known to exist, charcoal is the only fuel employed, its consumption reaching 1,500,000 tons per year, and large areas being laid waste to furnish the supply. The scantiness of the population, the vast areas possessing limited and precarious means of communication, and the great distance from the works to the markets are also great obstacles to its progression. The principal iron regions are: 1st. Those of the *Ural* and *Altai Mountains*, which are the great mineral storehouses of Russia. Large and valuable deposits are found in the Altai Mountains, around Nertschinsk, in Eastern Siberia, and Barnaul, in Western Siberia. The great deposits and works are, however, situated in the Urals, in the government of Perm, and the magnetic deposits of the mountains of Blagodat, 150 versts north of Jekaterinburg, of Nijni Tajilsk, etc., are celebrated for their magnitude and richness. Beside the magnetic ores, considerable quantities of red hematite are found near Barnaul, Jekaterinburg, and the South Urals. The vast establishments of Prince Demidoff at Perm, Nijni Tajilsk, and Jekaterinburg have a world-wide reputation.

2d. The region of *Central Russia* around Moscow, Nijni Novgorod, etc., in the governments of Nijni Novgorod Vladimir, Kaluga, Penza, Orel, and Tambov, in which the principal ore, the red hematite, is found in great abundance, containing usually from 45 to 48 per cent. of iron, together with carbonate ores. In addition to these two principal regions, considerable iron is produced in Russian Poland from carbonates and bog ores, and Finland is particularly rich in magnetites, though producing but litle iron. Information is limited concerning the magnitude of the Russian iron industry, but it is estimated to be between 200,000 and 300,000 tons per year.

France.—France is quite abundantly supplied with iron ores, but the manufactures have been much retarded from a want of a good supply of coal. A large part of the iron has been made from charcoal, but the introduction of a better system of communication has enabled the ironmaster to more thoroughly utilize the coals of the few and scattered coal-basins, which are neither of very superior quality, nor of great extent, and to very largely increase her production. Very considerable amounts of coal are also annually imported from England. The principal ore of France is the oölitic ore (similar to the Cleveland ore of England), which occurs scattered on the surface and in the rocks of the Jurassic formation, extending across the country from the Pas de Calais, on the northwest, to the Jury Mountains on the southeast. There are also found very abundant deposits of limonite in the tertiary and alluvium; some spathic ores, red hematites, and a little magnetite, besides which quite considerable quantities of magnetite and hematite are imported from Algiers, Elba, Sardina, and Spain, especially into the southern regions. The iron districts of France have been divided into nine groups, viz.: 1st. Group of the *Southeast*, or of the Rhone and Saone, including now the principal district of France, and the celebrated works of Le Creusot, Terrenoire, St. Etienne, of Petin, Gaudet & Co., at St. Chamond, etc. The ores are mainly oölitic and brown hematite, and imported ores from the Mediterranean, the fuel being coke from the coals of the basins of the Loire, Gard, etc. The production in 1867 was 28.8 per cent. of 1,380,422 tons, the total production of the country.

2d. The *Compte* district, situated in the east, along the Jura and Franche Compté, employing charcoal with oölitic and brown hematite ores, and in 1867 producing 5.6 per cent. of the production of the country.

3d. Region of the *Alps*, in the southeast, in Isère and Savoy, using charcoal and principally spathic carbonates, and in 1867 producing only 0.4 per cent. of the total production.

4th. The *Champagne* district, on the northern border, in Ardennes, Haute Marne, and Meuse, in which the fuel is charcoal and coke, from the coal-basin of du Nord and Pas de Calais on the west, and the borders of the Belgian coal-field on the east, with oölitic and hydrated peroxide ores, the production in 1867 being 12.8 per cent. of the national production.

5th. Group of the *North*, in Pas de Calais, basins of the Escant and Sambre, employing coke from the coals of the underlying coal measures as fuel, and granular limonites, etc., and producing in 1867 13.6 per cent. of the total production.

6th. Region of the *Centre*, comprising the manufacture in the provinces of Berry, Bourbonnais, Nivernais, etc., using charcoal mainly, and some coke, from the Allier basin, and alluvial with some little Spanish and Mediterranean ores. The proportion of the production for 1867 was 10.4 per cent.

7th. Region of the *Northwest*, north of the Loire and west of the Seine, in Bretagne, etc., using charcoal and a little coke, with limonites, little magnetite, and some ores

* Quite large amounts of ore are imported from Ireland, which is also sent, to a considerable extent, into Staffordshire and Wales. The ore is a pisolitic limonite, particularly free from sulphur and phosphorus, but remarkable for its large percentage of alumina, being, in fact, almost a *bauxite*. It has been found to add much to the case of smelting the pure hematites of the Cumberland region, and to mix well with the other English ores.

from Spain, producing in 1867 1.6 per cent. of the iron made in France.

8th. *Southeast* group, or group of the Pyrenees, in which the fuel is charcoal, with some coke, and the ores hematite, spathic, limonite, oölitic carbonate, etc., with a production of 5.6 per cent. in 1867.

9th. Region of the *Moselle and Meurthe*, in the northeast, where the fuel is from the Prussian coal-basin of the Saar, and the ores oölitic carbonate from the Lias, with a production in 1867 of 20.8 per cent. In 1870, by the annexation of Alsace and Lorraine to Prussia, twenty-five establishments out of thirty-seven were taken from this group, which represented 75 per cent. of the production of this region.

Belgium.—Belgium, though only about the area of the State of Maryland, by the devel0pment of the comparatively small coal-basins of Liége and Charleroi, and of the abundant iron ores, produced in 1871 nearly 900,000 tons of iron, which ranks her as fifth among the iron-producing countries of the world. The ore most important in her manufacture is the *minette, psammite*, or *oölitic limonite* from the Grand Duchy of Luxembourg. This is a hydrated peroxide of iron, the result of the oxidation of oölitic carbonate of the Lias, the equivalent of the Cleveland ironstone of England. Formerly the red hematites occurring in the limestone at the base of the coal measures, in the eastern provinces of Namur and Liége, were the main source of supply, but they became insufficient for the demand, and have been supplemented by the *minette*, which in many cases has to be transported a hundred miles or more. Besides these ores there are found considerable quantities of brown hematite in the eastern provinces, and some bog ore mainly from the northeast low countries. The iron manufacture is conducted chiefly around the cities of Liége and Charleroi, the fuel employed being coke made from the coal of the adjoining coal-basins. The usual inferior character of the Belgian and French coals, compared with the English, have neccessitated their most careful preparation, to enable them to be successfully used in the blast-furnace, and hence to these countries we are indebted for the development of and the best forms of coal-washing machines and coking apparatus, now in use.

Austria.—Austria, though one of the largest states, and containing some of the most valuable ores in Europe, ranks but sixth among the iron-producing countries, and in 1871 the make of pig iron, 450,000 tons, was but little more than half that of the small kingdom of Belgium. The cause of this is mainly to be found in the wide separation of the great ore deposits from the coal-fields, and the want of cheap and ready means of transportation. In 1870 84 pér cent. of iron made was produced with charcoal, and 16 per cent. with mineral fuel. The only valuable coal-fields are found along the northwestern border of the empire, in Bohemia and Silesia, the coals of which are much inferior, as smelting fuels, to the coals of France and Belgium. Brown coal, or lignite, and peat, are found in considerable abundance in many places, especially in Hungary and Bohemia, and when dried, or charred, they have been used to a small extent for smelting purposes, though they are more commonly employed in puddling and working iron. The most important iron ore deposits are found in the southeast, in Styria and Carinthia (the Noricum of the Romans), where charcoal is the only fuel, and as the manufacture has been pursued in these countries for several centuries, the production has been limited on account of scarcity of fuel. More perfect communication, however, is stimulating the industry, and permitting the transfer of mineral fuel from the northern coal-fields to these southern deposits. The ores are principally rich and pure spathic carbonates, the iron from which has long been famous for its excellent quality. The spathic ore deposits of the Erzberg and Eisenerz, in Styria, are celebrated for their great magnitude, being found in beds from 200 to 600 feet in thickness, while in Carinthia are similar deposits of less extent. The ore raised in Carinthia and Styria in 1858 was 15 and 20 per cent. of the total raised in the empire, and in 1870 the make of pig iron was respectively 11 and 37 per cent. of that made in the empire, exclusive of Hungary. Next in importance to the manufacture in Styria and Carinthia is that of Bohemia, Moravia, and Silesia. The principal ores of Bohemia are red hematite from the bordering mountains, and brown hematites, with clay ironstone, of the coal measures. In Moravia and Silesia the ores are mainly clay ironstone from the Carpathian Mountains. The proportion of ore raised in these countries was, in 1858, in the above order: 19.36, 12.43, and 2.09 per cent. of that raised in the empire, and the production of pig iron in 1870 was 23,11, and 2 per cent. of that made in the empire, excluding Hungary. In Hungary the ores are chiefly spathic carbonates, with some magnetites, limonites, etc. In 1858 Hungary raised 18 per cent. of all the ores produced in the empire, and in 1870 yielded about 133,000 tons of pig iron, while Carinthia and Styria produced 178,000, Bohemia 130,000, and Moravia and Silesia 33,000 tons.

The German Empire.—In the Empire of Germany the principal iron production is confined to the Prussian states, in which there are two great iron-making sections, viz., in the east, in Upper Silesia, and in the west in the region bordering the Rhine, or the Rhine provinces; besides a manufacture of less importance in the central and northern parts, Saxony and Hanover. These sections also contain all the coal-fields of any importance in the Empire, as those of Silesia, of the basin of the Saar, on the Upper Rhine, and of the basin of the Ruhr or Westphalia, and the adjoining basins of Aachen in Belgium, in the Lower Rhine, with the smaller and less important one of Saxony. The ores of the Prussian states are in the order of their importance as follows: The brown hematites, which furnish 40 per cent. of the ore used, are very widely distributed, and probably the most valuable of all the ores. The spathic or sparry carbonate forms nearly 20 per cent. of the ore used, and is mainly obtained in the Rhine provinces, especially in the Bonn region, where are the celebrated deposits of Müsen, Siegen, etc., which furnish large quantities of Bessemer iron, and spiegeleisen, the latter of which is exported to all parts of Europe and America for steel purposes. The red hematite deposits yielding 19 per cent. of the total ore produced are found chiefly in the Rhine provinces west of Bonn, where it is a continuation of the similar deposits of Belgium in the carboniferous limestone. Black band ore forms 10 per cent. of the ore used, and is exclusively obtained in the coal-fields of Westphalia. Limonites,—"bean ore,"—to the extent of 7 per cent. of the total ores, is used in the Clausthal or Hanoverian region. Clay ironstone, including the oölitic carbonate of the Belgian frontier, is used to the extent of 1.75 per cent., and is found mainly in the Silesian region and the Rhine provinces. Bog ore is found in considerable quantities in the plains of Northern Germany, and to the extent of 1.75 per cent., is mined and used in Silesia and Northern Germany.

The manufacturing districts are divided by the Prussian authorities as follows: The *Silesian* region around Breslau, Oppeln, etc., where the Silesian coal-field and the brown hematites, with clay ironstone and bog ores, produced in 1870 24 per cent. of the pig iron made in the Prussian states. The *Halle* region of Saxony, at Magdeburg, etc., of little importance, producing only 0.12 per cent. of the total production of pig iron. The districts of the *Rhine*, which are divided into: 1st, the region of Dortmond, the most important iron region, producing 36.75 per cent. of the iron made, containing part of the Westphalian coal-field, and using black band, brown hematite, spathic, and red hematite ores. In this division are included the celebrated works of Krupp at Essen—the largest iron establishment in the world—and a considerable manufacture at Dusseldorf, Osnabruck, etc. 2d. The Bonn region, which ranks next in importance, producing in 1870 33.67 per cent. of the pig iron made, and including portions of the Westphalian and Rhine provinces around Bonn. Fuel is accessible from the basin of the Ruhr on the north, and Aachen on the west, besides the celebrated lignite beds of the Rhine. The most important ore is the spathic carbonate, of Devonian age, which is found in the famous district of Siegen, where the most noticeable deposit is that of the Stahlberg or Steel Mountain, near Müsen, besides which large quantities of brown hematite and red hematite are also employed. The Clausthal region of Hanover, etc., using mainly limonite ores, is of smaller importance, producing in 1870 only 5.22 per cent. of the pig iron made in the Prussian states. The annexation of Alsace and Lorraine, after the war of 1870, has transferred to Prussia 25 blast-furnaces, producing in 1870 205,579 tons of pig iron. The principal ore used is the oölitic, *minette* of the Jurassic, the continuation of the same formation producing the valuable ores of Northeastern France, and Southeastern Belgium already mentioned. The fuel is all obtained from the basin of the Saar near Osnabruck, already alluded to. The other states of the Zollverein besides the Prussian—Wurtemberg, Bavaria, and the coal-basins of Zwickau in Saxony—hold but an unimportant position in the iron manufacture.

Spain.—We have but little accurate information concerning the mineral resources of Spain, but we know that she possesses many large and valuable deposits of iron ore with coal-basins of no mean extent. While, during the last half century, the iron manufacture in the other European states has advanced to a most wonderful extent, from inherent national conservatism, political uncertainty, etc., the iron industry of Spain has been far behind them, and her prosperity is still further checked by the present civil war. In former years a considerable industry was maintained in the production of charcoal iron on the Biscayan coast, etc., and of wrought iron by the Catalan direct process in the Pyrenean provinces, Catalonia, etc., but from the causes mentioned her present iron production is small, being in 1870 but 54,000 tons. Within the last five years, however, very earnest attention has been directed to the Spanish ore deposits by English and German iron masters, principally in seeking ore sufficiently pure for producing Bessemer pig iron. Many companies have been formed for working the deposits, with an aggregate capital of several million dollars, and large amounts of ore have been and are being constantly shipped to England, Belgium, and Germany. The principal deposits yielding these ores are situated on the Biscayan provinces of Oviedo, Santander, Biscay, Guipuzcoa, etc., and the deposits now most extensively worked are near Samorrostro (Santander), and especially in the vicinity of Bilbao (Biscay). The deposits of the range of mountains along the Biscayan coast, have been examined by Mr. David Forbes, who pronounces them to be of Cretaceous age. The ore is a hydrated peroxide, occupying veins or lodes in the rocks of this age, is quite rich, and particularly free from sulphur and phosphorus. It is an ore well adapted for making steel iron, and for such purposes is principally employed. The ore, as greater depths are reached in the veins, is found to be only a *gossan* or oxidized outcrop, the mass of the unchanged deposit being spathic iron or carbonate ores, containing, however, a greater proportion of sulphur than the gossan ore.

North European capital has also been at work developing the iron mines of the southern provinces, particularly in Murcia (near Cartagena), in Malaga, Seville, etc. The ore in these districts is principally magnetic and specular. The great addition this entails upon the expenses of sea transportation is, however, against their competition with the product of the Biscayan coast. In the coal-fields of Villanueva, the ore deposits of Seville, etc., find a ready fuel, and it is not unlikely that it will soon be the foundation of a prosperous local manufacture. Statistics of the yield of the Spanish mines are very meagre. According to some authorities the total annual production in 1870 was 436,000 tons, while from other sources the importation of England alone was in 1868 only 88,000, which had, however, risen in 1872 to 631,000 tons.

Africa.—Deserving of mention also are the rich and pure deposits of iron ore in Algiers, which have a growing importance in the iron manufacture of Europe. The ores are mainly spathic carbonates and limonites the result of the decomposition of the former. They are quite rich in iron, and particularly free from sulphur and phosphorus, and are now largely exported for the manufacture of Bessemer irons. France has heretofore been the chief importer of these ores, but owing to the Spanish difficulties considerable quantities have been sent to England and Germany. Some cargoes have also been shipped to the United States, and have been used by the Bethlehem, Pa., Bessemer Steel Works. This ore is said to have been sold in New York for $24 per ton. The principal export has been from the Mokta mines which produced in 1872, 335,000, and in 1873, 404,000 tons of ore. Attention has recently been directed toward smelting in Algiers, and works are said to have been erected to use coal brought by the ore vessels on their return voyage. Wood, though abundant, consists mainly of cork, mahogany, and other woods too valuable to make charcoal from.

North America.—In the abundance, purity, and wide distribution of iron ores, and their accessibility to the largest coal areas in the world, the United States possesses facilities for an iron industry unexcelled by those of any other land. Along the eastern coast, the magnetic ores are found as an almost constant associate of the older metamorphic rocks, the gneiss, hornblende, and mica schists of the Appalachian Mountains, in nearly continuous lines of outcrop from the borders of the St. Lawrence River and Lake Champlain in Northern New York, to their terminations in the northern part of Georgia. The ore occurs in beds interstratified with the other members of the Archæan system, following the severe contortions of that series, usually in lenticular-shaped deposits, and though limited in extent and thickness, are often of great magnitude. The thickness is subject to very great variations, and while sometimes occurring in beds 150 to 200 feet thick, they are usually of much less size. In the character of the ores, the mode of occurrence, and their associations, they bear a very close resemblance to the magnetic deposits of Sweden already mentioned. In Northern New York in the Adirondack Mountains, in Essex and Clinton Counties, immense beds are found, which have long been worked, and supply much of the ore consumed in Eastern New York and on the Hudson River. The great beds of the Moriah district in Essex County are remarkable for their great size, in some cases nearly 200 feet in thickness of solid ore. These ores often contain large proportions of titanic acid, sometimes from 12 to 30 per cent., which renders many deposits of little present value. Phosphorus and sulphur, especially the former, are quite generally present, and often in a damaging proportion. In the highlands of Eastern New York, and portions of the adjoining State of Massachusetts, in the same belt of metamorphic rocks, valuable deposits of magnetite also occur, which are of special importance in Orange, Putnam, and Dutchess Counties. In direct continuation of these deposits are those of the northern counties of New Jersey, Passaic, Sussex, Morris, and Warren, a belt of this same series passing across the State from northeast to southwest, and contains some of the most valuable ores of the Eastern United States. In this region is also included the unique deposit of Franklinite, a manganiferous magnetite containing zinc, which is of great importance in the production of zinc and manganiferous pig iron or spiegeleisen. The ores west of the Hudson, in New York and Northern New Jersey, have been wrought from a very early period, and contain but little or no titanium, but are commonly contaminated by sulphur or phosphorus, generally to so great an extent as to unfit them for the manufacture of steel-irons. In Pennsylvania, the only really important deposits of magnetite are found in the southeast part of the State, at Cornwall, in Lebanon County, where they occur near the junction of the Mesozoic sandstone and metamorphic Silurian slates. They are quite sulphurous and are associated with copper minerals, but particularly free from phosphorus, and are altogether one of the finest and most important deposits in the country. In other places in Eastern Pennsylvania, magnetites are found, and are remarkable often for an association with chrome and alumina.

Following this Archæan belt of the Appalachian Mountains, through Maryland and Western Virginia, magnetites occur in numerous places, but their importance is not yet fully known. In Western North Carolina they have been fully investigated, and occur in an abundance and of a purity unsurpassed by any other of the well-known regions of the country. They are found in several nearly parallel belts, passing across the western part of the State in a southwest direction into Northern Georgia, where they still retain considerable importance. Some of the North Carolina ores are quite titaniferous, others aluminous or chromiferous, while others again are of very exceptional purity, as the celebrated Cranberry ore of Mitchell County. These ores are found often in beds of 300 or 400 feet in width, and are destined to assume a great value in the development of the iron industry of that region, especially as they are not far distant from the valuable extensions of the Alleghany coal-field in the Cumberland region of West Tennessee, the Black Warrior basins, etc., of Alabama, and the Deep and Dan Rivers Triassic coal-fields of North Carolina. These magnetites of the Eastern United States flank the great Alleghany coal-basin along its entire eastern margin, and must form the most important store-houses of ore for the iron industry of that part of the country.

Analyses of Magnetic Iron Orea.

	Northern New York.	*New Jersey.*	*North Carolina (Cranberry ore).*
Magnetic oxide of iroo,	93.235	73.20	91.89
Oxide of Manganeae,	trace.	.50	.32
Alumina,	0.595	4.40	1.03
Lime,	.664	1.56	1.06
Magnesia,	.119	1.59	.23
Sulphur,	.007	0.11	.25
Phoaphoric acid,	.050	0.38	trace.
Silicic acid,	4.597	11.63	4.02
Titanic acid,	0.733	. .	. .
Water,	. .	6.58	1.15
	100.000	99.95	99.95
Metallic iron,	67.51	53 00	66.53

Bearing a similar though more remote relation to the northwestern margin of the Alleghany coal-basin and the coal-fields of the Mississippi Valley in Indiana, Illinois, Missouri, etc., are the rich specular hematites of Missouri and Lake Superior. The specular ores of Lake Superior, admixed in certain localities with magnetite, are found on the south shore of Lake Superior, beginning about ten miles from the lake in Marquette County, Michigan, and extending thence in a belt about eight miles in width, in a south and westerly direction, into Northern Wisconsin. Developments, however, have only been made extensively in Marquette County, Michigan. The ore occurs in distinct beds in the metamorphic rock of the Huronian age, which are chiefly quartzites, chloritic rocks, ferruginous schists, etc., in which the ore is often only a ferruginous stratum, rich enough to be valuable as an ore of iron. These beds are of great magnitude, in some instances 200 feet or more in thickness, and not unfrequently occur in lenticular masses, as mentioned when referring to the magnetites of the Eastern United States. The ore varies from a very pure specular ore, often beautifully crystallized in lamellæ, to a silicious ferruginous rock, of little value as an ore, and on the whole the ores are generally silicious and often contain much jasper. The ore is otherwise exceptionally pure, as may be seen from the following analysis from the Michigan State Geological Reports:

	(1)	(2)	(3)	(4)
Protoxide of iron,	11.87	. .	. .	. .
Peroxide " "	74.93	86.70	74.69	93.75
Manganeae oxide,	.05	trace.	.42	trace.
Alumina,	4.15	1.64	.50	.73
Lime,	.52	.57	.37	.61
Magneaia,	.92	.24	.63	.23
Sulphur,	.12	.02	.	.03
Phosphoric acid,	.28	.14	.18	.32
Silica,	3.70	9.82	16.44	3.27
Water,	.52	.61	7.16	1.09
	100.06	99.74	100.39	100.03
Metallic iron,	66.04	60.69	52.28	65.62

(1) Magnetic ore—Champion Mine.
(2) Specular ore—Lake Superior Mine
(3) "Hematite"—Foster Mine.
(4) "Specular" ore—Jackson Mine.

According to their richness, they are divided into three classes: 1st, containing 55 to 65 per cent. of iron; 2nd, those containing 45 to 55 per cent.; and 3rd, those ores below 45 per cent. of iron. The ore is mined almost entirely in large open quarries, and since the first openings in 1856 up to 1870 there have been produced 3,771,939 tons of ore, and in the year 1871 alone, the production was 1,073,979 tons, producing about one-quarter of the pig iron made in the entire United States.

The great deposits of specular ore in Missouri occur in isolated peaks, or islets of the older Archæan rocks, probably of the same age as the very similar ores of Lake Superior, surrounded by the more recent sedimentary rocks. They are situated about 75 miles southwest of St. Louis, and appear in two principal localities, removed from each other by only a few miles,—Pilot Knob and Iron Mountain. Adjoining Pilot Knob, are Cedar Hill, Shephard Mountain, etc., which are also ore-bearing. In both these localities, the characteristic associate of the ore is a porphyritic rock, which is usually very much decomposed. The Pilot Knob deposits form a regular bed, distinctly stratified, while the Iron Mountain ore is of a compact character and is found in veins in the porphyry more or less irregular. The ores of both localities have much of the character and purity of the Lake Superior ores, though the Pilot Knob ores are much more silicious than the Iron Mountain. The following analysis from the Missouri Geological Reports will show their composition:

	Iron Mountain.		*Pilot Knob.*	
Silica,	3.99	1.57	13.27	5.18
Peroxide of iron,	91.45	95.04	84.33	90.87
Protoxide "	2.34	2.57	.15	1.67
Alumina,	1.40	·79	2.19	.89
Lime,	.51	.17	.21	1.76
Magneaia,	.22	.137	.14	.13
Sulphur,	. .	.005	trace.	.078
Phosphorus,	.252	.071	.035	.069
	100.162	100.353	100.325	100.647
Metallic iron,	65.78	68.53	59.15	64.91

From the purity of the Lake Superior and Missouri hematites, they afford the main source of supply in the United States for making iron for conversion into steel by the Bessemer process, and for this purpose they are very largely used. They are the main dependence of the iron industry in West Pennsylvania, Ohio, and the Mississippi Valley, and in the coals of these regions, the Lake Superior ores first meet an abundant supply of fuel in which they are deficient at home. Magnetic ores have been found in the Archæan rocks of Wyoming Territory, Arkansas, etc., but they have not yet become an element in the iron industry of the country.

The next ore of importance in the United States is the "fossil" ore, an oölitic red hematite, which is found as a member of the Clinton group in the lower Silurian formation, and is known in different sections as the "Clinton," "fossil," "dyestone," and "flaxseed" ore. In the extent of its distribution, and the uniformity of its character and occurrence, it is one of the most remarkable ores in the country. Following the formation wherever it outcrops, it is found in almost a continuous stratum over a very large area of the Eastern United States. In Dodge county, Wisconsin, it occurs as a bed 20 to 25 feet in thickness, of a soft gravelly character, and is there mined and known as "flaxseed" ore. Its next place of appearance is where the inclosing formation enters New York State at Little Sodus Bay, from which it passes eastward in a curved line through Oneida and Wayne counties, and southward into Pennsylvania at Danville. It is mined and largely used in New York State, where it is familiarly known as "the Clinton" or "Wayne county" ore. From Danville, Pa., it passes southward, through Huntingdon and Bedford counties, and following the flanks of the Alleghanies, it is found in all the intermediate States, disappearing finally in Northern Alabama. At Danville and numerous other places in Eastern Pennsylvania and in Maryland, it is very extensively worked and known as the "fossil" ore. In Eastern Tennessee and Northern Alabama, as the "dyestone" ore, it forms a very important element in the iron industry of that region. The ore occurs as distinct strata in the Clinton group, usually in two beds, and though varying considerably, is on an average from two to four feet in thickness. The character of the ore is peculiar, being an aggregation of grains of peroxide of iron, each seeming to have a nucleus of some organic remains, and the mass is filled with fossils, and usually calcareous. It is probably the result of a deposition in shallow water in a manner similar to the accumulation of bog ore at the present day, and not a formation subsequent to that of the inclosing strata. Where, however, the beds have been highly tilted, the ore is not unfrequently found changed by the percolation of atmospheric waters into a brown hematite or hydrated oxide. The ore very generally contains considerable phosphoric acid, from 0.5 to 100 per cent., and the pig iron produced is wholly unfit for steel purposes and generally the better qualities of wrought iron, yet it fulfils excellently well foundry purposes and the ordinary grades of malleable iron. The following are analyses of this ore from three States:

	Tennessee.	*Pennsylvania.*	*Wisconsin.*
Peroxide of iron,	81.26	83.72	65 93
Oxide of manganese,	trace.	.	1.00
Magnesia,	.50	.	. . .
Magnesia carbonate,	. .	. . .	3.48
Sulphuric acid,	trace.	. . .	. .
Alumina,	3.40	1.15	1 40
Lime,	1.60	.20	. . .
Lime carbonate,	. .	. .	6.82
Lime phosphate,	. . .	. .	8.99
Silica,	6.50	2.96	4.80
Phosphoric acid,	1.45	.64	. .
Carbonic acid,	1.50	. . .	. . .
Water,	4.00	11.20	7.60
	100.21	99.87	100.02
Metallic iron,	56.88	58.12	46 15

The ores of the coal measures of the United States are much less abundant and important than those of Great Britain, and while valuable, are insignificant when compared with the richer and more commonly used ores already mentioned. In the Alleghany coal-fields no important deposits are found in the anthracite basins, and though some local accumulations of argilliferous ores are found at the base of the upper group of coals, as the Oliphant ore, etc., of Southwestern Pennsylvania and Northwest West Virginia, the chief deposits occur in the rocks of the lower group of coals. Several horizons in the lower coals in the western part of the Alleghany coal-field are peculiarly marked as ore-bearing, especially that of the "ferriferous limestones" of Northwestern Pennsylvania and Eastern Ohio, and while they are of some considerable value in Northwestern Pennsylvania, they become of particular importance in the Hanging Rock region of Southern Ohio and Eastern Kentucky, where they are the foundation of a large industry. The ore resting upon a limestone is a carbonate of iron, more or less calcareous and argillaceous, though it appears more largely as a hydrated peroxide, the result of the decomposition of the original bed. Near the same horizon are also other deposits, of less interest, of nodular clay ironstone. In the Kanawha Valley of West Virginia important accumulations of ore are also found in the lower coal series, which are not yet, however, an essential element in the manufacture of iron in that region. At many horizons in the Alleghany coal-basin deposits of argillaceous shale occur, including scattered kidneys or nodules of clay ironstone, but they are of very uncertain character and are rarely of any importance as ores. The coal-fields of the Mississippi Valley have nowhere been found to contain any considerable deposits of iron ore. Black band iron ores have been found in the Triassic coal-basin of North Carolina, but Dr. Genth reports them to be valueless as ores, from the large proportion of phosphorus present, derived from fossil organic remains. At Pottsville, Pa., black band occurs metamorphosed by the same action that changed the accompanying coal into anthracite, but the deposits have not been found to be of great extent. The only important deposit of black band known in the United States is in the coal measures of Eastern Ohio, where it exists as a local accumulation at the top of the lower series of coals, in limited portions of Stark and Tuscarawas Counties. The deposit varies greatly in thickness and character, and while ranging from 6 to as high as 16 feet, the average thickness is about 12 feet, though it not unfrequently thins out entirely, or passes into a non-ferruginous bituminous clay shale. The ore is generally less rich than the Scotch black band, and contains 25 to 40 per cent. of iron. The only deposits of crystallized carbonate or spathic iron ore known in the United States, are found at Roxbury, Conn., and in Southern Vermont, but they are of little economic significance. The brown hematites or limonites of the United States are very widely distributed, and are of great interest in the iron industry of the country, and while every State contains some deposit of them, they are particularly abundant in the valleys and lowlands along the flanks of the Alleghany Mountains, which are so rich in magnetic ores, and in similar relations, though in less extent, to the great ore deposits of Missouri and Lake Superior. These ores are largely used in the Eastern States as mixtures with the richer crystalline ores, and the deposits of South Vermont, Salisbury, Conn., New York, and at other places, are well known, and contribute largely to the iron industry of that region. In Eastern Pennsylvania, they are very abundant, and at numerous other places in the southern extension of the Alleghany Mountains, in Tennessee, etc., but from the great uncertainty of the extent of the deposits, they rarely can prove the basis alone of any important iron industry in our country.*

The Laurentian rocks of Canada are very rich in magnetic ores, similar in character to those of Northern New York. The area including them stretches in direct continuation of the Adirondack region on the north side of the St. Lawrence River in a northwesterly direction, crossing the river about Ogdensburgh, and passing in a broad area along the eastern shores of Georgian Bay and Lake Superior. The ore occurs in numerous deposits, similar in character to those of Eastern New York, and often of great dimensions, as the celebrated bed of Marmora, which is 100 feet in thickness. They have been mainly developed in the vicinity of the Rideau canal, Marmora, Belmont, etc., in the region north of Kingston, from which they have been shipped to some extent to the iron centres of Pennsylvania and Ohio. Though selected ore of a fair degree of purity is obtained, it is generally largely contaminated with sulphur and phosphorus, and often contains very large proportions of titanium. But while Canada contains very extensive deposits of ore, from the absence of mineral fuel it produces but a very small amount of iron. The immense deposits of magnetite, specular, and other ores which are found in the United States, and the facilities which our mode of transportation gives to their union with the great coal areas of the Alleghany and the Mississippi, must give to the United States the foremost position in the future iron industry, and consequently of the manufactures of the world. In their development we are yet but beginning to realize their importance, and the future must witness great advances in the manufacture in the Eastern States, but more particularly in the Virginias, East Tennessee, Northern Alabama, and in Western North Carolina, which are so abundantly provided with rich and pure ores. The manufacture of iron in the Eastern States will undoubtedly be divided into two great regions, the northern centring in Pennsylvania, and the southern in adjoining corners of Alabama, Georgia, Tennessee, and North Carolina. Independent, however, of these regions in the east, the facilities offered by the valley of the Mississippi, in its valuable coal-basins, and the rich ores of Missouri and Lake Superior, must surely give materials to large iron industries, and all the attendant manufactures, and the rich and fertile valley of the Mississippi must be the home of a large, wealthy, and from its position, a united population. To complete this article, it may not be inappropriate to add a brief synopsis of the great iron regions of our country, with the peculiar conditions of each, and to this end they may be divided as follows:

1st. The ANTHRACITE and MAGNETIC IRON ORE districts of NEW YORK, NEW JERSEY, PENNSYLVANIA, and EASTERN MARYLAND. The establishments included in this division, with the exception of a few charcoal furnaces in New York and Pennsylvania, depend entirely upon the anthracite coal-basins of Northeastern Pennsylvania for their fuel, and produce all the iron made in the country with anthracite coal. This was, in 1872, 52 per cent. of the total production

* Since the preparation of these notes much light has been thrown upon the distribution and mode of occurrence of the brown hematites of Eastern Pennsylvania, by the able and energetic investigation of Prof. Fred. Prim, Jr., of Lafayette College. These studies form the subject of a very interesting paper "On the Occurrence of the Brown Hematite Deposits of the Great Valley." It is replete with interesting facts, and is a long step toward an understanding of the sequence of events in the formation of those most puzzling deposits, the brown hematites.

of the United States, or 1,197,000 out of 2,300,000 tons, being the yield of 209 blast-furnaces. The ores used are chiefly magnetic and commonly an admixture of brown hematite, and in some cases the Clinton fossil ore, the Rossie red hematite of St. Lawrence County, New York, and in Western New York some Lake Superior and Canadian ores, and in Maryland argillaceous carbonate from the Cretaceous clays. The districts may thus be subdivided by reference to the position and the character of the ore in each group.

(*a.*) *The group of Eastern New York*, including the manufacture in the Adirondack region, at Port Henry, and various places on the Hudson River and contiguous counties; at Troy, Albany, Hudson, Poughkeepsie, etc., where the anthracite is brought by canal and railroad from Pennsylvania, and the ores used are mainly magnetic from the Adirondacks and the southeastern counties, with an admixture of the brown hematites of the region.

(*b.*) *The group of Central and Western New York.*—The ores used in the central counties, Chemung, Oneida, Wayne, etc., are mainly the fossil Clinton ore, and in some cases an admixture with magnetite or Rossie hematite, while in Western New York, at Buffalo, etc., Lake Superior and Canadian ores are generally employed. In 1872 New York produced about 16 per cent. of the anthracite, and about 9 per cent. of the total pig iron made in the United States, the greater part being produced in the eastern section of the State. The entire number of blast-furnaces in the State is about sixty-two.

(*c.*) *Northern New Jersey*, though furnishing large supplies of magnetic ore to the neighboring State of Pennsylvania, produced in 1872 only 84,035 tons of pig iron, or 7 per cent. of the total anthracite pig iron made in the United States. The ores exclusively used are the magnetites already alluded to, occurring in the northern counties, while the anthracite coal is supplied by Pennsylvania. The manufacture is conducted principally at Phillipsburg, Boonton, Ringwood, etc., and includes about sixteen blast-furnaces.

(*d.*) *Eastern Pennsylvania*, so well supplied by its abundant stores of anthracite coal and the accessible magnetites of the eastern counties and New Jersey, and by the large and scattered deposits of brown hematite, and, near the Susquehanna River, the fossil Clinton ore, is the largest pig iron producing region in the United States. In 1872 it produced 893,375 tons, or 74.6 per cent. of all the anthracite pig iron made in the country. This region of Eastern Pennsylvania may be again divided into four groups.

(α.) The Lehigh Valley, embracing the manufacture along and near the Lehigh River at Easton, Bethlehem, Catasauqua, Hohendauqua, Allentown, etc., producing about one-fifth of the total iron made in the country. The ores used are chiefly magnetites from New Jersey, with equal proportions of the brown hematite of the adjoining country.

(β.) The group of the Schuylkill River, embracing the manufacture in Schuylkill, Berks, Montgomery, Chester Counties, etc., where the ores are magnetic, obtained principally from the Cornwall mines of Lebanon County, with smaller proportions of brown hematite, smelted with anthracite coal from the Pottsville region. The manufacture is represented by about sixty-five furnaces, the chief points of production being Reading, Pottsville, Conshohocken, etc.

(γ.) The group of the Upper Susquehanna, embracing the manufacture in Montour, Luzerne, Columbia Counties, etc., where the fuel is obtained from the neighboring anthracite basins, the ores being chiefly magnetite from New Jersey, and brown hematite, with some Clinton fossil ore; the latter obtained in the vicinity of Danville. The chief points of manufacture are Scranton, Danville, etc., with a total of about twenty-five furnaces.

(δ.) The group of the Lower Susquehanna, in Dauphin, Lebanon, Lancaster Counties, etc., where the most important ore is derived from the magnetite mines of Cornwall, besides which considerable quantities of brown hematite and some fossil Clinton ore are also employed. Charcoal is used in some localities, the principal fuel being anthracite from the Pottsville basins. The furnaces of this group are about forty-five in number.

(ϵ.) The final group, which has been included in the region of the Eastern United States, is made to contain the manufacture in *Eastern Maryland*, in Harford, Baltimore, Howard, and Washington Counties, which though possessing a few anthracte furnaces, is rather an exception to the classification, as it includes quite a number of furnaces using charcoal and coke, the latter derived from the great Cumberland coal-basin, while the little anthracite used comes from Eastern Pennsylvania. The ores also are chiefly brown hematite, with some red hematite and argilliferous kidney ore from the Cretaceous clays of Eastern Maryland. The chief points of manufacture are near Baltimore, and the entire number of blast furnaces in the group is about twenty-one.

2d. THE MOUNTAIN REGION OF CENTRAL PENNSYLVANIA, lying on the eastern borders of the Alleghany coal-basin, and including also the manufacture depending upon the semi-bituminous coal-basins of Broad Top and Cumberland, and containing between 45 and 50 furnaces, located chiefly in Blair, Huntingdon, Centre, Franklin, Cambria, and Bedford Counties. Nearly one-half of this number employ charcoal as fuel, while the others use coke made from the coals of the eastern part of the Alleghany basin, and the semi-bituminous coals of the small Broad Top and Cumberland basins. The use of charcoal must soon be entirely superseded by coke, an abundant supply of coal being so accessible. The ore which occurs in greatest importance and regularity is the fossil Clinton ore, which is particularly abundant in Bedford and Huntingdon Counties, besides which large quantities of brown hematite are very generally distributed as surface deposits, and decomposed fossil ore, which in some cases, are the main source of supply. Large quantities of coal-measure carbonates are also used at Johnstown, and by the charcoal furnaces of Blair, Centre Counties, etc., while small qnantities of Lake Superior ore have been imported to one or two localities, but at great expense. The chief points where the pig-iron manufacture is carried on, are at numerous places in Blair County, where charcoal is the fuel, and the ores clay ironstones, fossil, and brown hematite; at Johnstown, where are located the works of the Cambria Iron Company, the most extensive rolling mills in the United States—supplied with fuel by the underlying coal, and using the fossil, coal measure and surface limonitic ores. The Broad Top region of Bedford and Huntingdon Counties, drawing its supply of fuel from the Broad Top semi-bituminous basin, has at present a limited manufacture. The presence, however, of vast deposits of the fossil or Clinton ore has destined it to be at no distant future a large producer. Near the latter, in Maryland, are a few furnaces bearing a similar relation to the semi-bituminous Cumberland coal-basin.

3d. THE PITTSBURGH REGION (which city being the great iron centre, may appropriately give a title to the entire region), including the maufactures of Western Pennsylvania, Eastern Ohio and Kentucky, and West Virginia. Though possessing much diversity in material and conditions in the various sections, all the different manufacturing points can with reason be included in one great iron district. While in some places charcoal is still an important fuel, the larger supply, and the entire future dependence must be upon the abundant deposits of coal of this part of the Alleghany coal-basin. The coals vary in character, as the celebrated open-burning block coals of the Shenango Valley, Pa., and Mahoning and Hocking Counties, Ohio, the splint coals of West Virginia, and the coking coals, which are widely distributed, and of which the celebrated Connellsville coal, of Southwestern Pennsylvania, and the Pittsburgh coal are types. This region bears also an important relation to the rich deposits of specular and magnetic ores of Lake Superior and Canada, which first find here an abundant supply of fuel, and which are the chief source of supply for the northern districts of the region. Besides these, large quantities of Missouri specular ores are also used, and in some parts of Southwestern Pennsylvania, Southern Ohio, Kentucky, etc., the coal-measure ores become of great importance. This region may be divided into four districts as follows:

(*a.*) *The Pittsburgh* district proper, embracing the manufacture in Armstrong, Alleghany, and the southwestern counties of Pennsylvania, and at Leetona, Steubenville, Martinsburg, Bellaire, etc., in Ohio, and Wheeling in West Virginia. The fuel is exclusively coke, derived principally from the Pittsburgh coal-seam, the Connellsville coal furnishing considerable used in the district, though coke is also made at each place from the local coals. The coal-measure ores are used in Armstrong and Lafayette Counties, but the main supply are the rich ores of Lake Superior, Missouri, and Canada. The chief points of the industry are Pittsburg, which from the extent of its manufacturing industry has not been inaptly called the Birmingham of America, as it is undoubtedly the city of the largest iron manufacturing interest in the country. Steubenville, Ohio, and Wheeling, West Virginia, though much inferior in importance, are rapidly becoming the centres of an extensive industry, and the latter place, from the magnitude of its nail manufacture, is commonly known as the "Nail City."

(*b.*) The *block coal regions* of the Shenango Valley, Pennsylvania, and Mahoning Valley, Ohio, in Lawrence and Mercer Counties, Pennsylvania, and Mahoning and Trumbull Counties, and Cleveland, Ohio, comprises 34 furnaces in Pennsylvania, and 25 in Ohio. The fuel is exclusively block coal, which is used in the raw state in the blast-furnace, and as the "Briar Hill" or "Mahoning Valley" coal, has become celebrated as one of the finest known smelting fuels. The ores are almost without exception the rich specular ores of Lake Superior, though sometimes small quantities of Canadian or Lake Champlain ores have also been imported. The ores of the region are generally shipped by way of Cleveland, which is the most important iron market on the entire chain of the great lakes, it being the commercial centre for the chief Lake Superior mines. The chief points of manufacture in the region are Sharpsville, Sharon, Middlesex, and Wheatland, Pennsylvania, and Youngstown and Cleveland, Ohio.

(*c.*) *The black band district* of the Tuscarawas Valley, in Stark and Tuscarawas Counties, Ohio, with furnaces at Massillon, Canal Dover, Port Washington, etc. Though but a small iron-producing district, from the exceptional character of its conditions it merits separate consideration. The ore used is the black band ore, the only place in the United States where it is used in any quantity, and though the deposits are of limited extent, it must be the foundation of a considerable industry, especially in the event of its mixture with the richer crystalline ores. The fuel now used is Massillon block coal, similar in character to the Mahoning coal, though coke will eventually be very considerably employed. In the character of its product it more closely resembles the celebrated "Scotch pig," than any other iron made in the country.

(*d.*) *The Hanging Rock region* of Southern Ohio and Eastern Kentucky, in Lawrence, Jackson, Vinton, etc., Counties of Ohio, and Boyd and Carter Counties, Kentucky, is the largest charcoal iron region in the United States; but charcoal is rapidly giving way to the use of mineral fuel, which underlies the entire region in great abundance. The special characteristic of this region is the rich and valuable deposits of ore found in the rocks in the lower group of coals, which occur either as a bed of unchanged calcareous or argillaceous carbonate of iron, or as a hydrated peroxide, the result of the oxidation of the original bed, as well as some less important accumulations of kidney ore, etc. The iron made from these ores with charcoal has long held a superior rank as a peculiarly soft and tough iron, and has been largely used by the government for ordnance purposes. The substitution of coal for charcoal and the opening up of new avenues of transportation are rapidly increasing the importance of the region, and permitting the importation of the Missouri and Lake Superior ores, which work admirably with those of native origin. Large and pure deposits of open-burning coal are accessible from the Hocking Valley region on the north, and have been long used from the Coalton region of Kentucky. The chief points of the manufacture are at Ironton, Ohio, and Ashland, Kentucky, which two places are the keys to the region, in their respective States, Ohio being represented by 46, and Kentucky by 15 blast-furnaces. In West Virginia, beside the points already mentioned, there are very large deposits of iron ore, as well as excellent fuel, both coking and open-burning, which must ere long be the foundation of a large industry. The valley of the Kanawha River has been characterized by numerous observers as particularly rich in such resources.

4th. THE REGION OF THE SOUTHERN ALLEGHANIES, in East Tennessee, West North Carolina, Northwest Georgia and Northern Alabama, or the *Chattanooga* region, though at present represented by but 52 blast-furnaces, some half dozen of which only use coke or raw coal, is still most important in its resources and in the relation which it must bear to the future iron industry of the South, and the country at large, when better means of communication are provided and the region becomes more developed. In the Cumberland table-land of East Tennessee, the Black Warrior, Coosa, and Cahawba basins of Alabama, we have the southern prolongation and termination of the Alleghany coal-fields, represented here by numerous coal-seams of great value, and which, though at present very little developed, must be the key to extensive manufactures and great wealth. The extreme northwest corner of Georgia possesses also some coal—the overlapping edge of the Alabama and Tennessee coal-fields, and North Carolina contains in the Triassic coal-basins of the Deep and Dan Rivers, coal similar in character to those of Richmond, Virginia, which may be of value in iron smelting. The great extent, purity, and importance of the magnetic iron deposits of North Carolina, which extend also into Northern Georgia, though not yet very largely opened, must make a chief source of supply in the future iron industry of the South. The ores at present mainly employed in Georgia, Alabama, and Tennessee are brown hematites, which are very abundant, and the dyestone or fossil ore, which latter is used in Georgia and Alabama. The fuel now employed is, with only a few exceptions, charcoal, but the supply of wood is necessarily limited, and in the future expansion of the manufacture, the dependence will be upon the coal-basins already mentioned. Many of the coals of Alabama and Tennessee are dry or open-burning in character. At present the manufacture in Tennessee is principally conducted in Roane, Carter and Green Counties, by about 10 furnaces; in Alabama, in Jefferson, Cherokee, Shelby, and Bibb Counties, by 17 furnaces; and in North Carolina, in Chatham and Lincoln Counties by 10 furnaces.

5th. The manufacture in WESTERN OLD VIRGINIA, along the flanks of the Blue Ridge Mountains, in Wythe, Pulaski, Page, Augusta, Botetourt Counties, etc., which, however, is not yet of great importance. The points of manufacture are widely scattered, the fuel with one or two exceptions being charcoal; while the forests will furnish a long supply of fuel, the basis of large industries must be the mineral fuel, which is readily accessible in the adjoining coal-basins of the Cumberland on the north, and West Virginia on the west, the use of which will concentrate the establishments in such places as are accessible to both ore and fuel. The ores employed are at present almost exclusively brown hematites, with a small proportion of red hematite, producing in 1870, according to the census returns, 17,200 tons of pig iron.

6th. THE REGION OF WESTERN KENTUCKY AND TENNESSEE, south and west from Louisville—in Lyon, Trigg, and Bullitt Counties, etc., in Kentucky; west of Nashville, in Stewart, Dickson, etc., Counties, Tennessee. Though containing, in Western Kentucky, part of the Illinois coal-field, this is an iron region of comparatively little interest. It is represented in Kentucky by 9, and in Tennessee by 14 blast-furnaces. The fuel is, with one or two exceptions in Kentucky, charcoal, the ore being brown hematite, which is found frequently in large deposits, mainly decomposed nodules of carbonate and sulphide of iron, from the lower carboniferous rocks of the region. This region is probably never destined to be of much importance in the production of iron; the ore is scattered somewhat uncertainly in its deposits, and too often quite silicious, but as a feeder of ores to the iron manufacture in the southern part of the Illinois coal-field it may meet a needed supply of raw material.

7th. THE BLOCK-COAL IRON REGION OF INDIANA, originated within the past few years, and though at present represented by less than a dozen blast-furnaces—situated in Clay, Vigo and Martin Counties—is a region of peculiar interest. The southwestern part of the State is underlaid by the eastern margin of the Illinois coal-field, and in the counties named, the coal is extensively mined and used in iron smelting. It is an open-burning block coal of unusually excellent and pure quality, resembling very closely the block coals of Eastern Ohio. Indiana contains no iron ores of economic value, and hence the supply is obtained from Missouri or Lake Superior, chiefly the former. The iron made is of excellent quality, and has been successfully used in the Bessemer process. The manufacture is centred principally around Terre Haute and Brazil.

8th. THE MISSOURI IRON REGION, with St. Louis as a centre, includes the manufacture in Southern Illinois and Eastern Missouri. Considering the immense deposits of specular ore of Pilot Knob and Iron Mountain, and the great extent of the workable coal area in Missouri, Illinois, and Kentucky, this region has resources which when developed fully must make it the great iron centre of the Mississippi Valley. At present the manufacture is maintained chiefly at and near St. Louis, Grand Tower, Pilot Knob, and in Franklin and Campbell counties, Illinois, the furnaces being about 24 in number. The ores are drawn almost entirely from Iron Mountain and Pilot Knob, while in the adjoining counties in Missouri, a small industry is supported by less important deposits of red and brown hematites. The coals of the Missouri and Illinois coal-basin are as a rule much more impure than the coals of the Alleghany basin, and most of them require washing before they will make coke suitable for iron smelting, though from their general dry character some of the coals are used in the raw state, as the coal from the Big Muddy, Illinois. At St. Louis and Grand Tower, coke is made chiefly from the Big Muddy coal of Illinois, though no inconsiderable amount has been brought from Pittsburgh and Connellsville, Pennsylvania. In the other works of Southern Missouri, charcoal is the only fuel used. The iron produced with these materials is of an excellent quality, and together with the iron made from Lake Superior ores, ranks as the best in the country.

9th. THE NORTHERN ILLINOIS or the CHICAGO REGION, is not large in the number of its establishments, but it includes, at Joliet, in Will county, Illinois, one of the largest pig iron and steel works in the West, and at Chicago and Milwaukee several fine blast-furnaces, beside a number of others in Southern Wisconsin, in Dodge, Sauk counties, etc. The ores that are the chief dependence of the industry of the region are shortly and easily transported by water from the Lake Superior region, via Escanaba, Some Missouri ores are used at Joliet, and in Central Wisconsin the celebrated fossil or flaxseed ore of Dodge county is largely smelted and exported, and to some extent used at Milwaukee and Chicago. In Wisconsin, charcoal is still used, while much of the fuel at the other places is coal and coke from the northern part of the Illinois coal-field. The coal is not of so good a quality as that of Pennsylvania and Ohio, and while at Joliet, etc., large quantities of Northern Illinois coal is consumed, there is still a very considerable amount of coke imported from Western Pennsylvania. At Chicago and Milwaukee, anthracite has been brought from Eastern Pennsylvania, and mixed with the native coals. The source of fuel supply, however, for this region must be the Illinois coal-field, and necessity will compel the use of more perfect methods of fuel preparation.

10th. THE LAKE SUPERIOR IRON REGION comprises the manufacture of pig iron in the Lake Superior iron ore district, from the rich native hematites, which, from the entire absence of mineral fuel, is conducted with charcoal, with only one or two exceptions where Ohio or Pennsylvania coals are imported by the ore vessels on their return trips from the lower lakes. The iron produced holds a deservedly high reputation in the Western markets, and is very largely used for the manufacture of Bessemer steel in Pennsylvania, Ohio, and Illinois. In this group is included the manufacture in Marquette county, Michigan, and the counties adjoining Green Bay, Lake Michigan, and in Brown and Outagamie counties in northern Wisconsin.

Though not properly included in this group, there is quite a considerable industry in Southern Michigan, depending on the supply of Lake Superior ores, and which belongs properly to none of the other groups mentioned. Thus the Lake Superior ores are carried from Escanaba across Lake Michigan to several counties adjoining Grand Traverse Bay, where are vast forests of timber, also to the southern end of the lake to Van Buren county. At Detroit also, on the direct line of communication between the upper and lower lakes, a considerable industry is established, where the ores await the anthracite and bituminous coals of Pennsylvania and Ohio, as well as the charcoal of the adjoining country. In all, the furnaces in the places mentioned number about 50, and in the Marquette region of Upper Michigan are located the greater proportion, nearly 40, producing in 1870, 50,000 tons of pig iron. The region to which this name is more generally applied is however, centered in Marquette county, where are located also the immense and valuable ore deposits.

—*A paper by Henry Newton, E. M., Transactions American Institute of Mining Engineers.*

IRON MANUFACTURE IN MEXICO.

THE works of the Tula Iron Company are in the Republic of Mexico, State of Jalisco, twenty-eight leagues southwest of Guadalajara, ten leagues northwest of the town of Sayula, through which passes the projected line of the Mexican National Railroad. Its geographical position would be about: latitude, 20° 10′ N., longitude, 4° 35′ W. of Mexico City. The surrounding country is a rolling plateau, 6000 feet above the sea, enjoying the most magnificent climate in the world, the average temperature being about 70°. The works were commenced in 1860 by a company with a very small capital, having not the least idea of the undertaking. They soon fell into the hands of the money-lenders, and after changing owners three times, the works came, in 1870, into the present company, and have been in a manner rebuilt. As they were originally commenced without any fixed plan, and each successive owner has pulled down and rebuilt acccording to his fancy, the result is a number of old machines and sheds, huddled together in the most inconvenient manner, which have cost about four times as much as an entirely new establishment.

Description of the Works.—*Water-Power.*—Being placed at the junction of two synclinal valleys, Atunajac on the north and Tapalpa on the south, the direct drainage of thirty square miles is partially received; and for a trifling amount expended in straightening and removing the obstructions of the various water-courses, the amount of water in the dryest season (the month of May), which is now 3.6 cubic feet per second, may be doubled. The rainy season commences in June and ends in October. The present dam collects sufficient water to last until the end of April, or about ten months, more or less. This dam is of rubble masonry, built in form of an L, across the valley. It is 650 feet long and 20 feet high at the highest point. Here it is 7 feet at the base and 3½ feet at the top; the back vertical and the face with a batter of 2 inches to the foot, or the base is equal to 0.35 of the height. A wall of this height (20 feet), to be just equal in resistance to the pressure of the water, should be at least 8.4 feet, or 0.42 of the height. The numerous retaining-walls added at intervals of 30 feet protect it from overturning. The back water extends half a mile; the average width is 600 feet. The ground contiguous to the works is in the shape of a horseshoe. At the apex or top there is a basalt dike, 80 feet high, which being in the bed of the old stream, the water has eroded a deep ravine below, and caused the present topography. On one side is a water-tank, to be subsequently mentioned, on the other are the works.

The Furnaces.—In a deep excavation in the hillside, No. 1 furnace was built. Stack (brick), 28 feet high; bosh, 6 feet 5 inches, inclination, 50°; throat, 3 feet; heart 19 by 20 inches, rectangular; two tuyeres, 1½ inches and 17½ inches above hearth-line; cold blast; pressure, 1 pound. The lining above the bosh is of refractory stone, said to have been in use thirteen years; the hearth is of stone. From the tuyeres to the bosh a composition is used, made of equal parts of clay, from a place called Capula, powdered stone, and powdered quartz. It generally lasts from four to six months. Blast is supplied by two double-acting wooden blowing cylinders, with clock valves; diameter, 3 feet; stroke 7 feet. These also furnish blast for four bloomary fires and two smith's forges. This machine is driven by a 30-feet overshot water wheel, which gives about 46 per cent. of the power of the water used. This wheel drives also a small drill-press and turning lathe. In front of furnace No. 1 is the foundry, 40 x 60 feet, arranged with suitable cranes and apparatus. To the right in an excavated space, are two badly constructed cupolas and the exit gate. At the end is the carpenter shop, very small and crampy, beneath which is a storeroom for pig iron and billets. On the same level is the bloomary, twenty feet below the level of the foundry, to the left, which consists of four bloomary fires two trip hammers, operated by separate overshot water wheels of 15 feet diameter. In the same building are also an old single-puddling furnace and nine inch bar mill, both worthless and abandoned. About fifteen feet to the left of the foundry and furnaces is a reservoir, 50 x 80 feet, which catches the water from the 30-feet water wheel and delivers it to the water-wheels of the bloomary. Furnace No. 2 is immediately behind or to the south of No. 1 about twenty feet, in a space excavated for the purpose. The stack was of cut stone, with ornamental cornices. It was erected in 1869. Two horizontal wooden blast cylinders, 4 x 7 feet, were geared to the above mentioned 30-feet water-wheel. A Wasseralfingen stove was constructed to supply hot blast. An attempt to blow in was made, and after two weeks' severe labor a gas explosion destroyed the stove, the machinery was found ineffective, the work was abandoned, and the lining torn out. Such was the condition of the old works in 1870, which are said to have absorbed $400,000, without taking into consideration the hacienda, church, workmen's houses, and other improvements necessary for the existence of iron works.

The New Works.—Blast furnace No. 2 has been reconstructed after plans furnished by Messrs. Taws & Hartman, of Philadelphia. Hearth (round), 3 feet 6 inches diameter; bosh, 9 feet; height, 35 feet; throat, 3 feet; two tuyeres, 3 inches diameter and 30 feet above the hearth-line. It is lined from the mantle to the throat with the so-called refractory stone This is a white magnesian silicious stone, which, when first quarried, can be cut easily with a hatchet, but when dry it breaks. It is very heterogeneous in quality. Of several samples, apparently alike, some may be very refractory and the others utterly worthless. When gradually heated to the temperature of melting cast iron in a thoroughly clean bloomary fire, it swells, cracks, and glazes greenish, the interior being porcelain-white. At the end of an hour it melts to a pasty mass of dark-brown color. The trouble experienced with the fire-stone caused all the brick in the country to be tried, and those of San Pedro, near Guadalajara, were found to be the best, and although having to be packed thirty leagues on mule-back, were cheaper than the cut stone, and fully equal, if not superior, to it in quality. These brick are badly burned; on being heated they contract 20 per cent. of their length, warp, and crack. There is no quartz near San Pedro, so old brick and broken quartz were sent to be mixed with the clay, but as the brick are made by Indians, who tread the clay with bare feet and knead it by hand, they would only add quartz in fine powder, and claim that it is the only proper way to make good brick. Over four months were consumed before we could get a few experimental brick made, which were found to be an improvement on the old brick, but many months, or even years, will elapse before they will make what is wanted. It was finally decided to line the bosh and hearth with brick, 16 x 1 x 1½ inches, which is the size the Indians could make most readily.

As there was already on hand a supply of water sufficient to run a thirty feet overshot water-wheel, consuming seven cubic feet a second, for ten months in the year, it was considered far preferable in every way, and more economical, to use water-power than steam, provided that with the great fall near the works a turbine could be got guaranteed to do all the work and use only three and one-half cubic feet per second, in which case the old wheel, which was much out of repair, would be abandoned. Acting on this view, one of the owners of the company, relying implicitly on the assurances and reputation of a well-known manufacturer of turbines in the United States, bought a horizontal turbine of eighteen inches diameter, to use as a motor. Two double acting blowing cylinders, three feet diameter by two feet stroke, made by Naylor & Co., of Philadelphia, with shafting, journals, and patterns for the gearing were bought and shipped. The housings, bed-plates, and cog-wheels (of brass) were made at the works. Twelve hundred cubic feet of air per minute, at two and a-half to three pounds pressure per square inch, and fifteen horse power, were required by the furnace. The turbine was expected to make six hundred to seven hundred revolutions per minute, or twenty-four revolutions to one of the blowing pistons. Considerable doubts were entertained about the turbine, but from repeated assurances from the manufacturers that, with one hundred and fifteen feet fall, it would give thirty horse-power, or eighty per cent. of the power of the water used, and as all the machinery and fixtures were on the ground, it was decided to put it in. It was the intention to use a wooden or brick conduit for the blast, but as the distance was great, and it would have to be built over a stream and up a hillside at an inclination of thirty-five degrees, a wrought iron conduit pipe, twenty inches in diameter, was sent for, which was shipped in sheets and riveted on the ground. The blowing machinery was placed on a solid cut-stone foundation in the ravine in line with the hot-blast. The length of the conduit-pipe was 387 feet. It was provided with a suitable expansion joint, and properly secured to solid masonry pillars. A rubble stone canal, 1,000 feet long, capable of delivering nine cubic feet of water per second, was built from the dam, around the hill-side, to a small reservoir placed on the other side of the horseshoe, opposite the works. This reservoir, sixty by ninety by three feet, was intended to catch mud, and also to retain water for thirty minutes, in case of sudden stoppages. Cast-iron pipes, twelve inches in diameter, conveyed the water two hundred and fifty feet from the reservoir to the turbine, having a fall of one hundred and fifteen feet. The season was so far advanced that little water could be obtained to make a thorough test of the machinery, but by filling the reservoir and noting the time it took to flow through the turbine, it was found that about seven to eight feet per second were used, and that the turbine gave very little power even then. The manufacturers now say it was only an experimental wheel, and they thought that it would work. A modification of Kent's hot-blast stove, with twenty pipes, capable of heating two thousand cubic feet of air per minute up to 1,000° F., a bell and hopper, drop-valves, and all of the most recent and improved fixtures from the United States completed the outfit of this furnace.

Bar-Mill.—This is placed on a hill, on a level with the top of furnace No. 2, the waste gases from which will heat, as desired, both hot-blast and boilers, which are also placed on the same level. The building is 150x40 feet, and fifteen feet in the clear, roof of tiles, supported by heavy wooden trusses resting on brick pillars; only a portion of the sides are boarded in as a protection against rain. The end farthest from the blast furnace, or east end, is allotted to the puddling furnaces, there being space for six; one double furnace is completed. In the center of the mill there is a one-ton steam hammer, to shingle the puddle-balls; it is from Ferris & Miles of Philadelphia, and works well. About midway of the building on the south side are the heating furnaces, one of which is in operation. Beyond the heating furnace is a three-high bar-mill, of the best workmanship, capable of making 2½ inch bars, and all sizes of flats, 1½ inch squares, and various sizes down to $\frac{3}{16}$ round. A set of puddle-rolls is provided, and an overhead railroad connects them with the steam hammer and puddling furnaces. The mill is driven by a twenty-inch leather belt from the fly-wheel of the engine, which is in a brick room on the north side of the building, opposite the heating furnaces. The engine is one hundred horse-power, from Mackintosh, Hemphill, & Co., of Pittsburg. It rests on a solid cut-stone foundation, and is a particularly well built and smooth working machine. There are two boilers of the best Pennsylvania charcoal iron, forty-two inches diameter by forty-five feet long; they have been tested to 150 pounds hydraulic pressure, or double the working pressure allowed. They are provided with both injector and steam-pump; the pump is usually worked, and the injector kept for accidents; a little water is always kept running from one of the cocks so that the fireman may know that the boilers are full. A steam-pump and shears were needed to complete the equipment. The mill has been constructed to work towards the blast furnace, or west, where there is but little space; it should have been made to deliver at the east end, where there is ample room.

Foundry.—This requires no special description; castings are generally made direct from the blast furnace, but when the latter is not in blast the cupolas are used; these are badly constructed and insufficiently supplied with blast, and as much as sixteen hours have been consumed in getting a single heat from them. The fly-wheel of the engine, fourteen feet in diameter, and weighing over four tons was cast in a single piece direct from the blast furnace, as were also the bed-plates of the engine and blowing machinery, and various heavy castings of the hot-blast. Every description of castings can be made from five pounds up to four tons, but they have no experience in making castings as thin as a quarter of an inch. Castings are generally made in the evening and removed in the morning. It seems to be a fixed custom to immediately remove the top covering as soon as the iron solidifies, and allow the top to cool, so the piece frequently warps and is generally so hard that it is difficult to cut with either file or cold-chisel. The workmen are specially skilful in making baluster railings, ornamental rustic chairs, and sugar-boilers; of this class of work few foundries of the United States or Europe can make neater or cleaner castings. There are several smith's forges scattered around, well supplied with tools, and a lathe and drill-press, in bad condition, driven by water-power. The carpenter shops, of which there are two, are fairly furnished, but no seasoned lumber is ever kept on hand even to make patterns; in fact only a few boards are brought on mule-back, from time to time, from the saw-mill fifteen miles distance, as necessity demands. There was but one good monkey-wrench, after which boys were kept in perpetual pursuit. The shovels were of wood, and there was a general deficiency of picks, axes, and other small but absolutely necessary tools. Tramways with hand-cars should be substituted for the barbarous and expensive system of packing loads on men's backs; but the most deep-seated and yet cunning prejudices exist against all labor-saving devices.

The District of Tula.—The nucleus of the hills is greenstone, generally overlaid by a thin seam of a shaly disjointed sand-rock, the joints of which are highly discolored by oxide of iron. In some places may be observed a layer of stone, which, from its position and character, has evidently been formed from the disintegratien of the greenstone, and subsequently cemented.

Amole Mine.—This is situated on the side of a ravine two and a half miles from the works; it is the only mine in the district, but from the occurrence of iron outcrops in various places, others will probably be found and opened up with advantage. On one side of it is a trap dike, on the other side the disjointed stone, and lower down the ravine the cemented stone. It is worked by an open cut extending horizontally seventy-five feet into the hill. So far it is only a pocket, but from the indications of float rock about, a small drift would possibly soon disclose a vein parallel with the dike. The ore and waste (the latter being thrown into the ravine) are packed on men's backs. A mine car is very much needed, since the farther the open cut penetrates the hill the more will be the waste and the greater the distance it will have to be carried. The ore occurs in bunches, and is very variable, passing from a limonite to a crystalline specular hematite and a micaceous hematite, the one verging into the other without any apparent regularity; it is broken and hand-picked at the mine. The gangue is clay mixed with decomposed hornblende. This ore is very unpopular with the furnacemen; the micaceous ore they call *plumbacina* (graphite) and throw away as worthless. The following are the analyses of two samples of the limonites, such as they prefer to work, made by Kenneth Robertson, E. M., of Easton, Pennsylvania:

	(1)	(2)
Silica,	29 33	27.50
Water,	2.19	6.21
Alumina,	1.16	2.10
Phosphoric acid,	0.21	0.46
Sesquioxide of iron,	63.74	63.38
Protoxide of iron,	2.56	
Lime,	0.56	0.25
Magnesia,	0.25	0.10
	100.00	100.00
Metallic iron,	46.68	44.36
Phosphorus,	0.092	0.20

The cost of mining is 0.9\frac{3}{8}$ per cargo of 300 pounds or 0.62\frac{1}{2}$ per ton; transportation to works 0.12\frac{1}{2}$ per cargo or 0.83\frac{1}{3}$ per ton; or total cost of one ton of 2000 pounds delivered at the works $1.46.

The Mineral District of Chiquilistlan.—This is twenty miles west of the works and is of very interesting character. The formation is limestone (probably Tertiary), greatly upheaved by volcanic action, and penetrated in various directions by trap dikes. The general trend is northeast by southwest. Comparatively near together are mines of iron, copper (both oxides and pyrites), silver, lead, coal, and, I am told, also, tin and graphite. Here, also, is the once famous cinnabar mine of La Manta, which caused the town to be a quite important place. It was worked by the Spaniards, who only employed prisoners, and it is said that any man who survived six months' work was given his freedom. The mine is now abandoned, but with machinery could easily be opened. The large excavations, and a pile of over ten thousand tons of *débris*, attest the extent of the operations. A little mercury is distilled in Canteras, from a hydraulic washing in the neighborhood. There is an abundance of wood and water near this mine.

Tacotes Mine.—This is the principal iron mine of the works, from which it is twenty-one miles distant, the transportation being effected as usual by pack-mules. It is situated in the southern portion of the district, on the side of a steep hill, about eight hundred feet above a ravine. The vein is what is termed segregated, occupying a space between parallel seams of limestone. Its outcrop may be distinctly traced from the top of the hill to near the bottom of the ravine, and I am told that it also extends to the other side of the hill, but that has not been proved. Half-way up the hill it is worked by an open cut, which now extends horizontally inward about two hundred feet by eighty feet wide, and exposes six seams of ore of an aggregate thickness of fifty to sixty feet. A little powder is occasionally used for blasting. The chief labor is in disposing of the waste, which is packed on men's backs, in raw-hide sacks, and dumped in the ravine. The natural way to work the mine would seem to be in benches or steps, using chutes and mine cars to carry off the waste to two small ravines which exist conveniently on either side of the vein, and down which water continually flows. The cost of exploration would thus be diminished and the yield be increased to any desired extent. The present cost of mining is 4$\frac{1}{4}$ cents per carga, or 28$\frac{4}{10}$ cents per ton; transportation to works, 37$\frac{1}{2}$ cents per carga, or $2.50 per ton. Total cost per ton at the works, 2.78\frac{4}{10}$. The gangue is clay, with very hard silicious nodules of iron ore. The following are the analyses of the various seams, made by the above-mentioned chemist:

	No. 1. *Espranza.*	No. 2. *San Antonio.*	No. 3. *El Coro.*	No. 4. *San Filipe*	No. 5. *Bartolina.*	No. 7. *De Labor.*	*Mean of these six analyses.*
Silica	1.14	1.70	2.81	2.49	9.50	4.72	3.73
Water	0.90	1.16	0.55	. . .	0.30	5.69	1.43
Alumina	0.76	0.58	2.36	2.18	2.03	1.20	1.52
Phosphoric acid	0.39	0.06	0.21	0.14	trace.	0.47	0.21
Sesquioxide of iron	95.97	95.97	69.68	94.80	64.39	86.67	84.58
Protoxide of iron	. . .	.	22.68	. .	22.68	. . .	7.56
Sesquioxide of manganese.	. . .	. . .	. . .	. . .	. . .	0.52	0.09
Lime	0.32	0.27	0.28	0.28	0.20	0.48	0.30
Magnesia	0.52	0.26	1.43	0.11	0.90	0.25	0.58
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Metallic iron	67.18	67.18	66.44	66.36	62.73	60.67	65.09
Phosphorus	0.17	0.026	0.092	0.06	. . .	0.20	0.092

These ores, from No. 1 to No. 4, are brown hematites; No. 5 is occasionally crystalline, and makes excellent fettling for the puddling furnaces; No. 7 is extensively sold to the numerous Catalan forges in the neighborhood, or exchanged for other ores that the forgemen dislike to work.

La Mora Mine.—This is nine miles north of Tacotes, in a similar formation to the last, but more irregular. It has been worked from the time of the Spaniards, and extends about three hundred feet under ground in various directions. The ore has not been *mined*, but dug out. Several crosses are placed at the entrance of the mine, to encourage the miner and insure him of safety. It is now only worked to a limited extent, to mix with other ores. It is much sought after by the Catalan-forgemen, and the blast-furnacemen consider it almost impossible to work without it. The following analysis does not indicate any important difference from the other ores. It must, therefore, owe its good qualities to its molecular condition:

Silica,	3.24
Alumina,	2.88
Phosphoric acid,	0.37
Sesquioxide of iron,	68.61
Protoxide of iron,	22.73
Oxide of manganese,	0.52
Lime,	0.34
Magnesia,	1.31
	100.00
Metallic Iron,	65.72
Phosphorus,	0.19

It costs to mine, 16 cents per carga, or $1.15 per ton; transportation, 43⅓ cents per carga, or $2.92 per ton. Total cost at the works, $4.07 per ton.

Las Animas Mine.—This is also a segregated vein in limestone, four miles west of La Mora mine. The outcrop can be traced without difficulty for over a thousand feet. The vein is well defined and regular, varying from three to five feet in thickness. It has been but recently opened and the exploitation is done in a very workmanlike manner. The property is not owned by the company, but the ore is exchanged for that of Tacotes and delivered at the works for the same price. The forgemen do not like it. In the blast furnace it works well and makes a very fine-grained and very tough iron, which has not yet been analyzed. Within half a mile of this mine occur several pockets of cinnabar, that have been worked from time to time for the last two hundred years, yielding from one to five per cent. of mercury.

Coal.—On the northern edge of this district, eight miles northeast of La Mora, occurs an outcrop of coal, occupying seams of limestone and shale, the latter being in contact with the volcanic rock. There are four distinct seams of bituminous coal, dipping conformably with the limestone, varying in thickness from eighteen inches to three feet. A shaft thirty feet deep on the largest, discloses a seam of bituminous shale interstratified with small seams of bituminous coal, with conchoidal fracture, bright surface, and very pyritiferous. When slightly heated it will burn with a bright flame. Before the blow-pipe it cakes and gives off a strong empyreumatic odor. It may be valuable some day for steam purposes, but will never be useful metallurgically and is probably a deposit that would not pay for prospecting.

Limestone.—This occurs in an inexhaustible bed nine miles south of the works, in a prolongation of the Chiquilistlan formation. It is delivered, calcined, at 75 cents per carga, or $5.00 per ton. The raw stone can be delivered at $1.40 per ton, but the calcined stone is used in the furnace because they are used to it, although the saving in fuel is inconsiderable. The following is the analysis of the calcined stone, and calculated analysis of the raw stone:

	Calcined.	Raw.
Silica,	1.96	1.48
Alumina and oxide of iron,	2.59	1.95
Lime,	70.43	53.12
Magnesia	1 08	0.82
Carbonic acid,	23.94	42.63
	100.00	100.00

Fuel.—The company owns six and a half square leagues, or thirty-six thousand acres of land surrounding the works, one-half of which is already cleared; but for twenty leagues around the mountains are covered with a magnificent forest of oak and pine, and several valuable leases or privileges are held for cutting timber at the most accessible points. The wood is burnt in piles containing about ten cords (one cord equal to one hundred and twenty-eight cubic feet), and yields charcoal of the best quality, weighing seventeen to twenty pounds per bushel, of two thousand seven hundred and forty-seven cubic inches.

The charcoal-burners are Indians, who work by contract. To avoid hauling or packing the wood they built their piles where the wood falls. They are always very small; sometimes they are built about one hundred feet apart, with only one man to attend them all. During a windy day, which frequently occurs, some are necessarily neglected. It is useless to try to persuade them that this system is very wasteful, and that experience elsewhere has shown, that it is far more economical in labor and yield of coal to haul wood and burn it in kilns, or at least in piles containing thirty or forty cords. The charcoal is delivered in sacks, weighing one hundred to one hundred and twenty pounds, including waste, at twenty-three cents a sack, or about four cents a bushel. The coal should be forked, all brands, waste, and stones rejected, and be paid for either by weight or by measure; but this is never done, being contrary to the "costumbus, del pais."

Cost Per Ton (2000 lbs.) of Pig Iron.—*Roasting and Breaking.*—The ores from the mines of Tacotes, Las Animas, and Amole are roasted in piles, with wood and charcoal braize, and then broken by hand, whether they have been fused or not, to the size of a walnut; about five per cent. is lost in this operation as waste.

Cost of roasting per ton,	$04.0
" breaking "	0.20

Charges of Furnace No. 1.

Tacotes,	1.5 boxes	= 118 lbs.
Amole,	0.5 "	= 33 "
La Mora,	0.5 "	= 33 "
		184 lbs.
Charcoal,	4 baskets	= 165 "
Calcined limestone,	½ shovel	= 2.06 lbs.

Number of charges a day, 50 to 60; yield of iron, about 55 per cent.; loss of iron in slag, 7 per cent.; average production per day, 3 tons; charcoal consumed per ton of iron, 3228 pounds. In addition, about 20 bushels are consumed at the tymp (no clay or sand stopper being used), from which rises a bright flame two or three feet high, similar to that of the Catalan forges, as worked by the Indians in the neighborhood.

Cost of Material per Ton of Iron.

Tacotes	ore roasted and broken,	1.15 tons	@ $3.38,	$3.89
Amole,	" " " "	0.33 "	@ 1.35,	0.44
La Mora,	" " " "	0.33 "	@ 4.27,	1.41
Lime, 41 lbs.			@ ¼ ct,	0.10
Charcoal, 180 bus.,			@ 4 "	7.20
Total cost of material,				$13.04

Cost of Labor per Ton of Iron.

First keeper,	$1.25	per day	
Second "	1.12½	"	
2 helpers, @ 50 cents,	1.00	"	
4 fillers, @ 37½ "	1.50	"	
Total for labor,	$4.87½	" for 3 tons, or per ton,	$1.62
Superintendence, repairs, etc.,			2.50
Total cost per ton,			$17.16

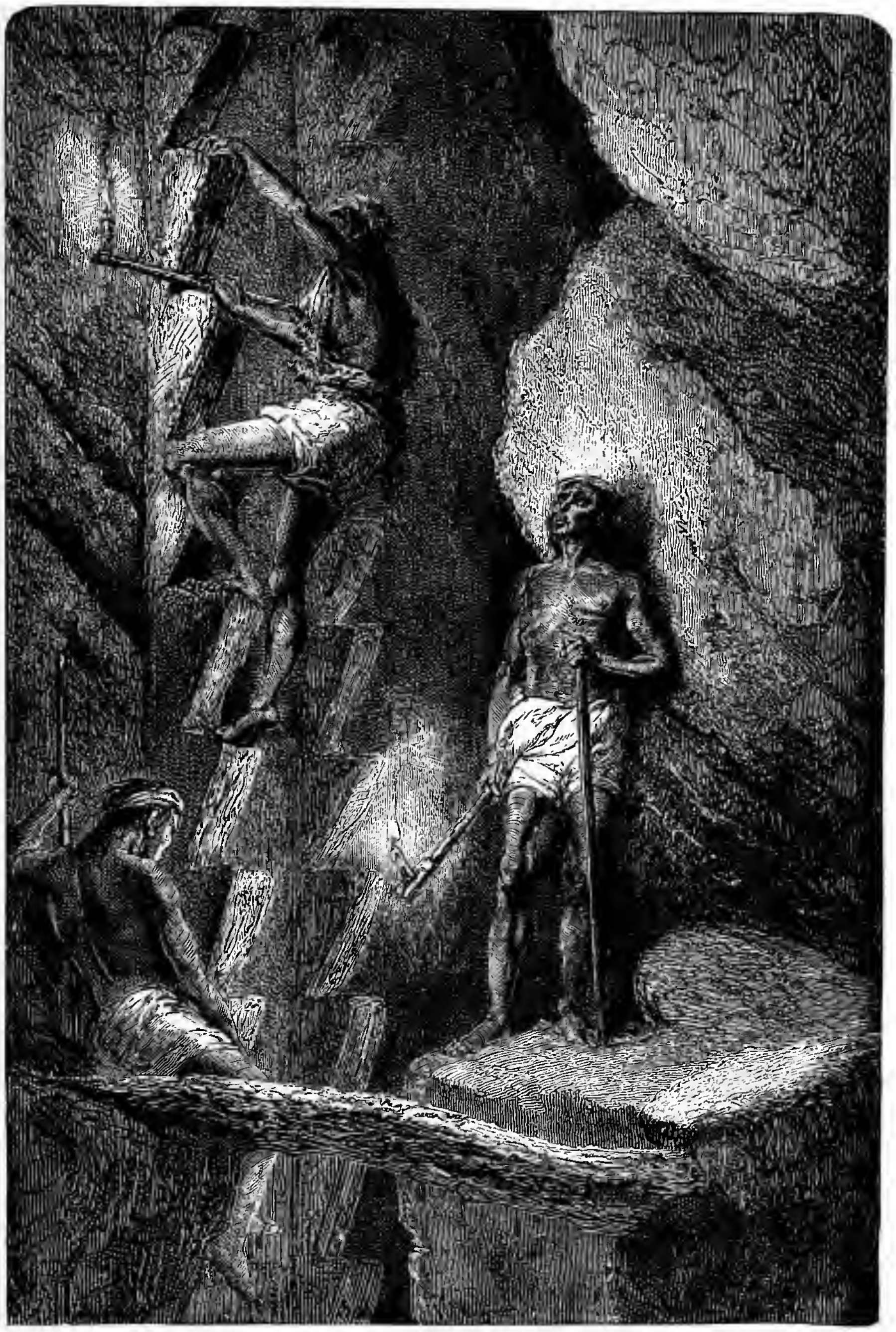
Cost per Ton of Iron Refined in Bloomary and Hammered into Billets.

Labor of melter per quintal, $0.43¾	
" hammerman " 0.30 —$0.73¾, or per ton,	$14.75
Fuel, 6000 lbs. charcoal, or 333 bus., @ 0.04,	13.33
Iron, 1.25 tons @ 17.16,	21.45
Repairs, superintendence, and foreman,	2.50
Total cost per ton of billets,	$52.03
Loss of iron, from 15 to 35 per cent,	

The hammermen are paid for other pieces as follows:

Shafts, per quintal	$1.00
Cart axles, "	.50

Cost of One Ton of Puddled Bar Iron, Shingled by Steam Hammer.—This estimate is based on the few weeks' work of the double puddling furnace.



MINING LIFE—A MINE SHAFT IN MEXICO.

—FROM "LA VIE SOUTERRAINE" BY L. SIMONIN.

1.05 tons of pig iron @ $17.16	$18.02
Packing " " top of hill to the furnace	.45
7 cartloads of wood (388 cubic feet) @ 75 cents	5.25
Labor, per ton	3.50
Shingling, "	.60
Roughing rolls	2.50
Engine-drivers, steam, etc.	1.18
Superintendence, repairs, and foremen	2.50
Cost per ton of puddle bar	$34.00

Capacity of furnace, 2 to 2.5 tons per day

Cost of One Ton of Ordinary Bar Iron, Rolled from Billets.

1.045 tons of billets @ $52.03	$54.36
Packing from bloomary to mill	1.04
Heating (labor)	1.00
Heating (fuel, 6 cartloads wood, 334 cubic feet, @ 95 cents),	4.50
Rolling, straightening, etc.	5.00
Engine-driver and firemen	.68
Fuel for engine	.50
Superintendence, repairs, and foremen,	2.50
Total cost per ton of bars	$69.58

Average rolled per day, 5 tons; maximum, 7 tons.

Cost of One Ton of Ordinary Bar Iron, Rolled from Puddle Bar.

1.045 tons puddle bar, @ $34.00	$35.53
Heating, rolling, etc.	14.18
	$49.71

From the notes of Mr. Michael O'Neil, an experienced puddler from Bethlehem, Pennsylvania, I gather the following, which is added as an interesting description of the condition of the works. He found the small puddling furnace choked up and that it had been used for melting brass. After making proper repairs, using the refractory stone of the country, which he was assured was "perfectly infusible," it was started. The charges were first 350 pounds of iron, and, finally, 450 pounds; the iron melted in three quarters of an hour, and each heat lasted about an hour and a half; here a heat usually takes from two to two and a quarter hours. The iron was very dry, but with plenty of good dry wood it worked perfectly. Balls of only 80 to 100 pounds were made, and shingled under a small trip-hammer of two and a half inch face. After every two or three heats, delays occurred on account of portions of the roof and stack melting down, which would have to be removed. Two entire new roofs of the "refractory" stone were built from Nov. 1st to Jan. 31st, when so much of the stack fell that it was deemed useless to repair it, and puddling was postponed for a time. The time from February until May was consumed in building the heating furnace. The refractory stone was again used, the roof was twelve inches thick, and would last about three weeks, single turn, but the chimney, after three days, melted so much as to entirely fill the take-up and stop operations; it was then lined with fire-brick, and has worked well ever since. The charge was 800 to 1200 pounds, according to the size of the billets, and took three-quarters of an hour to heat. The double-puddling furnace was commenced in May, and completed about the middle of August. Here numerous drawbacks again occurred; from the contraction of the fire-brick; the bridge wall fell, damaging a portion of the fire-chamber. The wood was so wet that even though dried in strips on hot iron plates, it would scarcely burn, so that the grate-bars had to be altered to allow the addition of charcoal. The hands were green, and from their little knowledge previously gained at the small furnace, were very conceited and impertinent, considering themselves teachers rather than learners. The charges were 900 pounds, and six heats were made in eleven hours; the iron hammered under the steam-hammer, worked well, and was of fair quality. Work continued about two weeks, when fifteen feet of the stack fell on account of the contraction of the fire-brick, a portion being constructed of key-brick; the work was then stopped. Mr. O'Neil's contract expiring at this time he came home, after having taught them all he could in a year. It is much to be regretted that they did not learn more, or rather that they concluded that they had learned everything, and allowed him to return so soon. His salary, travelling expenses and maintenance, amounted to about $4000. One may judge of the cost of this experiment, which may be taken as a type of the cost and difficulty of introducing new things into this country. We refrain from estimating the cost per ton of the iron he did puddle, but will mention the quality of that puddled in the small single furnace. The usual Mexican test is to hammer a rod cold into a nail: this it stood perfectly. Specimens of this iron were exhibited at the Centennial Exhibition, and tested on Riĕhle's testing machine. The tensile strength per square inch was as follows: 53,880 pounds; 54,060 pounds; 54,700 pounds; 58,930 pounds; 58,590 pounds. The qualities of this iron are magnificent. Even with the present rude manufacture, it fully equals the special brands of European and American iron, manufactured with the greatest care and skill.

Present Production of the Works.—Active operations are carried on from the first of July to the first of May, ten months, or while the supply of water lasts. During this period the furnace is in blast about two hundred days, producing about 400 tons of pig iron and castings. The bloomary fires are active, off and on, all the time; but from stoppages on Sundays, Saint's days, and break-downs, they may be said to average three and a half weeks' actual work during the month, or thirty-five weeks for the year. Each bloomary produces 3 tons of billets a week, with a loss of iron of about 25 per cent. These three bloomaries, during the year, produced 315 tons of billets and consumed 394 tons of pig iron. The loss of heating and rolling billets into bar iron is $4\frac{1}{2}$ per cent., leaving a yield of 301 tons of bar iron. Castings are made direct from the blast furnace at a cost for patterns and moulding of three-quarters of a cent. per pound, or $15 per ton; whence we have—

	Dr.	Cr.
To 206 tons of casting @ $32.16,	$6,624.96	
" 301 tons bar iron @ $65.58,	20,843.58	
By 507 tons @ 10 cts. per pound, or $200 per ton,		$101,400.00
Balance in favor,	$73,931.46	
	$101,400.00	$101,400.00

Estimated Production of the Works when Completed and in Good Running Order.—We will assume that all the production is from No. 2, the puddling furnaces and rolling mill, though for four months in the year, when there is an excess of water, furnace No. 1 and the bloomaries might be employed. Assuming furnace No. 2 to be worked under the same conditions as furnace No. 1. as regards ore, fuel, and labor, and that it produces ten tons of pig iron daily, the price of labor per ton will be reduced to $1.13, and it will then cost $16.03. Supposing the furnace in blast 200 days per year at 10 tons per day,—2000 tons; of this is sold as castings, 500 tons, leaving to be puddled and rolled into bar iron, 1500 tons. Assume that the mill works 250 days a year, and each double-puddling furnace only produces 2 tons per day, or 500 tons per annum, then three puddling furnaces (allow one more for accidents), and two reheating furnaces will do the work. We have then as the production of the works the following:

	Dr.	Cr.
To 500 tons castings @ $31.02,	$15.515.00	
" 1376 tons bar iron, $49.71,	68.400.96	
By 1876 tons @ 8 cts. pr pound or $160 pr ton,		$299,160.00
Balance in favor,	$215,244.04	
	$299,160.00	$299,160.00

Such is the condition of the manufacture of iron in this portion of Mexico, and it may be taken as a type of its manufacture in other parts of the republic. It is obvious that the works were badly located in the beginning, and it is a question whether it would not have been more judicious, instead of adding to their new improvements, to have built an entirely new concern at the Tacotes Mine, using steam-power entirely. While the large furnace is in full blast the daily transportation of 15 tons of ore from the Tacotes Mine, will require 210 mules and 35 mounted drivers, a day being allowed them to return. A wagon road will have to be constructed: then 6 wagons, 72 mules, and 12 drivers will do the work. Still these works possess advantages that few enjoy, and were their resources properly developed, they would make iron cheaper than anywhere in the world. They have the richest and purest of ores, that produce an iron only surpassed by the best from Sweden, abundance of cheap fuel, and superabundance of cheap labor. This last, however, is not an unalloyed blessing, for double the necessary number, and a host of decrepit old foremen are employed, and the "compadre" system all-powerfully reigns. The market for the iron extends throughout the States of Colima, Michoacan, Jalisco, and Zacatecas; covering an area of more than 100,000 square miles of the richest and most enterprising part of the republic, and the works always have more orders than they can fill, at prices ranging from eight cents to ten cents per pound. There is a slight competition from foreign iron in the towns near the coast, but as this has paid excessive duties and costs of transportation, it can be easily excluded by the really superior Tula iron, which can always undersell it.

There are many Catalan forges in the neighborhood operated by Indians, who eke out a meagre existence by selling, at three cents per pound, the plow-shares, axes, and billets they produce, to the shop-keepers, who advance them food. This manufacture does not amount to a competition; but a well-organized lot of forges throughout the country, and portable steam-engine and hammer to make nail-rods, which would require but very small capital, could offer very serious competition. In the face of numerous difficulties, and after the expenditure of immense sums of money and indomitable energy and pluck, Tula has been established, and fully contributed its share to the advancement of the independence and civilization of the country.

—A paper by J. P. Carson, Transactions American Institute of Mining Engineers.

THE FORMATION OF GOLD NUGGETS AND PLACER DEPOSITS.

IN the year 1874 I made some examinations of the hydraulic mines of California, and was very much struck with the distribution of the gold throughout these deep placers, which were almost invariably poor on the surface, while gradually growing richer towards the bedrock. The constant presence of fossil wood, and the large quantity of organic matter contained even low down in these beds, was also remarkable. Not being satisfied with the various theories advanced to account for the formation of these deposits, I began an investigation early in the year 1879 on the conditions of solubility of gold and the causes of the loss in working gold ore in a large way. The researches which I have undertaken show that gold must be considered a soluble rather than an insoluble metal, and that the conditions of solution are such as will be found anywhere where gold is likely to occur, and the solution may take place even under the ordinary circumstances of surface drainage, and may be going on freely even where the presence of gold has never been suspected, and that there are causes enough in nature to produce the solution of the gold in sufficient quantities to account for all the phenomena of both the vein and placer formations.

The general theory with regard to the formation of these placer deposits and nuggets has been that they were the result of the destruction of pre-existing vein-matter, which does not accord with the facts as shown in the deep placer deposits. The gold in such case would be distributed in layers of unequal richness throughout the bed, the richness depending on the amount of deposition taking place at any one time, and would not occur in increasing richness from the top to the bottom. Further, every particle of gold of whatever size would have a rounded form, resulting from its abrasion against the harder rocks, which is not the case, the small as well as the large grains being of very irregular shape. It must also be borne in mind that most of the veins from which the gold is supposed to have come had a gangue of quartz. The gold is much softer than the rock; the quantity of precious metal contained in the vein would also be very much less than the rock, so that in the destruction of the formations there would be a very small amount of gold being abraded and ground in a very large quantity of rock. It is therefore likely that the coarse particles of gold, which is so much softer, would be comminuted at least as fine as the rock, and the smaller ones much finer than the rock, so that the difference in density would hardly tend to make a concentration by any subsequent action of wind or water, since the small particles of gold would tend to float away and thus prevent the concentration. Where the large particles are not in sufficient quantity to make an extended natural concentration possible, and where the deposition of the sediment of the rivers is taking place, the result would be a very small quantity of almost impalpably fine gold, distributed uniformly in a very large amount of comminuted rock, or a production of clays resembling that used to make brick around Philadelphia, which contains very small amounts of gold uniformly distributed through it. The structure, too, of each one of these particles would be the same as that of the rock with which it was abraded, and would be uniform. It is, however, well known that the grains of gold found in the placers are not uniform; some of them are flattened with rounded edges, others rounded, and most are mammillary, all of which forms are not probable, and hardly possible, under the conditions suggested. A nugget rounded like a water-worn pebble is a great exception in any of the placer deposits.

While the theory of vein destruction might in some cases account for the presence of gold in small quantities throughout the sands in grains large enough to admit of concentration, it could never account for the presence of large nuggets, which if they had been transported any distance by water would have lost their mammillary form. Admitting the greater size and force of the ancient rivers, it is impossible to conceive that such large and irregularly shaped nuggets as those from Australia, Siberia, and from this country could ever have been so transported by water as to be entirely relieved of all their gangue, without having themselves assumed much more regular surfaces and a more uniformly cobble-stone shape. On the other hand, slow accumulations from solutions of varying strength and a deposition of unequal rapidity continued for a great length of time, accounts perfectly both for the form and for all the attendant phenomena. It is a fact, moreover, that very large masses such as these nuggets have never been found in veins, and are confined exclusively to placer deposits. The detrital theory accounts still less for the fact that in many of the deposits, especially where the bed-rock is soft and porous, the gold often enters it to the depth of nearly a foot, and it is frequently the richest part of the deposit. In 1867 Mr. Wilkinson, of Australia, made a series of researches with reference to the effect of organic material on the deposition of gold. Sonstadt* also made a series of researches on the presence of gold in sea-water, and found it to be present in the ratio of about one grain to the ton of water, or about $1 for every 25 tons of water.

Up to this time gold had always been considered as a very insoluble substance, because it was insoluble or very nearly so in most mineral acids. Ingenious metallurgical processes based on this insolubility have been invented, and are still in constant use; but it does not follow that because gold is not affected by the ordinary acids it is therefore not soluble in other substances much more likely to be found in nature. The action of organic acids and of the alkalies were left out of view, and also the fact that the solution of infinitesimal quantities may acquire great significance in a geological sense. Bischoff found that sulphide of gold is slightly soluble in meteoric waters, and much more soluble in a saturated solution of sulphuretted hydrogen in water. It has also been ascertained that chloride of gold in minute quantity in an alcoholic solution may remain in solution in the presence of proto-salts of iron, and that metallic gold is slightly soluble in solutions of the per-salts of iron. But the theories founded on these discoveries supposed that gold was much less soluble than it really is, and that the solution required peculiar agencies and a set of circumstances not likely to occur everywhere. Its diffusion in sea-water was accounted for by the presence of chlorine, iodine, bromine, and of alkalies, and these conditions were not thought to be of general application in the explanation of the phenomena exhibited in mineral veins.

Mr. Selwyn, the government geologist of Victoria, proposed a theory of solution to account for the formation of nuggets and placer deposits, suggesting that the gold was dissolved by the waters which filtered through the soil, was carried in solution until it met some nucleus around which it could deposit, and was then precipitated, and that nuggets and

* Chem. News, vol. xxvi, p. 159; Am. Chemist, vol. iii, p. 206.

placer deposits were formed in this way. He does not, however, state what he supposed the cause of the solution to be, and suggests that the gold is undoubtedly deposited on particles of gold previously existing in the sands. These researches and theories, however, did not attract very much attention, and the old theory of the destruction of pre-existing veins was still adhered to. It is to be observed, however, that when gold does come from the destruction of veins the surfaces are rounded and worn smooth, as is shown in the large boulder of quartz containing gold detached from a vein in Venezuela, which is now in the collection of the School of Mines. This is in entire contradiction to the mammillary structure of the nuggets. If they had been transported far by water they would have been rounded and water-worn to much more regular surfaces. These worn surfaces would of course have been confined entirely to the outside of the nuggets, any cavities existing in the interior of the piece would have been in the condition in which they left the vein, and the edges of any crystals found there would have been sharp; while in the nuggets the mammillary form exists even in the cavities of the interior, and even where crystals or the commencement of crystallization is observed, the edges of the crystal are very often blunted or rounded, showing both deposition and solution on these edges. It is also to be noticed that the analyses of nearly all the samples of gold taken from veins show it to be much less pure than the nuggets found in the placer mines of the same district. If the gold of the placers had come from eroded rocks it would be of the same composition as that of the veins of the district in which it was found. It is well known that most of the gold nuggets are pure, while the gold of the veins is of a much lower grade, containing considerable quantities of silver and other foreign metals. Thus the Ballarat nuggets are 992.5 fine, the Australian nuggets vary from 960 to 966; those from veins in California from 875 to 885; in Transylvania 600 with 399 of silver, and in Nevada there are some of 554 of gold and 429 of silver, and others only 333 of gold with 666 of silver.

It must be remembered also that the violence of the old placer currents was very much greater than that of the ordinary streams of these days. The rivers were not only larger and deeper, but more rapid, and the results of their action would have been an almost complete comminution of the gold by its rubbing against the harder rocks. If this were the whole of the process and no further action had taken place, the gold would be found in the sands in this comminuted condition exclusively, and few if any of the particles would have escaped the battering and pounding process incident to long exposure to rolling rocks; and the deposits resulting from it would be found on the bed of the stream.

Gold is, however, also found as nuggets, and in small particles in rocks which have never been disturbed from their original conditions, but which have been decomposed to a considerable depth; and it then has the same rounded form, occupying positions which make it evident that it must have been *in situ*, and never have undergone any abrasive action. The nugget found in 1828, in Cabarrus county, North Carolina, which weighed 37 pounds, and also the one found in the Valley of Taschku, Targanka, near Miask, in Siberia, which weighed 96 pounds, were both found under such circumstances in a decomposed dioritic rock. In some few cases it has been definitely ascertained that the gold has been dissolved and precipitated in the decomposed rocks, for it has penetrated just so far as the decomposition has allowed it, the yield in gold ceasing entirely at the point where the rock allowed no further filtration; while in other rocks of a more porous nature in the same district the gold has penetrated to a depth not yet ascertained. Such a condition of things is not uncommon in the gold belts of the Southern States. Admitting that heavier masses of gold did exist in the veins disintegrated by the ancient rivers, gravity alone cannot account for the bottom deposits (which are often 300 feet from the surface) being the richest. It would have required greater agitation of the earth than we have any evidence for believing ever took place to sift the coarse particles even through 50 feet depth of earth, and there is no indication that these deposits after they were once made were ever disturbed. It is undoubtedly true that in shallow placers, where the bed-rock comes near the surface, the surface-soil is rich; but it is the invariable rule that in deep placers the richest deposits are near the bed-rock, and at a great distance from the surface.

There is a tradition, which is prevalent in all the gold mines of the South, and in those of some other districts, to the effect that gold *grows*, so that every few years the tails of the old mines are reworked, generally with profit; the quantity separated each time, according to the local tradition, being in proportion to the length of time the material has remained undisturbed. As there is no opportunity for the gold in these sands to accumulate by gravity, the people of the region believe that gold grows like a plant. It would not, however, be rational to deny a theory so easily explained as the formation of placers by the destruction of vein-matter without having some other to replace it. If the theory of the destruction of pre-existing veins is not tenable, we are bound to examine carefully whether there are causes in nature sufficient to account for solution, and what are the agencies that render the gold soluble. A series of experiments have been made on this subject lasting over many months, both synthetical and analytical, which seem to be of considerable importance in the study of the origin both of placer and vein phenomena. In this investigation most of the known salts of gold were prepared; but as the chloride is most easily made, this was made the basis of almost all the solutions. While making the chloride of gold for the solutions some sponge-gold was placed in a tube and heated in a current of chlorine-gas until the chloride of gold formed was entirely sublimed. It deposited at the upper part of the tube directly over the gold, and as the tube cooled, on the gold also, in fine transparent crystals half an inch long. This tube, when cool, was closed while full of chlorine, by substituting for the glass tubes glass rods, and the joints made tight with paraffine. In five months the crystals were melted into a mass, and in a year the whole of the chloride had been transformed into metallic gold with occasional nodules of chloride through it; but the whole of it could be readily amalgamated. In order to ascertain the effect of different organic substances on salts of gold in solution, five portions of fifty cubic centimeters each of a solution containing 50 grams of chloride of gold were treated in different ways. The first was covered with a cubic centimeter of petroleum. In the second a quarter of a gram of cork was placed; in the third a quarter of a gram of peat; in the fourth half a gram of leather; in the fifth half a gram of leaves. These solutions were put in a dark place, and were left for three months before examination. When the solution containing the petroleum was brought to the light the liquid had lost its color, and there were suspended in it a number of very fine and long crystals of gold, distributed nearly uniformly from the top to the bottom, and floating almost perpendicularly in the water. They had the appearance of the hexagonal crystals described by Professor Chester.* As soon as the liquid was agitated they fell to the bottom. The solutions containing the cork, leather, and leaves had also been rendered colorless, but the gold had entered into these substances, replacing the organic matter, so that they were pseudomorphed into gold. The solution in which the peat was placed was also colorless, but the gold was precipitated in the form of very small mammillary masses, recalling perfectly the form of nuggets.

To ascertain the degree of solubility of gold a quantity of pure spongy gold was prepared, and placed in a variety of solutions; some of these were left exposed to the air; others were sealed at the ordinary temperature and pressure of the air for periods of from six to eight months; others were exposed to heat and pressure under varying conditions in an air-bath, arranged in such a way that the temperature could be kept constant for a number of hours at a time. Many of these last tubes burst after the liquid had acquired a tint. Of some of these the contents were entirely lost, of others a sufficient quantity of liquid was left to test for gold. Solutions of salt, sulphate of ammonia, chloride of ammonium, chloride and bromide of potassium in sealed tubes, after eight months gave no reaction. Heated for five hours at temperatures varying from 150° to 200° C., none of them, except the bromide of potassium, gave any reaction, and that reacted very strongly. In the sealed tubes the solution of salt, in which a few drops of nitric acid had been placed,

*American Journal of Science, 3d series, vol. xvi., p. 32.

reacted for gold; the iodide of potassium gave no immediate reaction, but when evaporated to dryness left a purple residue, soluble in bromine, which reacted for gold. Heated to a temperature of from 100° to 170° C., the iodide of potassium tube gave a reaction for gold not much stronger than the solution before heating. A solution of commercial nitrate of ammonia, which contained some chloride of ammonium as an impurity, kept in an open tube at the ordinary temperature and pressure for four and a half months, colored the solution bright yellow, and reacted strongly for gold. Two solutions were made each containing five grams of nitrate of ammonia and half a gram of chloride of ammonium in 200 cubic centimeters of distilled water. One of the solutions was left in an open room and the other put in a dark place, and left for eleven days. At the end of that time both reacted strongly and with equal intensity for gold. Pure sponge-gold was then placed in the following solutions, contained in sealed tubes at the ordinary temperature and pressure for three months. Sulphide of ammonium produced no change and no reaction. With sulphide of potassium a black precipitate was formed, and a strong reaction for gold was given by the liquid. Sulphide of sodium gave a black precipitate and a strong reaction for gold. Cyanide of potassium gave a yellow solution, a brown precipitate and smell of ammonia, and a strong reaction for gold. Chloride of magnesium, after nearly three months, gave a gelatinous precipitate, but no gold. Sulphate of soda, after the same length of time, produced no change and no reaction. The sulphate of copper produced no change after two and a half months. Spongy gold was then put into solutions of the following substances, and heated for six and a half hours between 145° and 180° C. Sulphide of ammonium showed no apparent change, but reacted strongly for gold. The solution of sulphide of potassium attacked the glass strongly; it looked greenish, and the liquid reacted for gold; a black precipitate was formed, which was dissolved in bromine, and reacted for gold. The solution of sulphide of sodium acted slightly on the glass, and acquired a greenish tint; a pink film was found on the glass, and a slight precipitate was formed. This film reacted slightly, and the solution very strongly for gold; there was not enough of the precipitate to examine. The solution of chloride of magnesium attacked the glass strongly, from which scales fell, but no gold was dissolved. The solution of sulphate of soda gave a cloudy, flocculent precipitate, but no reaction for gold. Commercial sulphuric acid and solutions of sulphate of potash, iron, and manganese gave white scales, but no reaction for gold. Solutions of sulphate and nitrate of soda gave no change and no reaction. The solution of permanganate of potash produced no reaction. In the solution of cyanide of potassium the brown precipitate which was formed in the previous experiment dissolved. reducing the gold in the solution so that no gold was found dissolved. A mixture of nitrate of silver and sulphuric acid produced no change after two months. A mixture of the sulphates of potash, iron, manganese, and commercial sulphuric acid produced no change after two months. The permanganate of potash and sulphuric acid gave a black precipitate and colored the liquid slightly pink, but gave no gold.

In order to test the effect of organic matter in solution, half a gram of chloride of gold was placed in two liters of Croton water in two large bottles. One of these was left exposed to the sunlight, and from this all the gold was precipitated in less than a week; the other was placed in a dark room and left there; at the end of eight months a small amount of gold was precipitated. When solid organic matter was placed in the bottle the precipitation was quite rapid, and when the bottle was then brought into the sunlight all the gold was precipitated in about forty-eight hours.

To ascertain the effect of different soils on weak gold solutions half a gram of chloride of gold was dissolved in ten liters of filtered Croton water, and made to pass continuously over the three mixtures given below arranged in glass funnels. The apparatus was so arranged that the liquid would flow drop by drop on the filters. No. 1 contained 30 grams of quartz sand, No. 2, 20 grams of sand and 10 of soil, No. 3, 30 grams of magnetic iron sand and ten of quartz sand. The filters were left exposed in a room where there was considerable dust arising, and where there was also the smoke from passing trains. In two days most of the gold had been precipitated in the filters, and the water had a greenish look. Half a gram of chloride of gold was then dissolved in ten liters of distilled water, and filtered in the same way over thirty grams of quartz sand, a mixture of twenty of sand and ten of soil and a mixture of ten of sand and thirty of magnetic sand. These filters were carefully covered to prevent any dust settling on them; so that they were protected from all organic matter except such as was contained in them. At the end of two months the clean sand and the mixture of magnetic and clean sand had reduced a small quantity of gold (a little more in the latter than the former) in concretionary shapes, which, owing to the rapidity of the action, were not coherent, but could be crushed with the pressure of the finger. In the mixture with the soil the whole had been reduced, and was distributed through the sand as an impalpable powder, no indication of any concretionary form being observed. The attempt was then made to dissolve gold in a manner similar to that which was supposed to take place in nature. For this purpose filters were prepared of thirty grams each of clean quartz sand; in one of these 1.161 grams of sponge-gold was placed and carefully mixed with the sand; in each of the other two half a gram of very fine gold was mixed. Over the sponge-gold ten liters of distilled water, containing thirty grams of common salt and five grams of nitrate of soda, was made to filter constantly for two months, but no observable change took place. For the second solution six liters of Croton water were taken, in which nine grams of nitrate of ammonia and one gram of chloride of ammonium were dissolved. This was made to filter constantly for one month, but no gold was dissolved. For the last experiment one gram of nitrate of ammonia and nine grams of chloride of ammonium were used, but no gold was dissolved. It was the intention to continue these filtrations for six months at a time, and with all the conditions of natural waters, but the difficulty of making the experiments continuous decided the abandoment of them after a number of the other results had been obtained. The failure to dissolve gold in this short time does not prove that there is no action, as the other experiments show. An amount equal to a little less than that in sea-water might easily escape detection. In these experiments there is lacking the certainty that all the conditions necessary to success are fulfilled. It was found in one of the experiments, made in the early stages of the investigation, that the fine dust circulating in the room was sufficient to precipitate the gold from a dilute solution. All these researches had to be made in a room to which many persons had access, and it is quite possible that the organic matter precipitated the gold in these last experiments as fast as it was dissolved; for in the experiments for the production of the placers the organic matter did deposit the gold in the sand. It is greatly to be regretted that these experiments could not have been made in the complete absence of dust.

In order to test the effect of organic life in such solutions, a plant was watered with a very weak solution of gold, but as is often the case in such experiments, the plant died of too much watering. In the anxiety to produce the kind of absorption by plants described by Durocher and Malaguti, the experiment was made a failure by too much enterprise. The examination of the ashes of the plant showed a small amount of gold, but most of the gold precipitated was in the soil around the plant, being thrown down there by the organic material in the earth. This experiment indicates the origin of the thin plates of gold which are sometimes found in the grass roots of certain placer countries. It will be observed that in almost all the cases where gold was dissolved, chlorine and some nitrogenous substances were found together in the presence of alkaline waters. These same conditions are favorable also to the separation and solution of silica. It has been proven by these experiments that the alkaline sulphides act on gold as well as the substances enumerated above, and it is quite easy to imagine the conditions under which the gold, already in solution in excessively small quantities, coming in contact either with solid or liquid organic matter, may precipitate all the metal.

In Grass Valley, California, I have known of gold being thrown down in the filter of a Plattner's vat by the organic matter contained in the very impure water used there for the solution of gold rendered soluble by the action of the chlorine. The filter was full of metallic gold, and there was no means of ascertaining how much of it had been lost. Several ounces of a brown deposit were taken from it which was nearly pure gold. This cause of deposition, and of loss in large operations, has, I believe, been entirely overlooked. It is quite easy to explain the presence of gold in alluvial sands by the action of sunlight alone on the waters containing the gold in solution, and to account for the gold on the bed-rock, by the solutions coming in contact with organic or mineral matter, such as the lignites, fossil woods, or the pyrites, which is everywhere found in deep placer deposits. The waters not being able to pass the bed-rock, remain there in contact with the organic matter until all the gold is precipitated. The same would not be true of the decomposing rocks, or of slaty strata coming up to the bottom of the deposit at an angle. The deposition would be rendered much more rapid by any electrical currents that might pass through the strata. In all of these phenomena, time, which in the operations of nature is unlimited, is one of the chief factors. In any laboratory experiment the limit of time must of necessity be short, but there is no such limit in nature. That this solution goes on on a large scale there is every reason to suppose. That this may be connected with vein phenomena the California nugget shows, since in this case both the formation of the quartz and of the nuggets are evidently posterior to that of the blue gravel. It will be seen from these reactions that many of the conditions favorable to the solution of gold are also favorable for the solution of silica, and that, as Professor Kerr shows,* the rocks may be actually decomposed and the gold deposited, forming in this way shallow deposits called veins, in which the gold disappears entirely beyond a few feet.

Nothing is more likely than that the infiltration of water through rocks undergoing decomposition, of which there are enormous quantities in the gold region, should take up the alkalies, and, slowly passing over the gold, should dissolve it. The composition of these alkaline salts would depend on the nature of the rock through which the waters passed, but it is more than likely that they would be mixtures of many of the compounds likely to attack the gold and carry it off in solution, and not alkaline carbonates and sulphides alone, although these would be likely not only to be present, but to be powerful agents in carrying on the work of solution. In some cases the decay of the rocks is so rapid that the phenomena may, as it were, be caught in the act. The agencies producing the decomposition of the rock, penetrating it beyond the limits of local drainage, and carrying off the soluble parts, leave the débris in a condition easily penetrated by the infiltrating solutions, and ready to receive any deposit which these solutions may for any cause leave behind them. A source of these deposits in the deep placers of California is the trap which sometimes covers the old river deposits to a depth of 150 feet. In the deep placers these waters would be capable of holding the gold in solution until they met some decomposing element, such as particles of metallic compounds, native metals or organic matter, which is always present in large quantities in the deep placers. If a nucleus of metal were present the gold would be precipitated on it, and if none were present then the gold would come down as a powder, each grain of which, however small, would serve as a nucleus for future aggregations. Admitting the solutions to be even more dilute than the sea-water near the coast of England, yet unlimited time and quantity would evidently produce these effects, redistributing the gold. Iodine, which is a solvent of gold, is found in many of the plants of the gold region, and in considerable quantities of sea-water. Sonstadt† supposed that gold is kept in solution in the water of the sea by the slow rate at which iodate of calcium is decomposed in the sea-water of the temperate zones, but suggests that where the decomposition of the iodate, whose presence is necessary to keep the small amount of gold in solution, is very rapid as in hot countries, the liberation of the nascent iodine, and consequent rapid solution of the gold, and subsequent precipitation by organic matter is quite sufficient to account for the great richness of the gold deposits of tropical countries.

It seems, by the experiments already cited, to be clearly proved that gold is not only not insoluble, but that in nature it is constantly being dissolved out of the rocks and placers, the waters of filtration dissolving out of the rocks in their passage through them all the materials necessary for the solution of the gold, and carrying it in very dilute solutions until it meets some substance that precipitates it. It seems to be proved that when the action is slow and localized, we have the phenomena of placers with large or small nuggets and irregularly shaped pieces, and when the action is rapid we find the gold in small particles distributed through the sands. We have reason to suppose that these phenomena are now taking place in such a way as to concentrate the gold by infiltration and precipitation in the tailings of mines which cannot be concentrated by mechanical means. Some of these phenomena can be accounted for by the simple action of sunlight, but others, mostly those of the deep placer deposits, have their cause in the large amount of organic material contained in them. The use of a charcoal filter to precipitate the gold from relatively concentrated solutions in one of the recently invented metallurgical processes, is a very suggestive idea of the means nature may have used on an immense scale on very attenuated solutions. The same conditions which cause the solution of gold in certain cases cause also the solution of silica. This explains the phenomenon of mammillary and apparently water-worn nuggets (like that from Placer county) encased in quartz, while both the gold and the quartz have been found posterior to the blue gravel. It also explains the presence of "putty stones," as the soft pieces of decomposed rock constantly found in placer deposits are called. Many of the causes which produce the precipitation of the gold would also produce the reduction of soluble sulphates to insoluble sulphides, the gold being detained in the mass. This would account for the almost constant presence of gold in pyrites, or the occurrence of some of the copper ores of Texas in the form of trees, the ore containing both gold and silver, and also for the constant presence of gold in the iron ores of Brazil, the so-called Jacotinga, and also for the presence of trees transformed into iron ore carrying gold in some of our Western States. In many of the deep placers of California the heavy cap of basalt is quite sufficient to account for many of the phenomena which occur not only beneath but around it. The fact that gold has not as yet been found in potable waters may be simply due to the extreme difficulty attendant on its detection in minute quantity. It is more than likely that many of the geological phenomena on a large scale were produced by very dilute solutions or very slight forces acting for a very long time. How far the electrical currents of the earth may have been a factor in these phenomena it is impossible to surmise. It is, however, more than probable that they were the result, not of one alone, but of all the causes mentioned, and perhaps many others which as yet have escaped our attention. No single agent is so powerful a solvent of gold as chlorine. Very few drainage-waters are free from some compound of it, and no soil is without the nitrogenous materials necessary to set the chlorine free, and therefore capable of attacking the gold and rendering it soluble. The experiments show that a trace of it is quite sufficient to dissolve enough gold to color a solution so that the eye can detect it after a few weeks' exposure. In the nugget of Placer county it would have been impossible for either the gold or the silica to have got into its position except by solution. The iron of the blue gravel in this case seems to have been the first cause of precipitation, and subsequently the gold itself was an active agent in increasing its own weight. The general absence of crystals and of their rounded edges, where they are found, can be easily accounted for by the fact of the rapid action possible in the placers. The readiness of filtration through the easily permeated gravel causes the gold to precipitate so rapidly that there is no time for any but a mammillary deposit; while in vein deposits the extreme slowness of the deposition allows the gold to assume a crystalline shape. When we consider that two-thirds of all the gold produced in the world comes from alluvial deposits it seems difficult to account for its presence in the sands in any other way than by solution.

—A paper by T. Egleston, Ph. D., School of Mines, Transactions American Institute of Mining Engineers.

* Transactions, American Institute of Mining Engineers, vol. 8, p. 462.
† Chem. News, vol. xxvi, p. 161. Am. Chemist, vol. iii, p. 208.

THE GEOGRAPHICAL DISTRIBUTION OF MINING DISTRICTS IN THE UNITED STATES.

PROFESSOR W. P. BLAKE, in a note to his Catalogue of California Minerals, pointed out that the mining districts of the Pacific slope are arranged in parallel zones, following the prevailing direction of the mountain ranges. This interesting generalization has been more fully illustrated and connected with the geological history of the country by Mr. Clarence King, who sums up the observed phenomena as follows: "The Pacific coast ranges upon the west carry quicksilver, tin, and chromic iron. The next belt is that of the Sierra Nevada and Oregon Cascades, which, upon their west slope, bear two zones, a foot-hill chain of copper mines, and a middle line of gold deposits. These gold veins and the resultant placer mines extend far into Alaska, characterizéd by the occurrence of gold in quartz, by a small amount of that metal which is entangled in iron sulphurets, and by occupying splits in the upturned metamorphic strata of the Jurassic age. Lying to the east of this zone, along the east base of the Sierras, and stretching southward into Mexico, is a chain of silver mines, containing comparatively little base metal, and frequently included in volcanic rocks. Through Middle Mexico, Arizona, Middle Nevada, and Central Idaho is another line of silver mines, mineralized with complicated association of the base metals, and more often occurring in older rocks. Through New Mexico, Utah, and Western Montana lies another zone of argentiferous galena lodes. To the east, again, the New Mexico, Colorado, Wyoming, and Montana gold belt is an extremely well-defined and continuous chain of deposits."

These seven longitudinal zones or chains of mineral deposits must not, in my opinion, be held to constitute a complete classification. The belts of the Coast Range and the west slope of the Sierra are well defined, both geologically and topographically; but it is not so easy to separate into distinct groups the occurrences of gold and silver east of the Sierra. For instance, the gold of Eastern Oregon, Idaho, and Western Montana, together with such occurrences in Nevada as those of the Silver Peak and New Pass districts, and numerous instances of sporadic occurrence of particular ores of silver or argentiferous base metals, cannot be brought within the classification above given. Either more zones must be recognized, or a greater mineralogical variety must be acknowledged in those already laid down. The latter alternative is, I think, the more reasonable. According to the principles set forth in a discussion of mineral deposits in my report for 1870,* it appears evident that the agencies which affect the general constitution of geological formation are far wider in their operation than those which cause the formation of fissures; and that the causes influencing the filling of fissures are still more local in their peculiarities than those which form the fissures themselves. Thus, of the area covered by rocks of a given epoch, more or less uniform in lithological character, only a small portion may have been exposed to conditions allowing deposits of useful minerals, even when such deposits are contemporaneous, as in the case of coal. Still more limited is the field for the formation of fissures; but it must be freely confessed that in the case before us, the corrugation of half the continent into parallel mountain ranges offers good grounds for the expectation of vast longitudinal systems of fissures. When we come to consider the filling of these fissures, however, it is evident that the mineralogical character of the vein-material must vary, to some extent, as to the gangue, but to a still greater extent as to the nature of the ores. Even single mines, in the course of extensive exploitation, have produced ores differing as widely as do those of the different zones enumerated by Mr. King. I am, in fact, strongly inclined to consider freedom from base metals, for instance, a peculiarity due in many cases to secondary processes, and not to be relied upon as characteristic for single veins even, to say nothing of whole groups, districts, and continental zones. Nevertheless, the generalizations of Professor Blake and Mr. King on this subject are highly interesting and valuable. The criticism here made is not in opposition to their views so much as in qualification of a possible rash application on the part of the general public. The zonal parallelism does exist, though in a somewhat irregular way; and it is clearly referable, as these writers have shown, to the structural features of the country, the leading feature of which is the longitudinal trend of the mountain ranges.

Subordinate to this trend (or, more strictly, resulting from the same causes as produced it) appear the predominant longitudinal strike of the great outcrops of sedimentary rocks, the longitudinal axis of granite outbursts, and finally, the longitudinal vents of lava overflows and the arrangement of volcanoes in similar lines. It is evident that in crossing the country from east to west we traverse a series of different formations, while, by following routes parallel with the main mountain ranges, we travel upon the continuous outcrops of the same general age. Mr. King distinguishes in the history of the entire Cordillera two periods of disturbance which have been accompanied by the rending of mountain chains and the ejection of igneous rocks. Such periods would afford the conditions of solfataric action, thermal springs, and the generation of acid gases and metallic sublimates and solutions, and thus favor the formation of metalliferous deposits. The first of these periods, he says, culminated in the Jurassic, produced over the entire system a profound disturbance, and is, in all probability, the dating-point of a large class of lodes. To the second, or tertiary period he assigns the mineral veins which traverse the early volcanic rocks. The expression "culminated in the Jurassic," merely refers, no doubt, to the fact that the cretaceous strata of California repose unconformably upon the upturned and metamorphosed Jurassic slates, having been themselves neither tilted nor highly metamorphosed. Perhaps it is well to remember, however, that the cretaceous is a weak point in the California series, at least, as determined by leading fossils; and perhaps the results of more complete stratigraphical surveys will indicate that there are gaps of no little significance, dynamically and chronologically, in this part of the geological record. At all events, the period of the folding of the Sierra Nevada (presumably that of the formation of many metalliferous deposits) was in some sense post-Jurassic, rather than Jurassic; and probably this is the meaning of Mr. King, who speaks of it in another passage as "late Jurassic." The lodes which are referred to this period are of two types: first, those wholly inclosed in the granites, the outburst of which accompananied the upheaval of the earlier stratified group, or in metamorphosed Jurassic and sub-Jurassic strata; secondly, those which occupy planes of stratification or jointure. thus following in general the dip and strike of the country rock, while they present in other respects the indication of fissure-veins. In the veins of Reese River granite are examples of the first type; many gold veins of California, the Humboldt mines, etc., are given as illustrations of the second. The White Pine district, the mineral deposits of which are said to be inclosed conformably between strata of Devonian limestone, is declared to be "a prominent example of the groups comprised wholly within the ancient rocks."

We have hitherto supposed the strata immediately overlying the argentiferous limestone at White Pine to be deep-water Carboniferous; but their Devonian character seems to be demonstrated by Mr. Arnold Hague.* More practically important is the assignment of these deposits to the earlier period of geological disturbance. Mr. King appears here to include in one group *all* the white Pine deposits, the "Base Range" as well as "Treasury Hill;" yet the striking distinction in mineralogical character is worthy of regard. The deposits of Treasure Hill are notably free from base metals; and it seems to me that in their present form they must be due to a secondary action, which has concentrated and recombined the metallic elements of older deposits. It should be added, however, that although the chlorides of Treasure Hill are as pure as those of Lander Hill, they do not appear, like the latter, to yield in depth to such silver ores as characterize the fissure veins of Reese River district—ruby

* Statistics of Mines and Mining in the States and Territories west of the Rocky Mountains, by R. W. Raymond, U. S. Commissioner of Mining Statistics.

* See Volume on Mining Industry of the United States Geological Exploration of the Fortieth Parallel.

silver for instance. Nor are they fissure-veins, so far as we can now decide.

To the Tertiary period of orographical disturbance are referred the volcanic overflows and the veins wholly or partly inclosed in volcanic rocks. Under this head Mr. King classes many important veins of Mexico, several of those which border the Colorado River, in the United States, and, in general, that zone which lies along the eastern base of the Sierra Nevada. The Comstock lode is adduced as the most prominent example of this type, and the Owyhee district in Idaho, is also referred to it, because, although in granite, it presents a series of volcanic dikes, which appear to prove, by the manner of their intersections with the quartz lodes, that the latter are of Tertiary origin. It will be seen that although the extent and number of the deposits of this class are inferior to those of the earlier period, they include some of the most brilliant instances in the history of mining. As Mr. King, however, points out, many of the veins which are wholly inclosed in the older rocks may nevertheless be due to this later period of disturbance. Nor does he ignore the bearing of his thought on his determination of the earlier period as Jurassic. He confesses that in more recent strata, formed from débris of Jurassic rocks, ore-bearing pebbles have not been found; but he regards this fact as a piece of negative evidence merely.

The distribution of mineral deposits east of the Rocky Mountains follows somewhat different laws. Here we have but one longitudinal range, that of the Alleghanies, which is accompanied by a gold-bearing zone of irregular extent and value. In the Southern States the strata flanking this range present a remarkable variety of mineral deposits. On the eastern slope of the Rocky Mountains, again, occurs what may perhaps be denominated a zone or longitudinal series of coal-fields. But between these mountain boundaries the geological formations of the country cluster, as it were, around centres or basins. We have such a group in Michigan, another in the Middle States, and a third in the Southwest.

The deposits of the different metals, ores, and useful minerals, in the country east of the Rocky Mountains, vary widely in age. The ores of gold, copper, and iron, in the pre-Silurian schists of the south; the galena and cobalt ores of the Southwest, and the copper ores of Lake Superior, in the lower Silurian rocks; the argillaceous iron ores of New York, and other States west of New York, in the Upper Silurian, and the salines of the same group; the bitumen, salt, coal and iron ores of the Subcarboniferous; the coal and iron of the Carboniferous; the coal, copper, and barytes of the Triassic; the lignites of the Cretaceous, and the fossil phosphates of the Tertiary period, are instances which may serve to show how great is this variety. It is not within the province of this paper to discuss the mineral deposits of the Mississippi Basin, the Appalachian Chain, or the Atlantic Coast. I shall content myself with brief mention of two points. The first is the greater relative age of the metalliferous deposits as compared with those of the inland basin and the Pacific slope. On this side the period of greatest activity in such formations was over before it began in the West. The great gold and silver deposits beyond the Rocky Mountains appear to be post-Devonian, post-Jurassic, and even Tertiary in their origin. The vast volcanic activity which affected so wide an area in California, Oregon, Washington, Idaho, and Nevada, is not represented in the East. The other point is the peculiar relative position of our coal and iron deposits. This was eloquently described by Mr. Abram S. Hewitt, United States Commissioner to the Paris Exposition, in his admirable review of the iron and steel industry of the world. I cannot do better than quote his forcible words:

"The position of the Coal-Measures of the United States suggests the idea of a gigantic bowl filled with treasure, the outer rim of which skirts along the Atlantic to the Gulf of Mexico, and thence, returning by the plains which lie at the eastern base of the Rocky Mountains, passes by the great lakes to the place of beginning, on the borders of Pennsylvania and New York. The rim of the basin is filled with exhaustless stores of iron ore of every variety, and of the best quality. In seeking the natural channels of water communication, whether on the north, east, south, or west, the coal must cut this metalliferous rim; and, in its turn, the iron ore may be carried back to the coal, to be used in conjunction with the carboniferous ores, which are quite as abundant in the United States as they are in England, but hitherto have been left unwrought, in consequence of the cheaper rate of procuring the richer ores from the rim of the basin. Along the Atlantic slope, in the highland range, from the borders of the Hudson River to the State of Georgia, a distance of one thousand miles, is found the great magnetic range, traversing seven entire States in its length and course. Parallel with this, in the great limestone valley which lies along the margin of the coal-field, are the brown hematites, in such quantities at some points, especially in Virginia, Tennessee, and Alabama, as to fairly stagger the imagination. And, finally, in the coal-basin is a stratum of red fossiliferous ore, beginning in a comparatively thin seam in the State of New York, and terminating in the State of Alabama in a bed 15 feet in thickness, over which the horsemen may ride for more than one hundred miles. Beneath this bed, but still above water-level, are to be found the coal-seams, exposed upon mountain sides, whose flanks are covered with magnificent timber, available either for mining purposes or the manufacture of charcoal iron. Passing westward, in Arkansas and Missouri, is reached that wonderful range of red oxide of iron, which, in mountains rising hundreds of feet above the surface, or in beds beneath the soil, culminates at Lake Superior in deposits of ore which excite the wonder of all beholders; and returning thence to the Atlantic slope, in the Adirondacks of New York, is a vast undeveloped region watered by rivers whose beds are of iron, and traversed by mountains whose foundations are laid upon the same material. In and among the coal-beds themselves are found scattered deposits of hematite and fossiliferous ores, which, by their proximity to the coal, have inaugurated the iron industry of our day. Upon these vast treasures the world may draw for its supply for centuries to come; and with these the inquirer may rest contented, without further question—for all the coal of the rest of the world might be deposited within this iron rim, and its square miles would not occupy one-quarter of the coal area of the United States."

This vivid description rests upon a geographical rather than a geological grouping. But it is none the less intimately connected with the underlying geological facts. Its strongest application is, however, economical. If any material thing may stand as the type of force, it is coal, the deposits of which may well be called vast storehouses of power—the product of solar activity through uncounted years—laid up for the use of man; and iron, on the other hand, may symbolize the inert, dead matter, awaiting the touch of power to wake it into efficient life. These are prime elements in our universe of industry. Take them away and our present civilization is annihilated. Put them together in the hand of an intelligent and mighty nation, and that nation could recall the world from the chaos of barbarism. But they need each other, and it is in the wonderful combination of both, as well as the exhaustless abundance of each, that America finds sure promise of enduring power. Thus East and West bear witness of our great inheritance of natural wealth. Every period of geological change has been laid under contribution to endow with rich legacies some portion of our land. Our territory epitomizes the processes of all time, and their useful results to man. Divided, yet in a stronger sense united, by mountain chains and mighty rivers, our diversified mineral resources may figuratively represent, as I firmly believe they will literally help to secure and maintain our characteristic national life, a vast community of communities, incapable alike of dissolution and of centralization; one, by mutual needs and affections, as the continent is one; many, by multiform industries and forms of life, as the members of the continent are many.

—A paper by R. W. Raymond, Ph. D., Transactions American Institute of Mining Engineers.

SILVER IN THE SEDIMENTARY ROCKS.

WIDESPREAD interest has recently been developed in the subject of the occurrence of silver ores in sandstones and related sedimentary rocks, by the success which has attended the developments of the famous Silver Reef mines in Southern Utah. These mines ship regularly between $70,000 and $80,000 worth of bullion per month, most of which is derived from ores taken from two or three strata of sandstone, a rock, which, like most sedimentary rocks, is continuous over many square miles of territory. This certainly must seem passing strange to the Pacific coast miner, who has been accustomed to consider that if there is any place where ores of the precious metals are *not* to be sought it is in the sandstones and related sedimentary rocks. The question is at once suggested, If precious metal is found in the sandstone of Utah, may it not be found in the sandstone of other districts? Has the prospector, who has with such untiring energy explored the most inaccessible recesses of our highest mountain chains in search of silver and gold, entirely overlooked a source of wealth which may be hidden in the monotonous sedimentary rocks of our plains and valleys? Finally, is there any practical consideration which guides the prospector which can tell him that in one locality he would seek fruitlessly for gold or silver, while in another he may hope to find it? I think it can be shown that there is. To the miner these are intensely practical considerations.

If argentiferous and auriferous ores are to be sought indiscriminately in all of our sedimentary rocks, then there is scarcely an acre of the surface of the dry land but must be investigated to prove either the presence or absence of ore. I am the more desirous of presenting a few thoughts on this subject for two reasons. On the one hand, prospectors have more than once recently sent sedimentary material to the geological department of the university, with a query as to whether ore deposits of the precious metals might be sought in them. On the other hand, one of the leading geologists of the country, Professor Newberry, of Columbia College, New York, has announced a theory of the formation of the silver sandstone deposits at Silver Reef which, pushed to its legitimate conclusion, would necessitate the investigation, as I said before, of almost every acre of sedimentary rock in every country before the miner could be satisfied that gold or silver did not exist in it. Now, I am aware that geology is far from being an exact science; furthermore, that that particular portion of it which deals with the genesis of ore deposits is one of the least understood. It is truly astonishing, when one reflects, that some of the fundamental principles of an industry which yearly adds hundreds of millions of dollars to the wealth of the country should be so little understood. However, while it is true that we know comparatively little about the genesis of ore deposits, still we are not altogether in the dark. In almost every mining district there are certain empirical laws which guide the miner in that particular district, but which are totally inapplicable, or at least not necessarily applicable, to any other district. The laws of the occurrence of gold and silver, which are of general application, are exceedingly few. The typical mineral vein, the "true fissure vein," as it is very properly called, is very simple in its structure and geological relations. It consists, essentially, of a fracture or fissure of a rock, varying from a fraction of an inch to many feet in width, of moderate length, rarely more than two or three miles, and of indefinite depth. This fissure becomes subsequently filled from side to side with ore and veinstone, probably introduced in the form of solutions from below. Very little obvious connection between the neighboring rocks and the contents of the fissure is observed. The bulk of the ore is confined almost entirely between the two walls of the fissure. It is often noticed, however, that the ore wanders out laterally into the wall rocks in sufficient quantities to render them worth mining, and, to a much less extent than this, even to very considerable distances. This takes place, too, under circumstances where the conditions would seem to be exceedingly unfavorable, as in solid granite and similar rocks. Special attention is called to this lateral impregnation of the country rocks, as it has an important bearing upon the genesis of the ore in the sedimentary deposits. The essential characteristics of fissure veins are, then, indefinite extension in depth, very moderate width (or thickness) and length, and subsequent formation to the inclosing rock.

The structure and geological relations of sedimentary rocks are in many respects quite the reverse of these. Take sandstone as a typical instance. It generally exists in the form of a widely extended horizontal deposit, covering many, often hundreds, of square miles, and varying in thickness from a few feet to thousands of feet. Other stratified rock often lie both above and below it, and it is always younger than the underlying and older than the overlying material. Suppose such a body of rock to be impregnated with silver ore, more or less, throughout its whole extent; you at once comprehend the vast difference in mode of occurrence between such an ore body and the typical mineral vein previously described. Such in general is the mode of occurrence of the ore at Silver Reef, Utah. I am indebted to Professor Newberry and to Mr. Rolker, for several years and until quite lately superintendent of the Stormont mine, for the facts concerning these mines; particularly to the latter gentleman, who has recently communicated a paper to the American Institute of Mining Engineers, upon the Leeds district mines, which was abstracted from the San Francisco Mining and Scientific Press, December 25, 1880. I have not been able to consult Mr. Rolker's original paper, but have been compelled to content myself with the above-mentioned abstract. I will not present a detailed description of the entire district and deposit, but will suggest only such points as bear more immediately upon the question to be discussed, namely, How did the silver get into the sandstone?

Let it be remarked right here, however, that no one can pretend to furnish a complete solution of the problem in all of its details without a most minute and accurate knowledge of every detail of structure and relation presented by the deposit in place. Such a knowledge can rarely be acquired at second hand, nor can it be attained even by investigation in the field until the mines have been much more thoroughly opened than is the case at the present time. These mines have been prospected to a slight depth this year (1877). The Comstock lode has been pierced to a vertical depth of over 3,000 feet, and scientific men are to-day unable to demonstrate precisely how the ore came into its present position, and where it came from. The temptation to hasty generalization from insufficient data is, perhaps, nowhere so great as in geology. Instances without number can be cited where theorists have fallen into error by drawing hasty conclusions from too few or imperfectly observed facts. I would prefer altogether to await the accumulation of observed facts and let them explain themselves, as they always will sooner or later, if properly recorded and collated. However, the average modern investigator in almost every department of science has found it necessary to have constantly in mind what he calls a "working hypothesis" concerning the subject under investigation, which is to him the most rational of the many explanations of the phenomena in question which suggest themselves. Since we must have these hypotheses, it behooves us (particularly where practical consideration of great moment are involved, as in mining) to see that our hypotheses rigidly conform to observed facts, and that, as soon as this is not the case, we discard them for less objectionable ones.

It is in this spirit that we approach the present question, fully aware that at this distance from the field, and with the few data in hand, a complete solution is impossible, but believing that at least a rational choice from the two or three proposed hypotheses can be made. To return, then, from this digression to the facts of the case. The Silver Reef mines are situated in extreme Southern Utah. The sandstone containing the silver ore is of Triassic age, as recently determined by Professor Newberry. They are not to any extent metamorphosed from their primitive condition. There are two silver-bearing sandstone strata or "reefs," as they are called, overlying each other but separated by beds of clay shale. The ore, which above water line is mostly horn silver, and below it silver glance, is not homogeneously distributed through the entire rock, but is largely concentrated in ore-channels, lying one above another in the different beds. Organic remains of plants, partially or wholly converted into ore, are very plentiful; they make up, perhaps, the bulk of the ore, although it is distinctly stated by Mr. Rolker that he had mined portions of these beds for a stretch of 200 consecutive feet, which were absolutely devoid, to the eye, of organic remains, and yet yielded an average of $30 per ton. On the other hand, organic remains are plentiful in sandstone layers quite free from ore, but overlaid and underlaid by sandstone free from fossils and full of good ore. Mr. Rolker also cites another instructive instance where a layer of 2 feet of $30 sandstone, lies upon 15 inches of barren rock, under which the sandstone again carries $20 ore. Further, at Silver Reef comparatively little copper is found, while farther south copper enters largely into the ore, and in the same Triassic sandstone on the west flank of the Nacimiento Mountains, in New Mexico, the silver gives place entirely to copper. Professor Newberry finds that the extension of these sandstones into the table lands to the east of Silver Reef, and along Cedar Mountains as far north as Beaver, all contain silver, though rarely more than 7 or 8 ounces per ton. Finally, in the words of Mr. Rolker, "the Silver Reefs are, where the silver is mostly concentrated, in close proximity to former volcanic centers; as is likewise the case at another less known locality, viz., at Virginia City, on North Creek." These, then, are the facts which we have to interpret. How did the silver get into the sandstone? Several theories have been propounded. Professor Newberry thinks that "the silver, like the copper, which the sandstones contain, was deposited with them, and not introduced subsequently." Mr. Cazin, of New York, takes exception to this and thinks that "the ore deposits both of copper and silver in the Triassic sand-rocks are precipitations from solutions containing metals, upon animal and vegetable matter, such matter, and not the metallic ores, being contemporaneous with the deposition of the sandstone." This is really, however, one of the possible interpretations which can be given to Professor Newberry's statement of the case. The usually accepted theory is that the metal solutions come from below, and are dependent upon, and immediately subsequent to, the eruption of igneous rocks in the vicinity of the present deposits. The hot springs bringing the metal solutions are the last dying manifestations of subterranean activity. Let us examine these theories in the order indicated. It is unfortunate that Professor Newberry's opinion is not couched in specific language. It was probably not intended as a scientific statement, as it was contained in a personal letter to the president of the Stormont Mining Company, published in the Engineering and Mining Journal of October 23, 1880. It is susceptible of two or three quite different interpretations, possessing in common only the fact of contemporaneousness of deposition of the inclosing sandstones. I will give first the most natural one and the one which I think he intended, viz., that the ores were precipitated out from solution in the ocean, at the bottom of which the sandstones were formed. The only ground for this view given by Professor Newberry is his discovery of copper and silver in the same Triassic sandstones in the table lands to the east, and as far north as Beaver. Now, on the one hand this comparatively widespread impregnation can be equally well explained by another theory, while on the other hand the theory itself seems to be unable to explain already observed facts. Conceding for the moment that the theory is the true one, there are two ways by which this precipitation could be effected, viz., by separation, caused by over-concentration of the Triassic ocean, or by reduction out of a far less concentrated solution by means of organic matter. I find it hard to believe that Professor Newberry would have us accept the first method. It would be like asking us to believe that the Pacific Ocean, or any considerable area thereof, was made up of a concentrated solution of blue vitriol.

Mr. Rolker urges against this view that it would necessitate the existence at the present time of an homogeneous mechanical impregnation of the entire Triassic sandstone covering hundreds of square miles in Utah, New Mexico, and Colorado, while, as a fact, we find the most of the ore locally segregated, and but a small amount at distances removed from these local segregations. This objection is not a valid one, as it is quite possible for the local segregation to have been entirely subsequent to the original deposition of the ore and sandstones. One certainly could not explain upon this hypothesis, however, the peculiar form in which this local concentration is at present found, viz, in ore channels lying over each other in the two beds. It is likewise difficult to conceive how the alternation of sandstone layers, rich in silver, poor in silver, and free from silver, as described above, could be explained upon this hypothesis. We should have to suppose the superincumbent ocean to be alternately exhausted and re-supplied several times, or else, that later, the ore in the now barren sandstone was leached out and concentrated in the next lower bed. The first supposition is, to say the least, a strained one; and as for the second, there certainly appears to be no good reason why such a leaching process if it took place at all, should favor narrow zones of but 15 inches thickness, and not be general over the entire sandstone bed. Again, there seems to be no adequate relation between the amount of ore existing in the sandstones and the amount of copper and silver salts required to saturate an ocean to the point of deposition. Finally, the fact that the Silver Reef region contains almost exclusively silver ores, while farther south it becomes largely replaced by copper, and again still farther to the southeast in the triassic sandstone of the Nacimiento Mountains, in New Mexico, the silver gives place entirely to the copper, seems to me fatal to the hypothesis. I do not see how a subsequent separation of copper from silver over such an extensive area could be brought about.

Without denying, however, that in the progress of chemical geology the chemical possibility may be established, it must at least be acknowledged that at the present day it looks like an arbitrary assumption. The second method of deposition above indicated, viz., reduction by organic matter out of the sea very far below the point of saturation, is an altogether more natural assumption. We are quite prepared to believe that a minute proportion of silver existed in the waters of the triassic ocean, inasmuch as it appears highly probable, although not yet directly proven, that copper and silver exist in the sea-water of the present ocean in exceedingly minute quantity. Now, while organic matter would unquestionably reduce the ore even from exceedingly dilute solution, my principal objection to this view of the question is, that in an ocean made up of such dilute solution, there would be even far less probability that most of the copper would be reduced in one portion of the sea-bed, as at the Nacimiento Mountains, while most of the silver was deposited in a different portion of the same sea, as at Silver Reef. Ocean currents would certainly bring about a comparatively homogeneous composition to the whole body of water, necessitating a chemical homogeneous impregnation of copper and silver over the entire triassic area; and, as I have said before, I do not see how the copper and silver could subsequently become differentiated. But again, conceding this to be possible, neither of these theories would explain why the ores in the two or three principal localities (Silver Reef and Virgin City, Utah, and on the west flank of the Nacimiento Mountains, in New Mexico) should become concentrated in the vicinity of eruptive rocks, and, so far as we yet know, there only. Mr. Cazin advocates essentially this theory of reduction by organic matter out of an ocean containing an exceedingly small amount of copper and silver. He modifies it, however, by assuming that the deposition of the organic matter only was contemporaneous with the formation of the sandstones, which organic matter became gradually converted into ore by exposure during thousands of years to the waters of the superincumbent ocean percolating downward through the subsequently formed and forming sandstone. The theory, even thus modified, is open, however, to all the objections above stated. The only remaining interpretation that can be given to Professor Newberry's language (and this, in my estimation, is the most plausible of all) is that the ore particles are the result of the mechanical disintegration of pre-existing ore deposits, just as the grains of quartz in the sandstones are the result of the mechanical disintegration of pre-existing siliceous rocks, or that the ore grains thus originally formed by mechanical disintegration became subsequently oxidized into sulphates, and again reduced to sulphides by the organic matter in the sandstones. A fatal objection to the first process (as indicated by Cazin) is that the difference in grains would inevitably lead to the mechanical segregation of the ore in comparatively restricted areas. Furthermore, the ore particles are not rounded or water-worn, but have evidently been formed just where they are now found, proven also by the plant remains converted into ore, which would not bear transportation and preserve their form. The second process, viz., oxidation to sulphate and subsequent reduction by organic matter, would obviate the objection that the ore particles are not rounded, but would certainly not that founded upon differences of specific gravity, although such a process would certainly admit of a far more extensive impregnation of the sandstone than the purely mechanical theory. Further, we have the testimony of Mr. Rolker that the mountains in the immediate vicinity of these deposits have as yet revealed no ore bodies to the industrious prospector, while the nearest vein deposits, situated to the north, contain gold and lead with the silver. Rolker pertinently asks, if the ores are derived from this source, why do we not find lead or gold with the silver in the sandstones? Finally, neither of these theories explains the occurrence of the ore in channels previously described, nor the concentration in the neighborhood of eruptive rocks. There being, then, valid objections to all of the theories thus far suggested, let us turn to the last and most generally accepted theory, viz., that the metallic solutions came from below, and were dependent upon and immediately subsequent to the eruption of the igneous rocks in the neighborhood of the present deposit. In the first place, let it be noted that this is substantially the theory ordinarily accepted for the formation of true fissure veins, so that if it can be made equally applicable to such deposits as these under consideration, there would be a certain amount of presumption in its favor, even if other things were equal. As fast as an hypothesis becomes gratuitous in science, it is eliminated—it becomes unnecessary. Not that nature always produces the same effects in precisely the same way. Too close adherence to this idea has frequently led into error. The only safe test is for each specific case to bring our theories to the ordeal of a satisfactory explanation of observed facts. In the present instance I fail to see a single fact which cannot be explained upon this hypothesis. In the first place, the igneous rocks are in close proximity to every locality where ore in paying quantities has been discovered. It explains the occurrence of ore in chutes or ore channels, one above another, in different beds. The eruption of igneous rocks could not fail to fissure more or less the adjacent sedimentary rocks. The solutions which followed, bringing the silver and copper, would come through these fissures, and would, of course, deposit the greater portion of their metallic contents in and near the fissures which now form the ore channels. It would explain the alternation of rich and barren zones in the sandstone. We know that solutions will travel in channels offering the least resistance. The layers richest in ore will be such channels, and in proportion as the physical or chemical conditions for absorption are unfavorable, in the same proportion will the rock be poorer in ore. It would explain the preponderance of silver in one portion of the triassic sandstone, and of copper in another portion; viz., they came through different fissures and from different sources below. It would explain the impregnation of the sandstones even at considerable distances from the larger bodies of ore. I have already cited the common occurrence of lateral impregnation of the country rock on either side of fissure veins. In the same way from the main channels in the sandstone the lateral impregnation of the body of the rock, even to considerable distances, would take place. Mr. Cazin objects to this theory (and considers the objection fatal) that the ore deposits are local, but extend over Utah, New Mexico, &c., and thence they cannot be dependent upon local fissures; and furthermore, that it is characteristic of the triassic sandstone that it is not fissured.

In reply I would say that if the ore deposits are not local neither are the igneous rocks local; and that according to Mr. Rolker the two go together; *i.. e.* the larger or more pronounced concentrations are in the neighborhood of crystalline rocks. In the second place, I am compelled on general principles to doubt Mr. Cazin's statement concerning the absence of these fissures over such an extensive district. The greater portion of the Jura-triassic area between Leeds district, Utah, and the Nacimiento Mountains, New Mexico, is deeply covered by later sedimentary rocks, exposed only in places in the deep cañons of the rivers which drain the country. Even these exposures have not all been investigated to prove either the presence or absence of silver or copper ores. One cannot speak, therefore, of an universal impregation of the entire Triassic sandstone, nor of the absence of fissures over the whole area. Finally, concerning the existence of fissures in those places which have been explored, neither Professor Newberry nor Mr. Cazin recognized any fissure; but Mr. Rolker has discovered the key to the whole problem when he recognized the existence of the ore channels at the Stormont mine, and properly explains them, viz.: During the disturbances attendant upon the eruption of the neighboring igneous rocks, the sandstones were fractured without opening. Instead of producing open fissures, to be subsequently filled like ordinary fissure veins, the result was the formation of cracks, along which, from the friable nature of the sandstones, the rock would be considerably crushed, and might later partially heal up. But the ultimate result would be the existence of numerous vertical channels or water-ways, which would certainly be followed by metal solutions forcing their way upwards. These water-ways would finally contain the largest amount of ore, and would form the ore channels which Mr. Rolker describes, and from them the lateral impregnation of the sandstones, even to considerable distances, would be easily effected. These water-ways would branch and ramify through the rock in all directions, never making themselves visible on the surface as fissure veins, and, in fact, by the entire absence of all the usual characteristics of fissure veins, such as distinct walls, selvages, &c., would easily escape the observation of even such an acute observer as Professor Newberry. It is, then, by such a process as this that I would explain the wide-spread impregnation of the sandstone, so far as yet observed, and the apparent absence of fissures, as insisted upon by those who have written upon the subject. The silver came into the sandstones, consequently, in the same general way that the silver came into the Comstock lode, or any other fissure vein, the present difference in the mode of occurrence being due to the fact that the fissures did not open, and that the sandstone absorbed the metallic solutions like a sponge, as fast as they came in contact with it. The existence of water-ways was first suggested to me by a large and magnificent specimen of ore from the Bassick mine in Colorado, now in the museum of economic geology of the University of California, presented about a year ago by Mr. J. B. Farish, then of Silver Cliff, California. The country rock of the Bassick mine is an igneous rock (sanidin trachyte), and the difference between their modes of occurrence at this mine and the Silver Reef mine is due entirely to the different nature of the country rocks. The trachyte exists in the form of irregular fragments from the size of a walnut to many feet in diameter, all more or less rounded and greatly decomposed by the action of infiltrating metallic solutions which have deposited the ore between the fragments. Had the rock been anywhere nearly as porous as sandstone, we should have found here the same extensive lateral impregnation as at Silver Reef. A subsequent visit to the Sulphur Bank quicksilver deposit, in Lake County, California, disclosed precisely similar relations at that mine. There augite andesite, which forms the bank, has been irregular fissured at the time of its original solidifications, and subsequently infiltrated with metal solutions carrying mostly quicksilver ore. I have learned recently from Prof. Joseph Le Conte that this idea of the widespread occurrence of water-ways has been suggested by him in his lectures on geology for the past two years, and that in the next edition of his geology he proposes to give it prominent place. We are both convinced of the value of the suggestion. In fact, it is only by means of it that many otherwise puzzling deposits can be understood. It brings likewise into close genetic relation a large number of ore deposits which pass in the literature as impregnations, stocks, veins of substitution, irregular deposits, geyser deposits, &c., into genetic relation, not only with each other, but with what must be regarded as the simplest type of them all, viz., the fissure vein.

It is certainly to be expected, *a priori*, that the process of rock fracturing that accompanies every considerable disturbance in the mutual relations of rocks, for one fracture that is accompanied by the formation of an open fissure, many would be formed without opening, and through which metallic solutions could force their way upwards. The form of the resulting deposit would then depend upon the nature of the rock in which the fracture was produced. If the fissure opened, we should have the simple fissure vein; if it remained closed and the rock was porous like sandstone, should have, as at Silver Reef, ore channels with very extensive lateral impregnation of the surrounding rock; if the rock was not porous, like the Bassick and Sulphur Bank rocks, we should have comparatively thin veinlets ramifying in all directions, accompanied, as it always is, by extensive decomposition of the rock; if the rock is very readily acted upon, chemically, by the metallic solutions, as is the case with limestone, dolomite, etc., the softer portions would be dissolved, outforming huge caverns of most irregular form, which would subsequently become partially or wholly filled with ore, as at the Eureka and Richmond Consolidated mines in Nevada. The ore deposits at Silver Reef and at the Nacimiento Mountains are by no means the first sedimentary rocks containing sulphuretted ores which have been discovered. These beds are the first that have yielded any considerable amount of silver; but copper, lead, and quicksilver, and even gold, have long been known in similar beds. I will mention but one or two localities; thus, at Vorospatak, in the Siebenburgen Mountains, the Carpathian sandstones are impregnated with gold and quartz; at Bleiberg, in Carinthia, galena is found in limestone; at Bohmisch-Brod and Schwarzkosteletz, in Bohemia, the sandstone of the Rothleigenden formation of the Germans is impregnated with copper ores. The copper schist of Mansfield, at the base of the Harz Mountains, is another instance, and many more might be mentioned.

I have studied carefully the geological relations of many such deposits, to see which of the above mentioned theories best explained the recorded facts. The theory which best explains the phenomena at Silver Reef is, likewise, the one which appears most rational for most of the others. With but a single exception (Commern, near Aachen, in Rhenish Prussia), sedimentary rocks are impregnated only in the neighborhood of eruptive rocks. I will mention here but a single striking instance, the copper mines of Eastern Russia. Central Russia is one vast, monotonous region of comparatively undisturbed sedimentary strata, perfectly free from sulphuretted ores of all kinds. But as soon as we reach the extreme eastern edge, where the igneous masses of the Ural Mountains have forced their way upwards through the sedimentary beds, there we find these same sedimentary rocks impregnated with ores of copper, while in the immediately adjacent mountains the same metal is abundantly present in the fissure veins of the eruptive rocks. One more point, and I will close. It is the answer to the question I asked in my introduction—"Has the prospector any practical guide in his search for the precious metals?" I can only state what must still be considered as about the only law which is generally applicable to all mineral districts where the precious metals have thus far been mined, viz., that deposits of the precious metals occur almost exclusively in the neighborhood of the massive crystalline rocks. Gold and silver may at any time be found in sandstones and similar sedimentary rocks, but only in the neighborhood of the massive crystalline rocks, and it is useless to prospect sedimentary rocks for the precious metals at great distances from such geological formations. It is scarcely necessary to add that superficial drift deposits and all kinds of placer deposits, both recent and older, may form exceptions to the law as above stated.

— *A paper by A. W. Jackson read before the California Academy of Sciences.*

THE HYGIENE OF MINES.

IT is convenient to divide mines, with reference to this subject, into two classes, collieries and metal mines. Subterranean quarries, rock-salt mines, etc., present no conditions requiring them to be separated from the latter class. With regard to the hygiene of American collieries (a branch of the subject which I shall not discuss at length), I take the liberty of quoting some excellent observations contained in a recent article by Mr. Henry C. Sheafer, of Pottsville. Mr. Sheafer says: "The working miner usually devotes his whole life to that occupation. He frequently, perhaps generally, begins at the age of from eight to twelve years as a slate picker in the breaker—the building in which the coal is prepared for market—where his business is to sit all day, with twenty or thirty companions of about his own age, and pick out fragments of slate from a thin stream of coal flowing past him. The place in which he works is apt to be more or less open and exposed to draughts. His clothing consists of shirt and pantaloons, usually old and ragged; a battered cap, and a pair of coarse shoes—the last often omitted in summer. His whole costume, whatever its original color, is soon stained a uniform black by the thick cloud of coal-dust which fills the breaker, filters through his clothing and begrimes his skin, and which forms a large component part of the atmosphere he breathes. As boy and man, his invariable practice at the close of every working day, is to wash himself thoroughly from head to foot, a custom to which his hardiness and generally rugged health in early life, are largely attributed. His diet, as boy and man, is simple. Pork, salt fish, potatoes, and home-made bread are its staple constituents; but when work is good and money sufficient, all the luxuries of the local market are to be found on the miner's table. He learns to smoke and chew tobacco at an early age, has few or no scruples against the use of either malt or alcoholic liquors, and withal grows up to be a lusty, sinewy youth, who seldom troubles the doctors, unless overtaken by one of the numerous accidents to which his own recklessness, not less than his somewhat dangerous occupation, exposes him. At the age of eighteen or twenty, if he has not previously entered the mine as a driver, or for some other description of boys' work, he goes in as a laborer, becoming in effect, though not in name, an apprentice to a practical miner, with duties so nearly the same as those of his boss, that, for the purposes of this article, they may be considered identical.

"The miner gets to his work shortly before seven o'clock in the morning, if on the day shift, or between five and six in the evening, if on the night shift. He is dressed in flannel shirt, woolen or heavy duck pantaloons, heavy shoes or boots, and usually with a coat thrown loosely over his shoulders. On his head he wears a cap, a slouch hat, or a helmet shaped like a fireman's, but of smaller dimensions. Whatever the headgear, his lamp, a small tin one, shaped like a miniature coffee-pot, swings by a hook over the visor; unless the place in which he works is fiery, when he carries a safety-lamp in his hand. His dinner-can and canteen of water or cold tea are swung from a strap passing over his shoulders. Thus equipped, he rides down the shaft or the slope, and if he is lucky enough to catch a train of empty mine wagons going to his working place, he rides in, a distance, it may be, of two or three miles from the foot of the shaft. If no wagons are at hand, he walks most of the way through water and slush, taking small account of wet feet, or, indeed, of wet clothing at any time, though the roof over him may drip all day long. It is an exceptional case if he wears a rubber or oil-cloth suit, even in the wettest places.

"Two miners, or two miners and a laborer, form a gang, and their work is an alternation of exhausting physical labor and intervals of rest. They work with drilling-bar, powder, and pick, getting down the coal and breaking it to a size small enough to handle; with drills, preparing and charging a hole for blasting; with shovels, clearing away the coal and getting it into the mine-cars to be sent to the surface; and then, when a particular job is done, or a blast is to be fired, they repair to the nearest place of safety, and in their overheated condition sit down in the cold, damp draught of the ventilating current to cool off as rapidly as possible. Is it any wonder that rheumatism, consumption, and 'miner's asthma,' are the common ailments among them? In walking to and from his work along the mine gangway, the miner tries to step on the sills on which the track is laid, thus avoiding the hollows worn by the mules' feet between the sills; and as these are laid from two and a half to three and a half feet apart, the effort gives him a long, slow, swinging gait, the head being thrown to counterbalance the body. The same posture is found best for traversing the manways and other smaller passages, the long stride being advantageous in picking the way over rough and uncertain ground, while the bent head escapes projections of the roof, and permits the light of the lamp in the miner's cap to fall on the ground at his feet. The habit becomes fixed, and the old miner may always be known by his bent shoulders and swinging stride. That this unnatural compression of the chest cannot but be injurious is evident.

"Among the most laborious of the miner's duties is setting the timbers which support the roof. The gangway, or general passageway of the mine, is usually from seven to ten feet in height, and about the same in width, seldom falling below these dimensions in American mines, where thick beds of coal are worked and the cars are drawn by mule or locomotive power, though in the thin beds of England and Wales, they are often so small that a man cannot stand upright in them. The gangway timbers, unless the rock and coal are unusually solid, consist of a prop on each side, with a cross-piece uniting them. They are from 10 to 15 inches thick, of length adapted to the dimensions of the gangway, and being of green wood, are correspondingly heavy, weighing from 300 to 500 pounds, according to size. Yet three men are not only expected to set the side-pieces, but to lift the heavy cross-beam into position far above their heads, and fix it there. The work is so hard, performed as it is beyond the brattice which supplies fresh air, in an atmosphere more or less charged with powder-smoke and carbonic acid gas, that, by the time it is done, all three are thoroughly exhausted and overheated, and in most favorable condition for the reception of colds, lung disorders, and rheumatism. If working in a steeply pitching breast,* though the timbers used are not so large, they are quite large enough to tax the strength of two men who have to get them up a steep and difficult 'manway' by sheer lifting and pulling. In this way, which is almost like working up through a chimney, timbers averaging perhaps eight feet long by six inches thick are carried to the top of the breast, which may be from sixty to eighty yards above the gangway level.

"Mention has been made of the brattice. This is a highly important aid to the ventilation of the mine. It is an air-tight partition, generally carried along one side of the gangway, though sometimes over its top, and so arranged with reference to the ventilating current, that the fresh air is carried along one side of it, while the impure air, which is to be withdrawn, passes along the other. Its object is to keep up a circulation of air in the recess formed by advancing operations at the face of the workings. As every passage or chamber is pushed forward into the solid coal or rock, it necessarily forms a bay, in which the air is always stagnant, unless moved by some such appliance at the brattice. Communicating passages, called headings, are made between the working-chambers about thirty yards apart, for the same purpose; but as the chamber is opened beyond the heading, a brattice becomes necessary here also. One great cause of impurity in the atmosphere in which the miner works is that the brattice is frequently neglected, and the work pushed so far beyond it that it ceases almost entirely to affect the air at the face which then becomes loaded with powder-smoke and carbonic acid, or, in fiery mines, carburetted hydrogen. In either case the effect on the miner's health is most injurious.

"Of course the principal occupation of the coal-miner is cutting and getting out coal, and here again his work is performed under disadvantageous circumstances as regards the preservation of health. Much of it consists in lying on the side, holding under the mass in a low cut, where every stroke of the pick dislodges a fresh shower of dust, to be inhaled by the miner. Other portions consist of straining at arm's length to dislodge a mass hanging from the roof, of lifting and tugging at heavy weights, of shovelling continuously, hour after hour (where coal has to be shovelled into the mine-cars, the filling of from eight to ten cars, holding three tons each, is considered a day's work for a laborer), and of swinging a heavy sledge in drilling by hand-power. His footing is frequently unsteady, having to be maintained on a steep-pitching floor of smooth slate, so that, as a miner once expressed it to a friend of the writer, 'it is very much like asking a man to stand on the roof of a house while working.' There are chasms under foot and loose rocks overhead, equally to be avoided, and the whole shrouded in a darkness which the miner's lamp reduces only to a semi-obscurity, and which hides without removing the danger,

"The miner's life when not at work also has its effect on his general health, and, as with every other class of men, this varies according to the tastes and temperament of the individual. His house is of frame, plainly but conveniently built, and furnished with the necessary conveniences of life. Being situated in the country, and in a section where land is of little value for either building or agricultural purposes, there is plenty of space about the house, and fresh air in abundance. Even the close neighborhood of frequent hog-pens and occasional stables, and the universal practice of emptying slops from the house on the ground at the back door, have little or no deleterious effect, being neutralized by the abundance of pure air with which their odors and gases mingle.

"The miner's first care on coming from work is to take a tub-bath, cleansing his skin thoroughly. He then dresses in a clean suit, eats his supper, and is ready for the duties and amusements of the evening, both of which are few and simple. Usually the male inhabitants of the 'patch' gather in groups in the open air, in the village store, or in the omnipresent saloon, and smoke and talk, until the coming of an early bedtime sends them home. Comparatively little drinking is indulged in except on pay day, which comes once a month, and is celebrated by the drinking classes with a 'spree.' In this particular the miner's nationality makes itself seen. While men of all nations may be found drinking to intoxication, the practice as a race is confined to the Irish. There are few of American descent among the miners, and these are generally found among the best and steadiest of their class. The Irish are the most numerous, and they are fond of liquor, drink to excess, and are very quarrelsome when drunk. Terrible fights often accompany a pay-day spree among them. Next to the Irish, in numbers, are the Welsh, a temperate, thrifty, and intelligent race, who form a valuable element in the population. They are industrious and economical, generally succeed in securing homes of their own, which they delight in beautifying and keeping in order, and are apt to be found in positions of trust and authority in later life. Germans and Poles, too, are industrious and economical, but less intelligent and less temperate than the Welsh, more careless in their personal habits, and utterly regardless of the laws of health. They eat unwholesome food, sleep in ill-ventilated rooms, and early acquire a sallow, unhealthy appearance. Nevertheless, their active occupation and the enforced cleanliness of the 'shifting-suit' counteract many of the ill effects of their mode of living, and they will probably be found to average as long lives as the other races. Less numerous, though making up the bulk of the population in certain localities, are Scotch, English, and Italian miners. The last are much like the Irish in habits, while the others hold an intermediate place between them and the Welsh. It is of course to be understood that these remarks apply in general to the nationalities; there are very good workmen and excellent citizens in all classes, and, similarly, there are worthless characters in all; but the general tendency will be found as has been stated. As in every other occupation, personal habits have their effect on the constitution, and predispose it to invite or to repel disease. Thus, drunkenness causes gray tuberculosis, which, with the inhalation of dust and noxious gases, predisposes to consumption, a very common disease in mining towns.

"One of the most prominent conditions of a miner's working life—certainly the first to be noticed by the casual visitor—is the absence of sunlight, a very deleterious condition as many physicians and engineers of large practical experience consider it, while others as positively deny that it has any injurious effect. Dr. J. T. Carpenter, of Pottsville, in a paper read before the Schuylkill County Medical Society, says (*Transactions Medical Society of Pennsylvania*, 1868–9, p. 488): 'The deprivation of sunlight must be a very strongly predisposing cause of disease. It is to be expected that the results of this deprivation will become apparent in general anæmia, in chronic nervous irritations, in tendencies (easily to be developed by exciting causes) toward scrofula, tubercular phthisis, and allied maladies.' Other practitioners, however, assert that the deprivation of sunlight is among the least of the miner's afflictions; that

*In steeply pitching breasts of great thickness—say, like the Mammoth Vein in Pennsylvania—timbers are not used, but the miner works the coal on benches, and works from the top rock downward, having his breast constantly full of coal, on which he stands. In coal-beds of ordinary thickness, say ten feet and less, these timber are used.

no injurious effects from it are perceptible, and that no acute disease can be traced either wholly or in part to this cause; while physicians will probably continue to differ forever as to whether or not absence from sunlight during all the working hours predisposes to or prolongs any chronic complaint. In this connection it must be borne in mind that the miner's work is carried on wholly by artificial light, and that usually of a very poor quality. Not the faintest ray of sunlight can penetrate to him, and about the first thing the unaccustomed visitor usually remarks is that it is so *very* dark. It needs but a slight exercise of the imagination to persuade him that he has at last found a sample of that 'thick darkness that might be felt' which once visited the land of Egypt.

"In the winter season, especially when the mines are working full time, their inmates, as a rule, see but little of the sun during their working days. They enter the mine before sunrise, and quit it after sunset. It is, however, a very common practice among them to work week about, one week by day and the next week by night. In this case they have at least from four to six hours of every day's daylight during their night week, and in any case they usually spend Sunday above ground. They do not complain of want of sunshine, and it is difficult to trace any ill-effects of its absence upon them. Their complexions are pale, but not more so than these of persons who work at night, or in shaded rooms above ground; and their eyesight, as a general thing, considering the miserable light they have to work by, is remarkably good. Few miners are compelled to wear eye-glasses, for either working or reading, before reaching old age.

"Too much care cannot be exercised to guard against carbonic acid gas in mines. It not only exists in large quantities in a natural state, but is constantly being formed by the exhalations from the lungs of men and animals, the products of combustion in the miners' lamps, the ventilating furnaces, and especially the small locomotive engines now so commonly employed. When mixed with common air it is only safe up to the proportion of five per cent., though it is said that some miners become so accustomed to it that they can breathe an atmosphere charged with twenty per cent. of carbonic acid. Mr. Andrew Roy, State Mine Inspector of Ohio (Third Annual Report, 1876), calls attention to the insidious workings of this unseen but deadly foe of the miner. 'The air,' he says, in speaking of the comparatively shallow mines of Ohio, where natural ventilation is depended on to a very great degree, 'is best in the morning, because the circulation is partially, if not wholly, renewed in the night, during the absence of the miners; but in the afternoon and toward quitting-time it becomes very foul, and miners frequently leave work because their lights will no longer burn, or because they are so oppressed with languor and headache that they can no longer stay in the mine. The black-damp, however, is more insidious than direct in its operations, gradually undermining the constitution and killing the men by inches. By reason of constant habit, young and robust miners are able to stay several hours in a mine after a light goes out for want of fresh air, where a stranger, unused to such scenes, would fall insensible, and, if not speedily removed, would die.'

"Similarly, Mr. J. K. Blackwell, appointed British Commissioner of Mines in 1849, with instructions to make an inspection of their sanitary condition, reports: 'There is another class of injuries, resulting from defective ventilation, to which miners are exposed. The circumstances producing these injuries are slow in operation, and as their effects bring disease, and not immediate and sudden death, their existence has been little considered. These effects are the result of an inadequate supply of air, which has become vitiated and unfit for breathing on account of its having lost its due proportion of oxygen, which is replaced by the formation of carbonic acid. This gas has its sources in respiration, the lights of the mine, the decomposition of small coal in the goaves (cavities of the roof), and of timber in the workings. Air in this state is also usually found to be loaded with carburetted hydrogen, yielded from the whole coal or in the goaves. Sulphuretted hydrogen, arising from the decomposition of pyrites, is sometimes present, especially in coal-seams liable to spontaneous ignition. The gases formed by blasting are also allowed to load the air of mines to a very injurious degree.'

"And Thomas E. Foster, Government Inspector in 1864, says: 'In collieries that I alluded to as being badly ventilated, they had no inflammable gas, *and that was the reason why they were not well ventilated.* Although you sometimes kill a few men by an explosion, these collieries where they have no inflammable gas kill the men by inches. There are quite as many, in my opinion, killed where there is nothing but carbonic acid gas, as where there is inflammable gas. The men's health is naturally destroyed, and they kill them by inches. They do not go immediately, but they go in for a few years and die.' Attention is especially called to Mr. Foster's remarks. Colliery managers are altogether too prone to think that fire-damp is the only 'damp' that is to be feared, and force their men to work year after year in an atmosphere loaded with carbonic acid, because in this gas they die slowly and one by one, dropping off without any of the dramatic circumstances attending death by an explosion. It is cause for congratulation that the improved state of science and the requirements of the mining laws in all civilized countries have greatly improved the condition of the mines with regard to ventilation.

"Another evil too commonly met with in coal-mines is the cloud of dust with which the air is loaded. Where the coal is kept damp by the percolation of water, little dust is made, and the miner is comparatively free from its injurious effect; but it is exceptional for the coal to be in this condition, and it has been found that the deeper the workings penetrate the less water is found and the drier and more dusty the coal becomes. Any one who has seen a load of coal shot from a cart, or has watched the thick clouds of dust which sometimes envelop the huge coal-breakers of the anthracite region so completely as almost to hide them from sight, can form an idea of the injurious effect upon the health of constant working in such an atmosphere. The wonder is not that men die of clogged-up lungs, but that they manage so long to exist in an atmosphere which seems to contain at least fifty per cent. of solid matter. Ventilation mitigates this evil, but does not obviate it, as a stream of pure water flowing into a muddy pool, of which the bottom is continually being stirred up, will thin the contents of the pool, but will not make them clear. Every fresh stroke of the pick or the hammer, every shovelful of coal moved, every fall of a dislodged mass, causes a fresh cloud of dust, until the ventilating current would need to flow with a force little short of a hurricane to keep the miner's lungs supplied with unvitiated air. Inspector Roy, who has given much attention to the subject of mine ventilation, says (Report for 1876, p. 92): 'Constant labor in a badly aired mine breaks down the constitution and clouds the intellect. The lungs become clogged up from inhaling coal-dust and from breathing noxious air; the body and limbs become stiff and sore, and the mind loses the power of vigorous thought. After six years' labor in a badly ventilated mine—that is, a mine where a man with a good constitution may from habit be able to work every day for several years—the lungs begin to change to a bluish color. After twelve years they are black, and after twenty years they are densely black, not a vestige of natural color remaining, and are little better than carbon itself. The miner dies at thirty-five years of coal-miners' consumption.' Mr. Roy attributes the frequent strikes and other expressions of discontent among the miners primarily to defective ventilation, saying: 'The sources of discontent among miners arise, not, in my judgment, so much in the evil nature of the men, as in the evil genius of the mines; and no conspiracy laws are needed to compel miners to be law-abiding citizens, but better ventilation to expel the demons of the mines—those noxious gases which in remoter ages the priests of Germany were wont to combat with religious exorcisms.' The following cases reported by Dr. William Thomson, show the condition of the lungs above referred to: 'D. C., aged 58; miner for 12 years; lungs uniformly black and of a carbonaceous color. D. D., aged 62; miner from boyhood; lungs uniformly black. G. H., aged 45 years; lungs uniformly deep black through their whole substance, with a density equal to caoutchouc. L. A., aged 54 years; miner all his life; whole lungs dyed with black carbonaceous matter.'

"Dr. R. C. Rathburn, of Middleport, Ohio, testified before the Ohio Mining Commission, on this subject, as follows: 'I have made two post-mortem examinations in which there was carbonaceous solidification in the air-cells. The Scotch people call it spurious melanosis, really a coal-miners' consumption. I have no doubt the carbonaceous particles caused their death. I examined them after death, because before their decease they spit up a black substance whose real character I wished to ascertain. Four cases came to my knowledge.

"The black substance referred to is solid carbonaceous matter, inhaled while at work. As noted above, it is very slow to operate as a direct cause of death; but aggravates diseases of the lungs, acting principally as an irritant. Once in the lungs it remains there ever after, manifesting itself in a peculiar black sputum in all cases of expectoration from lung troubles.

"Dr. J. T. Carpenter, of Pottsville, in his treatise before quoted, says: 'I saw, a short time since, a patient suffering from chronic bronchitis, with coal-dust sputa, who had not entered a mine for nineteen years. A gentleman of Pottsville, under my care, is now recovering from pneumonia, with softening and abscess of the lung, who in former years was engaged in mines, but has not habitually entered them for eight years past. During his recent illness the characteristic black sputum was constant.' . . . . . .

"After what has been said, it is evident that the greatest necessity for healthful mining is good ventilation. With air-currents sufficient to carry off noxious gases, powder-smoke, and at least the most of the dust, mining becomes not merely a healthful but an agreeable occupation, notwithstanding all that has been said about its perils and drawbacks. The latter may seem a bold statement to those whose experience in mines is limited to a single visit, but it is the testimony of the great majority of miners, and is confirmed by the well-known fact that men who go from farms and shops to work for a season in the mines rarely go back to the old work. There is something about the comparatively free and easy life of the miner, who is to a great extent his own boss—the uniform temperature, which in most mines varies little, if any, with the seasons, and which ranges from 45° to 65° Fahr., according to local circumstances, the year round—and perhaps the spice of danger which is always present, that makes the miner, once initiated, cling to that work for the rest of his life. Nor is that life necessarily a short one, though the appalling frequency of easily avoidable accidents reduces its average length far below what it should be. So far as the writer is aware, no comparative statistics of the average length of miners' lives, or of their liability to disease, have ever been published; but old men are common among them, and men who have worked thirty, forty, or fifty years in the mines, and are still hale and hearty for their age, are by no means rare. Their principal diseases, as before stated, are miner's asthma, consumption, and rheumatism, and, among those who have worked long in badly ventilated places, dyspepsia, tremors, vertigo, and other troubles arising from blood-poisoning. The two principal causes are dampness and bad air. Pumps and precaution obviate the one, and proper ventilation the other.

"In conclusion, it is the opinion of the writer, formed from long personal acquaintance with the subject, and sustained by the almost unanimous testimony of practicing physicians, mining engineers, colliery owners, and miners themselves, that, were it not for accidental injuries and deaths, the mining class would show as good average health, as fair a percentage of longevity, and as low a death-rate as any other class of manual laborers; that the hygienic conditions of American mines are receiving more attention and consequent improvement year by year, and that, if the average miner could only be taught to exercise caution and common-sense about his work, the list of fatal accidents would be materially shortened, and mining would lose most or all of the terrors which now invest it in the minds of the general public."

Coming now to the second class of mines, I wish to inquire whether the general conclusions expressed by Mr. Sheafer with regard to collieries are equally applicable to metal-mines.

The chief differences in this country between the sanitary conditions of coal-mines and those of metal-mines are the following:

1. The coal-mines are, as a rule, neither very deep nor very high above the sea-level; whereas a large proportion of the metal-mines are situated at great altitudes (5000 to 13,000 feet above tide). The comparative rarity of the atmosphere, though not perhaps injurious to health *per se*, nevertheless intensifies the changes of temperature to which both the mountain climate and the underground work render the miner liable, and thus promotes certain febrile and rheumatic complaints.

2. Although it cannot be said of American metal-mines, in general, that they are deeper than the coal-mines, yet it must be admited that they grow deep faster, and that the deepest of them far exceed our coal-mines in this respect. In some cases—notably in that of the Comstock Lode—the increase of heat in depth is a very serious inconvenience and injury to the mining work.

3. With rare exceptions, metal-mines do not generate poisonous or explosive gases in large quantity or in brief periods. Slow decomposition in the rocks of minerals such as pyrites may give rise to sulphurous or sulphhydric gases; carbonic acid may be generated by decaying wood, or by the burning candles, or the exhalations of the workmen; but there is no such imminent danger fom these sources as threatens the coal-miner, who may be overwhelmed by a sudden irruption and explosion of "fire damp," or drowned in a flood of "black damp." On the other hand, this immunity from sudden catastrophes due to imperfect ventilation leads, in metal-mines, to a degree of carelessness in this department of mine engineering of which no one would dare to be guilty at a colliery. As a rule, therefore, the air is much worse in metal-mines than in coal-mines. The former are usually left to ventilate themselves, according to aerostatic laws; and when changes of wind or season cause a reversal or stagnation of the ordinary current, the phenomenon is submitted to with a kind of fatalism. Miners say "the air is bad" in this or that level, very much as one would speak in helpless resignation about the weather out of doors. When the heat or foulness of the air at any point actually prevents work, remedies are applied; but so long as it is merely an inconvenience or a slight enhancement of the price per yard of contract work, it is too often neglected, since neglect is not exposed to the death penalty.

4. The greater expense and completely unremunerative character of excavations in rock such as usually incloses metalliferous deposits, leads to the making of much smaller and less regular passages than the gangways of collieries; while separately excavated airways may be said not to exist in metal-mines at all—a brattice or an air-box or a weather-door now and then being the most that is done for the artificial direction of the ventilating current. The smallness of the excavations in metal-mines is therefore another cause for imperfect ventilation. On the other hand, the old workings, particularly if well packed with "deads," or waste-rocks, do not need to be ventilated so much as is often the case in coal mines, to prevent the accumulation of dangerous gases in them.

5. There is, as a rule, much more climbing in metal-mines. The miners often descend and ascend through great vertical distances by means of ladders and stairs.

6. It is in a few localities only, apart from the coal regions, that a permanent class of miners exists. Moreover, the hygienic conditions of most American metal-mines are not extreme; and, finally, the effects often attributed to underground conditions, in other countries, may be largely due to other causes, and it may be that better diet, less prolonged and exhaustive labor, more comfortable homes, and more rational habits have to some extent rescued the American miner from the evils which have been supposed to inhere in his avocation.

The points thus suggested will now be briefly reviewed, under the heads of physical exertion, air, and temperature.

Physical Exertion.—The wielding of sledges and pick, the pushing of cars, the wheeling of barrows, and the lifting of heavy rocks and timbers are forms of exertion which the miner undergoes in common with laborers of many other classes, and which cannot be deemed, apart from the peculiar conditions surrounding them, specially injurious to health, though they are doubtless more or less competent to cause or to aggravate certain organic diseases. The ascent and descent upon the ladders may be considered characteristic of his avocation, though it is involved also in the ordinary method of raising bricks and mortar to buildings in process of construction. Here the hod-carrier not only climbs, but climbs frequently, and carries a heavy load—a practice once common in the mines of Mexico and South America, but unknown in this country, from which its cost as well as its inhumanity has excluded it. It is the custom now to use windlasses or hoisting engines even for buildings, when these exceed one or two stories in height; and it must be remembered that the highest buildings come far short of the vertical extension of ordinary mines. The question, how much the health and efficiency of miners are affected by climbing up and down ladders, has been carefully examined. The loss of working-time involved in this method of transit is serious. But the exercise of climbing itself, if taken slowly and with due caution, and if the heated climber is not afterward exposed to a chill, is not generally held to be injurious to healthy and strong men. Added to other enfeebling conditions, it is said to hasten the period of declining strength; and it is an important objection to the use of ladders in deep mines that they necessitate the employment of the younger men in the lower levels, and thus deprive the mine, at the points where skilled labor is most desirable, of the services of the oldest and most experienced workmen. Ladders placed at a proper angle are better than stairs, since they permit the arms to take part in raising the body. The loss of time and waste of strength involved in ladder-climbing are shown by the relative amount of work done per man in the upper and lower levels, this amount being, for instance, in the lead-mines of the north of England, one-fifth greater in the upper levels. On the question of health, it may here be added that sailors are not reported to suffer from climbing any more than bricklayers do; and the sum of the whole discussion appears to be, that the economical view of the subject of climbing in the mines is more important than the sanitary one. This view has led to the introduction of the man-engine, and the practice of lowering and raising workmen in skips and cages. This is not the place for a criticism of the comparative merits of these devices. It is sufficient to say that in most of those American mines which are deep enough to render the use of ladders a matter of hygienic importance, the workmen are raised and lowered by the machinery that hoists the ore; and the ladders being kept merely as a means of transit between neighboring levels, or as a resort in case of accident, do not enter into the hygienic problem.

Air.—The most thorough and satisfactory reports on the air of metal-mines are those of Dr. R. Angus Smith and Dr. A. J. Bernays, included in appendix B to the Report of the Commissioners, appointed to inquire into the condition of the metal-mines of Great Britain, with reference to the health and safety of the persons employed in such mines. (London, 1864.) Dr. Smith begins with an elaborate discussion of the normal amount of oxygen and carbonic acid in pure air, and, after citing many analyses of distinguished chemists, adopts 20.0* parts by volume of oxygen, and 0.04 of carbonic acid as a fair out door average, and shows that in confined spaces, and under various influences, the amount of carbonic acid may be increased indefinitely. At 11 P. M., in the pit of London theatre, it was 0.32. But many samples of bad air, taken from mines, have shown over two per cent. of carbonic acid. By a series of most interesting experiments, conducted in a hermetically closed lead chamber, containing 170 cubic feet of air, Dr. Smith established, among other important results, the following:

A person shut up in the chamber for five hours raised the amount of carbonic acid to 2.25 per cent. In this atmosphere the breathing was changed from 16 inspirations per minute to 22, and the pulse fell from 76 to 55, becoming, at the same time, so weak that it was difficult to find. On another occasion, when the carbonic acid had risen to 3.9 per cent., the number of inspirations advanced to 26, and the pulse became so weak as to cause alarm. This is a symptom of poisoning by carbonic acid. An experiment, tried by blowing carbonic acid into fresh air, containing 20.1 oxygen, without removing the oxygen, showed that the pulse of the subject was weakened, though breathing was not very difficult, and the candles burned moderately well. Four miners' candles, inclosed in the chamber, ceased to burn at the end of five hours, having raised the temperature from 50° Fahrenheit to 65°, and vitiated the air until it contained 13.8 oxygen and 2.28 carbonic acid. It follows that men can live where candles will not burn; but that the poisonous effect of carbonic acid begins before its subject is conscious of serious inconvenience. Moreover, it appears that the presence of carbonic acid is a more noxious agency than the mere diminution of oxygen in an otherwise pure air. According to Dr. Smith's experiments, respiration is not affected sensibly by a small or even a considerable diminution of oxygen, when the place of that gas is not taken up by others of a harmful character. But we do not usually have to deal, in mines, with simply rarefied or deoxygenated air. The abstraction of oxygen is due to processes which load the air with such gaseous products as carbonic acid. The facility with which water absorbs certain percentages of its weight of carbonic acid and other gases, explains the fact that the air is more tolerable in wet than in dry workings. Trickling streams or spray perceptibly improve the ventilation; and this means is occasionally resorted to for enabling men to continue work where it otherwise would be difficult.

Dr. Bernays points out another most important fact, namely, that there is a great difference in the personal sensations of comfort or distress occasioned by breathing different atmospheres containing practically the same proportion of carbonic acid. This is undoubtedly the effect of organic impurities, which greatly aggravates that of the carbonic acid. A much larger proportion of the latter may be breathed with impunity when it is the result of inorganic processes, and particularly of the slow oxidation of coal, than when it proceeds from animal exhalation, and the quick, smoky combustion of candles. Dr. Bernays says that he has often found the air of a crowded room intolerable, though it contained not more than 0.1 per cent. of carbonic acid. He mentions also, as a curious fact, that a man may continue to breathe without distress in a confined space so long as it is contaminated by his own breath only, though he could not, without great disgust, enter an atmosphere rendered equally foul by the respiration of others. But I suspect that the inference he suggests is not well founded. It is, perhaps, not the source of the contamination, but the entrance of the observer from purer air, that makes it more repulsive in the latter case.

Carbonic acid and accumulations of organic impurities are most troublesome at the end of galleries, or in confined stopes, winzes, etc., which are not swept by the general current of ventilation. The operation of blasting in such places has the good effect of breaking up the stagnation of the air; but, on the other hand, it contributes certain impurities of its own, partly volatile, and partly in fine, suspended floating particles. Carbonic acid, sulphuretted hydrogen, sulphide and nitrite of potassium, etc., are among the products of explosion from ordinary gunpowder. Guncotton is less harmful in this respect, and was recommended by the British Commission; but it has never found general application in mines, perhaps because its use in mines, as a quick and violent explosive, has been superseded, or rather forestalled, by the various nitroglycerin compounds. It is well known that the gases from these produce most distressing headache; but this appears to be the effect on those persons only who are unaccustomed to them. I have seen miners return to a stope almost immediately after a blast of dynamite, apparently without inconvenience. This was, however, in a well ventilated mine. With all explosives it is necessary and customary to allow the gases to clear away before resuming work. Sulphuretted and arsenuretted hydrogen may be given off by rocks which contain such minerals as pyrites of iron or copper, mispickel, etc., which undergo decomposition in the presence of air and moisture. To this cause, in part may be due the alleged unhealthiness of the copper-mines of Cornwall as compared with the tin-mines, in which the ore, being already an oxide, suffers, upon exposure, no chemical change. Besides the gaseous impurities of the air, the dust produced by drilling has been considered a source of disease. This is probably not a serious evil. The almost invariable practice is to put water in the bore-holes to facilitate the work, and there is from this source little or no dust to be

* The proportions given throughout this paper are parts in 100, by volume.

inhaled. What has sometimes been mistaken for mineral dust in post-mortem examinations of the lungs of miners, is finely divided carbon; and this is almost certainly attributable, not so much to the occasional inhalation of gunpowder vapors as to the constant breathing of the products of the imperfect combustion of candles. Some reported cases of the "lead-colic" among lead-miners in Great Britain, and similar cases in the "carbonate lead-mines of our West" may be attributed to the inhalation of plumbiferous dust. The effect of all these impurities of the air has been found on the continent of Europe and in Great Britain to be a peculiar form of "asthma," "consumption," or "anæmia," known as the miners' disease. It is difficult to say how much the general low tone of vitality due to insufficiency of animal food, lack of healthy dwellings, and reckless personal habits, contributes to the prevalence of this disease; but it is probably fair to conclude that these causes weaken the ability of the workman to resist the effects of impure mine-air.

Temperature.—There is a gradual increase of temperature in the rocks of the earth's crust, below the zone of uniform temperature which is found near the surface. The law of this increase in temperature is not clearly established. It is certainly much affected by the chemical reactions which may go on in the rock. Mr. Robert Hunt, in his testimony before the British Commission, says that whatever may be the temperature of the atmosphere on the surface of the earth, there is in the Cornish mines a constant temperature throughout the year at the depth of about 150 feet. Below that point, he says, the increase is one degree Fahrenheit for every 56 feet down to about 750 feet; then one degree in every 75 feet down to about 1350 feet; and below that about one degree to 85 feet. Mr. Henwood (quoted by Prof. J. A. Church, in his paper published on the Heat of the Comstock Mines) gives for different kinds of rock the following distances in feet, corresponding with each rise of one degree: granite, 51; slate, 37.2; cross veins, 40.8; lodes, 40.2; tin lodes, 40.8; tin and copper lodes, 39.6; copper lodes, 38.4. These figures show how great is the variation due to local causes. Assuming the increase in granite to be least affected in this way, and applying also Mr. Hunt's formula for the rate of increase, we may adopt as a probable standard of comparison a scale of depths and rock temperatures, as follows:

Depth—Feet.	Temperature of rock.
150, . .	60°
300, . .	62°
600, . . .	66°
1350, . . .	76°
2000, ...	84°

It will generally be admitted that most mines are hotter than this, the fact being that the heat given off by lights, explosives, animals, and men is not immediately removed by the ventilation, and hence the rock is perceptibly cooler than the air. But chemical reactions and hot springs in the rock may very greatly raise its temperature; and when this is the case the miners, finding that the rock feels hot, in comparison with the air, say that the lode or the wall "makes heat." Even when the air is still somewhat the warmer, the rock may seem to be so when touched with the hand.

One of the United mines in Wales is mentioned by Prof. Church, in the paper already cited, as possessing springs which discharge water at 116° Fahr., the depth being 1320 feet. The heat of the air in the workings is given at 100° to 113° Fahr. The hottest mine in Cornwall is, or was in 1862, the Wheal Clifford, concerning which the superintendent, John Richards, testified that the temperature was 102° fifty-one feet below the 1200 feet level, and a "pretty deal hotter" (120° he guessed) at the 1380 feet level. At one time, in a confined working, the temperature was known to rise as high as 128°. Mr. Robert Hunt, speaking apparently of the same mine, says that, by his personal measurement, the air showed 110° in the deep level, and the tests of the rock, made by leaving a thermometer for two hours in a bore-hole, gave from 112° to 114°. He reports the maximum with which he was acquainted as 117°. Mr. Richards says the workmen can endure 120° perhaps half an hour, but cannot continue to work for an hour at 102°, while they can make a four-hour shift without interruption at 95°. Mr. Hunt gives the average time of working at twenty minutes, and says that on retreating, the men washed themselves in water at 90°, to cool off. Six sets of men were employed, so that each set had one hour and forty minutes to recover from the effects of the twenty minutes' exertion. Four turns of twenty minutes, thus distributed through an eight-hour shift, constituted a day's work. It is not surprising that, under these circumstances, the labor account was heavy. It is said that three guineas per inch was paid for driving a cross-cut in this mine.

These remarkable statements are even surpassed by the recent experience of the deep mines of Comstock Lode in Nevada. For many data on this subject, corroborating and completing my own hasty observations and recollections, I am indebted to the paper of Professor John A. Church, already mentioned, and to the unpublished memoranda of that gentleman, generously placed at my disposal. In the lower levels of these mines (say about 2000 feet below the croppings of the Gould & Curry, the usual datum-line) the temperature of the rock is generally about 130°. In freshly opened ground the air usually varies from 108° to 116°; but higher temperatures are not unfrequently reported, as, for instance, 123° in the 1900 feet level of the Gould & Curry. The water, which enters the drift from the lode and the country rock, is, however, often much hotter. The vast body which filled the Savage and the Hale and Norcross mines for many months had the temperature of 154°. But the water, like the rock and the air, varies in this respect in different portions of the mines. The ordinary range of "hot drifts" is 105° to 110° air-temperature. The ventilating current is delivered at a temperature of 90° to 95°, which seems to be most conducive to comfort. It is blown upon the men through zinc pipes by means of powerful mechanical blowers. The question of present interest being the effect upon the health of the miners of working under such conditions, further description of the peculiar phenomena of the case will be unnecessary. Before considering the health of the Comstock miners, it should be noted that by no means all, or even the majority of them, are employed in the hot drifts, and, moreover, that these mines are provided with arrangements which enable every miner to bathe and change his clothing immediately upon emerging from underground. The diseases of the Comstock miners are mainly typhoid and mountain fever, rheumatism and erysipelas. There is little or no consumption, bladder, kidney or liver disease. The superior ventilation (apart from the question of temperature) in the mines, the hearty and abundant diet of the miners, the constant enormous activity of their perspiratory functions, and the personal cleanliness resulting from their daily baths, seem to have abolished among them the disease, supposed elsewhere to be characteristic of their avocation. It is admitted by all observers that they are healthier than their wives and children.

As to the immediate effect of the high temperature upon those who work in them, it must be confessed that while actually working, the men display apparently undiminished vigor, delivering with seven, eight or even nine pound hammers, very rapid and effective blows. Perhaps a third of the time is lost in resting and cooling. In very hot drifts, a relief gang is employed; and, in extreme cases, four and even six men to the pick have been found necessary. In the main, however, the rapid progress in the hot drifts is remarkable, and shows that the heat does not greatly lessen the power of work, except by necessitating longer or more frequent rest. At the usual temperature of 108°, three shifts of three men each, working in turns of eight hours, advance three to five feet daily in hard rock. This is so much better than the efficiency reported from the hot lode in Cornwall, that we are led to infer that the method of delivering air to the Comstock drifts affects the temperature and perspiration of the miners in such a manner as to protect them to a large extent from the otherwise distressing action of the heat. My own sensations, as I recall them, in a deep and very hot level of the Crown Point (about 116°, I believe), were not specially uncomfortable on the surface of the body, except when a drop of still hotter water fell upon me. The principal feeling of distress was internal, and was caused by the inhalation of the scorching air.

The question whether those who labor in such places are permanently injured, is more difficult to decide. One of the physicians at Virginia City has declared that "there is not a sound heart in any man on the lode who has worked in a hot drift for two years." This statement is perhaps too strong, though it is possibly true that many of the miners are organically affected. Yet this appears not to interfere with ordinary and equable work, though it may, perhaps, develop into distinct disease under special strain or excitement. After long work in the hot drifts, the men have a waxen color, and are known as "tallow-face." Prof. Church noticed some men who, without being lazy, showed unusual care in handling their work, and two or three of them told him that they were "broken down" in hot drifts. In the only instance in which the time required for "breaking down" was given, the workman had been employed underground six years.

The actual effect of the heat on the men is, first, excessive perspiration, and, if this is not removed by evaporation with sufficient rapidity, great faintness. The pulse increases, as is shown in the following interesting data, obtained by Prof. J. D. Whitney and Prof. Church, in the 1800 feet level of the Julia Mine, the drift being about 1200 feet long, and having an air temperature of 108° to 110°, while the air temperature at the station or junction of the drift with the (downcast) shaft was only 84°. The following observations were made:

	Pulse-beats per minute.
Carman, after bringing out car, say 1200 feet	140
Carman, after resting at station	64
Carman (another case), after partial rest	128
Prof. Whitney, after walking through drift	120
Prof. Whitney, normal rate	60
Prof. Church, after moving about, without exertion	88

A case of death is reported as follows: A powerful man, accustomed to hot drifts, returned to work after a rest of three months, and entering the Imperial Mine as carman, pushed his first car to the end of the drift, in the 2000 feet level—say 1000 to 1200 feet—loaded it, and brought it back to the station, where another man was waiting to relieve him. But, instead of taking his turn, he dumped the car and started back without cooling off. He loaded the car again at the end of the drift, and proceeded to return, but was found a few minutes later hanging senseless to his car, and died, I believe, before he could be got to the surface. Another died in the Imperial incline while that was sinking. Three such deaths in all are reported from this mine, which is an excessively hot one. Sometimes accidental deaths may be the indirect result of the faintness caused by the effect of the heat on the circulation. Thus a man fell down the Imperial (upcast) shaft last year, who was probably overcome by the heat while putting in timbers. In these worst places, strong and healthy young men are employed. Fat men seem to stand the heat best, and, among visitors, women endure it better than men. Some men wilt under the work, and are said to have "no pluck." Drinking habits unfit the miner for this severe test. Unaccustomed men are often unable at first even to reach the end of the drift where they are to work. An intelligent miner told Prof. Church that the first month of such work after a long rest is hard; then comes three months of brisk feeling; and then follows a "dragged-out" sensation.

The underground use of machine-drills, operated by compressed air, is an important aid to ventilation and cooling, since the expansion of the escaping air absorbs much heat from the immediate neighborhood. But when, as in the Comstock, the heat radiated from the whole surface of exposed rock is far in excess of that which men and lights supply, nothing can sensibly reduce it, or mitigate its effects, except abundant mechanical ventilation. This is carried to a large extent in the Comstock mines; and to the fact that, in counteracting the high temperature, the impurities of the air are thus removed, the remarkable good health of the Comstock miners may be partly ascribed. Other causes have been already mentioned, such as the healthy mountain climate, the good food, and the comfortable dwellings. Finally, the fact must not be omitted from consideration that the miners of our Western regions are emigrants, and presumably men of such bodily vigor and health as their adventurous spirit would imply. Incidental to the question of temperature is the effect of sudden changes of temperature, such as are experienced on coming suddenly from the depths of a mine to the surface. The hygienic conditions here do not differ from those which any similar change of temperature produces; and since they may easily be counteracted by the product miner, they need not be set down as sources of disease inherent in his occupation.

Another kindred question relates to the effect of barometric pressure, which varies in mines with the depth of the openings, and also with the changes of the outside weather. The general experience is that high barometric pressure, though it permits a greater inhalation of oxygen with each breath, causes a feeling of distress, and affects the heart unfavorably. Dr. Bernays says that undoubtedly the most injurious, as well as the most unpleasant, condition of mine air is that in which a high temperature is accompanied with excessive barometric pressure and great humidity. The effect of the pressure alone can best be studied in the records of work in highly compressed air, as in the sinking of the caissons for the East River and other bridges. It may be affirmed, as a general rule, that sound men are not permanently injured by it. In ordinary mines the chief sensible effect of the barometric pressure is the variation it may cause in the natural ventilating current. Where the ventilation is wholly or partly artificial, these changes may be controlled. The introduction of compressed and cool air by machinery tends powerfully to reduce to a minimum the humidity of hot mines, and thus (as in the Comstock) to give an atmosphere in which free perspiration, rapidly evaporating, cools and refreshes the body. A comparison of the statements above made, as to the Comstock miners and the miners in the hottest mine of Cornwall, shows how much more can be endured and accomplished by workmen when thus protected from vitiated or over-humid air. The injurious effect of working under artificial light, instead of sunlight, has been often asserted; but there is no definite proof of it. Where other conditions are wholesome, and the habits of the workmen are regular, this is not likely to have a traceable effect. At all events, it is subordinate to many other causes.

General Conclusions.—The British Commission, to which reference has been made, summed up its voluminous report in a few conclusions and recommendations, the substance of which I quote below, in order to point out how far they are applicable to miners in the United States. The Commission finds that a large proportion of the diseases affecting miners in the metal-mines is to be ascribed to defective ventilation only. However various the opinions of physicians concerning the causes of the disease so well known under the name of miners' consumption or miners' asthma, there is in one respect a remarkable unanimity among all the experts, namely, that the health of the miner is chiefly affected by the quality of the air in which he works. This conclusion is emphasized by the results of very wide inquiry on the part of the Commission. In the coal-mines, where special attention is paid to ventilation, on account of explosive gases, the mortality of miners, apart from accidents, is lower than in the metal-mines. Starting from this significant fact, the Commission recommends that some of the methods of artificial ventilation employed in the former should be more generally introduced into the latter, and favors particularly the use of furnaces in "upcast" shafts, to accelerate the natural current by heating the upward-moving column of vitiated air, and to prevent the stagnation or reversal of the current by change of season or weather.

With reference to other causes of disease, the Commission recommends that every mine be provided with a conveniently situated, separate house, in which the workmen may change and dry their clothes; that boys under fourteen be not permitted to work under-ground; and that mechanical means be adopted for transporting the miners into and out of the mines. The man-engine is praised; but the system of hoisting the men in skips and cages is also pronounced satisfactory provided the machinery be properly constructed and carefully tended. These recommendations are as timely now as they were ten years ago, except that the increasing use of compressed air in mining has furnished an aid to ventilation not then considered. There is no proof that the metal-miners of America are less healthy than other laborers, and there is no need that they should ever become so. In my judgment a wise regard for financial economy alone will cause capitalists to do all that philanthropic considerations would require in dealing with the problem of hygiene in mines—a problem which contains, as the foregoing discussion shows, no fatally insuperable difficulties, and no insoluble mysteries.

—*A paper by R. W. Raymond, M. E. Ph. D., Transactions American Institute of Mining Engineers.*

PROVISION FOR THE HEALTH AND COMFORT OF MINERS.—MINERS' HOMES.

WHEN we consider the efforts made in Europe to promote the physical and moral well-being of the working classes, the question is suggested whether in this country, where, theoretically, every man is peculiarly the arbiter of his own destiny, we may not be too prone to expect every man to take care of himself, and neglect to make those provisions for the welfare of the employed, demanded alike by enlightened economy and humanity. In the older countries, where the disproportion between capital and labor is greater, and the working classes are more dependent, their welfare largely occupies the attention of employers. The subject is involved in the problem of the just relations of capital and labor, and we are rapidly approaching the time, if we have not already reached it, when a generous paternal interest in the welfare of the employed should be more generally manifested. It is a subject which is of special importance to mine-owners and engineers in this country, especially to those located in the coal regions. My own attention has been particularly directed to it by a visit made to the Hassard collieries, a few miles from Liège, Belgium, under the direction of M. Andrimont. This celebrated engineer has established a generally known. The miners wear a special dress into the mine, and remove it on coming out. When they reach the hotel at the end of the shift they go to the bathroom and bathe, each in a small compartment. Hot and cold water are plentifully supplied in movable tubs. The soiled mining clothes are removed to the laundry, and are neatly washed and ironed in the course of the next day, and placed in the miner's room. The miners wear sabots in the mine, and leather boots or shoes above ground. These are nicely blacked daily at the hotel, and kept in readiness for the miner when he dresses for the surface. The men are not allowed in the restaurant or other apartment of the hotel until their toilet is made. Meals are furnished at a fixed rate. The food is wholesome, well selected, and well cooked, as I can testify from actual trial. The miner is charged only with the meals that he takes; that is, he does not pay by the day or week, but is furnished with a printed card upon which each meal taken is registered, and at the end of the time named the account is squared. These cards or tickets are in the subjoined form, and entitle the holder to the privileges of the hotel for the eight days, of which the dates are given, by stamping in the figures when the card is issued. New cards are issued at the end of the time, and the old ones are surrendered. Whenever a meal is taken the clerk of the hotel punches a hole through the proper square under the date. At the end of the time the card shows exactly how many and what meals have been taken. Upon the back of this ticket the miner is informed, by a printed notice in French and in German, that no workman is permitted to lodge at Hôtel Louise unless he works regularly for the company, and conducts himself honestly and properly toward his fellow-workmen and the officers of the establishment. The hotel has proved a success. Its comforts are prized by the men, and it helps to secure an excellent class of miners for the company. The moral effects are important. The library is an excellent one; the books are well selected, are substantially bound, and are well used. The total cost of all this wholesome comfort was stated to me as only one franc and twenty centimes a day (25c.).

HOTEL

LOUISE.

Numéro du Lit.

Numéro du contrôle.

Du 8——au 15———1873————

	15	14	13	12	11	10	9	8
° Cette carte n'est valuable que pour le délai inscrit en tête; elle doit être échangée le jour de la distribution.	Souper.	Souper.	Souper.	Souper.	Souper.	Souper.	Souper.	Souper.
Diese Karte ist nur gültig für die vorgeschriebene Zeit, und mus nach Ablauf gegen eine neue umgetauscht werden.	Dîner.	Dîner.	Dîner.	Dîner.	Dîner.	Dîner.	Dîner.	Dîner.
	Déjeuner.	Déjeuner.	Déjeuner.	Déjeuner.	Déjeuner.	Déjeuner.	Déjeuner.	Déjeuner.

comfortable home for the miners near the mouth of the shaft of the mine. It has been highly successful and beneficent in its results, and may to a great degree be regarded as a model for such undertakings.

It is known as "Hotel Louise," this being the name of Madame d'Andrimont, who laid the corner-stone of the building April 4th, 1871. The structure is of brick, upon three sides of a square, and is three stories high. The ceilings are high; it is thoroughly well ventilated, and is fireproof. It has lodgings for 200 men, and all above the first floor. The first or ground floor is used for the restaurant, the coffee-room, the reading-room, library, store, and the office. The basement is divided off into kitchen, laundry, bathing-room, store-room, etc. Each miner has a separate room, with separate bedding and clothing, all marked with the number of his room, by which number the occupant is

At the store connected with the hotel the men can purchase any clothing or delicacies of which they have need at very low rates. The cheapness of sabots, of boots and shoes, and of well-made Cornish hats was surprising. But this is only one of many prominent examples of provision for the health and comfort of workingmen abroad. To give only a general view of what has been accomplished at the great industrial and metallurgical establishments would require more space than can appropriately be given in conjunction with the technical papers of the Institute. The subject is a broad one, and much has been written upon it since the lamented Prince Consort more fully aroused the attention of the public to it by the model dwellings which he erected at the Great Exhibition in 1851. Those who visited the Paris Exhibition in 1867 will remember the miner's cottages, with their furniture, shown by the Blanzy

Coal Mining Company as examples of the 676 cottages of the kind which they had erected at the works, and rented for 45 francs a year, including fuel and a garden privilege.

Prof. Egleston.—The improvement of the condition of workmen, which is the subject of Prof. Blake's paper, is one in which every one must feel the greatest interest. There is, however, something beside their mere physical welfare, which is the topic of Prof. Blake's paper, which requires the most earnest attention. I do not know of any place where laundry privileges seem to be carried out in so great perfection, or where such special attention is given to the restaurant department as in the hotel which he has described. These are, however, only insignificant items, so far as the general well-being of the men is concerned. Something requires to be done to elevate their moral as well as physical condition; and unless it is done, it is impossible to keep up their *morale* for any great length of time. To ameliorate their condition, it is not sufficient to provide restaurants and laundries, although good food and cleanliness are very important moral as well as physical correctives. But the world cannot generally depend upon unmarried men, for whom these provisions are made at Hôtel Louise. It is generally conceded that, to keep a skilled or even an ordinary workman for any length of time in the same place, he must be married. He should be able to hope that his family, which is as dear, and, perhaps dearer to him, than that of persons occupying higher stations in life, will be reasonably provided for in case of his death; or that, if he is disabled by accident, there will be some expectation that he will either receive treatment which will cure him, or, at least, will render him as capable as possible, under the circumstances, of supporting his family. He wishes to be assured that his family will be provided for in case of sickness, that his children will be educated, that his dead shall have a decent burial. In those establishments where the best work is obtained, some kind of rational amusement is provided, which not only elevates the tone of the society which surrounds him, but keeps him with his family, and, what is quite as important from worse things. It is not always possible to combine all this in any one institution; nor are they anywhere combined, but each one separately does exist in the highest state of perfection in different parts of Europe. As a student, my attention was very early called to this subject, and the condition of the working people has been a subject of great interest to me ever since. The establishments for ameliorating the condition of workmen differ in different countries. Most of them have been founded for the sake of keeping the men quiet and satisfied where they are. No one is applicable in this country as it exists abroad. There are too many races here, each one of which has its own national customs and amusements, and they refuse as persistently to blend as oil and water.

In the Georg-Marien Hütte, in Hanover, each workman is provided, at a low rent, with a house built of slag brick, which is of a gray color, and is light and singularly free from dampness, and makes a house of exceedingly pleasant exterior aspect. These houses are arranged for families of different sizes, and their interior is in every way comfortable and commodious. They have each a cellar, and are one story and an attic high. Every attention is given to their proper sanitary condition, and their arrangement in streets is most convenient. The plans of these houses attracted very great attention at the Vienna Exposition, and I think, on the whole, are the best of their kind, furnishing a comfortable, commodious home, where more than ordinary sanitary regulations are carried into effect. In certain parts of Austria there is a choice in such houses, the best being given to those married men who have been longest in the works, and who have had the least complaint made against them for abuse of the sanitary laws. Of the mere matter of houses, these form the two most conspicuous examples that have fallen under my notice. Under such conditions as these, where houses are furnished, the restaurant system becomes impossible; and it is doubtful whether it is desirable, except in the case of unmarried persons, who are, in Europe, almost always transient men, and, therefore, are not a very desirable class. The part of the old Guild system, which requires that the workman shall travel, is still in moral force, from the fact that it has become a custom, though the *Meisterstück* is no longer required, and there are consequently a considerable number of transient workmen who use the time they remain in works for their own benefit. With the modern system of rapid travel the transient workman is generally a very demoralizing element.

It is characteristic of almost all the German works, where the system of looking after the workmen is carried into effect, that they provide some kind of rational amusement. The best types of these are Georg-Marien Hütte, where the workmen have a small *Bier Garten*, and have beer furnished to them at cost price, and where they have also a theatre and a concert hall. The actors and musicians are composed exclusively of workmen. I visited this theatre and *Bier Garten*, and examined it in detail, and I was told by the director of the works that the musical and theatrical performances of the men were creditable in the highest degree, and that the families of the officers of the works were in the habit of visiting the theatre and concerts as a matter of amusement; and that since the erection of the theatre there was an appreciable elevation in the condition of the men. The bier-garten system, or the pleasure-garden of the Anglo-Saxon, is most extensively and completely carried out in Borsig's Works, in Silesia. A garden, comprising a number of acres, laid out in the most artistic style, and planted with trees and flowering shrubs, is provided by the works. It is arranged on the same general plan as the pleasure-gardens of the great European cities, but, of course, not so luxuriantly fitted up. This garden is provided with the ordinary amusements for children, and handsome arbors and shade-trees; and on holidays a band of music, composed of workmen, play at stated intervals. All kinds of amusements, for grown people as well as children, are provided, such as is usual in gardens of that character in Europe. All the buildings are decorated artistically, and are filled in the evening and on holidays with men, women, and children, including the families of the officers of the works. On special occasions there are grand demonstrations of music, and special decorations of the gardens, all of which are carried out by the men, under proper direction. Such a garden as this, filled with families engaged in all kinds of harmless recreation, goes far to make the men and their families respectable, and is certainly an interesting spectacle, which, unfortunately, cannot be seen in any country inhabited by Anglo-Saxons. Its influence is seen directly, in the product of the works. The men rarely leave of their own accord, and their general *morale* is no small part of the reason why the works turn out some of the highest grades of iron manufactured in Germany. The free hospital and school systems are carried out in their greatest perfection in England, where day and night schools have been established by the proprietors of some of the works, under the direction of clergymen and government schoolmasters. I became so much interested in some of these schools, that after examining them in a good deal more than the ordinary routine of arithmetic, etc., I offered a prize for a written examination on subjects which I proposed to them, and these examinations were afterwards sent to me. The children of this school, which was a day school, were none of them over thirteen or fourteen years of age. The examination would have certainly done credit to the lower classes in our colleges and the universities abroad. The night schools were attended principally by persons over the age of sixteen. The parts of these schools which principally attracted my attention were the drawing classes; they were organized to teach not only free hand sketching, but to some extent geometrical and mechanical drawing. The interest excited even among the older workpeople of both sexes was surprising, and their performances highly creditable. The school-houses are so arranged as to be easily transformed into a church on Sunday, and I certainly never saw a more quiet and devout congregation than that assembled there for worship. I visited the families in their homes with the clergyman in charge, and as is not unusual in England, I frequently found that the grandfather of the family had been a workman in these same works, and the grandson was looking forward to the same position. There was connected with these works a hospital system, a physician being paid by the works, and the men allowed the liberty, in all ordinary cases, of being treated in a hospital or in their own homes. A system, which I have seen nowhere else, was adopted here with reference to boys who had become maimed in the works so as to render them unfit to become workmen. They were specially trained to occupy office positions, or educated for occupations suited to their condition. One of the brightest boys I saw had lost a leg by some accident about the rolls, and was being trained to occupy the position of bookkeeper. My attention was specially attracted to these works because I had gone to Staffordshire to ascertain how their iron was made, as it was of superior quality, and much better than that of their neighbors who were using the same materials. My impression, of course, was that the superiority was owing to some peculiar process. After visiting the works carefully I saw nothing in any way different from the other works of the neighborhood, and I became convinced that the whole secret lay in these excellent arrangements for elevating the moral and physical tone of the workmen. The proprietor of these works informed me that he had spent £30,000 in the erection of the necessary buildings, and in carrying out the plans, which were the most perfect that I saw in England; and I am certain that every penny of the capital so invested came back to him, in the superiority of the work done in consequence, every few years.

In France the hospital system—for the school system was not formerly in favor—is carried out mainly by the workmen themselves. A society of the workmen is formed, of which the director of the works is president. Members chosen from among the workmen by ballot are associated with him as a council or board of trustees. A certain part of the funds necessary is subscribed by the company, the rest is raised among the workmen themselves, by means of a tax on wages or by fines. These fines are established for such things as coming to the works intoxicated, arriving late, unnecessary neglect, and, in some cases, for profanity, etc. The workman declared sick by the physician in the employment of the company receives so much per day from the common fund. In case of death a portion of the funeral expenses is paid by the society and the works together, and the widow receives a pension, graduated according to the position of her husband and the length of time he had been connected with the society or the works. Persons disabled by sickness or age receive a pension, to provide for which a certain percentage of the wages received by every workman is retained by the society to create a pension fund. Any workman discharged for incompetence or neglect, or who voluntarily leaves the works, loses all right to any part in the administration of this fund. In case he should return, he commences, except under special circumstances, as if he had never been connected with the works. I have been convinced for a great many years that the workman does the best where he is most kindly treated, and where he can look forward to some reasonable support for his family in case of his death or inability to work. When I first returned to this country I hoped to put some of these schemes into practice, and I commenced with more enthusiasm than judgment to apply a system drawn from my experience in England and the Continent to Celts, with not very fortunate results. They were suspicious of the houses that I built, were certain that I was personally deriving benefit from the fines that I proposed for the foundation of their fund; were jealous of their own members, raised to higher position than themselves, as they thought, by being brought more in contact with the officers of the company than they were, and caused so much trouble that in the interest of the company I was obliged to abandon any attempts to elevate the condition of the men, and I must confess that I have been obliged as conscientiously to abstain from acting as I was at first disposed conscientiously to act. The short time that can be allowed to the discussion of any question like this by the Institute is greatly to be regretted, not only because anything that can be done to raise the condition of the workmen, necessarily increases the product, but also because there is a greater humanitarian interest in elevating the moral and physical welfare of our own people and our adopted countrymen. Unfortunately our religious and political differences greatly aggravate the difficulty. I believe it, nevertheless, to be true that some plan may be devised which will work successfully with the various nationalities which we are obliged to employ as workmen. The chief trouble with them all, as far as they have come under my notice, is that, as a class, the men engaged in mining are improvident, and that they are addicted to the use of the stronger alcoholic stimulants. If they used good liquors in moderation there would be little objection. The difficulty, however, is that the liquor which they buy in preference is cheap, and that, as a general rule, even if they should try to purchase good liquor the cheap article would be furnished to them at a high price. This cheap liquor contains so much fusel oil as to endanger the constitution of the men and make them more unmanageable than they would be if inebriated simply by alcohol. To furnish the men with good liquor at a low price, or at least liquor which did not contain fusel oil, would strike me as being one of the means of remedying the real evil. I cannot pretend to say how this should be carried out or regulated in each particular case. The German would certainly be content with good beer, and if he understood that better beer was furnished to him for the same money he would take that in preference; while the Irishman would probably want something which scratched all the way down which could be furnished him without the poison. Whether it would be worth while for any company to undertake to inspect the liquor sold to their men is a question. Those who have large works have probably tried the experiment of regulating the sale, and know more about it than I can suggest, but it is a matter of real moral and physical importance that some method should be devised by which workmen should be prevented, if possible, from drinking liquors which, from their method of manufacture, must be more or less poisonous. We cannot prevent their use of stimulants and I therefore think it is better that, since they cannot be prevented from drinking, a good and always pure liquor should be furnished them, and that they should be furnished a better article than they can buy at the same price, which can only be done by those who have no interest in making money out of them.

I cannot pretend to give you a remedy for the improvident character of the miners, except to encourage marriage among them, and I do not feel certain that even this would be effectual; but it seems to me that some plan of furnishing them comfortable, commodious, well-drained and ventilated houses, provided with plenty of good water, would be an efficient means of keeping them at home. The question of education is provided for much better in this country under State laws than it is in any of the countries of Europe, and I do not know that it would be wise for any company to interfere further, than perhaps to see that the State system was really carried out. The matter of pensions, hospital relief, etc., has been taken up so much by societies among the workmen in this country that it would seem, perhaps, a difficult matter for any company to interfere in any way with it. I am satisfied, however, that if any plan could be devised by which the society could have its officers members of the company, who would show in their meetings a real interest in the welfare of the men, that would go far toward destroying the influence of demagogue workmen upon their fellows. I am not prepared to furnish any plan for such a society, nor am I at all sure that such an organization would be possible. This class of people are difficult to treat with, and my experience of many years' charitable work among the poor has shown that the great difficulty in reaching them is not so much the kind of treatment or the distribution of alms as their suspicion of you, for they are, as a general rule, slow to believe in disinterested motives. I make these suggestions with diffidence in presence of persons largely engaged in manufactures, and who have so many men working under them, on account of my great interest in the subject, because I have become convinced by long connection with charitable work that a great deal of our charity makes beggars, and that there is a great deal of misdirection in the philanthropic work undertaken to elevate or relieve the classes known as the working classes. It is much easier, I know, to find fault than to carry out plans for relief, or even to suggest some practical method for effecting the object in which we are all so greatly interested. Prof. Blake said that we, in the United States, were not without notable example on a considerable scale of care of working men, both unmarried and married, with suitable provision for their education, amusement, and morals.

—A paper (and discussion) by Prof. W. P. Blake "Transactions American Institute of Mining Engineers."

OUR NON-PRECIOUS MINERAL INDUSTRIES.

THE three great divisions of industry—agriculture, mining and the fisheries,—are usually classed together by writers on political economy, for the reason that they do not add a value to raw material, but draw it directly from the land or sea. They must be the primitive occupations of mankind, and in the subsequent development of society must remain the foundation industries on which manufactures, transportation and exchange are built. Therefore, though they may not occupy the largest space in the public eye nor in the marts of great cities, their growth is one of the surest criteria of the material progress and independeuce of a community. This is especially true of the coal and iron ore mining industries; for coal furnishes the power, and iron the lever, by which the work of modern civilization is accomplished, and a very rapid increase in their production has been one of the marked industrial features of the nineteenth century. A brief presentation of some of the leading facts made public by the tenth census of the United States, in its reports on the mining of the non-precious minerals, will prove that our country has never participated so fully in the movement as it has during the past decade, and may not be devoid of interest to the readers of this magazine. The table below is condensed from the official bulletins, which, though subject to final revision, will not be changed materially, —certainly, not enough to affect any of the important relations.

The coal and iron ore production referred to in the following table is that of the firms and individuals who make mining their regular business, and employ more or less capital and labor. To arrive at the total output of the country, there should be added to these figures 628,569 tons of coal and 909,877 tons of iron ore mined by farmers from shallow deposits which are worked in a desultory manner when the season for the operations of husbandry is ended. Obviously, such irregular production must be kept distinct from the returns of the industry at large. The copper comes exclusively from the part of the country east of the one hundredth meridian. Over three thousand tons of ingot were produced from mines west of that line; but a large portion of this is a by-product in the smelting of the precious metals, and the difficulty of determining exactly the labor and capital applicable to the copper alone has led to its rejection from the present consideration.

The minor minerals include asbestos, asphaltum, bismuth, barytes, chromium, emery, graphite, glass, sand, kaolin, manganese, mica, nickel, ochre, pyrites, etc., the production of which, though not individually of great importance, makes a respectable aggregate, which is rapidly increasing. The table, therefore, covers the mineral industries of the United States, with the exception of gold and silver, salt, petroleum, building stone and material, and the fertilizers, gypsum, marl, and the phosphates of South Carolina. Care has, of course, been taken to apply the same limitations to the summations from the ninth census before instituting comparisons.

In interpreting the figures, it must be borne in mind that they represent strictly raw material at its first point of shipment, and imply the existence of a vast body of secondary workers before the finished product is ready for the consumer. Thus, the value of the coal, which is given at one dollar and forty-seven cents per ton for anthracite and one dollar and twenty-five cents per ton for bituminous, is, as we have occasion to notice on our bills, more than doubled by the cost of transportation before it melts our iron or warms our houses. The iron ore, Mr. Swank tells us, in passing into its first manufactured state of pig and bar iron, is five-folded in value, and gives employment to a corps of the industrial army numbering over seventy-seven thousand men. The seventy-eight million tons of raw material dug every year from the earth are all worked up within our borders, with the exception of a little copper and a trifling amount of the minor minerals. An increase in mineral production means to us an increase in machine shops and artisans in all the metal-working trades. It is an increase in the hidden foundations of the industrial world, on which a broader and higher superstructure may safely rest. More iron and coal means to us more railroads, more steam-engines, more plows, more reaping-machines, more labor-saving implements of every description, which do not perish in the using, but cause a permanent gain in productive capacity.

Space will not permit us to refer to the geographical distribution of mineral production in the United States, further than to say that it is very wide. There are few large areas in our country that do not contain workable beds of coal or iron ore. All things considered, our Appalachian coal field, extending from Northern Pennsylvania to Central Alabama, is the largest and most valuable mineral deposit in the world. The next census will show a marked development of the coal and iron industries in the extreme North-west, a promising beginning having already been made at Washington and Oregon. Pennsylvania, Ohio, Illinois and Michigan will undoubtedly retain their leading positions as mineral producers for many years to come. Relative gains have been made, and will continue to be made, by the Southern States, West Virginia, Kentucky, Tennessee and Alabama.

Restricting the consideration to the United States as a whole, and comparing the figures in our table with the corresponding ones from the census of 1870, the great advance becomes at once evident. The gross weight of minerals

Production of the Non-precious Minerals of the United States during the year ending June 1st, 1880.

1880.	*No. of establishments.*	*Tons of 2,240 lbs. produced during census year 1880.*	*Value of product.*	*Value of materials consumed.*	*Total hands employed.*	*Wages paid annually.*	*Capital employed invested.*
Bituminous coal,	2,989	41,789,195	$52,316,868	$4,851,093	99,916	$32,535,460	$98,478,674
Anthracite coal,	275	28,640,829	42,172,948	6,729,477	70,669	22,664,055	154,399,796
Iron ore,	805	7,061,829	20,470,756	289,604	31,668	9,538,117	61,782,387
Copper ore,	32	*1,005,955	8,842,961	1,391,101	6,116	3,115,103	31,675,096
Lead and zinc ore,	234	†182,414	4,242,409	347,807	7,787	2,716,217	7,565,672
Minor minerals,	178	218,452	3 235,703	583,980	3,982	1,227,050	5,673,415
Total,	4,513	78,898,674	131,281,705	14,193,062	220,138	71,796,004	359,574,940

* Yielded 25,376 tons of ingots copper.
† Yielded about 27,228 tons of lead and about 26,812 tons of zinc.

The same remark applies to lead, which is largely yielded as a by-product in silver mining, and comes East with it in the form of base bullion. The entire amount of lead produced in the country during the census year varied but little from seventy thousand tons. The table, in a word, is confined to the statistics of what may be termed "regular mining establishments."

removed from the earth has increased one hundred and thirteen per cent., although, in consequence of a decline of thirty-three per cent. in the average price received per ton, owing principally to the resumption of species payments, the money received for it has increased only forty-one per cent. But the total number of employés has increased eighty-eight per cent. only, or considerably less than the result of their labor. This would seem, at first sight, to indicate a striking gain in the efficiency of labor,—so striking, indeed, as to suggest inaccuracies in the data; for it is hardly possible that the number of tons produced per man, yearly, can have increased as much as fifteen per cent. Most of this apparent gain is undoubtedly due to the fact that labor has been much more continuously employed than it was ten years ago, although it is impossible to determine accurately the proper allowance to be made for "short time" in 1870. The average number of full days worked by a miner in 1880 varied but little from two hundred and thirty. Strikes, slack demand, etc., probably caused a greater loss in 1870. From the best evidence attainable, it is safe to say, however, that the efficiency of mining labor has been increased not less than three per cent. in the past ten years by increased experience and the introduction of labor-saving machinery, when the effect is spread over the entire industry.* In certain cases, the use of the power drill and "high explosive" has enabled two men to do as much as three did before.

That increase in mineral production has been much more rapid than in population, is shown by the following comparative table:

Yearly Production Per Capita of Population.

	The United States, 1870.	*The United States,* 1880.	*The United Kingdom of Great Britain and Ireland,* 1881.
	lbs.	*lbs.*	*lbs.*
Coal, ...	1,608	2,818	9,30
Iron ore, ...	177	283	1,500
Metallic copper, .	0.7	1	—
Pig iron, . . .	—	141	492

Estimating the world's consumption of coal in 1880 at three hundred and fifty million tons,—the mean of several authorities,—the industrial standing of Great Britain and the United States is shown by the fact that of this total we produce twenty per cent. and England forty-seven per cent., leaving only thirty-three† per cent. to be distributed among the non-Anglo-Saxon populations. Any ideas based on the future scarcity of coal in England, may as well be dismissed at once, since the careful surveys of the royal commissioners show the available fuel yet in the ground, within four thousand feet of the surface, which they consider the limit of workable depth, is sufficient to keep up her annual output of one hundred and forty-seven million gross tons for ten centuries to come. The expense of English deep mining is shown by the high average price of coal at the pit's mouth, —one dollar and eighty-two cents,—the price per ton of bituminous coal in the United States in the same position being only one dollar and twenty-five cents. Nevertheless, the price in the London market was only three dollars and seventeen cents a ton, a cheaper fuel than is obtained by any great city here outside of the Ohio valley. Iron ore in England costs much less than it does here; but so large a proportion of it is argillaceous carbonate, that their furnace yield of pig iron is only thirty-three per cent. of the ore, whereas ours averages fifty-two per cent. Therefore, though Great Britain produces three and one-quarter times as much iron ore as we do, her output of iron weighs but little over twice as much as ours. The price of ore averages one dollar and fifty-nine cents there, against two dollars and ninety cents here; so that, admitting that her native ores can be cheaply brought up to a higher grade by calcination, the iron masters of the United States must, when they enter on the area of large production and moderate profits, become formidable rivals of their transatlantic brethren. When the day comes that we contend with her for the markets of the world in manufactured iron, our strong points will be richer ore, stronger iron, and more accessible coal, and hers, proximity of coal and iron ores to each other and to the ocean. In addition to her native ores, England imported, in 1881, from Spain, Elba, and Algeria, 2,632,601 gross tons of high grade ores, especially suitable for the manufacture of Bessemer steel; but in this regard the only advantage she has over us lies in our tariff of two dollars a ton, since such freight could be brought as cheaply here as ballast for return grain vessels as it can to Wales. We were restricted during the census year to the importation of four hundred and thirty-nine thousand, four hundred and fifty-one net tons of this valuable raw material.

Since 1870, the increase in our product of iron ore has been one hundred and eight per cent., in bituminous coal, one hundred and forty two per cent., and in bituminous and anthracite coal, together, one hundred and fourteen per cent.* The great increase in the demand for iron and steel is due to the extension of railroad building, as well as to the natural growth of the country. The production of coal bears, of course, an intimate relation to that of iron. That it has increased in a greater ratio, is due to the following causes: 1. The great relative growth of urban and village communities burning coal only. A strictly rural population is generally able to supplement its supply of coal with wood. 2. The increase of internal transportation, effected by that great consumer of coal, the locomotive. 3. The decreasing supply of wood, which is gradually forcing even the inhabitants of the agricultural districts to burn coal. 4. The increase of machine labor, energized by steam. This cause is intensified by the gradual failure of water-powers, owing to the shameless and wanton destruction of our forests in the absence of any intelligent State supervision. We may safely take the increased production of iron ore as one of the surest gauges of industrial advance, since its consumption is less likely to be influenced by science and the lesser economic changes. Iron enters into our industrial bone and blood. A thousand tons of ore, removed from the earth and converted into useful forms, become a possession of permanent value; whereas, the burning of a thousand tons of coal may mean only the substitution of one fuel for another. An English writer says that the consumption of sulphuric acid in a country is a measure of the development it has attained in the useful arts; but, surely, it is iron, which "breaketh in pieces and subdueth all things," that does the work of modern civilization, from "turning the furrow to reaping the grain."

The great consumption of copper in the United States is a remarkable economic feature. The world's annual yield of ingot copper is but little over one hundred thousand tons, of which we contribute more than one-quarter. Substantially, the whole of our product is worked up and used in our own country. Since the decline of wooden shipbuilding, its principal applications have been to articles, the use of which implies a certain degree of comfortable living, as clocks, ornamental hardware, modern household appliances, etc. It would be interesting, by the way, to know how much copper is shot away yearly by the American people in the form of metallic cartridges,—probably as much as any other people can afford to consume in all its forms. It is certainly a striking evidence of the distribution of wealth in our country, that we can absorb so large a quantity of this metal at its present high price; for, compared to iron, it may be called semi-precious. Possibly, the new demand for copper wire created by the development of electrical machinery is an important factor in fixing the price and consumption. It may not be considered too fanciful to say, that if we take the production of iron as a measure of industrial progress, we can regard that of copper as an indication of accumulating wealth. The engines that drive our great factories are built of iron, but ornamented with brass.

* Mr. Swank's bulletin on the manufacture of iron and steel shows a still more marked increase in the "effectiveness of labor." Mechanical applicances, however, pay a more important part in rolling-mills and furnaces than they do in mines; and improvements are much more likely to increase the product per head. But, in both cases, "steady work" is the important factor.

† Part of this last comes from the English colonies, Nova Scotia and Australia.

* Attention is again called to the fact that the "irregular product" of coal and iron is disregarded in all these computations, and that they are, therefore, safely within the mark. This product —at least in the case of iron ore,—is a part of the yearly addition to our national wealth; for it is created by labor that would otherwise be unoccupied. The reasons for omitting it are, first, the importance of keeping the "regular industry" distinct, since it is the labor-employer, and must more and more displace the farmer mines; second, the Superintendent of the Census reported that the ore product of 1870 was underestimated; third, more ore was produced in 1880 than was consumed, by about ten per cent., the active demand following the "ore famine" of 1879, stimulating production beyond the requirements of the market.

The following table, to return to more solid ground, shows the relative importance of the industries under consideration:

Comparative View of the Non-Precious Mineral Industries.

	Per cent. of total tonnage.	Per cent. of value of total yearly product.	Per cent of total employes.	Per cent. of total Capital.
Anthracite coal,	36.3	32.1	32.1	42.9
Bituminous coal,	53.0	39.0	45.4	27.4
Iron ore,	8.9	18.6	14.4	17.2
Copper rock and ore,	1.3	6.7	2.8	8.8
Lead and zinc ore,	.2	3.2	3.5	2.1
Ores of the minor minerals,	.3	2.5	1.8	1.6
Total mineral product of above	100.0	100.0	100.0	100.0

In anthracite coal, the figures approach nearest to equality, and it is the industry which has most fully entered upon an area of large establishments, ample capital, improved mechanical appliances and modern profits. Grouping together all the above industries, the average yearly product for a "full hand" is three hundred and eighty tons of material, ready for transportation, valued at six hundred and thirty-one dollars. Of this value, labor receives three hundred and forty-five dollars, and thirty-seven dollars and fifty cents more go to pay for the materials and supplies consumed. The number of boys below sixteen years of age employed about the mines has increased from ten for every one hundred men to twelve and one-half for every one hundred men. Mr. Swank's bulletin on the manufacture of iron and steel shows a still greater gain in the number of young boys allowed to work at an age when the community has a right to their time in the public schools it has provided for them. It is not an encouraging sign, though one of the results of an increased demand for labor.

The workingman is better off than he was in the days of paper money; for the average earnings reported in these mining industries in 1870 was only four hundred and eighty-nine dollars yearly, so that the purchasing power of his income is evidently greater now than it was then. A "full hand," too, produces forty-eight tons more, yearly, than he did ten years ago; but, as said before it is impossible to tell how much of this increased product is due to fuller time made during the year, and how much to increased effectiveness of the individual resulting from the use of improved labor-saving machinery. Steam-power certainly plays a more important part than it did, and has increased in a greater ratio than the number of employés.

The true test of the position of labor is, however, the proportion it receives of the value of the product, measuring in the units of the cost of living. In applying this test, however, we are met by the difficulty that the pay of miners usually includes varying allowances for powder, candles, etc., furnished by the men, which are not in any sense wages of labor, but expenditures for material. In the foregoing tables, this item has been carefully separated from the wages returns and added to the amount stated as the cost of supplies. This deduction was usually made when filling up the original census blanks, so that it is now impossible to state exactly how far it had the effect of changing the laborers' apparent income. Consequently, an exact comparison of earnings with those of 1870 cannot be made. The share retained by capital has increased one per cent. Labor received fifty-five per cent. of the product in 1880; and distributing the cost of supplies in 1870 as far as possible, it would appear to have lost at least one-half of one per cent. of its share, as compared with the earlier period. However, the comparison need not arouse the depressing reflection that the condition of labor is growing worse as civilization advances in our country; for the miner receives, on the average, fifty-five per cent. of his yearly product of three hundred and eighty tons, as against fifty-five and one-half per cent. of three hundred and thirty-two tons ten years ago; nor could any general deduction of this nature be safely drawn from the averages of only two periods.

The increase in the amount of capital in the mining industries referred to is one hundred and fifty-eight per cent. and is much greater than the corresponding increase in income. Still, the figure of $359,574,940 bears about the expected relation to the yearly productiveness of the property it represents, and contains no items of a speculative or unreal value. Mines individually should yield a larger profit than other fixed capital, because their income is always terminable. There is a time in the future—indefinite, perhaps, but always certain to be reached,—when any mine must be exhausted and the capital invested in it sunk. The net income of a mining property must, therefore, be applied to paying for the maintenance of the plant and to creating a sinking fund which will make good the original cost when the value has reached zero, besides paying interest charges and the expenses of the general management. These principles have been borne in mind in assessing the value of the "capital invested in mining establishments" for the census of 1880. That the sum total returned is so much greater than it was in 1870, arises from several causes in addition to natural growth. These are, first the ruling rate of interest has fallen, and the values of income-bearing properties have risen correspondingly; second, the steadiness of all prices brought by the return to specie payments further increases the value of all fixed productive capital; third, in 1870, the mine operators were simply asked to state the amount of their capital. When they did not own the land, but, as is true in many cases, worked it on a royalty, they naturally omitted any estimate of it in their answer. But the real estate forms seventy-five per cent of the capital of the industry. In 1880, the questions were: "What is the value of the real estate attached to the mine?" "What is the value of the plant and equipment?" and, "How much do you usually use as working capital to carry on your business?" None of these questions were resented, and, if the answers were palpably wrong, the agent could use his own judgment to correct them on the spot. Undeveloped mineral lands, which, from the economic standpoint, are the property of the next generation, were omitted entirely. Therefore, the capital returned is not a mere summation of share capital,—often fictitious,—but represents, at a fair valuation, productive wealth of a kind in which only one nation on earth can make any comparison with us.

On the "face of the returns," there is no evidence of any tendency to concentration in the hands of large operators. In fact, the number of separate establishments has increased rather more rapidly than production. This is owing to the great number of small mines of bituminous coal. The areas of mineral lands are so extensive, there are so many producers in widely distant localities, that it is not likely that combinations can ever be formed to create a monopoly in any of the leading mineral products. At the same time, the influence of large capital in the mining industries is greater than it was. Nineteen mines yield over one-third of our most valuable iron ore. One mine yields over one-half of our copper. The two hundred and seventy-five anthracite collieries are virtually owned or controlled by seven great corporations. Should the man ever appear possessed of force and tact enough to combine them, such a pool could easily lay the Eastern public under an annual contribution of several millions of dollars. Our experience with the Standard Oil Company proves that neither law nor public opinion affords the community any protection against oppressions of this nature. On the other hand, it must be admitted that large mining establishments pay higher wages than small ones, and even yield to labor a larger share in the division of the product, depending for their profits more on the volume of the business than on a large margin. Thus the average wages earned in copper mines reach five hundred and twenty-two dollars, while in the soft coal mines labor makes only three hundred and thirty-six dollars per annum, being subject to an average period of three months of enforced idleness.

The industrial returns of the tenth census must, of course, be interpreted with reference to the time they cover. The year ending June 1st, 1880, marked the termination of a period of depression. There can be few, who were engaged in active business during the five years previous, who have forgotten how economy and industry seemed powerless against some malign cause which paralyzed effort and made each successive balance-sheet more discouraging than the last. There are few now who do not understand that the hidden sinister influence was a currency "based on the faith of the nation," but divorced from a direct connection with objective value, which caused the prices of commodities to "peak, dwindle and pine," while the debts incurred for purchases remained unaffected. Many can, no doubt, recall the day when the relation between buyer and seller changed —when a guardedly written letter brought an unstinted order and disclosed the fact that price was less an object than promptness. The productive energies of the country were released from their bonds and came into action with a sudden spring which carried them, for a time, beyond their normal power. Every department of industry was infused with a feverish energy. The census year covered this period of "boom," as it was not inaptly called, and the census statistics, no doubt, reflect the sanguine feeling then prevalent.

Making all possible allowances for this and every other imaginable cause, it is evident that the United States have made and are making wonderful progress in mining, as in all other industries. This progress is in no sense fictitious. It is a gain in tangible and comparatively indestructible property; but, after all, it is only a gain in material things. Corresponding advance in the world of ideas—of ideas embodied in institutions and in definite habits of action—must, in the end, determine whether material progress prove a blessing or a curse to the nation at large. Our growth on the material side is so rapid as to be alarming. It suggests undefinable dangers, and should be as much a source of uneasiness as of congratulation. It renders the responsibilities of the American citizen, educator and legislator graver and more complex. The coming years may not call for passionate loyalty and sacrifice, but they will call for a thoughtful patriotism and a broad comprehension of the organic life of a great republic. The more rapidly we grow rich, the sooner we shall be called upon to settle the question of equitable distribution. The sudden accumulation of wealth is as trying to national character as it is to that of an individual. It is an increase of power. The philosophers of the twentieth century, from the vantage-ground of recorded history, must determine whether in our hands it proved a power for good or for evil.

—A Paper by C. F. Johnson, Jr., in the Penn Monthly.

THE GERMAN SPELTER INDUSTRY.

AT the present time, when considerable quantities of spelter are imported from Germany, and the sales for future delivery indicate an increasing strength in this movement, some data concerning the spelter industry of the most formidable rival of our common Western metal in Eastern markets are of value. In a recent issue of the *Verhandlungen des Vereins zur Beförderung des Gewerbfleisses*, Herr Oskar Bilharz, of the Altenburg Company, treats of the Western or Rhenish District, while Herr E. Althaus, a well-known authority, reports elaborately on the Silesian District. Though both reports relate to the year 1880, the technical questions involved and, to a certain extent, the commercial status are unchanged. Herr Bilharz gives the following valuable estimate of the production of Europe, the figures being in metric tons:

	1879.	1880.
Germany	96,360	99,405
Belgium	63,007	65,010
England	16,750	22 000
France	14,467	13,715
Austria, Poland, etc.	3,200	3,200
Total	193,784	203,330

Silesia produced 63,476 tons in 1879, and 65,437 tons in 1880, leaving 32,884 and 33,968 tons respectively to the rest of Germany. Up to the present time, the supply of German zinc ores keeps pace with the increasing production; but the use of blende instead of calamine, carbonates and silicates is steadily increasing. In the Aix la Chapelle District, for instance, the quantity of blende treated has, in three years, reached a quantity double that of the calamine used. The following figures may serve to illustrate the increase in that district:

	1879. *Tons.*	1880. *Tons.*
Calamine	21,800	19,690
Blende	31,790	34,580
Total	53,590	54,270

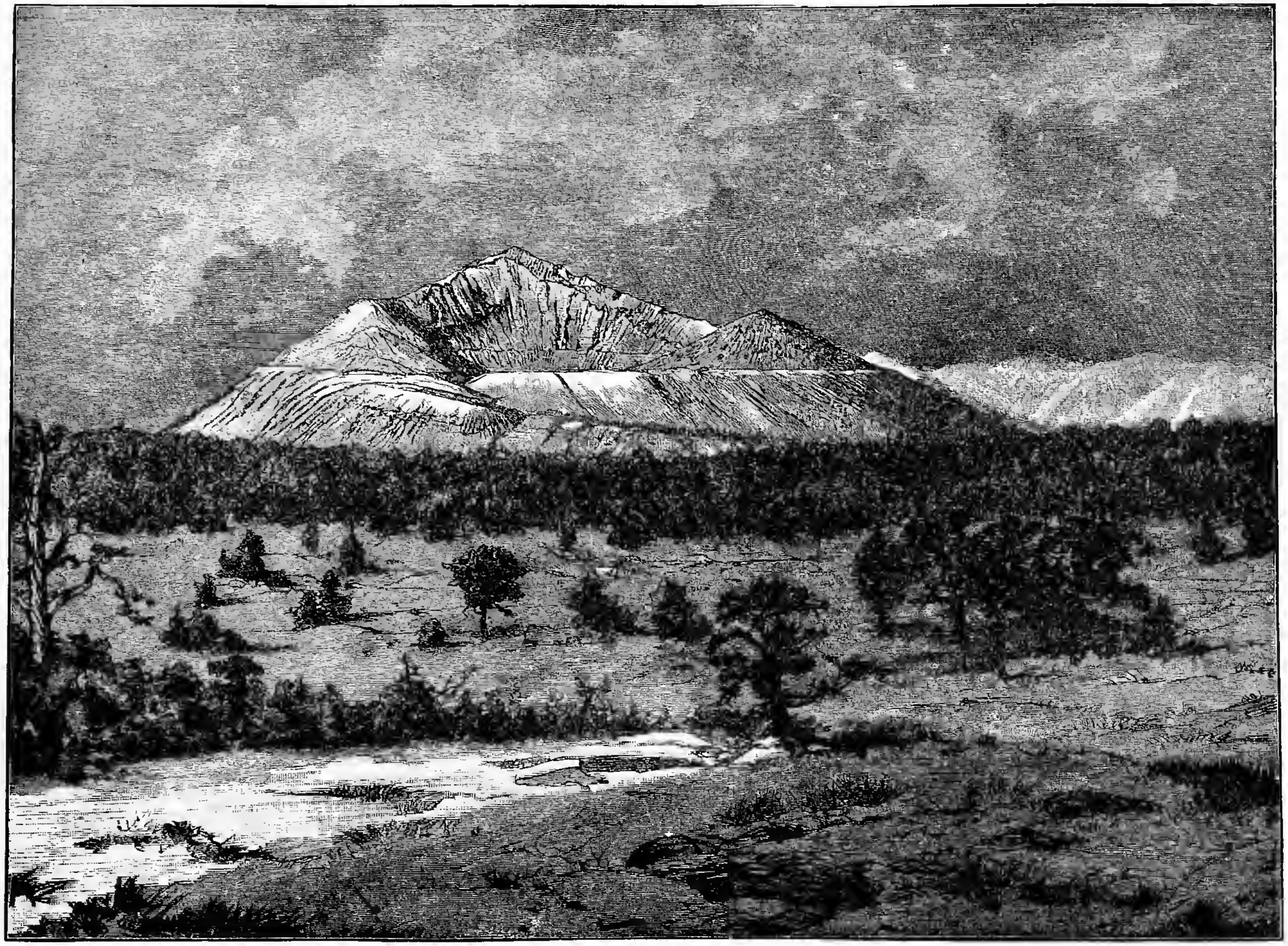
Besides the German ores, the works of the Rhenish District draw largely upon the northern and southwestern coast of Spain, and upon Sardinia. Quite recently, the mines of Laurium, in Greece, have sent rich ores running as high as 62 per cent. Herr Bilharz states that, while no trouble is at present experienced concerning the supply of calamines, he seems to fear that in a few years, when the Mediterranean mines, now worked to full capacity, approach exhaustion, the question will become a serious one, because the manufacture of zinc from blende is not alone more expensive, but also furnishes a poorer grade of metal. Some of our Western works which are contending with the same difficulties will appreciate the importance of this confession. Herr Bilharz gives the following interesting figures concerning the articles into which the spelter made by the Vieille Montagne Company of Germany and Belgium, the largest producer of the world, is manufactured. It will be seen that sheet-zinc is in that district the most important article:

	1879.	1880.
Production of spelter	43,750 tons	44,690 tons
Manufactured into:		
Sheet-zinc	41,882 "	37,522 "
Zinc-white	6,016 "	5,583 "

Herr Althaus, who reports on the great Silesian District, goes into the questions at issue much more at length. The causes which gave that district such a commanding position, notwithstanding its remoteness from the markets of the world and the low grade of the ores, are that the zinc mines are located in close proximity to the coal mines, and that mines and works are in the hands of a few strong parties. The cost of the raw materials is, therefore, very low. While the older calamine mines are gradually becoming exhausted, blende, which predominates in the lower workings, is more and more superseding calamine. The necessity of roasting it and the difficulty of handling the gases of the roasting process increase the cost of working. The manufacture of sulphuric acid from the gases is less profitable than in other districts, because the market for acid is limited and the blende contains arsenic. Only one works is making sulphuric acid, and that one has not introduced it for an extension of the plant recently made. The other works are forced to adopt some means of getting rid of the roasting gases, and generally use towers in which the sulphurous acid is absorbed by milk of lime. It may be of interest to state that one of the largest of our Western works is now putting up a sulphuric acid plant in connection with blende roasting. The lead ores associated with the zinc ores of Silesia have hitherto paid for a part of the cost of mining. It is found that they are not only much more difficult to separate by dressing from blende than from calamine, but also that in the former they are poorer in silver than in the latter. The large producers are, on the other hand, favored by the large extent and the regularity of their deposits, and by the cheapening of freights by the construction of narrow-gauge roads between the mines and the works. The production of zinc ores in 1880, the quantities taken from (—) or added to (+) the stocks at the works, and the actual consumption of the latter are given in the following table:

Kind of ore.	*Production.*	*Drawn from or added to stock.* *Tons.*	*Total supply of works.* *Tons.*	*P. c.*
Calamine	449,672	+22,865	462,537	84·6
Blende	81,322	— 8,516	72,806	14·6
	530,994	14,349	545,343	99·2
Excess of imports and exports of ore			3,185	0·8
Total			548,528	100·0

The following table will serve to show the development of the Silesian zinc industry since 1810:



WESTERN SCENERY—PAVANT BUTTE—A SUBMARINE VOLCANO—UTAH.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

Period.	Average annual production of — Ore.	Average annual production of — Spelter.	Value of ore in per cent. of value of spelter.	Pounds of coal per — Pound of ore.	Pounds of coal per — Pound of spelter.
1810–1819	2,600·0	680·0	23·1	6·300	20·20
1820–1829	27,984·0	7,466·0	34·0	4·200	15·80
1830–1839	37,445·5	8,190·6	51·0	. .	. .
1840–1849	94,779·1	17,068·0	21·9	3·284*	14·75*
1850–1859	180,915·1	30,352·0	42·5	2·594†	14·15†
1860–1869	275,938·1	38,155·4	35·3	2·557	19·03‡
1870–1879	392,988·8	45,224·3	38·5	1·807	14·00
1880 . . .	630,904·0	65,443·0	36·6	1·529	12·40

* 6·5 per cent. being slack. † 18·4 per cent. being slack. ‡ 46·6 per cent. being slack.

The reduction in the consumption of fuel is due to the introduction during the years 1870 to 1880 of gas firing, either in the shape of step grates with upper and lower blast or the Siemens regenerative system with natural draught. The former is economical, because it allows the use of otherwise unsalable slack; while the latter, notwithstanding high first cost, is cheaper still, although market sizes of coal must be used. Herr Althaus says that, in consequence of the almost general introduction of the gas firing, the smoke is almost entirely disappearing. He expresses his surprise that the recuperative system introduced by Dr. Wedding at the small Friedrich works at Tarnowitz has not been more generally adopted, as it combines the advantages of both of the above methods. The upper blast is heated in a cast-iron hot stove. The following table will best illustrate the effect of the introduction of these improvements:

	Production of spelter. Tons.	Yield of ore. Per cent.	Consumption of coal per pound of — Ore.	Consumption of coal per pound of — Spelter.
1860	40,354	15·3	2·699	17·63
1870	36,444	12·8	2·455	19.16
1871	31,971	12·1	2·040	16.80
1872	32,502	9·6	1·425	14·80
1873	30,719	10·0	1·342	13·40
1874	41,518	11·3	1·575	13·97
1875	43,194	11·4	1·666	14·60
1876	49,377	11·0	1·553	14·14
1877	57,423	12·0	1·526	12·70
1878	59,619	11·8	1·509	12·78
1879	62,476	12·7	1·420	11·21
1880	05,443	12·3	1·529	12 41

Herr Althaus gives the following estimate of the cost of manufacture of spelter, the cost of the ore, which is generally mined by the smelting companies themselves, being placed at the assessed valuation of the government for the purposes of taxation:

	Per metric ton of ore.	Per metric ton of spelter.
Assessed valuation of ore	15·23 Marks.	129·45 Marks.
Freight to works, unloading, etc.	1·70 "	14·45 "
Fuel	6·78 "	49·10 "
Wages	6·29 "	45·00 "
Other expenses	2·94 "	25 00 "
Interest and sinking fund	3·06 "	26·00 "
Total cost	34·00 "	289·00 "
Average selling price	39·77 "	338·00 "
Average profit	6·77 "	49·00 "

Spirek gives the following figures for four Silesian works:

	1.	2.	3.	4.	Average.
Cost of ore at works	203·8	209 0	200·0	195·0	202·0
Cost of fuel	82·0	60·4	40·0	38·0	52 6
Other expenses	80·0	67·7	67·8	65·0	70·1
Total cost	365·8	337.1	307·8	298·0	324·7
Average selling price	338·0	338·0	338·0	338·0	338·0
	—27·8	+0·9	+30·2	+48.0	+33·1

The German imports and exports of spelter and sheet-zinc during the year 1880, were as follows, in metric tons:

	Imports from. Spelter.	Imports from. Sheet-zinc.	Exports to. Spelter.	Exports to. Sheet zinc.
Bremen	47.7	3·2	. . . .	156·3
Hamburg	620·4	36·5	17,388 9	6,007·6
Denmark, Sweden and Norway	64·2	. . .	. . . .	1,248·3
Russia	. . .	. . .	488·3	993·4
Austria-Hungary	705·8	2·3	6,845·3	499·3
Switzerland	. . .	2·2	. . . .	173·1
France	. . .	10·5	1,956·0	. . .
Belgium	1,755·4	66·9	1,290·5	235.3
Netherlands	76·2	2·3	3,158·4	1,254·2
Great Britain	631·3	. . .	8,573·4	2,772·4
United States	. . .	. . .	. . . .	134·0
Other countries	98·8	0·9	921·6	50·9
Total	3,989·8	114.8	40,622 4	12,524·8

It will be noted that a very considerable portion of the exports are to Hamburg, which, being a free city, is outside of the German customs union. Hamburg is really the main distributing point for spelter exported, the other figures being only shipments from other German ports. To a certain extent, the metal that goes into the Netherlands is really only in transit. It is not, therefore, correct to assume that the figures given under "United States," represent all of the German spelter and zinc which has come to this country.

—*Engineering and Mining Journal.*

COPPER SMELTING IN THE MANSFELD DISTRICT.

ONE of the old established and successful mining industries of Germany has been that of Mansfeld, where a thin stratum of cupriferous slate has been worked for centuries. The miners of the district, by nice distinctions divide the bed into a series of nine layers, the whole of which do not aggregate more than from 13.5 to 22 inches. Only a few inches are worth mining, and yet the working of this deposit for copper has been profitable. The average percentage of copper in the slate between Gerbstadt and Eisleben, the principal district, is from 2 to 3 per cent. with an average of half a per cent. of silver in the copper. In the Sangerhausen District, silicious ores run as high as 5 and sometimes even 10 per cent. of copper, but contain only one-half the quantity of silver. The average of the ore smelted is 2.5 to 3 per cent., and 0.015 per cent. of silver. The Mansfeld copper slate contains a considerable quantity of bitumen, and it is, therefore, first calcined in open heaps, the operation taking four to six weeks, and occasioning a loss of weight of from 8 to 12 per cent. The calcined ore is smelted in five works in cupolas or shaft-furnaces. In the older establishments, the furnaces have a fore-hearth into which the melted cinder and matte flow directly, thus separating outside of the furnace. They do not put through as large a quantity as the more modern furnaces, closely modeled upon iron blast furnaces, but they possess the advantage that there is less danger of the formation of salamanders, bodies of metallic iron reduced from the ore. Their maximum capacity is 100 tons per day, while the larger modern furnaces, from which slag and matte are tapped at intervals, can put through 160 tons per day, being run with a higher pressure of blast, which ranges between 1.9 and 5.2 inches of mercury. Generally the ore is fluxed only with impure slag from the furnaces themselves, or with slag from smelting roasted matte. The coke used holds only about 5 per cent. of ash, 3.5 to 4 cwts. being used per ton of charge. The slag contains 48 to 50 per cent. of silica at one works, and 53 to 57 per cent. at another, and its contents of copper vary from 0.2 to 0.3 per cent. of copper, the loss of that metal being, therefore, very nearly 10 per cent. The gases escape from the tunnel-head with a temperature of 100 to 300 degrees C., and are partially utilized under steam boilers or in hot-blast stoves. By analyses, the gases of two works contained:

	1.	2.
Carbonic acid	10·8	15·0
Oxygen	0·4	0.1
Carbonic oxide	16·8	14.0
Nitrogen	72·0	70·9
Total	100·0	100·0

The matter produced by four works held:

	1.	2.	3.	4.
Copper	30·500	44·900	36·400	44.815
Silver	0·152	0·230	0·180	0·225
Lead	1·210	0·690	1·046	0·643
Iron	26·600	20·000	25·900	23·778
Nickel	0·590	0·350	0·485	0·488
Cobalt	0·180	0·010	0 055	0·146
Zinc	9·149	4·570	5.550	3·012
Total	68·381	70·750	69·616	72·135

The rest embraces 23 to 27 per cent. of sulphur, and generally some manganese. This first matte is roasted in kilns 10.4 feet high, 4 feet wide, and 5 feet deep on the level of the grate, and somewhat larger in section on the top. One kiln will hold ten tons, and calcines 1.25 to 1.50 tons of matte per day, 85 parts of partly roasted matte being added to the raw matte, in order to prevent sintering. The access of air is so regulated that the roasting gases contain from 4.5 to 5.5 per cent. of sulphurous acid. The latter is conducted into lead chambers for the manufacture of sulphuric acid. The kiln is so run that a layer of sintered matte is formed about three feet above the grate, so that the roasting material can be drawn without causing the unfinished material above to mix with it. After drawing, this sintered layer is broken through, and the matte above it descends quite uniformly. One ton of raw matte yields 1.015 to 1.070 tons of roasted material. The latter is worked in reverberatory furnaces, built after the English model. They are fired with coal, though recently a Groebe-Lauermann gas producer is on trial. The Kupferkammer works has ten furnaces, and the Eckardt works six, the charge being respectively 2.8 and 2.5 tons of roasted matte, 616 and 440 pounds of sandy ores, and 308 and 220 pounds of quartz, and some richer scrap, the time for a charge being seven to nine and six to seven hours respectively. After three to three and a half hours strong firing with luted doors, the charge is rabbled three times, until there are no accretions on the hearth. Then a portion of the slag is drawn out of the working-doors, and the rest of it is tapped, together with the matte. In 1880, the average working of the two establishments referred to was as follows, respectively; Daily capacity, 8.02 and 9.34 tons; yield 902 and 1,188 pounds of second matte, and 1,250 and 1,100 pounds of slag. The matte held 74.391 and 74.375 per cent. of copper, and 0.427 and 0.433 per cent. of silver. The consumption of coal per ton of first matte was 2,174 and 1,888 pounds respectively. The slag drawn from the furnace held 9 per cent. of copper, and 0.036 per cent. of silver, and the slag tapped 4 and 2.943 per cent. of copper, and 0.01 and 0.0085 per cent. of silver respectively. The slag held from 17 to 20 per cent. of silica and as high as 50 per cent. of protoxide of iron, and being so basic is used as flux in smelting raw ore. The percentage of the second matte is roughly determined by its density; 74 per cent. matte having a specific gravity of 5.76, and 75 per cent. matte, 5.80. Recent analyses of the second matte gave the following result:

	1	2.
Copper	73·320	73·512
Silver	0·427	0·429
Lead	0·816	0·557
Iron	2·590	2·870
Nickel	0·536	0·304
Cobalt	0·178	0·187
Zinc	1·378	0·514
Manganese	0·011	0·010
	79·256	79·383

The matte contained besides about 20 per cent. of sulphur. It is desilverized by the Ziervogel process, being groud in mills and roasted in 13 reverberatory furnaces with three hearths, one above the other, which together have a capacity of 15,000 tons of matte per annum. The silver is extracted after careful roasting as sulphate of silver, and is precipitated as metallic silver by copper. The precipitated silver is treated with silver solution, to dissolve the copper, washed, pressed, and melted into bars 999 to 999.4 fine. The residues from this leaching process, when they have less than 0.023 per cent. of silver, are worked for copper directly. If they hold more, they are roasted over again and are again extracted, then yielding residues carrying 0.018 per cent. of silver. The residues, which contain 74 to 75 per cent. of copper as oxide, are mixed with 10 per cent. of coal slack, dried and charged in lots of 10 tons into reverberatory smelting-furnaces. In 9 to 9½ hours the copper is reduced and melted down, and a thick slag is drawn off. Refining then begins with open doors, and large quantities of sulphurous acid and zinc oxide escape. Iron, zinc, lead, and finally nickel are slagged, the operation taking from 1½ to 2 hours. The copper then begins to boil, in consequence of the escape of sulphurous acid, which continues for 2 to 2½ hours, at the close of which samples show a convex surface and little porosity. Two hours afterward, the copper is ready for poling, which is followed by toughening, the latter operation taking about 2 to 2½ hours. The copper refined in this way is better than that made by first smelting the residues of the Ziervogel process for "blister copper," and then refining the latter. This was formerly done in the Mansfeld District, and the following range of analyses will show the difference fairly, No. 1 being the present metal, and No. 2 that made between 1864 and 1868:

	No. 1.	No. 2.
Copper	99·394 to 99·550	99·120 to 99·277
Silver	0·028 " 0·030	0·024 " 0·031
Lead	0·043 " 0·103	0·169 " 0·316
Iron	0·025 " 0·132	0·044 " 0·069
Nickel	0·239 " 0·275	0·337 " 0·468

The drosses from refining the copper are smelted in a blast-furnace, and are toughened in a reverberatory. In 1880, the composition of this copper ranged within the following limits:

Copper	99·110 to 99·270
Silver	0·015 " 0·020
Lead	0·134 " 0·259
Iron	0·019 " 0·024
Nickel	0·314 " 0·405
Arsenic	0·101 " 0·144

By adding lead or phosphor-copper, this metal is made fit for rolling purposes.

—Engineering and Mining Journal.

THE COAL-FIELDS OF GREAT BRITAIN.

In briefly calling attention in our last issue of Coal to the work just issued by Mr. Richard Meade, Assistant Keeper of Mining Records, we stated that we would endeavor to gather the main data of general interest in a series of articles. The information at the disposal of Mr. Meade is so extensive and in many points reaches so far back that we can only attempt a brief summary. The following is the area of the coal-fields of the United Kingdom:

Coal-fields.	Area in Square miles.
England:	
Durham and Northumberland	796
Yorkshire, Derbyshire, and Nottinghamshire	800
Cumberland	25
Lancashire and Cheshire	220
Leicestershire	15
Warwickshire	30
Shropshire	28
North Staffordshire	75
South Staffordshire	93
North Wales:	
Anglesea, Denbighshire, and Flintshire	90
South Wales:	
Monmouthshire	104
Glamorganshire	518
Brecknockshire	74
Caermarthenshire	228
Pembrokeshire	76
Gloucestershire (Forest of Dean)	34
Somersetshire (Bristol)	150
Scotland	1,720
Ireland	2,800
Total	7,876

According to the returns of the Inspectors of Mines, the following was the product of the various coal-fields in the years 1860, 1870, and 1881, the figures for the latter year having been substituted by us for those of 1880, given by Mr. Meade, the data for 1881 not having been published at the date of his report:

England:	1860.	1870.	1881.
Northumberland, North and South Durham	18,244,708	27,613,539	35,592,420
Cumberland	1,171,052	1,408,235	1,769,213
Westmoreland	.....	.....	1,860
Cheshire	750 500	929,150	782,000
Lancashire, North, East, and West	11,350,000	13,810,600	18,500,810
Yorkshire, North Riding	......	......	7,036
" West Riding	9,284,000	10,606,604	18,287,141
Derbyshire }	4,940,000	{ 5,102,265	8,508 923
Nottinghamshire }		{ 2,115,372	4,758,060
Warwickshire	545,000	647,540	1,133,419
Leicestershire	730,000	599,450	1,145,265
Staffordshire, North and South, and Worcestershire	7,648,300	13,230,062	14,858,070
Shropshire	850,500	1,343,300	892,500
Gloucestershire, Somersetshire }	5,503,400	1,955,910	1,361,396
Monmouthshire }		4,364,342	5,412,840
North Wales:			
Flintshire, Denbighshire	1,750,500	2,329,030	2,670,597
South Wales:			
Glamorganshire, Brecknockshire, Pembrokeshire, and Caermarthenshiro	6,254 813	9,299,770	1,584,886
Gloucestershire	....	..	15,257,050

Scotland:			
Eastern District, Western District	10,900,600	14,934,553	20,823,055
Ireland	119,425	141 470	127,586
Total	84,042,698	110,431,192	154,184,300

The following statistics will show the development of the production of coal in the United Kingdom:

Year.	Production.	London consumption.	Exports.
1660	2,148,000	. . .	. . . .
1700	2,612,000	. .	. . .
1750	4,773,000	. . .	. . . .
1770	7,205,400	. . .	. . . .
1780	6,424,976	. . .	. . . .
1790	7,618,760	. . . . .	. . . .
1800	10,080,300	. . . . .	. . . . .
1816	27,020,115	1,500,000	237,667
1854	64,661,401	4,376,770	3,359,575
1860	84,042,698	5,070,515	7,412,575
1865	97,160,587	5,903,271	9,283,214
1870	110,431,192	6,759,100	11,702,649
1872	123,497,316	7,556,422	13,198,494
1874	125,067,916	7,423,488	13,927,205
1876	133,344,766	8,451,375	16,265,839
1878	132,607,866	8,794,516	15,483,816
1879	134,008,228	10,058,811	16,442,296
1880	146 969,409	9,915,488	18,702,551
1881	154,184,300	. . . . .	. . . . .

The quantity of coal available in 1880 is estimated to be 135,288,613,038 tons, or, at the present rate of production, fully 900 years supply. Of this quantity, 79,015,613,038 tons exist at depths not exceeding 4000 feet in known coal-fields, and 56,273,000,000 tons as the probable amount of coal, under Permian and other overlying formations, at depths of less than 4000 feet; 40 per cent. being deducted for loss and other contingencies. The following are the data:

England and Wales	69,192,056,317
Scotland	9,669,172,642
Ireland	154,384,079
Total known coal-fields	79,015,613,038
Concealed coal-fields	56,273,000,000
Total coal available, 1880	135,288,613,038

The Great Northern Coal-Field.—The earliest record of the use of coal of this great field is the receipt, in 852, of twelve cart-loads of coal by the abbey of Peterboro'; and in 1239, Newcastle coal was sent to London. The field comprises an exposed area of 460 square miles and a concealed area of 225 square miles, its length being nearly fifty miles, while its greatest width is twenty miles. Beyond the area above referred to, there is extending under the German Ocean another area of 111 square miles known to be available. The coal measures are about 2000 feet thick, and they are much intersected by faults in the immediate neighborhood of which the beds have a high dip. Through the greater part of the measures, however, the seams lie at a gentle inclination. The principal seams are the High Main and the Low Main or Hutton, both averaging six feet of coal. It is an interesting fact that the latter seam, in different parts of the field, has the best description of those varieties of coal suitable for purposes not at all similar to each other, namely, the best household, the best gas, and the best steam coal. The household coals of this field, of which the choicest kinds are known as Wallsend coal, may be illustrated by the following analysis:

	Haswell.	Hartley.	Original Hartley.
Carbon	83·47	84·284	81.18
Hydrogen	6·68	5·522	5·56
Nitrogen	1·42	2·075	0·72
Sulphur	0·06	1·181	1 44
Oxygen	8·17	6·223	8·03
Ash	0·20	0·715	3·07

The gas coals of the Northern field are obtained from the lower seams on the Tyne, Wear, and Tees, and yield from 10,000 to 11,000 cubic feet of gas per ton. The following analyses show the character of this coal:

	South Peareth.	Bowden Close.	Willington.	Garesfield.
Carbon	81.41	84·92	86·81	86.9
Hydrogen	5·33	4·52	4·96	
Nitrogen	2·05	0 96	1.05	5·4
Sulphur	0.74	0·65	0·38	
Oxygen	7.90	6·66	5·22	5·2
Ash	2·07	2·28	1·08	2·5

The steam coals of the field are found in the northern part, the constituents of the fuel being shown by the following analysis:

	Buddles Hartley.	Newcastle Hartley.	Haswell Sunderland.	Seaton Burn.
Carbon	78 69	81·81	83·71	78·65
Hydrogen	6·00	5·60	5·30	4·65
Oxygen	10·07	2·58	2·79	13·06
Nitrogen	2·37	1·28	1·06	. .
Sulphur	1·51	1·69	1·21	0.55
Ash	1·36	7·14	5·93	2·49

The best coking coal of the district is obtained from the lower seams of the Tyne and South Durham: together with the ironstone of the region, it forms the basis of the development of the great Cleveland iron-making district, the greatest in the world. In South Durham alone, the production of coke exceeds four millions of tons, and the total number of oveus in Durham is estimated to be nearly 14,000 bee-hive ovens. The following analyses will indicate the nature of the coal.

	Durham best.	Average Durham.	Busty upper.	Busty lower.	Brockwell.
Carbon	93·150	84·92	81·22	78·46	83·40
Hydrogen	0·721	4·53	4.70	4·42	4·40
Nitrogen	1·276	0·96	9·45	8·82	7·18
Oxygen	0.905	6·66			
Sulphur	. .	0·65	0·81	1·83	1·00
Ash	3·948	2·28	3·28	6·17	3·50
Water	. .	. .	0·85	0·99	0·99

The yield of coke varies widely, running from 53 to 72 per cent., the average, however, being 60 to 65 per cent. The coke is very pure, the average of the best varieties being 6 per cent. of ash and 0·6 per cent. of sulphur. The time of coking ranges from 18 or 19 hours to as high as 96, according to whether a light, soft, or hard and compact coke is to be made. During the past years, efforts have been made to save the gases given off in the ovens; but the success so far has not been equal to what could be desired. At several places, however, the waste heat of the coke ovens has been utilized. Mr. Meade says that experience at Durham has taught him that to have good coke it is necessary that the gases should have a free outlet and the ovens kept burning in the ordinary way. To secure this object, ovens were erected at Brownley Colliery, and the results attained have been most favorable. The ovens were built back to back, but with larger flues than usual between them. To each stack—about 116 feet in height—were connected about 100 ovens, an equal number on each side, there being four flues and boilers so arranged that the heat was carried past, when cleaning or repairs were carried on, the connecting flues being built compact and tight. There was great freedom from smoke, owing, no doubt, to the air-tight and perfect character of the flues, the small proportion of air present not cooling the gases to a point below, by which the hydrocarbons escaped imperfectly burnt. This was shown to be the case by admitting the air, when flame was at once seen. By this arrangement, no coal whatever was used for the boilers, and the produce of the pits was drawn from a depth of 600 yards and the water pumped, for which purpose, before the new system was adopted, 600 tons per fortnight were wasted. The amount of heat available for evaporative purposes was found to be very large. Mr. Stevenson, of Durham, in speaking of these ovens, states that 50 of them coked at the rate of 230 tons of coal in 84 hours, which yielded 50 per cent. of coke composed of 132·7 tons of carbon to 5·3 tons of ash. He found the composition and the weight of the material lost in coking to be: Carbon, 62·6 tons; hydrogen, 10·3 tons; nitrogen, 2·3 tons; sulphur, 1·4 tons; and oxygen, 15·3 tons. At several places in Durham, the coal is crushed to powder before going into the oven, and this has been found to be beneficial, producing a larger percentage of coke with less refuse.

The Midland Coal-Field.—The second coal-field described by Mr. Richard Meade, in his work on the Coal and Iron Industries of the United Kingdom, is the Midland or Yorkshire coal-field which has a known area of about 800 square miles. It extends from Bradford and Leeds, on the north, for sixty-six miles, to Derby and Nottingham, on the south, Sheffield occupying a position in its center. Its breadth varies from 5 to 20 miles, and it is the most continuous of the British coal-fields. In a section of 4500 feet are fifteen seams over two feet thick, their aggregate being 43 feet of coal. Besides, there are numerous veins less than two feet, equal in all to 53 feet of coal. Mr. Meade, following his plan, has given three widely-separated chapters on the various parts of this field: one covering that portion in Yorkshire; another that in Nottinghamshire; and a third in Derbyshire. This division has little or no significance for American readers, and we shall therefore consider these portions together. The lower coal measures contain only unimportant veins of coal, but are remarkable for the occurrence of seams of ganister, a highly siliceous rock, which, when ground down and mixed in some cases with powdered fire-brick or similar materials, forms one of the best fire-resisting materials known. The middle coal measures are those which are particularly rich in coal, the seams of the upper measures being less numerous and valuable. In the northern part of the field, a number of veins, varying from 2 to 3 feet thick, are worked; while in the southern part of Yorkshire, the great seam is that of Barnsley, which so far exceeds in thickness and value the other seams that, with the exception of the Silkstone, it is the only one likely to be touched until they are exhausted. This Barnsley coal, which is about from 6 to 9 feet thick, derives its great value from the fact that the middle portion of the vein is semi-anthracite or steam coal, and is particularly adapted for use in locomotives, ships, and iron-smelting, on account of its high heating-power. This portion of the bed is made up of alternating layers of dull and bright coal. The "Silkstone," or, as it is called in the northern part of Yorkshire, the "Blocking Bed" coal, is remarkable for its purity. It is largely sent to London as a house coal, and is also employed for steel-making in Sheffield, as coke, and for gas manufacture. In the Derbyshire and Nottinghamshire fields, which are the southern extension of the Yorkshire field, a number of veins, some of them averaging six feet, are worked.

The following analyses are given by Mr. Meade for the Yorkshire coals, the first five being from the Barnsley vein, while the last is from Silkstone coal:

Constituents.	Womburll	Darfield.	Oaks.	Elsecar.	Marsboro' Park.	Silkstone.
Carbon	80·500	81·390	82·520	81·30	82·190	80·46
Hydrogen	5·500	5·500	5·025	5·19	5·173	5.08
Oxygen	6·205	7·451	6·915	8·21	8·144	6·80
Nitrogen	1·862	1·496	2·120	1·89	1·730	1·67
Sulphur	1·833	2·100	1·144	1·21	1·537	1·65
Ash	4·100	2·063	2·276	2·20	1·226	3·30
Specific gravity	1·266	1·270	1·270	1·29	1·268	. .
Coke, per cent	63·130	63·190	65·620	62·00	63·600	. .

The composition of the Derbyshire and Nottinghamshire coals appears from the following analyses, the first three belonging to the former field and the last two to the latter:

Constituents.	Stavery.	Loscoe.	Langley	Shireoaks.	Portland.
Carbon	79·85	77·490	77·970	77·40	80·410
Hydrogen	4 84	4·860	5·588	4·96	4·650
Nitrogen	1·23	1·640	0 800	1.55	1·590
Sulphur	0.72	1 300	1·140	0·92	0·860
Oxygen	10·96	12·410	9·890	7·77	11·260
Ash	2·40	2.300	4·050	3·90	1·230
Specific gravity	1·27	1·285	1·264	. .	1.301
Coke, per cent	57·86	52·800	54·900	63·18	60·900

The acreage of this Yorkshire or Midland coal is estimated at 7,970,156 acres, of which 7,783,610 remain unworked, which contain an estimated quantity of 18,406,799,433 tons available for future supplies, or a total of 32,721,198,832 tons. The production of the Midland coal-field has increased from 17,824,241 tons to 29,804,763 tons. The average quantity raised per man was 295 tons in 1880.

Cumberland Coal-Field.—A small though, in some respects, an important field is the Cumberland, in the northwest of England. It is only twenty miles long, and at its greatest width five miles broad. The coal measures in this area attain a thickness exceeding 2000 feet, the middle division containing seven workable seams of coal. In the Workington District, the most important are the cannel, from 4 to 6 feet, and the Bannock band, 5½ feet thick; the Lower Main, from 3 to 4 feet; and the Main, from 9 to 10 feet thick; the total workable thickness being estimated at 35 feet. In the Whitehaven and, to some extent also, in the Workington District, the colliery workings extend as far as two or three miles under the sea. Mr. M. Dunn, describing the dangers attending these under-sea operations from inundation, gives an account of a calamity which occurred in this district in July, 1837, when 36 men and boys were killed, the water having filled up the whole of the extensive workings to the level of the sea in a few hours. The scene of the accident was the Workington colliery, where the two pits were sunk 90 fathoms deep, close to the seashore, and the coal was worked to the distance of 1500 yards under the Irish Sea, in a ten-foot seam. The workings were driven considerably to the rise, at the rate of one in three, which brought them within 15 fathoms of the bottom of the sea. The bed of the sea gave way, flooding the colliery.

The following analysis of cannel coal from this field, made with special reference to its adaptability for gas manufacture:

Volatile matter	Gas, tar, etc	52·65	
	Sulphur	0·66	
	Water (212° F)	1·16	54·47
Coke	Fixed carbon	26·25	
	Sulphur	0·92	
	Ash	18·36	35·53
	Total		100.00

The quantity of gas per ton at 60 degrees Fahr. and 30 inches barometer was 10,765 cubic feet; the illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour at 0.5 inch pressure, being 40.48 candles. In 1880, the production of the Cumberland coal-field was 1,680,841 tons, of which 654,763 were shipped coastwise.

The Lancashire Coal-Field—This important coal-bearing tract, most irregular in outline and greatly disturbed by faults, has an estimated area of 217 square miles. The chief centers of activity are Prescot, St. Helen's, Wigan, Bolton, Bury, and Manchester, and the isolated tract of Burnley. The South Lancashire area of the coal-field is 32 miles in length, its average breadth being about six miles. The number of seams of workable coal, as also the character of the strata in which they occur, vary considerably in the different parts of the area; thus, in the neighborhood of St. Helen's, the number of coal seams exceeding two feet are 13, compared with 17 in Wigan, and 18 in the Manchester districts. A general thickening out of the coal measures takes place toward the north-northeast, the same coal seams being found farther apart at St. Helen's than at Prescot, and at Wigan than at St. Helen's. The middle coal measures, with a section of 3,500 feet, contain all the important seams of coal, which vary from 3 to 9 feet, and under different names can be traced over the whole district. The Burnley basin lies to the north of the main coal-field: it is small but rich. The Manchester field, farther south, is only four and a half miles long, and its greatest breadth does not exceed one and a half miles. The coals of this field are chiefly used for steam and domestic purposes, and cannel coal for gas making. The following are a number of analyses:

Constituents.	Bal-carres.	Blackley Hurst.	Ince Hall.	Pember-ton.	Cannel.
Carbon	83 54	82·01	77·010	76.160	79·23
Hydrogen	6·24	5·55	3·930	5·350	6·08
Nitrogen	0·98	1·68	1·400	1·290	1·18
Sulphur	1·05	1·43	1·050	1·050	1·43
Oxygen	5·87	6·28	5 520	10·130	7·24
Ash	3·32	4·05	11·090	6·020	4·84
Specific gravity	1·26	1·26	1·2760	1·283	1·23
Coke, per cent.	62·89	57·84	67·100	56·100	60 33

The production of the Lancashire coal-field, which was 9,080,000 tons in 1854, was 19,120,294 tons in 1880. Of this large quantity only 753,804 tons were shipped coastwise, and 610,572 tons were exported in 1880, thus showing that the consumption is almost entirely local. The coal area available for future supplies is estimated at 5,264,787 acres, in which it is computed there are 5,436 millions tons, enough to last 275 years at the present rate of production. The Cheshire coal-field lies south of the Lancashire field, and is closely allied with it.

The Leicestershire Coal-Field.—This lies to the south of the Midland field, and is irregular in form. It has been divided into three districts. The middle measures are the most productive, containing many seams of coal, ten of which, exceeding two feet in thickness, are workable and give a total average of from 40 to 45 feet of coal. The central part of the measures is that containing the principal beds. The main vein of the western or Moira District is from 12 to 14 feet thick, while that of the eastern field is 6 to 8 feet. The following two analyses may serve to show the character of some of these coals:

Constituents.	Ibestock.	Whitwick.
Carbon	74·970	69·00
Hydrogen	4·830	4.35
Nitrogen	0·830	10·78
Oxygen	11·880	
Sulphur	1·450	0·78
Ash	5·990	5·42
Specific gravity	1·291	. .
Coke, per cent.	50·800	58·14

The production of this field has increased from 425,000 tons in 1855 to 1,063,382 in 1880, the total tonnage still available for consumption being estimated at 836,799,634 tons.

—From Coal.

THE GOLD FIELDS OF NOVA SCOTIA.

THE gold-fields of Nova Scotia occupy a district extending along the Atlantic coast from Cape Canso to Yarmouth, and varying in width from 10 to 40 inches. The total area assigned to the auriferous strata and the rocks most intimately connected with them is estimated at from 6500 to 7000 square miles, of which about one half is occupied by what is known as "granite" rocks. The shore presents a low, rugged front, and the land rises gradually to a height of 560 feet.

Geology.—The "granite" rocks of Nova Scotia may be divided into two sections. The western one extends from Halifax to Windsor, a distance of forty-five miles, and stretches in a great belt, interrupted by occasional patches of auriferous measures, nearly to Yarmouth. To the eastward, another band of less width stretches with several interruptions from Waverly to the Cape of Canso. These great masses are but little known and have never been mapped. Some ingenious theories have been advanced as to their being really of Laurentian age, based, it would appear, chiefly on the fact that they have in contact with them at many places bands of gneisses, mica schists, etc., which have been set down as Huronian, as they are more metamorphosed than the ordinary auriferous strata. So far, however, as these granites have been studied in their relation to auriferous and newer strata, they serve to confirm the view entertained by Dr. Dawson, that they are intrusive masses. Near Sherbrooke, as remarked by Dr. Dawson, the quartzite at the point of junction with the granite, is slightly changed in character, having apparently minute hornblende and mica crystals developed in it; but the granite sends numerous veins into it, and in them becomes coarser in texture, and presents beautiful aggregations of plumose mica. At Cochran's Hill, auriferous measures are found lying close to one of the most persistent of the granite ranges, and are penetrated by bands of granite from one inch to six feet in thickness. The measures have exhibited a metamorphism equal to that found anywhere in the coastal range. The slates have become perfectly crystalline. Mica schists, or micaceous gneisses, with crystals of chiastolite, staurolite, have been developed in them.

Dr. Dawson similarly describes the granite of Nictaux, as altering the Devonian beds and converting them, for a short distance away from the junction into gneissoid rocks holding garnet. The granite sends veins into the strata, and, near the junction, holds numerous angular fragments of altered slate. In the case of both the auriferous and Devonian strata, the gradual passage from gneissoid rock into the normal metamorphosed quartzite and argillite can be frequently observed The Nova Scotia granite has all the characters of a plutonic rock in its want of stratification, its frequent porphyritic appearance, its passage into graphic granite, etc., and closely resembles in lithological characters the intrusive granites of the Eastern Townships of Quebec and of New England, some of which belong to the Montalban series of Hunt, while others are later than the Upper Silurian; and it differs materially from the typical Laurentian of Canada. In the latter, the gneisses are usually hornblendic, laminated, and interstratified with diorites, pyroxene rock, limestone, serpentine, etc. These granites are evidently older than the Carboniferous; for at Horton their *debris* is found in the Lower Carboniferous. At Nictaux, they penetrate rocks of Oriskany age. They are therefore much more recent than the auriferous strata to which, as will be shown, a greater age must be assigned. Around and between these granite masses, the gold-bearing strata are spread, with a general strike parallel to the line of the shore, and are now presented in a series of undulations, such as would be expected from a pressure acting against the trend of the coast. Denudation on an immense scale has swept away the crests of the anticlinals, and presented the strata in a succession of elliptical curves, the axes of which are variously inclined. The gold-bearing strata may be divided into two great sections. The upper is composed principally of black earthy pyritous slates with few beds of quartzites, and not many quartz veins. These veins are auriferons when exposed in the anticlinals similar to those in the lower section, to be described farther on. An instance of this auriferous character of the veins is met at Lunenburg, but it is not known at what horizon they occur. Its thickness has been estimated by Professor Hynd to be about 3000 feet. The lower section is composed of alternating beds of quartzites and compact sandstones, sometimes felspathic, and argillites, and is estimated to be 9000 feet thick. It is to be regretted that the age of these rocks can not as yet be definitely determined. There has been no systematic survey of the district, and the strata can not be continuously followed into connection with well-defined horizons farther west. Mention has been already made of the anticlinal folds of the auriferous measures, and their denuded summits. The veins of auriferous quartz, more particularly the subject of this paper, occur in them, and run parallel to the strata, having usually quartzite on one side and slate on the other. They follow the dips and turns of the incasing rocks, and to a casual observer appear to be really beds of quartz, formed at the same time as the beds containing them. They have, therefore, been considered by numerous writers to be true aqueous sediments. Others, again, who have considered the reason of their formation, and the characteristics of the deposits, affirm with great show of reason that they are true veins. Imagine these alternating layers of slate and quartzite ridged up under the influence of a pressure acting in a horizontal direction, and possibly to some extent confined by the more unyielding granite masses, it will be readily conceived that, at points of least resistance, which would be the crests and sides of the flexures, the strata would separate most readily at the junction of beds of differing toughness, leaving fissures closely following the outlines of the undulations. Denudation has swept away the crests of these anticlinals, and now presents these concentric fissures filled with quartz. A different effect, however, is noticed when the ends of the anticlinals are penetrated. Here the pressure acting on the layers not capable of escaping the pressure by flexure as readily as those already described has caused the beds to form corrugations, accompanied, doubtless, in many cases, by a slight movement of one bed on another. The larger of these corrugations, when filled with quartz, present the appearance of logs of wood laid side by side and connected by threads of the same mineral, and are called "barrel quartz." One of these corrugated lodes, worked last year at Moose River, varied in thickness from three quarters of an inch to four inches, and presented the apex of an anticlinal dipping to the east. The lode was accompanied by a similar one a few inches below it. Both lodes carried gold, iron, and lead sulphides, and a little calcite, and gold showed through the intervening slates. The corrugations of the slates were parallel to those of the lodes, and extended as far as a section was exposed by the excavations. Similar but less strongly marked corrugations occur in many of the straight-running lodes, and in some instances their transverse axes point to the line of pressure. Other effects are recognizable as caused by this pressure. Thus, veins called "anglers" are observed breaking abruptly across the quartzites and obliquely across the slate-beds, and in some instances proving rich sometimes in one rock and sometimes in the other. Numerous feeders, sometimes auriferous, radiate from the lodes into the surrounding beds, and in some cases connect them. The thin layers of slate found in most instances on one side of the lode are frequently so soft and broken as to be readily removed by the miner's pick. The wider beds of slate are frequently penetrated by several irregular veins, sometimes uniting and again diverging, and the whole mass is filled with a network of spurs and threads of quartz.

It is found, as a rule, that in wide bands of slate the veins are feebly auriferous, as is also the case in massive sandstones, or in sections composed principally of quartzites. The most productive veins are found where bands of quartzite and slate of moderate thickness alternate. This may possibly be due to the slates being readily penetrated by solutions, owing to their original lamination, and its increase by the pressure alluded to above, and to the fact that the original deposition of the gold may have been dependent on this alternation of beds of differing minerals. These remarks apply to the lower section of the auriferous measures. The overlying slates, although pyritous and containing numerous quartz lodes, indistinguishable from those already considered, have not yet yielded any containing enough free gold to warrant working by the present systems of milling. The worked veins vary in thickness from half an inch to six feet, the usual width being from four to eight inches. A twenty-inch vein is considered a large one. The length varies from a few hundred feet to over two miles. They show frequently a banded structure with cavities filled with quartz and calcite crystals. Other veins show a compact oily quartz or are slightly granular, and break most readily across the vein. Pieces of slate constantly occur in them, and there are also "horses." The fissures have been seen to extend after the quartz filling them has run out. The undulations of the auriferous strata were subsequently disturbed on numerous faults. The Waverley gold-field is disturbed by two heavy faults, running north and south, and throwing the measures 180 to 570 feet. Numerous small faults are met, and they are found, as a rule, to belong to either of two sets of faults, the one having a north and south, and the other an east and west course. These heavy faults seldom hold veins; but there have been disturbances, subsequently to the filling of the veins, which have produced fissures also holding veins, sometimes themselves auriferous, and generally influencing the gold values of the veins they intersect or touch. There seems to be but one true igneous dike cutting the gold measures This occurs at Strawberry Hill, Tangier, and is about 40 feet wide, and runs at right angles to the measures, cutting the veins, without, to any appreciable extent, influencing their positions or metallic contents. Bedded diorite dikes are met in the Lunenburg District.

The period at which the veins were filled can not be precisely ascertained. From its occurrence in the Lower Carboniferous conglomerate, to be referred to, it would appear that the greater part had been deposited previous to that era. The date of the subsequent faults and of the filling by quartz, etc., of the fissures they formed is not clear. There are no measures in the province of date later than the Triassic sandstones of Truro, and it is not known if they are faulted by the extensions of the sets of dislocations in the gold-fields which have been described. It is known that the strata succeeding the Carboniferous limestones up to a period as late at the Upper or Permo-Carboniferous are intersected by sets of faults corresponding to those of the gold districts. It may, therefore, be conjectured that the filling of the second set of fissures was not earlier than the latest period to which can be referred these systems of faults.

The minerals usually associated with the gold are sulphides and arsenides of iron, galena, blende, copper pyrites, oxide of iron, copper glance, molybdenite, native copper, sulphur, chlorite, feldspar, garnet, mica, calcite, felsite, etc., not, however, in quantities of economic importance. The presence of these minerals, especially of the sulphides and arsenides of iron, appears to be essential to the value of the lodes. It is true that numbers of lodes have been worked, causing but trifling quantities of pyrites, etc.; but if not present in the vein, they are found in the inclosing walls, which, in this case, are sometimes rich enough to warrant crushing. The gold occurs chiefly as free or coarse gold in grains, visible to the naked eye, and in strings or filaments between the planes of the quartz. A considerable quantity is inclosed in the nodules and nests of the associated minerals, as well as noticed farther on. Crystals have occasionally been found not exceeding one-third of an inch in diameter. One from Tangier was a rhombic dodecahedron with beveled edges, and brilliant, finely striated faces. Others are octahedra, sometimes elongated and flattened, with dull and rounded faces. The distribution of the gold in the veins is to a certain extent capricious. Few lodes carry a uniform yield over a space exceeding 500 feet. There is in almost every vein one or more zones or "pay-streaks" of quartz much richer than that surrounding it. These zones do not appear to be the effect of any law that has yet been applied to our mines. They lie at every angle, and appear to be of very varied length and width. At the Wellington mine, in Sherbrooke, one of these streaks has been followed nearly 600 feet from the surface without showing signs of exhausting. The surrounding quartz varied from 2 to 6 dwts. to the ton, while the "pay-streak" ran as high as 20 ounces.

Mining.—In the earlier operations, many companies were started with schemes too ambitious for their means, and broke down before they could get into working order. Others paid large dividends for a few years; but having no reserve funds, abandoned the work, when they encountered the trial of poor ore, which must be faced by every mine sooner or later. Other properties, again, have been continuously worked and have made handsome returns. On the failure of many of the large companies, their properties were sub-let to tributers, some of whom have done well by systematic mining, and others have effected little beyond robbing the richer parts of the lodes within a few yards of the surface.

During the past two years, a number of the more promising properties have been purchased by American capitalists, and it is expected that their mining experience, gathered in the Western States, will lead to a much larger output than has been obtained for some years past. When it is determined to work a vein, a mine shaft is sunk, at first, to a depth of about 60 feet, and a shaft on each side from 50 to 150 feet from the central one. At a depth of 40 feet, these shafts are connected by levels, and stoping started from six points, and continued, in some cases, to the surface. Then commencing 15 or 20 feet below the levels, a breast of two or more underhand stopes is carried from shaft to shaft. Frequently, when it is not desired to work to any depth, shafts are sunk at close intervals, and the rock raised through several of them. All these shafts are sunk on the vein, so that they vary from perpendicular sinkings to slopes at various angles, as low as 45 degrees.

This work is continued as long as the quartz pays, and some of the mines have reached a depth of 600 feet. Usually, in the more systematically worked mines, each stope has the following scaffold low enough to permit of convenient stowage. Formerly, it was customary to take out at one operation the lode and enough of the slate, etc., to allow working room of from two to three feet. This was found to lead to serious loss of gold, both by theft and by mixture of the quartz with the rock, which had nearly all to be sorted at bank. Now, the slate, etc., on one side of the vein is first taken out, and the vein allowed to stand untouched until several hundred square feet of it are exposed. Then it is removed at one operation, and sent directly to the surface. This method costs rather more, as the width of the ground removed is increased by the thickness of the lode; but the quartz is uot so much exposed to the workmen, and very little of it is lost. As might be expected from the nature of the strata, the mines are as a rule very free from water. It may be said that at a depth of 300 feet they are perfectly dry whenever proper care has been taken to puddle the shafts on the rock-beds, and not to carry the stopes too near the surface. The most noticeable exception to this rule that has come under the writer's notice occurred recently at the Rose mine, Montagu, where, at 150 feet, the main shaft struck a flat throw to the south of three feet. This throw evidently came to the surface under an adjacent swamp, and passed the water so rapidly that the men had immediately to leave their work, which was not resumed until more powerful pumps had been set up. The pumps used are of every variety, from Cornish patterns to steam ejectors.

The explosive used is chiefly powder; but in many of the lodes narrow slate bands, or very tightly bound, dynamite is used. Formerly, English dynamite and powder were exclusively used, but local factories now supply both these requisites at fair rates and of good quality. The drilling is entirely two-handle, and the system of single-hand drills never succeeded in establishing itself here. Machine drills are but little used, and the narrow inclined workings which necessarily characterize our gold mines almost forbid their application except for driving levels, etc. They will, however, be found economical when attention is turned to the broad belts of banded slate quartzite which are met in many of the districts, and offer an abundant supply of low-grade ores. The cost of extracting a ton of ore varies between wide limits. In the narrow veins, it frequently costs as high as $15 per ton of 2000 lbs., while in veins three feet wide and upward, it is raised for $1.50 a ton, and in slate bands from three to ten feet wide, the cost has been known not to exceed 95 cents; the wages of miners being $1.25, and of laborers 90 cents to a dollar a day.

Milling.—The quartzite from the mine is passed directly to the stampmill. At the commencement of gold mining here, attempts were made to roast the ores before they were stamped; but as the ordinary circular open kilns were used, with wood for fuel, the heat was not more than sufficient to drive off part of the sulphur in combination with the iron, and to coat the free gold with arsenic from the almost omnipresent mispickel, and they were abandoned. The fineness to which the quartz is crushed varies in different mills, from a size passing through a mesh of 150 holes to the square inch, down to one of 400 holes. The following estimate of the cost of crushing is from actual performance, and a mill of ten stamps driven by steam-power, which is also utilized for driving a small pump:

Quartz crushed to pass through finest Twilled Wire Cloth.

Wood 2⅛ cords at 75 cents	$1.57
One man by day, to fire and feed batteries, at	1.50
One man by night at	1.50
One man by night at	1.25
Chemicals and oil	.50
Wear and tear	.75
Total	$7.07
Quartz crushed in 21 hours, 8 tons.	
Cost per ton	$0,88⅜

The above is for quartz alone; when, as is frequently the case, slate is crushed with the quartz, the cost per ton would be materially reduced. At the Ophir mill, at Renfrew, some years ago, the cost per ton for quartz was 60 cents per ton crushing at the rate of 600 tons per month.

In some mills, the use of plates in the "batteries" is not adopted, but mercury is added at regular intervals to the ore undergoing pulverization; the resulting amalgam accumulates around the circular dies on which the stamps fall, and is taken out at the week's end. The use of mercury traps and blankets is not as general as it might be. As the gold is generally coarse, much of it is retained in the batteries, and the loss is in the fine gold not caught by the plates. Excluding the gold found in a state of minute subdivision in the sulphurets, the mills as a rule do not extract over 75 per cent. of the gold. The causes of this are the casing of the gold by grease from lamps, dynamite, etc., and the powdered silicates of alumina, which form an unctuous slime, as well as the vibratory motion of the stamps, inducing a crystalline condition of the gold unfavorable to amalgamation, in addition to the flouring of the gold by the stamping, so that it floats too rapidly over the plates to permit of its being caught by the mercury. No process has yet been found equal to the task of recovering the gold thus lost. As already stated, considerable quantities of arsenical pyrites and sulphurets of iron, lead, and copper are found in the veins, usually in close connection with the gold. The percentage present of these minerals varies very much. Some veins and the incasing rocks are heavily loaded with them up to a proportion, as high as 60 per cent.; while in other veins, equally auriferous, the quantity will not exceed one per cent. The average amount may be estimated at not less than 5 per cent. They are presented as scattered crystals, as films in the bands of the veins, and as irregular masses or pockets frequently connected by threads. As an almost universal rule, they contain gold. A marked exception has been noted at Mount Uniacke, where a number of small veins containing large amounts of mispickel yielded but mere traces of gold and silver. Beautiful specimens of gold are frequently secured by treating nodules of pyrites with acid, which presents the metal in curiously interlaced plates and films, when by a previous examination no gold could be detected. As yet, the treatment of these pyrites has been of the most superficial character; they are passed through the mills together with the quartz, and allowed to run away with the tailings. The following assays of these ores, freed from quartz, will show their value:

Locality.	*Area.*	*Ore.*	*Yield per ton of 2000 lbs.* Gold.			Silver.		
			Oz.	*Dwt.*	*Gr.*	*Oz.*	*Dwt.*	*Gr.*
Mine Harbor	Provincial Co.	Arsenical pyrites	11	8	16	.	.	.
Sherbrooke	Boulder area.	Arsenical pyrites and galena	4	1	16	8	19	10
"	Coburg "	Arsenical pyrites	1	12	15	6	10	16
"	Canada Co.	Mispickel and iron pyrites	45	0	0	.	.	.
"	Meridian Co.	Mispickel and iron pyrites	1	12	16	9	0	0
Montagu	O'Connor area	Mispickel and iron pyrites	12	12	22	1	0	0
"	Belt lode	Mispicket	100	0	0	.	.	.
Ovens	McCulloch lot	Mispickel and iron pyrites	242	16	10	16	5	0

These results are confirmed by the assays of the same ores from various districts made by the writer, who, on several occasions, has found nickel and cobalt present up to 2 per cent. The following assays of pyrites which have been concentrated from tailings show the inadequacy of the ordinary process of stamping to extract the gold from them:

District.	*Area.*	*Yield per ton of 2000 lbs.* Gold.			Silver.		
		Oz.	*Dwt.*	*Gr.*	*Oz.*	*Dwt.*	*Gr.*
Tangier	New York Co.	6	5	0	2	4	0
"	Leary lode	4	14	4	. . .	. . .	. . .
Waverley	. . . . . .	6	14	1	0	10	0
Sherbrooke	Average lots	2	10	0	. . .	. . .	. . .

The following table shows the assay values of several samples of tailings and pyrites taken from waste-heaps not concentrated, showing that much pure gold is lost in addition to that carried away by the various pyrites, as already alluded to:

District.	Area.	Ore.	Yield per ton of 2000 lbs. Gold.			Silver.		
			Oz.	Dwt.	Gr.	Oz.	Dwt.	Gr.
Waverley	. . . .	Tailinge	0 oz. 7 dwt. 4 gr.					
"	Barrel quartz.	"		15	0			. . .
Montagu.	Belt mill	"		16	13			. . .
"		Tailings natural concentration.	3	0	0			. . .

It would seem that no regular system of assays of the values of the ore and pyrites before and after milling has ever been carried out here. A few such experiments would afford valuable data to replace the empirical and haphazard method of treating the ores too frequently seen among our miners. At Montagu, a Frue vanner has been erected to treat the tailings of that district, which are said to yield pyrites averaging $60 to the ton. It is yet too soon to speak of its practical working; but should it equal the expectations of the builder, there is a good field for this work, as about 412,700 tons have been crushed since gold mining began here. Nova Scotia gold, like that of other countries, is an alloy, of which silver forms the chief impurity. As a rule, it is of a high degree of fineness. The following analyses represent the character of the bullion:

Locality.	Authority.	Composition.				Total.
		Gold	Silver	Copper.	Zinc.	
Mooseland	O. C. Marsh	98.13	1.76	0.05	. . .	99.94
Tangier, Field lode	B. Silliman, ...	97.25	2.75	. . .	. . .	100.00
" Leary "	U. S. Assay Office .	96.60	. . .	. . .	. . .	. . . .
Waverley	H. Howe	94.69	4.74	0.39	0.16	99.98
Ovens	A. Gesner	93.06	6.60	0.09	. . .	99.75

Doubtless, the chief attention of the miners here, who as a rule, possess little capital, will continue to be directed to the small rich veins yielding quick returns, and it is to be regretted that as a rule their operations are confined to working out the more accessible parts of the pay-streaks, and no systematic scheme of work is attempted. It is anticipated, however, that in the future the greatest reliance will be placed on the low grade ores. There are numerous belts known to contain many thousands of tons of quartz and slate, yielding by mill test up to seven pennyweights (6-70 dollars) of gold to the ton. From the costs of extraction and milling already given, it will be seen that in many cases these ores would yield good returns if worked on a fairly large and careful system. This experiment is now practically being testing in the Sherbrooke District by parties who propose adopting the usual treatment in stamp mills to secure the coarse gold, and a systematic concentration of the trailings which will yield considerable quanties of arsenical and other pyrites. These would find a ready sale at the reduction-works of the Eastern States, and form an important item in the returns.

The gold is held by the provincial government, which grants areas of 250 by 150 feet for a term of twenty-one years, with option of removal, for a fee of two dollars, and a royalty of two per cent. on the gross value of the smelted gold produced, which is valued at nineteen dollars an ounce (from 20 to 60 cents less than its market value). The royalty is collected from the mill owners, who are obliged to give bonds, and make sworn returns of the quartz crushed and the yield of gold.

Nova Scotia Gold-Fields—General Annual Summary.

Year.	*Total ounces of gold extracted.*			*Stuff crushed.*	*Yield per ton of 200 lbs.*			*Total days labor.*	*Average earnings per man per day and year of 300 days at 18 dollars per oz.*	
	Oz.	*Dwt.*	*Gr.*	*Tons.*	*Oz.*	*Dwt.*	*Gr.*		$	$
1862	7,275	0	0	6,473	1	2	11	156,000	.82	249
1863	14,001	14	17	17,002		16	11	273,634	.92	276
1861	20,022	18	13	21,434		18	16	252,720	1.42	456
1865	25,454	4	8	25,423	1	0	20	121,966	2.15	745
1866	25,204	13	4	32,161		15	2	312,796	2.14	642
1867	27,314	31	11	31,386		17	9	211,796	2 24	672
1868	20,541	6	10	32,262		12	17	241,462	1.53	459
1869	17,868	0	19	35,147		10	4	610,938	1.52	456
1870	19,866	5	5	30,829		12	21	173,680	2.05	615
1871	19,227	7	4	30,791		12	11	162,994	1.12	636
1872	13,094	17	6	17,093		15	7	112,476	2.09	627
1873	11,852	7	19	17,708		13	9	93,470	2.23	684
1874	9.140	13	9	13,844		13	5	77,246	2.12	636
1875	11,208	14	19	14,810		15	4	91,698	2.20	660
1876	12,038	13	18	15,490		15	13	111,304	1.94	582
1877	16,882	6	1	17,367		19	10	123,565	2.46	738
1878	12,577	1	22	17,990		13	23	110,422	2.05	615
1879	13,801	8	10	15,936		17	8	93,002	2.24	702
1880	13,234	0	4	14,037		18	20	103,836	2.18	654
1881	10,756	13	2	16,556		12	20	126,308	1.52	456
Total	321,362	18	7	422,741	. . . .			3,157,391	. .	. .

It is computed that about 8000 ounces were produced before that date, which would make the total amount to the present date about 330,000 ounces. In addition to the amount legitimately mined and crushed, there is reason to believe that in every district a very considerable quantity is stolen by the miners, theft being assisted by the common occurrences of the gold in small nuggets or "sights" in the quartz. Much of the richest quartz from numerous veins worked by two or three men is known to be reduced in hand-mortars, and the resulting gold is surreptitiously sold, so that the returns made to the department of mines may be considered as by no means fully representing the amount of gold extracted.

The tables also show the number of mills, which it may be remarked, work only at intervals; also the number of days' labor performed at mining, prospecting, and surface work, from which it would appear that business, although small, is fairly remunerative. From the foregoing remarks, it will be seen that the area containing gold is very large, and that the little work that has hitherto been performed has shown that there are numerous lodes that have yielded good returns. The district as yet has not shown the extensive alluvial deposits characterizing those countries which have become famous for their production of gold, and the future development will, so far as can be judged at present, be due to more extensive working of the veins. The district affords good openings for men having capital and experience, and as a rule such men have done well. Companies have done equally well whenever their operations have been controlled by competent agents, who have learned to work on the systems experience has shown best adapted to the country, and have not maintained the rules of mining learned in wide lodes, etc. When cheapness of labor, the abundance of water-power, a favorable climate, and the accessibility of the district are considered, it may be fairly anticipated that gradually the attention of miners and capitalists will be turned to Nova Scotia gold-fields: and that with improved methods of treatment and accumulation of experience in detecting and following the richer deposits, this industry will become a leading one in the province.

—Compiled from a paper by Edward Gilpen, Inspector of Mines, read before the North of England Institute of Mining and Mechanical Engineers.

RARE MINERALS OF CALIFORNIA.

PROF. WM. P. BLAKE has contributed the following paper to the Mining Bureau of the State of California.

New Mineral Localities.—*Erythyrite:* Cobalt Bloom.—In minute mammillary incrustations, showing, when broken, radial aggregations of silky, fibrous crystals. Color: deep carmine or rosy red, also, peach blossom red. Streak, the same color, but blue after the mineral has been heated. It gives the usual reactions for cobalt, arsenic and water. Occurs, also, in massive earthy aggregations, of small fibrous crystals of a rose-pink color. It was associated with an ore of silver and cobalt in dark colored earthy masses, a mechanical mixture, assaying at the rate of 5,000 to 6,000 ounces of silver to the ton, but the precise nature of which is not yet ascertained, in a gangue of heavy spar, containing, also, nodular masses of chalcopyrite (yellow copper ore). From the Bernardino range, Southern California. This is believed to be the first observation of the occurrence of this species in the United States.

Rubellite—Rose-colored Tourmaline.—This very interesting mineral is now observed for the first time in California, in the form of long tender crystals from one sixteenth to one-eighth of an inch in transverse diameter, with the usual triangular section. Color, a beautiful rose pink, contrasting well with matrix of white lepidolite. When ignited the color disappears and the mineral becomes perfectly white. Infusible. Locality, Bernardino range Southern California.

Lepidolite—occurs with the above in massive aggregations of minute pearly scales, both colorless and purple-red in color. It is traversed by the crystals of tourmaline. It fuses readily to a white enamel and colors the flames next to the assay a dark crimson-red for a moment.

Cassiterite—"Wood Tin."—A single specimen of wood-tin, a segment of a botryoidal mass, with concentric structure and dark brown in color, was found by Mr. Thomas Lane, of Laporte, in the bed of the middle fork of the Feather river, about three miles above Big Bar, Plumas County. The mass is about five-eighths of an inch in diameter, and closely resembles the wood-tin brought from Durango, Mexico, and that found in Idaho. The attention of Placer miners should be directed to this, as other fragments may be found in cleaning up sluices, and thus lead to the discovery of the source of this valuable ore of tin.

Bornite—Variegated Copper Ore.—This beautiful ore copper is found upon the claim of Mr. A. J. Ford, at Light's Canyon, Plumas County, in a vein affording massive specimens three inches or more thick. In the same region there are veins of yellow copper ore and of massive Hematite.

Section from Merced to Coulterville and Big Oak Flat.—From Merced station upon the Southern Pacific railroad, the line of section described in this contribution extends in a northeasterly direction, nearly transverse to the line of strike of some of the most interesting gold-bearing rocks of the Sierra Nevada. Merced is situated upon the alluvial plains of the San Joaquin. The level and clay soil, noted for its fertility and adaptation to cereals, extends without change to the Six-mile house, where gravel begins to show itself and the soil is poorer and more arid. Another six miles over a gentle rolling gravelly plain brings us to the banks of the Merced. Crossing by ferry to the right bank, we travel along the broad and rich bottom lands to Snellings and Merced Falls, passing plantations of India corn and cotton.

At Merced Falls, the first outcrop of the older rocks is observed. It is a hard bar of compact black clay slate, like roofing slate, very uniform in texture, in broad flat plates, standing vertically on edge, trending in remarkably straight lines northwest and southeast. This hard outcrop forms a natural dam, upon which the rapidly flowing water of the Merced has made but little impression. There is a fine water power at all seasons, which is partially utilized by a woolen mill. We here leave the river and ascend the hills to the northeast. The black slates carry numerous veins of white quartz which have not been much prospected. A few miles beyond the falls, the surface rises rapidly, and the slates give way to harder rocks. These are light bluish-green in color, weathering in places almost white. They are evidently of sedimentary origin, though much altered and changed from their original condition. They form the outlying belt of a series of heavily bedded conglomerates, sandstones, and shales, which, being harder and less susceptible to erosion than the slates, form the high hills and ridges. These elevations trend northwest and southeast, and are probably the northwestern extension of the Mount Oso range, which traverses a large portion of Mariposa County, and forms the western wall of Bear Valley, on the Mariposa estate. The heavy and bold outcrops of the massive conglomerates composing this range are not readily recognized as conglomerates. Their composite character is obscure. Generally it is scarcely possible to recognize that the rock is made up of rounded boulder-like masses. The boulders which form these rocks are so much compressed, welded, and united in one apparently homogeneous plasma, that the dividing lines and contact surfaces are obliterated, and cannot be seen except upon surfaces that have been weathered, and sometimes upon broad surfaces of fracture. Occasionally, where the metamorphic action has not been as strong as in other places, the original forms of the boulders can be made out, and the masses stand out from the general surface. In decomposing, these old conglomerates reveal their origin by yielding a vast amount of hard boulder-like masses, elongated and lens-shaped spheroids, which are utilized for fencing. These rocks are generally known and described as "greenstone," the color being light bluish-green, and the mineral composition of the boulders being like the green stones. They offer a very interesting subject of study to the lithologist and to the student of dynamical geology. They border on each side the belts of slates in which most of the quartz veins are found and have, next to the granites, best withstood the denuding and wearing forces of the elements, and thus have to a great extent determined the topography of the Piedmont region of the Sierra Nevada. Upon the line of the section herein described, such conglomerates occur in a number of parallel outcrops with slaty rocks between and belts of sandstone, the exact succession of which cannot be determined without painstaking investigation. The whole series occupies a breadth of about twenty miles between the slates of Merced Falls and the similar slates of Coulterville Valley. It includes at least two bodies of well-defined pebbly conglomerates, in which the pebbles are small—not much larger than beans. These conglomerate beds lie parallel with bodies of argillaceous slate, and clearly demonstrate a succession of deposits formed in alternating deep and shallow waters. Approaching Coulterville we descend the hills of greenstone conglomerate and pass suddenly upon the black slates of the valley. They greatly resemble the outcrops at Merced Falls, and probably are a repetition of that series. Here, however, they are especially interesting, as the matrix of the two chief lines of gold-bearing veins in California, the so-called "mother lode" of the State. In this valley, as also upon the Mariposas and farther north, there are two nearly parallel lodes of great size, the croppings of which are so bold and prominent, crowning the hills, as to be visible for miles. The western lode rises between walls of black slate, and carries films and sheets of the slates in its mass, giving to it a more or less stratified form and a striped appearance when seen in cross sections, or as it stands in the mines. Such quartz is technically known as ribbon quartz, and is a great favorite with quartz miners. In the mother lode proper, a short distance farther east, the quartz is more massive and solid, and is in close proximity to a belt of serpentine, and for a great part of its course follows and penetrates a stratum of magnesian rock, referable to ankerite and magnesite. It is characterized by rusty outcrops and an abundance of a foliated, bright green mineral to which the name "Mariposite" has been given. It appears to owe its green color to chromium and iron rather than to copper or nickel. The quartz penetrates this magnesian rock so thoroughly as to form in many places a complete network of veins branching off from the chief body. Beyond the veins and magnesian belt the slates are seen again for a short distance, and are succeeded by greenstone conglomerates. Beyond these, on the road to Big Oak Flat, there is a heavy body of syenite forming a hilly region traversed by the road for ten miles north and east to Priest's, on the Yosemite road. From Priest's, westward, there is a region of massive, hard black slates, which appear to belong to the series of formations in which the limestone belt of Sonora and the Hite group of veins occur. I regard them as older than the mother lode series of slates, and believe that they belong to the period of the carboniferous; the reasons in part for this belief being their stratigraphical relations to other formations and the abundance of carbonaceous matter which they contain.

The mother lode slates have been shown to correspond in age to the jurassic period. I am inclined to refer the greenstone conglomerate series to the trias. The whole series of formations embraced in the section give satisfactory evidences of extensive plication and subsequent erosion. The dips are generally eastward and at a high angle.

Coulterville to Chinese Camp.—Leaving for the present a notice in detail of the mother vein, we follow its course approximately to Chinese Camp, near Sonora, in Tuolumne county. Crossing the line of the great vein at Coulterville, the road leads for a short distance over an outcrop of the heavy greenstone conglomerate, bordering the slates on the west. From that point to Priest's hotel, on the Yosemite road, a distance of ten miles, the rock formations are entirely different from those of the valley, being granite and syenite. The hills rise higher and the topography changes. The altitude at Coulterville is about 1,700 feet, and the road, upon the granite formation, is about 2,500 feet. Priest's is between 2,300 and 2,400 feet in altitude. The hills are but sparsely timbered and generally are wholly covered by a dense growth of chemisal. When this is in blossom, it never fails to remind one of the heather-covered downs of England, although it is comparatively gigantic in growth. These high hills, which have been generally regarded as barren and worthless, are now being sought for and utilized for grain-growing and vineyards. Wherever water can be distributed over the surface, the granite soil yields excellent crops of wheat. The vine takes kindly also to this soil and particularly where there is an excess of iron oxide, giving a red color to the earth. Probably the greenstone conglomerate hills are better than the granite. It is said that wherever the vines get well started they do not afterwards require irrigation. The fact that these hills can be covered with vineyards is extremely important as greatly extending the area of the vine-producing region of the State. About midway between the points mentioned, the syenitic granite gives way for a short distance to a thin belt of gneissic rock and a metamorphic slate. These formations are bordered by felsites, which, in decomposing, have formed banks and layers of kaolin, cut through by the graded road. Near Priest's some gold-bearing quartz seams, or veins, have been found traversing the granite. These probably hold about the same relation to the veins of the slate belt as the veins in the granite at West Point, farther north, do to the veins in the slates of Amador county. At Priest's we pass upon another and heavier belt of slaty rocks, which are more massive, harder, and appear older than the jurassic slates of Coulterville. This formation extends east and southeast from this point, and is probably the same body of hard black slates reaching southeast to Hite's Cove and beyond, carrying the celebrated Hite vein and others. These slates are regularly stratified, and appear to be traversed by dykes of trap or greenstone.

From Priest's to the Tuolumne river at Stephen's Bar the road leads in a northwesterly direction. The granite and syenite appear to thin out, for directly after leaving Priest's the greenstone conglomerate takes its place. The road descends rapidly between high chemisal covered hills, underlaid by the conglomerates, to Culbertson's in the valley, only a mile west of Priest's, and 1,300 feet lower. At this point we are again upon the mother lode formation, and follow it down Moccasin creek to the Tuolumne. Looking back toward Coulterville, the view is interrupted by the Peak of Penyon Blanco, the crest of which is formed by the massive blocks of white quartz of the mother vein. About Culbertson's the vein is split up, and does not come boldly to the surface. Lower down the valley it appears in the foothills on the right bank, and on the left bank there are heavy outcrops of serpentine, extending nearly to the Tuolumne, where the slates are found largely developed. The mouth of Moccasin creek is only about 700 feet above tide. Running parallel as it does with the great vein for several miles, it might be expected to be rich in gold, which was the fact. It has been worked and reworked with profit, but now the gravelly bed is being leveled, and vineyards and orchards cover its surface and give a perpetual bonanza to the appreciative sons of Italy. The wonder is that more of our American young men and women do not avail of the many opportunities to make charming and profitable homes in the forsaken gold fields of California.

We cross the river in a boat and follow the left bank for about two miles to Jacksonville, noted years ago for its figs and oranges. The general direction of the river corresponds with the strike of the formations, but it soon turns abruptly to the west and cuts across the slates and sandstones of the chief gold belt. Conglomerates and outcrops of serpentine with traces of the mother lode are also found; and these rocks continue, with a regular northwest trend, to Chinese Camp, eight miles southeast of Sonora. This place is situated in an open, gently rolling country, at an altitude of about 1,300 feet. Surface gold washings were very extensive in this vicinity, and sustained a large population of miners for many years, but the diggings are now overgrown with grass, and many of the once well-filled stores are vacant.

Chinese Camp to Sonora.—In my last communication the course of the lode was followed from Coulterville to Chinese Camp, and it was shown that for most of the distance northwest of Penyon Blanco the lode does not crop out strongly, and appears at intervals only. The formations, however, continue unchanged, and the line of the lode is east of Chinese Camp. Leaving Chinese camp, and passing northeastward at right angles to the strike of the rocks, we first cross the eroded outcrops of the conglomerates, and then over a belt of slates standing on edge, but presenting an almost flat surface, greatly resembling the outcrops at Merced Falls. This smooth, and apparent planed-off outcrop is in strong contrast with the sharply serrated edges of the slates standing above the soil like tombstones, generally known among the miners as "grave-stone slates." The difference of surface is very likely due to a difference of internal grain; the absence of the elongated structure made by pulling or stretching the strata during the period of plication, to which we may refer the sharp ellipsoidal outcrops of the slates in a great part of the gold region. Beyond these outcrops, north and west, there is a belt of greenstone conglomerate, succeeded by serpentine; apparently the prolongation of the serpentine belt traced northwestward from Coulterville and along the Tuolumne. Pliocene gravel also makes its appearance in remnants of a tableland formation; and a short distance beyond, the lava-capped beds of Table Mountain bound the view from north to west.

Thinly-bedded clay slates come to the surface east of the serpentine, and continue up to the outcrop of the mother lode, about one mile west of Jamestown. The lode of this place crops strongly, and forms the crest of a ridge, upon the flanks of which there are heavy deposits of quartz gravel, evidently derived from the disintegration of the vein. The many pits and trenches in this gravel clearly indicate its valuable auriferous character, and at the same time, show that the vein is not a mere barren outcrop of quartz. The vein is accompanied by many branches and veinlets penetrating the adjoining slates in various directions. It follows the formation and trends northwest towards Table Mountain, under which it disappears. It would be interesting to ascertain what the fineness of the Table Mountain gold is, compared with the fineness of the gold from the vein. There can be little doubt that the Table Mountain deposit was greatly enriched below the mother vein by the gold broken from its croppings upon the banks and in the bed of the ancient river, along which the deposits and lava overflow of the present mountain were formed.

The lode is in the midst of the clay-slate formation which extends to and beyond Jamestown. East of this place the slates become harder, more massive, and are traversed occasionally by quartz veins. All the formations trend toward Table Mountain, and are there covered from view. As the slates become harder, the surface of the country rises from 1,400 feet elevation at Jamestown to nearly 1,800 feet at Sonora. This may be due in part to a very hard dyke of dioritic rock just west of the town. Sonora is built upon hard, massive black slates, resembling those beyond Priest's, and at the Hite mine, belonging, I believe, to the most eastern belt of slates of the Sierra; these black argillaceous slates are firm and hard enough to be quarried for building purposes. They are gold-bearing, and at the present time, there is a most notable development of a vein within the town limits, from which fabulous amounts of gold are taken by two men, the metal being so abundant that but little crushing in a hand mortar is required to free it from quartz.

The limestones at Sonora, bordering the slate formations on the east, constitute one of the most interesting geological formations of the State. They are here developed over a considerable area and stretch for many miles to the northwest, to Columbia, Shaw's Flat, Murphy's and beyond; and southeastward it is believed to reach to Hite's Cove and beyond it, though I have not traced them in that direction. In a section which I shall hereafter give, from Mariposa to Hite's Cove, I shall show the similarity of the formations; that there are several distinct strata, or beds, and that some of them abound in fossil encrinites. The Sonora outcrops have failed, so far as I know, to give any evidence by fossils of their age or place in the geological scale. There is no doubt, however, of their deep-sea marine origin. They show distinct stratification and alternate layers of gray, white, and blue color. The stratification is nearly vertical and the beds being of differing degrees of solubility now present a very extraordinary and uneven surface, especially where in the flats and valleys they were covered with alluvial gravels and clays. In such places, notably in Columbia and Shaw's Flat, the outcrop consists of a succession of sharp, irregular bodies of limestone, separated by deep, fissure-like chasms. The masses, in many instances, seem like loose boulders, and where the soil and gravel were removed by mining, they toppled over. Such a surface proved to be wonderfully retentive of placer gold, and the harvest from this strangely irregular surface of limestone was very great. Miners have worked the crevices to great depth, and there is reason to believe that the bottom of many of the chasms has never been reached. A similar formation occurs in the Ural mountains, and was described by Sir Roderick Murchison. A reference to this and a more complete notice of the Sonora deposits, with figures, will be found in my report to the United States Government in 1853 to 1855. The cause of the uneven surface is not as generally supposed, mechanical wearing away, or erosion, but is chiefly chemical. It is due to the solvent action of carbonated water percolating through the soil or standing in the undrained and swamp-like flats. As the rock was dissolved the gravel and gold sank down into the cavities and crevices far below the surface upon which they were originally laid down.

At the time of my first visit, in 1854, the whole limestone belt was populous with miners, and many relics of the Pliocene age were brought to light and were often lost to history and science. These for the most part consisted of teeth of elephants, the mammoths, and of the mastodons of primeval days, when they roamed through the forests and glades of California with the tapir and hipparion. Whether the progenitors of the modern Digger Indians were "there to see" is still an open question, though some cracked skulls are thought to bear evidence on this part.

The late Dr. Snell, of Sonora, was an enthusiastic collector of aboriginal stone implements and relics which have been peculiarly abundant about Table Mountain, and were supposed by the doctor to be of great age, even antedating the lava flow. This, however, is very doubtful. As the subject is very interesting, and the facts are important in the discussion of the antiquity of man upon the globe, I propose to make them the basis of a second paper. Since the death of Dr. Snell, his collection appears to have been scattered. I did not find in Sonora any one who could give me an account of it. Casts of soms of the specimens have been sent to the Smithsonian Institute; and the doctor presented me with a collection of specimens some years before his death. At the same time, I made exact drawings of some of the more important pieces.

Occurrence of Vanadates of Lead at the Castle Dome Mines.—The occurrence of the rare metal *vanadinite* at the Castle Dome mines is sufficiently interesting to receive a special notice in this series, although the locality is just beyond the line of the State, across the Colorado river, and in the Castle Dome district, Arizona. Vanadinite, which occurs in considerable abundance in the claim known as the "Railroad," is a rare mineral, and has not hitherto been found in the United States, if we except some minute microscopic crystals mixed with Wulfenite found in the ores of the Wheatley mines, at Phœnixville, Pennsylvania, and referred to the species Descloizite, also a vanadate of lead. The vanadinite occurs in groups of hexagonal prismatic crystals with curved sides, tapering at each end, and closely resembling pyromorphite in form and grouping. These crystals are rarely over one-sixteenth of an inch in diameter, being generally half that size and less than three-sixteenths long. They are in confused aggregations, forming crusts and filling cavities in the decomposing ores of lead, and also on fluor-spar. Some of the crystals are cavernous, presenting the appearance often seen in phosphate of lead. One side of a crust of crystals is often in distinct hexagonal crystals, and the other consists of an aggregation of minute crystals grouped in arborescent forms, and differing in color from the coarser crystals. The larger crystals are generally light-brown in color, with a bronzy luster. The smaller crystals are lighter, and are of various shades of orange-yellow, becoming in places nearly white with a silvery wax-like luster, due possibly to a pellicle of some other mineral covering the surface. The yellowish brown crystals have a wax-like appearance and luster. The difference in appearance in the crystalline crusts, their difference of aggregation and color, suggest the probability of several species. It is possible that Dechenite, Descloizite and Mimetite are represented; also Eusynchite. The behavior with nitric acid is different, some crystals showing a distinct separation of red vanadic acid, and others giving but a slight reaction. The Wulfenite crystals in association are extremely brilliant and light-yellow in color, presenting a beautiful appearance upon a background of green fluor-spar, or white crystalline carbonate of lead. There is great need of investigation of the composition of the many varieties of yellow, red, and brown crystals from Castle Dome and silver district, now usually referred to Wulfenite, though it is probable that several species are represented.

The Castle Dome vanadinite is totally different in appearance from the red crystals of Silver district. At Castle Dome the vanadium appears to be present in varying proportions in the crystals of different appearance, though all hexagonal, and to be associated with arsenic acid in the mineral species, Mimetite.

Some of the specimens giving strong arsenical odors on coal and having the external characters of mimetite or arsenate of lead, give also characteristic reactions for vanadic acid though not to the same degree, or so distinctly as other crystals where the arsenical reactions are weaker. The strongest reactions for arsenic, so far obtained, are from the crusts of small aggregated crystals of a light brown or straw-yellow color and wax-like luster. The deportment with nitric acid varies, but all the varieties disolve and give finally yellow solutions, which become green and blue where deoxidized by organic acids or alcohol, The occurrence of vanadic acid in mimetite is not unknown, Domeyko having found it in mimetite from Mina Grande, Chile. In all of the specimens so far examined, whether the light yellow, barrel-shaped crystals, or the long, tapering, hexagonal prisms, or the dendritic aggregates, reactions for chlorine are obtained, and the yellow nitric solutions become green by heating with alcohol. It is interesting to note here that recent researches by M. Bertrand go to show that the hexagonal crystals of mimetite are compound crystals, made up by twining of orthorombic crystals. This has been shown by the study of the optical characters. While pyromorphite is truly hexagonal, showing only one axis of symmetrical polarization, mimetite was found to have two optic axes. It is possible that we may find crystals large enough from Castle Dome or Silver district to examine with the polariscope, and ascertain whether they are in reality compounded or single.

Vanadinite also occurs in beautiful crimson red crystals in the Hamburg mine at Silver district. These crystals are small, but are beautifully distinct hexagonal prisms or "berylloids," being similarly shaped, and are terminated by a flat plane at right angles with the planes of the prism. The terminal edges are replaced by a minute brilliant plane, and in one or two of the crystals a plane replacing one of the solid angles has been observed. The material at hand is insufficient to give me the best specimens for examination by the goniometer, so as to accurately measure the inclination of these terminal planes to the base or sides. I have, however, mounted one of the minute crystals in hand, and the angles of the prism apparently equal, so there is little doubt of its truly hexagonal form. The seemingly partial termination or modification of the terminal edges in some crystals raised the question whether, though apparently hexagonal, the true form might not be rhombic. The streak or powder of this mineral is salmon-colored or orange red. It dissolves completely in dilute nitric acid, but in strong nitric acid, if added in small quantities, there is a separation of a red powder, which floats off in the acid and is then dissolved, giving a yellow solution, which, after standing some hours, becomes green. It is also turned green in a few moments by the addition of a small quantity of alcohol, and this green solution, on boiling, turns blue. These reactions are characteristic of vanadic acid. With microcosmic salt in the outer blowpipe flame, we obtain a yellowish green glass, which in the reducing flame is changed to an emerald green when cold. With borax in the outer flame an olive brown bead results. Strong reactions for chlorine are obtained by the silver test. Some of the crystals are light amber colored and are transparent, and some of them are much darker in color near the terminal plane than at the foot of the prism where it adheres to the gangue.

In the Red Cloud mine at Silver district and likewise at the Silver Glance mine numerous fine specimens of tabular crystal of Wulfenite have been procured from time to time for the past two years. These crystals are often half an inch across, and are from one sixteenth to one eighth of an inch thick. The chief peculiarity is their fine red color, very different from that of ordinary molybdate of lead and contrasting strongly with the yellow Wulfenite crystals from the same localities, and from those also of Castle Dome. These red crystals I provisionally refer to the vanadiferous variety of Wulfenite. A complete analysis is, however, needed to show the composition of this and other allied varieties found in other claims at Silver district, notably at the mines opened by Bamber & Sons—"The Oakland Boys' claim." The first red crystals of Wulfenite observed in the United States were extremely small, being almost microscopic, and were implanted on the ores from the Wheatley mine, at Phœnixville, Pennsylvania. They were found by the writer, and the red color was at first supposed to be due to chromic acid, but when the mineral was procured in quantity sufficient for analysis, Professor J. Lawrence Smith showed that the red color was due to the presence of vanadic acid. The Silver district specimens now afford sufficient material to permit of a quantitative determination of the constituents.

Beautiful octahedral crystals, of a reddish-brown color, are obtained at the Oakland Boy's claim. I regard these as another vanadic mineral, possibly a vanadic variety of Wulfenite; though the form and the color are so different from the form and color of undoubted Wulfenite in the district, I am inclined to regard it as a distinct species, or, at least, a well characterized variety. I am indebted to Mr. William P. Miller, the general superintendent of the Castle Dome mines and the smelting works at Melrose, for assistance in procuring some of the specimens which I have been describing. Some were obtained by me at the mines, April, 1880, and others at the time of my last visit to the mines in 1881.

INTERESTING STATISTICS FROM FOREIGN COUNTRIES.

IN Part III we have thought it advisable to introduce certain statistics from foreign countries; that while not properly belonging to the mining interests of the United States are still of deep interest and necessary to know. We begin the compilation with tables on the foreign iron trade, from the admirable report of Mr. James M. Swank, Secretary of the American Iron and Steel Association, a gatherer of statistics, who can always be relied upon.

General Summary for 1881 and 1882.—In our Annual Report which was published in the summer of 1881 the statement was made that the foreign iron and steel industries had been generally prosperous since the latter part of the year 1879, when the influence of the revival of American prosperity began to be felt abroad. This favorable condition continued, although in a modified degree, throughout the whole of the year 1881, which, as has already been stated, was also a year of great prosperity in the iron and steel industries of our own country. Without a single important exception every European country produced more iron and steel in 1881 than any preceding year, while prices were in the main satisfactory to producers. They were not, however, so high as in 1880. The production of British iron and steel in 1881 was enormous, and exports were well maintained all through the year, the latter being slightly in excess of the extraordinary exports of 1880. Among Continental countries France, Germany, Belgium, Austria, and Sweden could boast of active and prosperous iron and steel industries in 1881. The iron and steel manufacturers of France especially enjoyed a very prosperous year. It is an interesting coincidence that in many European countries—France, Germany, and Austria particularly—the increased demand for iron and steel in 1881 was largely due to the same activity in railway building which prevailed in that year in our own country. Iron and steel rails and railway rolling stock were required in larger quantities in these countries in that year than in any preceding year since 1872 and 1873. During the first five months of the present year these requirements were continued without serious abatement. Naturally the stimulus imparted to general business by the activity in railway building extended to other forms of iron and steel than those mentioned.

While we are without positive information concerning the probability of continued activity in the building of Continental railways, various other circumstances, already developed, point to the conclusion that the European iron and steel industries will not as a whole be so actively employed in 1882 as they were in 1881. The most important of these already developed circumstances will readily occur to the reader. The decline in the American demand for foreign iron and steel unfavorably affects all foreign markets, but it particularly affects the British iron market, compelling British ironmasters to lower their prices, and leading them to more sharply and severely compete with native manufacturers in the supply of the Continental markets. We obtain a hint how severe this competition may be from a remark recently made by the English metallurgical authority, *Iron*, in referring to the influence of the Protective policy in Germany. It said: "The Protective tariff which Germany adopted in 1879 is unable to check the steady importation of English pig if that description of metal is low enough in the English market to bear the import duty and thus to make its importation into Germany profitable." As the German duty on pig iron is only $2.50 per ton, our American readers will see that British pig iron at its present low prices is altogether likely to find its way into German markets in large quantities, or else it will so depress the price of German pig iron that its manufacture can not be profitable. The plain truth is that the German tariff, although nominally protective, is really too low to afford sufficient protection to German iron and steel manufacturers whenever their British rivals find it necessary to enter German markets. Some other Continental countries do not have even so highly protective duties as Germany. British ironmasters, therefore, lacking the large American demand this year to which they have for two or three years been accustomed, will crowd their products on Continental purchasers, to the injury of native manufacturers. Even France, by its new duties, is not free from the influence of British competition. The general adoption of the Protective policy on the Continent has, of course done much to develop Continental industries, but duties are as a rule still too low to afford adequate protection in periods of great depression. In many Continental countries they too much resemble the duties imposed by American statesmen upon foreign commodities in the early years of our history, which for purposes of protection were more ornamental than useful.

The action of France, in generally reducing duties on imports by the law of May 7, 1881, is a reactionary step which was certainly not expected from a country which has been so pronounced an advocate of Protective policy, and which has, as all the world knows and admits, been so greatly benefited by it. The education in the duties on certain forms of iron and steel is very marked, and this reduction has been emphasized by the conclusion of a new treaty with Belginm, whereby the duty on pig iron from that country has been still further reduced five francs per ton. The same rate of duty will apply to German pig iron, under "the most favored nation clause" in a treaty between the two countries. It will also, by the spontaneous act of the French Government, apply to British pig iron. The effect of the new duties on the French iron and steel industries can easily be conjectured. The French journal, *L'Ancre*, in a recent issue, thus describes it:

> What cannot be denied is that foreign competion causes home iron manufacturers to be constantly on the look-out, and that they are compelled to keep their eyes upon Germany, Belgium and England, and to follow the movements and the tendency of the markets of those countries. England and Luxemburg for pig iron, and Germany and Belgium for manufactured iron, become to some extent regulating markets which we must consult. The general position, for instance, of our foreign neighbors does not inspire apprehension of a reaction; nevertheless, we must not forget that competition has been made easier by the recent modifications of the customs tariffs. We may expect them to take part, and be sometimes even successful, in competitions for contracts given out both by the government and private firms.

France, therefore, in lowering her duties on iron and steel invites competition from all her neighbors—an experience to which she has not been much accustomed. It is entirely safe to predict that the new policy will not be well received by the great iron and steel interests of France, and it is, we think, equally safe to predict that it will not long continue to receive the approval of the French Government itself. The French iron and steel trades are now, however, very active. The most recent information we have received from other Continental countries represents a weakness in prices and some difficulty in securing orders in the Belgian iron markets; activity in the manufacture of Bessemer steel rails in Austria, but dullness in its finished iron markets; depression in the pig iron trade of Germany, in consequence of British competition, and a lack of animation in some other branches of its iron trade, but continued activity in its various steel works; and stagnation in the Swedish iron markets, relieved, however, by a decided improvement, originating a year or two ago, in the Bessemer and Siemens-Martin steel industries of the country. In the manufacture of locomotives, railway cars, and machinery generally Austria, Belgium and Germany are well employed, as is also France. Sweden is fortunate in having received numerous orders for iron and steel ships for Russia, Denmark and Norway. The iron trade of Russia does not prosper, but the manufacture of steel is supposed to be increasing. In the remaing Continental countries comparatively little iron or steel is ever made. The condition of the British iron trade in the early part of May was described by the London *Times* in a leading article from which we take the following extracts.

"The iron trade of the United Kingdom is in an anomalous condition at present, and much attention is, therefore being directed to this enormous industry. The year opened with a strong buoyant feeling, full of hope and expectation of a general expansion of our home and foreign iron industries, great stress being laid on the certainty of another 'boom' from America. As a consequence of that feeling consumers and merchants bought all kinds of iron freely and in large quantities in anticipation of the good time coming. Scotch pig iron warrants in the beginning of January were quoted 53s., Bessemer iron 65s., and Cleveland pig 43s. To-day the respective prices are 47s. 6d., Scotch, 52s. 6d., Bessemer, and 43s. Cleveland. It will be noticed that a serious fall in values has occurred in the two former, but the price of Cleveland remains the same. The present depression in iron and steel is undoubtedly traceable to the disappointment in the American demand.

Since the beginning of this year stocks of iron in Scotland have increased by about 25,000 tons. Stocks of Bessemer iron have also increased considerably. As a further indication of the demand having to a large extent been overtaken by supply, it may be stated that steel rails which were lately selling freely at £6 5s. can now be purchased at 15s. per ton less and manufactured iron is from 10s. to 15s. per ton cheaper than the highest point touched this year. The unprecedented demand for steam shipping alone remains as the prop of the great iron industries of the North of England. Her iron rail trade is a blank. But even in this important branch of trade we do not hear of the same number of new steamers being placed on the Tyne, Wear, and Teas, or on the Clyde, as there was at the opening of the year. It is evident that if shipbuilders do not get fresh work at the same rate as they launch vessels their order-book which has been so full will diminish, and bring about a change before long."

Since *The Times* gave these facts and opinions to the world the price of Bessemer steel rails has fallen in England to £4 15s. per ton. It is by constantly lowering her prices as occasion demands that Great Britain succeeds in sending such large quantities of her iron and steel products to other countries. Her manufacturers are first to see and to act upon any tendency to reaction from prosperous times. In this country manufacturers frequently insist on holding up prices when every sign indicates that the tide has turned.

Great Britain.—*Coal.* Great Britain's production of coal in 1881 was the largest in her history. According to the statistics of the Inspectors of Mines it amounted to 154,184,300 gross tons. In 1880 the production, according to Mr. Robert Hunt, Keeper of Mining Records, was 146,818,622 tons. The production of coal in each of these years was twice that of the United States. The production of coal in Great Britain from 1854 to 1880 is given as follows by Mr. Hunt, to which we add the figures of the Inspectors of Mines for 1881. (We may state here that Mr. Hunt is the official government statistician, but that his statistics do not usually appear annually until after the issue of our annual report.)

Years.	*Gross tons.*	*Years.*	*Gross tons.*	*Years.*	*Gross tons.*	*Years*	*Gross tons.*
1854	64,661,401	1861	84,013,941	1868	103,141,157	1875	131,867,109
1855	64,453,079	1862	81,638,338	1869	107,427,557	1876	13[illegible],344,765
1856	66,645,450	1863	86,292,215	1870	110,431,192	1877	134,910,763
1857	65,394,707	1864	92,787,873	1871	117,352,028	1878	132,607,866
1858	65,008,649	1865	98,150,687	1872	123,497,316	1879	134,008,228
1859	71,979,785	1866	101,630,544	1873	127,016,747	1880	146,818,622
1860	80,042,698	1867	104,500,480	1874	125,042,757	1881	154,184,400

The exports of coal from Great Britain to foreign countries in 1881 amounted to 19,591,598 gross tons. In 1870 they amounted to 11,702,649 tons. The increase from 1870 to 1881 was gradual. France is the leading importer of British coal—Germany, Italy, Russia, and Sweden and Norway coming next in the order named.

Iron Ore.—Mr. Hunt gives the quantity of iron ore produced in Great Britain in 1880 as 18,026,049 gross tons, to which were added in that year 427,730 tons of "burnt ore" from cupreous pyrites, and 2,632,601 tons of imported iron ore. The approximate total of iron ore smelted in Great Britain in 1880 was, therefore, 21,086,380 tons. The production of iron ore in Great Britain in 1881 is not yet obtainable. The imports of iron ore into Great Britain in 1881 aggregated 2,449,277 tons, the average cost of which to consumers was from 15s. to 16s. per ton. Of the importations of the year two million tons came from Spain. The imports of iron ore in 1880 were, however, larger than in 1881, being 2,632,601 tons, of which 2,278,962 tons came from Spain. Mr. J. S. Jeans, the Secretary of the British Iron Trade Association, says that in 1866 British imports of Spanish iron ore amounted to only 27,619 tons, and that in 1870 they amounted to only 179,083 tons.

Pig Iron.—Great Britain's production of pig iron in 1881 exceeded the production of any previous year, even of 1880, a year which saw a great advance upon any previous yearly record. In 1880, according to Mr. Hunt, the production amounted to $7,749,233 gross tons, while in 1881, according to Mr. Jeans, it rose to 8,377,364 tons. To realize how enormous was the production of pig iron by Great Britain in these two years we need only to reflect that in each year the production was more than twice that of the United States, and yet our production in these two years far exceeded all our previous achievements. The following table, compiled from statistics prepared principally by Mr. Hunt, shows the growth of the pig iron industry of Great Britain from 1740 to 1881. The figures for 1881 are by Mr. Jeans.

Years.	*Gross tons.*	*Years.*	*Gross tons.*	*Years.*	*Gross tons.*	*Years.*	*Gross tons.*
1740	17,000	1835	1,000,000	1858	3,456,604	1870	6.963,515
1788	98,009	1839	1,347,790	1859	3,712,904	1871	6,627,179
1796	125,009	1840	1,396,400	1860	3,826,762	1872	6,741,629
1806	259,000	1842	1,099,138	1861	3,712,390	1873	6,666,451
1818	325,000	1844	1,999,608	1862	3,943,469	1874	6,991,408
1820	400,000	1845	1,512,600	1863	4,510,040	1875	6,365,462
1823	454,866	1847	1,999,608	1864	4,767,901	1876	6,555,997
1825	681,367	1852	2,700,000	1865	4,819,254	1877	6,608,664
1827	690,000	1854	3,069,838	1866	4,623,897	1878	6,381,051
1828	703,184	1855	3,218,151	1867	4,761,023	1879	5,995,337
1830	678,417	1856	3,586,377	1868	4,970,206	1880	7,749,233
1833	700,000	1857	3,659,477	1869	5,446,767	1881	8,377,364

Cleveland (Durham and North Yorkshire) and Scotland, which are leading pig iron producing districts in Great Britain, both increased their production in 1881, notwithstanding an agreement by the ironmasters of both districts to restrict production 12½ per cent. for six months commencing on the 1st of October. The production of Scotland was 1,176,000 gross tons in 1881, against 1,049,000 tons in 1880; the production of Cleveland was 2,670,339 tons in 1881, against 2,510,853 tons in 1880. In the West Cumberland district there was a large increase in 1881 as compared with 1880—the production in 1881 being 077,871 tons, against 751,371 tons in 1880. This district produces Bessemer pig iron, and a large part of the increase in its production in 1881 was due to the increase exports in that year of this class of pig iron to the United States. Mr. Jeans says that the manufacture of spiegeleisen in Great Britain is largely increasing, and now amounts to nearly 100,000 tons annually, of which the largest quantity is produced in South Wales. He also says that nearly 3,000 tons of charcoal pig iron are still made annually in Great Britain—all by one firm with a few furnaces, which, as we learn from another source, are located in Scotland and "over the border" in Cumberland and Hampshire.

The stocks of British pig iron in the hands of makers or in warrant stores at the close of 1881 were very large, amounting to 1,736,262 tons—an increase of 194,851 tons on the quantity held at the close of 1880. Some of the unimportant districts decreased their stocks in 1881, but Scotland increased its stocks 201,000 tons during the year, or from 739,-

000 tons to 940,000 tons. Cleveland stocks increased 47,046 tons, or from 331,124 tons to 378,170 tons. With the exception of Scotland, stocks were reduced in all the leading districts during the second half of 1881, but notwithstanding this reduction they still amounted at the close of the year to 20 per cent. of the year's production. The exports of British pig iron in 1881 were 152,147 tons less than in 1880. In 1880 they amounted to 1,732,343 tons, and in 1881 to 1,480,196 tons.

Prices of Pig Iron.—Prices of pig iron in Great Britain varied greatly in 1881. Messrs. William Fallows & Co. say of prices in the Cleveland district: "The year opened with No. 3 at 41s., and the price gradually receded until 36s. was accepted in May. From this time there was a slow but gradual recovery until 43s. 3d. was reached by the close of the year." Of prices in Scotland they say: "The condition of the pig iron trade in Scotland was unsatisfactory. In previous years this market had been very much stimulated by the American demand, and as this was disappointing in 1881 there was a corresponding amount of depression. The year opened with G. M. B. warrants at 53s. 9d., but the small shipments and restricted demand soon told upon prices, and 45s. was reached by the end of May. A slight rally took place in June and July, but in August the price had receded to 45s. 6d. In September the expectation of some reduction in the output of Cleveland and Scotland led to a considerable advance, and 51. 10½d. was paid on 23d September, when the agreement was finally concluded. The result of this movement was to draw out buyers all round, both for pig and manufactured iron, and the former advanced to 53s. 6d. in October. After some reaction 53s. 6d. was again reached by 9th December, and, after touching 50s. 9d., the year closed at 51s. 10d." Mr. Jeans says that the average range of prices for pig iron in 1881 was lower than for many years, with the exception of 1878 and 1879, and submits the following table of average prices of Cleveland and Scotch pig iron in the ten years from 1872 to 1881.

Years.	Average price of Middlesbrough No. 3.	Average price of Scotch warrants.
1872	£4 18 5	£5 1 10
1873	5 8 0	5 16 11
1874	3 9 10¾	4 7 6
1875	2 14 2	3 5 9
1876	2 7 4½	2 18 6
1877	1 1 10	2 14 4
1878	1 19 2	2 8 5
1879	1 17 6	2 7 0
1880	2 4 11	2 14 6
1881	1 19 2	2 9 1

Mr. Jeans adds that in the statistics of the Scotch iron trade it is necessary to go back to 1852 before as low an average of prices can be found as ruled in 1881, the years 1878 and 1870 excepted. "The average price of Cleveland No. 3 iron over the last ten years has been £2 19s. 9½d. per ton, which is £1 0s. 7½d. above the average of last year. The average price of Scotch warrants over the same period has been £3 11s. 9½d., being £1 2s. 8½d. above that of 1881." Manufacturers of pig iron in this country will now understand more fully than heretofore why Great Britain was able to send us so many tons of pig iron in 1881 and in the first months of 1882. British ironmasters were not only burdened with heavy stock, but their prices had fallen much lower proportionately than the prices of American pig iron.

Manufactured Iron.—Mr. Jeans has been unable to obtain complete returns of the production of manufactured iron in Great Britain in 1881 or preceding years. The total production of iron rails in 1881 was about 150,000 tons, of which South Wales produced all but about 30,000 tons. Nearly all the rails made were exported. Mr. Jeans publishes a very interesting series of tables which show the variations in the quantities of each of the leading forms of iron rolled in the Cleveland district in the ten years from 1872 to 1881 namely, rails, plates, bars and angles. The changes in these ten years are clearly indicated in the following summary of the percentages of total sales of these products at the beginning and end of the decade mentioned. The decline in the iron rail-trade of the district almost amounts to its annihilation.

Articles—Percentage of Sales.	1872.	1881.	Difference.
Rails	49.01	2.62	46.39
Plates	29.16	66.41	36.25
Bars	12.28	11.76	.52
Angles	9.52	20.19	10.67

Prices of Manufactured Iron.—Mr. Jeans gives the following comparative statement of the prices of manufactured iron in 1881 and preceding years in the Cleveland district:

With the exception of 1879 the past year has witnessed a lower average range of prices than any twelve months since 1870. In the former year the lowest prices realized for iron rails were those of the second and third quarters. when £4 14s. 5d. and £4 14s. 8d. respectively were brought out. Last year an average of £5 1s. 9d. per ton was realized during the second quarter, being only 7s. more. The lowest price realized for plates in 1879 was £5 4s.; in 1881 it was £6 1s. 8d., or 17s. 8d. more. Bars touched their lowest quotation at £5 5s. 9d. in the third quarter of 1879; in 1881 their lowest average was £5 15s., so that the difference was 9s. 3d. in favor of last year. Angles were £4 16s. 11d. at their lowest in 1879, and £5 8s. 5d. in 1881, giving an increase of 11s. 6d. in the latter year.

Bessemer Steel.—As we have already stated in the first part of this report, devoted to the iron and steel industries of the United States, and there used for comparison, the production of Bessemer steel ingots in Great Britain in 1881 was 1,441,719 gross tons, and the production of Bessemer steel rails was 1,023,740 tons. In 1880 the production of ingots was 1,044,382 tons, and that of rails was 739,910 tons. The increase in the production of ingots was 397,337 tons, and in the production of rails it was 283,830 tons. In each year 70 per cent. of the ingots produced was manufactured into rails. The largest increase in the production of both ingots and rails was in the Cleveland district, but every other district except Staffordshire also increased its production. The leading Bessemer steel districts in Great Britain now are, in the order named, Sheffield, South Wales, Cleveland, Lancashire, and Cumberland. Staffordshire makes an inconsiderable quantity of Bessemer steel. At the close of 1881 there were 82 Bessemer converters at work in Great Britain, 27 unemployed, and 14 in course of erection. The average yield of the converters at work was 17,582 tons. Mr. Jeans selects from the whole number 21 especially well-managed converters which produced 533,000 tons, or an average of 25,400 tons for each converter. The best results obtained were 64,861 tons with two converters, and 140,000 tons with a four-vessel plant. Of the production of 1,023,740 tons of Bessemer steel rails by Great Britain in 1881, more than the half, or 594,419 tons, was exported, the remainder being taken for home consumption. The statistics of the production of Bessemer steel ingots and rails in Great Britain in the last five years, compared with similar statistics for the United States in the same period, are as follows:

Years.	Gross tons.			
	Great Britain.		United States.	
	Ingots.	Rails.	Ingots.	Rails.
1877	750,000	508,400	500,525	385,865
1878	807,527	633,733	653,773	491,427
1879	834,511	519,718	829,439	610,682
1880	1,044,482	739,910	1,074,262	852,196
1881	1,441,719	1,023,740	1,374 247	1,187,770

The following additional details of interest concerning the Bessemer steel industry of Great of Britain in 1881 are taken from Mr. Jeans's report for that year:

No real progress has been made during the past year in the direction of employing Bessemer steel for shipbuilding purposes. The total quantity of Bessemer plates made was 21,989 tons, being an increase of only 489 tons on the preeding year, and an advance of 12,838 tons on the production of 1879.

Of the 400,000 tons of ingots which were used for other purposes than rails in 1881 a large part took the form of blooms for export to the United States. The production of blooms in 1881 was about 100,000 tons in excess of that of any former year. About 500,000 tons of ingots were manufactured into tires, axles, and general forgings; and 15,000 tons were made into angles for shipbuilding purposes, and so forth.

The course of prices has been much more uniform in 1881 than it was during the preceding year. Statistics with which we have been furnished from some of the principal works show that in 1880 steel rails were sold as low as £5 7s. 6d., and as high as £9 15s. per ton. During last year, however, the minimum was £5 11s. 4d., and the maximum £6 10s. per ton, so that between the two limits there was a difference, by increase, of only 17 per cent., as contrasted with the difference of about 70 per cent. in the previous year.

Prices of Bessemer Steel Rails at the Works in Wales.—Mr. Jeans gives the following table of the average net realized prices of Bessemer steel rails during the last twelve years at the works in Wales. It shows that the average of last year was the lowest of any year in the series except two, and the average over the whole period was £9 12s. 11d., or £3 12s. 11d. more than that of 1881.

Years.	*First half.*	*Second half.*	*Average of year.*
1870	£10 2 6	£10 17 6	£10 10 0
1871	11 12 6	12 5 8	11 18 9
1872	13 17 6	13 17 6	13 17 6
1873	15 5 0	15 10 0	15 7 6
1874	13 18 6	9 17 6	11 17 6
1875	9 7 6	8 18 6	9 2 6
1876	8 7 6	7 15 0	7 15 0
1877	6 15 0	6 8 6	6 11 3
1878	5 15 0	5 10 0	5 12 6
1879	5 0 0	5 5 0	5 2 8
1880	7 10 0	6 10 0	7 0 0
1881	5 15 0	6 5 0	7 0 0

Open-hearth Steel.—The production of open-hearth steel in Great Britain in 1881 was 338,000 gross tons; in 1880 it was 251,000 tons. Of the whole quantity produced in 1881 Scotland produced nearly one-half. South Wales is now the next most important open-hearth district in Great Britain; in 1870 it was the leading district. The growth of the open-hearth steel industry of Great Britain since 1873 is shown in the following table.

Years.	*Gross tons.*	*Years.*	*Gross tons.*	*Years.*	*Gross tons.*
1873	77,500	1876	128 000	1879	175,000
1874	90,500	1877	137,000	1880	251,000
1875	88,000	1878	175,500	1881	338,000

The total number of open-hearth furnaces constructed in Great Britain at the close of 1881 was 149, but, all of these were not at work. Twelve additional furnaces were at that date in course of construction. The average production of the furnaces which were at work in 1881 was 2,925 tons, according to Mr. Jeans. The Landore Siemens Steel Company, in South Wales, and the Steel Company of Scotland, with 24 and 34 furnaces respectively, together produced 179,280 tons of open-hearth steel in 1881, or 53 per cent. of the total product of the year. Open-hearth steel is put to a great variety of uses in Great Britain. It is largely used for plates, but much of it is used for rails, angles, forgings, springs, castings, and tin plate.

Crucible Steel.—The statistics of the production of crucible steel in Great Britain from year to year are not given by Mr. Jeans, nor are they obtainable from any other source.

Tin Plate.—The statistics which Mr. Jeans gives of this branch of the British iron trade are tantalizing, if not exasperating, to an American reader who remembers that his own country does not make a single box of tin plate. Its manufacture forms an important branch of the British iron trade. The business employs over one hundred works, which consumed in 1881 fully 225,000 tons of iron. But the worst remains to be stated. The production of tin plate in Great Britain has doubled since 1872, and doubled solely to supply the American demand. The United States has for many years taken annually about three-fourths of the tin plate exported by Great Britain. In 1874 it imported 1,585,944 boxes out of a total exportation of 2,143,468 boxes. The American demand has since steadily increased. In 1880 we imported 2,959,380 out of an exportation of 4,089,160 boxes.

Iron and Steel Shipbuilding.—We abbreviate from Mr. Jeans's report the following information under this head.

The total tonnage of new vessels constructed in the United Kingdom during 1881 was, 1,013,208, as compared with a total of 796,221 tons launched in the preceding year, being an increase of 216,987 tons. These figures not only represent the largest amount of shipbuilding yet launched in any twelve months, but they also indicate the greatest stride that the industry has made in a single year.

The statistics already available do not indicate what proportion of the total tonnage launched during 1881 was of iron and what of timber; but inasmuch as the statistics compiled by Lloyd's Registry showed that, of 843,000 tons of new shipping contracted for at the beginning of the year, only 8,769 tons, or 1.4 per cent. of the whole, were of timber, it may be assumed that wooden shipbuilding has now practically ceased to be carried on.

The effect of this process of change upon the iron trade has, of course, been very important. In 1850 the total quantity of iron plates required in the construction of the hulls of the 12,000 tons of vessels built of that material would not exceed 7,000 tons. Last year the quantity of ship-plates and angles used in the construction of the hulls of the vessels built of iron and steel would not be less than 600,000 tons, while nearly 200,000 tons more would be employed in the construction of the boilers, engines, and other machinery.

The chief advance made during 1881 has occurred on the Clyde, which shows an increase of 104,244 tons over the preceding year. The Wear follows with an advance of 31,732 tons, then the Tyne with an increase of 28,183 tons, and Barrow with an advance of 18,661 tons—the last-named figure being more than double that of 1880.

Next to the enormous volume of work turned out, and the decay of wooden shipbuilding. the most notable feature of the trade is the tendency to increase of size in ocean-going vessels. The total number of vessels launched during the past year has been 662, which divided into the 1,013,208 tons constructed, gives an average of 1,530 gross tons for each vessel. The port producing the largest average size of vessel appears to be Barrow, which turned out ten vessels, each of over 3,200 gross tons capacity.

The use of steel for naval construction has made substantial progress during the past year. Thirty-seven vessels in all were built of this material, representing an aggregate of 71,533 tons. This is an increase of 33,369 tons, or nearly 100 per cent., on the steel tonnage launched in the previous year. The total number of vessels that were being built of steel on the 1st January, 1882, and are likely to be completed this year, was, however, largely in excess of the total tonnage launched during the preceding ten years: their tonnage will amount to 183,818 tons. The number of vessels under contract to be built of steel during the current year is 61,000 tons more than the total tonnage of iron vessels launched in 1862.

At the beginning of the present year there were under construction 736 vessels of iron and steel, representing a gross aggregate tonnage of 1,264,603 tons.

Exports.—The total exports of all kinds of iron and steel from Great Britain from 1871 to 1881 were as follows, in gross tons.

Years.	*Gross tons.*	*Years.*	*Gross tons.*
1871	3,169,219	1877	2,346,370
1872	3,382,762	1878	2,296,860
1873	2,957,813	1879	2,883,484
1874	2,487,162	1880	3,792,993
1875	2,458,309	1881	3,818,338
1876	2,224,470		

The exports of iron and steel from Great Britain to the United States in the last three years are given in the following table.

Articles.	1879.	1880.	1881.
	Gross tons.	*Gross tons.*	*Gross tons.*
Pig iron	277,939	614,005	391,784
Bolt and rod	29,648	51,413	18,957
Rails	44,919	221,131	294,378
Hoops, sheets and plates	10,447	45,237	36,125
Tin plates	155,595	164,167	179,744
Old iron for manufacture	188,705	197,653	99,974
Other iron	10,437	20,464	6,222
Steel	9,296	44,066	135,275
Total	717,986	1,358,136	1,162,459

Germany.—*Production.*—It appears, according to the German Mining Bureau, that the production of pig iron in the German Empire was 2,613,795 metric tons in 1880, and 2,784,037 tons in 1881; the increase in the latter year over the former was therefore 170,242 tons. This statement of production we find accompanied by another, in these words: "It is officially estimated, however, that if complete returns had been received from all the works last year's production of pig would have really stood at 2,907,000 tons, while the production for 1880 ought to be increased to 2,729,000 tons. We do not know whether these statements include Luxemburg. The production of steel of all kinds in 1881 appears to have been 890,000 tons, of which 745,000 tons were Bessemer, 121,000 tons were open-hearth, and the remaining 24,000 tons were made by minor processes. The production of steel in 1880 is stated to have been 650,000; the increase in 1881 was therefore 230,000 tons, or about 35 per cent. The Bessemer steel industry of Germany has steadily grown since 1871, when the production was 143,305 tons. The production of coal in Germany in 1881 amounted to 48,598,000 metric tons, and the production of lignite 12,843,000 tons, making a total of 61,541,000. In 1880 the production of coal was 46,972,000 tons, and the production of lignite was 12,136,000 tons; total, 59,108,000 tons. The increased production of these two classes of fuel in 1881 over 1880 was 2,433,000 tons. The following statistics of the production of coal alone in Germany from 1854–1881 are published by authority of the Department of the Minister of Public Works at Berlin. We would be glad to see an equally authoritative statement of the production of pig iron and various kinds of steel in Germany in recent years.

Years.	*Metric tons.*	*Years.*	*Metric tons.*
1856	8,634,200	1869	26,774,000
1857	9,841,200	1870	26,397,000
1858	10,721,600	1871	29,373,000
1859	11,419,000	1872	33,306,000
1860	12,347,800	1873	36,392,000
1861	14,133,000	1874	35 918,000
1862	15,576 300	1875	37,436,000
1863	16,906,700	1876	38,454,000
1864	19,408,900	1877	37,629,000
1865	21,794,700	1878	39,689,000
1866	27,629,700	1879	42,025,000
1867	23,808,000	1880	46,972,000
1868	25,704,700	1881	48,698,000

Prices.—Dr. Gurlt, of Bonn, has contributed to the London *Iron* a paper on the metallurgical progress of Germany in 1881, from which we compile the following general view of the range of prices of iron and steel in that year.

We must remember that 1880 had begun with fair prices, which, however, gave way in an alarming manner in the middle of the year, and that they improved again in the last quarter. There were, therefore, in the beginning of 1881, fair average prices with a tendency upwards. In the middle of February a retrograde movement set in with slight occasional oscillations, until the lowest point was reached in June. Just at that time, when the German ironmasters, in order to stay the downward current, had concluded the convention to blow out a number of blast furnaces and to reduce the output, another and healthier movement, with the rising tide, set in from the other side of the Atlantic. It was followed by fresh orders from home and abroad, so that many steel works have secured contracts which will give them work up to and even after the middle of this year, 1882. The prices went gradually upward, and by the end of the year they stood about the same as at the beginniug, or even slightly better; during the first part of 1882 they have rather continued in that tendency.

Iron Shipbuilding.—The Imperial Chancellor, Prince Bismarck, addressed an important memorial to the Reichstag on the 6th of April, 1871, in relation to the necessity of extending government aid in building up the shipbuilding and navigation interests of Germany. The immediate occasion of the transmittal of this memorial was the passage by the French Legislative Assembly on January 30, 1881, of an act for the encouragement of the shipbuilding and navigation interests of France. The Chancellor took the most advanced ground in favor of bounties to German shipbuilders and ship-owners. We may expect some positive action to result from the Chancellor's recommendations, especially as the action of France would seem to render similar action by Germany absolutely necessary as a measure of protection.

Luxemburg.—We are indebted to the London *Iron* for information from which we glean the following summary concerning the character of the iron industry of Luxemburg.

The grand-duchy of Luxemburg, situate to the east of the Belgian province of the same name, is 998 square miles in extent, and has a population of 210,000. The inhabitants are chiefly of German origin, and speak a German patois. The use of French or German is optional, but the higher education is carried on in the latter language. Although the King of Holland is also Grand-duke of Luxemburg, the duchy is in no way connected with Holland, but has its own government, consisting of a responsible ministry and a chamber of deputies. By virtue of a treaty with Germany, Luxemburg forms part of the Zollverein. The chief mineral wealth of Luxemburg consists in its deposits of oolitic limonite or ferruginous schorl, which are divided by the river Else, or Alzette, into two basins. It is estimated that there remain altogether about 270,000,-tons of ore still to be extracted, which will admit of a production rather over that of 1880 for a hundred years to come. About two-thirds of the ore extracted is exported to neighboring countries. Hitherto Belgium has been the largest consumer; but now German ironmasters are offering higher prices, and thus driving their Belgian competitors out of the market. Besides five small furnaces for reducing ore called *fourniquets*, erected at the tool and machine factories, and producing 1,579 tons of pig, there exist in the grand-duchy twenty regular blast furnaces, sixteen of which were in blast at the beginning of the present year, while one has since been blown in. Besides the oolitic iron ore there are some deposits of alluvial ore which form two distinct groups. These deposits are, however, to a considerable extent worked out or abandoned.

From the same source we gather the following statistics of the production of iron ore and pig iron in Luxemburg since 1877.

Years.	*Iron ore—Metric tons.*	*Pig Iron—Metric tons.*
1877	1,262,825	215,388
1878	1,407,617	248,377
1879	1,623,392	291,236
1880	2,173,463	260,666
1881	2,166,881	293,616

France.—*Production.* The production of pig iron in France in 1871 is officially stated to have been 1,894,861 metric tons. The production in 1880 was 1,725,293 tons; the increase in 1881 was therefore, 169,568 tons. The production of finished iron in France in 1881 was, 1,019,170 tons, against 965,751 tons in 1880, an increase of 53,419 tons. Of the finished iron produced in 1881 there were 28,411 tons of iron rails; in 1880 there were 42,325 tons of iron rails produced. The production of all kinds of steel in France in 1881 was 418, 094 tons, against 388,693 tons in 1880, an increase of 29,401 tons. The statistics of Bessemer and Martin (or open-hearth) steel in France are not kept separately; hence we cannot tell how much of each was produced in 1881, but other details are at hand. Of Bessemer and Martin steel the product was 300,580 tons of rails; 71,385 tons of bars; and 17,075 tons of plates: total production of Bessemer and Martin steel, 389,040 tons. The remaining 29,054 tons of steel produced in 1881 embraced puddled, cemented, and crucible steel, but principally puddled steel.

Imports and Exports.—The *Bulletin du Comitê des Forges de France* gives the following statistics of the imports and exports of iron ore by France in 1880 and 1881:

Countries.	*Imports—Metric tons.*		*Exports—Metric tons.*	
	1881.	1880.	1881.	1880.
Algeria	242,494	326,363	......	...
Germany	348,488	279,286	37,427	39,098
Belgium	130,822	97,961	29,065	52,148
Spain	419,097	332,207	......	...
Italy	121,920	1:6,314	...	...
Other countries	25,049	4,375	21,803	23,550
Total	1,287,870	1,166,506	88,292	114,796

The imports of iron and steel by France in 1881 were much larger than in 1880. They amounted in 1881 to 361,-046 tons, and in 1880 to 228,172 tons, a difference of 132,-874 tons. The details are as follows:

Articles.	1881.	1880
	Metric tons.	*Metric tons.*
Pig iron	271,532	169,137
Finished iron	65,337	60,208
Steel	24,177	8,827
Total	361,046	228,172

The exports of iron and steel to all countries in 1881 were very nearly the same as in 1880, being 121,324 tons in 1881, against 121,895 tons in 1880.

Coal and Coke.—From the *Bulletin*, above quoted, we learn that the production of coal in France was 19,361,564 metric tons in 1880 and 19,909,057 tons in 1881. In 1881 the production of coal in the Pas-de-Calais was 5,320,616 tons, against 4,844,323 tons in 1880, an increase of 476,293 tons. The Nord production, however, was 3,668,733 tons, against 3,701,589 tons in 1880, a decrease of 32,856 tons. The total output of the two districts in 1881 was 8,989,349 tons, against 8,545,912 tons in 1880, an increase of 443,437 tons.

The following table gives in metric tons the imports and exports by France of coal and coke in the last three years.

Years.	Coal.		Coke.	
	Imports. Metric tons.	*Exports. Metric tons.*	*Imports. Metric tons.*	*Exports. Metric tons.*
1879	8,662,385	513,938	760,529	20,589
1880	8,451,129	646,455	943,416	40,905
1881	8,106,761	724,885	1,110,974	24,514

Nearly all the coal and coke imported by France is derived from Great Britain, Belgium, and Germany.

Steel Rails.—The growth of the steel-rail manufacture in France is shown in the following table.

Years.	*Metric tons.*	*Years.*	*Metric tons.*
1866	3,687	1874	102,227
1867	10,967	1875	120,660
1868	25,759	1876	130,681
1869	50,225	1877	136,549
1870	41,189	1878	196,240
1871	22,613	1879	253,742
1872	62,104	1880	279,847
1873	64,097	1881	300,580

Railroads.—The New York *Railroad Gazette* calls attention to the fact that the railroads of France have been very prosperous in 1880 and 1881. It adds: "If our railroads had earned as much per mile in 1880 as the French lines, their gross receipts would have been $592,000,000 greater than they actually were."

Shipbuilding.—The provisions of an act of the French Government, passed January 29th, 1881, for the encouragement of the shipbuilding interests of France, by the granting of bounties or subsidies, need not be recited in these pages. The policy adopted has already given a decided stimulus to the enlargement of the French mercantile marine.

The New French Tariff.—A new general tariff was approved by the President of the French Republic on the 7th of May, 1881, and formally promulgated on the 8th. We give at the foot of this page the clauses which relate to iron and steel, compared with corresponding clauses in the old tariff and in the conventional, or treaty tariffs. The treaty tariffs are practically superseded by the new tariff. The famous British commercial treaty, negotiated with France by Mr. Cobden, has at last come to an end.

Belgium.—*Production.*—The production of pig iron in Belgium in 1881 was 631,764 metric tons, against 595,704 tons in 1880, an increase of 36,060 tons. The production of pig iron in Belgium in any one year has never reached 700,000 tons, and since 1865 has not fallen below 400,000 tons. The mining of iron ore in Belgium has gradually declined in the last ten years, mainly through the competition of the cheaper iron ore of Luxemburg. The production of finished iron in Belgium in 1881, including rails and plates, is reported to have been 493,200 tons, against 489,366 tons in 1880. The production of steel of all kinds in 1881, according to M. Max Goebel, of Liège, was 138,076 tons. We are without like statistics for 1880. The manufacture of steel is increasing in Belgium, and the low price at which it can be sold threatens serious interference at no distant day with neighboring steel producers. A new Bessemer plant, owned by Messrs. Caramin & Company, has recently gone into operation at Thy-le-Chateau, the company rolling its first steel rails in March last. These works are adapted to either the acid or basic process.

Imports and Exports.—The total imports of pig iron, other iron, and steel by Belgium in 1881 amounted to 242,747 metric tons, against 260,388 tons in 1880, a decrease of 17,641 tons. The total exports in 1881 were 384,599 tons, against 363,769 tons in 1880, an increase of 20,830 tons. The sidururgical imports of Belgium consist principally of pig iron, and the exports consist principally of finished iron and steel.

Coal.—The statistics of the production of coal by Belgium in 1881 are not yet accessible. In 1880 the production

Denomination of articles. [Duties in francs & centimes. One franc=19.03 cts. One centime=19 cts. One kilo=2.2 lbs.]	Old general tariff. Per 100 kilos.	Conventional tariff. Per 100 kilos.	New general tariff. Per 100 kilos.
Cast iron:			
Rough, in masses weighing 15 kilograms or more	4.99	2.00	2.00
Refined, in masses weighing 15 kilograms or more	8.74	2.75	2.00
Other	Prohibited	2.75	2·00
Iron:			
In masses or prisms containing slags (at least 6 per cent.)	do.	4.50	4.50
Draw, in bars, angle and T rails, of every dimension	12.48 and 17.47	6.00	6.00
(Pig iron in bars, containing 6 per cent. or more of slags, shall pay the same duty as imposed upon prisms still containing slags.)			
Band and hoop iron:			
Of more than 1 millimeter in thickness	12.48	6.00	6.00
Of 1 millimeter or less in thickness	17.47	7.50	7.50
Iron, called "machine, for manufacturing wires"	12.48 or 17.47	6.00	6.00
Sheet-iron, rolled or hammered, smooth, of more than 1 millimeter in thickness:			
Not cut	24.96	7.50	7.50
Cut, in whatever manner	24.96	8.25	8.00
Sheet-iron, thin and black iron plates, smooth, of 1 millimeter or less in diameter:			
Not cut	24.96	10.00	10.00
Cut, in whatever manner	24.96	11.00	11.00
Tin plates, galvanized or coated with copper, zinc, or lead	49 92	13.00	13.00
Iron wire, coated or not, with tin, copper, or lead:			
Not more than $\frac{5}{10}$ of 1 millimeter in diameter	37.44	10.00	10.00
Over $\frac{5}{10}$ of 1 millimeter in diameter	37.44	6.00	6.00
Steel in bars:			
Rails	37.44	9.00	6 00
Other, all kinds, and hoop and band steel	37·44	9.00	9.00
Steel, brown, in sheets or plates rolled when heated, of more than ½ millimeter in thickness:			
Not cut	62.40	11.25	9.00
Cut, in whatever manner	62.40	11.25	9.90
Of ½ millimeter or less in thickness:			
Not cut	93.60 & 137.28	15.00	15.00
Cut, in whatever manner	do.	15.00	16.50
Steel, white, in sheets of plate, rolled when cold, of whatever thickness:			
Not cut	93.60	15.00	15.00
Cut, in whatever manner	137.28	15.00	16.50
Steel wire for chords of instruments	87.36	20.00	20.00
Old and scrap iron	9.98	2.75	2.00
Old and scrap cast iron	4.99	2.00	2.00
Iron dross and slag	1.04	Free	Free

was 16,866,698 tons. The production in the ten years ending with 1880 was as follows;

Years.	Metric tons.	Years.	Metric tons.
1871	13,733,176	1876	14.329,578
1872	15,658,948	1877	13,938,523
1873	15,778,401	1878	14,899,175
1874	14,669,029	1879	15,417,292
1875	15,011,331	1880	15,866,698

In 1880 Belgium exported 4,525,085 tons of coal, and 850,346 tons of coke. In the same year it imported 917,033 tons of coal and 19,217 tons of coke.

Austria and Hungary.—Herr Wilhelm von Lindheim, of Vienna, reports to the London *Iron* that 1881 was a year of greater animation in the Austro-Hungarian iron trade than 1880, the construction of more miles of railway being under way in 1881 than in 1880. Complete statistics of the production of iron and steel in 1881 are, however, wanting. Owing to a continuance of the activity in railway building, and to the benefits expected to result from a slight increase in the duties on iron and steel, to go into effect in June, the production of 1882, especially of steel rails, is expected to be larger than that of last year, although, in anticipation of the increase in the duty on pig iron, Great Britain has since the beginning of the year shipped large quantities of that article to Austrian ports. From a report made to our Government by Consul-General Weaver, of Vienna, we obtain the following interesting statistics of the production of Bessemer and Martin (open-hearth) steel in Austria and Hungary in recent years.

Products.	1878.	1879.	1880.
	Metric tons.	Metric tons.	Metric tons.
Bessemer steel ingots.	103,590	86,465	101,369
Martin steel ingots	25,888	35,222	27,368
Total	129,478	121,587	129,007

The first Bessemer steel works in Austro-Hungary were erected in 1872, in the province of Styria, and in 1880 there were eleven works in operation, producing as has been seen, over 100,000 tons of Bessemer ingots. The production of Martin steel dates from 1870, with two works, which in 1880 had increased to seven, with an aggregate production of nearly 30,000 tons. The total production of Bessemer and Martin steel in Austro-Hungary down to the close of 1880 is given in the following table.

Years.	Martin steel.	Bessemer steel.	Years.	Martin steel.	Bessemer steel.
	Metric tons.	Metric tons.		Metric tons.	Metric tons
1864	...	305	1873	3,782	76,611
1865	..	3,545	1874	3,422	85,339
1866	.	7,921	1875	3,481	99,250
1867	..	8,766	1876	4,504	93,668
1868	.	14,479	1877	13,468	104,119
1869	...	20,717	1878	25,888	103,590
1870	298	29,076	1879	35,222	86,365
1871	9,118	49,724	1880	27,638	101,369
1872	5,746	55,444			

Sweden.—*Production.*—Professor Richard Akerman, of Stockholm, furnishes in *Iron* the following details of the production of iron and steel in Sweden in 1879 and 1880. The statistics for 1881 are not yet published.

Products.	1879.	1880.
	Metric tons.	Metric tons.
Iron	645,365	775,344
Pig iron	342,547	405,713
Bar iron, rods, and rolled wire	208,606	219,234
Plates	10,581	11,909
Nails	6,567	7,445
Bessemer steel	20,723	30,013
Siemens-Martin steel	6,720	7,718
Blister and crucible steel	2,129	1,550

Professor Akerman adds the following interesting comments upon the above statistics, and particularly with reference to the increased production of Bessemer steel in 1880.

The production of ore was indeed somewhat greater in the middle of the decade beginning 1870 and 1880, and the make of bar and fine-grained iron also in one year, 1877, when it amounted to 224,818 metric tons, somewhat exceeded the figures of 1880, but the make of pig iron and ingot metal during the last-named year considerably exceeded the largest amount of production hitherto attained in Sweden. Comparatively, it appears, the production of Bessemer metal has most increased in Sweden during 1880. As there are no rails made in the country, the Bessemer metal produced there is only used for nicer purposes, and it is in this circumstance that we have to seek for the reason why the Bessemer manufacture has increased so slowly as compared with what has been the case in the countries where enormous quantities of rails have been made of Bessemer metal. As the amount of 21,303 metric tons of Bessemer metal produced in 1874 was not again reached during any of the five following years, it even almost appeared as if the Bessemer manufacture of Sweden was not to undergo any further development. Of this, however, there cannot now be any question, for the Bessemer manufacture in Sweden, in 1880 exceeded by 54 per cent. the annual make during the years 1875–'79, which, as has been stated, was somewhat less than that of 1874. The great increase during 1880 depends, in incomparably the greatest degree, on an augmented use of Bessemer iron within the country, above all for boiler and ship plates; but also on an increased sale of Bessemer ingots and blooms abroad, especially at Sheffield, where they now at least appear to be beginning to find out that a Bessemer steel so pure as the Swedish may not only equal but even surpass many a less pure crucible steel.

Professor Akerman expresses the opinion that the production of both Bessemer and Siemens-Martin steel in 1881 will be found to have been larger than in 1880. He then adds:

The production which otherwise of recent years has made most progress in Sweden is that of rods and rolled wire, but no exact figures on this head can unfortunately be given. Yet this follows, among other things, from the annually increased export of such fine iron. The export in 1880 was, for instance, fully double that of 1875, viz., 52,162 metric tons, against 24,047 tons in 1875, when it was, besides, considerably greater than in any of the preceding years.

The old wooden shipbuilding of Sweden is now only in a languishing state; but, on the other hand, our iron shipbuilding yards in recent times have to felicitate themselves on full employment not only on native orders, but also on orders from the neighboring countries—Russia, Denmark, and Norway. It is also this fortunate circumstance which has conduced most of all to the present improvement of the Swedish Bessemer manufacture. For incomparably the greater part of both ship and boiler plates are now made here of ingot iron, [steel] and only a very small quantity of puddled plates is for the present manufactured in Sweden.

Exports and Imports—The exports of iron and steel from Sweden during the last three years are shown in the following table:

Articles.	1879.	1880.	1881.
	Metric tons.	Metric tons.	Metric tons.
Iron ore	12,570	29,662	24,432
Pig iron	34,569	61,585	55,289
Blooms	10,470	8,860	8,842
Bar iron	110,325	131,218	135,856
Rods and rolled wire	41,776	48,713	52,162
Plates	2,022	2,174	2,362
Nails	781	876	1,052
Ingot iron and steel	8,519	8,155	7,465

The imports during 1881 are not yet known; but in 1879 and 1880 they were as follows:

Articles.	1879	1880.
	Metric tons.	Metric tons.
Pig iron	11,314	15,972
Rails	19,804	9,971
Bar iron	1,514	2,464
Hoop iron, etc.	2,180	2,821
Plates	2,166	3,080
Tinned plates	1,067	369
Nails	522	1,665
Steel	484	552

Coal.—The mining of coal in Sweden is making some progress. In 1879 over 200,000 tons were mined, and in 1880 almost as many tons were mined. We presume that the mining operations were restricted to the district of country in the southwestern part of Sweden, opposite the Sound, Helsingborg, being the principal town.

Spain.—*Iron Ore Exports.*—In 1881 there were exported from the district of Bilboa, according to the authority of Mr. William Gill, in a paper read before the British Iron and Steel Institute at its May meeting at London, 2,500,532 tons of iron ore. From all the iron ore districts of Spain, including Cartagena and Malaga, the exports in 1881 slightly exceeded 3,000,000, tons. The exports from Bilboa in 1880 amounted to 2,345,598 tons; in 1879 to 1,117,836 tons; and in 1878 to 1,224,730 tons. In the first two months of the present year the exports from Bilboa reached 458,000 tons, against 390,000 tons in the corresponding period of 1880, a gain of 68,000 tons. It is not probable, however, that this year's exports from Bilboa will greatly exceed those of 1881; they may not, indeed, equal them.

Prices of Iron Ore at Bilboa for Twelve Years.—In the following table Mr. Gill gives the average prices of iron ore, free on board, in Bilboa river, from 1870 to 1881. (The average price is not a mean of highest and lowest, but is that which prevailed during each year.)

Years.	Prices per ton.			Years.	Prices per ton.		
	Maximum.	Minimum.	Average.		Maximum	Minimum.	Average.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
1870 . .	6 6	5 6	5 10½	1876 . .	10 0	6 3	8 0
1871 . .	6 6	4 8½	5 8	1877 . .	8 0	6 3	6 10
1872 . .	10 0	6 2	6 7	1878 . .	7 11	6 2	7 0
1873 . .	12 0	7 1	9 0	1879 . .	6 6	5 9	6 0
1874 .	Carlist	Carlist	Carlist	1880 . .	15 9	6 0	9 0
1875 .	War.	War.	War.	1881 . .	9 9	6 7	7 0

Manufactures.—Spain makes but slow progress in developing the manufacture of iron and steel. The country is largely dependent upon other countries for its supply of these articles.

A National Exhibition.—An official notice has been published relative to a mineralogical and metallurgical exhibition which is to be opened at Madrid on April 1, 1883, under the auspices of the Spanish Government. It may be expected that the display of the extraordinary riches of the country in iron ores will be complete.

Italy.—*Production.*—The most recent statistics of the iron industry of Italy that we have noticed do not come down to a later period than 1877, in which year the total production of iron and steel is stated to have been about 76,000 tons. The most of this production was bar iron, made principally in Catalan forges. We find the production of 1877 classified as follows: bar iron, 49,000 tons; cast iron, 4,600 tons; rough iron, 20,278 tons; steel, 2000 tons. Of the total production 32,000 tons are credited to Liguria. The following details we take from a European technical journal: "The iron works of Vobarno, near the lake of Garda, now yield 8,000 tons of iron per annum, fused in Siemens furnaces, as against 3000 tons in 1872. The fuel used at these works is chiefly peat, procured either in the neighborhood or from the peat beds of Fiavé, the Trentino. The works belonging to Messrs. Masson, at Colle di Val d'Elsa, are also provided with Siemens furnaces."

Coal.—The French journal, *La Houille*, briefly describes as follows the poverty of Italy in lacking a supply of coal as a basis on which to build up manufacturing enterprises, especially of iron.

"The kingdom of Italy and the islands dependent upon it are very poor in mineral fuel. Coal, properly speaking, does not exist, and the very rare carboniferous layers consist of anthracite and lignites. These deposits of anthracite possessed by the country are not very productive, and the chief of them are situated in the Valley of the Piedmont. According to a recent report of the Belgian Consul at Savona, the total production does not exceed 2000 tons. The layers of lignite are more numerous, and all belong to the tertiary formation. The largest basins are found in Tuscany, Sardinia, Liguria, Vicentino, and Lombardy. M. Cappa, the Belgian Consul, estimates their annual production at about 100,000 tons. In addition to this about 90,000 tons of peat are extracted annually. If Italy were as rich in mineral fuel as in iron ores it would be able to rival the most favored nations with respect to metallurgical industry, but fuel being in default it is reduced to exporting most of its production of iron ore."

United States Consul Crain, of Milan, in a recent communication to the Department of State makes the following more hopeful statement of the prospects of Italian manufactures.

The development of the manufacturing industries of Italy is seriously impeded by the great cost of coal for steam-power. This fuel not being produced in the country is brought principally by sea from England, and is so heavily burdened by Italian railway freights as to discourage the erection of factories requiring steam power. Hence, an active agitation is being carried on by capitalists for some measure of relief, and the Milan Chamber of Commerce has taken the initiative in making important recommendations. All signs point to a rapid growth of manufacturing in this country, and this, with the extension of the railway system must, in the near future, vastly augment the consumption of coal.

The Chamber of Commerce of Milan states that Italian manufacturers pay for coal three times as much as it costs the competing English industries, and twice as much as it costs these of France. The importation of coal into Italy in recent years is increasing. In 1878 it amounted to 1,325,245, in 1879 to 1, 523,676 tons; in 1880 to 1,737, 746 tons; and in the first nine months of 1881 to 1,646,249 tons, against 1,256,249 tons in the corresponding period of 1880. England and Wales supply most of the coal imported by Italy.

Iron Ore.—The quantity of iron ore mined in Italy 1877 amounted to 237,931 tons. The iron mines of the Island of Elba are reported to have been lately transferred to an Italian company represented by the National Bank of Rome. The royalty to be paid to the government has been fixed at 5.25 fr. per ton of ore extracted. A communication which we have just received from F. Regolini, of Turin, dated May 20, 1882, informs us that it is proposed to establish in Italy a company of bankers, merchants, and other capitalists for the manufacture of Bessemer steel from Elba ores, and that the enterprise only awaits the engagement of a competent director for the technical department.

Russia.—*Imports and Exports.*—Notwithstanding its high tariff Russia still remains a large importer of many raw and manufactured products. The following table gives the imports of iron and steel and coal in 1880 and 1881, in metric tons.

Articles Imported.	1880.	1881.
	Metric tons.	Metric tons.
Pig iron . . .	243,854	234,864
Bar iron, etc . . .	105,109	71,761
Plates and sheets . .	49,183	30,530
Iron rails	4,628	776
Bessemer steel rails	50,728	15,385
Machines	65,778	23,226
Coal	1,929,799	1,790,368

The exports of iron from Russia in 1880 were 133,371 tons; in 1881 they probably amounted to about the same quantity.

Production.—The following statistics of the productions of iron and steel and coal in Russia in 1879 are extracted from a report by Mr. Skalkofski, sub-director of the Russian Department of Mines. No later statistics of production are available.

Products.	Metric tons.
Pig iron	429,865
" " castings	50,974
Blister and puddled steel	3,084
Bessemer and Simens-Martin steel	203,636
Crucible steel . .	4,284
Iron bars, angles, etc.	206,438
" sheets and plates . .	69,325
" rails . . .	6,131
" wire	1,899
Bituminous coal .	2,378,138
Anthracite "	477,972
Brown " . .	16,157

Of the total quantity of Bessemer steel produced in 1879 there were 144,801 tons of rails. As compared with the statistics of production in the five years preceding 1879, Russia had not in that year made any progress worthy of note in the manufacture of pig iron, and no progress at all in the manufacture of finished iron, but in the manufacture of steel her progress had been very rapid. From 1874 to 1879 the production of steel was as follows, in metric tons.

Years.	Metric tons.	Years.	Metric tons.
1874	8,466	1877	43,446
1875	12,684	1878	93,242
1876	17,577	1879 . . .	211,004

MISCELLANEOUS.

At about 150 miles from the mouth of the Bosphorus, on the Asiatic coast of the Black Sea, there is a coal basin of considerable extent and richness, known as the Heraclea Basin, and near the Heraclea Pontia of the ancients. Surveys have been made, which show that the beds extend over an area of about 450 square miles, and are estimated to contain 60,000,000 tons. During the Crimean war the British Government operated these mines to supply the allied squadrons operating against Sebastopol and their numerous steam transports, and the works undertaken in the mountains south of Zougal Daugh, 60 miles east of Heraclea, furnished nearly all the coal consumed during the siege. After 1856 the working of the mines was left to the Ottoman Government. The best quality of coal is obtaned at Koosloy, in the district of Heraclea, where it is found in seams varying from 3 to 18 feet in thickness. The mines are the property of the government, and in 1880 yielded about 33,000 tons. Turkey imports annually from Great Britain about 20,000 tons of coal.

The annual consumption of coal in India by railways, manufactories, and steamers amounts, in round numbers, to 1,500,000 tons, of which over one-third, or 600,000 tons, is imported from Europe and Australia, and the remaining two-thirds, or 1,000,000 tons, are raised in the country.

Coal is found in the Colony of New Zealand, and its production is steadily increasing, while the importation of foreign coal is decreasing, as will be seen by the returns for the years 1878, 1879, and 1880, which are given in the following table:

Years.	*Raised in the Colony.*	*Imported.*
	Tons.	*Tons.*
1878	162,218	174,148
1879	231,218	158,076
1880	299,923	123,278

At the Esk Bank Iron Works in New South Wales, the only works of their kind that are now in operation in the colony, 1,200 tons of pig iron and 800 tons of bar iron and rails were made in 1880. This production is reported to have exceeded that of any previous year by these works, which are well managed but operated under difficulties. The pig iron produced in 1880 was valued at $20 per ton, and the rolled iron at $50 per ton.

There has been organized in the United States a company of capitalists which proposes to develop the iron ore deposits of the celebrated iron mountain of Durango, in Mexico. Hon. W. L. Helfenstein, of New York, is the president of the company. Mr. John Birkinbine, civil engineer, of Philadelphia, has recently accompanied Judge Helfenstein to Durango, and since his return has published an elaborate description of the company's property. It is expected that steps will be taken to utilize the vast resources of the iron mountain, and this expectation is strengthened by the probability of railway communication between the United States and Durango being soon accomplished.

Mr. Birkinbine tells us in the *Journal of the United States Association of Charcoal Iron Workers*, of which he is the editor, that during his visit to Durango he could not gather much definite information concerning the iron industry of Mexico. He says that bar iron and ordinary iron castings are sold at Durango and in Northern Mexico generally at 12½ cents per pound. He adds:

> We made diligent search for information concerning the charcoal iron works of Mexico, but were able to obtain no reliable data. There are several works which have been long in existence in Southern Mexico; but the only one above the Tropic of Cancer is that near Durango, described below.
>
> Five miles south of Durango, on the bank of the Rio Tunal, is the plant of the Piedra Azul (Blue Stone) Iron Works, consisting of a blast furnace, 35 feet by 8 feet; a heating furnace; a puddling furnace; one train of rolls; two sinking fires; one wooden helve hammer, and three smith fires. Power is obtained from a masonry dam across the Rio Tunal, giving a head and fall of seventeen feet. There are four water-wheels—two over-shot, one under-shot, and one turbine. The blast furnace is built of stone.

In our last Annual Report allusion was made to an enterprise for the manufacture of both pig and bar iron, with mineral fuel, which had been projected and undertaken in the State of Boyaca, in the United States of Columbia. We now learn that this enterprise, after absorbing a large amount of capital, said to be $400,000, has been abandoned, at least for the present.

STATISTICS OF MINERAL PRODUCTION.

ALTHOUGH the following figures are a little more than a year old they will be found necessary often in reaching such conclusions as the latter tables of Mr. Swank's report will suggest. They are compiled from "The Progress of the World" by Michael G. Mulhall, F. S. S., an exceedingly careful authority.

Minerals of the World.—During the present century the mineral resources of the world have been developed on a scale surpassing anything in history.

Coal.—Seventy years ago the world produced annually 9,000,000 tons of coal, or one-thirtieth of the present quantity, the only coal-fields then working being those of England, although the mineral was known to exist in France, Germany, and North America. Coming down to the year of Queen Victoria's accession, we find the production had then risen to 40 million tons, of which Great Britain stood for four-fifths. Since the introduction of railways and steamers the quantity raised has quintupled, viz.—

	1842. Tons.	1878-79. Tons.
Great Britain	35 million	135 million
United States	2 "	55 "
Germany	11 "	42 "
France	3½ "	17 "
Belgium	3 "	15 "
Austria		12 "
Russia		7 "
China, Spain, Australia	1½ "	7 "
	56 "	290 "

In the last ten years the exports from Great Britain have doubled, and the consumption increased 30 per cent. According to the report of the Parliamentary committee in 1871, there are still 90 milliard tons available, going no deeper than 4000 feet:* at an average consumption of 150 million tons there is, therefore, enough for 600 years to come. Electricity is, meantime, coming to supply in many ways the place of coal, which will doubtless tend to reduce the consumption. The average output per miner is greater in England than in other countries, viz.—

	Output.	Miners.	Per miner.
Great Britain	135,000,000 tons	440,000	306 tons
United States	55,000,000 "	190,000	288 "
Germany	42,000,000 "	160,000	262 "
France	17000,000 "	92,000	185 "
Belgium	15,000,000 "	81,000	185 "

Great Britain exports 20 million tons, which would suffice to freight all the merchant navies of the world. In the best years of California or Australia the yield of gold in either of those countries never exceeded £15,000,000, whereas the coal-fields of Great Britain produce £47,000,000 per annum.

Iron.—Men still living can remember when the world produced annually but 450,000 tons of iron: at present the production reaches 14 million tons which is equivalent to 35 million tons iron ore, the ordinary yield being 40 per cent. There is hardly a part of the globe in which iron is not found, but it can be advantageously worked only where fuel is cheap and transport easy. So plentiful is the iron ore of England that the Cleveland district possesses as much as would take all our coal-fields to smelt. The production as compared with population, is greatest in England, but the relative increase in other countries, since 1850, exceeds ours; we produce, nevertheless, as much pig-iron as all the rest of mankind collectively, and manufacture 40 per cent. of the steel of the world. In the

* The deepest coal-mine now working in Great Britain is Rosebridge, 2500 feet; the Lambert mine in Belgium goes down 3490 feet.

subjoined Table is shown the production of pig-iron for population:—

	1850.	1877.	Increase
Great Britain	182 lbs. per inhab.	225 lbs. per inhab.	24 p. c.
United States	55 " "	132 " "	140 "
Germany	27 " "	88 " "	224 "
France	27 " "	96 " "	250 "
Belgium	80 " "	190 " "	137 "
Sweden	105 " "	170 " "	62 "
Austria	18 " "	30 " "	67 "
Russia	8 " "	11 " "	37 "
Average	44	110	150

Copper.—In the Waterloo period the world depended on Cornwall for this mineral, until the Chilian copper-fields rose into importance. Subsequently, in 1842, some buffalo hunters discovered a rich mine near Lake Superior, which yielded 100,000 tons copper in twelve years. At present the production is as follows:—

Chile and Peru	34,000 tons
United States	15,000 "
Australia	14,500 "
Russia	5,600 "
England	5,200 "
Other Countries	19,000 "
	93 300 "

The price of copper has fallen 33 per cent. since 1870, and the industry seems rapidly declining. There is nothing of copper manufactures in modern times to compare with the Colossus of Rhodes, the metal of which formed 900 camel-loads on its removal.

Lead.—The world produces 140,000 tons per annum, of which Cornwall gives one-half. The Spanish mines, near Cordoba, are worked by English companies, yielding over 30,000 tons. Missouri first produced lead in 1854, and gives at present 18,000 tons. This metal abounds in Bolivia and the lower ranges of the Andes.

Tin.—Cornwall has now to compete with Australia and Malacca in the production of this mineral. The tin factories of the world consume 24,000 tons annually, of which Great Britain stands for five-eighths.

Zinc.—Germany produces 60 per cent. Russia and Belgium the rest.

Quicksilver.—The Almaden mines in Spain have been famous since the time of the Romans, but are now surpassed by the California mine. The annual production is as follows:—

California	2,000 tons
Spain	1,000 "
Other countries	300 "
	3,300 "

Summary.—The mining industries of all nations (not including precious metals) give employment to 1,500,000 miners, as shown in the following Table:

	Miners.	Products.	Per miner.	Output.
United Kingdom	475,000	£66,000,000	£139	325 tons.
United States	280,000	46,000,000	165	220 "
Germany	204,000	16,000,000	75	230 "
France	206,000	13,000,000	63	105 "
Austria	92,000	8,000,000	87	135 "
Belgium	105,000	9,000,000	85	160 "
Russia	80,000	4,000,000	50	100 "
Spain and Portugal	48,000	6 000,000	125	50 "
Italy	36,000	2,000,000	60	10 "
Scandinavia	29,000	1,000,000	34	34 "
	1,555,000	£171,000,000	£110	206 "

It appears from the above that Great Britain stands for one-third of the mining industry of the world. The mortality of miners in this country in 1879 was 3 per 1000, say 1 killed for 103,000 tons of coal or iron extracted.

Great Britain.—*Hardware.*—There are 530,000 operatives engaged in hardware, cutlery, and the manufacture of machinery. The raw material is valued at £20,000,000, and the manufactured goods reach £100,000,000, of which one-third is exported, the rest being kept for home consumption. Until recently the hardware industry of Great Britain was equal to that of all the rest of the world put together. Although no longer without a rival, she is still far ahead of all competitors. It was supposed that the invention of Bessemer steel would be almost fatal to our trade, but the returns for 1877 show that out of 94 Bessemer factories in the world, there are 21 in Great Britain.* Such has been the progress of steel, cutlery, and all species of hardware † manufactures, that Sheffield and Birmingham have quadrupled their population in a life-time—

	1811.	1880.
Sheffield	53,000	284,000
Birmingham	86,000	380,000

The export of hardware and machinery has risen as follows:—

1820	£1,920,000
1840	3,793,000
1878	37,200,000

The iron consumed in our manufactures is about 2,500,000 tons, or less than half the quantity we produce, the rest being exported. We also use about 30,000 tons of superior Swedish iron, and an equal quantity from Biscay, especially suited for steel. Our copper manufactures consume £4,500-000 sterling of this metal, which is imported from Chile and United States. Our tin factories require 15,000 tons, worth £3,000,000 sterling, two-thirds of which is imported from Australia, East Indies, or Prussia. The total value of hardware manufactures in 1801 was £16,500,000; it follows, therefore, that the industry has multiplied six-fold. It appears that the total manufactures of the kingdom amount to £665,000,000, the work of 2,930,000 operatives, say £224 per head. Deducting the exports, the balance for home consumption is about £460,000,000, or £14 per inhabitant. The above, of course, includes minerals.

Minerals of Great Britain.—The value of coal and iron extracted from the mines of Great Britain in twenty-five years (1854–1879) has been £1,076,000,000, or nearly equivalent to the yield of the gold and silver mines of Spanish America in three centuries. The development of our mineral resources has been as follows:—

	1800–1805.	1835 to 1840.	1875 to 1879.
Coal	£3,000,000	£10,000,000	£47,000,000 per ann.
Iron	2,000,000	7,000,000	16,000,000 "
Copper, tin, salt, etc.	1,000,000	3,000,000	3,000,000 "
Total	£6,000,000	£20,000,000	£66,000,000

Coal.—The production has increased thirteen-fold, more than keeping pace with our manufactures, which have grown eleven-fold since the beginning of the century. The output in 1801 to 1805 averaged 10,000,000 tons, of which one-fourth was shipped at Newcastle and Sunderland, the rest conveyed inland. The duty of 75 per cent. imposed by William III. on coal, even for consumption in England, was such an obstacle to the manufacturing and general industry of the kingdom, that it was abolished in 1830. This caused the price in London to fall from 50s. to 17s. per ton, whereupon the consumption rose rapidly. At the same time the invention of steamboats and railways increased the demand, and in 1853 the output reached 54,000,000 tons. As foreign countries constructed railways, the exportation of English coal increased year by year, while the onward march of British manufactures gave equal impetus to the home consumption. At present the annual demand reaches 135,000,-000 tons, viz.—

British factories	46,000,000 tons.
Railways and steamers	25,000,000 "
Gas and water companies	14,000,000 "
Domestic use	30,000,000 "
Exportation	20,000,000 "
	135.000,000 "

Great Britain raises one-half the coal consumed in the whole world. It has been supposed that our coal-fields will hardly last more than 200 years longer, but the result of the Parliamentary inquiry rather indicated a sufficient supply for six centuries to come. A new coal-field of Durham is now worked some miles under the sea. Moreover, electricity has begun to supplant coal-gas, and also to take the place of steam as a motive power, which will reduce the demand upon our coal-fields.

* Before Bessemer's invention the annual production of steel in Great Britain was only 51,000 tons; in 1873 it rose to 480,000 tons.

† The manufacture of pins averages 50,000,000 daily, or nearly three times the quantity produced in 1840.

Iron.—In the earlier part of the century (1801-1805) we imported 20 per cent. more iron than we exported. The invention of Nelson's hot-blast, in 1828, gave an extraordinary impulse to the industry, by cheapening the production of pig-iron from ore. Previous to that time it required four tons of coal for a ton of pig-iron; but this was reduced by Nelson almost one-half, and subsequent improvements have caused a still greater economy of fuel. The iron ore of England gives about 40 per cent. metal—that is, 2½ tons ore equal to 1 ton pig-iron. The relation which Great Britain bears to the world is as follows:

	Ore.	Pig-iron.
Great Britain . .	16 million tons	6½ million tons
Rest of World . . .	22 "	8½ "
	38 "	15

The production of pig-iron in Great Britain has grown as follows:

1802 .	227,000 tons.
1848 .	1,998,000 "
1877 .	6,608,000 "

This enormous increase was chiefly due to the construction of 150,000 miles of railway, in all parts of the world. It was also, in some measure, caused by the building of steamers and sailing vessels of iron instead of wood. The annual consumption of iron in the United Kingdom is much greater per inhabitant than in any other country. The weight of coal and iron annually exported by Great Britain is over twenty million tons—enough to freight all the vessels in the world.

Copper, Lead, Tin.—These minerals are of secondary importance, and their annual production may be briefly noticed as follows:

	1801-1806. Annual average.	1877-1878. Annual average.
Copper .	£600,000	£340,000
Tin .	300,000	700,000
Salt	100,000	1,500,000
Lead, Silver, etc. .	500,000	2,460,000
	£1,500,000	£5,000,000

Previous to 1823 salt was subject to a duty thirty times its own value. Since the repeal of the duty the production has increased tenfold, being now close on three million tons. The average output of miners is increasing as shown thus:—

	Mineral extracted.	Miners.	Per head
1878	149 million tons	515,000	290 tons.
1878	146 " "	475,000	307 "

The above includes not only coal and iron, but all other minerals.

Australia.—In the last thirty years the population has multiplied five-fold, chiefly owing to the discovery of gold in 1851, from which date, down to 1878, Australia produced £247,000,000 of the precious metal, viz.—

	Production	Per annum.
1852-1862	£110,760,000	£10,070,000
1863-1873 .	101,310,000	9,210,000
1874-1878 . . .	34,930,000	6,980,000
	£247,000,000	£9,200,000

During the last five years the gold fields* employed 48,500 miners and 1100 steam-engines, representing 24,000 horse-power: the average product per miner was £144 per annum. Gold-digging is now superseded by sheep-farming, as shown by the exports of wool and those of gold in 1877.

Value of wool exported . .	£19,460,000
Do. of gold "	7,499,900
Surplus for wool . . .	£11,860,100

New South Wales has produced more than £50,000,000 of gold, or one-fifth of the total exported. Wool has been, however, in the last ten years, a more valuable staple than gold:—

	Ten years.
1868 77 exported gold . .	£18,200,000
" " " wool .	30,410,000

Victoria.—A wandering party of sheep farmers from Tasmania, attracted by the beauty of the Yarra-Yarra river, settled on its banks in 1835, on the spot where the superb city of Melbourne now stands. Only a year before gold was discovered the settlers obtained permission to constitute themselves into a separate colony, for they now numbered 77,000 souls, and thus the colony of Victoria was established in 1850, with a territory of 88,000 square miles, or twice the area of the kingdom of Portugal; this being the smallest of all the Australian colonies except Tasmania. The gold fields in 1851 gave an extraordinary impulse to everything, the quantity of gold dust extracted in twenty-five years exceeding £170,000,000 sterling. The gold fields produced in 1879 over £3,000,000 sterling. Comparing the value of gold dust and of wool exported in the last ten years, we find as follows:

	1868-77.
Gold dust . .	£49,000,000
Wool	51,000,000

At present the latter item stands for three times as much as the former.

France.—*Minerals and Metals.*—These industries, which were insignificant in the time of Buonaparte, now amount to £36,000,000 per annum. The greatest development, strange to say, has taken place since the removal of the oppressive tariff against English coal and iron.

Coal.—In 1836 there were 170 coal-fields, employing 24,000 miners, who raised annually 3,000,000 tons, worth £1,200,000. At that time the supply of coal from England averaged 1,000,000 tons. But, with the introduction of railways, an increased consumption imparted vigor to the home production, as also to the imports, which have grown as follows:—

	Native coal.	Imported.	Consumption.
1830-1840	2,700,000 tons	900,000 tons	3,600,000 tons per an.
1860-1865	10,200,000 "	7,300,000 "	17,500,000 " "
1875-1877	17,100,000 "	7,600,000 "	24,700,000 " "

The number of coal-fields now working is 623, which employ over 100,000 men. The value of coal raised is little short of £10,000,000 per annum.

Iron.—Prohibitory duties upon foreign iron obliged people to extract it from the mines at double the cost for which English iron might have been imported. During many years the average price of iron in France was £26 a ton, or three times the price then ruling in England (£9 : 10s.) In this manner the farmers and others lost £1,500,000 sterling per annum for about thirty years, say £45,000,000. In fact, iron was so dear that the peasants used wooden ploughs until 1840. The production of iron rose to its highest in 1860-64, but it has since fallen away one-fourth.

1820-25 .	80,000 tons per annum.
1840-45 .	150,000 " "
1860 64 .	1,530,000 " "
1871-75 . . .	1,170,000 " "

There are over 2,000 iron mines and 1100 furnaces (including 600 blast-furnaces), employing 120,000 workmen. The production of steel averages 260,000 tons per annum. The various branches of this industry, from the extraction of the ore from the mines to the finer classes of cutlery, represent more than £20,000,000 sterling per annum. France produces one-fourth of the quantity of iron that England does.

Lead.—This metal was imported, although known to exist in France, until about 50 years ago, when some quantities were extracted. In 1839 there were forty mines, producing in the aggregate a value of £22,000 sterling, and employing 900 workmen. In late years the industry rose, until 1860-64, when the average yield was 86,000 tons lead, but the production since 1871 has been under 70,000 tons yearly.

Copper.—Another metal that was utterly neglected for half a century. In 1839 there were two mines, employing 130 men, who produced 90 tons copper.

The returns since 1860 may be summed up thus:—

1860-64	54,000 tons copper ore per ann.
1871-75	108,000 " "

The ore is of inferior kind, say 5 per cent. copper, since it takes 20 tons ore to produce one ton of copper. France produces 6 per cent of the copper of the world.

Quarries.—There are 24,000 in the various Departments, employing altogether 88,000 workmen, and yielding about £2,000,000 per annum.

* Some of the mines are very deep—the Magdala, for example, 1990 feet.

Salt.—For an interval the duties were removed, and the consumption rose to 1,000,000 tons yearly, but when they were re-imposed the consumption fell to 100,000 tons, on which the State levied the enormous tax of £18 per ton. This industry, under modified duties, has so far recovered, that it now employs 24,000 workmen, who produce 350,000 tons per annum, valued at £400,000.

Germany.—Ironworks and foundries are 1200 in number, and employ 120,000 workmen, who produce merchandise worth £28,000,000 per annum. The quantity of iron and steel of all descriptions manufactured is over 2,400,000 tons yearly. Krupp's factory at Essen covers 10,000 acres, and employs 10,000 men, 286 steam-engines (9230 horse-power), and 71 steam-hammers of 220 tons weight. Germany imports 500,000 tons pig iron yearly, besides 2,000,000 tons produced from native ore. This iron is used for the manufacture of 400,000 tons steel rails, plates and wire, and 2,000,000 tons of castings, rolled iron, etc. After supplying her own requirements, Germany has still a surplus of steel and iron merchandise for exportation, especially railroad bars, viz:

	1872-75.	1876-77.
Exported	90,000 tons per annum.	185,000 tons per annum.

The exportation in 1877 was 225,000 tons, at a period when the iron trade in Great Britain and the United States was under great depression.

Coal.—The production is over 42,000,000 tons yearly, including 9,000,000 tons brown coal or lignite. The following table shows how rapidly this industry has advanced:

1805	300,000 tons
1822	1,270,000 "
1864	16,200,000 "
1873	42,300,000 "

More than two-thirds are raised in Prussia, the rest in Alsace and Saxony. There are 920 pits, which employ 160,000 miners, the output being valued at £10,000,000, including £1,500,000 for brown coal. The home consumption is 40,000,000 tons, leaving a surplus of 2,000,000 tons for exportation.

Iron.—The production has multiplied fifteen-fold in half a century. In 1830 the ore extracted gave but 120,000 tons pig iron. At present there are 1071 mines, yielding over 4,500,000 tons ore, from which are obtained 2,000,000 tons of iron. The miners number 20,000 hands, nine-tenths of the iron mines being in Prussia.

Copper.—In 1830 the production barely reached 2,000 tons, or one-fourth of what it is at present. The mines are in Prussia and Saxony. The ore is not very rich, 260,000 tons giving about 1,000 tons pure copper, say 3 per cent. The 69 mines employ about 8,000 men, and the annual output is valued at £300,000.

Zinc is produced by Prussia on a larger scale than in any other part of the world, the production having multiplied fifteen fold since 1830. There are 77 mines, worked by 11,000 miners, who raise 350,000 tons ore per annum, worth £1 per ton. The ore gives 17 per cent. zinc, that is, 58,000 tons.

Lead and Silver are produced by Prussia and Saxony, the former country standing for three-fourths. There are 168 mines, employing 11,000 miners, who raise 125,000 tons ore, or six times the quantity raised in 1830. Almost half the ore is lead, say 46 per cent.

Salt.—Actual production 1,000,000 tons, or seven times what it was in 1830.

Summary.

The mineral industries have grown as follows in thirty years:—

1846	68,000 miners
1866	148,000 "
1876	205,000 "

The value of the minerals at the pit's mouth is about £15,500,000, or £75 for each miner. Prussia represents 80 per cent. of the minerals produce of Germany, employing 160,000 miners.

Belgium—*Minerals and Manufactures.*—These branches of industry employ 760,000 persons, Belgium having come to rival Great Britain in certain manufactures, and employing comparatively more operators, with reference to population, than any other country in the world.

Coal.—The production has multiplied six-fold in forty years:—

	Tons.	Miners.	Tons per miner.
1836	2,100,000	32,000	70
1850	6,200,000	49,000	126
1878	14,900,000	81,000	185

The value was 17s. per ton in 1873, but has now fallen to 11s. The average profit is 3d. per ton, although it appears that 82 mines do not cover expenses. Miners' wages have been reduced from £46 to £37 per annum. The highest output yet attained was at Hainault in 1872, say 206 tons per miner.

Iron.—Mr. John Cockerill, from England, introduced the system of smelting with coke in 1816, and established at Seraing one of the finest ironworks in Europe. This gave such an impetus to the trade that it grew as follows:—

	Ore.	Pig-iron.	Operatives.
1836	460,000 tons	150,000 tons	12,500
1860	900,000 "	320,000 "	25,000
1873	1,700,000 "	607,000 "	42,000
1878	1,300,000 "	464,000 "	24,000

Notwithstanding the depression in this trade, it is worthy of remark, "that in so adverse a season of three years (1874-77) not a single ironmaster in Belgium failed." The operatives accepted a reduction of 60 per cent. in wages, and thus enabled their masters to import pig-iron from England, make it into girders, send it back to England, and sell it at a profit.* Belgian ironmasters explain that they can undersell the British because their workmen are more thrifty and live on lower wages, the price of provisions being also less than in England. The value of the hardware industry of Belgium may be measured by the fact that the exports average £4,000,000 sterling, whereas ten years ago they were barely one-third.

Liege has grown up to be one of the great factories for arms. The value of this manufacture in 1829 was only £120,000, and now it falls little short of £1,000,000.

There are manufactures of zinc, copper, and lead, amounting in the aggregate to £2,000,000 per annum.

Glass has lately risen to great importance, as shown by the exports of this article:—

1867-68, average	£590,000 per annum
1877-76	1,550,000 "

Sweden.—The decree of 1765 prohibiting all manufactures, with the view of promoting agriculture, had a very disastrous effect. Factories of steel and of silk were closed, and the skilled artisans took refuge in Russia. After an interval of twenty years the insane law was repealed, but the country did not soon recover the blow. Prohibited duties upon foreign merchandise existed in full force till 1828. No sooner were they abolished than manufacture increased in a surprising manner. In 1839 the official returns showed an increase of 35 per cent. over ten years before. In 1876 the Swedish manufactures reached £10,250,000 sterling, counting merely the products of 2825 factories.

Coal abounds in Sweden, but costs more to raise than the price of coal imported from England. Swedish iron has long been considered the best in the world, and especially suited for making Bessemer steel. This is partly from the quality of ore, partly from the smelting with wood instead of coal. The supply of iron is inexhaustible. Tuberg, a hill of 370 feet high, is simply a mass of magnetic iron; it is described as "a source of riches to remotest posterity," although the ore is not very pure, yielding from 20 to 30 per cent. (which is considerably below the average of England). Persberg is another mountain of ore, containing thirteen mines; but the best ore is that of Dannemora, which produces 4000 tons of iron annually, the shaft (500 feet deep) being worked by blasting. The production of iron has increased as follows:—

1812	65,000 tons
1850	140,000 "
1870	292,000 "
1876	340,000 "

* In 1877 Belgium imported from Great Britain 68,000 tons pig-iron, and sent it back in the form of 46,000 tons of girders.

This does not include 78,000 tons Bessemer steel. The total number of miners and hands in the 200 mines and 1400 smelting-works usually ranges from 18,000 to 20,000. Copper-mines in Dalecarlia have been worked for a thousand years, especially those at Fahlun. The yield, however, has steadily declined, from 4000 tons per annum in the seventeenth century to 500 tons in recent years. The Fahlun mines now count but 500 workmen; the ore is inferior. All the copper-fields of Sweden now produce about 1400 tons, say one per cent. of the copper-crop of the world. Silver exists in many parts of Sweden, mixed with lead. Konigsberg was reputed the richest silver mine in Europe, having produced a block, almost pure, weighing 600 lbs., and worth £1800 sterling. At present, the total yield of silver in Sweden is under one ton per annum, say £6000 worth, or one day's produce of the Nevada or Peruvian silver-fields. Zinc is of some importance, the yield being over 40,000 tons yearly. There are numerous mines of lead, iron, and copper in Lapland, which can only be worked in midsummer, as the cold at other times congeals the engines.

Russia.—*Manufactures and Minerals.* From the beginning of the century until 1815 the industry of Russia was seriously checked by the Napoleon wars, but not altogether paralyzed. In 1808 there were 640 factories, chiefly at Moscow, Kazan, and Tula, for the manufacture of cottons, linens, woollens, leather, canvas, and cutlery, without counting the iron-works of Perm and Olonetz, or the mines of Siberia. The Ural mountains were said to be "the Potosi of Europe," yielding in minerals £6,000,000 per annum, of which one-third consisted of gold and silver. The iron of Dougua was esteemed equal to the best Swedish, however little developed owing to the difficulty of transport, sometimes taking three years to reach St. Petersburg. A second epoch may be said to date from the opening of three main canals between the Caspian, the Baltic, and the White Sea, almost coincident with the accession (1825) of the Emperor Nicholas. Shubert, in his report of 1828, sums up the total manufacture of Russia thus:—96 million yards of cotton, woollen, and linen fabrics, 16,000 tons of sugar, 7000 tons of soap, 15 million glass bottles, and £800,000 worth of silk manufactures. He took no account of hardware, although thousands of operatives were employed in the iron industries of Perm, Viatka, and Nijni, which counted 900 furnaces, while Tula and Olonetz produced large quantities of cutlery, arms, and artillery. Tula was already known as the Sheffield of Russia, its 600 workshops and 7000 artificers being specially famous for cutlery and snuff-boxes. At that time (1827–1832) iron was so dear that the horses were unshod, and even the farming implements were entirely made of wood. So rapidly did industry progress after the peace with Turkey (1828), that we find in 1840 there were 6850 factories, employing 413,000 operatives, besides 280,000 men engaged in the mines and ironworks. A separate report on the cotton factories (1842), shows 620 factories, of which 63 moved by steam, the whole employing 47,000 looms and 96,000 operatives, whose yearly product was over £5,500,000 sterling. The iron and copper works at Perm counted 7400 furnaces, and the annual production in all Russia was 4000 tons copper and 170,000 tons iron. Mining industry was still far from being adequately understood; the coal-beds of Taganrog were said to be not worth working, and salt was imported from England because the carriage from Orenburg was so expensive. The first time Russian coal came into use was in 1847, the yield being only 50,000 tons. Tegebolzki the same year estimated the manufactures of the empire at £72,000,000 sterling, but this seems to have been above the reality, as we find that in 1856 the amount was only £35,000,000, not including the minerals and metals. The production of iron between 1840 and 1850 averaged 150,000 tons per annum.

The production of coal has in late years risen to 7,000,000 tons, or two-thirds of the required quantity for consumption, the importation being close on 3,000,000 tons yearly. Gold-digging usually employs 20,000 miners in Siberia; the annual yield varies from £3,000,000 to £6,000,000 sterling. The iron-fields have yet to be fully opened up, the supply being so far short of the demand that the importation of iron and steel has grown six-fold in ten years, and now averages 300,000 tons per annum. The salt-works produce yearly about 1,000,000 tons, besides which 250,000 tons are imported. The progress of internal industry may be measured by the returns of the great annual fair at Nijni-Novgorod, viz.—

	Goods offered.	Goods sold.
1841	£8,000,000	£7,000,000
1857	13,000,000	12,000,000
1876	30,000,000	28,000,000

The merchandise disposed of between the 100,000 traders at this fair in 1876 consisted of:—

Cotton, linens, silks	£8,000,000
Ural metals	7,000,000
Flax, furs, leather, etc.	7,000,000
Flour, fish, brandy, etc.	3,000,000
Tea and luxuries	3,000,000
	£28,000,000

Austria-Hungary.—Exports have doubled in the last ten years, silk factories consume 2,000,000 lbs. silk, of which one-sixth is grown in the Tyrol, the rest imported. The factories are unable to supply enough silk fabrics for home use, although the manufacture has multiplied five-fold in ten years. The import of raw silk shows as follows:—

Average.	Raw silk.
1865-66	£292,000
1870-72	1,350,000
1875-76	1,490,000

Besides the home-made goods, Austria consumes imported silk fabrics to the value of £3,000,000 yearly.

There are 100 glass factories in Bohemia, and 70 in other provinces, producing wares to the value of £1,000,000 sterling, three-fifths of which are exported.

Bohemia has 1000 breweries, and the other provinces in proportion. The total product is 270,000,000 gallons, an increase of 60 per cent. on the returns for 1852. The exportation averages 4,000,000 gallons, leaving 266,000,000 for home consumption, or $7\frac{1}{2}$ gallons per head.

The sugar industry has increased as follows in twenty years:—

	1857.	1878.
Sugar-mills	91	217
Beet-root	410,000 tons	3,700,000 tons.

The annual production of beet-sugar is over 300,000 tons, worth £6,000,000 sterling, of which one-half is exported.

The growth of Austrian manufacturing industry in forty years is shown by the consumption of coal.

1839	500,000 tons
1864	3,500,000 "
1878	14,300,000 "

Minerals.—At the beginning of the century Transylvania was called "the gold-mine of Europe," the yield of the Kremnitz for 100 years averaging £300,000 per annum. Various mines of iron, copper, etc., were also carried on with such activity that Hungary had 45,000 miners, and at least as many more were employed in Illyria, Bohemia, and the salt-mines of Galitzin. Thus the annual yield of mines was not far short of £3,000,000 sterling in 1830, since which time it has more than doubled. The mining interest reached its highest point in 1873, when the total product was up to £9,000,000; but since then the iron industry has so much declined that the minerals do not sum up £7,000,000:—

Coal	£3,320,000
Iron	1,710,000
Sundries	1,770,000
	£6,800,000

Coal is increasing, the output now averages 12,000,000 tons, or 20 per cent. more than in 1873. The supply is, nevertheless, insufficient, and Austria has to import 3,000,000 tons yearly. The production of iron, in like manner, is so far short of the requirements, that the importation in the last ten years averaged 400,000 tons per annum. Styria ore is considered equal to Swedish in quality, and yields about 45 per cent. of metal. In the last century the Idria quicksilver mines averaged 600 tons per annum, but now they do not reach one-third of that quantity. These mines formerly exceeded the yield of the Almaden mines in Spain. Copper-mines in Hungary were advantageously worked before the present century. Most of the works, however, had been destroyed, the mines lying idle for several years. The ore is not rich, barely 4 per cent. being pure metal.

MINING LIFE—EXPLOSION OF FIRE DAMP.

—FROM "LA VIE SOUTERRAINE" BY L. SIMONIN.

Tin is extracted in Bohemia, and lead in Illyria. Sixty per cent. of the lead ore is metal. The salt mine of Wieliczka in Galitzia, at the base of the Carpathians, is the greatest in the world, extending six hundred miles, and seeming inexhaustible. For six centuries it has given prodigious quantities of salt. The Government has a monopoly, and sells the salt at £10 for home consumption, or £1 per ton for exportation. The works occupy 9,000 miners. The various mining and furnace works employ 84,000 men, 6,000 women, and 2,100 children, the distribution of hands being as follows:—

	Hands.
Coal	62,650
Iron	13,360
Silver	5,380
Lead, etc.	10,710
	92,100

The coal miners raise 12,000,000 tons a year, which represents £72 per miner. The iron miners and founders turn out twenty tons, worth £120 a head. The product of the lead mines is £80 each; and the general average of all mining £87 per head. Notwithstanding the depression, especially in iron, which has prevailed for a couple of years, it is likely mining will take strength, owing to the better economy in working. Each miner now produces much more than the average of 1873:—

	Coal.		Iron.	
	Miners.	Per head.	Operatives.	Per Head
1873	66,742	153 tons.	20,823	17¾ tons.
1876	62,650	192 "	13,360	20½ "
Increased yield per head		26 per cent.		16 per cent.

In like manner the production of silver has in several years increased 65 per cent. per head. The royalties on all the mines in the empire were £70,000 in 1869, and at present exceed £124,000 sterling. The miners have, in the last seven years, constructed seven hundred miles of railway. Steam power is aiding efficiently in the development of the mines, the number of engines at work having nearly doubled in seven years.

	1869.	1876.
In coal mines	447 engines	842 engines.
In other "	63 "	118 "
	510	960

Spain.—The miners are a prosperous and thrifty class of people. The masters provide them with schools, libraries, hospitals, etc., besides which the men have 355 joint stock banks, holding an aggregate capital of £717,000 sterling.

Hardware.—Toledo swords are still unequalled for temper, which some ascribe to the water of the Tagus. The royal factory usually employs about 300 operatives. Firearms are made at Valencia, artillery at Seville, nails, horseshoes, and copper utensils in Biscay. The muleteers of Vittoria convey weekly a ton of horseshoes to the inland provinces.

Minerals.—No country of Europe is richer in minerals, yet the total number of miners employed is only 43,500. There is no return of the value of minerals extracted, which will probably reach £7,000,000 as the exports are over £5,000,000. This branch of industry has trebled in twenty years, the exports of minerals in 1860-61 not exceeding £1,400,000. The returns for 1875 to 1877 average as follows:—

Lead	£2,050,000
Copper	1,650,000
Quicksilver	780,000
Iron	460,000
Zinc	240,000
	£5,180,000

The iron of Biscay, being specially suited for Bessemer steel and Krupp guns, is mostly exported to England and Prussia. The largest iron works are those of two English companies, and of Messers. Ibarra at Bilboa. The English companies at Cordova and Grenada have extracted such quantities of lead in the last twenty years, that other countries have had to suspend working their mines. The most productive coal-fields are those of Belmez and Seville, employing 10,000 miners, who extract only 300,000 yearly; this is barely one-third of the consumption in Spain, the rest being imported from England and Belgium. Previous to the discovery of quicksilver in California this article was almost a monopoly of Spain; the Almaden mines have been worked from the time of the Romans, and belong to the State; they employ 4000 miners, who raise 1500 tons yearly. Rio Tinto, near Sevill, is the most productive copper mine. There are 2000 silver mines, but the yield is trifling; even the Sierra Morena mines give less than in the eighteenth century.

Brazil.—There are various mining companies, but the most successful is that of San Juan del Rey, the annual output being 70,000 ounces of gold-dust, worth £220,000. The average dividends for the last thirty-three years have been 23 per cent. per annum; shares usually sell at four times their nominal value.

THE MINERAL PRODUCTION OF ITALY.

AMONG those countries on which we rarely obtain statistics is Italy. We are indebted to a memoir written by MM. Jean Beco and Lean Thouard, two well-known Belgian engineers, for the following data taken from quite an elaborate table, accompanied by many explanatory notes. The figures given are averages for the period of 1875 to 1879 for the production, exports, and imports:

	Production.	*Exports.*	*Imports.*
Iron ore	215,000	185,000	...
Pig-iron	16,000	.	56,000
Wrought-iron	46,000	.	66,980
Rails	...	...	47,470
Manganiferous iron ore	11,800	8,400	..
Ferro-manganese	3,000	3,000	.
Manganese ore	6,000	3,000	.
Copper ore	23,400	9,200	.
Copper (imports include brass, etc)	400	...	4,542
Zinc ores	65,200	65,200	...
Zinc	....	....	1,780
Lead ores	35,600	25,000	....
Lead	10,000	....	3,500
Silver ores	750		.
Silver, kilos	15,000	. .	..
Gold, kilos	100	..	.
Quicksilver	109	112	..
Iron pyrites	4,000	1,000	.
Graphite	740	710	70
Coal and coke	...	.	1,340,000
Anthracite	700	.	....
Lignite	120,000		..
Asphalt	6,000		12,500
Sicilian brimstone	282,000		
Romagnes refined sulphur	31,000	216,600	.
Other brimstone,	9,000		
Salt	321,000	102,800	.
Boracic acid	2,680	2,680	...
Sulphuric acid	13,000	..	510
Soda	15,900	472	13,400
Niter	1,700	...	3,520
Superphosphates	4,500	..	...
Powder and dynamite	1,500	....	....
Marble (Carrara, Masas Seravessa)	132,000	78,570	.
Marbles, other localities	45,000		
Pozzolana, cubic meters	230,000		
Talc	7,300		
Strontianite	1,000		
Ordinary lime	680,000	31,100	....
Hydraulic lime	60,000		
Cement	10,000		
Plaster	130,000		

—*Engineering and Mining Journal*

Great Britain's Coal and Iron Output in 1881.—The following statistics of the production of coal and ironstone (from the coal measures only) in the United Kingdom in 1881, has been supplied by the Home Office to the British Iron Trade Association. The total number of hands employed in and about the mines of the United Kingdom in 1881 was 495,477 as compared with 484,933 in 1880. The number of mines at work in 1881 was 3,847 as compared with 3,904 in 1880.

District.	*Coal.* *Tons.*	*Ironstone.* *Tons.*
Northumberland, Cumberland and North Durham	15,830,720	705
South Durham and Westmoreland	21 532,773	...
North Riding of Yorkshire and Cleveland	7,036	6,474,464
North and East Lancashire	9,326,722	....
Ireland	127,585	....

West Lancashire and North Wales	11,843,685	23,569
Yorkshire	18,287,141	171,146
Lincolnshire (Ironstone)	....	90,589
Derbyshire, Leicestershire, Nottinghamshire & Warwickshire	15,545,667	47,137
North Stafford, Cheshire and Shropshire	6,473,900	2,113,600
South Staffordshire and Worcestershire	10,058,670	198,069
Monmouth, Somerset, and parts of Glamorgan and Breconshire	8,318,821	32,128
South Wales	16,008,525	111,984
Scotland, East	14,148,880	778,994
Scotland, West	6,674,175	1,816,381
Total	154,184,300	11,858,766
Ditto in the preceding year	146,969,409	11,664,726

—*Coal Trade Journal.*

Consumption of Coal in France.—For the year 1880, the consumption of coal in France was distributed as follows, according to *La Houille.*

Railroads	2,499,000 or	9·6	per cent.
Ocean steamers	450,000 "	1·8	" "
River steamers	112,000 "	0·4	" "
Mines	1,112,000 "	4·4	" "
Other industries	3,819,000 "	15·1	" "
Iron and steel-works	4,546,000 "	17·9	" "
Other metallurgical works	141,000 "	0·6	" "
Salt-works	115,000 "	0·5	" "
Domestic fuel	12,606,006 "	49·7	" "

Quicksilver Production in Spain.—Through the kind attention of his correspondent at Almaden, Spain, Mr. J. B. Randol, general manager of the New Almaden mines, Santa Clara county, California, is enabled to place at our disposal the accompanying statement of the production of quicksilver at the famous Almaden mine for the year 1881. As usual there was no work in June, July, August and September on account of hot weather. It will be observed that the production is given in kilograms, as 1,737,571,600 and dividing this amount by the number of flasks—50,353, we have as the contents of each flask 34,507 kilograms, which, at 2.2046 lbs. avoirdupois to the kilogram, gives the contents of the flask or bottle in English weight 76.07 lbs., or .403 of a pound less than is contained in the New Almaden "A" brand, which latter have a guaranteed weight of 76.50 lbs. net. To large consumers and close buyers this difference of weight and quantity in favor of the product of the New Almaden may be found worthy of note and we therefore call attention to the fact.

Quicksilver Production of the Almaden Mine (Spain) during the Year 1881.

Months.	*Production in Kilograms.*	*Equal in Flasks.*
January	251,503,400	7,288
February	223,961,100	6,490
March	273,743,200	7,933
April (29 days)	250,873,200	7,270
May (19 days)	192,490,200	5,578
June	......	..
July	......	..
August	......	..
September	......	..
October (12 days)	96,550,300	2,798
November	220,876,700	6,401
December	227,573,500	6,595
Total	1,737,571,600	50,353

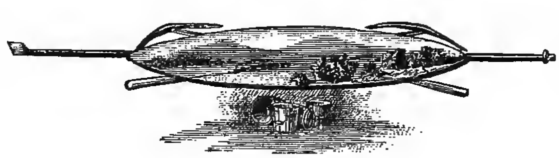
Equal to 34,507 Kilograms per flask.

N. B.—34,507 kilograms at 2.2046 lbs. avoirdupois=76.07 lbs. avoirdupois. 75 lbs. Spanish at 1.014331 lbs. avoirdupois=76.07 lbs. avoirdupois.—*Mining & Scientific Press.*

Russian Coal Statistics.—M. K. Shalkowsky, of the Russian department of mines, has officially published the following statistics of the production of coal in Russia for the year 1879. We have converted the figures on the basis of 36.116 pounds to the Russian pound.

	Pounds.	*Net tons.*
1874	78,813,137	1,423,245
1875	104,348,067	1,884,313
1876	111,302,028	2,009,941
1877	110,120,054	1,988,547
1878	154,024,302	2,781,363
1879	178,238,013	3,218,661

—*Coal.*



PART IV.

THE DISSEMINATION OF KNOWLEDGE, CONCERNING MINING INTERESTS—COURSES OF ENGINEERING—SCHOOLS OF MINES—MINING JOURNALS—U. S. GEOLOGICAL SURVEY.

KNOWLEDGE was defined on one occasion by one of the Argonauts of '49 to be "the possession of everything." Following out the Californian's idea the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES would not be complete unless it supplied its readers with an outline or panoramic view of what is being done in the country to forward a true knowledge of mining matters and to prepare the mining engineers for the duties before them. When in 1869 Professor R. W. Raymond, who has done so much for the honest growth of American mining, urged upon Congress the necessity of government founding a national mining school, it was done because he saw the great need of the hour, and was afraid that private initiative would not gratify it. Since then, though the government has taken no steps in the matter, the American colleges have come to the rescue, and where twelve years ago, a good outfit in mining education was difficult to obtain, to-day there is apparently some danger of overcrowding in the professions of Mine Engineering and Metallurgy.

Their courses are full and complete, and thoroughly practical. The wisdom of the old world has been drawn upon wherever it would aid the altered condition of the new. The student can, too, have his education for nothing. If circumstances have given him only an heritage of poverty the fullest and best courses in high technical education are still to be obtained at the cost only of hard work and earnest study.

In Part IV of our volume we furnish a good idea of the course of instructions in our various colleges as far as we have been able to obtain direct information from the colleges, also some notes on Education at Freiburg; Information Concerning the American Institute of Mining Engineers, the pioneer institution of its character; a list of prominent mining papers, the work of the U. S. Geological Survey, the Denver Mining Exposition, and some topics of kindred interest are touched upon.

TECHNICAL EDUCATION.

IT is no doubt to the interest of a metallurgist to employ a skilled laborer who will prevent waste by properly proportioning his materials; by regulating the supplies of air and fuel; by arranging his plant in the most economical manner, and by disposing of his products to the greatest advantage. The engineer is benefited by selecting for his assistant a person able to determine the values of his factors of safety for the same materials in different forms and positions, avoiding expensive suits for damages and cost of reconstruction; he should be able to so locate a road as best to fulfil the requirements of a through traffic, and yet develop local industries. But I need not multiply instances to show what all will readily concede, viz.; the advantages of a *theoretical* education; that was fully demonstrated at the previous special meeting, but it is still an open question whether the practical instruction should precede, accompany, or follow the theory.

In carefully canvassing the opinions of the members* who committed themselves on this subject, I find that *eight* were inclined to favor the first arrangement, *twelve* the second, and *eight* the last—giving a plurality in favor of the synchronal combination of the two departments of study of thirty-three per cent. over either of the other systems. Most of the advocates of this middle course are men of experience in both practical work and professional duties, and whose faith in the ability of the schools to make it a practical success is founded upon their knowledge of the requirements of both theory and practice. Numerous precedents are established in the technological schools of Russia, Germany, France, England, Sweden, and other countries; and so decided has been the impression made in this country by the exhibits of such institutions at the late Exhibition, that many of our instructors and their enterprising boards of trustees are using every effort to modify their rosters so as to embrace as large a proportion of practical work as possible in their curricula. A combined course conforms to the order of nature. From the very inception of knowledge, the sound or name and the thing are associated; the senses and mind are co-laborers—the first to glean, the second to direct, arrange, digest and utilize the information thus obtained. The mind and hand are essential to the engineer, and they are constantly called upon to assist each other, and this interpreter of the mind, the hand, gives exact expression to the imaginative and inventive faculties in the only universal language, that of form, as exemplified in drawings. But that the mind may direct the hand intelligently, it must itself be cultivated, and thus taught to know what is right or wrong, good or bad, safe or

* Members of the American Institute Mining Engineers.

unsafe, practical or visionary, and such knowledge can only be obtained by an intimate association with materials and tools, and the methods of using them, by which is developed their physical properties. To educate the mind simply by reading, as in a purely theoretical course for a number of years, and then to develop the practical requirements of one's nature, is abnormal, and a waste of time; the two assist each other by giving substance to the idea and weight to the formulas that may be used.

Another important consideration is the physical benefit conferred by a small amount of labor. The diligent student, without exercise, may graduate well, but it will be with an impaired constitution, caused by constant confinement and continuous and sometimes severe mental strain, which overtaxes and hence weakens the intellect; on the contrary, a due percentage of shopwork not only furnishes recreation and physical exercise, but enables the student to appreciate much better the practical advantage of his theory. It is urged by some of the advocates for separating the courses, that it is impossible to meet fully the requirements of practice in the schools. While this is undoubtedly true, much more may be taught in a practical direction than is generally imagined. All practical knowledge is progressive, and the sooner a student begins the better will be his chance of success. It is only by knowing what has been done and what has failed, with the reason why, that he can proceed rapidly to add to the general fund of invention or discovery. The greater the number of elements he possesses, the larger will be the number of possible practical combinations; and if the practical men will not furnish these elements, they must not expect from the schools such men as they desire to assist in developing their industries. The statement has been made that "before eighteen or twenty years of age the body is not generally sufficiently developed to endure the physical hardships of engineering." My own experience was so totally at variance with this, that I hope I may be excused the egotism of remarking that I was but a boy fourteen years old, only four feet nine inches high, and hardly more than an animated shadow, from the effects of intermittent fever and too much study, when my father took me from school and gave me a level rod, almost as heavy as myself (at least so it seemed), and so tall that I could not reach the target at the top, to operate on the Troy and Boston and Troy and Greenfield Railroads, in Massachusetts, during some severe fall and winter weather. Had I consulted my own comfort and convenience I should have preferred anything else, but I was obliged to weather it through whether I would or not, and it was, doubtless, the best school I ever attended.

A fellow-member remarks, of a blast furnace manager, "though he may have efficient subordinates in various departments, he must be able to understand and check their work, and he will find it extremely useful to be something of a mason, bricklayer, and carpenter, largely a surveyor, engineer, and mechanic, and well up in the general principles of chemistry and metallurgy." This I can heartily indorse, but I do not entirely approve the method proposed for acquiring such varied knowledge, that has been: "After the school *practice.*" Graduates, as a rule, are above mixing mortar, laying bricks, framing timbers, etc., but all this they can be made to do willingly, if incorporated in their course, and their tutor is the right sort of man, and will *show* them how. But this introduces the difficult element of finding capable teachers. It requires that they shall be practical men as well as scholars, and it is one of the chief obstacles to the successful establishment and operation of technical schools. If a man is a successful practitioner, and has the requirements of a good teacher, there are no schools that can hold out sufficient inducements for him to close his business and consent to teach. Again, there are many who are *too practical* to teach, having, as they say, "grown rusty on their mathematics," and most of those now engaged in teaching have not the experience required to do justice to so expanded a course of instruction. For the present, however, the difficulty may be met by calling in the service of some expert or foreman to explain the tools and their uses, and to direct students in their efforts to use them. A few weeks of such practice, with carefully prepared notes and sketches, would give them a fund of information they could never gather from books, and would do much towards breaking the ground for further cultivation by the professors. To accomplish this would require a small endowment, to be disposed of in a manner similar to the Whitworth scholarships in England.

Besides his practical knowledge, the engineer must be a man of integrity and good judgment, with experience in the management of men, and a financier. Most of these requirements can only be taught by combining theory and practice, organizing students into squads, gangs, or parties, and appointing one of them foreman, who directs the workmen in their several duties. By comparing the cost of a piece of finished work with the estimates, they learn the value of labor and materials; and so, in many other ways, can the workshop be made to supply a great defect in the older methods of education. With reference to æsthetics and art instruction, the greatest obstacle to progress arises from the apathy of the class intended to be benefited, the manufacturers, who, to protect themselves from competition, hesitate to furnish the information required to make such instruction practical. Hence it is that the remark is often heard that the designs of certain schools are pretty but impracticable. To overcome this defect to a certain extent, the Franklin Institute sent out the following circular to such of its members as would be most apt to respond favorably, but in return only a few drawings were received from a single firm:

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, September, 1875.

Dear Sir: In view of the great demand for a better class of designs in our American manufactured articles, it is proposed to give especial attention to this subject in the Franklin Institute Drawing School during its coming sessions. In furtherance of this object, it has been decided to request from manufacturers of textile fabrics, paper-hangings, porcelain, etc., the donation of such articles as will exhibit the necessary elements of design, such as structure, form, color, etc., with any suggestion they may be pleased to make as to any special requirement which must be fulfilled to make a design of *practical* value. Donations are also requested from manufacturers of machinery of all kinds, of drawings or models that will serve as examples of mechanical drawing, representing modern practice in machine building. Any services that you may render the Institute, either by donation or information, will be properly acknowledged.

Respectfully yours,
J. B. KNIGHT,
Secretary.

Until we can have a better understanding and more perfect co-operation between manufacturers, engineers, and teachers, we cannot expect to make much progress in our efforts to educate men who may practice successfully from the date of their graduation. In conclusion, I have only to suggest that it would be a step in advance if such organized societies as this were to identify themselves with the educational institutions teaching kindred subjects, and by the appointment of a committee on Technical Education see that such information was placed within reach of those institutions as would assist them in keeping up with the progress of the age, and enable them to introduce, explain and exemplify the latest advance in methods and processes, by giving publications, pamphlets, drawings, photographs, models, ores, or manufactured articles to such schools; prevailing upon manufacturers to open their doors for visits of inspection by students, and assisting the latter to secure positions after graduating, by keeping a register of their names and addresses.

—Compiled from a paper by Lewis W. Haupt, Professor of Civil Engineering, Transactions American Institute of Mining Engineers.

THE UNIVERSITY OF PENNSYLVANIA

STUDENTS of Mining and Geology who aspire to an education fitting them to the duties and trials of the Mining Engineering profession will find a good course of study easily available in the Towne Scientific School, of the University of Pennsylvania. Students are practically under the supervision of Prof. George A. König, who writes us concerning the course of study as follows:

"Special students for the course of three years, must be thorougly prepared in the whole of Geometry, plane Trigonometry and

Algebra, including quadratic equations. Other knowledge outside of plain English, is *not required*, however desirable. But I place special stress upon a sure mathematical foundation, without which no satisfactory result can be obtained in matters belonging to Mining Engineering. Another feature of my course, is the absence of recitations from text books. My teaching is direct, as far from mechanical learning as possible. Mineralogy in all its branches is treated thoroughly, and altogether practically. My lectures on ore deposits I consider as very valuable facts, the specimens having all been collected by myself on the spot. Ore dressing and the metallurgical treatment of ores, I have made a specialty of, and recommend to the attention of all aspirants to the profession. Whilst the course and its success rely mainly upon my personal exertion, they are freely and wholly given to the earnest student."

The University of Pennsylvania is the outgrowth and successor of the College of Philadelphia, which was founded chiefly through the influence of Dr. Benjamin Franklin and Dr. William Smith. Dr. Smith was the first Provost, and he is conspicuous in American college history as having established here in 1757 the curriculum of study which was adopted substantially by all the colleges of later foundation, until scientific departments were attached to them. The College of Philadelphia was chartered in 1755, and is therefore the sixth in the order of succession of American Colleges. Instruction is now given in eight different departments, viz.:—

The Department of Arts, established in 1755; the Department of Medicine, established in 1765; the Department of Law, established in 1789; the Auxiliary Department of Medicine, established in 1865; the Towne Scientific School, established in 1872; the Department of Music, established in 1877; the Department of Dentistry, established in 1878; the Wharton School of Finance and Economy, established in 1881.

Public commencements are held—(1.) For the Towne Scientific School, on June 15th, or if this day falls on Saturday or Sunday, on the previous Friday. The following degrees are conferred: Bachelor of Science (B.S.) with mention of special course of study pursued. The latter degree is awarded to graduates of the Towne Scientific School. Post-Graduate Degrees—Civil Engineer (C.E.), Mechanical Engineer (M.E.), Mining Engineer (E.M.), to graduates in Science of three years' standing; Bachelor of Science (B.S.), in Sciences Auxiliary to Medicine, by the Auxiliary Faculty of Medicine.

The college year in the Towne Scientific School is divided into three terms: the first beginning on the 15th of September, and ending on the 24th of December; the second beginning on the 2d of January, and ending on the Wednesday before Easter; and the third beginning on the Tuesday after Easter, and ending on the 15th of June (Commencement Day). The annual tuition fee is $150, payable to the treasurer of the university in three instalments, on October 1st, January 1st and April 1st. The graduation fee is $20. A separate charge of ten dollars per term is made to the chemical and geological students of the junior and senior classes in the Towne Scientific School, for chemicals and gas, and a like charge of five dollars per term to students of the sub-junior class. Students are required to have their own apparatus. Examinations are held by the faculties of these departments, partly in the month of January, and partly, for the senior class in May, and for the lower classes at the close of the college year in June. During the first and second terms, private examinations by way of review may be held by each professor. At the end of each term students who attain distinction are classed in order of merit. Students shown by their term average to be deficient in any of their studies, may be conditionally attached to their class until they prove on re-examination that said deficiency has been fully made up. In case of persistent neglect of study, great irregularity of attendance, or evident inability to keep up with the class from any cause, the student must be dropped from the rolls.

The Towne Scientific School occupies a building that has a front on Locust street (between Thirty-fourth and Thirty-sixth streets, Philadelphia) of 254 feet, by 102 feet 4 inches in depth, exclusive of towers, bay windows, buttresses, &c., with an additional projection of the center 21 feet 10 inches beyond the wings. The cellar is arranged for the storage of coal, and an apartment in connection, outside the building, is provided for the boilers of the steam-heating apparatus. The basement on the sides and rear is entirely above ground, 15 feet high. There is an entrance in the rear for students to the assembly-room, 44 feet by 50 feet, and entrances on the east and west ends to a wide corridor, which extends the whole length of the building, in all the stories. The eastern wing contains: Laboratory, 30 by 45 feet, apparatus and store-room, 24 by 29 feet, metallurgical laboratory, 30 by 50 feet, a fire-proof furnace-room, 24 by 34 feet, balance-room, 14 by 17 feet, as well as smaller rooms for silver and gold assaying. The western wing contains: Laboratory, 30 by 45 feet, and apparatus and diagram room, 24 by 29 feet, for the chemical-lecture room on first floor, one laboratory, 30 by 50 feet, and one, 24 by 34 feet, for the physical department. Apartment for janitor and assistants are arranged on this floor, and for machinery, storage, dumb-waiters, water-closets, &c. The first or principal floor is 16 feet high. On the eastern side of the main entrance is the faculty-room of the scientific department, 13 by 22 feet, professors' laboratory, 19 by 45 feet, preparing laboratory, 21 by 24 feet, qualitative laboratory, 30 by 45 feet, quantitative laboratory, 30 by 50 feet, laboratory for organic analysis, 24 by 34 feet, two balance-rooms and two assistants' rooms. On the western side is the reception and secretary's room, 13 by 22 feet, trustees' and faculty-room, 19 by 37 feet, provost's recitation-room, 24 by 33 feet, and private room, 14 by 18 feet, chemical-lecture room, 30 by 45 feet, physical-lecture room, 30 by 50 feet, and apparatus-room, 24 by 34 feet. The library in center of rear, 44 by 50 feet, is entered from a hall 34 by 40 feet. This part of the building is fire-proof. The second floor is 15 feet 6 inches high. The chapel 50 by 80 feet, occupies the front of the center building, and is 28 feet high. The eastern side contains lecture-rooms for civil engineering, mining and metallurgy, and mineralogy, and a large museum for these departments. The western side and center of rear is divided into six large recitation-rooms, with adjoining private rooms. The third floor is 14 feet high, and contains three large recitation-rooms, lecture and model rooms for mechanical engineering, three large rooms for the study and practice of drawing in the departments of civil and mechanical engineering, architecture, &c. A large examination-hall is in the rear of the chapel. The fourth floor, over the chapel, has two society-rooms for students, each with an adjoining library. The design is in the collegiate gothic style; the material used is Lieperville stone, for the basement, with base course of Hummelstown brownstone. The walls above are serpentine marble, with cornices, gables, arches, &c., of Ohio stone. The entrance-porch is of Franklin stone, with arch supported on polished red-granite columns, with enriched capitals of Ohio stone. The windows of chapel and gables are decorated with geometrical tracery. The space devoted to the sciences more immediately connected with mining and metallurgy is one-half of the building. The chemical departments were planned by the late Prof. Wetherell, of Bethlehem.

THE FACULTY.—William Pepper, M. D., LL. D., Provost of the University, and *ex-officio* President of the Faculty. Rev. Charles P. Krauth, D.D., LL. D., Vice-Provost, and Professor of Intellectual and Moral Philosophy. E. Otis Kendall, LL. D., Dean of the Faculty, Professor of Mathematics. J. Peter Lesley, LL. D., Professor of Geology and Mining. Oswald Seidensticker, Ph. D., Professor of the German Language and Literature. John G. R. McElroy, A. M., Professor of Rhetoric and the English Language. Rev. Robert E. Thompson, A. M., Professor of Social Science. Frederick A. Genth, Ph. D., Professor of Chemistry and Mineralogy. George F. Barker, M. D., Professor of Physics. Lewis M. Haupt, C. E., Professor of Civil Engineering. Thomas W. Richards, A. M., Professor of Drawing and Architecture. George A. Koenig, Ph. D., Assistant Professor of Chemistry, Instructing in Metallurgy, Technical Chemistry, and Mineralogy. Samuel P. Sadtler, Ph. D., Assistant Professor of Chemistry, instructing in General and Organic Chemistry. Joseph T. Rothrock, B. S. M. D., Professor of Botany. William D. Marks, Ph. B., C. E., Whitney Professor of Dynamical Engineering. Otis H. Kendall, A. M., Assistant Professor of Mathematics. Andrew J. Parker, M. D., Ph. D., Professor of Comparative Anatomy and Zoölogy. John Welsh, Centennial Professor of History and English Literature.

INSTRUCTORS AND ASSISTANTS.—Morton W. Easton, Ph. D., Instructor in French and in Elocution. Henry W. Spangler, Assistant Engineer U. S. N., Instructor on Marine Engineering and Naval Architecture. Carl Hering, B. S., Instructor in Dynimical Engineering. Frederick A. Genth, Jr., M. S., Assistant in Analytical Chemistry. Herman A. Keller, B. S., Assistant in Geology and Mining Engineering. Lawrence B. Fletcher, Ph. D., Assistant in Physics. John G. McElroy, Secretary.

In order that this professional training shall be complete and systematic, and rest upon a broad basis, so that the student at its close may not be a mere *specialist*, but a man of liberal education as well, the course is comprehensive, extending through five years.* The students are divided into five classes,—Senior, Junior, Sub-Junior, Sophomore, and Freshman. The first two years are devoted, not merely to a thorough training in the preparatory and elementary Mathematics, Chemistry, and the methods of scientific research in general, but (for a considerable portion of the time) to instruction in History, English Composition, and Rhetoric, as well as to the Modern Languages and to Mechanical and Free-hand Drawing. At the close of these two years, the student is presumed to be prepared for studies of a strictly professional or technical character, and he then selects one of six parallel courses, in which instruction is given in this department. During the last three years, his work is confined mainly to the studies of one or another of these courses, in accordance with the plans he may have formed in regard to his future profession.

Terms of Admission and Degrees.—Candidates for admission to the Freshman Class must pass an examination in the following subjects:

GEOGRAPHY.—Ancient and Modern Geography. (Mitchell's *New Ancient Geography* and *Ancient Atlas* are recommended.)

ENGLISH.—Grammar, Composition, and Etymology (*Greek and Latin Roots.*)

Abbott's *How to Parse* indicates the amount required in Grammar, and Sargent's *Manual* the amount in Etymology. A composition, one (foolscap) page long, will be required on a theme to be set at the time of the examination.

MATHEMATICS.—Arithmetic (*including the Decimal System of Weights and Measures*), Algebra (*through Quadratic Equations,*) Geometry (*the first four books of Chauvenet or Wentworth*).

The professional courses from which a student may select are at present—I. A course in Analytical and Applied Chemistry and Mineralogy. II. A Course in Geology and Mining. III. A Course in Civil Engineering. IV. A Course in Mechanical Engineering. V. A Course in Drawing and Architecture. VI. A Course Preparatory to the Study of Medicine.

On the completion of any one of these professional courses, in addition to the studies pursued by the whole class during the five years of the curriculum, and on the presentation of a satisfactory thesis, the student is graduated BACHELOR OF SCIENCE. Special students, not candidates for a degree, may be received into any of the professional courses, when the Professor in charge of that course is satisfied of their competency to profit by his instruction. They take all the studies that the Professor thinks necessary to the completeness of the course, together with such others as the faculty may require. At the end of the course, upon passing the examinations required and presenting a satisfactory thesis, they will receive a Certificate of Proficiency. Application should be made to the Professor in charge of the department in which the student wishes to study; and definitive arrangements may be made with him,—subject, however, to the approval of the Faculty.

Course, Methods, and Means of Study—Instruction is made as practical as possible. It is given by lectures and recitations,—and by daily exercise in the Laboratories and the Drawing and Model Rooms. These are open to the students all day, work being required of the higher classes in the afternoon as well as in the morning hours.

* The four years' curriculum heretofore in force has been found too short for the work required of undergraduates in this Faculty, and it has accordingly been lengthened to five years. The statements in the catalogue have been adapted to the new arrangement; but the Seniors, the Juniors, and one section of the Sophomore Class, are pursuing the four years' course, whose requirements will be found in the catalogue of 1879-80.

In the Department of Chemistry, the Sophomores have a course of fully illustrated lectures, covering the whole ground of Inorganic Chemistry. In the Sub-Junior year, their work commences in the Analytical Laboratories, while they also attend lectures on Mineralogy and Metallurgy. In the Junior and Senior years, Qualitative and Quantitative Analysis and the making of Chemical Preparations are combined with lectures on Organic Chemistry and practical work on Metallurgical and Technical Subjects.

Students in Geology and Mining Engineering are trained in drawing-rooms in the platting of original field-notes, in contouring, in making relief maps of mineral properties, and in constructing sections on an equal vertical and horizontal scale, converting thereby their maps into clay and plaster models, with coloring to show the structure of the country. Solid models of underground work are made to show the position of the veins and beds, and the connection of these with the surface. To these are added illustrative diagrams and pictures, calculations of quantity, and whatever else is needed for the preparation of professional reports.

Students in Civil Engineering are instructed by recitations, lectures, and practical work, so as to develop to the best advantage the qualities required of the practical engineer. The afternoons and Saturdays are devoted to drawing and practical work in the shop, or to the surveying or visiting public or private works, manufactures, etc.

The *Course of Drawing* includes the projection of maps; various methods of representing Topography; conventional signs; problems in shades, shadows and perspective; details of framing; composition; general drawings for constructions in wood, stone, and iron; special designs; working drawings for modelling; platting; and drawing of profiles and cross-sections.

In *visiting shops and manufactories*, students are required to collect all the practical information possible, and to embody it in a written report, noting particularly any new or special features for economizing time or materials, improved methods of assembling parts, etc., as well as the general plant, apparatus, and facilities for receiving and shipping materials.

The *field practice* embraces the various problems in chain surveying, the measurement of areas, and the computation of results; line surveys and location, cross-sections and levels for estimating quantities, hydrography, topography with the plane-table, and the solution of such geodetic problems as relate to the orientation of maps.

Students of Dynamical Engineering are required to give particular attention to the kinematics of mechanism, to the conditions under which work and power act, and the means of regulating and transmitting the same; to the problems of hydraulics or hydraulic motors, and to the mechanical theory of heat, with its applications to the steam engine, etc., as will appear from the detailed course of study given elsewhere.

Special attention is given to the execution of drawings, first from designs and models, and afterwards from calculations; and also to the methods of casting and working in iron, and of making and using machine tools. The recent appointment to this department of an Instructor in Marine Engineering and Naval Architecture provides for instruction in these subjects. Weekly visits of inspection will be made during two years of the course to blast furnaces, foundries, machine shops, iron and steel rolling-mills. The instruction in Physics extends over three complete years. In the Sub-Junior year, the subjects treated are Elementary Mechanics and Sound, the exercises consisting of recitations from a text-book, illustrated by experiments, with occasional lectures. In the Junior year, the subjects treated are Heat and Light, the instruction being by lectures, with recitations and examinations. In the Senior year, lectures are delivered on Electricity, and on Astronomical and Terrestrial Physics. The Senior Class receives also practical instruction in the Physical Laboratory throughout the year. The education of the eye and hand which is thus given, secures familiarity with apparatus and the knowledge of methods of precise measurement.

The Rogers Engineering Library is composed of standard works on the various sub-divisions of the profession, treating of drawing, mathematics, astronomy, physics, surveying and explorations, technical works on the roads, and strength and properties of materials, railroads, tunnels, canals, water-supply, drainage, architecture, mechanics, navigation, harbor improvements, park and landscape engineering, with a valuable collection of Reports of American, English and French Engineering Societies, and periodicals, Coast Survey and hydrographic charts, maps, diagrams and drawings. Letters of inquiry may be addressed to Professor E. O. Kendall, Dean of the Faculty, or to Professor J. G. R. McElroy, its Secretary, at the University.

COURSE OF STUDY.

FRESHMAN YEAR.—*History.*—Freeman's *General Sketch of History.*
English.—Abbott's *How to Write Clearly,* and McElroy's *System of Punctuation.*
French.—Collot's *Pronouncing French Reader.* Bregy's *Compendium of Grammatical Rules* (First Part).
Mathematics.—Thompson and Quimby's *Algebra.* Chauvenet's *Geometry.* Chauvenet's *Plane Trigonometry.*
Drawing.—Geometrical and Isometrical Drawing (Minifie), and Drawing from the Flat. Free-Hand Sketching. Use of the Scale and Protractor. Shading in India Ink. Graphical representations from Geometry.
German.—Schmitz's *German Grammar; Elementary German Reader.*
SOPHOMORE YEAR.—*English.*—Elements of Rhetoric (Lectures). Haldeman's *Outlines of Etymology.* Lounsbury's *English Language.* Compositions and Declamations.
German.—Hodge's *Course of Scientific German.* Storm's *Immensee. Guide to German Conversation.* Translations into German.
French.—Souvestre's *Un Philosophe sous les Toits.* Bregy's *Compendium of Grammatical Rules.* (Part II).
Mathematics.—Chauvenet's *Spherical Trigonometry.* Bowser's *Analytical Geometry.* Descriptive Geometry.
Drawing.—Linear Perspective. Geometric and Isometric Drawing. Projection of Shadows. Architectural Detail and Ornament. Gothic Tracery. Shading in India Ink. Free-Hand Drawing.
Chemistry.—Inorganic Chemistry (experimental Lectures).

STUDIES PURSUED BY THE WHOLE CLASS.

SUB-JUNIOR YEAR—*Chemistry.*—Exercises in Analytical Chemistry and recitations in analytical and general Chemistry.
Physical Science.—Mechanics (including Hydrostatics and Pneumatics), Sound.
Mineralogy.—Crystallography and General Description of Minerals.
Mathematics.—Descriptive Geometry. Differential Calculus.
German.—*Der Mensch und die Natur* Lessing's *Nathan der Weise.*
French.—Racine or Corneille.
English.—Critical Reading of English Authors. Compositions and Declamations.

1. *Studies pursued by the Chemical Section.*

Mineralogy.—Special description of species, and practical exercises in determining minerals by their physical properties.

2. *Studies pursued by the Geological and Mining Section.*

Mineralogy.—Same as in 1st section.

3. *Studies pursued by the Civil Engineering Section.*

Engineering.—Spherical Projections. Graphical Statics.
Mathematics.—Differential Calculus.
Drawing.—Topographical Charts. Problems in map projections. Perspective. Details of frames, joints, etc.

4. *Studies pursued by the Dynamical Engineering Section.*

Mathematics.—Differential Calculus.
Statics.—The application of the principles of Statics to Rigid Bodies. The Elasticity and Strength of Materials. Forms of uniform strength. Theory of framed structures. Stability of structures. Theory of the arch. Strains in parts of mechanism. The Equilibrium and Pressure of fluids, as water, air, steam, etc. The equilibrium of fluids with other bodies, stability of vessels; determination of specific gravity; use of Hydrometers, Manometers, Gauges, etc. The Equilibrium of Funicular Structures.
Drawing.—Copies of bolts and nuts; riveting; gudgeons, pivots, axles, shafts, couplings, pillow-blocks; shaft-hangers, pulleys, sheaves, and gear-wheels; connecting rods and cranks, working-beams, crossheads, pipe-connections, valves, steam cylinders, pistons, stuffing-boxes, glands, etc., etc.

STUDIES PURSUED BY THE WHOLE CLASS.

JUNIOR YEAR.—*Physical Science.*—Heat and Light. Lectures and Recitations.
Philosophy.—Atwater's *Logic.* Intellectual and Moral Philosophy.
English.—Compositions and Declamations.
Descriptive and Determinate Mineralogy.
Elements of Geology.
Metallurgy.—Theory of Metallurgical Processes. Construction of Furnaces. Dressing and Mechanical Treatment of Ores.

1. *Studies pursued by the Chemical Section.*

Organic Chemistry—Lectures and making of organic chemical preparations and organic analysis.
Qualitative analysis by the blowpipe, in connection with reactions in the humid way for the rapid determination of Minerals and Ores.
Introduction to Metallurgy.—Theory of Metallurgical Processes; theory and construction of furnaces and other metallurgical apparatus. Dressing of ores considered theoretically and practically.
Assaying of ores and fuels, with special application of volumetric analysis.
Demonstration of the principal metallurgical processes by furnace practice.
Instruction in the practical production of chemical salts, preparations, and simple substances in their greatest perfection and purity; and also according to the principles which govern their manufacture on a large scale.
Qualitative Analysis of more complex substances, with practice in determining the color and condition of products and in the determination of minerals.
Qualitative Analysis and detection of the rarer elements and organic constituents of bodies. Introduction of Quantitative Analysis. Use of the spectroscope in qualitative determinations.

2. *Studies pursued by the Geological and Mining Section.*

Lithology and Palæontology.—Examination and determination of Rocks and of Fossil Organic forms.
Mining Engineer.—Methods used in searching for and developing deposits of valuable Minerals. Sinking of Shafts. Drifting and Stopeing.
Drawing and Modelling.
Dynamical Engineering.—Statics and Dynamics of rigid bodies. Determination of centres of gravity; moments of flexure, rupture, etc. Practical exercises in constructing and drawing machines.
Surveying.—Same as Section 3. At the beginning of summer vacation a complete mine survey will be executed in the coal regions.
Analytical Chemistry, Metallurgical Practice and Assaying.—The same as the Chemical Section.
Field excursions into the neighboring mineral districts for the demonstration of practical Geology.

3. *Studies pursued by the Civil Engineering Section.*

Mathematics.—Differential and Integral Calculus.
Surveying.—*Field-Practice;* including Chain Surveying, Use of Compass, Transit and Plane-Table in measuring lines and areas, Traversing and Location of Roads, Drains, etc., on Topographical Charts. Recitations from Gillespie's *Land and Higher Surveying,* Henck's *Field-Book for Engineers,* and *Earthwork Formulæ.*
Drawing.—Topography in ink and colors, Studies in Contours. Platting field-notes; Shades, Shadows, and Perspective.
Architecture.—Ornament. History of Architecture. Decorations and Shading.
Engineering.—Mechanics of Engineering, embracing the Statics of Rigid Bodies, Determinations of the Centres of Gravity, Moments of Flexure, Rupture, Resistance, Torsion, Analysis of Bridge and Roof Trusses, Strength and Properties of Materials, etc.
Modelling.—Construction of Scarfs and Joints used in Framing, Centres, Caissons, Coffer-Dams, Trestles, Bents, etc., from working drawings.

4. *Studies pursued by Dynamical Engineering Section.*

Mathematics.—Differential and Integral Calculus.
Statics.—The application of the principles of Statics to Rigid Bodies. The Elasticity and Strength of Materials. Forms of uniform strength. Theory of framed structures. Stability of structures. Theory of the arch. Strains in parts of mechanism. The Equilibrium and Pressure of fluids, as water, air, steam, etc. The equilibrium of fluids with other bodies; stability of vessels; determinations of specific gravity; use of Hydrometers, Manometers, Gauges, etc.
Kinematics.—Laws of motion. Elementary combinations of Pure Mechanism. Pulleys and belts. Trains of gearings and forms of teeth of wheels. Parallel motions. Link and valve motions, with a consideration of the various forms of valves, illustrated by working models.
Drawing.—From the model and original design.
Construction and Practical Applications.—Weekly visits of inspection will be made to blast-furnaces, foundries, iron and steel rolling-mills, ship-yards, steam and hydraulic forges, etc.

5. *Studies pursued by the Section in Drawing and Architecture.*

Mathematics.—Differential and Integral Calculus.
Drawing and Architecture.—The Study of Executed Works and of Buildings in Progress. History of Architecture, illustrated by

views of structures of all ages. Ornament. Shading in India Ink.
Engineering.—Same as Section 3.

6. *Studies in the Course preparatory to Medical Studies.*

Chemistry.—Laboratory Practice in Qualitative Analysis. Organic Chemistry (Lectures and practical analysis.)
Botany.—Systematic Botany and Special Morphology.
Zoology.—Invertebrate Zoology and Embryology.
Latin.—Reading of Latin Authors.

SENIOR CLASS.—STUDIES PURSUED BY THE WHOLE CLASS.

English.—Compositions. Declamations.
History.—Mediæval History. Lectures.
Social Science.—International Law. Thompson's *Social Science and National Economy.*
Astronomy.—Gummere's *Astronomy.*
Physical Science.—Electricity, Astronomical Physics, Practical Physics (Instruction in the Physical Laboratory.)
Geology.—Structural Geology of North America with reference to that of Europe, and with the principal minerals and fossils, distribution of metals and fuels. History of Geology.

1. *Studies pursued by the Chemical Section.*

Lectures on the applications of Organic Chemistry in the useful arts.
Quantitative Gravimetric Analysis of the simple and complex salts and minerals. Volumetric Analysis and preparation of normal solutions. Gas Analysis. Manufacture, graduation, and use of eudiometers.
Determination of the constituents of cast-iron and steel. Practice in Agricultural Chemistry, and Analysis of Manures.
Determination of small amounts of impurities (adulteration and poison in food and drink). Analysis of water of mineral springs. Practice in production of Chemical preparations. Quantitative Blowpipe Analysis.
Special Metallurgy—Gold, Silver, Lead, Copper, Zinc, Cobalt, Nickel, etc. Metallurgy of Iron and Steel treated with special attention. Metallurgical practice. Construction of plans for metallurgical works, with estimates of cost.
Practical determination of minerals by their physical properties.

2. *Studies pursued by the Geological and Mining Section.*

Geology.—The ore and Coal deposits of the United States in their topographical and structural relations.
Mining Engineering.—Ventilation and Drainage of Mines. Description and construction of Mining Machinery.
Dynamical Engineering.—Motors and Principles of Mechanism.
Surveying.—The survey made during the previous vacation will be mapped.
Metallurgy, Analytical and Didactic Chemistry.—with Section 1.
Practice in Lithological Determination by means of microscopic sections and microchemical tests.
Construction and Application of Geological Sections relating to problems of mining.

3. *Studies pursued by the Civil Engineering Section.*

Engineering.—Nomenclature of and Constructions in Masonry, Timber, Iron and Steel, as applied to Lighthouses, Bridges and Roofs, Depots, and other engineering structures. Strains in Girders and similar structures. Equilibrium of Arches and Retaining Walls. Tunnelling and Earthworks, with the required plant and organization. Sea-Coast and Harbor Improvements. Canal and River Improvements. Transportation. Hydraulics. Preparation of estimates and contracts. Reports on Tours of Inspection. Thesis, etc.
Drawing.—Details of Engineering Works, Composition, Plans, Sections, Elevations, Profiles and Cross-Sections. Working drawings. Platting field notes and computations from data.
Surveying.—Field Practice. Reconnoissance, Use of Prismatic Compass, Level, Solar Transit, Repeating Theodolites, and Heliotropes, Sketching; Preliminary Surveys for and Locations of Roads, Railroads or Canals; Hydrography; Laying Out of Parks; Use of Sextant, etc.
Geodesy.—Measurement of Bases, Triangulation, Determination of Meridian, Latitude, Longitude, Time, and Azimuth.
Visits of Inspection to public and private works, with reports thereon.
Architecture.—Shading, Decorations. History of Architecture (continued).
Metallurgy.—Technical Chemistry and Metallurgy.
Modelling.—Construction of trusses for bridges and roofs, girders, etc. Conducting experiments on strength of beams and trusses, Problems in stone-cutting. Tunnels.

4. *Studies pursued by the Dynamical Engineering Section.*

The Analysis and Synthesis of Mechanism.—Machine Tools and their principles. Lectures on forging, riveting, pattern-making and moulding.

Dynamics.—Lectures on the conditions under which work and power act, and the means of regulating and transmitting the same. The Efflux of Fluids. The Flow of Fluids through pipes. The Impulse and resistance of Fluids. Theory of Oscillation of Fluids. Lines of least resistance. Hydraulic Motors Turbine, overshot, breast, and undershot water-wheels.

Thermodynamics.—Value of Fuels. Strength, safety, and evaporative power of boilers. Steam and its properties. The Mechanical Theory of Heat. Stationary, locomotive and marine Steam Engine. Lectures on the proper proportions of the various parts of the Steam Engine.

Lectures on, and Use of Instruments.----Steam Engine Indicator. Planimeter. Dynamometer. Odontograph. Slide Rules. Arithmometers. Trammel and Testing Machines. Peaucelier's Compound Compass.
Construction and Practical Applications.—Weekly visits of inspection will be made to blast-furnaces, foundries, machine shops, iron and steel rolling-mills, ship-yards, steam and hydraulic forges, etc., etc.
Drawing.—Original designs. Designs and calculations for special machines. Detailed working drawings with specifications.
Metallurgy.—Chemical Technology and Metallurgy.

5. *Studies pursued by the Section in Architecture and Drawing.*

Engineering.—Calculation of the strength of roofs and bridges. Foundations, retaining walls, arches. Same as Section 3.
Architecture.—Elements of designs and principles of composition. Ornament of all styles. Sketching and measurement of works executed and in progress, building materials and processes. Specifications. Contracts.
Drawing.—Plans, Elevations, and Sections of original designs. Exercises with perspective views. Water-color.

The students of the school for the academical year 1882-3 are as follows: Post-Graduate, 1; Seniors, 24: Juniors, 23: Sophomores, 42; Freshmen, 49; Special Students, 33. Total Matriculates in Towne Scientific School, 171.

The Lehigh University.—The Hon. ASA PACKER of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational Institution in the rich and beautiful Valley of the Lehigh. From this foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000. The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete technical education for those professions which had developed the peculiar resources of the surrounding region. Instruction was to be liberally provided in Civil, Mechanical and Mining Engineering, Chemistry, Metallurgy, and in all needful collateral studies. French and German were made important elements in the collegiate course. A School of General Literature was part of the original plan, together with tuition in the ancient Classics. The Institution was freely opened to pupils from every part of the country and the world. It will be observed that all these educational facilities are provided without charge. Through the generosity of the Founder, the Trustees were enabled, in 1871, to declare tuition free in all branches and classes. The Lehigh University is open to young men of suitable talents and training from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered *without charge*, every facility for studying the professions of the Civil, Mechanical and Mining Engineer, and of the Metallurgist and Analytical Chemist. In the Classical and Scientific departments of the School of General Literature instruction is given to those who wish to become lawyers, clergymen, physicians, editors, or merchants.

Expenses.—Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratory, and drawing instruments, are furnished by the student. Rooms and board can be had in University buildings, under the following rules:

1. The room-rent, for each term, must be paid in advance to the Treasurer of the University. The price for board must also be paid monthly in advance.

2. The charge for board and room-rent shall be $5 per week. Where two students occupy a room jointly, the charge shall be $4.50 per week for each. The charge for

room without board shall be $2 per week for each room. These prices include gas and heat.

3. The choice of rooms shall be in order of the classes; in any class the first applicant to have the first choice.

4. Students may retain their rooms from year to year by giving notice of their intention so to do at the close of the academic year, and by procuring their tickets therefor on or before the first day of the next term.

5. Students are required to keep their rooms in order, or to employ some proper person to do so for them.

6. No furniture for rooms will be provided by the University.

7. The use of kerosene, coal oil or burning fluid, in any of the buildings, is prohibited. The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks	from $100	to	$200
Room rent, with fuel and lights	" 40	"	80
Care of room and use of furniture	" 5	"	20
Washing and incidentals	" 15	"	30
Books, stationery, etc.	" 20	"	45
Total	$240	to	$375

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

Admission.—Application for admission into the University should be made to the President, from whom all information may be obtained. Candidates for the Freshman class are examined orally and rigorously. All candidates must be at least sixteen years of age, must present testimonials of good moral character, and satisfactorily pass in the following subjects: 1. *English Grammar*, including composition, spelling, and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any other course than the classical. 2. *Geography*, general and political. 3. *History of the United States*. 4. *Physical Geography*, Mitchell's or Guyot's, or an equivalent. 5. *Arithmetic*, including the metric system of weights and measures. 6. *Algebra*, through equations of the second degree. 7. *Chauvenet's Geometry*, or Davies' Legendre, six books, (Chauvenet preferred).

All applicants for regular standing in the classes or schools must be prepared to pass an examination according to the programme of studies. A student may be admitted at any time if able to pass a satisfactory examination in the studies already pursued by the class that he proposes to enter. The only exception will be in the case of a young man who is very nearly but not thoroughly prepared to enter in full standing and who may, at the discretion of the Faculty, be admitted conditionally, to make up his deficiencies by extra study. When they are made up, he will be received in full standing into his class. Young men who do not desire to take a full regular course may enter, upon a satisfactory examination, and select special shorter courses, with the sanction of the Faculty.

Programme of Studies.—The following is presented as the general programme of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees. The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parenthesis immediately following. Two hours of Drawing, three of work in the Laboratory, or three of practice in the field, are equivalent to a recitation or lecture of one hour's duration.

Faculty. — Robert A. Lamberton, LL.D., President. Henry Coppée, LL.D., Professor of English Literature, International and Constitutional Law, and the philosophy of History. William H. Chandler, Ph.D., F.C.S., Professor of Chemistry and Director of University Library. Benjamin W. Frazier, A.M., Professor of Mineralogy and Metallurgy, H. W. Harding, A.M., Professor of Physics and Mechanics. James P. Kimball, Ph.D., F.G.S., Professor of Economic Geology. C. L. Doolittle, C.E., Professor of Mathematics and Astronomy. W. A. Lamberton, A.M., Professor of the Greek Language and Literature. Mansfield Merriman, C.E., Professor of Civil Engineering. S. Ringer, U.J.D., Professor of Modern Languages and Literatures and of History. Henry C. Johnson, A.M., LL.B., Professor of the Latin Language and Literature. The Rev. Frederic M. Bird, A.M., Chaplain and Professor of Psychology, Christian Evidences and Rhetoric. Edward H. Williams, Jr., E.M., A.C., Professor of Mining and Geology. J. F. Klein, D.E., Professor of Mechanical Engineering. LECTURER.—Traill Green, M.D., LL.D., Lecturer on Physiology and Hygiene. INSTRUCTORS.—Spencer V. Rice, C.E., Instructor in Drawing and Civil Engineering. E. H. S. Bailey, Ph.B., Instructor in Chemistry. A. E. Meaker, C.E., Instructor in Mathematics. Lester P. Breckenridge, Ph.B., Instructor in Drawing and Mechanical Engineering. A. W. Sterner, Clerk to the Director of Library.

Calendar—1882-83.

1882.

Sept. 4-5,	Monday and Tuesday		Examinations for Admission.
Sept. 6,	Wednesday	. . .	First Term begins.
Oct. 12,	Thursday	. . .	Founder's Day.
Nov. ,	Thursday	. . . .	Thanksgiving Day.
Dec. 20,	Wednesday	. . .	First Term ends.

1883.

Jan. 10,	Wednesday	. . .	Second Term begins.

THE SCHOOL OF TECHNOLOGY.—This school includes four distinct courses: I. The Course in Civil Engineering; II. The Course in Mechanical Engineering; III. The Course in Mining and Metallurgy; IV. The Course in Chemistry. These have the same curriculum of studies for the first three terms (one year and a half.) At the end of that time the student selects his course and follows its programme.

FIRST TERM.

FRESHMAN CLASS.—*Mathematics.*—Chauvenet's Geometry, (completed). (5)

Physics.—Mechanics, with Lectures. (2)

German.—Otto's Grammar. Writing in German Text. Translations into English. (3) Or *French.*—Fasquelle's Introductory Course. Chouquet's Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. Free-Hand Drawing. (4)

Physiology and Health.—Lectures. (1)

English.—Essays and Declamations. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (3)

German.—Otto's German Grammar. Translations. Ahn's Second German Reader. (3) Or *French.*—Languillier and Monsanto's Practical French Course. Translations. Keetel's Analytical Reader. (3)

Botany.—Lectures and Practice. Gray. (1)

Drawing.—Projection Drawing. Descriptive Geometry. (2)

English.—Essays and Declamations. (2)

THIRD TERM.

SOPHOMORE CLASS.—*Mathematics.*—Analytical Geometry. Olney's General Geometry. (4)

Chemistry.—Lectures and Laboratory Practice. Galloway's Qualitative Analysis. (5)

Physics—Heat, Meteorology, Magnetism and Statical Electricity. with Lectures. Laboratory Practice in these branches and Mechanics. Barometrical leveling and Measurement of heights. (3)

German.—Otto's Grammar. Oral translations. Ahn's Reader. (2) Or *French*—Languillier and Monsanto's Practical French Course. Translations. Keetel's Analytical Reader. (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

English.—Essays and Declamations. (1)

The Course of Civil Engineering.—The general scope of this Course comprises the higher branches of the applied mechanics and mathematics, together with the principles of construction and exercises in mapping, drawing and designing. The student is made acquainted with the strength of materials, including the theory of elasticity or flexure, the principles of construction of roof-trusses, beams, girders and bridges, the determination of their proper dimensions and the preparation of working-drawings. Under this head belong also the theory of the stability of structures, including the theory of the arch and of retaining walls; the principles of hydrostatics and hydraulics with their applications to vertical water-wheels and turbines. The theoretical priciples are in all cases illustrated by examples from actual engineering practice. Much time is devoted to surveying operations and to actual practice in the field. Profiles, plans of topographical surveys, contour maps, and railroad charts are made. The practical operations connected with the reconnaissance, location and survey of roads, canals and railroads, are fully illustrated in the field. Thorough instruction is given in drawing, the construction of working drawings of structures, topography and hydrographical charts.

Attention is also paid to the application of the general principles of the science of engineering, or to engineering construction, incluing the composition and qualities of materials; their dressing and preservation; foundations, earth and rock-work; the drainage, collection and distribution of water. Visits of inspection to engineering structures in the Lehigh Valley and vicinity are regularly made. So much of Mechanical Engineering is necessarily included, as refers to the construction of bridges, and the special machinery and appliances used in the erection of structures. There is also thorough instruction in mineralogy and geology. The course in astronomy in the Senior year includes practical work in the observatory. Designs for and reviews of special structures, specifications and estimates of quantities and cost, and the preparation of a graduation thesis giving evidence of satisfactory attainments, complete the course of study. The graduate in this course will receive the degree of Civil Engineer. (C. E.)

SECOND TERM.

SOPHOMORE CLASS.—*Mathematics.* — Differential and Integral Calculus: Olney. (4)

Physics.—Galvanism, Acoustics, Light, with Lectures and Laboratory Practice. (5)

German.—Systematic Readings. Translation. Dictation. (2) Or *French.* — Wall's Student's Grammar. Systematic Readings. Dictation. (2)

Drawing. — Line Shading. Sketching. Drawing of Structures from actual measurement. (2)

Surveying.—Use of Compass, Level and Transit. Maps of Farm Surveys. Profile and Contour Maps. (3)

English. Essays on Scientific subjects. Declamations. (1)

FIRST TERM.

JUNIOR CLASS. — *Mathematics.* — Integeral Calculus: Courtenay. (2)

German.—Systematic Readings. Lectures on Syntax. Compositions in German. (2) Or *French.*—Readings. Translations. Dictation. (2)

Mechanics.—Smith. Mathematical Theory of Motion. Science of Motion in General. Statics. Dynamics and Statics of Fluids. Lectures on the Theory of Centre of Gravity and Momenti of Inertia. (5)

Surveying.—Triangulation. Leveling. Topographical Surveys and Maps. (4)

Construction.—Materials of Construction. Carpentry. Masonry. Foundations. (1)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

English.—Essays on engineering subjects. Declamation. (1)

SECOND TERM.

German—Systematic Readings. Compositions. (2) Or *French.* Systematic Readings. Compositions. (2)

Strength of Materials.—Elasticity and strength of wood, stone, and metals. Theory of columns, shafts, and beams. Testing of materials. (3)

Surveying.—Railroad Reconnoissance and Location. Survey of a Line, with profile, map and estimate of cost. (3)

Stone-Cutting.—Working drawings of piers and arches. (2)

Construction.—Methods of construction and maintenance of roads and railroads. (1)

Prime Movers.—Steam Engines and their accessories. (3)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals. (3)

Essays and Original Orations.

FIRST TERM.

SENIOR CLASS.—*Astronomy.*—Descriptive Astronomy: (3)

Roofs and Bridges.—Theories and calculation of strains in trusses. (3)

Graphical Statics.—Analysis of roof trusses and arches. (2)

Surveying.—Use of plane table and sextant. Hydrographic surveys and charts. Gauging of streams. Geodetic surveying (3)

Construction and Design.—Study of bridge details. Reports on stability of bridges. Design for a simple structure. (3)

Geology.—Lithology, with practical exercises in determining rocks. (3)

SECOND TERM.

Astronomy.—Practical Astronomy as applied to Geodesy and Navigation. Lectures and Observatory work. Determination of Latitude, Longitude and Azimuth. Practice with the Sextant, Transit and Zenith Telescope. (2)

Surveying.—Mine Surveying, with practical work. (1)

Hydraulics. Flow of water in pipes and rivers. Water supply engineering. Hydraulic motors. (3)

Construction and Design. Specifications and Contracts, with Designs and Estimates for Engineering Projects. Patent office Rules and Regulations. (2)

Practical Dynamics. Machinery for transporting, handling, and lifting materials. (2)

Geology. Historic, dynamic and economic. Dana. (3)

English Literature. Lectures. (2)

Christian Evidences.—Lectures. (1)

Preparation of Theses.

THE COURSE IN MECHANICAL ENGINEERING.—The object of this course is the study of the Science of Machines; the principal subjects taught are: the nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers, they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform and the order of the various operations, to the dimensions most needed by workmen (in order that the students may learn to dimension working drawings judiciously) and to the various devices—ordinarily escaping the beginner's notice—for increasing the accuracy of the work, durability of the parts, conveniences of manipulation and safety of the workmen. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool-hand. The acquirements peculiar to the latter are by no means despised, and students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all the processes, operations and machinery, and ready at any moment at the call of the teacher, to witness an operation of special interest or to examine into the causes of and remedies for any sudden break down. Dressed in overalls and provided with note-book, pencil, calipers and measuring rule, the student sketches the important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and, having first obtained a clear idea from the working drawings of what is about to be constructed, follow pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the drawings or blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed programme given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and who tests the extent and accuracy of his knowledge by examining the sketches and notes, and by frequent questioning. Finally the results of these observations and the sketches made are to be neatly embodied in a memoir.

During the course there are frequent visits of inspection to engineering works, both in and out of town, with special reference to such subjects as Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. The instruction in Machine Design, during the second term of Junior year, consists in determining rational and empirical formulas for proportioning such machine parts as come under the head of fastenings, bearings, rotating, sliding and twisting pieces, belt and toothed gearing, levers and connecting rods, also, in comparing recent and approved forms of these same parts with respect to their advantages as regards fitness, ease of construction and durability, and in making full sized working drawings of these parts; all the dimensions are determined by the students from the above mentioned formulæ, the data being given as nearly as possible as they would arise in practice. Duriug the first term of the Senior year, the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine, tracings are to be made and then "blue prints" taken for distribution among the other members of the class. During the latter part of the term the whole class take up the design of a steam engine, every dimension being determined by the students, and complete working drawings made. In the case of the simple machines and of the steam engine, the general plan or arrangement will be given to the students in the form of either rough sketches, photographs or wood-cuts. This work will continue to the middle of the last term of the Senior year. From this time on the students are expected to make original designs for simple mechanisms, whose object has been fully explained. Throughout the course the work in the draughting room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulæ, tables and diagrams. The graduate in this course will receive the degree of Mechanical Engineer (M. E.)

SECOND TERM.

SOPHOMORE CLASS.—*Mathematics.*—Differential and Integral Calculus: Olney. (4)

Physics. Galvanism, Acoustics, Light, with Lectures and Laboratory Practice. (5)

German. Systematic Readings. Translation. Dictation. (2) Or *French.* Systematic Readings. Dictation. (2)

Drawing. Line Shading. Sketching, Drawing of Machines from actual measurement. (2)

Kinematics. Nature and equivalence of mechanism. (3)

English. Essays on scientific subjects. Declamations. (1)

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

German. Systematic Readings. Compositions. (2) Or *French.* Systematic Readings. Compositions. (2)

Mechanics. Smith. Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of Fluids. Lectures on Theory of Centre of Gravity and Movement of Inertia (5)

Mechanical Technology. Shop instruction. Examination of the processes and appliances involved in pattern making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Essays and Declamations. (1)

SECOND TERM.

German—Systematic Readings. Compositions in German. (2) Or *French.*—Systematic Readings. Compositions. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Experimental tests. (3)

Prime Movers.—Steam Engines and their accessories.

Machine Design.—Proportioning of such machine parts as come under the head of Fastenings, Bearings, Rotating and Sliding Pieces, Belt and Toothed Gearing, Levers and Connecting Rods. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory. Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Essays and Original Orations.

FIRST TERM.

SENIOR CLASS.—*Thermodynamics.*—General principles; application Steam Engines and Air Compressors. (3)

Graphical Statics.—Geographical analysis of roof trusses and girders. (2)

Machine Design.—Calculations and working drawings for the following machines: Drills, Hoists, Pumps, and Shearing, Punching and Milling Machines. Design for a Steam Engine begun. (5)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and valve motions. Quick return Motions. (3)

Practical Dynamics.—Machinery for lifting, handling and transporting materials. (2)

Mechanical Engineering Instruments.—Appliances and apparatus for gauging, recording and testing employed in shops and in experimental work. (2)

SECOND TERM.

Practical Dynamics.—Machinery for lifting, handling, and transporting materials. (2)

Machine Design.—Design for a Steam Engine completed. Original Designs. (5)

Hydraulics.—Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Mill Work.—Setting of Machinery and transmission of power. (1)

Specifications.—Contracts.—Requirements of Patent Office. (1)

English Literature.—Lectures. (2)

Christian Evidences.—Lectures. (1)

Preparation of Theses.

The Course in Mining and Metallurgy.—In addition to the physics, chemistry, literature, higher mathematics and mechanics necessary to all technical education, the scheme of studies comprises courses in mining, metallurgy, geology, mineralogy, dynamics, qualitative and quantitative analysis, blowpipe analysis, topographical and mine surveying and drawing. On account of the great number and scope of the studies necessary to the completion of this course, it is five years in length. The graduate in this course will receive the degree of Engineer of Mines. (E. M.) At the completion of the fourth year of this course, the student will receive the degree of Bachelor of Metallurgy. (B. M.)

In the courses of mineralogy, geology and analytical chemistry, much attention is paid to the practical instruction of the student in determining minerals by their crystallographical and physical properties, and, by the aid of blowpipe analysis, in the determination of rocks; in the qualitative and quantitative examination of ores and metallurgical products and in the rapid methods of assaying ores by the dry and wet ways employed in metallurgical laboratories. The location of the University in the vicinity of the iron works of the Lehigh Valley and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other Institution in the country. The zinc mines at Friedensville and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the anthracite coal fields of Pennsylvania, the iron and zinc mines of New Jersey, and the celebrated iron mines at Cornwall, Pa.

SECOND TERM.

SOPHOMORE CLASS.—*Mathematics.*—Differential and Integral Calculus: Olney. (4)

Physics.—Galvanism, Acoustics, Optics, with Lectures and Laboratory Practice. (5)

German.—Systematic Readings. Translation. Dictation. (2) Or *French.*—Systematic Readings. Translation. Dictation. (2)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Copper, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (1)

Chemistry.—Quantitative Analyses: Laboratory Work. Fresenius. (5) The following analyses are executed by the students.

1. Iron Wire (Fe)
2. Bronze (Cu, Sn, Zn)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zu) By both Gravimetric and Volumetric Methods.
5. Copper Ore. (Cu)
6. Speigeleisen (Mn)
7. Lead Ore (PbS)
8. Ilemenite (TiO^2)

FIRST TERM.

JUNIOR CLASS.—*Mathematics.*—Integral Calculus: Courtenay. (2)

Mechanics.—Smith. Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of Fluids. Barometrical Leveling and Measurement of Heights. Lectures on Theory of Centre of Gravity and Movement of Inertia. (5)

Chemical Philosophy.—Cooke. (5)

Kinematics.—Diagrams of the changes of position, speed and acceleration in Mechanics. Link and Valve motions. Quick Return motions.

German.—Systematic Readings. Compositions in German. (2) Or *French.*—Reading. Translation. Dictation. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Blow-pipe Analysis.—Lectures with Practice. Plattner, Brush, or Nason and Chandler. (1)

Prime Movers.—Steam Engines and their accessories. (3)

Strength of Materials.—Elasticity and strength of Wood, stone and metals. Theory of beams, columns and shafts. (3)

Surveying.—Use of Compass, Level and Transit. Maps of Farm Surveys. Profiles and Contour Maps. (3)

German.—Systematic Readings. Compositions in German. Or *French.*—Systematic Readings. Compositions. (2)

Drawing.—Elements of Machine Design. Plans and Elevations of Furnaces. (2)

FIRST TERM.

SENIOR CLASS.—*Metallurgy.*—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Crystallography.—Lectures with Practical Exercises in the determination of Crystals. (2)

Thermodynamics.—General Principles: Applications to Steam Engines and Air Compressors. (3)

Practical Dynamics.—Machinery for lifting, handling and transporting matter. (2)

Roofs and Bridges.—Theory and calculation of strains in framed trusses. (3)

Chemistry.—Fresenius' Quantitative Analysis. (2) The following analyses are executed by the students:

9. Iron Ore (Complete Analysis)
10. Limestone (Complete Analysis)
11. Coal (Volatile Matter,—Fixed Carbon, Ash, (H_2O, S, P)

SECOND TERM.

Mineralogy.—Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals: E. S. Dana. (3)

Blow-pipe Analysis—Practice. (1)

Hydraulics.—Flow of water in pipes and channels; hydraulic motors. (2)

Practical Dynamics.—Machinery for lifting, handling and transporting matter. (2)

Measurement of Power.—Indicator Cards. Determination of Evaporative Efficiency of Boilers. Dynamometer Experiments. (1)

Mill Work.—Setting of Machinery and Transmission of Power (1)

English Literature—Lectures. (2)

Christian Evidences.—Lectures. (1)

Chemistry.—Fresenius' Quantitative Analysis. (3) The following analyses are executed by the students:

12. Slag. (Complete Analysis).
13. Manganese Ore (MnO_2)
14. Pig Iron (Complete Analysis)
15. Nickel Ore (Ni. Co)
16. Gas Analysis (Complete Analysis of Illuminating Gas)

Projects.—On Metallurgical Subjects. (1)

FIRST TERM.

FIFTH YEAR.—*Astronomy.*—Descriptive Astronomy; Loomis. (3)

Mining.—Modes of Occurrence of the Useful Minerals. Searching for Mineral Deposits. Examination of Mining Properties. Boring. Mining Tools, Machines and Processes. Timbering and Masonry. Callon. Andre. (4)

Geology.—Lithology, with practical exercises in determining Rocks. Cotta. Rutley. General Geological Definitions and Principles. Dana. (4)

Zoology—Lectures. (2)

Surveying.—Triangulation. Levelling. Topographical Surveys and Maps. (4)

SECOND TERM [TO EASTER.]

Mining.—Methods of Working. Underground Transportation. Hoisting, Drainage and Pumping, and Lighting. Ventilating. Mechanical Preparation of Ores. Coal Washing. (3)

Geology.—Historic, Dynamic and Economic. (4)

Mine Surveying.—Practice in the mines. Map Drawing. (2)

Astronomy.—Practical work. (2)

Drawing.—Mining Plant. System of Timbering. Geological Maps and Sections. (4)

Projects.—In Mining, Geology and Metallurgy. (2)

THIRD TERM [AFTER EASTER.]

Astronomy.—Practical work. (2)

Notes on mining costs.

Excursions.

Theses.

THE COURSE IN CHEMISTRY.—This course of instruction continues the subject of Theoretical Chemistry from the general course of the two previous terms, the subject of Chemical Philosophy and Organic Chemistry being taught by daily recitations in the Junior and Senior years. In analytical Chemistry, the course of Qualitative Analysis in the first term of the second year is followed by preparation of Chemical Compounds and purification of Chemicals.

Subsequently, Quantitative Analysis is pursued to the end of the course, including the Dry Assaying of Ores of gold, silver, copper, lead, iron and tin, and the Wet Analyses, included in the appended schedule. In addition, courses of Lectures on Medical, Agricultural and Technical Chemistry are given, and various industrial establishments in the neighborhood and in Philadelphia and New York are visited in the company of an instructor. The course also includes thorough instruction in Physics and Mechanics, Mineralogy and Blow-pipe Analysis, Metallurgy, Geology and Descriptive Astronomy. The last term of the Senior year is mainly devoted to the preparation of a Thesis on some subject, selected by the professor, involving practical work in the Laboratory, in addition to the literary labors, and each graduate will thus make a contribution to the progress of the science as a preliminary to the reception of his degree. The course is thus seen to include thorough instruction in theoretical and applied chemistry, in their various branches, as well as in those cognate sciences of such great value to the chemist.

The Laboratories are under the immediate charge of the Professor and his Assistant, and together with the Lecture-room, are unsurpassed in excellence by any similar establishment in the country, being supplied with all the modern improvements. The collections of apparatus, specimens and models, illustrating theoretical and applied chemistry, are already important and rapidly increasing.

Students are charged for the chemicals and apparatus consumed. If the student is moderately careful, this expense need not exceed $60 per year

The graduate of this course will receive the degree of Analytical Chemist. (A.C.)

SECOND TERM.

SOPHOMORE CLASS.—*Mathematics*, Differential and Integral Calculus; Olney. (4)

Physics.—Galvanism, Acoustics, Light: with Lectures and Laboratory Practice. (5)

German Systematic Readings, Translations. Dictation. (2) Or *French.* Systematic Readings. Translations. Dictation. (2)

Chemical Preparations. Including the Preparation of Chemical Compounds and the Purification of Chemicals by Distillation, Sublimation, Fusion, Crystallization, Precipitation, etc. (2)

Assaying. Including the Assays by the dry methods of gold, silver, copper, lead, iron and tin ores. Ricketts. (1)

Blow-Pipe Analysis. Lecture with Practice. Plattner, Brush, or Nason and Chandler. (1)

Essays and Declamations. (1)

FIRST TERM.

JUNIOR CLASS. *Chemical Philosophy.* Coke. (5)

Toxicology. Otto on Poisons. (1)

Quantitative Analysis. Fresenius' Quantitative Analysis. (6) The following analyses are executed by the students:

1. Iron Wire(Fe)
2. Potassic Dichromate (Cr_2O_3)
3. Baric Chloride (Ba, Cl,H_2O)
4. Magnesic Sulphate (MgO,SO_3, H_2O)
5. Hydro Di-Sodic Phosphate (P_2O_5)
6. Bronze (Cu, Sn, Zn)
7. Rochelle Salt (K_2O, Na_2O)
8. Volumetric Determination of Chlorine.
9. Acidimetry (HCl, H_2SO_4, HNO_3)
10. Alkalimetry (KOH, NaOH, NH_4OH)
11. Chlorimetry (Bleaching Powders)
12. Silver Coin (Au, Ag, Pb, Cu)
13. Zinc Ore (Zn)

Crystallography.—Lectures, with Practical exercises in the Determination of Crystals. (2)

German.—Systematic Readings. Compositions in German. (2) Or *French.*—Systematic Readings. Compositions. (2)

Anatomy and Physiology.—Lectures. (1)

SECOND TERM.

Organic Chemistry.—Wohler. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (7) The following analyses are executed by the student:

14. Copper Ore (Cu)
15. Spiegelcisen (Mn)
16. Lead Ore (PbS)
17. Ilmenite (TiO_2)
18. Iron Ore (Complete Analysis)

20. Coal (Volatile Matter,— Fixed Carbon, Ash H_2O, S, P)
21. Slag. Complete Analysis.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

German.—Systematic Readings. Compositions in German. (2) Or *French*—Systematic Readings. Compositions. (2)

Mineralogy.—Descriptive Mineralogy, with Practical exercises in the Determination of Minerals. E. S. Dana. (3)

FIRST TERM.

SENIOR CLASS. *Metallurgy.*—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (8) The following analyses are executed by the student:

22. Guano (NH_2, P_2O_5, H_2O)
23. Clay (Complete Analysis)
24. Manganese Ore (MnO_2)
25. Mineral Water (Complete Analysis)
26. Pig Iron (Complete Analysis)
27. Nickel Ore (Ni, Co)
28. Organic Analysis (C, H, O, N)
29. Gas Analysis (Complete Analysis of Illuminating Gas)

Astronomy.—Descriptive Astronomy: Loomis. (3)

SECOND TERM.

Chemistry Applied to the Arts.—Lectures. (3)
Medical Chemistry.—Lectures. (1)
Agricultural Chemistry.—Lectures. (1)
Geology.—Historic, Dynamic and Economic Geology. Lectures. Dana. (4)
Christian Evidences.—Lectures. (1)
English Literature and History.—Lectures. (2)
Preparation of Theses.

Graduating Theses.—Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the university, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

Diplomas and Certificates. The diploma is given only to those who have passed all the examinations in a regular course and is signed by the President and Secretary of the Board of Trustees and by the Faculty of the University. For all partial courses a certificate is given showing what the student has accomplished, and is signed by the President and Secretary of the Faculty.

Graduate Students.—Graduates of the University wishing to remain a year or more and pursue a course of studies as candidates for another degree may do so with the sanction of the Faculty. Graduates wishing to take special courses of study will be afforded every facility in so doing.

Post Graduate Degrees.—M. A. —The Faculty will recommend for the degree of Master of Arts candidates otherwise properly qualified, who after taking at this University the degree of Bachelor of Arts, shall pursue for at least two years, at the University, a course of liberal study approved by the Faculty, pass a thorough examination in the same, and present satisfactory theses. *Ph. D.*—The Faculty will recommend for the degree of Doctor of Philosophy, candidates otherwise properly qualified, who, after taking at this University either of the degrees of Civil, Mechanical or Mining Engineer, or Analytical Chemist, shall pursue, for two years, at the University a course of advanced scientific study in the line of their profession, pass a thorough examination in the same, and present satisfactory theses. *D. Sc.*—The Faculty will recommend for the degree of Doctor of Science, candidates otherwise properly qualified, who, after taking at this University, the degree of Bachelor of Science, shall pursue for at least two years, at the University, a course of scientific study, embracing two subjects approved by the faculty, pass a thorough examination showing in one of the subjects special attainments, and shall present satisfactory theses in one of the subjects, based upon original scientific investigation. Candidates for any of the above post graduate degrees, who are not graduates of this University, must give satisfactory evidence of having fulfilled the requirements for graduation in the corresponding undergraduate course; the acceptance of a certificate as evidence of proficiency, in lieu of examination, is at the discretion of each professor as to the subjects in his department. The requirement of residence may be omitted in special cases by the Faculty.

Students' Societies.—The Chemical and Natural History Society.—This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits by election students from all departments of the University. The collections of Chemical Preparations, and Botanical and Zoölogical Specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets. The Society has organized and maintained several courses of public scientific lectures. Among the honorary members of the Society are more than one hundred of the most distinguished scientists in Europe and the United States.

The Engineering Society—This Society was organized in 1873, and admits by election students in the Junior and Senior Classes. Its meetings are held monthly.

LAFAYETTE COLLEGE, EASTON, PA.

THIS College furnishes in its Scientific Department an opportunity to the student of acquiring that education that will be the most useful to him in his encounter with mining and metallurgy. The faculty is as follows:

Rev. William C. Cattell, D. D., LL. D., President, and Professor of Mental and Moral Philosophy. (The Hon. John I. Blair Foundation.) Traill Green, M. D., LL. D., Professor of Chemistry. (William Adamson Professorship of Analytical Chemistry.) Francis Andrew March, LL. D., Professor of the English Language and Comparative Philology. Rev. John Leaman, A. M., M. D., Professor (Emeritus) of Human Physiology and Anatomy. Rev. Lyman Coleman, D. D., Professor of Latin and of Biblical and Physical Geography. Rev. Thomas C. Porter, D. D., LL. D., Professor of Botany and Zoölogy. (Jessie Chamberlain Professorship of Botany.) Rev. Augustus A. Bloombergh, Ph. D., Professor of Modern Languages. Rev. Robert Barber Youngman, Ph. D., Professor of the Greek Language and Literature. Rev. Selden Jennings Coffin, Ph. D., Professor of Mathematics and Astronomy. (George Hollenback Professorship of Mathematics.) James W. Moore, A. M., M. D., Professor of Mechanics and Experimental Philosophy. Justus Mitchell Silliman, M. E., (George B. Markle Professorship of Mining Engineering and Graphics.) Joseph G. Fox, C. E., Professor of Civil and Topographical Engineering; Rev. Addison Ballard, D. D., Professor of Moral Philosophy and Rhetoric; Joseph Johnston Hardy, A. M., Adjunct Professor of Mathematics; David Bennett King, A. M., Adjunct Professor of Latin; Wm. Baxter Owen, A. M., Adjunct Professor of Greek; John G. Diefenderfer, A. M., Adjunct Professor of Modern Languages; Edward Hart, Ph. D., Adjunct Professor of Chemistry; Allen P. Berlin, C. E., A. M., Adjunct Professor of Mathematics; Addison B. Clemence, B. S., Assistant in Chemistry; Traill Green, M. D., LL. D., Dean of the Pardee Scientific Department; Francis Andrew March, LL. D., Librarian; Rev. R. B. Youngman, Ph. D., Clerk of the Faculty; Wm. H. Weaver, Janitor.

Pardee Scientific Department.—This department was organized by the Trustees of the College in 1866, to carry into effect the conditions of a donation from A. Pardee, Esq., of Hazleton, Pennsylvania. In July, 1867, in response to the growing wants of the Department, the original donation was increased to $200,000. In1871 Mr. Pardee made another and still larger donation for the erection of a building designed for the use of the Scientific Department. This building, costing with its scientific Equipment, nearly three hundred thousand dollars, was completed in 1873, and upon the 21st of October of that year was formally handed over by the munificent donor to the Trustees.

It consisted of a centre building five stories in height, fifty-three feet front and eight-six feet deep, and a lateral wing on each side of the centre building, measuring sixty-one feet in length and thirty-one feet in width, four stories in height, including a mansard roof, the whole terminating in two cross wings forty-two feet front and eighty-four feet deep, and four stories in height, the entire length of front, in a straight line, being two hundred and fifty-six feet. In determining what rooms were needed and the best arrangement of them, similar buildings in Europe, as well as in this country, were carefully studied, and liberal provision has been made in all the departments of instruction for every aid which has been devised for the most thorough and attractive teaching, and also for the prosecution of original researches. The original building was burned on the evening of June 4th, 1879. It has been rebuilt on the same site, of the same dimensions and external appearance. The arrangement of the interior has been much improved as experience with the former building suggested. In addition to its strictly scientific provisions, it contains suits of rooms for the Literary Societies, and an Auditorium for the oratorical exercises of Commencement and similar occasions.

The reopening was celebrated with appropriate ceremonies by a great concourse, on the 30th of November, 1880. An assembly so distinguished has rarely gathered in honor of any educational foundation in this country. His excellency, Rutherford B. Hayes, President of the United States, with members of his Cabinet, the General of the army, and the Commissioner of Education, His Excellency, Henry M. Hoyt, Governor of the Commonwealth of Pennsylvania, the State Superintendent of Education, the Moderator of the General Assembly of the Presbyterian Church, and the Moderator of the Synod of Philadelphia, with many other dignitaries of Church and State, took part in the addresses of thanks and congratulation to the Founder of the Hall and the friends of the College.

The Board intend that the whole Scientific Department shall be impressed with the Christian character of the College. In addition to the systematic and thorough study of the Word of God in all the classes, special attention will be given to the harmony of Science with revealed religion. The Scientific Department of the College leading to the Degree of B. S., is designed for those who wish to study the Natural Sciences, Mathematics, Modern Languages and Literature, History, Rhetoric, Logic, and Mental and Moral Philosophy, as thoroughly as they are studied in our Colleges, and who would be glad to enjoy the cultivation and learned habits and associations of College life, but who will not study Greek and Latin. The Trustees of the College are deeply impressed with the thought that our present collegiate system has grown up under the fostering care of the church, and that the relations of our old collegiate studies to manly culture and religious training have been studied by generations of Christian educators. They have, therefore, taken care that the new course shall not be removed from the old landmarks, and that, as far as possible, the old approved methods of instruction shall be used in all the departments of study. It will be found that the new course includes all the studies of the old, except the Ancient Languages, and it is believed that the method of teaching English and other modern Classics, which has been for some years in use in the College, gives, in a good degree, the same kind of discipline that is derived from the study of Greek and Latin. Latin, however, may be taken in this department if the student elect; the course then leading to the Degree of Ph. B.

Technical Studies.—Still further demands have been made on this institution on account of its peculiar relations to the *industrial resources* of our country. Lafayette College is in the midst of the great mining and manufacturing region of the Middle States. Every process used in the *mining* and *working* of the various ores of iron, and in the manufacture of iron into the thousand forms in which it is used, is going on almost within sight. Near by are the coal mines which supply the markets of Philadelphia and New York. Mineral wealth abounds on all sides. The expert is continually called on to examine new tracts of land, to analyze new ores, and to devise new ways of working and handling them. Here every resource of engineering is displayed in the works connected with the preparation and transport of lumber, and the carrying of railroads and canals through the mountains and over the rivers. Those who wish to prepare themselves to be working engineers in any of these departments, come from all parts of the country to observe and study these works, and it is most desirable that adequate means should be provided for the prosecution of scientific studies in the midst of them. In addition, therefore, to the GENERAL COURSE of the Scientific Department, which is designed to lay a substantial basis of knowledge and scholarly culture, courses have been arranged for those who may wish to devote themselves to studies essentially practical and technical.

I. ENGINEERING, CIVIL, TOPOGRAPHICAL AND MECHANICAL.—This course is designed to give professional preparation for the location, construction and superintendence of Railways, Canals and other engineering works; the design, construction and use of Steam Engines and other Motors, and of machines in general; and the construction of geometrical, topographical and machine drawings.

II. MINING, ENGINEERING AND METALLURGY.—This course offers the means of special preparation for exploring undeveloped mineral resources, and for taking charge of mining and metallurgical works.

III. CHEMISTRY.—This course includes text-book study, lectures, and laboratory practice, every facility for which is found in the Laboratories. Provision is made for advanced and special students who may wish to make original researches, or to study any particular department of Chemistry.

POST GRADUATE DEPARTMENT.—Resident Graduates, and others having suitable preparation, may pursue special studies in any branch, either of the Classical or the Scientific Department, under the Direction and Instruction of the Professor in that branch, and have the use of the Laboratories, Apparatus, Collections and Libraries, while prosecuting original researches. These studies and researches will not be confined to any fixed Course. Particular information may be obtained by addressing the President.

Admission.—SCIENTIFIC DEPARTMENT.—Candidates for admission to the Freshman Class for the Scientific Course are examined in English Grammar; Modern Geography; Arithmetic, including the metric system; Algebra, through Quadratic Equations; Plane Geometry, two books; (for Civil Engneers Plane Geometry entire,) the elementary principles of Natural Philosophy, and the outlines of History. Those who elect the study of Latin are examined also in the Latin required for admission to the Classical Course and in Ancient Geography. It is expected that all candidates for admission to the College will be acquainted with the general contents of the Bible.

TECHNICAL AND SPECIAL STUDIES.—Application for instruction in Technical or special studies are examined on such subjects connected with the study as have been gone over by the class which they propose to enter.

ADVANCED STANDING.—Candidates for advanced standing are examined in the preparatory studies, and also in the studies gone over by the class which they propose to enter. No student is admitted to the Senior Class after the beginning of the second term.

TESTIMONIALS.—Testimonials of good moral character are in all cases required; and those coming from other Colleges must produce certificates of dismission in good standing. All those who enter on scholarships must produce certificates for the same, and have their entrance endorsed thereon.

MATRICULATION.—No student is considered a regular member of College until he has been matriculated, after a probation of thirty days, during which time, however, he is subject to the laws of the College.

FIRST TERM.

Civil Engineering Course.—Freshman Year.—Algebra (completed), Elements of Industrial Drawing, English, March's Method, French, Chemistry, Lectures on Health.

SECOND TERM.

Geometry (completed), Surveying, Plane Problems, French, German, Problems in Division of Land.

THIRD TERM.

Surveying, Field Work, Elementary Projections, Trigonometry and Mensuration, French, German Analytical Chemistry.

Throughout the Year.—Declamations, Themes and the Bible.

FIRST TERM.

Sophomore Year.—Analytical Geometry (begun), Surveying, Field Work, Elementary Projections, Mineralogy, French, German, Study of Words, Trench.

SECOND TERM.

Analytical Geometry (completed), Topographical Drawing, Botany, Zoology, French, German, Mineralogy.

THIRD TERM.

Differential and Integral Calculus, Descriptive Geometry, Botany, Zoology, French, German, Determinative Mineralogy.
Throughout the Year.—Declamations, Themes and the Bible.

FIRST TERM.

Junior Year.—Descriptive Geometry (General Orthographic Projections), Triangular Surveying, Field Work, Adjustment of Instruments, French, Mechanics, Lithology, Practice with the Blow-pipe.

SECOND TERM.

Physics (begun). Road Engineering—Theory (begun.) Calculus (continued). Colored Topography. Shades and Shadows. Hydrographical Surveying.

THIRD TERM.

Linear Perspective, Physics (completed), Analytical and Applied Mechanics, Topographical Surveying, Map of Topographical Survey, Road Engineering—Theory (completed).
Throughout the Year.—Declamations, Themes, written Debates and the Bible.

FIRST TERM.

SENIOR YEAR.—Water Supply, Road Engineering—Practice, Plans, Profiles and Sections of Road Surveys, Astronomy, Machine Drawing, General Theory of Machines. Anatomy and Physiology.

SECOND TERM.

Stone Cutting, Machines and Motors, Strength of Materials, Stability of Structures, Supply and Distribution of Water, Astronomy, Geology, Mineralogy, Political Economy.

THIRD TERM.

Bridge Drawing, Foundations, Retaining Walls, River and Canal Improvements, Designs for, and Reviews of Engineering Works, Bridge and Roof Construction, Graphical Statics, History, Geology, Graduation Theses.
Throughout the Year.—Themes, Speaking and Biblical Studies.

FIRST TERM.

MINING ENGINEERING.—The Freshman and Sophomore years are essentially the same in this as in the Civil Engineering Course.

FIRST TERM.

JUNIOR YEAR.—Mechanics, Analytical Chemistry, Mine Surveying, Adjustment of Instruments, French, Lithology, Practice with the Blow-pipe.

SECOND TERM.

Physics, Colored Topography, Practice in Lithology, Analytical Chemistry, German, Assaying, Maps of Survey.

THIRD TERM.

Topographical Surveying, Map of Topographical Survey, Analytical Chemistry, French or German, Analytical and Applied Mechanics.
Throughout the Year.—Declamations, Themes, written Debates and the Bible.

FIRST TERM.

SENIOR YEAR.—Mining, Ore Deposits, Analytical Chemistry, Machine Drawing, General Theory of Machines.

SECOND TERM.

Mining, Analytical Chemistry, Machinery and Motors, Geology, Mineralogy, Political Economy, Supply and Distribution of Water.

THIRD TERM.

Mining, Metallurgy, Designs for, and Reviews of Special Metallurgical and Mining operations, History, Geology, Analytical Chemistry, Graduation Theses.
Throughout the Year.—Themes, Speaking and Biblical Studies.

WORKING SECTION.—Graduates of Schools of Science and Practical Engineers wishing to devote all their time to thorough preparation for professional employment in Civil Engineering, may enter, without examination the Senior Class, which is organized as an Engineering Corps, and goes though all the necessary operations for the construction of a Railroad from Easton to some selected terminus. Others wishing to enter the Section must pass an examination on the studies leading to the work of the section. Those completing the work of the Section may obtain from the Faculty a certificate to that effect. Further information may be had by addressing the Dean of the Pardee Scientific Department.

CHEMISTRY—The study in this department begins with a course of lectures on General Chemistry combined with the study of a text-book. In connection with these lectures each student is required to work in the laboratory, under the direction of the Professor; and he may pursue Analytical Chemistry through the rest of the course. The Chemical students of the General Scientific Course spend during their last two years the greater part of their time in the laboratory, electing such chemical and related studies or investigations as they may wish to pursue. The instruction is then mainly individual, and a student's progress depends on his ability and industry. Partial or special students may enter the laboratories at any time, provided they have the necessary knowledge of general chemistry to work advantageously. Advanced students will be afforded opportunity for continuing their studies, or for conducting investigations in organic or inorganic chemistry.

BOTANY, ZOÖLOGY, GEOLOGY.—*Freshman year*, Third Term, Mineralogy. *Sophomore year*, Second and Third Terms, Botany, Zoölogy. *Junior year*, First Term, Zoology. *Senior year*, First Term, Botany, Zoology. Second and Third Terms, Mineralogy, Geology.

The exercises of the Freshman, Sophomore and Junior years belong to the Scientific Course; those of the Senior year belong also to the Classical Course. The instruction includes structural and descriptive Science—field excursions for observations and collection, preparation and care of specimens, drawing, the use of microscope, and other means of refined observation. The collections in Botany are mcst ample. There has been lately added to the College Herbarium the extensive collection of Professor Porter, the fruit of thirty years' labor on his part, embracing the complete Flora of Pennsylvania. In GEOLOGY, besides the text-book study, Professor Porter delivers a course of lectures on the connections between Natural Science and Revealed Religion. In MINERALOGY the classes have the advantage of the admirable cabinets prepared for the Technical Course of Metallurgy and Mineralogy.

RELIGIOUS EXERCISES—All the students attend prayers in the College Chapel daily, and preaching on the Sabbath. A daily social prayer meeting has long been maintained by the students; it is under the auspices of the Christian Brotherhood of the College, an organization composed of professing Christians, having for its object mutual helpfulness in right living and usefulness. Thursday evening there is a divine service in Brainerd Hall, conducted by the President, or one of the Professors, to which all the students are invited.

DEGREES.—*The First Degree.* Graduates of the Engineering Course receive the degree of CIVIL ENGINEER. Graduates who have taken the special studies in Mining Engineering, Metallurgy and Chemistry may receive certificates of the same, or have the fact stated upon their Diplomas.

Certificates.—Students who have been admitted to any Department of the College, and have passed satisfactory examinations therein, may obtain certificates of the same, if they have been in attendance not less than one year.

LIBRARIES AND READING-ROOM.—The College Library is open Thursday, Friday and Saturday at nine o'clock, A. M.; the libraries of the Literary Societies, on Wednesday afternoon; of the Brainerd Society and of the Scientific Societies at the regular meetings. The Eastonian Hall is fitted up as a Reading-room; and is supplied with the best newspapers and periodicals of America, England, France, and Germany. Dictionaries, cyclopædias and other works of reference belonging to the Library are also placed in this room. It is kept open to all members of the College daily (Sundays excepted), for consultation during study hours, morning, afternoon and evening, and for general reading out of study hours. It occupies the first floor of the east wing of South College and the second story in galleries, making a spacious, light and airy hall. It is adorned with literary treasures and portraits of honored benefactors and officers of the College. Among these collections is a Papyrus Scroll, five feet long, from a mummy at Thebes, with a hieratic inscription pronounced by Seyffarth the finest he has seen, presented by Hon. John W. Garrett, of Baltimore. There is also a full-length portrait of Lafayette, painted by Healey at the Chateau La Grange, from Ary Sheffer's famous painting, and presented by Dr. Thomas W. Evans, of Paris.

College Societies.—The CHEMICAL SOCIETY has for its object the preparation and discussion of papers on chemical or allied subjects. Laboratory students have the opportunity of working on original investigations and communicating the results to the Society. The society of PHYSICS AND ENGINEERING, Professor Moore, President, has for its object the investigation and discussion of subjects connected with these departments.

Terms and Vacations.—The College year is divided into three terms, with intervening vacations. All the Classes are examined at the close of each term, and a report sent to the parent or guardian. Students are required to be present punctually at the beginning of each term, and are not allowed during term-time to be absent from town except by written permission from the president.

Expenses.—Tuition (to those not on scholarship) in the Classical or General Scientific Department, ... $15 00 a term

Tuition in Technical Studies or Chemical Sections, . .	25 00	"
General Expenses, ...	8 00	"
Library and Reading-room, ...	2 00	"

The annual College charges are therefore, for those who pay tuition in full, $75 for the Classical or General Scientific Course; and $105 for Technical Studies. Each student pays $5 when he is registered on entering college, and $10 when he is matriculated thirty days afterwards. These fees are appropriated to the Library fund, and to the increase of the scientific collections and apparatus. No fees are charged for diplomas. Apparatus for the use of students in the Chemical Laboratories will be furnished and charged in their account, and the charge canceled for that returned in good condition. Chemicals and all other materials will be charged according to the average cost. A deposit sufficient to meet these expenses is made on entering the laboratories. Members of the Classical Department are admitted to all the privileges of the laboratories while studying General Chemistry, and for the present, without charge for the aid of the Professor in attendance; each student will, however, pay for chemicals which he uses, and for any apparatus which he may break or injure. For the present the scholarships securing free tuition in the Classical Course will hold good for the Pardee Scientific department, unless the students shall select Technical Studies, in which case he must pay each term one-half of the regular fee for tuition. A number of scholarships have been placed at the disposal of the Faculty, for the benefit of young men of talents and good moral character. Applications for these scholarships should be made to the President. In all cases the place of boarding must be approved by the Faculty. The price of board in clubs managed by the students is from $2.00 to $3.50 per week.* Board, including furnished rooms in private families, is from $5 to $7 per week. Unfurnished rooms in the College building may be had at a cost of from five to fourteen dollars a term (average $8). Unfurnished rooms adjacent to the College premises can be rented for from twelve to sixteen dollars a term. Students obtain washing at 40 cents per dozen pieces. The College charges must be paid each term in advance, also the room rent, when the student occupies a room in the College buildings. The Treasurer also, on behalf of the Committee of Students, collects with the College bills at the beginning of the first term $5, and of the second term $7, for fuel. The unexpended balance is refunded by the Committee at the close of the year. For the last few years the average cost for fuel to those in double rooms was $6.75, to those in single rooms $10.07. A deposit of one dollar is also made, at the beginning of each term, to pay for public damages, the unexpended balance of which is returned to the students at the end of the year. Some money for books and other incidental expenses will be needed; but, with economy, the total annual expenses—exclusive of tuition, clothing and traveling expenses—need not exceed $250, as will be seen from the following summary:

College Charges.		
General Expense, ...	$24 00	
Library and Reading-room, ...	6 00	$30 00
Incidental Expenses.		
Fees and dues, Literary and Scientific Societies (estimated),	$ 8 00	
Text-books and Stationery (estimated), ...	20 00	
		$28 00
Personal Expenses.		
Board for 39 weeks (at lowest club rates, see note below)	$78 00	
Room Rent average as above	24 00	
Fuel (average as above)	6 75	
Light and Washing (estimated)	24 00	$132 75
		$190 75
Leaving a balance for contingencies,		59 25
Total as above,		$250 00

Board at the highest club rates, $3.50 per week, would add $58.50 to the above estimate, and still keep the annual expenses within the two hundred and fifty dollars. Parents or guardians at a distance may deposit funds with some member of the Faculty, who will pay particular attention to the pecuniary concerns of the student, settling his bills, and transmitting an account of the expenditure, for which services he will charge a commission. It is strongly recommended that parents furnish their sons with little beyond what will meet their necessary expenses.

Recent Additions.—An important addition has been made to the Mineralogical Cabinet through the liberality of Dr. Joseph Mixsell, of Easton, who has presented to the College the large and valuable collection known as the "Wagener Collection." This collection is the result of the labors of the late Jacob Wagener, one of the founders of the College, and is particularly rich in specimens of local interest, like the collection of Dr. Joseph K. Swift, which was purchased by the College in 1872. Mr. Wagener and Dr. Swift were warm personal friends, and for many years were interested in the same scientific investigations. It is believed that their combined collections completely illustrate the local mineralogy, while many of the specimens in Mr. Wagener's collection are of remarkable beauty and interest, and were obtained by him at a great expense. Another noticeable and valuable feature of his collection is the large number of minerals from Russia. This collection, upon the death of Mr. Wagener in 1859, became the property of his widow, who presented it to the donor, Dr. Joseph Mixsell. The Mineralogical Cabinet has also been increased during the past year by a valuable contribution of minerals from Rev. H. H. Beadle.

CALENDAR.—*Vacation of Nine Weeks.*

Sept. 12–13, Tuesday and Wednesday.—Examinations for admission.
Sept. 15, Thursday.—First term begins.
October 25, Wednesday—Founder's Day.
November 27, Monday.—Anniversary of the Franklin Literary Society.
November 30, Thursday.—Thanksgiving Day.
December 20, Wednesday.—First term ends.

Vacation of Two Weeks.

1883.

January 4, Thursday.—Second term begins.
March 21, Wednesday.—Second term ends.

Vacation of Two Weeks.

THE INDUSTRIAL SCHOOL FOR MINERS AND MECHANICS, AT DRIFTON, LUZERNE CO., PA.

AT the meeting of the American Institute, of Mining Engineers, in February 1879, Mr. Eckley B. Coxe, then president of the Institute, called attention in his address to the subject of Secondary Technical Education, and gave an outline of a scheme for a school for boys, which it was intended to start at Drifton, Pa., on the general plan of the Steigerschulen of Germany. This school was first opened on May 7th, 1879, when twenty-nine applicants for admission, from 12 to 24 years of age, were

* There are at the present time nine of these Clubs. The price of board per week in each is as follows: (1) and (2) $2.00; (3), (4) and (5), $2.25; (6), (7), and (8), $3.00; (9), $3.50.

examined. Of these eleven were admitted, the others being considered either too young or too deficient in primary education to profit by the instruction. In order that parents might be encouraged to send their children to the public schools, it was thought best not to receive pupils under 15 years of age. The number in each class was limited to sixteen, so that each boy might receive proper attention. Of the first class only eight passed through the full year's course. At the end of the year, on June 29th, 1880, a public examination was held with the most gratifying success.

The second year opened on the 1st of September, 1880. Nine candidates were then admitted after examination, and three more later in the course; one pupil has been dismissed. The school now comprises nineteen pupils, seven in the advanced and eleven in the preparatory class. There is also one boy in attendance at the drawing lesson who is too young for the other classes. Thus far the regular instruction has been given only for two hours each evening, Sunday excepted. At times when the pits are closed the pupils are requested to attend during the day from 9 to 12 A.M., and 2 to 5 P.M., the time being occupied in the drawing-room or in solving problems, or in review. If a sufficient number of boys from the regular classes are present, the regular studies are pursued. Attendance during the day is, however, voluntary. The limited, and to some extent uncertain time devoted to instruction is a disadvantage to the school, but it must be borne in mind that the school is as yet an experiment, and that the boys and their parents have to learn from experience that an education is worth the pecuniary sacrifice which would be involved in working half time and attending a day-school. The interest evinced by the pupils thus far is very gratifying, as is shown in the following figures, expressing their attendance and progress during the first three months of the session:

For attendance—Grades,	10	9½	9	8½	8	7½	6½
Number of pupils,	4	3	5	1	3	1	1
For progress—Grades,	9½	9	8½	8	7		
Number of pupils,	1	4	6	5	3		

A grade of 10 signifies "perfect" and 5 "indifferent." The plan of instruction is, in general, as follows:

I. *The Preparatory Class.*—In this class English branches are taught—spelling, reading, writing, grammar, the elements of composition, arithmetic, and geography. An assistant teacher has charge of these branches. Algebra is studied as far as involution and evolution. In teaching geometry, particular stress is laid on the names, properties, and relations of geometrical figures in connection with geometrical construction in drawing. Both freehand and mechanical drawing are taught with especial regard to developing artistic perception and the power of correct expression. Object lessons are also given to stimulate the reasoning faculties, which we often find but very imperfectly developed. In this preparatory class it is intended to admit boys under 15 years, that they may be well drilled in the elementary branches and better prepared for the next class.

II. *The Junior Class.*—In this class the English branches are continued, particular attention being paid to composition. The elements of bookkeeping are also taught, which serves, by the way, for an exercise in writing and arithmetic. Algebra is continued to equations of the second degree, with one or more unknown quantities, series and exponential equations including logarithms. The boys are also drilled in mental arithmetic and algebra to develop the power of quick perception and decision. The course in geometry is completed, including trigonometry, mensuration, and solid geometry. There is also provided an elementary course in analytical geometry, which is taught as algebraic projection in relation to geometrical projection and mathematical drawing. Geometry is divided into two parts—algebraic and practical geometry. In the first the subject is developed algebraically, with the aid of the trigonometrical properties of angles; in the second, the practical applications are seen in the solutions of problems and in construction of figures both on the drawing board and in the field. A course in geometrical projection aims to give the pupil facility in drawing any figure in plan, elevation, or section which may be called for, both with instruments and free-hand. In the course of mathematical physics, instruction is given in the elements of natural philosophy. To save time the mechanical portions, as for instance, the laws of motion, centre of gravity, the mechanical forces, etc., are treated mathematically, and the course becomes thus a combination of elementary mechanics and natural philosophy. Where feasible, experimental demonstrations are given. Chemistry is taught so that the pupils may become acquainted with names, properties, and combining proportions of the most important elements, particularly with those which enter into the composition of the common minerals. Simple chemical tests for minerals are also taught. The instruction in mineralogy and lithology is confined to the more generally occurring minerals and rocks, and those in which the miner or manufacturer has the most immediate practical interest. In this junior class a thorough knowledge of elementary mathematics and drawing is considered the basis for all subsequent instruction.

III. *The Senior Class.*—The course of instruction laid out for this class will include the writing of a plain, intelligent report upon some practical subject, either directly from investigation or from memory. This concludes the instruction in English branches. In the drawing-room the work will include the elements of construction in wood, stone, and metal, making working drawings, and designing simple structures and machinery. Lectures will accompany this course. The subject of mining is treated systematically under the following heads:

I. Mining; including:

1. The useful minerals and metals; their occurrence, and the methods for their exploration.
2. The various means employed for the extraction of ores, etc.
3. The opening and laying out of mines.
4. The method of exploitation.
5. The maintenance of mines in good order.
6. Transportation.
7. Drainage.
8. Ventilation.
9. Mine surveying and mapping.
10. Accidents in mines, and their prevention.
11. Mining accounts, contracts, and estimates.
12. Hygiene of mines, with the remedies to be adopted in case of accident.

II. Preparation of the useful minerals for smelting or for market, which will include the machinery used in ore-dressing and in the mechanical preparation of coal. During the senior year there will be practical exercises in the mine and in the field, which will involve the presentation of reports to the principal. It is possible that there may be formed a fourth class, to be known as

IV. *The Expert Class.*—This class will enable pupils and graduates at their leisure to continue their studies with the instructors outside of the regular classes, and thus perfect themselves in certain branches already gone over, or take up studies not provided for in the course. It is required that all the pupils must have regular work in the mines or in the shops, and, as far as possible, arrangements made to accommodate them. The instruction is entirely free, the pupils providing only their books and materials. Annual public examinations take place and prizes are awarded to the best scholars. The school-rooms are in Cross Creek Hall, a large building 106×51½ feet, having a basement room 12 feet high and an upper hall 42 feet high. In the basement are the office of the principal, 18×14 feet, two large class-rooms, 31×22 feet and 32×15 feet, and a drawing-room 28×18 feet. There are also a lecture-room, 49×30 feet, and a reading-room with a library the same size, all for school purposes. The reading-room is open every evening for the use of the employés. A separate building, 34×16 feet, contains the laboratory and lecture-room for chemistry and mineralogy. The school-rooms are open all day and until 9 o'clock in the evening. They are all lighted by gas and heated by steam. Collections of apparatus and minerals for the purpose of instruction have been commenced, and it is the aim to illustrate the lectures as far as possible by facts from every-day practice. The instruction is given by the principal, assisted by Mr. D. D. Davidson, a graduate of Lafayette College, who teaches the English branches, bookkeeping, and elementary mathematics. It is in the highest degree gratifying to record the praiseworthy conduct and punctual attendance of the boys; and the progress in their studies has been very fair, considering their previous ignorance. The nationalities represented in the school are as follows:

Americans (9 of Irish descent),	12
Welsh,	3
Irish,	2
Swede,	1
French	1

A noteworthy change is noticed in the pupils with regard to their appearance and dress, which are much improved by their attendance at the school. The effect of the school is also shown in the expressions of regret heard from many young men that they had not entered the school at the start, and some of the foremen deplore the fact that there was not such a school when they were boys. The success of this school, let us hope, will induce others in charge of large works or mines to try the experiment. It is to be recommended to start first, a preparatory class, say three evenings a week, and, in addition, to use the day hours when the mines or works are idle. When the boys are well prepared, a day-school, every afternoon for two years is desirable, the mornings being spent in practical work in the mines or shops. They should not, however, be employed in routine duties, such as picking slate, pushing cars, tending doors, etc. Such work tends to blunt the perceptions and stupefy the mind. If the suggestion above, of an expert class, is carried out for boys who have passed through the school, a very considerable technical training may be accomplished without taking an inordinate amount of time from working hours, or any considerable expenditure of money. The school must adapt itself to the works, which in turn must give aid and encouragement to the school. This co-operation is attained in some industrial sections of Europe, and I do not see why it cannot be introduced with us. The keynote of success, let me say in conclusion, is not to endeavor to turn out young engineers, but to raise up intelligent foremen.

The above paper is from the Transactions of the American Institute of Mining Engineers, and was written by Mr. Oswald J. Heinrich, principal of the school. In addition Mr. Heinrich writes us under date of June 22nd:

I give you in addition the following statement in regard to the "Drifton Industrial School for Miners and Mechanics." The second year's course was completed by an examination June, 1881, with the following results up to Sept. 1st, 1881.

For attendance, Grades,	10,	9½,	9,	8½,	8,	7½,	6½,	5.
Number of Pupils, 15	6,	3,	3,	—	1,	1.		
Grades for Progress	9½,	9,	8¾,	8½,	8,	7.		
Number of Pupils, 15,	2,	5,	2,	3,	1,	2.		

Seven prizes were awarded to the best scholars for attendanee and progress. The result of the third year's session is as follows: There were thirty-four [34] candidates, for admission, of whom twenty-six were Americans; five were Welshmen; one Scotch; one Irish; one Polander. Of these sixteen were admitted to the preparatory class, and two more joined during the session. Nine were admitted te the Junior class. The school, therefore, stands now:

Classes.	Admitted.	Remaining.
Preparatory	18	14
Junior	16	8
Senior	6	5
Total	40	27

One scholar has been dropped from the roll for irregular attendance. The balance were obliged to leave, either because of changing their plaee of work, or becoming discouraged on account of not being able to attend regularly because of their duties at the works. This last cause is one to be lamented, and a change for the better is to be hoped for. The preparatory class is now under the charge of Eugene B. Wilson, formerly of Yale College, in elementary, physics and algebra, and book-keeping for all three classes. The conduct and interest shown by the scholars is still the same as stated before, if not better, and all that is wanting is more time for recitations and tuition.

SCHOOL OF MINES—COLUMBIA COLLEGE, NEW YORK CITY.

THIS undoubtedly, one of our leading representative institutions, furnishes the student in mining and metallurgy as well as engineering, a most capital course of instruction. The faculty of the School of Mines is as follows:

FREDERICK A. P. BARNARD, S.T.D., LL.D., L.H.D.,
President of Columbia College.

PROFESSORS.—Thomas Egleston, E.M., PH.D., LL.D., Mineralogy and Metallurgy. Charles F. Chandler, PH.D., M.D., LL.D., Chemistry, Dean of the Faculty. William G. Peck, PH.D., LL.D., Mechanics. J. Howard Van Amringe, A.M., PH.D., Mathematics. Ogden N. Rood, A.M., Physics. John S. Newberry, M.D., LL.D., Geology and Palæontology. William P. Trowbridge, PH.D., LL.D., Engineering. William R. Ware, B.S., Architecture. Henry S. Munroe, E.M., PH.D., Surveying and Practical Mining (Adjunct). Frederick R. Hutton, C.E., PH.D., Mechanical Engineering (Adjunct).

OTHER OFFICERS.—John K. Rees, A.M., E.M., Director of the Observatory and Instructor in Geodesy. Frederick Stengel, A.M., Instructor in German. Jules E. Loiseau, A. B., LL.B., Instructor in French. Elwyn Waller, A.M., E.M., PH.D., Instructor in Quantitative Analysis. Pierre DePeyster Ricketts, E.M., PH.D., Instructor in Assaying. James S. C. Wells, PH.D., Instructor in Qualitative Analysis. Jasper T. Goodwin, A.M., LL.B., Instructor in Mathematics. Alfred D. Churchill, A.M., M.S., E.M., PH.B., Instructor in Drawing. Alexis A. Julien, A.M., Assistant in Analytical Chemistry. Charles A. Colton, E.M., Assistant in Mineralogy. Louis H. Laudy, PH.D., Assistant in General Chemistry. Nathaniel L. Britton, E.M., Assistant in Geology. Henry C. Bowen, Assistant in Quantitative Analysis. C. Herbert Torrey, PH.B., Assistant in Qualitative Analysis. Alford L. Beebe, PH.B., Assistant in Assaying. William W. Share, PH.B., Assistant in Physics. James L. Greenleaf, C.E., Assistant in Engineering. William G. Baker, Librarian. George F. Fisher, Registrar. Robert M. Ricketts, Assistant Registrar.

General Statement.—The School of Mines was established in 1864, for the purpose of furnishing to students the means of acquiring a thorough knowledge of those branches of science, which form the basis of the industrial pursuits that are to play the most important part in the development of the resources of the country. The system of instruction includes six parallel courses of study, viz.:

I. Mining Engineering.
II. Civil Engineering.
III. Metallurgy.
IV. Geology and Palæontology.
V. Analytical and Applied Chemistry.
VI. Architecture.

During the first year the instruction given to all the students of the First Class is the same; at the beginning of the second year each student must elect which of the six courses he intends to pursue, and must thenceforth abide by his election unless permitted by the Faculty to make a change. No student is permitted to pursue a special or partial course. The plan of instruction includes lectures and recitations in the several departments of study; practice in the chemical, mineralogical, blowpipe, and metallurgical, laboratories; field surveying; practice in operative mining; projects, estimates, and drawings for the establishment of mines, and for the construction of metallurgical, chemical, and other works; reports on mines, industrial establishments, and field geology. The course of instruction occupies four years. There is an advanced course for graduates of the school. The method of instruction is such that every pupil may acquire a thorough theoretical knowledge of each branch, of which he is required to give evidence, at the close of the session, by written and oral examinations. At the commencement of the following year he is required to show, from reports of works visited, that he understands not only the theoretical principles of the subjects treated, but also their practical application—a point that is insisted on with great rigor.

Admission.—Candidates for admission to the First Class, at its formation, must be of the age of seventeen years, complete; and, for admission to advanced standing, there will be required a corresponding increase of age. Candidates for the first class must pass a satisfactory examination in arithmetic, including the metric system of weights and measures; in algebra, on the first ten chapters of Peck's Manual of Algebra; in geometry, on the first six books of Davies' Legendre; in French, on the equivalent of twenty-five lessons of Jewett's Ollendorff Grammar; in German, on the equivalent of twenty lessons of Otto's German Grammar; in English grammar, on the equivalent of Quackenbos's English Grammar; in composition and rhetoric, on the equivalent of Quackenbos's Course of Composition and Rhetoric; in history, on the equivalent of Thompson's History of England and Doyle's History of the United States as contained in Freeman's Historical Course for Schools; in physical geography, on the equivalent of Guyot's Physical Geography; and in free hand drawing, including the ability to sketch, both in outline and with proper shading, ordinary objects, such as a tree, a house, a simple piece of machinery, a piece of flat ornament from a copy, a group of geometrical solids, etc. Candidates for advanced standing must pass a satisfactory examination upon the studies named above, and also upon those pursued by the class which they propose to enter.

From and after the beginning of the year 1883 candidates for admission to the First Class will, in addition to the requirements above specified, be examined on—

1st. Physics, equivalent to Ganot's smaller Treatise (Peck's Ganot's Natural Philosophy).

2d. The general principles of French Grammar, including an ability to read Montmahon's "Cours d' Histoire Naturelle," or its equivalent.

3d. The general principles of the German Grammar, including an ability to read Hans Andersen's "Märchen," or its equivalent.

Candidates for admission after the opening of a term will be required to pass satisfactory examinations on the part of the course already gone over by the class for which they are applicants. No candidates are admitted later in the course than the beginning of the third year. Graduates and students of colleges and schools of science, who shall have completed so much of the course as shall be equivalent to the requirements for admission, may be admitted at the beginning of the second year, or earlier, without examination, on presenting diplomas or certificates of good standing and honorable dismissal satisfactory to the examining officers. The regular examinations for admission are held annually, beginning on the Friday before commencement, and on the Wednesday preceding the first Monday in October. Candidates will, however, be examined during the session, but not in vacation. The annual tuition fee is two hundred dollars, payable one-half on the first day of each session.

Free Students.—Whenever it appears to the satisfaction of the President and the Treasurer of the college that a student, who is of good moral character and industrious habits, desires to pursue the studies of the school, but is unable to pay the usual fees for tuition, he may be admitted without charge. Candidates for free tuition must fulfil the following conditions:

1. He must present a certificate from some person of good repute, that the writer is acquainted with the circumstances of the applicant (his parent or guardian, if he has such) and knows him to be unable to bear the expense of his education if obliged to pay the tuition fee; also, that he (the writer) is not himself a relative of the applicant. A proper blank will be furnished ou application to the Registrar.

2. He must exhibit a proficiency in every subject of examination expressed by the number 6 of a scale in which 10 is the maximum.

3. He must maintain, subsequent to his admission, a standing in scholarship, also in every branch, expressed by the number 7 of a similar scale, failing which he will forfeit his privilege.

Apparatus Supplies.—I. Students may purchase apparatus of any of the dealers in the city.

II. To save inconvenience and expense to the students, and to secure a proper selection, the school undertakes, at considerable trouble and expense, to lend apparatus on the following conditions:

1. Each student must make a deposit with the Registrar, which deposit will be credited to him on the ledger. This deposit will be $25 for students of the Second Class, $40 for students of the Third Class, and $50 for students of the Fourth Class.

2. Each student will be entitled, on presenting his receipt at the supply room, to draw the regular set of apparatus for qualitative or quantitative analysis, or for assaying, according to his deposit, and from time to time to obtain ordinary articles which he may need, and these will be charged to him. At the end of the session he will be credited with those articles which he returns in good order, and the value of those which he has injured or broken will be deducted from his deposit.

III. The supply room will be open for issuing supplies every day at convenient hours.

IV. No charge is made for ordinary chemicals.

Excursions.—During the session, the students may visit the different machine shops and metallurgical establishments of the city and its environs. During the vacation, each student is expected to visit mines, metallurgical and chemical establishments, and to hand in on his return, a memoir on some subject assigned him. He is also required to bring collections illustrating his memoir, which collections are placed in the museum, reserved as a medium of exchange or made use of in the laboratories. During the vacation following the close of the second year, students of engineering may join a volunteer class in practical mechanical engineering under the supervision of the Adjunct Professor of Mechanical Engineering. During the vacation following the close of the third year, students of mining engineering visit a mine and engage in actual work or study under the superintendence of the Adjunct Professor in Surveying and Practical Mining. During the vacation following the close of the third year, the students of civil engineering are required to attend a summer class in Geodesy for six weeks. The class is under the supervision of the Director of the Observatory and Instructor of Geodesy.

Scholastic Year.—The year is divided into two sessions: The first commences on the first Monday in October; the second, on the first or second Thursday of February. The lectures close on the Friday of the fourth week before commencement.

Examinations.—There are two examinations every year, one commencing on the last Monday in January, and the other on the Monday of the third week preceding commencement. The latter is the final examination in each department of all the classes for the year. The former embraces such subjects only as have been completed during the first session. In addition to the examination above noted, examinations are held monthly in all the classes, and in every department, for the purpose of ascertaining the proficiency of the students in their respective studies.

Commencement and Vacation.—The annual commencement is held on the second Wednesday in June, on which occasion degrees are publicly conferred. A vacation of all the classes extends from the day of commencement until the first Monday in October, on which latter day the regular course of study commences. The exercises of the school are suspended on public holidays established by law, on such days in each year as may be recommended by the civil authority to be observed as days of fast or thanksgiving, and for two weeks from the third (or fourth) Monday in December.

Necessary Expenses.—Board, including room-rent, fire and light, and washing, may be had in the city from six and a half to nine dollars per week. Annual tuition fee, $200. Text books about $15 for the first class, $30 for the second class, $50 for the third class, and $20 for the fourth class. Drawing materials $15 to $25 for each of the first and second classes, and $5 to $10 for each of the others. Laboratory apparatus $30 to $60 for each of the three years. Travelling and board for summer class in Practical Mining (Mining Engineers only) and for summer class in Practical Geodesy (Civil Engineers only), $50 to $60. Graduation, including Diploma, $5. The fees required of graduates of the school, attending the school, are as follows:

1. Full fee, entitling the student to all the privileges of the school per annum, $150.

2. For use of the library and cabinets, $25.

3. For attendance on lecture-room and other special instruction, per annum for each hour per week of such instruction, $25.

Or for any number of hours per week as above specified, $150.

4. For the use of the drawing academy, $25.

5. For the use of the laboratories, or either of them, $50.

Should the amount of fees payable by any student not exceed $100, the entire amount is payable at the beginning of the academic year, or at the matriculation of the student. Should the amount exceed $100, payment is required in two equal instalments, one at the beginning of each session of the academic year.

BY-LAWS.—*Fulfilling Conditions.* 1. Conditional students must fulfill all conditions within two months of the date of their admission.

Attendance.—2. Prompt attendance is is required upon all the exercises of the school. Each instance of tardiness will be counted as half an absence.

3. Any student who shall have been absent from more than ten per cent. of the exercises in any subject shall not be entitled to examination thereon.

4. Any students who, being present at the school, shall absent himself from any exercise, or shall leave the grounds during the hours at which his attendauce is due, shall be liable to removal from the roll of his class.

5. Students are required to attend all the exercises and pass all the examinations of the class and course to which they belong, unless specially excused by vote of the Faculty.

6. Students who obtain on examination a mark of eight or more in any subject may be excused from attendance upon the exercises in that subject. This rule to apply to new students and also to those who repeat the studies of any year. Reports of such standing must be filed with the Dean of the Faculty, who alone is authorized to excuse students from attendance.

7. Any student who shall have passed a satisfactory examination in the School of Arts of Columbia College in any study forming a part of the regular course in the School of Mines, will not be required to pursue that study in the school.

8. EXAMINATIONS.—Examinations will be held each month, on all subjects taught in the school.

9. Examinations will be held at the end of the first term (semi-annual), or at the end of the year (annual), on all subjects taught in the school.

10. No student who absents himself from a regular examination is allowed to proceed with his class without a special vote of the Faculty.

11. Any student who shall fail to pass in any of his studies at the regular examination at the end of the academic year, may present himself for a second examination during the last week of the summer vacation. Failing to pass in this second examination, he can only go on with his class by special permission of the Faculty, and provided that he takes private instruction approved by the Faculty, and within two months from the beginning of the term, presenting to the Faculty a favorable report of his progress from his instructor. This will entitle him then to a third examination, failing in which his name shall be dropped from the roll of the class.

12. Examinations at times other than here designated are not held except by order of the Faculty.

13. Students deficient in any department are not allowed to go on with their classes without a special vote of the Faculty.

14. No student is entitled to a degree until he has passed satisfactory examinations in all the studies of the course in which he desires to graduate.

15. Any student who, at the close of the fourth year, may have failed to complete a course required for graduation, and desires to continue his studies in the school for a longer time, is permitted to do so; and, with the consent of the Faculty, may have an examination for a degree at the close of any subsequent term.

16. When a student fails to receive his degree with his class, and returns at some later period to present himself for examination for the same, he will be required to comply with all the requirements at the later date, and the same rule shall apply to students who have received one degree and make application for another.

17. STANDING.—Every officer keeps a record of the scholarship of each student.

18. The maximum mark is ten in each department, and six is required to pass a student.

19. Free students must maintain a standing of seven in every branch of study, failing which they will forfeit their privileges.

20. CHANGE OF COURSE.—No student shall be permitted to change his course till he has passed in every study of the course which he proposes to leave.

21. ANALYSES.—Analyses and Assays must be made on material supplied or authorized beforehand by the Instructor in charge of the laboratory, and the reports must be handed in on the completion of the work.

22. MEMOIRS.—Each student, at the commencement of his second, third, and fourth year, is required to present memoirs on such subjects as may be assigned to him by the Faculty.

23. Students of the Second, Third, and Fourth classes who fail to hand in, on or before November 1st, the memoirs, drawings, and other Summer work required of them under the rules, shall be dropped from the roll of their respective classes.

24. PROJECTS AND DISSERTATIONS.—Each student, before graduating is required to execute projects or dissertations on subjects assigned to him by the Faculty. These projects or dissertations must be illustrated by drawings made to a scale.

25. All memoirs, projects, dissertations, and drawings executed in the drawing academy, may be retained by the School.

26. DEGREES.—Every student who has passed satisfactory examinations in all the studies of a course, and completed the required number of projects, dissertations, memoirs, analyses, assays, and drawings, is recommended to the Board of Trustees for the degree of Engineer of Mines, Civil Engineer, or Bachelor of Philosophy.

27. Graduates of the school, who fulfil the following conditions, are recommended to the Board of Trustees for the degree of Doctor of Philosophy.

(1.) Each candidate shall pursue, for the term of at least one academic year, a course of higher study, at the school and under the direction of the Faculty, in two or more branches of science, and shall pass an approved examination thereon.

(2.) He shall also present an acceptable thesis or dissertation embodying the results of special study, research, or observation, upon the subject previously approved and accepted by the Faculty.

28. SPEAKERS AT COMMENCEMENT.—A list of members of the graduating class, from whom the speakers at commencement may be chosen, will be made by the Faculty and submitted to the class, who may select as speakers two of the number, subject to the approval of the Faculty.

29. LIBRARY.—The library is open to students from 9:30 A.M. to 4 P.M.

30. Books taken from the library must be returned within two weeks.

31. Students must give receipts for books taken, and are responsible for their return in good condition.

32. THE LABORATORIES AND DRAWING ACADEMY.—The analytical, assay, blowpipe, and mineralogical laboratories and the drawing academy, are open on week days, except Saturdays and during vacations, from 10 A.M. till 4 P.M.

33. No student will be allowed in the laboratory or the drawing academy at the time when his attendance there is not due. During hours assigned for practical work in each of the laboratories, in the drawing academy, and in practical surveying, the attendance of students will be required. A record of the daily attendance and of the progress of each student will be kept by the officer in charge.

34. ORDER.—Good order and gentlemanly deportment are required of all students, as a condition of attendance upon the exercises of the school.

35. Smoking is prohibited on the college grounds, as well as in the buildings.

SYNOPSIS OF STUDIES.

FIRST SESSION.

First Year. Common to all the Courses.—Geometry—Plane, volumetric, and spherical; Conic Sections. Text books: Davies' Legendre and Peck's Conic Sections.

Algebra—Text book: Peck's Manual of Algebra.

Physics—Doctrines of heat, viz., expansion, conduction, radiation, thermometry, latent heat, tension of vapors, steam. Lectures, and "Atkinson's Ganot's Physics."

Chemistry—The non-metallic elements, through carbon. Lectures, and "Roscoe's Elementary Chemistry."
Qualitative Analysis—Lectures, and "Fresenius' Manual of Qualitative Analysis."
French—Text books: Jewett's Ollendorff's French Grammar, Montmahon's Cours d'Histoire Naturelle.
German—Text books: Wershoven's Technical Vocabulary, Schoedler's Buch der Natur, Parts I., II.
Drawing—Use of instruments; lettering, instrumental drawing; projections, intersections, and developments. Text book: Binn's Orthographic Projection.

SECOND SESSION.

Trigonometry and Mensuration, as contained in Davies' Legendre.
Physics—Specific heat, magnetism, electricity static and dynamic, thermo-electricity, induction, magneto-electricity, the electric telegraph. Lectures, and "Atkinson's Ganot's Physics."
Chemistry—To the metals. Lectures, and "Roscoe's Elementary Chemistry."
Qualitative Analysis—Lectures, and "Fresenius' Manual of Qualitative Analysis."
French—Text books: same as first session.
German—Text books: same as first session.
Drawing—Same as first session.

1. COURSE IN MINING ENGINEERING.

FIRST SESSION.

SECOND YEAR—*Analytical Geometry*—Text book: Peck's Analytical Geometry.
Graphics—Descriptive Geometry. Text book: Church's Descriptive Geometry.
Chemistry—Metals. Lectures, and "Fownes' Manual of Chemistry."
Blowpipe Analysis—Qualitative.
Zoology—Lectures, and Nicholson's Manual of Zoology.
Botany—Lectures, and Gray's Botanical Text Book.
French—Fasquelle's French Grammar; Beudant's Geologie; La bouchee de pain.
German—Text books: Wershoven's Technical Vocabulary; Stoeckhardt's Schule der Chemie; Bernoulli's Vademecum des Mechanikers; Stoehr's Katechismus der Bergbaukunde; Gurlt's Bergbau- und Huettenkunde.
Drawing—Topographical drawing; tinting and grading; problems in graphics. Text book: Honey's Perspective.

SECOND SESSION.

Differential and Integral Calculus—Text book: Peck's Practical Calculus.
Graphics—Shades and shadows, perspective, isometrical drawing. Text book; Church's Shades and Shadows.
Stone Cutting.
Chemistry—Organic. Lectures, and "Fownes' Manual of Chemistry."
Crystallography—Lectures, and "Egleston's Diagrams of Crystals."
Zoology—Lectures, and Nicholson's Manual of Zoology.
Botany—Lectures, and Gray's Botanical Text Book.
French—Text books: same as first session.
German—Text books: same as first session.
Drawing—Problems in graphics: architectural drawing.

FIRST SESSION.

THIRD YEAR—*Mechanics of Solids*—Including forces, moments, equilibrium, stability, etc., and elementary machines; dynamics, including uniform, varied, rectilinear and curvilinear motion, rotation, vibration, impact, work done, etc.
Engineering—General principles relating to materials and structures, physically and mechanically considered.
1. *Materials*—Stone, cements, brick, metals, timber, treated in regard to strength, durability, mode of preparation, defects, tests of quality, and fitness for special uses.
2. *Structures*—Foundations and supports, superstructure, joints, stability, strength and stiffness of parts; special rules of construction for masonry of public buildings, bridges, retaining walls, arches, railroads, common roads, and canals.
3. *Theory of Strains and Strength of Materials*—Elasticity, mechanical laws, application of principles of mechanics to beams, girders and roof trusses, under various conditions of loading and supports.

Kinematics of Machinery—(1) General theory of motion, (2) uniform and varied motion, (3) compositions of motions, (4) instantaneous centre, (5) rolling centroids, (6) graphical and analytical representations of machine motions, (7) line of centres.
Surveying—Field work, with compass, sextant, hand level, and pacing, use of solar compass in land and mineral surveys, adjustments and use of transit and levelling instruments, triangulation and traversing.
Practical Mining or Miners' Work—Excavation, quarrying, drilling and blasting, tunneling.

Applied Chemistry—Air, water, fuel, artificial illumination.
Quantitative Analysis.
Stoichiometry.
Mineralogy—Determinative.
Geology, Lithological—Rocks and rock masses.
Metallurgy—General metallurgy, fuel, furnaces, etc.
Physics—Mechanical theory of heat, electrictiy.
Drawing—Constructions; machines, furnaces, plans, etc.

SECOND SESSION.

Mechanics of Fluids—Including pressure, buoyancy and specific gravities, motion in pipes and channels, undulation, capillarity, tension and elasticity of gases, the atmosphere, the barometer, barometric formulæ, and hypsometry.
Engineering—Theory of Strains and Strength of Materials continued—Graphical methods of determining strains, deflection of beams and girders; quantity of material in braced girders under various conditions of loading and supports; angle of economy for bracing torsion; of shafts; crushing and tensile strength of materials; working strains and working load; mode of estimating cost of girder work.
Dynamics of Machinery—Forces of nature employed or acting in all machines, dynamical laws, mathematical theorems, measure of forces, work of forces, elementary machines and their combintions, theory of efficiency, theory of flywheels, governors and brakes, strength and proportions of parts of machines, dynamometers.
Transmissive Machinery—
1. Transmission by rolling contact, friction gear, and cams.
2. Transmission by sliding contact, spur, bevel screw, and skew-bevel teeth, and cams.
3. Transmission by shafting.
4. Transmission by belts, ropes, chains, etc.
5. Transmission by links.
6. Transmission by fluids.

Practical Mining (*or Miners' Work*)—Excavation, quarrying, drilling and blasting, tunneling.
Surveying—Topographical work with plane table, magnetic survey, underground surveying.
Physics—Physical optics and the undulatory theory of light.
Applied Chemistry—Limes, mortars, and cements; building stones: decay and preservation; timber and its preservation: pigments, paints, essential oils, varnishes; glass and ceramics; explosives; gunpowder, guncotton, nitroglycerine, etc.
Quantitative Analysis.
Mineralogy—Determinative.
Metallurgy—Iron and steel.
Geology—Historical, including palæontology, or a systematic review of recent and fossil forms of life.
Drawing—Constructions; machines, furnaces, plans, etc.

WITHOUT DISTINCTION OF SESSIONS.

FOURTH YEAR—*Dynamics of Machinery completed*—Prime Movers, as driven by animal power, water power, steam power, compressed or heated air, wind power, comprising the theory of animal power, theory of water wheels, overshot wheels, undershot wheels, breast wheels, turbines, reaction wheels, centrifugal pumps; properties and laws of heat as applied to the generation of steam and the construction of boilers; properties of steam and air in their relation to prime movers; mechanical theory of heat applied to steam engines, hot air engines, compressed air engines; general description of heat engines of various forms; description and theory of ventilating fans or blowers.
Mining Engineering—
1. Considered in its widest sense as a course of study.
2. Considered in reference to the application of general principles of engineering to the development and working of mines.
3. Classification and nomenclature of mineral deposits; descriptions of lodes or veins, beds, masses, and irregular deposits, with illustrations of the disturbances to which they are subjected, as affecting the work of mining.
4. Graphical representations of deposits, with examples showing modes of occurrence and disturbances.
5. Prospecting or searching for mineral deposits.
6. Exploratory workings.
7. Establishing seats of extraction.
8. Description of typical methods of exploitation as applied to wide veins or lodes, to narrow veins, masses, to beds of various thickness and degrees of inclination.
9. General principles relating to subterranean transportation.
10. Methods and machinery employed for extracting minerals from the pits, and for facilitating ascent and descent of workmen.
11. Drainage of mines; theory of infiltration of water, methods of machinery for draining or freeing mines from water.
12. Ventilation of mines; causes of vitiation of the air of mines; quantities of fresh air required under various circumstances; natural ventilation; mechanical ventilation, by fires and by ventilating machinery; distribution of air through galleries and workings.

13. Graphical illustrations of exploratory workings; methods of exploitation; machinery for hoisting, pumping, ventilation, and transportation, including the use of steam engines and pumps, air compressors, air engines, pumping engines, winding engines, centrifugal and other ventilating machines.

Practical Mining—

1. Boring, earth augers, driven wells, boring with rods and cable tools, upward, inclined, and horizontal boring, diamond drill and its use in prospecting.
2. Shaft sinking, shaft timbering and spiling, boring of shafts, sinking of iron and masonry linings, cribbing, walling, and tubbing.
3. Drifting of adits and levels, timbering and walling in levels and working places.
4. Mining of coal and ores, coal cutting machines, hand and machine drilling.
5. Handling of coal and ores in working places.
6. Tramming, cars, tracks, locomotive and wire rope haulage, planes and gravity roads.
7. Accidents to miners, cause and prevention.
8. Organization and administration.
9. Time books, measurement of contracts, pay roll, analysis and dissection of accounts, and cost sheets.

Ore Dressing.

1. Introduction, theory of separation, hand and machine dressing, general principles governing crushing and sizing of ores of different character.
2. Jigging—theory of, description of different forms of jigs and methods of working, air jigs.
3. Slime treatment, classification of slimes in troughs, spitz kasten, etc., and treatment on buddles and tables.
4. Description of crushing machinery, jaw crushers, rolls, stamps, mills, etc.
5. Sizing apparatus, screens, riddles and trammels.
6. Description of coal washing plant; anthracite breaker.
7. Description of American ore-dressing works.
8. Foreign ore-dressing works.

Hydraulic Engineering—Application of principles of mechanics, of fluids to determining the discharge of water over weirs or dams; the dimension of conduit pipes; discharge of canals and rivers; the effect of varying forms and sections of channels and of obstructions to flow; the gauging of streams; retaining walls for reservoirs.

Mechanical Engineering—

1. Steam boilers—construction, wear and tear, fittings, setting, testing, care and management, firing, feeding, injectors, pumps, etc.
2. Mechanism of engines—Valve gearing, link motions, governors, etc.
3. Management of engines—Erecting, emergencies, special types of engines, etc.
4. Proportions of engines, etc.
5. Testing efficiency of engines and boilers, etc.
6. Pumps, hoisting engines, ventilating machinery, construction and management of hot air, gas, and petroleum, engines, etc.
7. Machine tools.

Surveying.—Railroad surveying, reconnoissance, location of line, calculation of cuttings and embankments.

Economic Geology.—Theory of mineral veins, ores, deposits and distribution of iron, copper, lead, gold, silver, mercury, and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones. etc.

Assaying.—Ores of lead, silver, gold; and gold, silver, and lead alloys.

Metallurgy.—Copper, lead, antimony, iron, copper, silver, gold, zinc, tin, mercury, etc.

Drawing.—Graphic statics and project.

FIRST SESSION.

II.—Course in Civil Engineering.—*Second Year.*—*Analytical Geometry.*—Text book: Peck's Analytical Geometry.

Graphics.—Descriptive Geometry. Text book: Church's Descriptive Geometry.

Chemistry.—The Metals. Lectures, and "Fownes' Manual of Chemistry."

Blowpipe Analysis.—Qualitative. Text book: Plattner's Blowpipe Analysis.

Zoology—Lectures, and Nicholson's Manual of Zoology.

Botany.—Lectures, and Gray's Botanical Text Book.

French.—Text books: Fasquelle's French Grammar; Beudant's Geologie; La bouchee de pain.

German.—Text books: Wershoven's Technical Vocabulary; Stoeckhardt's Schule der Chemie; Bernoulli's Vademecum des Mechaniker's; Stoehr's Katechismus der Bergbaukunde; Gurlt's Bergbau und Huettenkunde.

Drawing.—Topographical Drawing; tinting and grading; problems in graphics. Text book: Honey's Perspective.

SECOND SESSION.

Differential and Integral Calculus—Text book: Peck's Practical Calculus.

Graphics.—Shades and Shadows, perspective, isometrical drawing. Text book: Church's Shades and Shadows.

Stone Cutting.

Chemistry.—Organic. Lectures, and "Fownes' Manual of Chemistry."

Crystallography.—Lectures, and Egleston's Diagrams of Crystals.

Zoology.—Lectures, and Nicholson's Manual of Zoology.

Botany.—Lectures, and Gray's Botanical Text Book.

French.—Text books; same as first session.

German.—Text books; same as first session.

Drawing.—Problems in graphics; architectural drawing.

FIRST SESSION.

Third Year.— Mechanics of Solids, including forces, moments, equilibrium, stability, etc., and elementary machines; dynamics, including uniform, varied, rectilineal and curvilinear motion, rotation, vibration, impact, work done, etc.

Engineering.—General principles relating to materials and structures, physically and mechanically considered.

1. *Materials*— Stone, cements, brick, metals, timber, treated in regard to strength, durability, mode of preparation, defects, tests of quality, and fitness for special uses.
2. *Structures* — Foundations and supports, superstructure, joints, strength and stiffness of parts; special rules of construction for masonry of public buildings, bridges, retaining walls, arches, railroads, common roads and canals.
3. *Theory of Strains and Strength of Materials*— Elasticity, mechanical laws, application of principles of mechanism to beams, girders, and roof trusses under various conditions of loading and supports.

Kinematics of Machinery—(1) General theory of motion, (2) uniform and varied motion, (3) composition of motions, (4) instantaneous centre, (5) rolling centroids, (6) graphical and analytical representations of machine motions, (7) line of centres.

Practical Mining—Excavation, quarrying, drilling and blasting, tunneling.

Practical Astronomy and General Principles of Geodesy.

Surveying—Field work, with compass, sextant, hand level, and pacing, use of solar compass in land surveys, adjustments and use of transit and levelling instruments, triangulation and traversing.

Applied Chemistry—Air, water, fuel, artificial illumination.

Mineralogy—Determinative.

Geology—Lithological, cosmical, and physiographic.

Metallurgy—General metallurgy; fuels, furnaces, etc.

Physics—Mechanical theory of heat, electricity.

Drawing—Constructions; machines, furnaces, plans, etc.

SECOND SESSION.

Mechanics of Fluids, including pressure, buoyancy and specific gravities, motions in pipes and channels, undulation, capillarity, tension and elasticity of gases, the atmosphere, the barometer, barometric formulæ, and hypsometry.

Engineering—Theory of strains and Strength of Materials continued—Graphical methods of determining strains; deflection of beams and girders; quantity of material in braced girders under various conditions of loading and supports; angle of economy for bracing; torsion of shafts; crushing and tensile strength of materials; working strains and working load; mode of estimating cost of girder work.

Dynamics of Machinery—Forces of nature employed or acting in all machines, dynamical laws, mathematical theorems, measure of forces, work of forces, elementary machines and their combinations, theory of efficiency, theory of flywheels, governors and brakes, strength and proportions of parts of machines, dynamometers.

Transmissive Machinery—

1. Transmission by rolling contact, friction gear, and cams.
2. Transmission by sliding contact, spur, bevel screw, and skew-bevel teeth, and cams.
3. Transmission by shafting.
4. Transmission by belts, ropes, chains, etc.
5. Transmission by links.
6. Transmission by fluids.

Practical Mining—Excavation, quarrying, drilling and blasting, tunneling.

Practical Astronomy and General Principles of Geodesy.

Surveying—Topographical work with plane table.

Physics—Physical optics and the undulatory theory of light.

Applied Chemistry — Limes, mortars, and cements; building stones: decay and preservation; timber and its preservation: pigments, paints, essential oils, varnishes; glass and ceramics; explosives: gunpowder, gun-cotton, nitroglycerine, etc.

Mineralogy—Determinative.

Metallurgy—Iron and Steel.

Geology—Historical including palæontology.
Drawing—Constructions; machines, furnaces, plans, etc.
Summer Vacation.—Memoir.

WITHOUT DISTINCTION OF SESSIONS.

FOURTH YEAR—*Dynamics of Machinery*—Prime movers, as driven by animal power, water power, steam power, compressed or heated air, wind power, comprising the theory of animal power, theory of water wheels, overshot wheels, undershot wheels, breast wheels, turbines, reaction wheels, centrifugal pumps; properties and laws of heat as applied to the generation of steam in steam boilers; properties of steam and air in their relation to prime movers; mechanical theory of heat, applied to steam engines; hot-air engines, compressed-air engines; general description of heat engines of various forms; description and theory of ventilating fans or blowers.

Civil Engineering—Hydraulic and Sanitary Engineering, embracing water supplies for cities and towns, for the purposes of irrigation and improvement of lands; quantity and quality of water required; rainfall, flows of streams, storage of water, capacity of water sheds, impurities of water; practical construction of water works, pumping machinery; clarification of water; systems of water supply.

Principles of Sanitary Engineering—As regards necessity of sanitary measures, different systems of removing refuse and decomposing matters, warming and ventilation.

Works of Sewerage—Rainfall and sewers; influence of geological and topographical features of the sites of towns and districts; discharge of sewers; intercepting sewers; forms, modes of construction, and materials used; flushing of sewers and ventilation; traps, outfalls, tide valves; subsoil and surface drainage of towns; house drainage; water closets; ventilation of houses, in connection with sanitary measures.

Improvements of Rivers and Harbors—Action of tides and currents in forming and removing deposits; methods of protecting and deepening harbors and channels.

Geodesy—Continued, with lecture on figure of the earth, and practical illustration in the use of geodetic instruments, such as measurement of base lines, measurement of horizontal angles for a primary, a secondary, and a tertiary triangulation; signals, astronomical determinations of time, latitude, longitude, and azimuth of a direction.

Railroad Engineering—Permanent way; rolling stock; motive power; administration, etc.

Hydraulic Engineering—Application of principles of mechanics of fluids to determining the discharge of water over weirs or dams; the dimensions of conduit pipes; discharge of canals and rivers; the effects of varying forms and sections of channels and of obstructions to flow; the gauging of streams; retaining walls for reservoirs.

Mechanical Engineering—(1) steam boilers: construction, wear and tear, fittings, setting, testing, care and management, firing, feeding, injectors, pumps, etc.; (2) mechanism of engines, valve gearing, link motions, governors, etc.; (3) management of engines, erecting emergencies, special types of engines, etc.; (4) proportions of engines, etc.; (5) testing efficiency of engines and boilers; (6) pumps, hoisting engines, ventilating machinery; (7) construction and management of hot air, gas, and petroleum engines, etc.; (8) machine tools.

Surveying—Railroad surveying: reconnoissance, location and survey of line with curves and slope stakes, calculations of cuttings and embankments.

Economic Geology—Theory of mineral veins, ores, deposits and distribution of iron, copper, lead, gold, silver, mercury, and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones, etc.

Metallurgy—Supplementary lectures on iron and steel.
Drawing—Graphic statics and project.

FIRST SESSION.

III.—COURSE IN METALLURGY.—*Second Year.—Analytical Geometry*—Text book: Peck's Analytical Geometry.

Graphics—Descriptive Geometry. Text books: Church's Descriptive Geometry.

Chemistry—The Metals. Lectures, and "Fownes' Manual of Chemistry."

Quantitative Analysis—Lectures, and "Cairn's Quantitative Analysis."

Stoichiometry.

Blowpipe Analysis—Qualitative. Text book: Plattner's Blowpipe Analysis.

Zoology—Lectures, and Nicholson's Manual of Zoology,

Botany—Lectures, and Gray's Botanical Text Book.

French—Text books: Fasquelle's French Grammar; Beudant's Geologie; La bouchee de pain.

German—Text books: Wershoven's Technical Vocabulary; Stoeckhardt's Schule der Chemise; Bernoulli's Vademecum des Mechanikers; Stoehr's Katechismus der Bergbaukunde; Gurlt's Bergbau-und Huettenkunde.

Drawing—Tinting and grading: topographical drawing; problems in graphics. Text book: Honey's Perspective.

SECOND SESSION.

Differential and Integral Calculus—Text book; Peck's Practical Calculus.

Graphics—Shades and shadows, perspective, isometrical drawing. Text books: Church's Shades and Shadows.

Stone Cutting.

Chemistry—Organic, Lectures, and "Fownes' Manual of Chemistry."

Quantitutive Analysis—Lectures, and "Cairn's Quantitative Analysis."

Crystallography—Lectures, and illustrative diagrams.

Zoology—Lecture, and Nicholson's Manual of Zoology.

Botany—Lectures, and Gray's Botanical Text Book.

French—Text books: same as first session.

German—Text books: same as first session.

Drawing—Problems in graphics; architectural drawing.

Summer Vacation.—Memoir.

FIRST SESSION.

Third Year.—Mechanics of solids, including forces, moments, equilibrium, stability, etc., and elementary machines; dynamics, including uniform, varied, rectilineal and curvilinear motion, rotation, vibration, impact, work done, etc.

Quantitative Analysis.

Applied Chemistry—Air, water, fuel, artificial illumination.

Mineralogy—Determinative.

Geology—Lithological, cosmical, physiographic.

Metallurgy—General Metallurgy; fuel, furnaces, etc.

Physics—Mechanical theory of heat, electricity.

Drawing—Constructions; machines, furnaces, plans, etc.

SECOND SESSION.

Mechanics of Fluids, including pressure, buoyancy and specific gravities, motion in pipes and channels, undulation, capillarity, tension and elasticity of gases, the atmosphere, the barometer, barometric formulæ, and hypsometry.

Physics—Physical optics and the undulatory theory of light.

Applied Chemistry—Limes, Mortars and Cements; building stones; decay and preservation; timber and its preservation; pigments, paints, essential oils, varnishes; glass and ceramics; explosives; gunpowder, guncotton, nitroglycerine, etc.

Quantitative Analysis.

Mineralogy—Determinative.

Metallurgy—Iron and Steel.

Geology—Historical, including palæontology.

Drawing—Constructions; machines, furnaces, plans, etc.

FOURTH YEAR.—(*Without distinction of Sessions.*)

Machines, including prime movers, as driven by (1) animal power, (2) water power, (3) steam, (4) heated or compressed air, (5) the winds; comprising water wheels, turbines, and reaction wheels, steam engines in their various forms, and air engines.

Principles of Heat applicable to these Engines.

Steam Boilers.

Mechanism and Management of Engines.

Machine Tools.

Assaying—Ores of Lead, silver, gold, platinum, tin, antimony, bismuth, copper, nickel, cobalt, iron, mercury and zinc; and gold, silver and lead bullion; mattes, slags, etc.

Metallurgy—Copper, lead, silver, gold, zinc, tin, mercury, etc. Supplementary lectures on iron and steel.

Economic Geology—Theory of mineral veins, ores, deposits and distribution of iron, copper,, lead, gold, silver, mercury and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones, etc.

Applied Chemistry—I. Chemical manufactures; acids, alkalies and salts. (1) Sulphur, sulphurous acid, hyposulphite, sulphuric acid, bisulphide of carbon, etc. (2) Common salt, soda ash, hydrochloric acid, chlorine, binoxide of manganese, bleaching powder, chlorimetry, etc. (3) Carbonate of potash, caustic potash, alkalimetry, acidimetry, etc. (4) Nitric acid and nitrates. (5) Iodine, bromine, etc. (6) Sodium, aluminium, magnesium. (7) Phosphorus, matches, etc. (8) Ammonia salts. (9) Cyanides. (10) Alum, copperas, blue vitriol, salts of magnesia, baryta, strontia, etc. (11) Borates, stannates, tungstates, chromates, etc. (12) Mercury salts, photography. (13) Electro-Metallurgy. (14) Oils, fat, soaps, glycerine. II. Food and drink; milk, cereals, starch, bread, meat, tea, coffee, sugar, fermentation, wine, beer, spirits vinegar, preservation of food, tobacco, etc. III. Clothing; textile fabrics, bleaching, dyeing. calico printing, paper, tanning, glue, India-Rubber, gutta percha, etc. IV. Fertilizers; guano, superphosphates, poudrettes, etc.

Drawing.—Project and Theses Work.

FIRST SESSION.

IV. COURSES IN GEOLOGY AND PALÆONTOLOGY.—*Second Year.—Graphics*—Descriptive Geometry. Text book: Church's Descriptive Geometry.

Chemistry—The Metals. Lectures, and "Fownes' Manual of Chemistry."

Quantitative Analysis—Lectures, and "Cairns' Quantitative Analysis."

Stoichiometry.
Blowpipe Analysis—Qualitative. Text book: Plattner's Blowpipe Analysis.
Zoology—Lectures, and Nicholson's Manual of Zoology.
Botany—Lectures, and Gray's Botanical Text Book.
French—Text books: Fasquelle's French Grammar; Beudant's Geologie; La bouchee de pain.
German—Text books: Wershoven's Technical Vocabulary; Stoeckhardt's Schule der Chemie; Bernoulli's Vademecum des Mechanikers; Stoehr's Katechismus der Bergbaukunde; Gurlt's Bergbau und Huettenkunde.
Drawing—Topographical drawing; tinting and grading; problems in graphics. Text book: Honey's Perspective.

SECOND SESSION.

Graphics—Shades and shadows, perspective and isometrical drawing. Text book: Church's Shades and Shadows.
Chemistry—Organic. Lectures, and "Fownes' Manual of Chemistry."
Quantitative Analysis—Lectures, and Cairn's Quantitative Analysis.
Crystallography—Lectures and illustrative diagrams.
Botany—Lectures, and Nicholson's Manual of Zoology.
Zoology—Lectures, and Gray's Botanical Text Book.
French—Text book: same as first session.
German—Text books: same as first session.
Drawing—Problems in graphics.
Summer Vacation.—Memoir.

FIRST SESSION.

THIRD YEAR—*Geology*—Lithological, cosmical, physiographic.
Surveying, with compass, sextant, hand level, and pacing, use of solar compass in land and mineral surveys, adjustments and use of transit and levelling instruments, triangulation and traversing.
Applied Chemistry—Air, water, fuel, artificial illumination.
Quantitative Analysis.
Stoichiometry.
Mineralogy—Determinative.
Metallurgy—General metallurgy, fuels, etc.
Physics—Mechanical theory of heat, electricity.
Drawing—Geological drawings.

SECOND SESSION.

Geology—Historical, including palæontology.
Surveying—Topographical work with plane table, magnetic survey.
Physics—Physical optics and the undulatory theory of light.
Applied Chemistry—Limes, mortars, and cements; building stones; decay and preservation; timber and its preservation: pigments, paints, essential oils, varnishes; glass and ceramics; explosives: gunpowder, guncotton, nitroglycerine, etc.
Quantitative Analysis.
Mineralogy—Determinative.
Metallurgy—Iron and steel.
Drawing—Geological drawings.
Summer Vacation.—Memoir.

WITHOUT DISTINCTION OF SESSIONS.

FOURTH YEAR—*Economic Geology*—Theory of mineral veins, ores, deposits and distribution of iron, copper, lead, gold, silver, mercury, and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones, etc.
Surveying—Principles of Geodesy; Railroad surveying: reconnoissance, location of line, calculations of cuttings and embankments.

FIRST SESSION.

V.—COURSE IN ANALYTICAL AND APPLIED CHEMISTRY.—*Second Year.-Graphics*—Descriptive Geometry. Text books: Church's Descriptive Geometry.
Chemistry—The Metals. Lectures, and "Fownes' Manual of Chemistry."
Quantitative Analysis—Lectures, and "Cairn's Quantitative Analysis."
Stoichiometry.
Blowpipe Analysis—Qualitative. Text book: Plattner's Blowpipe Analysis.
Zoology—Lectures, and Nicholson's Manual of Zoology.
Botany—Lectures, and Gray's Botanical Text Book.
French—Text books: Fasquelle's French Grammar; Beudant's Geologie; La bouchee de pain.
German—Text books: Wershoven's Technical Vocabulary; Stoeckhardt's Schule der Chemie; Bernoulli's Vademecum des Mechanikers; Stoehr's Katechismus der Bergbaukunde: Gurlt's Bergbau und Huettenkunde.
Drawing—Topographical drawing; tinting and grading; problems in graphics. Text book: Honey's Perspective.
Metallurgy.—Copper, lead, silver, gold, zinc, tin, mercury, etc.
Drawing.—Dissertation and thesis work.
Supplementary lectures on iron and steel.

SECOND SESSION.

Graphics—Shades and shadows, perspective and isometrical drawing. Text book; Church's Shades and Shadows.
Chemistry—Organic. Lectures, and "Fownes' Manual of Chemistry."
Quantitative Analysis—Lectures, and "Cairn's Quantitative Analysis."
Crystallography—Lectures, and Egleston's Diagrams of Crystals.
Zoology—Lectures, and Nicholson's Manual of Zoology.
Botany—Lectures, and Gray's Botanical Text Book.
French—Text Books: same as first session.
German—Text books: same as first session.
Drawing—Problem in graphics.
Summer Vacation.—Memoir.

FIRST SESSION.

Third Year.—Applied Chemistry—Air, water, fuel, artificial illumination.
Quantitative Analysis.
Mineralogy—Determinative.
Geology—Lithological, cosmical, physiographic.
Metallurgy—General metallurgy, fuel, furnaces, etc.
Physics—Mechanical theory of heat, electricity.

SECOND SESSION.

Applied Chemistry—Limes, mortars, and cements; building stones; decay and preservation; timber and its preservation; pigments, paints, essential oils, varnishes; glass and ceramics; explosives; gunpowder, guncotton nitroglycerine, etc.
Mineralogy—Determinative.
Geology—Historical, including palæontology.
Metallurgy—Iron and steel.
Physics—Physical optics and the undulatory theory of light.
Quantitative Analysis.
Summer Vacation.—Memoir.

WITHOUT DISTINCTION OF SESSION.

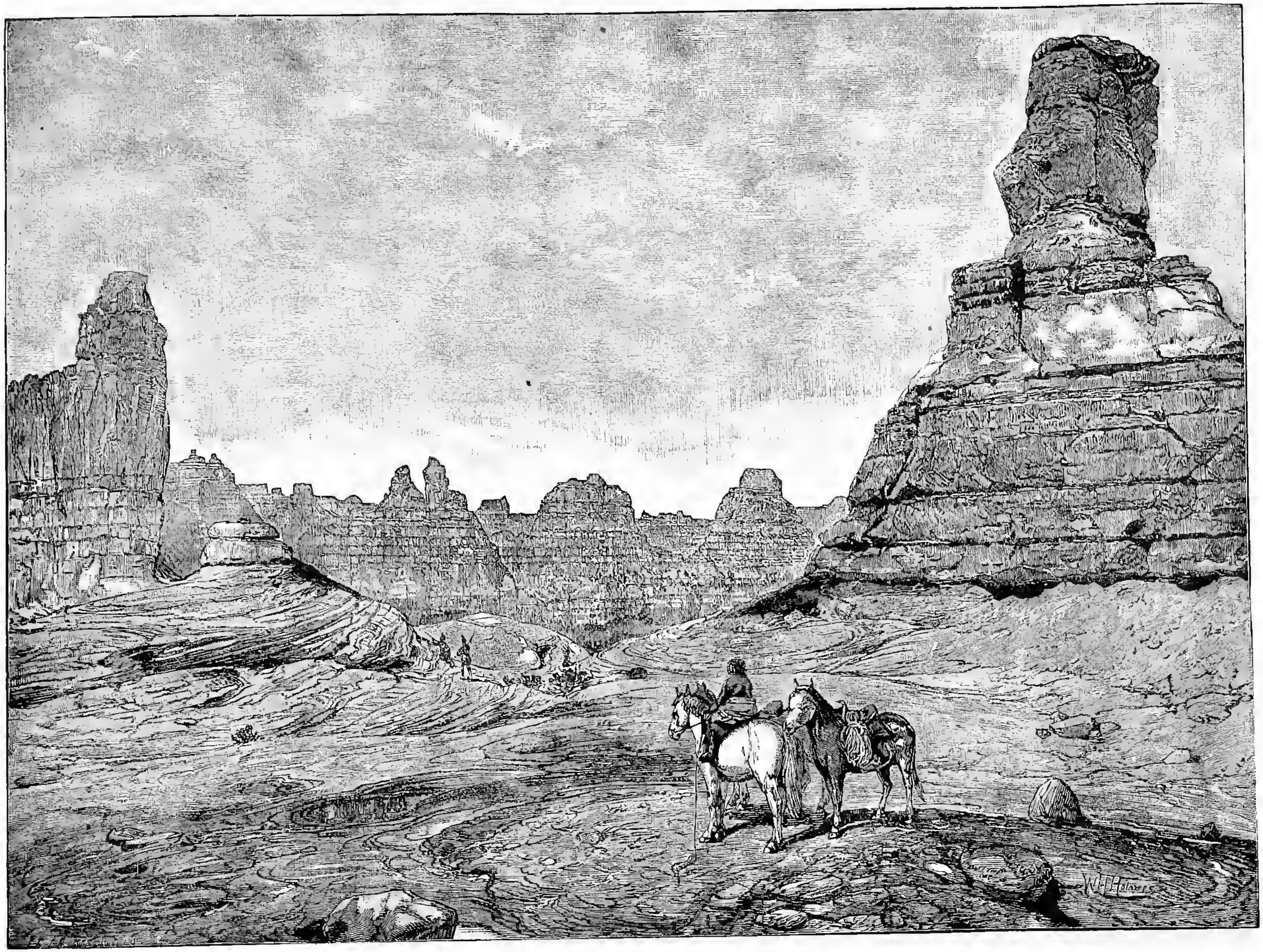
FOURTH YEAR.—*Applied Chemistry.*—I. Chemical manufactures; acid, alkalies and salts. (1) sulphur, sulphurous acid, hyposulphites, sulphuric acid, Bisulphide of carbon, etc. (2) Common salt, soda ash, hydrochloric acid, chlorine, binoxide of manganese, bleaching powder, chlorates, chlorimetry, etc. (3) Carbonate of potash, caustic potash, alkalimetry, acidimetry, etc. (4) Nitric acid and nitrates. (5) Iodine, bromine, etc. (6) Sodium, aluminium, magnesium. (7) Phosphorus, matches, etc. (8) Ammonia salts. (9) Cyanides. (10) Alum, copperas, blue vitriol, salts of magnesia, baryta, strontia, etc. (11) Borates, stannates, tungstates, chromates, etc. (12) Mercury salts, silver salts, photography. (13) Electro-metallurgy. (14) Oils, fats, soaps, glycerine. II. Food and drink: milk, cereals, starch, bread, meat, tea, coffee, sugar, fermentation, wine, beer, spirits, vinegar, preservation of food, tobacco, etc. III. Clothing: textile fabrics, bleaching, dyeing, calico printing, paper tanning, glue, India-rubber, gutta percha, etc. IV. Fertilizers: guano, superphosphates, poudrettes, etc.
Organic Chemistry.—Laboratory practice.
Assaying—Ores of lead, silver, gold, platinum, tin, antimony, bismuth, copper, nickel, cobalt, iron, mercury, and zinc; and gold, silver, and lead bullion, mattees, slags, etc.
Metallurgy—Copper, lead, silver, gold, zinc, tin, mercury, etc. Supplementary lectures on iron and steel.
Economic Geology—Theory of mineral veins, ores, deposits and distribution of iron, copper, lead, gold, silver, mercury, and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones, etc.
Drawing—Dissertation and thesis work.

FIRST SESSION.

VI.—COURSE IN ARCHITECTURE.—*Second Year.—Analytical Geometry*—Text book; Peck's Analytical Geometry.
Graphics—Descriptive Geometry. Problems.
Chemistry—The Metals. Lectures, and "Fownes' Manual of Chemistry."
The Elements of Architecture—The forms and proportions of the five orders, and of balustrades, steps, doors, windows, arches, vaults, domes, roofs, spires, etc.
Greek Architectural History—Reber's History of Ancient Art.
French—Text books: Fasquelle's French Grammar; Beudant's Geologie; La bouchee de pain.
German—Text books: Wershoven's Technical Vocabulary; Stoeckhardt's Schule der Chemie; Bernoulli's Vademecum des Mechanikers; Stoehr's Katechismus der Bergbaukunde; Gurlt's Bergbau und Huettenkunde.
Drawing—Tracing; ornament; plans, sections, and elevations. Text book: Honey's Perspective.

SECOND SESSION.

Differential and Integral Calculus—Text book: Peck's Practical Calculus.
Graphics—Shades and shadows; perspective, isometrical drawing. Problems.



WESTERN SCENERY—LAND OF THE STANDING ROCKS—GRAND CAÑON. DISTRICT.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

SEE PART X.

Stone Cutting.
The Elements of Architecture, continued.
Roman Architectural History.
French—Text books, same as first session.
German—Text books: same as first session.
Drawing—Ornaments from casts; details; perspective drawings. Text books: Honey's Perspective.

FIRST SESSION.

THIRD YEAR—*Summer Vacation*—Memoir.
Mechanics of Solids—Including forces, moments, equilibrium, stability etc., and elementary machines.
Engineering.—General principles relating to materials and structures, physically and mechanically considered.

1. *Materials*—Stone, cements, brick, metals, timber, treated in regard to strength, durability, mode of preparation, defects, tests of quality, and fitness for special uses.
2. *Structures*—Foundations and supports, superstructure, joints, stability, strength, and stiffness of parts; special rules of construction for masonry of public buildings, bridges, retaining walls, arches, railroads, common roads, and canals.
3. *Theory of Strains and Strength of Materials*—Elasticity, mechanical laws, application of principles of mechanics to beams, girders, and roof trusses under various conditions of loading and supports.

Applied Chemistry—Air, water, fuel, artificial illumination.
Geology—Descriptive.
* *Mediæval Architectural History.*
* *The History of Ornament*—Lectures and exercises.
* *The Decorative Arts*—Terra cotta, faience, stained glass, enamels, mosaic, fresco, distemper. Lectures and sketching. Excursions.
* *Specifications and Working Drawings*—Excavation, foundations, piling, stone work, brick work, plastering, and stucco work. Lectures and laboratory work. Excursions.
Architectural Design—Design by dictation. Problems.
Modelling.
Drawing from the Cast—Ornament and the human figure.

SECOND SESSION.

Mechanics of Solids—Dynamics, including uniform, varied, rectilineal and curvilinear motion, rotation, vibration, impact, work done, etc.
Engineering—Theory of Strains and Strength of Materials continued—Graphical methods of determining strains, deflection of beams and girders; quantity of material in braced girders under various conditions of loading and supports; angle of economy for bracing; torsion of shafts; crushing and tensile strength of materials; working strains and working load; mode of estimating cost of girder work.
Applied Chemistry—Limes, mortars and cements; building stones; decay and preservation; timber and its preservation; pigments, paints, oils, and varnishes; glass and ceramics; explosives; gunpowder, guncotton, nitro-glycerine, etc.
Geology.—Historical.
**Mediæval Architectural History.*
**The History of Ornament*—Lectures and blackboard exercises.
**The Decorative Arts*—Embroidery, weaving, jewelry, metal work, inlays. Lectures and sketching. Excursions.
* *Specification and Working Drawings*—Carpentry, painting, glazing, plumbing, iron, lead, and copper work; tinning and slating. Lectures and laboratory Work. Excursions.
Architectural Design—Alterations and Restorations—Problems.
Drawing—Water colors.
Summer Vacation—Memoir.

WITHOUT DISTINCTION OF SESSIONS.

FOURTH YEAR.—*Sanitary Engineering.*
Sewerage.
Economic Geology—Clay, limestone, cements, building and ornamental stones.
Graphical Statics.
Book-Keeping—Time books, contracts, pay rolls, analysis of accounts, and cost sheets.
**Business Relations* between architects, clients, mechanics, and draughtsmen: office papers; competitions; legal obligations; superintendence.
**Estimates*—Quantity, weight, time, labor, cost; squaring.
**Modern Architectural History.*
**The History of Painting and Sculpture.*
**The Theory of Architecture*—the theory of form, the theory of color, the theory of composition.
Literature and Criticism—Themes, Reports. Abstracts of book.
Architectural Design—Problems.

DEPARTMENTS OF INSTRUCTION.—*Modern Languages.*—The design in this department is to teach the students to read French and German scientific books with facility. Instruction is given for three hours a week in each of these languages during the first year and two hours a week during the second year. As the text-books employed in the class-room are altogether works on science, the students can acquire a sufficient vocabulary to enable them to use French and German authors in all the departments of the school. No attempt is made to produce accomplished scholars in all branches of German and French literature, but attention is concentrated upon the immediate wants of the young men. In this way no time is lost, and the instruction is made thoroughly practical.

Mathematics.—The students of the First Class attend four hours per week throughout the year. In the first session, they complete the subject of Geometry, plane, volumetric, and spherical; the parabola, ellipse, and hyperbola, geometrically treated; and Algebra, including the general principles and properties of logarithms and the logarithmic series, the general theory of equations, embracing the principal transformations and properties, derived equations and equal roots, Sturm's theorem and the solution of higher equations. In the second session they are taught Trigonometry, plane, analytical, and spherical, with the solution of many practical problems by formulæ and by construction; and the Mensuration of surfaces and of volumes. The students of the Second Class attend four hours per week throughout the year. In the first session, they complete the subject of Analytical Geometry, with applications to lines and surfaces of the second order; and in the second, the Differential and Integral Calculus, with some of its applications to mechanics and astronomy, as centre of gravity, moment of inertia, falling bodies, attraction of homogeneous spheres, orbital motion, law of force, etc.

Mechanics.—This subject is taught during the third year. The course of instruction embraces the following subjects: Representation and measurement of forces: Composition, resolution, and equilibrium of forces; principles of moments and virtual moments; theory of parallel forces; application to centre of gravity; stability. Elementary machines: friction, resistance to rolling, stiffness of cords, atmospheric resistance, General equations of motion: rectilineal, uniform, and uniformly varied motion; curvilinear motion, free and constrained; centrifugal force; application of the Governor; vibratory motion; application to the pendulum; motions of translation and rotation; moment of inertia, principal axes, and ellipsoid of inertia; laws of impact; centre of percussion; general theorem of work; accumulation of work; application to fly-wheel. Mechanics of fluids: pressure due to weight; equal transmission of pressures; application to hydraulic press; buoyancy and flotation; application to specific gravity. Tension and elasticity of gases and vapors: laws of variation; application to pumps and siphons; investigation of the barometer formula; motion of liquids in pipes and open channels; living force of fluids; application to hydraulic ram; mechanics of capillarity.

Practical Astronomy and Geodesy.—Students of the Third and Fourth Classes in the course of Civil Engineering are required to attend the course of Practical Astronomy and Geodesy. This course includes the theory and use of the transit and sextant, and the determination of geographical position; also the theory and use of geodetic instruments.

Physics.—The students of the First Class are occupied during the first term with the subject of heat including the steam engine, and with acoustics; during the second term, in the study of optics, voltaic electricity, magnetism, and electro-magnetism. The courses are fully illustrated by appropriate experiments, and practical problems are occasionally proposed for solution. To the students of the Third Class, courses of lectures are delivered on the laws of electro-statics, on the mechanical theory of heat, on mathematical optics, and on the undulatory theory of light. Portions of these courses are accompanied by experimental demonstrations. The cabinet of physical apparatus will rank with the best on this continent, and extensive additions are made to it each year.

Chemistry.—I. GENERAL CHEMISTRY.—The First Class attends three exercises a week in the general chemistry of the non-metallic elements throughout the year. It is intended to lay the foundation of a thorough knowledge of the theory of the subject preliminary to the practical in-

* For convenience these subjects are given in alternate years, the third and fourth year students taking them together.

struction in the chemical laboratory. For this purpose the students are drilled upon the lectures, with free use of a text-book. They are expected to write out full notes. At the end of the year, they must pass a rigid examination before being admitted to a higher grade. The Second Class also attends three times a week during the year, and receives instruction in theoretical chemistry adapted to the wants of special scientific students. In the first session, the chemistry of the metals; in the second session, organic chemistry.

II. ANALYTICAL CHEMISTRY.—There is a laboratory devoted to qualitative analysis, another to quantitative analysis, and an assay laboratory. These laboratories are provided with all the necessary apparatus and fixtures, and each is under the special charge of a competent instructor with an assistant. Each student is provided with a convenient table, with drawers and cupboards, and is supplied with a complete outfit of apparatus and chemical reagents. During the first year, qualitative analysis is taught by lectures and blackboard exercises, and the student is required to repeat all the experiments at his table in the laboratory. Having acquired a thorough experimental knowledge of the reactions of a group of bases or acids, single members of the group or mixtures are submitted to him for identification. He thus proceeds from simple to complex cases till he is able to determine the composition of the most difficult mixtures. When the student shows, on written and experimental examination, that he is sufficiently familiar with qualitative analysis, he is allowed to enter the quantitative laboratory. During the second and third years, quantitative analysis is taught by lectures, and the student is required to execute in the laboratory in a satisfactory manner a certain number of analyses. He first analyzes substances of known composition, such as crystallized salts, that the accuracy of his work may be tested by a comparison of his results with the true percentages. These analyses are repeated till he has acquired sufficient skill to insure accurate results. He is then required to make analyses of more complex substances, such as coals, limestones, ores of copper, iron, zinc and nickel, pig iron, slags, technical products, etc.—cases in which the accuracy of the work is determined by duplicating the analyses and by comparing the results of different analyses. Volumetric methods are employed whenever they are more accurate or more expeditious than the gravimetric methods. In this way each student acquires practical experience in the chemical analysis of the ores and products which he is most likely to meet in practice.

III. ORGANIC CHEMISTRY.—Organic chemistry is taught by lectures in the second session of the second year. During the fourth year the students in the course of Analytical and Applied Chemistry devote their time in the laboratory to organic chemistry.

IV. STOICHIOMETRY.—Stoichiometry, the arithmetic of chemistry, is taught by lectures and blackboard exercises as a part of the course of instruction in general chemistry in the first and second years; and its practical applications are developed in lectures on quantitative analysis and assaying.

V. ASSAYING.—During the fourth year, the student is admitted to the assay laboratory, where he is provided with a suitable table and a set of assay apparatus, and where he has access to crucible and muffle furnaces, and to volumetric apparatus for the assay of alloys of gold and silver. The general principles as well as the special methods of assaying are explained in the lecture room, and at the same time the ores of the various metals and their appropriate fluxes are exhibited and described. The student is then supplied with the different ores, and is required to assay each one in duplicate under the immediate supervision of the instructor. To facilitate the assay of ores of the precious metals a system of weights has been introduced by which the weight of the silver or gold globule obtained shows at once, without calculation, the number of troy ounces in a ton of ore. Students are also given an opportunity of testing the milling qualities of gold and silver ores, and are required to give special attention to sampling and the mechanical assaying of the ores of the precious metals.

VI. APPLIED CHEMISTRY.—The instruction in applied chemistry extends through the third and fourth years, and consists of lectures illustrated by experiments, diagrams, and specimens.

The subjects discussed are:

IN THE THIRD YEAR.

(*For all Students.*)

I. Air; nature, sources of contamination, sewer gas, plumbing, drainage, disinfection, ventilation.
II. Water; composition of natural waters, pollution, disposal of sewage and house refuse.
III. Fuel and its applications.
IV. Artificial illumination: candles, oils and lamps, petroleum, gas and its products, electric light.
V. Limes, mortars, and cements.
VI. Building stones: decay and preservation.
VII. Timber and its preservation: pigments, paints, essential oils, varnishes.
VIII. Glass and ceramics.
IX. Explosives, gunpowder, guncotton, nitroglycerine, etc.

IN THE FOURTH YEAR.

(*For students in the course of Analytical and Applied Chemistry*).

I. Chemical manufactures: acids, alkalies, and salts.
(1) Sulphur, sulphurous acid, hyposulphites, sulphuric acid, bisulphide of carbon, etc.
(2.) Common salt, soda ash, hydrochloric acid, chlorine, binoxide of manganese, bleaching powder, chlorates, chlorimetry, etc.
(3.) Carbonate of potash, caustic potash, alkalimetry, acidimetry, etc.
(4.) Nitric acid and nitrates.
(5.) Iodine, bromine, etc.
(6.) Sodium, aluminium, magnesium.
(7.) Phosphorus, matches, etc.
(8.) Ammonia salts.
(9.) Cyanides.
(10.) Alum, copperas, blue vitriol, salts of magnesia, baryta, strontia, etc.
(11.) Borates, stannates, tungstates, chromates.
(12.) Mercury salts, silver salts, photography.
(13.) Electro-metallurgy.
(14.) Oils, fats, soaps, glycerine.
II. Food and drink: milk, cereals, starch, bread, meat, tea, coffee, sugar, fermentation, wine, beer, spirits, vinegar, preservation of food, tobacco, etc.
III. Clothing: textile fabrics, bleaching dyeing, calico printing, paper, tanning, glue, India-rubber, gutta percha, etc.
IV. Fertilizers: guano, superphosphates, poudrettes, etc.

Geology and Palæontology.—The course of instruction in this department is as follows:

SECOND YEAR.

Botany and Zoology, as an introduction to Palæontology—lectures throughout the year.

THIRD YEAR.

Lithology: Minerals which form rocks and rock masses of the different classes—lectures and practical exercises.

Geology: Cosmical, physiography, and historical—lectures and conferences throughout the year.

FOURTH YEAR.

Economic Geology: Theory of mineral veins; ores; deposits and distribution of iron, copper, lead, gold, silver, mercury, and other metals; graphite, coal, lignite, peat, asphalt, petroleum, salt, clay, limestone, cements, building and ornamental stones, etc.

MINERALOGY AND METALLURGY.

1. *Mineralogy.*—The studies in mineralogy continue through two years. During the first year the students are instructed in the use of the blowpipe, in crystallography, and in theoretical mineralogy.

The instruction in blowpipe is entirely practical, and lasts through the first half of the year. It consists in instruction how to use the different flames, and in teaching the students how to examine mixtures, alloys, and natural compounds, so that they are able to determine with ease the constituents of a mixture containing a large number of simple substances. In order to do this, substances whose composition they know are given to them, upon which they are required to perform all the characteristic reactions which take place in the different flames with different fluxes. After they are sufficiently familiar with the behaviour of substances the composition of which they know, they are given substances, the composition of which they do not know, to determine. The collection of blowpipe substances consists of four hundred alloys, mixtures, and minerals. Students are taught to examine qualitatively all the different commercial alloys and a large number of the natural combinations which exist in minerals. The blowpipe laboratory is a large, well-ventilated room, to which the students have access at all hours of the day, where each student has a drawer with a lock assigned to him, which he retains until the close of the term.

At the commencement of the second term the lectures on crystallography commence. They embrace the entire subject of crystallography, including the descriptions of both normal and distorted forms, for the study of which the students have access to a collection of over 300 models in wood, embracing all the theoretical forms. Besides this collection they have the use of the collection of 150 models in glass, and have access to the collection of minerals, most of the species of which are illustrated by models in wood, showing the perfect and distorted crystallographic forms. Conferences are held during the term, in which the students are required to determine models of the theoretical forms as well as those found in minerals. They are also taught theoretical mineralogy, including the optical and physical properties of minerals, which lectures are illustrated by the very complete set of apparatus, presented by F. A. Schermerhorn, and a cabinet containing a large number of sections of minerals for lantern and instrumental use. For the study of sections the students are taught the use of Groth's and Soleil's Polariscopes, and of Goniometers. At the commencement of the third year the students begin the study of practical mineralogy. They are required to determine minerals by the eye, or by asking questions with regard to those characteristics which cannot be determined without experiment. They are required to give the name, the composition, the crystalline form, and the prominent blowpipe chemical and physical characteristics of the mineral they determine. To facilitate this work they have unrestricted access to a collection of about 3,000 carefully labeled specimens, on which they are allowed to make any experiments. They have, besides, constant access to the cabinet of minerals, which contains about 30,000 specimens, arranged in table cases to show the different characteristics of minerals, and about three thousand specimens, arranged in wall cases to show their association. The crystals of minerals are arranged upon pedestals in such a way that they can be readily seen and examined by the students. At the commencement of the second term of the third year they are required to determine the minerals without asking questions, by making the chemical and blowpipe tests on specimens given to them for the purpose. Most of the instruments in this department were presented to the School by D. Willis James, C. R. Agnew, and the late Gouverneur Kemble. The collection of minerals was founded by a valuable collection presented as the first donation to the School before it was opened in 1864, by the late George T. Strong, of this city. It was shortly afterwards supplemented by another collection, presented by the late Gouverneur Kemble, containing many autographs and specimens from the cabinet of Hauy. As these collections were both very rich in duplicates, very many valuable additions have been made to the cabinet by exchange. Collections were also made in Europe during several years by the Professor in charge, having the necessities of the collection of the school in view, and were presented to the school through the generosity of Morris K. Jessup, Wm. E. Dodge, Jr., D. S. Egleston, C. Lanier, and J. Crearer, of this city; and the late John H. Caswell, Wm. H. Aspinwall, and R. P. Parrot.

II. Metallurgy.—The lectures in metallurgy continue through two years, and discuss in detail the methods in use in the best establishments in this country and in Europe for working ores. They embrace, in general metallurgy, the subjects of combustion, fire-clays, furnaces, natural fuels—wood, peat, lignite, bituminous and anthracite coals—artificial fuels, charcoal, peat charcoal, and combustible gases manufactured in generators, chimneys, the different kinds of blast engines, regulators, hot-blast ovens, and tuyeres. The metallurgy of iron consists in discussion of the general properties of iron and its ores; theory of the blast furnace process—the causes of variation in the charge produced in the furnace by the blast, by the fuels, by the variations in the charge, and by the form of the furnace; the effects of moisture; the methods of ascertaining the cost; the calculations of the heat developed and lost in the furnace; moulding; melting the iron in crucibles, in cupolas, in reverberatory furnaces; methods of making the moulds; precautions required in casting; and the manufacture of malleable cast iron. In the manufacture of wrought from cast iron, the German process and its modifications are discussed; the English processes, including fining; the dry and boiling process in puddling; stationary and rotary furnaces; shears; hammers; squeezers; saws; rolls; reheating in ordinary and regenerator furnaces; two and three high trains; method of caculating cost of wrought iron. In the manufacture of iron from the ore, the Catalan processes and its derivatives are discussed; in the metallurgy of steel, low furnace processes, puddled steel, cement steel, Bessemer steel, Siemens-Martin steel, crucible steel, the utilization of scrap-iron, manufacture of sheet iron, nails, wire, and rails. The lectures on the metals include the treatment of native copper; the treatment of pure sulphurous ores by the Swedish, German, and mixed methods in Europe and the United States; the treatment of rich pure ores; the treatment of impure ores in the Hartz mountains and in the United States; the treatment of very poor ores by lixiviation; the treatment of rich and pure ores by the English method in the reverberatory furnace in the United States and Europe, and the treatment of impure ores in the same furnace; method of making calculations for works treating a definite number of tons; mixed method treatment in Europe and in the United States; treatment of oxides of copper, wet methods; treatment of ores of lead, roasting and reaction in France, England, and the United States; method of roasting and reduction; method by precipitation in France, Germany, and the West; mixed method in France, Germany, and the West; refining of lead, extraction of silver by the Pattinson method and by zinc; cupellation; condensation of volatile products; treatment of silver ores in furnaces, in Germany and in the United States; separating of silver by amalgamation, Saxon method, Mexican method, pan amalgamation, treatment in the wet way; Augustin's methods, Ziervogel's methods, Von Patera's method; refining silver; treatment of gold ores, washing, sluicing, hydraulic mining, Plattner's process, parting gold and silver; treatment of tin, in shaft furnaces and in reverberatory furnaces; treatment of ores of zinc, Silesian method, Belgian method, English method, wet method; treatment of ores of mercury, method by precipitation, by roasting, in Europe and in California, by the wet way; treatment of ores of antimony; treatment of nickel and cobalt; treatment of ores of bismuth.

It is designed to make these lectures as practical as possible, and for this purpose the economic details of cost are given whenever they can be obtained from authentic sources. Special details are given of the ores of this country which are difficult to treat, to the solution of practical problems which may occur, and to changes which different economic relations are liable to cause in the treatment of the same ore in different localities. Nearly a thousand lecture diagrams and the same number of photographic illustrations for use in the lantern have been prepared to illustrate the furnaces, machines, and appliances used in the different metallurgical works, as well as to illustrate the construction of furnaces, etc. To the Fourth or graduating Class is given a course of twelve supplementary lectures on the metallurgy of Iron and Steel, embracing: (1) Steam engines, boilers and apparatus as adapted to iron manufacture; hydraulic mchinery; lifting and transporting apparatus. (2) Heating and melting furnaces; the gas furnace. (3) Direct processes; the crucible steel processes; refractory materials. (4) Puddling, especially mechanical puddling and refining by oxide of iron. (5) The Bessemer plant and manufacture. (6) Open-hearth plant and manufacture. (7) Casting apparatus; the manufacture of castings in steel and iron. (8 and 9) Rolling mill; roll turning. (10) Forging machinery and rolling mill finishing machinery. (11) General arrangement of iron and steel works. (12) Temper and treatment of steel. The collection illustrating the department of metallurgy includes models of furnaces and a very large collection of drawings and tracings, in most cases copies from the working drawings of establishments in actual operation. This collection embraces several hundred tracings collected from the best types of works in this country and abroad, many of them being sufficiently detailed to be used as construction drawings. The metallurgical collection, properly speaking, embraces about 3,000 specimens, illustrating every stage of all the prominent metallurgical processes. Many of these specimens have been analyzed and assayed. They are constantly open to the inspection of the students. As an application of the lectures the students are required to work out a project, and to present working drawings and estimates for the erection of works to treat a giveu ore under stated conditions. The problems given are those which require solution in some parts of the United States.

ENGINEERING.—Engineering, in its widest sense, involves applications of the sciences of physics, mechanics, and chemistry to a great variety of problems met with in works and enterprises of a public and private nature or of an industrial character, in which the employment of materials, the building of structures, the use of machinery, the utilization of natural resources, or the protection or improvement of the ways of commerce, are essential and important elements and conditions. The educated engineer, whatever may be the branch of the profession to which he devotes himself, should, therefore, have a thorough foundation of knowledge in certain subjects of common application; for example, free-hand and instrumental drawing; mathematics, physics, and mechanics, and the application of these sciences to the resistance of materials to machinery, to structures of iron and wood and masonry; the flow of streams in artificial channels required for water-works, drainage, and for sanitary purposes; the theory of heat, as applicable to air and steam in their various uses in ventilation, etc.

The courses in mining engineering and civil engineering are, therefore, identical in all that pertains to these subjects. It is essential, however, that in each of these branches of engineering the subjects technically appertaining to each should receive as great a share of the attention of the students, in the courses in mining and civil engineering respectively, as possible in the short period devoted to collegiate instruction. The mining engineer encounters in his practice questions which are rarely met with in civil engineering, for example, the results of experience in the searching for, winning, and exploitation of mineral deposits, special problems of ventilation, and drainage; while, on the other hand, he is seldom or never called upon to discuss questions which are common and important in the practice of civil engineering, such as the supply of water to towns and cities, and other sanitary works, on a large scale, the erection of extensive public buildings, the improvement of harbors and rivers, works of irrigation, the building of extended bridges, etc. The arrangement of the two courses in engineering has been made under the above view of the subject, utilizing, as it does, in the best manner, the time of the instructors, and avoiding a repetition of the same instruction to different classes. The collateral branches of study for the engineering courses, chemistry, metallurgy, geology, subjects quite as essential to mining and civil engineers as physics and mechanics, have also been assigned to these two courses, in accordance with the general requirements of the respective professions.

I. DRAWING, DESCRIPTIVE GEOMETRY, ETC. — The course in drawing embraces instrumental drawing, descriptive geometry, shades, shadows and perspective, stone cutting, isometric drawing, topographical and geological drawing, drawings of engineering constructions and machinery. The first year is devoted to the elements of instrumental drawing, the use of instruments, lettering, projections of objects, plans, sections, and elevations, intersection of solids and of surfaces, and the development of surfaces. During the vacation which follows, the execution of sketches from nature and from engineering and architectural constructions is required. During the second year, the first session is occupied in the study of descriptive geometry, in grading and tinting as well as in topographical drawing. The instruction in these subjects requires all the problems and illustrations to be carefully and neatly executed on the drawing board, and the principles of construction explained by the student in oral examinations. During the second session, the subjects of shades and shadows, perspective and isometrical drawing and stone cutting, are taken up in the same manner. Practice is also given in drawing the simple elements of architecture, such as the plans of private and public buildings, showing the details of walls, floors, windows, and door casings, etc. During the vacation which follows, definite architectural plans are required. The drawing of the third year includes elements of machine construction, the drawing of maps from field work executed by the students themselves, parts of engines, geological drawings, etc. During the vacation which follows, the necessary drawings for memoirs and theses are made. The drawing of the fourth year is limited to working drawings of machines and engineering constructions, drawings illustrating the principles of mechanism, and the execution of plane table maps with contour lines, etc. The whole course of drawing is progressive, and embraces nearly 100 sheets, each succeeding sheet being illustrative of a principle of construction or an advance towards more difficult methods or combinations; and it is designed to qualify students for the execution of all kinds of drawing and the most difficult constructions.

II. CIVIL ENGINEERING.—Instruction in civil engineering extends through the third and fourth years. During the third year, the more simple elements of civil engineering and surveying are taught. In civil engineering the various subjects are considered in the following order: First, Materials —building-stones, limes, cements, mortar, concrete, brick, wood, metals; their properties and general qualities, mode of preparation, and their respective uses, and combinations in constructions, their strength and durability. Second, Masonry—construction of masonry, retaining walls, arches, etc. Third, Framing—structures of wood, carpentry. Fourth, Stone and Wooden Bridges—descriptions of various kinds of wood and iron trusses in use, suspension bridges, etc., general principles of roof constructions. Fifth, Common Road Construction—general principle of railway construction; construction of canals, general principles of rivers, slack water navigation, etc. The instruction in surveying embraces a series of lectures on the principles of the subject and the use and description of instruments, and the following order of field work, viz.

1. At the beginning of the third year, the students are divided into small squads of 3 to 6 each, each squad being provided with an instrument. The field work begins with instruction in general methods of ascertaining distances and dimensions without instruments, by pacing and by employing the height of the body, the length of the arm, etc., for obtaining rough measurements when instruments are not available.

2. The use of the compass for topographical surveys and for ascertaining areas; the use of the hand-level for contouring or for determining differences of levels, use of sextant, measurements with chain and tape, in making compass surveys, a map of each survey being made by each student.

3. Use of solar compass for U. S. land and mineral surveys.

4. Use of transit; measurement of angles, closed survey by traversing; calculation of coördinates; city surveying.

5. Use of surveyor's level; running line of level, trigonometrical levelling, by measurements of vertical angles.

Spring work—four or five weeks.

1. Use of plane table for a topographical survey of a portion of Central Park.

2. Magnetic survey with solar compass and dipping needle, with determination of curves of equal deviation and intensity.

Instruction in Practical Astronomy and Geodesy during the third year embraces:

1. A course of general lectures on Astronomy, fully illustrated by lantern views.

2. Lectures on Geodesy; general outlines of Geodesy; description and illustration of the different kinds of triangulation, primary, secondary, and tertiary; description of the United States Coast Survey primary base apparatus; description of the United States Coast Survey secondary base apparatus; measurement of subsidiary base lines; reconnoissance surveys; stations and signals; observing tripods and scaffolds; station marks, underground and surface; observation of angles; instruments, direction and repeating; application of Legendre's Theorem to the solution of spheroidal triangles; records and computations; latitude, longtitude, azimuth, and time observations and computations.

3. Practical use, in the observatory, of the transit instrument for time and zenith telescope, for latitude, and, in the

field, use of the sextant and reflecting circle for time, latitude, and longitude approximations. During six weeks of the summer vacation, at the close of the third year, the students in Civil Engineering are required to make a geodetic survey of some region. In the summer of 1882 a survey was made of Otsego Lake, N. Y., at the request of the Director of the New York State Survey. The results of this survey are to be used by the State Board in constructing a map of that region.

During the fourth year a line of railroad is surveyed, locating the line on the ground, setting grade and slope stakes, levelling, and calculation of cuttings and embankments, drawings, and estimates. In addition, the course in railroad engineering embraces a series of practical lectures on permanent way, rolling stock, motive power, and administration of railroads, with instruction in the economics of location and transportation. The course in civil engineering in the fourth year embraces the principles of mechanics applied to engineering constructions and to machinery, the strength of materials, the theory of retaining walls and arches, and the methods of determining the dimensions of the parts of iron roof and bridge trusses, by means of the stresses to which they are subjected, the theory of such structures and the details of practical construction; the principles of hydraulics applied to the improvements of rivers, the water supply of towns, reservoirs, dams, etc., and the general principles of sanitary engineering, drainage, sewers, house drainage and ventilation. The students in the civil engineering course are also instructed in the principles of mechanisms beginning with the general theory of motion; the principles of transmission of motion, the various modes of mechanical connection, the calculation of relative velocities of moving pieces of machinery, valve gearing, and the mechanism, movements, and construction of machinery in practice; the dynamics of machinery or the determination of the relations between the forces which act upon machines, and the general application of mechanics to machines; the study of prime movers, including steam-engines, hot-air engines, and water-wheels; the theory and construction of steam boilers, and the general principles of heat, as applied to air and vapors. Instructions in Geodesy continued, by lectures and use of instruments—spirit levelling—trigonometric levelling—magnetic determinations—figure of the earth.

III. Mining Engineering.—The course in mining engineering is the same as that in civil engineering, in drawing and surveying, except that the students of mining will have additional instruction in underground surveying and geological reconnoissance. The courses in mining and civil engineering are also identical during the third year in all that relates to materials and general principles of engineering constructions, excepting that the course in mining engineering is intended to be more extended in the principles of mechanism and construction of machinery, and less extended in the detailed principles of roof and bridge construction, hydraulics as applied to river improvements, sanitary engineering, water supply of towns, etc. During the third and fourth years, the course in mining engineering embraces lectures on practical mining, or miners' work, including excavation of clays, peat, bog iron ore, and other easily worked materials; quarrying for extraction of large blocks of stone, marble, etc.; blasting, drilling tools, hand boring, use of explosives; well-boring, by hand for exploration, and machine-boring, sinking of shafts and slopes, timbering and driving of adits and levels, in the use of picks and gads in the mining of coal, salt, fire-clay, and other soft rocks, coal-cutting machines, mining of ores and hard rocks; handling of excavated mineral in working places; underground transportation, tramming by man or animal power, mechanical haulage with chains or wire rope, and by underground locomotives; accidents to men, their cause and prevention; organization and administration; mine book-keeping, accounts with men, time books, pay roll, analysis and dissection of mine accounts and making out of cost sheets. The instruction in mining engineering during the fourth year is the same as for the civil engineers in all that relates to the general dynamics of machinery, and to the application of the principles of mechanics to engineering constructions. It is more extended in the application of machinery to mining purposes, especially in connection with the use of compressed air, pumping and ventilating machinery, and hoisting machinery.

It embraces also the study of mineral deposits, classification and description of veins, beds, and masses, and their geological characteristics, interruptions and intersections, methods of prospecting, of reaching deposits, of prosecuting the underground workings; and methods of making and supporting excavations made for special purposes, junctions of levels, chambers for machines, and of making and supporting excavations in watery strata; proper provisions for pumping and ventilation; general principles to be observed in laying out, opening and working mines, and methods applicable to special deposits, such as narrow and wide veins or lodes, thick and thin seams of coal; hydraulic mining, etc.; also instructions in the proper administration of mining works, exterior transportation, mine regulations, etc. A course of lectures on ore dressing includes the general principles of ore dressing, preliminary hand dressing, and sorting and preliminary cleansing and sizing; crushing by hand and with machinery; cleansing in ditches and troughs, in sieves, trommels, and by special machines; sizing, bar gratings, and other stationary screens, riddles, revolving screens; concentration of coarse and fine material by jigs, buddles, tables, etc.; illustrations from American and foreign practices; mechanical preparation of coal and other minerals, and the concentration and purification of copper, lead, iron, and other ores. A course of lectures on the machinery of the plant for the manufacture of iron and steel includes the engineering of blast engines and hoists, and all the hydraulic machinery of the steel works, overhead-cranes, etc.

Architecture.—During the second year the time which is given in the other courses to laboratory work is in this course given to architectural drawing. This is so laid out as to include exercises in the ordinary processes of draughtsmanship, the making of plans, elevations, sections, and details, both on a large and on a small scale; using pencils and pens, brushes, and colors, with auxiliary exercises in tracing and sketching. The examples are so chosen as to make the student familiar with the common-places of architectural form, and are accompanied by lectures upon the Elements of Architecture, in which the forms and proportions of the Greek and Roman Orders, of doors and windows, arches, staircases and balustrades, domes and vaults, roofs and spires, are set forth, and the best ways of drawing them explained. At the same time a series of illustrated lectures is given upon Egyptian, Assyrian, Greek, and Roman Architectural History. During this year the students of architecture complete their elementary studies in Mathematics and Chemistry, French, and German, following at the same time the work in Descriptive Geometry, Stone Cutting, and Shades, Shadows, and Perspective, given in the Department of Engineering, and a portion of the work in Geology. In the third and fourth years the study of scientific construction is pursued in connection with the classes of Engineering, most of the time, however, being given to strictly professional work. This is for the most part pursued by the two classes in common, one class taking up in their fourth year what the next class takes in the third, and *vice versa*, the whole thus forming a single two years' course. These studies are arranged under four heads:

I. Under the head of History, the architecture of the Middle Ages is taken up in one year, and that of the Renaissance, and its more modern derivatives, in the next. On completing the study of ancient architecture, then, in the second year, one class goes on directly to that of the Middle Ages in the third year, and to that of the Renaissance in the fourth. The next class passes at once from ancient classical architecture to modern, finishing with the Mediæval styles.

II. Under the general head of Ornament, etc., is comprised the study of the decorative details of the different architectural styles, and of the contemporary forms in other branches of art, especially the decorative arts employed in building. The materials and processes employed in these arts, and the theory of æsthetics, in form and color, come under this head.

III. Under the head of Architecural Practice comes the study of specifications and working drawings, so far as they can be profitably studied in such a school, and of the materials and processes employed in building operations. The buildings erected in the neighborhood will here serve as examples, and a special architectural laboratory will afford opportunity for the study of oils and paints, cements, mortars, etc., and for testing their quality. Experiments upon the strength of materials will be made at the same time by classes in Civil Engineering.

IV. Under the head of Drawing and Design is comprised the practice of original composition in the working out of problems, in design, from given data, as well as further exercises in draughtsmanship, both free hand and with the pencil, pen, or brush, illustrating the study of the special topics enumerated above. The laboratory will be provided with facilities for modelling in clay or wax, and for working in plaster. The students of the fourth year will give a certain portion of time to exercises of a critical and literary character, designed to practice them both in reading and in writing. The buildings now in process of erection will afford ample accommodation for this work, and for the necessary collections of drawings, photographs, casts, and books.

Memoirs, Projects, and Dissertations—The following memoirs, projects, and dissertations required from students of the several classes of the year 1881–82, are given simply to illustrate the kind of work required by By-laws 22 and 24, pages 14 and 15. Students of the Second Class in all the courses were required to hand to the Instructor in Drawing, on or before October 3, 1881, six free-hand sketches as follows:

No. 1. Hoisting Machine. No. 2. Stone Doorway. No. 3. Bridge. No. 4. Staircase. No. 5. Steam Pump. No. 6. Railroad Car. These sketches must be drawn from the objects themselves, on sheets 15x22 inches, and location, date, and signature must be given on each.

Course in Mining Engineering—Students of the Third Class are required to hand to the Professor of Engineering, on or before October 3, 1881: For those not attending the Summer School of Mechanical Engineering, six drawings (15x22) as follows; No. 1. Orthographic View. Plan and Elevation of a Building, Dimensions, etc., assigned in class. No. 2. Details—Doors, Windows, Stairs, etc. No. 3. Tracing of No. 2. No. 4. Enlarged Plan and Elevation of principal entrance, with details. No. 5. Perspective view of Exterior. No. 6. Isometric view of exterior. For those attending the Summer School of Mechanical Engineering, descriptive and illustrated memoirs upon shop practice. Students of the Fourth Class were required to hand to the Professor of Engineering, on or before October 3, 1881: A Memoir upon some topic assigned to each member of the class in connection with the Summer School in Practical Mining; and on or before January 13, 1882, to hand in to the Professor of Metallurgy: A Metallurgical Project on a subject assigned by the Professor of Metallurgy.

Course in Civil Engineering.—Students of the Third Class were required to hand to the Professor of Engineering on or before Oct. 3d, 1881.

For those not attending the Summer School of Mechanical Engineering, six drawings, 15x22 inches, as follows:

No. 1. Orthographic View. Plan and Elevation of a Building. Dimensions, etc., assigned in class.

No. 2. Details—Doors, Windows, Stairs, etc.

No. 3. Tracing of No. 2.

No. 4. Enlarged Plan and Elevation of principal entrance, with details.

No. 5. Perspective View of Exterior.

No. 6. Isometric View of Exterior.

For those attending the Summer School of Mechanical Engineering, descriptive and illustrative memoirs upon shop practice.

Students of the Fourth Class were required to hand the Professor of Engineering, on or before October 3, 1881, descriptive memoir upon engineering topics assigned to the member individually, embracing: Reclamation of Tide Lands at Green River Harbor, Mass.; Methods of Laying Out and Constructing Roadways on Pennsylvania Railroad; Improvements of Charleston Harbor, S. C., and Cape Fear River, N. C.; Construction of New Railroad Bridge across the Harlem River at 155th Street.

Course in Metallurgy.—Students of the Third Class were required to hand to the Professor of Metallurgy, on or before October 3, 1881.

A Memoir on one of the following subjects:

(1) The occurrence, preparation and properties of Ozone. (2) The comparative certainty and delicacy of the different qualitative tests for Arsenic. (3) The occurrence and detection of Titanium. (4) Qualitative detection and separation of Nickel and Cobalt.

Students of the Fourth Class were required to hand to the Professor of Metallurgy, on or before October 3, 1881:

A Memoir on one of the following subjects:

(1.) Regenerative Furnaces. (2.) Blair's Direct Process. (3) The Siemens-Martin Process.

And on or before January 13, 1882:

A Metallurgical Project on a subject assigned by the Professor of Metallurgy.

Course in Geology and Palæontology.—Students of the Third Class were required to hand to the Professor of Geology, on or before October 3, 1881:

A Memoir on one of the following subjects:

(1.) Notes on the Fauna or Flora of any geographical district visited. (2.) Observations on the structure, distribution, and habits of any of our Fresh-water Fishes. (3.) Catalogues and collections of Mollusks inhabiting any lakes, rivers, or districts. (4.) Notes on the economy of observed insects. (5.) Notes on the various observed methods by which the Seeds of Plants are distributed.

Students of the Fourth Class were required to hand to the Professor of Geology, on or before October 3, 1881:

A Memoir on one of the following subjects:

(1.) Report on the Geology of any district visited. Embracing: *a.* Topographical features and their causes. *b.* Surface geology. *c.* Sections of strata, with lithological character, thickness, dip, strike, and fossils of each bed. Sketches of rock outcrops. *d.* Suites of specimens of rocks and fossils, rocks 3—4—1 inches.

(2.) Report on any special formation which may be examined. Embracing: *a.* The geographical area of its outcrops. *b.* Its mineral character, and origin of the material composing it. *c.* Sets and collections of its fossils. *d.* Reading of the history of its deposition.

(3.) Report on any examined deposits of ore or other useful minerals: as, *a.* The Magnetic Iron Ores of New York and New Jersey, phenomena and history. *b.* The Limonite Ores of the Alleghany Belt, character of deposits and age. *c.* The Zinc Ores of Franklin and Friedensville. *d.* The Chromic Iron of the Alleghany Belt, where and how it occurs.

And on or before the 15th of April, 1882; A Dissertation on one of the following subjects:

(1.) The Mesozoic Sandstones of New Jersey and the Connecticut Valley; their geological phenomena, history, and relations to the associated trap rocks.

(2.) The Limonite Ores of the Alleghany belt; their phenomena, age, and origin, *i. e.;* Where and how they occur, when and how they are deposited.

(3.) Eozoon Canadense; is it organic?

Course in Analytical and Applied Chemistry.—Students of the Third Class were required to hand to the Professor of Chemistry, on or before November 3, 1881:

A Memoir on one of the following subjects:

(1.) Water Gas. (2.) Petroleum. (3.) Photo-Mechanical Processes. (4.) Gun Cotton.

The Memoir must include a general account of the group; constitution, formation, physical and chemical properties, and decompositions; together with a complete classified list of all the members of the group, with the names of the discoverers, date of discoveries, and references to original publications.

The students of the Fourth Class were required to hand in to the Professor of Chemistry, on or before November 3, 1881; A Memoir on one of the following subjects:

(1.) Artificial Stone. (2.) Artificial Indigo. (3.) Quinine and its allies. (4.) Resins and Varnishes.

The Memoir must contain full references to authorities throughout the text, a table of contents, and an index.

And on or before April 14, 1882.

A Chemical Dissertation on a subject which they may select, subject to the approval of the Professor of Chemistry. All memoirs and Dissertations must be written on paper 8x10 inches, with a margin of one inch, and be illustrated by drawings made to scale, on paper 24x36 inches in size, and accompanied, when possible, by specimens.

Vacation Work.—During the vacations at the close of the first, second, and third years, students are required to prepare memoirs on subjects assigned to them by the Faculty. Specimens illustrative of the kind of work required in the memoirs have just been given. During the vaction, a class in practical mining, composed of students in the course in Mining Engineering who have completed the third year, is required to visit a mine for practical mine work. The class is under the immediate superintendence of the Adjunct Professor in Surveying and Practical Mining, and is occupied in this way from four to six weeks. During the vacation, also, a volunteer class in practical mechanical engineering is formed from among the students of either of the Engineering courses who have completed their second year, for the purpose of visiting foundries and machine shops in the city, and engaging in practical work and study. This class is under the immediate supervision of the Adjunct Professor of Mechanical Engineering, and is occupied in this way four or five weeks of the months of June and July. During the vacation a class in practical geodesy, composed of students in the course of Civil Engineering who have completed the third year, is required to make a geodetic survey of some region. This includes measuring a base line with a United States Coast Survey secondary base apparatus—secondary and tertiary triangulation with eight inch theodolite—trigonometric levelling with eight inch theodolite, with vertical circle. Determinations of time, latitude, and azimuth, using portable transit, zenith telescope, and theodolite. Approximate determinations of time, latitude, and longitude, with sextant and reflecting circle. The class is under the immediate supervision of the Director of the Observatory and Instructor in Geodesy.

Text Books.—The text books required by the first and second classes are named in connection with the subjects in the synopsis of studies. Books preceded by an asterisk (*) are optional—the others are indispensable.

Third Class.—Peck's Mechanics (new edition). Murray's Land Surveying. Newcomb's and Holden's Astronomy. *Publications of the U. S. Coast and Geodetic Survey, relating to the fundamental geodetic operations. *Rankine's Machinery and Mill Work. Mahan's or Wheeler's Civil Engineering. Gillmore's Roads and Pavements. Stoney's Theory of Strains. Searle's Henck's Field-book for Engineers. *Davis's Formulæ for Railroad Earthwork. Ritter's Iron Bridges and Roofs. *Callon's Lectures on Mining. Johnson's Fresenius's Quantitative Analysis. Dana's Manual of Geology. Nicholson's Palæontology. Wagner's Chemical Technology. *Kerl's Metallurgy. Plattner's Blowpipe Analysis. Egleston's Lectures on Mineralogy. Egleston's Tables for Determining Minerals. Egleston's Metallurgical Tables. Egleston's Tables of Weights, Measures, Coins, etc. Von Cotta and Lawrence's Rocks. Cairn's Quantitative Analysis.

Fourth Class.—Burat's Géologie Appliqué. *D'Orbigny's Palæontologie Elémentaire. Rickett's Manual of Practical Assaying. *Whitney's Metallic Wealth of the United States. *Kerl's Probirkunst. Egleston's Metallurgical Tables. *Cotta's Treatise on Ore Deposits, by Prime. Page's Economic Geology. Weisbach's Mechanics of Engineering. Callon's Lectures on Mining. *Burat's Exploitation des Mines. *Rigg on the Steam Engine. Goodeve on the Steam Engine. *Welsh's Designing Valve Gearing. Rankine's Prime Movers. Rankine's Civil Engineering. Rankine's Machinery and Mill Work. *Lottner's Bergbaukunst. Stevenson on Harbors. Stevenson on Canals and Rivers. *Vose's Railroad Engineering. *Clarke's Geodesy. *Publications of the U. S. Coast and Geodetic Survey, relating to the fundamental geodetic operations. *Gaetschsman's Aufbereitung. Fanning's Water Supply Engineering. Diedrich's Theory of Strains. Latham's Sanitary Engineering. *Röntgen's Thermodynamics, Du Bois's Translation. *Planât on Warming and Ventilation. *Joly, Warming and Ventilation. *Colyer's Hydraulic Lifting and Press Machinery. *Rittinger's Die Aufbereitungkunde. Allen's Introduction to the Practice of Commercial Organic Analysis. Berthelot's Leçons sur les Methodes Générales de Synthése en Chimie Organique. Berthelot and Jungfleisch's Traité Elémentaire de Chimie Organique. Roscoe and Schorlemmer's Treatise on Chemistry (Organic Chemistry). Strecker's Short Text Book of Organic Chemistry by Wislicenus.

Library.—The Library of the School of Mines, established when the school was founded, was especially designed to assist the students in the course of studies pursued in the various departments. Having at the time no fund for the purpose, a portion of the college library appropriation was devoted to the purchase of a few books which partially supplied the existing needs. To these were subsequently added about a thousand volumes removed from the library of the School of Arts to another department, and a further increase was soon after made by the addition of books obtained in exchange for duplicate reports of Natural History, Surveys of States and Territories, presented by various authorities. Since then frequent donations, and a gradually increasing annual appropriation, have raised the number of volumes to about eighty-five hundred. The number of volumes upon its shelves, however, affords by no means a just measure of the value of the library, which consists rather in the judicious selection of standard and recent works in the various departments of science which, it embraces, and in their adaptation to the specific wants of the school. The catalogue contains the titles of about three thousand monographs, rather more than one-half of which are in the English language, and the remainder in German and French. But the most important feature of the library, and that which places it in advance of others much larger, is its valuable collection of periodical publications, which now make up about half the number of volumes collected. The present subscription list comprises a hundred and fifty serials devoted to science and the arts, published at the various literary and scientific centres of the world. The early numbers of some of the most important of these have been procured, and form complete series not to be found elsewhere in New York, or, indeed, in the country. Valuable maps and volumes of plates have also been added to the library by purchase and by generous donations to which the School of Mines is frequently indebted for important acquisitions. The appropriations made by the Trustees for the increase of the library have gradually increased from sums of less than five hundred dollars to two thousand dollars per annum. The books are arranged upon the shelves in alphabetical order, and in sections bearing labels which indicate the subject to which each is devoted. A catalogue was published in 1875, giving first, the systematic works and periodical publications, arranged alphabetically, without reference to subjects; and secondly, the same titles repeated and classified according to a logical method. This is supplemented by catalogues printed each session, containing the list of books recently added.

Cabinets and Collections.—Collections of specimens and models, illustrating all the subjects taught in the school, are accessible to the students, including:

Crystal Models.
Natural Crystals, Pseudomorphs.
Ores and Metallurgical Products.
Models of Furnaces.
Collection Illustrating Applied Chemistry.
Fossils.
Economic Minerals.
Rocks.
Olivier's Models of Descriptive Geometry.
Models of Mechanical Movements.
Models of Mining Tools.
Models of Mining Machines.
Casts, Antique Statuary, Animals, etc.

Crystal Models.—The lectures on crystallography are illustrated by a collection of 150 models in glass, which show the axes of the crystals and the relation of the derived to the primitive form. This suit is completed by 400 models in wood, showing most of the actual and theoretical forms.

Minerals.—The cabinet of minerals comprises about 30,000 specimens, arranged in cases. It includes a large suit of pseudomorphs, and a collection illustrating crystallography by natural crystals, showing both their normal and distorted forms. The minerals are accompanied by a large collection of models in wood, showing the crystalline form of each. Arranged in wall cases are large specimens, showing the association of the minerals.

Ores and Metallurgical Products.—A very complete collection of metallurgical products, illustrating the different stages of the type process in use in the extraction of each metal in this country and in Europe, is accessible to the students. This collection is constantly increasing. Most of the specimens have been analyzed and assayed.

Models of Furnaces.—An extensive collection of models of furnaces has been imported. A very large number of working drawings of furnaces and machines used in the different processes is always accessible to the students.

Applied Chemistry is illustrated by several thousand specimens of materials and products, arranged in a cabinet of industrial chemistry, for exhibition at the lectures and for inspection by the students.

The Geological Collection consists of over 80,000 specimens (to which additions are constantly made), forming the following groups:

1st. A systematic series of the rocks and fossils characteristic of each geological epoch, numbering over 50,000 specimens.

2d. A collection of ores, coals, oils, clays, building materials, and other useful minerals, illustrative of the course of lectures on economic geology, and believed to give the fullest representation of our mineral resources of any collection yet made.

3d. A collection of 5,000 specimens of rocks, and the minerals which form rocks, to illustrate the lectures on lithology.

4th. A Palæontological series, which includes collections of recent and fossil vertebrates, articulates, mollusks, radiates, and plants. In this series is to be found the largest collection of fossil plants in the country, including many remarkably large and fine specimens, and over 200 species, of which representatives are not known to exist elsewhere. Also the most extensive series of fossil fishes in America, including, among many new and remarkable forms, the only specimens known of the gigantic *Dinichthys;* a suit of Ward's casts of extinct saurians and mammals: a fine skeleton of the great Irish elk, etc., etc.

DRAWING MODELS. There are, for the use of students, a large collection of flat models and of plaster casts; the Olivier models, forming all mathematical surfaces by silk threads, and admitting of a variety of transformations; also other models, illustrating general and special problems, of descriptive geometry, shades and shadows, and stone cutting; photographs of plaster casts and of parts of machines for use in free hand drawings; drawings of machines and parts of machines for studying and copying; also landscapes in crayon and in water color for instruction in sketching; models of mining machines and mining tools, stationary steam engines, single and double cylinders, sections of steam cylinders, water wheels, turbines; shaking tables, stamps, crushers, blowing machines, pumps, etc.

CIVIL ENGINEERING is illustrated by a collection of models of beams, beam joints, roof and bridge trusses, masonry doorways, arches, walls, culverts, bridges, and canal locks; working models of overshot, breasts, undershot, and different kinds of turbine water wheels, a machine, made by Fairbanks & Co., for testing the strength of materials; a five inch condensing steam engine, with a stroke of six inches; horizontal, vertical, and sectional steam engines and valves, etc. There has recently been added to the department of Engineering for the use of students in Geodesy two four-metre compound bars with Borda's scales, etc., for measuring base lines; one standard four-metre bar; one eight-inch theodolite with horizontal and vertical circles for measuring horizontal angles and double zenith distances.

MINING ENGINEERING is illustrated by models of blowing engines, ventilators, mine shafts, tunnels, galleries, methods of walling, methods of tubbing shafts, methods of measuring shafts, shaft house, hoisting engine, safety cages, man-engines, ladders, shaking tables, washers, stamps, crushers, mining machines, lamps and tools, artesian wellborer, blasting apparatus, etc. Additions to the various collections are constantly made.

ASTRONOMICAL OBSERVATORY.—The Astronomical Observatory contains a set of portable astronomical instruments; a forty-six inch transit, by Troughton & Simms; a combined transit and zenith instrument for time and latitude determinations, an equatorially mounted refractor of five inches aperture, to which is attached a spectroscope with the dispersive power of twelve flint glass prisms of fifty-five degrees, by Alvan Clarke; also a diffraction spectroscope with grating, by L. M. Rutherfurd, Esq. A set of comparison apparatus, with electrodes, Plucker's tubes, coil, etc., accompanies the spectroscope. Instruction in practical astronomy is given in the observatory to students of the Third and Fourth Classes in the course of Civil Engineering.

DEGREES.—Those who complete the required course of studies will receive the degree of Engineer of Mines, Civil Engineer, or Bachelor of Philosophy. Graduates of the school who pursue for not less than one year a course of study prescribed by the Faculty, pass a satisfactory examination thereon, and present an acceptable dissertation embodying the results of special study upon an approved subject, receive the degree of Doctor of Philosophy.

CALENDAR.—Examination for Admission begins, Wednesday, Sept. 27th, 1882.

Oct.	2.—First Session begins, Monday.	
Nov.	14.—Election Day, Holiday.	
	Thanksgiving Day, Holiday.	
Dec.	25.—Christmas Holidays begin, Monday.	
1883—Jan.	8.—Lectures resumed, Monday.	
	29.—Examinations begin, Monday.	
Feb.	7.—Ash Wednesday, Holiday.	
	7.—First Session ends, Wednesday.	
	8.—Second Session begins, Thursday.	
	22.—Washington's Birthday, Holiday.	
March	23.—Good Friday, Holiday.	
	26.—Easter Monday, Holiday.	
May	21.—Annual Examinations begin, Monday.	
	30.—Decoration Day, Holiday.	
June	13.—Commencement, Wednesday	

A SUMMER SCHOOL OF PRACTICAL MINING.

WE get a further insight into the excellent work of Columbia College, in this direction from a paper by Professor Henry S. Munroe of the School of Mines, read before the American Institute of Mining Engineers, which paper Professor Munroe has corrected to date for this work. It is appended:

The plan of organizing a summer class of students of the School of Mines, for practical study of mining and miner's work, received at the outset the following cordial indorsement:

"I have thought over the plan proposed by you of taking the students to the mines during the summer, and of having them actually take part, under the direction of skilled workmen, in all the various kinds of mining work; and of using them as a corps of engineers to make inside and outside surveys, particularly with a view to the detailed study of the geology of the mine. I have no hesitation in saying, that if the students have been previously instructed in the theoretical part of their studies, by lectures and practice during the winter, the plan would be an admirable one. Of course experience will suggest modifications of detail. From the work you have done at our mines this spring, I feel sure that you would be perfectly competent to carry out your plan, and I shall gladly aid you in any way I can.

"Yours, sincerely, E. B. COXE."

The plan of the proposed summer school thus indorsed by Mr. Coxe was adopted by the trustees of Columbia College, and an appropriation of one thousand dollars, or so much thereof as might be necessary, was voted for the experiment. A volunteer class of thirteen students was formed, and the first summer school was held at Drifton, in July and August of that year (1877). The following extract, from an editorial notice in the *Engineering and Mining Journal*, of August 11, 1877, will give an idea of the organization of the school and the work required of the students.

"The students, on reporting to Professor Munroe, were divided into squads of two or three men each, and on Monday, July 2d, were assigned to the care of skilled miners, selected for the purpose by the mine boss, for instruction in gangway work. Half of the students worked in the morning, and the other half in the afternoon, one squad at a time with each miner. The times of going and coming to and from work were so arranged that each student spent four to four and a half hours in the mine each day. While in the mine, they assisted the miner to load his car, thereby learning readily to distinguish 'slate' and 'bony' from good coal, even in the uncertain light afforded by their mine lamps. They were also instructed in the use of the drill and pick, boring themselves the blast-holes, judging the quantity of powder required, making up the cartridge, tamping and firing the shot. On coming out of the mine, each squad was required to make a written report of the work done, with sketches showing the location, direction, depth, etc., of each shot fired, and the effect produced. Four days were thus spent in the gangways learning the rudiments of miners' work, and then the students were transferred to the charge of other miners, selected by the mine-boss, working in breasts of different degrees of pitch, spending one or two days with each. From this time on less importance was attached to manual labor on the part of the students as a necessary part of the scheme of instruction, though most of the students of their own choice still continued to work more or less. The principal advantage gained by this manual work was the breaking of the ice between the student and the miner, placing them in pleasant relations and on common ground, the student for the time becoming, to all intents and purposes, the miner's 'butty,' and to be treated and instructed as such.

"Another advantage gained was the knowledge of the different conditions having influence on the ease or difficulty of working, and thus some idea of the value of that most variable quantity—a day's work. In addition to their work in gangways and breasts, the students also spent some days with other skilled miners in setting props and timbering gangways, building brattice and driving airways, laying tracks and putting in switches on mine roads, in getting coal by robbing, in artesian-well boring for water, boring by hand for exploration, etc.

"After the students had spent in this way about twenty days at different kinds of work underground and in the 'breaker,' subjects for more detailed study and investigation were assigned them. Each student having chosen his theme, spent the remainder of his time in collecting material for a memoir. 'Underground Haulage,' 'Ventilation,' 'Mine Pumps,' 'Hoisting Engines,' 'Winning of Coal in Breasts of Different Degrees of Pitch,' 'Artesian-Well Boring,' 'Breaking and Sizing of Anthracite,' 'Separation of Slate from Anthracite,' 'Water-supply for Boilers and for Household Use, and Washing of Coal,' etc., were among the subjects thus assigned. During the last few days trips were made to several mines in the vicinity, at Hazleton, Ebervale, etc., spending a day underground in each case with the mine-bosses, who explained in detail the characteristics of their mines and their methods of working. Mr. Coxe, also, during their stay, gave the students several informal talks of great practical value on the mining of anthracite, installation of machinery, management of men, necessity for scientific bookkeeping, discussion and analysis of mine accounts, etc.

"The miners and the mine-bosses of the Cross Creek collieries have taken great interest in the experiment, and to their cordial and hearty co-operation in the carrying out of all the details of the plan is due in no small degree the very gratifying success attained. It is, however, to the interest taken by Mr. Eckley B. Coxe in this new departure in mining education that its success is in a large measure due, for he not only encouraged the idea when proposed, but placed his collieries—probably the finest in this country—at the service of the school, and gave such instructions as secured for the student a favorable introduction to the miners. 'One of the most notable and prominent features of this effort to introduce the practical element into the studies of the School of Mines has been the demonstration that the students are not 'a nuisance' about the works, but, on the contrary, are welcomed by the miners, and are found to make no trouble or interference with the work of the colliery."

The experiment having proved successful, the trustees of the college voted to make the summer class a part of the regular course of study for the degree of Mining Engineer. The next summer (1878) the school was held at Mineville, N. Y., at the large magnetite mines of Witherbees, Sherman and Co., and of the Port Henry Iron Ore Company. The session of 1879 was held in the copper regions of Lake Superior, with headquarters at the Atlantic Mine, near Houghton. In 1880 the field of operations was enlarged, and the time devoted to practical work was divided between the Dickerson Mine (magnetite) of the Musconetcong Iron Company, near Dover, N. J., and the mines of the Westmoreland Coal Company, near Pittsburgh. Last Summer (1881) the time was divided between the copper mines of Keweenaw County and the iron mines of Marquette County, Michigan. The present summer (1882) the class spent four weeks at the Cross Creek Collieries of Messrs. Coxe Brothers & Co., and one week at the Hibernian Iron Mines, Morris Co., New Jersey. The plan of Work, as it has developed itself in these five sessions of the school, begins with a detailed study on the part of each student of the plant and methods of working at the mine selected for the summer school. The students for this purpose are divided into squads of two or three men, and each squad is assigned to the care of a skilled miner and given each day some one subject for observation and study. To aid the student in systematizing his work, and to suggest lines of investigation, he is provided with a printed scheme of study, which he is expected to follow in making out his daily reports. The following scheme of study was used (1880) at the Dickerson Iron Mine.

Dickerson Mine, Ferromont, Morris County, N. J.,

June 14th, 1880.

Each student of the summer school will be required to make the following reports:

1. *Hand-drilling and Blasting.*

Description from actual observation, of the method of blasting in driving a cross-cut or drift. The report will include:

1. A description of the tools employed, illustrated by careful sketches, half size, showing form and dimensions of each tool.

2. The time of boring, number and size of drills used, and the position, direction, and depth of each hole. To be illustrated by drawings of the heading of the drift or cross-cut, on a scale of one-twentieth, showing in three projections the position and direction of each hole bored. Holes bored during the night shift, or in the absence of the student, should be drawn in dotted lines, and the order in which the holes were bored should be indicated by numbering them.

3. The kind and amount of powder and of tamping used in each hole, and method of charging, tamping, and firing.

4. The reasons for the location and direction of each hole, and the work intended and actually performed by the blast. The failure of any blast to do the work expected, and holes which for any reason have to be abandoned, should be carefully noted, with the reason for such failure or abandonment, if possible.

5. The number of men employed at the work and duties of each; number and length of shifts; amount driven during previous months, and average progress of drifts; number of drills, hammers, shovels, and other tools required, average number of drills sharpened per day, wear of steel, consumption of powder, oil or candles, etc.

2. *Stoping of Ore.*

Description, from actual observation, of the methods of stoping, including the preparatory sinking or drifting, and the breaking of the ore by machine or hand-drilling and blasting; illustrated by sketches of the stope in horizontal projection, with longitudinal and cross-sections.

Sketches on a scale of one-twentieth, showing the location, direction, and depth of several consecutive blast-holes, with description in detail of the boring, charging, tamping, firing of each hole.

3. *Machine Drills.*

Description of machine drills, size, weight, pressure of air, and size and shape of drilling-bits, etc.

Description of the work of boring one or more blast-holes, including setting of machine, starting of hole, feeding of drill, changing of bits, etc. Give time of each operation, noting delays and their cause. Number of holes and total depth bored per shift. Number of drills blunted per day. Wear of steel.

4. *Timbering.*

Description and sketches of the different forms of timbering used in the mine, stulls and lagging, studdles, etc.

Sketches of details of skip-roads, showing different methods of supporting track-timbers and ladders on stulls, etc.

Sketches of timbering of slope and of shafts. Supports of ladders and pump-rods, details of landing-stage and sollars.

Arrangements for protecting men, machinery, etc., from blasts and falling rock—batteries, pentice, etc.

Description and measurement, illustrated by careful sketches and from actual observation, of the work of putting in one or more stulls; including cutting of hitches in rock, measuring and cutting timber, lowering of timber from surface and handling it in the mine, arrangement of tackle and hoisting of timber to place, and wedging.

Kinds of timber used, whence obtained; seasoned *vs.* green timber; stripping of bark; renewal of timber, etc.

5. *Pumps.*

Details of pumping engines and of pumps, stroke, diameter, speed, valve motion, etc. Sketches of pumps, pump-rods, bobs, and methods of changing direction of rods. Manner of connecting and supporting rods. Use of plunger, and of lift or jack-head pumps. Repair and packing of pumps. Pumps, location and size. Gallons of water pumped per day. Use of steam pumps in the mine, support and covering of steam-pipes, disposal of exhaust steam.

6. *Handling of Ore.*

Description of the method of handling ore in the stopes, including the getting down of ore after a blast with pick or bar, the breaking up of large masses by block-holing or sledging, sorting of ore from rock, loading of cars or barrows, dumping into skips, etc. Sketches of tram-car, loading platform and chute, details of track, turnouts, and switches, etc.

Description of hoisting engines, dimensions, speed, steam pressure, valve motion, gearing, etc. Construction of hoisting drum, diameter, length; number of revolutions per minute, and to hoist from bottom. Description of brake. Size and character of wire rope. Tell-tales and signals. Number of skips of ore hoisted and of timber lowered per day. Speed of buckets, skips, or cars. Sketches of skip, and self-dumping devices. Sketches of sheaves, and of guide rollers for wire rope, on surface and in the mine.

Handling of ore on the surface, loading of cars, breaking, cobbing, and hand-picking. Transportation to market.

Handling and disposal of waste rock underground, and on the surface.

Sketches of whims, poppet-heads, and other surface constructions.

7. *Surface Works.*

Sketch map showing relative position of surface works, shafts, tunnels, engine and boiler-houses, shops, change-house and other buildings; railroad tracks, switches, turnouts, etc., tramways; lines of steam, water, and air-pipes, and of surface drainage. Description of above buildings, roads, etc., and notes on source of water-supply for boilers and for household use. General description of miners' houses, number, internal arrangements, etc. Plans of change-house, shops, and other buildings.

8. *Shops.*

Sketches showing arrangement of blacksmith-shop, machine-shop, carpenter-shop, etc. Description of the method of sharpening and tempering drills, picks, etc. Sharpening and repairs of bits of machine drills. Work of machine-shop, repairs to pumps, rock drills, and other machinery. Carpenter-shop, making of ladders, tram-cars, and miscellaneous repairs. Number of men required, etc.

The following scheme of study was prepared for the use of the students at the mines of the Westmoreland Coal Company after the completion of their work at the Dickerson Mines:

Westmoreland Coal Mines, Irwin's Station,
Westmoreland Co., Pa., July 12th, 1880.

Each student of the summer school will be required to make the following reports:

1. *Shaft Sinking.*

Description, from actual observation, of the method of blasting in sinking a shaft. The report will include:

1. A description of the tools employed, illustrated by careful sketches, half size, showing form and dimensions of each tool.

2. The time of boring, number and size of drills used, and the position, direction, and depth of each hole. To be illustrated by drawings of the bottom of the shaft, on a scale of one-twentieth, showing in three projections the position and direction of each hole bored. Holes bored during the night shift, or in the absence of the student, should be drawn in dotted lines, and the order in which the holes were bored should be indicated by numbering them.

3. The kind and amount of powder and of tamping used in each hole, and method of charging, tamping, and firing.

4. The reasons for the location and direction of each hole, and the work intended and actually performed by the blast. The failure of any blast to do the work expected, and holes which for any reason have to be abandoned, should be carefully noted, with reason for such failure or abandonment, if possible.

5. The number of men employed at the work and duties of each; number and length of shifts; amount sunk during previous months; and average progress of the sinking; number of drills, hammers, shovels, and other tools required, average number of drills sharpened per day, wear of steel, consumption of powder, oil or candles, etc.

2. *Drifting.*

Description of the method of driving entries, "bearing in" or undercutting, "shearing," and wedging. Main entries and cross entries; entries on the "face" and on the "end" or "butt" of the coal; advantages of double entries. Cross-cuts or "cut-throughs." Section, to scale, of the coal seam, showing the "bearing in" seam and the different slate partings. Inventory and sketches of tools used in driving. Description of work, number of men required, length and number of shifts, progress of work per shift and per month. Time required for each operation, undercutting, shearing, breaking down, loading, taking up bottom coal, laying track, etc.

3. *Mining of Coal.*

Description of method of getting coal in the rooms. Sketch, to scale, showing plan of room, with track, posts and slate heap, stump, ribs, etc. Breaking down of coal by wedges or powder, after undercutting and shearing. Precautions necessary for safety. Manner of conducting the work so as to make a minimum of fine coal or dirt. Separation and disposal of slate and fine coal. Number of cars loaded per day, etc.

Getting of coal by robbing. Sketches showing method of attacking ribs, with subsequent robbing of stumps and pillars. Description of the work and precautions used for the safety of the men and to avoid loss of coal. Number of men, length of shifts, and amount of coal obtained and lost.

4. *Ventilation.*

Sketch map showing the course of the air through a section of the mine, location of doors, stoppages, brattice, crossings, etc. Sketches showing construction of fans employed, and the passages by which they are connected with the air-ways of the mine. Arrangement for reversing the ventilating current. Description and sketch of ventilating furnace. Details of doors, stoppings, brattice, air-boxes, etc. Methods of measuring air and regulating and dividing air-currents. Résumé of ventilation law, with object of different requirements.

5. *Drainage.*

Description of the different methods of draining the mines. Ditches in entries; grade required, etc. Special water-courses. Drainage of "swamps" by siphons, pumps, or water cars. Pumping of acid waters and method of protecting water-column and the working parts of the pumps from the action of the acid.

6. *Timbering.*

Timbering in shafts, entries, and rooms. Sketches showing arrangement of timbers, manner of notching and wedging, etc.

7. *Underground Haulage and Shipment of Coal.*

Description and sketches of cars, size, weight, capacity, etc. Description of different kinds of track used, width of gauge, size and weight of strap iron or rails, etc. Switches and crossings. Maximum and minimum grade of track in main and cross entries. Hauling by mules and locomotives, number of cars hauled at once on different grades and on different tracks. Organization of trips.

Description of hoisting engines, dimensions, speed, steam pressure, valve motion, gearing, etc. Construction of hoisting drum, diameter, length, number of revolutions, and time required to hoist from bottom. Speed of cage. Description of brake. Size and character of wire ropes. Tell-tales and signals. Number of cars hoisted per day. Sketch of cage, showing safety catches, hood, means of holding car on platform, etc.

Description and sketches of arrangements for screening and weighing the coal and for the loading of railroad cars. Transportation to market.

8. *Surface Works and Shops.*

Sketch map showing relative position of surface works, entries, shafts, engine and boiler houses, shops, change-house and other buildings; railroad tracks, switches, turnouts, etc., tramways; lines of steam, water, and air pipes, and of surface drainage. Description of above buildings, roads, etc., and notes on source of water-supply for boilers and for household use. General description of miners' houses, number, internal arrangements, etc. Plans of change-house, shops, and other buildings.

Sketches showing arrangement of blacksmith-shop, machine-shop, carpenter-shop, etc. Description of the method of sharpening and tempering drills, picks, etc. Work of machine-shop, repairs to pumps, and other machinery. Carpenter-shop, making of tram-cars and miscellaneous repairs. Number of men required, etc.

About four weeks was required for the detailed study indicated in these schemes. By this time the student is familiar with the ordinary routine of mine work, having spent from two to four days each with the miners engaged in sinking, drifting, stoping, and timbering, making sketches and taking notes under ground, and each afternoon or evening reviewing carefully the work of the day as he makes out the required report. In a similar manner he has examined and studied the plant connected with the mine, pumps, engines, etc., the timbering in the shafts, slopes, and gangways, the shops and other surface work, and has followed the coal or iron ore from the time it is broken down by the miner, till it is finally loaded on the railroad cars. This careful and detailed examination of one mine finished, the student is prepared with the information and insight thus gained to visit other mines in the same district, for the purpose of studying variations in practice, and differences in plant and methods of working, by comparing similar work as carried on in other mines and under different conditions. A week or ten days is, therefore, devoted to excursions to neighboring mines. Finally, each member of the class has assigned him a subject for a memoir, either the description of the plant and workings of some mine, or the machinery and methods of a stamp-mill or dressing works, or some general subject connected with mining. In most cases he is instructed to describe in greater detail some one or more machines or methods peculiar to the place. In collecting the data for this descriptive memoir the student spends about two weeks at one mine, or in visiting different mines, as the subject assigned him may require; the class being divided into small parties, not more than two or three men at a mine. The memoirs are illustrated by sketches, tracings, and working drawings, and have in most cases been compiled with great care. They are often exceedingly interesting and valuable, containing much material descriptive of plant and methods of working at the mines visited. Under this plan of work it will be seen that the student makes a careful and detailed study of at least two mines, at first with the class and under the instruction and superintendence of the professor, and afterwards at another mine by himself, in collecting the data for his memoir. The excursions and visits to other mines supplement this detailed study, and give the student a wider view of the practice of the whole region.

THE STEVENS INSTITUTE OF TECHNOLOGY, HOBOKEN, N. J.

THIS institution was founded in accordance with the will of Mr. Edward A. Stevens, of Hoboken, who bequeathed for the purpose a large block of land in that city, and a large sum amounting, at the discretion of the trustees, to $650,000. The Stevens Institute is especially a school of mechanical engineering; but the fact that chemistry, metallurgy, and mineralogy, as well as the whole science of machinery, so important to mining engineers of the present day, are taught here, and the magnificent completeness of the buildings and apparatus of instruction, justifies us in including it in the present chapter. The building is situated in the pleasantest portion of the city, its windows commanding a beautiful view of the surrounding country, as well as of New York harbor and bay, and the edifice itself presenting a fine appearance when viewed from the deck of the ferryboat as we cross the river to visit it. The building is very substantially built of blue trap-rock, with brown-stone trimmings, from designs by Upjohn. It extends from street to street, and has two wings in the rear. It is three stories in height, and has a dry and roomy basement.

FACULTY.—Henry Morton, Ph. D., President; Alfred M. Mayer, Ph. D., Professor of Physics; Robert H. Thurston, A. M., C. E., Professor of Mechanical Engineering; De Volson Wood, A. M., C. E., Professor of Mathematics and Mechanics; Charles W. MacCord, A. M., Professor of Mechanical Drawing; Albert R. Leeds, Ph. D., Professor of Chemistry; Charles F. Krœh, A. M., Professor of Languages; Rev. Edward Wall, A. M., Professor of Belles-Lettres; James E. Denton, M. E., Instructor in Experimental Machines and Shop-work; Adam Riesenberger, M. E. Instructor in Mechanical Drawing.

PLAN OF THE INSTITUTION.—The plan of instruction which has now been successfully pursued for eleven years, is such as will best fit young men of ability for positions of usefulness in the department of mechanical engineering, and in those scientific pursuits from which this and all sister arts are daily deriving such incalculable benefits. With this view there is afforded:

1. A thorough training in the elementary and advanced branches of Mathematics, and their application to mechanical constructions.

2. The subject of Mechanical Engineering, including theory and practice in the construction of machines, forms a distinct department, under the charge of a professor experienced in the practical relations of his subject, who will devote his entire attention to the branch. A Mechanical Laboratory has been instituted as an adjunct to this department, in which students are permitted to study the materials of construction during the process of testing, which is at nearly all times in progress, and frequently to take part in such work. They are given opportunities to take part in tests of steam engines, boilers, and other commercial operations carried on in this laboratory, and witness and take part in the construction of machinery and other work done in the workshop. Much of this work is made from designs produced by students, and some machines here used are the work of students entirely.

3. The subject of Mechanical Drawing (which may well be called the language of engineering) forms a separate department, to which much time and attention is devoted. The course comprises the Use of Instruments and Colors, Descriptive Geometry, Shades, Shadows and Perspective, and the Analysis of Mechanical Movements—the principles involved being at once and continuously applied in the construction of working drawings from measurements of machines already built, as well as in making original designs.

4. An extensive course of manual exercises in shop practice is combined with a course of experimental mechanics, to form a separate department, which aims to co-operate with the departments of engineering, mechanics, and drawing, so as to bear to them the same relation as the physical and chemical laboratories do to the class-room work in physics and chemistry. Its courses, aside from the introduction of the student to the function of tools, etc., are directly supplemental to the department of mechanical drawing, by familiarizing the student with the use of working drawings in the shop, and by the embodiment of the theoretical principles of mechanism in the form of exercises in gear cutting, etc., and directly supplemental to the departments of engineering and mechanics, by re-enforcing the apprehension of theoretical principles through the performance of exercises in the course of experimental mechanics.

5. Arrangements of an unusually perfect character have been made, to give a thorough, practical course of instruction in Physics, by means of physical laboratories, in which the student is guided by the Professor of Physics, in experimental researches bearing upon the subjects of his special study. Thus the student will experimentally study those methods of making measures of precision which are used in all determinations in Physics; he will measure for himself the tension of steam at various temperatures, and construct the curve showing their relations; he will determine the electrical resistance of several conductors and insulators, and so on through the subjects of Physics. By such means as these not only will facts and laws be impressed in a manner which no other process can approach, but a training will be given in methods of investigation, which will be invaluable for the mastery of the always new and varied problems of actual work.

6. The subject of Chemistry is taught, chiefly by experimental work in the laboratory, with accompanying lectures and classroom instruction. It is believed that in this manner only can students be made thoroughly conversant with the subject.

7. The French and German languages form an essential part of the course of instruction, since they are indispensable to the engineer and man of science as the vehicles of a vast amount of information, and also as affording that kind of mental culture which mathematical and physical science, if followed exclusively would fail to supply.

8. A department of Belles-Lettres furnishes the means of cultivating literary taste and a facility in the graceful use of language, both in speaking and writing, which are as desirable in the engineer and man of science as in the classical student.

THE WORKSHOP.—During the last three years the course of workshop instruction has been greatly extended, and as a result of this, a year since there came to be an urgent need for larger accommodation and an increase in the number of machine and other tools. Fortunately, this need has been supplied by a gift from President Morton, who fitted up the building (formerly used as a lecture hall, and afterward as a gymnasium), and stocked it with an engine of 20 horse power, and numerous machine and other tools, at an aggregate outlay of $10,000, and presented the same to the trustees. The building occupied by the shop is 50 feet wide by 80 feet long, with a high open roof. Galleries have been erected on all sides of it at a height of 12 feet, reaching out 15 feet from the walls, thus leaving a space 20 by 50 open in the centre. The engine being placed about the middle of the building, two lines of main shafting run along the front of the galleries, and from these belts are carried off to the counter shafts of the various machines. A spiral stairway gives access to the west gallery near its centre, where is located the tool room, which is fully stocked with all the small tools, mandrels, gauges, cutters, taps, dies and the like, required for use with the machine tools. These are given out to students on presentation of brass checks, as in all large shops. Platforms run the whole length of the room under the windows, and on these are placed, on the east side, 10 carpenter benches, each with a locker or cupboard above it, containing a set of carpenter's tools. On the west side 10 benches are fitted up for vise work.

Other Appliances for the Workshop Course.—In the basement of the main building is a foundry, provided with a 17″ cupola furnace, a 12″ brass furnace, a number of moulders' benches, moulders' tools, and everything else required for practical work in this direction. A large collection of carefully selected patterns are here provided, and each student is required to make a good mould in sand of each of these, including the making and baking of the requisite cores. Castings in iron are make likewise, by the students, of a selected series of these patterns. Two forges, anvils and sets of blacksmith tools, and a steam hammer are provided for the course of instruction in this subject. Two sets of steam fitter's tools and vises are arranged so that two pair of students at once can work at the exercises required in this subject. The large basement room, formerly occupied as a workshop, is now provided with a small engine and one line of shafting. Extra sets of shafting, hangers, couplings, pulleys, etc., of various styles, are also provided, with which the exercises in this subject are carried out. In one of the small rooms of the basement is a vertical engine of 5-horse power, from the New York Safety Steam Power Company, and the transmitting dynamometer built in the Institute by the Class of 1879. Also absorbing dynamometers, measuring tanks and calorimeters. These, as well as the engine and other appliances of the old shop, are used in the course of Experimental Mechanics.

CALENDAR.—The full course of the Stevens Institute of Technology occupies the period of four years, each year being divided into a Preliminary Term, during which the Sophomore, Junior and Senior Classes devote eight hours per day to the Department of Experimental Mechanics and Shop Work, and three regular terms.

Preliminary Term.

Junior and Senior Classes, from Monday, September 4th, 1882, to Wednesday, September 27th, 1882.

Candidates for admission to the Freshman Class should not present themselves for examination prior to September 20th, 1882.

First Regular Term.

From Wednesday, September 27th, 1882, to the Wednesday before Christmas.

Public examination on the work of the term begins Wednesday, December 13th, 1882.

Second Regular Term.

From Wednesday, January 3d, 1883, to Wednesday, March 21st, 1883.

Public examination on the work of the term begins Wednesday, March 14th, 1883.

Third Regular Term.

From Monday, April 2d, 1883, to Wednesday, June 13th, 1883.

Public examination on the work of the term begins Wednesday, June 6th, 1883.

Commencement, Thursday, June 14th, 1883.

Examinations.—The examination of applicants for admission, and the re-examination of students deficient at the end of the preceding college year, will be held between the hours of 10 A. M. and 2 P. M., on September 20th, 21st, 22d, 23d, 25th, and 26th, 1882. Students will present themselves as early as possible, in order that they may have ample time to prepare answers to the questions assigned them. Examinations in each department will be held in public at the end of each term; and, previous to graduation, a special examination, also in public, will be held, of the graduating class, and from the combined results of all these examinations, the questions of proficiency and qualifications for degrees will be determined. The transfer of a student from a lower to a higher class will depend in each case upon the result of the examination of the year preceding the time of transfer, so that no student can pass from a lower to a higher class until he has given satisfactory evidence of his proficiency in the studies of the former. The following days will be observed as Holidays: Thanksgiving Day (First Term), Washington's Birthday (Second Term), and Decoration Day (Third Term). Thanksgiving Day and Washington's Birthday falling on Thursday, there will be no exercises on the Friday and the Saturday following.

Requirements for Admission.—No applicant under the age of seventeen years will be admitted to the examination, unless the Faculty be satisfied that he is able to bear the burden of the Institute course, without detriment to his health, nor will any applicant under the age of seventeen be allowed to enter his class unless his examination show proof of unusual proficiency. The examinations will be on the following subjects:

Arithmetic.—The preparation should be especially thorough upon the properties of numbers, the operations in common and decimal fractions, the methods of finding the greatest common divisor, and the extraction of the roots of numbers.

Algebra.—Simple equations, theory of radicals, equations of the second degree, arithmetical and geometrical progression, permutations, binomial theorem, indeterminate coefficients, and the summation of series.

Geometry.—All of plane and solid geometry. The examination in this subject will be chiefly upon the definitions and the statements of facts, as contained in the more important propositions; but the ability of the applicant to make a logical demonstration will also be tested.

English Grammar.—The requirements are a practical acquaintance with the parts of speech, their relations, agreement, and government; the proper use of tenses and moods; the construction and arrangement of sentences. On all these points we desire exact knowledge of the principles deduced from copious examples, and we attach no value to a minute knowledge of subtleties and exceptions. The latter properly belong to an advanced college course.

Geography.—The examination will be in the most important countries, cities, rivers, etc., most frequently occurring in the perusal of the daily newspaper and in general history.

Composition.—An Essay upon some topic assigned at the time of examination, and examined with reference to legible hand-writing, correct spelling, punctuation, and proper expression.

Universal History.—In the examination in Universal History but little prominence is given to dates. The questions relate to the great events; their cause and effects. A conspicuous place is given in the questions to the History of the United States.

Rhetoric.—The examination in Rhetoric will embrace all parts of the subject which are contained in the text books on Rhetoric. Candidates for admission to the higher classes must be prepared to pass a satisfactory examination in the studies previously pursued by the class which they enter. Advanced students and men of science desiring to avail themselves of the appliances of the laboratories of the Stevens Institute, to carry on special investigations, may make arrangements to that end with the President.

DEGREES.—The Stevens Institute of Technology, as will be seen from its secondary title, and from the account of its general scope and plan of studies already given, is essentially a School of Mechanical Engineering, and will therefore confer upon its regular graduates the degree of Mechanical Engineer, when due evidence of proficiency has been afforded in the final examinations, and upon the presentation of these, as described further on. Three years after graduation an alumnus, who shall have creditably pursued the practice of the profession, may, upon producing satisfactory evidence of the fact, receive a post-graduate degree—the title and the conditions of the conferring of which have not yet been definitely determined. Five years or more after graduation, a second and higher degree may be conferred, where evidence of good professional standing and of the performance of work of exceptional importance or excellence shall show the candidate to be entitled to such distinction. In certain cases, however, graduates from other institutions, or meritorious students, of at least two years' standing, may pursue a special course, from which they may graduate, upon passing the requisite examinations, with the degree of Bachelor of Science; and such graduates, on presenting a thesis embodying the results of original investigation in the subjects of chemistry and physics, may receive a further degree of Doctor of Philosophy.

EXPENSES.—The fees for each year of the entire Course, for instruction and the use of instruments, are one hundred and fifty dollars, for students at the time residing in the State of New Jersey. Those not so residing—(*i. e.*) coming across the river each day from New York or the like—are charged seventy-five dollars extra. This discrimination is made necessary by a clause in Mr. Stevens' will. In the Chemical Laboratory each student will be supplied with a set of reagent bottles; and an adequate quantity of chemicals, and platinum vessels, agate and steel mortars, etc., will be loaned to him from time to time, as his work may make their use necessary. With reference to other apparatus, he is at liberty to furnish himself from any dealer, or borrow from the supplies of the school. At the end of each session he will be credited with those articles returned in good order, while the cost value of those destroyed will be deducted from his deposit. In the Drawing Department each student will be expected to furnish his own instruments and materials. In the Department of Shop Work the student will be expected to pay for the material used; the total cost for the entire course will not exceed sixty-five dollars. The student is advised not to make his purchases before coming to the Institute, as arrangements have been made by which the best articles can be had on advantageous terms. The fees are payable in advance, at the beginning of each term. Each student will be required on admission to make a deposit of ten dollars to meet incidental expenses, such as those for drawing materials or special chemical supplies. This deposit can only be withdrawn when he graduates or leaves the Institute. Boarding and commons will not be supplied in connection with the Institute; but board, on reasonable terms, may be readily secured in private families in the city, at a cost of from six to ten dollars a week.

SCHOLARSHIPS.—One scholarship each year is given to the graduate of the Stevens High School who passes the best examination at the end of the Spring Term. The candidates for these scholarships must have attended the regular course in the High School for at least one year and be in good standing. Three scholarships each year are given to such graduates from the public schools of Hoboken as are recommended by the officers of the same, provided such candidates pass successfully the regular examinations for admission to the Stevens Institute of Technology. A scholarship confers the privilege of attending the entire course of the Institute for four years, free of all charge for tuition, provided, of course, the student holding the scholarship keeps up in all cases with the standard of proficiency and good conduct required.

PRIZES.—A prize in Chemistry, known as the "Priestley Prize," in honor of the renowned discoverer of oxygen, was instituted in the year 1877, by means of funds contributed by Mr. William W. Shippen, Rev. S. B. Dod, President Henry Morton, and Prof. Leeds. The income, amounting to twenty-five dollars, is annually bestowed as a prize upon the student who has most distinguished himself in the department of chemistry during the current year. Mr. Wm. A. Macy has contributed one hundred dollars, the proceeds of which are to be awarded to that student entering the College from the public schools of Hoboken, who has the best standing at the end of the Freshman year.

The Course of Instruction—*Department of Mathematics and Mechanics.*—It is intended in this course to give the student such a thorough knowledge of the several branches of Mathematics as will enable him to use them advantageously in the investigation of Practical Problems. The Course for 1882-3 is arranged as follows:

First Year.—First Term—Trigonometry (Olney); Theory of Logarithms and Theory of Equations.
Second Term.—Co-ordinate Geometry (Wood).
Third Term.—Differential Calculus.

CLASS OF 1885.

Second Year.—Co-ordinate Geometry (Wood); Differential and Integral Calculus.

CLASS OF 1886.

Differential Calculus (continued), Integral Calculus, and Analytical Mechanics (Wood).

CLASS OF 1885.

Third Year—Analytical Mechanics (Wood), and Resistance of Materials (Wood)

CLASS OF 1886.

Analytical Mechanics (Wood); Resistance of Materials (Wood); and Theory of Bridges and Roofs (Wood).

CLASS OF 1885.

Fourth Year.—First Term.—Theory of Bridges and Roofs (Wood), and use of the Transit and Level.
Second Term—Graphical Statics.

CLASS OF 1886.

First Term.—Theory and use of the Transit and Level. Graphical Statics.

Department of Mechanical Engineering.—At the close of the second year the student will be prepared to enter upon the studies of the Department of Mechanical Engineering, which will occupy the principal portion of his time during the remainder of his course. The course of instruction in Mechanical Engineering will commence with lectures upon the nature of materials used in constructing, locating, and operating machinery; and the methods of obtaining them and preparing them for use, so far as such instruction is not included in the Course of Technical Chemistry. The uses to which each material is specially adapted are stated, the methods of testing their quality and preserving them from decay are described, while the principles and practical considerations involved in the application of tools to the working of each are exhibited in the work-rooms of the institute. A Course of Instruction in the Strength of materials follows, in which the laws determining the forms of greatest strength are deduced from experiment, and applied to the solution of such problems as arise daily in engineering practice. In the illustration of this portion of the Course, samples exhibiting the various qualities of each material are placed before the student for his inspection; models and drawings illustrate the methods of their preparations; and specimens of materials, wrought into their strongest forms, impress upon him the principles already learned of the strength of materials, and their application in design. The mathematical principles, and the theory of the strength of materials are taught in the Department of Mathematics. The course is continued by the study, from the text-book and lecture, of the Theory of Machinery, with detailed instructions in the use of tools and in designing machinery and mill work; care being taken to call the atteution of the student to such modifications in design as are dictated by difficulties in forging, pattern-making, moulding, finishing, and, "fitting-up." Finally, the course is completed by a series of lectures and lessons from text-books, treating of the prime movers, accompanied by exercises in planning and estimating the cost of machinery, mills, and manufactories. While studying heat engines, the steam engine is made a subject of special and extended investigation in its principles, and in the details of design, construction, and management, according to the best and most recent practice. Essays on professional subjects are written by the student at stated intervals during his course, in which he is expected to give concise and accurate statements of knowledge acquired by the course of reading accompanying his regular studies. In some instances, reports and opinions relating to the merits of mechanical devices, or to the economical performance of machinery, are demanded, as an exercise of essential importance.

Problems in design are presented to the student at intervals during the course, which are made, as far as possible, similar in character to those which meet the Mechanical Engineer most frequently in the practice of his profession. The student is informed of the exact result to be attained, and of the conditions necessary, and means available for reaching it. He is then expected to prepare his plans, and submit them to the Head of the Department, together with a report, oral or written, for criticism. A "graduating thesis" is demanded of the student at the close of his studies, in which he is expected to exhibit his proficiency, by designing and describing the construction and management of some machine, or in planning a manufacturing establishment, giving estimates of cost. The originals of these theses are retained at the Institute, and deposited among the manuscripts of its library.

THE MECHANICAL LABORATORY.—The Trustees have established a Mechanical Laboratory in connection with the Department of Mechanical Engineering. It is evident that a Laboratory for Technical Research, or a "Testing Laboratory," if properly organized, well equipped, and effectively operated, must be of exceptional value in the direct advancement of science, as well as in the promotion of purely technical interests. The officers of our important lines of railroad desire frequently to obtain dynamometric determinations of the resistance of trains, and of the efficiency of locomotives; to learn with precision the strength and the various other hardly less important characteristics of materials which it was proposed to use in construction; and to ascertain the value of fuel and of lubricating materials. Iron and steel makers are equally desirous of obtaining reliable and thoroughly accurate knowledge of the chemical constitution of their products, and of their physical structure and properties, and such knowledge of the relations existing between these two sets of qualities as can only be secured by careful comparison of the results of skilful and systematic investigation. Manufacturers of machinery, and constructors generally, are seriously in need of a recognized authority, to which they may send the materials purchased, or proposed to be purchased by them, with confidence that their qualities shall be carefully determined and their value ascertained, and that the deductions from experimental examination shall be intelligently made, uninfluenced by any private interest. Those members of the engineering profession who are engaged in general practice, constitute still another class of business men to whom such an institution would lend valuable aid; and, in fact, every business would derive, directly or indirectly, great advantage from its establishment. This plan gives to the country an institution such as has never before been organized, and one whose value will prove beyond estimation. The accumulation of facts, the valuable application of science, and the directly practical bearing of the work which may be done, will, in a comparatively short time, be productive of rich results. It will do most effectually that work which has hitherto been too much neglected—the application of scientific knowledge to familiar work and matters of business. It will do much to close up the space which so widely separates the man of business from the man of science, and will lead to a far more perfect system of mutual aid than has yet existed; it must also aid in the development of the natural resources of our country, stimulate the growth, in extent and perfection, of its most important industries, and contribute in many ways to the welfare of the people. The Trustees have placed at the disposal of the Director of the Mechanical Laboratory, for use where required, the machine shop and tools of the Institute, and a considerable amount of apparatus, including several testing machines, steam engine indicators, dynamometers, and other instruments, of a total value of about $5,000. They authorize the use of any available space within the buildings or upon the grounds, and set apart a strip of land adjacent to the buildings of the Institute, not exceeding 200 feet in length and 50 feet in breadth, upon which any new buildings required may be erected.

DEPARTMENT OF MECHANICAL DRAWING.—In the organization of the department of mechanical drawing, the object aimed at was to make the course of instruction thorough, practical, of direct utility, and comprehensive. The requirements of many of the industrial arts at the present day are such as to necessitate the delineation, not only of what already exists, but of what is yet to be made. Both demand a knowledge of the science of drawing, and the latter especially involves a certain exercise of the imagination, in order to form clear physical conceptions of the particular design in contemplation, not only in regard to its appearance as a whole, but as to the relations and proportions of its parts. This ability to form a vivid and distinct mental image, as well as to fix it permanently by accurate representations, though useful to all, is more emphatically so to the mechanical engineer, who is daily called on, not to copy what has been done, but to do what has not been. These considerations have been kept distinctly in sight in the conduct of this department; the matter taught and the method of teaching having been selected with the view of giving the student a firm grasp of underlying principles, of developing and strengthening his imaginative power, and of giving him direct practice in the application of both. The course adopted to attain these ends may be briefly outlined as follows: The foundation is laid by practice in the simple drawing of lines, in order to acquire facility in the manipulation of the instruments. The exercises selected are such as will be of subsequent use, arranged in a progressive order; beginning with geometrical constructions involving straight lines and circular arcs only, and ending with the more complex curves, such as the ellipse, helix, epicycloids, etc. Attention to symmetry, proportion and arrangement is enforced from the first, the diagrams not being copied, but constructed, mostly from rough sketches. Elementary studies of projection are then taken up, the method adopted being that of beginning by making the drawings of a solid object bounded by plane surfaces, such as a prism, in various positions, and proceeding by degrees to the similar treatment of more complex forms. The relation between the drawing and the thing drawn is more easily grasped at first, when the latter is not a mere abstraction, like a line or plane in space, but a definite and tangible object; and when the subject is presented in this manner, no difficulty is experienced with the simpler problems of intersection and development, which not only brings the imaginative faculty into play, but affords practical exercises of great utility. The next step is to the drawing of parts of machines from actual measurements. The student is at once set to work as a draughtsman; a part or the whole of some piece of mechanism is assigned to him, which he is to study, to measure, to sketch, and finally to draw; the requirement being, exactly as if he were employed in the drawing office of an engineering establishment, that he shall produce complete working plans, from which the original could be replaced were it destroyed. He thus acquires some knowledge of details, and is taught to observe closely, while at the same time his previously acquired skill and information are practically applied. Simultaneously with this, descriptive geometry is taken up as an abstract science, not as an ultimate object, but its practical applications being kept always in view, it is made a means to an end, and that end is the acquirement of such a mastery of the principles of drawing, that the student shall be able to cope with any problem when it arises in the course of his practice. The identity of the operations with those of Mechanical Drawing is never lost sight of, and the problems are frequently put in a practical form. This is not done exclusively, however, because they afford, in the abstract, the best possible exercise of the imaginative power. The study is continued in application to shades and shadows and to linear perspective; in connection with which the principles of aerial perspective, as applied to the shading of mechanical objects, are explained, and a little time is given to practice in the execution of finished drawings. But the ability to make elaborately shaded pictures is regarded as the least valuable of the qualifications of a mechanical draughtsman. However great his skill in this way may be, the accomplishment will serve him but little in his professional career if it be acquired at the expense of accuracy, or facility in the construction of working plans. Therefore, while it is designed to impart a thorough understanding of the principles involved in making such drawings, comparatively little time is devoted to their practical execution. The mechanical engineer plans machines, and these move; consequently the study of the laws of their motions is an important branch of his education; and it is properly given a place in this department, since to make the drawings of a piece of mechanism implies the making of them so that each part shall move in harmony with the rest, and the depth of engineering disgrace is reached when, through any oversight, one part interferes with another. This study might also, especially when the more complicated mechanical movements are considered, be regarded as a branch of applied mathematics of the higher order. But, however these laws may be investigated, this fact remains: that for the purposes of the draughtsman the results must be translated into his language and expressed in a graphic form—the ways of the analyst are not his ways, and the algebraic formula must be replaced by a diagram. Fortunately, however, the investigations may be made, at least as applied to by far the larger and more important part of the motions with which he has to deal, in his own language and by his own methods. In this part of the course, therefore, the geometry of mechanism is taught by graphical construction alone, practical exercises in the platting of mechanical movements, the drawing of the various forms of gearing, the construction of curves representing varied motion and the like, being introduced from time to time.

Further, the course includes some practice in actual planning. A subject being assigned or selected, the student proceeds to work it up as though already engaged in the active pursuit of his profession; making first a skeleton diagram of the movement, and sketching in the proposed arrangement of parts, he calculates the strength and proportion of these, thus making the design an exercise in the Departments of Engineering and Mathematics, modifying the original plan when it is found necessary to do so by the results of these calculations, then making drawings of each part in detail, and finally a general plan of the completed designs; a general supervision being exercised over the work while in progress, and hints and suggestions as to details and arrangement being made as occasion arises. It should be stated, also, that much care is taken throughout the course to form the habit of correct judgment in determining what drawings to make of any subject in hand, and how to arrange them most advantageously. Written instructions in regard to this are exceedingly meagre, and yet it is a very important matter. The object is to show the workman what to make and how to make it; and experience proves that it is very easy to produce drawings which are perfectly correct, and yet do not clearly illustrate the objects represented. Nothing facilitates the operations of the mechanic more than to have a set of working plans which are clear, easily read, and connectedly arranged, and it is almost as important that the draughtsman should know just what to draw, as that he should be able to draw it well. From the first to the last, therefore, the student is taught the necessity of exercising his judgment in this direction, as well as care and forethought in all that he does; in a word, he is led to put his brains into his fingers, and every precaution is taken to guard against the common and offensive heresy that Mechanical Drawing is a simple matter of rote and routine, and the draughtsman a mere animated machine, to which a mind is superfluous. Summarily, then, the object of the course is not merely to teach the student to read and write certain set phrases of the graphic language with ease and fluency, but to enable him to wield it with power and for a purpose. He is taught not so much to memorize as to compose; he is encouraged to think for himself, and to acquire vigor and facility by giving expression to new ideas; his practice during the course being made as nearly as possible to resemble that upon which he will enter at its close. It would be impossible to state in detail all that has been done in carrying out the design sketched above; but it is proper to mention some of the more meritorious pieces of practical work in this Department, executed by the students since its organization in 1871. The fact that some, coming well prepared from other institutions to complete their studies here, were able to undertake work of this description from the outset, gave at once an opportunity to test the working of the system proposed, which has been such, we think, as to entitle it to be considered fairly successful.

Department of Experimental Mechanics and Shop Work.—The "work shop" course of the Institute is intended to supply the student with a knowledge, as complete as possible, of the best existing appliances, methods, and processes necessary to the construction of such mechanical designs as the theoretical part of the Institute's course will enable him to originate. In accordance with this plan, the Institute is provided with a machine and carpenter shop, an iron and brass foundry, and a blacksmith's shop, in which the student is first sufficiently familiarized with the working of wood and metal, to enable him to recognize and appreciate differences in machines, tools, and methods of manipulation in founding and blacksmithing, after which he is taken to certain large manufacturing establishments, so selected as to enable him to see and examine, on a large scale, that with which the Institute's shops have afforded him familiarity in an elementary and limited degree. In accordance with this plan, a regularly organized inspection tour is undertaken with each class. The following are the outlines of the tours of the classes of 1882:

Inspection Tours of Class of 1882.—After a day spent at Iron Mines in observing the use of the Dipping Needle, Pumping, Hoisting and Rock Drilling Machinery, the Timbering and Blasting Processes, a day at the Bethlehem Iron and Steel and Zinc Works, Bethlehem, Pa., a day at the Wire Rolling Mills of the Trenton Iron Co., at Trenton, and visits to typical machine shops, an extended tour was made as follows: Left New York on New Haven boat from Peck Slip at 11.30 P. M., Wednesday, April 5th. Every one took his own means to be on board boat, where instructor had engaged sleeping quarters. Arrived at New Haven, 6 A. M., April 6th. Took train immediately for Hartford and breakfasted at Allyn House. Visited Pratt and Whitney Co. and Billings & Spencer Drop Forging Works, before dinner. After dinner at Allyn House, visited Hartford Engineering Company's Works, Colt's Armory and Machine Works, and Heating and Ventilating Plant in Hartford State House. Remained at Allyn House over night, took train to Willimantic where the Mills of the Willimantic Linen Company were visited in order to inspect two pair of Porter-Allen Engines running at very high speed, and also to observe the processes of spinning and weaving linen fabrics. Returned to Hartford at 11.30 A. M. Dinner at Allyn House. Left Hartford for Springfield at 2.12 P. M. Immediately upon arriving at Springfield, took train for Holyoke, where the Holyoke Water Power Constructions were inspected and a return was made to Springfield, where the night was spent at the Massasoit House. On the morning of April 8th, the Springfield Arsenal was visited. Left Springfield at 12.28 P. M., for Worcester. Visited Pond Tool Works and Worcester Free Institute. Left for Boston at 5 P. M. Arrived in Boston at 6 P. M., and put up at United States Hotel until Monday April 10th.

On the morning of April 10th, Boston & Albany R. R. for Watertown Arsenal to inspect large U. S. testing machine. Took dinner at arsenal, and took Fitchburg R. R. to Waltham Watch Works. Returned by Fitchburg road to Boston to United States Hotel. Tuesday, April 11th, visited Boston sewage engines and South Boston Iron Foundry at South Boston, and also the Massachusetts Institute of Technology. Left same day at 5.30 P. M., from Boston and Providence depot for Providence, arriving at Narragansett House to supper. Wednesday, April 12th, visited Brown Manufacturing Co. and Nicholson File Works in the forenoon, and the Cornish and Corliss five-cylinder pumping engines in the afternoon. Thursday, April 13th, visited Corliss Steam Engine Works in forenoon. Took dinner at Pawtucket and visited Pawtucket pumping engine in afternoon, returning by horse-cars to Providence to take steamboat train for New York at 7 P. M. Total Expense $40 per head. Following this a trip was made to Philadelphia, Chester, Edge Moor and Wilmington, to the Southwark Foundry, Cramp's and Roach's Ship Yard, Sellers & Co., Baldwin Locomotive Works, Ferris & Niles' Works, Bement's Works, Betts Machine Co.'s Works, Morris, Tasker & Co.'s Tube Mill, Edge Moor Iron Works, the Otto & Lange Gas Engine Works, and the Works of I. P. Morris & Co.

The course, as a whole, is divided into two main sections, viz.:

I. Carpenter work and wood turning, millwrighting and steam fitting, which are pursued by the Freshman Class during the three regular terms of the college year, and during the Preliminary Term.

II. Machinist work, blacksmithing, moulding and founding, and pattern making, which are pursued by the Sophomore Class during the Preliminary Term and three regular terms, and by the Junior Class during a portion of the regular terms. The student finishes the course in machinist work by being sent: 1. To two of the leading machine tool manufacturing establishments of the country, where he is required to prepare himself for examination upon a set of questions with which he is provided, regarding the various sizes, and the reasons for such variety of lathes, planers, and shapers, boring and drilling machines, and also regarding any general differences in the angles and rates of cutting of such tools as he has used here.

2. To a locomotive works, a rolling mill, three of our large iron works, and two marine engine works, where he will be required to acquire material for an examination upon a set of questions regarding the kind and size of tools and the methods used in the manufacture of certain large machinery.

Course of Experimental Mechanics.—This is a course given to the Senior Class during the Preliminary Term, and during a portion of the regular terms, which is intended to be supplementary to the work of the third year in Analytical and Applied Mechanics, Resistance of Materials and Heat, as well as preparatory to the study of the Steam Engine pursued during the regular term of the fourth year. It involves the following experimental tasks, at each of which a group of three or more members of a class are simultaneously engaged:

1. Dynamometrical Measurement of Power of Machine Tools.
2. Experimental determination of effects of different Fly Wheels upon steadiness of engine.
3. Determinations of Coefficients of Friction of Leather Belts and of Lubricants.
4. Comparison of Huntoon, Porter, Pickering and common Fly Ball Governors.
5. Test of Transverse Strength and Elasticity of Cast Iron, Wrought Iron, Wood and Brass.
6. Test of Tensile Strength and Elasticity of Cast Iron, Wrought and Steel.
7. Test of Compressive Strength of Cast Iron, Wrought Iron, and Stone.
8. Test of Shearing Strength of Wrought Iron.
9. Test of Torsional Strength of Cast Iron, Wrought Iron and Steel.
10. Test of Evaporative Power of Boilers, including Calorimetrical test of Quality of Steam, measurement of Temperature of Furnace and Chimney, and Pressure and Velocity of Draught.
11. Experimental determination of Total Heat of Combustion of Coal used in Boiler Test, and comparison of this heat with that computed from the analysis of the coal.
12. Measurement of effect of boiler covering in preventing radiation.
13. Measurement of Friction of Steam flowing through pipes.
14. Comparison of Velocity of flow of Steam experimentally determined, with velocity as computed from formulæ.
15. Comparison of Efficiency of Steam Pump and Injector.
16. Setting of Engine Valves with Link Motion and Independent Cut-off.

The Department of Physics.—This department offers the students every facility for the acquisition of a thorough knowledge of physics. During the *first year* the first term is given to the study of the general properties of matter and to inductive mechanics; the second term, to pneumatics and to the laws of vibratory motions and acoustics; the third term to light. In the *second year* the first term is occupied in the study of heat and meteorology; the second and third terms are spent in the study of magnetism and electricity. During the *third year* the Professor of Physics delivers lectures on the modes of making precise measures. He shows the application of these measures in the various departments of physics, and explains the construction, the methods of adjustment, and the manner of using instruments of precision. The *fourth year* the student spends in the physical laboratories, pursuing experimental investigations, schedules of which are prepared for him by the Professor of Physics. In the organization of the Department of Physics, two objects were sought: *First*, to give thorough instruction to the students by means of lectures and recitations on general physics, aided by the most perfect illustrations, followed by practical experimental work in the physical laboratory; and *secondly*, to advance knowledge in this department of science by original researches, conducted by the Professor of Physics. This mode of work has been of eminent service to the student, by causing a lively interest in his studies, as he verifies and extends, by his laboratory experiments, the knowledge which he had previously derived from lecturers and text-books. The extensive cabinet of instruments which the Institute possesses affords the student advantages which are nowhere excelled. It would be proper to state in this connection, that the facilities of the laboratories and cabinets of the Institute will be extended to advanced students who may wish to avail themselves of such means in carrying out their investigations, on such conditions as may be determined by arrangement in each special case.

Department of Chemistry.—The material employed for purposes of instruction in this department, while embracing too great a variety of substances and apparatus to be particularly described, may be conveniently summarized under its most important heads:

First.—Apparatus for purposes of demonstration and for teaching, by means of lecture illustration, the principal topics of general and applied chemistry. This includes the various forms of apparatus, designed by Hofmann and others, for elucidating the doctrines of modern chemistry.

Second.—Materials for qualitative, volumetric, and quantitative analysis, including standard solutions and apparatus for the determination of weight and volume, which have been carefully calibrated and adjusted. As part of this material, should be mentioned, a cabinet of somewhat more than 5,000 specimens of the principal ores, minerals and rocks.

Third.—Instruments of precision, employed in the graduation of eudiometers, the measurement of crystals, in the operations of gas analysis, etc. The study of chemistry is begun by instruction in the subject of chemical physics, in the laws of chemical combination, and in the principles involved in the determination of atomic and molecular weights. This is followed by the study of chemical notation and nomenclature, with practice in stoichiometry. Afterward, the subject of chemical structure is taken up, along with an examination of the chemical and physical properties of bodies, as far as is involved in their identification and chemical classification. Instruction in these general principles is accompanied by a course of lectures, the chief object of which is to supply the experimental demonstrations required. In the third year, the student enters upon a course of laboratory practice. He begins by acquainting himself with the properties and reactions of the elements, and their most generally occurring compounds. Then he proceeds to the examination of more or less complex minerals and artificial mixtures. This course of qualitative analysis is continued, until it is believed that the student should have no difficulty in ascertaining the composition of any ordinary mineral substance. Practice is likewise given in the examination of ores, with instruction in the chemistry of metallurgical processes. Finally, it is required to understand the methods involved in quantitative analysis, both gravimetric and volumetric, and to determine the percentage composition of certain salts and common minerals.

The course laid down above is to be pursued by students proposing to obtain the degree of Mechanical Engineer. For those desirous of fitting themselves for the profession of chemistry, the time devoted to work and instruction in the laboratory is greatly extended at the beginning of the third year. The number and variety of the substances which are required to be analyzed are much increased, and it is expected that a student shall become qualified to analyze all the ordinary minerals and chemicals, and the most important technical products. In addition, some acquaintance with the methods employed in organic analysis is imparted. A reasonable amount of proficiency in the various lines of work indicated will be required in order to obtain the degree of Bachelor of Philosophy. If, after this has been conferred, a research be undertaken, with the result of discovering new and important chemical compounds, or of adding materially to the store of precise information concerning the properties of bodies previously known, or of originating or perfecting some important chemical method, and a thesis, embodying these results, be prepared and submitted to the Faculty, the student will be eligible to the further degree of Doctor of Philosophy. Special arrangements will be made for these advanced courses of study, which, however, in all cases, must be prosecuted with the approbation and under the direction of the head of the department.

SHEFFIELD SCIENTIFIC SCHOOL, YALE COLLEGE, NEW HAVEN.

THE Sheffield Scientific School is devoted to instruction and researches in the mathematical, physical, and natural sciences, with reference to the promotion and diffusion of science, also to the preparation of young men for such pursuits as require especial proficiency in these departments of learning. It is one of the Departments of Yale College, like the law, medical, theological, and art schools, having its separate funds, buildings, teachers, and regulations, but governed by the Corporation of Yale College, which appoints the professors and confers the degrees. It is, in part, analogous to the academic department, or classical college, and, in part, to the professional schools. The instruction is intended for two classes of students:—

I. Graduates of this or of other Colleges, and other persons qualified for advanced or special scientific study.

II. Undergraduates who desire a training chiefly mathematical and scientific, in less part linguistic and literary, for higher scientific studies, or for various other occupations to which such training is suited.

The School was commenced in 1847. In 1860, a convenient building and a considerable endowment were given by Joseph E. Sheffield, Esq., of New Haven, whose name at the repeated request of the Corporation of Yale College, was afterward attached to the foundation. Mr. Sheffield has since frequently and munificently increased his original gifts. In 1863, by an act of the Connecticut Legislature, the national grant for the promotion of scientific education (under the congressional enactment of July, 1862) was given to this department of Yale College. Since that time, and especially since the autumn of 1869, numerous liberal gifts have been received from the citizens of New Haven, and from other gentlemen in Connecticut, New York, and St. Louis, for the endowment of the School, and the increase of its collections. The action of the State led to the designation by law of a State Board of Visitors, consisting of the Governor, Lieutenant-Governor, three senior Senators, and the Secretary of the State Board of Education; and this Board, with the Secretary of the Scientific School, is also the Board for the appointment of students to hold the State scholarships. At the request of the Governing Board, the Corporation of Yale College has also appointed a Board of Councillors for the School, consisting of a number of gentlemen who have taken a deep interest in its welfare. The Governing Board consists of the President of Yale College and the Professors who are permanently attached to the School. There are several other instructors associated with them, a part of whom are connected with other departments of the College.

Buildings and Apparatus.—The two buildings in which the work of instruction in the Scientific School is mainly carried on are called Sheffield Hall and North Sheffield Hall; but instruction in Mineralogy, Geology, and Biology, including Zoölogy and Comparative Anatomy, is now given entirely in the Peabody Museum. These halls contain a large number of recitation and lecture rooms, a hall for public assemblies and lectures, chemical and metallurgical laboratories, a photographical room, an astronomical observatory, museums, a library and reading room, besides studies for some of the professors, where their private technical libraries are kept. The following is a summary statement of the collections belonging to the School.

1. Laboratories and Apparatus in Chemistry, Metallurgy, Physics, Photography and Zoology.

2. Metallurgical Museum of Ores, Furnace Products, etc.
3. Agricultural Museum of Soils, Fertilizers, useful and injurious insects, etc.
4. Collections in Zoology.
5. Astronomical Observatory, with an equatorial telescope by Clark and Sons of Cambridge, a meridian circle, etc.
6. A Collection of Mechanical Apparatus, constituting the "Collier Cabinet."
7. Models in Architecture, Geometrical Drawing, Civil Engineering, Topographical Engineering, and Mechanics; diagrams adapted to public lectures; instruments for field practice.
8. Maps and Charts, topographical, hydrographical, geological, etc.

The herbarium of Professor Brewer, and the astronomical instruments of Professor Dyman, are deposited in the buildings. Professor Eaton's herbarium, near at hand, is freely accessible. Students also have access to the various laboratories and collections in Natural Science in the Peabody Museum.

Students are also admitted, under varying conditions, to the College and Society Libraries, the College Reading Room, the School of the Fine Arts, and the Gymnasium.

Library.—The special technical library of the Scientific School consists of about five thousand volumes. Included in this is the "Hillhouse Mathematical Library" of twenty-four hundred volumes, collected during a long series of years by Dr. William Hillhouse, and in 1870 purchased and presented to the Institution by Mr. Sheffield. A catalogue of this collection forms a supplement to the Annual Report of the Governing Board for 1870. All the prominent scientific journals of this country and of Europe, together with the proceedings of foreign academies, and of scientific societies, can be found either in this library or in the College Library, to which students have access.

Instruction for Graduates and Special Students.—Persons who have gone through undergraduate courses of study, here or elsewhere, may avail themselves of the facilities of the School for more special professional training in the physical sciences and their applications, gaining in one, two, or three years the degree of Bachelor of Philosophy, or, in two additional years of Engineering study, that of Civil Engineer, or of Dynamic Engineer. Or, engaging in studies of a less exclusively technical character, they may become candidates for the degree of Doctor of Philosophy. The instruction in such cases will be adapted to the particular needs and capacities of each student, and may be combined with that given by the graduate instructors in other departments of the University. This degree is conferred upon those who, having already taken a Bachelor's degree, engage as students in the Department of Philosophy and the Arts for not less than two years in assiduous and successful study. It is not given upon examination to those whose studies are pursued elsewhere. The requirements for it will in some cases exact of the student more than two years of post-graduate labor; so, especially, wherever the course of undergraduate study has been, as in the Scientific School, of less than four years. The candidate must pass a satisfactory final examination, and present a thesis giving evidence of high attainment in the branches of knowledge to which he has attended. A good knowledge of Latin, German and French will be required in all cases, unless, for some exceptional reason, the candidate be excused by the Faculty. The graduation fee is ten dollars.

Subjects likely to receive special attention are suggested as follows:—Professor Norton will instruct in applied mechanics and in spherical astronomy. Professor Lyman, in the use of meridional and other astronomical instruments. Professor DuBois, in the principles of thermodynamics, and utilization of heat as a source of power. Professor Brush, in the analysis and determination of mineral species, and in descriptive mineralogy. Professor Johnson, in theoretical, analytical, and agricultural chemistry. Professor Brewer, in agriculture and forest culture, in the use of the microscope, and in physical geography. Professor Clark, in definite integrals, differential equations, analytical mechanics, the theory of numerical approximation, and the method of least squares. Professor Eaton, in structural and systematic botany, with reference to both flowering and cryptogamous plants. Professor Allen, in analytical chemistry, and in metallurgy. Prof. Verrill, and Prof. Smith, in zoology and geology. The same courses of study are open, for a longer or shorter time, to graduate students who do not desire to become candidates for a degree.

Students who have taken the degree of Bachelor of Philosophy, may obtain the degree of CIVIL or of DYNAMIC ENGINEER at the end of two academical years, by pursuing the following higher course of study and professional training.

The course of study for the degree of CIVIL ENGINEER will comprise—

1. Higher Calculus. Higher Geometry. Theory of Numerical Operations.
2. Analytical Mechanics. Mechanics applied to Engineering.
3. A Course of Construction and Design. Projects.
4. Practical Astronomy, with use of instruments, computations, etc.

This course will occupy one year.

To secure the requisite amount of professional knowledge and practice, the candidate will be required to furnish a comprehensive report of the results of an examination into the existing condition of some special line of constructive art; or to present proper evidence that he has had actual charge in the field, for several months, of construction or surveying parties, or held some responsible position deemed equivalent to this. An elaborate design must also be submitted of some projected work of construction, based upon exact data obtained from careful surveys made by the candidate, and comprising all the requisite calculations, and the necessary detailed drawings, and accompanied by full specifications of the work to be done, and the requirements to be met by the contractor. The fee for this degree is five dollars. The course of study for the degree of DYNAMIC ENGINEER will comprise—

1. Higher Calculus. Higher Geometry. Theory of Numerical Operations.
2. General Principles of Dynamics (Analytical Mechanics), including special application of these Principles to Dynamical problems.
3. Construction of Machines. Designs.
4. Preparation of theses on special subjects in Dynamic Engineering.

During the second year candidates will be permitted to employ such a portion of their time as may be deemed advisable or necessary in the examination of engineering works and manufacturing establishments, and may also have the privilege of entering upon professional practice, provided it is done with the knowledge and consent of the Professor of Dynamic Engineering, and under such circumstances as shall appear to him to be favorable to professional progress. An elaborate thesis on some professional subject, with an original design, or project, accompanied by proper working drawings, will be required at the end of the second year. The fee for this degree is five dollars.

SPECIAL STUDENTS.—For the benefit of those who, being fully qualified, desire to pursue particular studies without reference to the obtaining of a degree, special or irregular students are received in most of the departments of the School; not, however, in the Select Course or in the Freshman Class. It should be distinctly understood that these opportunities are not offered to persons who are incompetent to go on with regular courses, but are designed to aid those who, having received a sufficient preliminary education elsewhere, desire to increase their proficiency in special branches.

Requirements for Admission.—TERMS OF ADMISSION.—Candidates must be not less than fifteen years of age, and must bring satisfactory testimonials of moral character from their former instructors or other responsible persons. For admission to the Freshman Class the student must pass a thorough examination in the following subjects:

English.—Including grammar, spelling, and composition. In grammar, Whitney's Essentials of English Grammar, or an equivalent.

History of the United States.

Geography.

Latin.—(1.) Simple exercises in translating English into Latin. (Smith's "*Principia Latina,*" Part I, or the First and Second Latin Books of the Ahn-Henn Latin Series, are named as indicating the nature and extent of this requirement, and an acquaintance with one of these works will be required unless some satisfactory substitute is offered. In the last-named course one-third of each exercise may, if desired, be omitted.) (2) Cæsar—six books of the Gallic War, or their equivalent. (As advantageous substitutes for the last three books of Cæsar may be suggested three books of Virgil's Æneid, or a similar quantity of Ovid.)

Arithmetic.—Fundamental Operations, Least Common Multiple, Greatest Common Divisor, Common and Decimal Fractions, Denominate Numbers, including the Metric System of Weights and Measures; Percentages, including Interest, Discount, and Commission; Proportion, Extraction of the Square and Cube Roots.

Algebra—Fundamental Operations, Fractions, Equations of the First Degree, with one or several unknown quantities; Inequalities, Ratio and Proportion, Involution, including the Binomial Formula for an entire and positive Exponent; Evolution, the Reduction of Radicals, Equations of the Second Degree, Progressions, Permutations and Combinations, the Method of Indeterminate Coefficients, Fundamental Properties of Logarithms, Compound Interest.

Geometry—Plane, Solid, and Spherical; including fundamental notions of Symmetry, and examples of Loci and Maxima and Minima of Plane Figures.

Trigonometry—Including the Analytical Theory of the Trigonometrical Functions, and the usual formulæ; the Construction and Use of Trigonometrical Tables; and the Solution of Plane Triangles; so much, for example, as is contained in Wheeler's Plane Trigonometry (Boston, 1877), or Richards's Plane Trigonometry (New York, 1878). While no entrance examination is held in the *History of England*, candidates for admission are urgently advised to make themselves as familiar as possible with that subject; as a knowledge of it is essential to the most successful prosecution of some of the studies of the course. Candidates will be allowed the option of passing on the above-named subjects in two successive years. In such a case they must present themselves for examination at the June examination of the first year in the following subjects or parts of subjects: *History of the United States, Geography, Arithmetic, Plane Geometry, Algebra to Quadratic Equations.* In order to have this preliminary examination counted, candidates must pass satisfactorily on *all* the subjects; and notice must be given of the intention to divide the examination to Professor G. J. Bush, Executive Officer of the School, on or before June 15.

For preparation in Algebra and Geometry the recently published text-books of Professor Newcomb on these subjects, may, without indicating undue preference, be especially recommended. And to the candidate who prepares in other works, they may serve to indicate the extent and kind of attainments expected in the prescribed topics. Candidates who prepare in the Geometry of this author, may for the present omit the short chapters on the Ellipse, Hyperbola, and Parabola; though they will find it advantageous to study them. In his preparation in GEOMETRY the candidate should, as far as practicable, have suitable exercises in proving simple theorems and solving simple problems for himself. It is important, too, that he should be accustomed to the numerical application of geometric principles, and especially to the prompt recollection and use of the elementary formulæ of mensuration. In TRIGONOMETRY he should be exercised in applying the usual formulæ to a variety of simple reductions and transformations, including the solution of trigonometrical equations. Readiness and accuracy in trigonometrical calculations are also of prime importance to the candidate. If the use of logarithms is postponed in his preparation till Trigonometry is taken up (which is by no means necessary or advisable), he should then have abundant applications of them to all forms of calculation occurring in ordinary practice, as well as those appearing in the solution of triangles. Finally, in all of his calculations, he should study the art of neat and orderly arrangement. In LATIN the student should have such continued training in parsing as shall make him thoroughly familiar with declensions and conjugations, and with the leading principles of Syntax. To secure these results more effectually, the requirement has been adopted of simple exercises in translating English into Latin. As this course of exercises is designed solely as a preparation for reading, it should be begun at the earliest stage of Latin study. A very large proportion of the deficiencies in the Latin examination for several years past has been due to the neglect of the suggestions of this paragraph, and to attempt to read a Latin author with totally inadequate grammatical preparation. The examination for admission takes place at North Sheffield Hall, on Tuesday and Wednesday, September 12, 13, 1882. Opportunities for private examinations, may, in exceptional cases, be given at other times. Candidates for advanced standing in the undergraduate classes are examined, in addition to the preparatory studies, in those already pursued in the class they wish to enter. No one can be admitted as a candidate for a degree, later than at the beginning of the Senior year.

THE COURSES OF INSTRUCTION, occupying three years, are arranged to suit the requirements of the various classes of students. The first year's work is the same for all; for the last two years the instruction is chiefly arranged in special courses. The special courses most distinctly marked out are the following:

(*a.*) In Chemistry; (*b.*) In Civil Engineering.
(*c.*) In Dynamical (or Mechanical) Engineering;
(*d.*) In Agriculture; (*c.*) In Natural History:
(*f.*) In Biology preparatory to Medical Studies;
(*g.*) In Studies preparatory to Mining and Metallurgy;
(*h.*) In Select studies preparatory to other higher studies.

The arrangement of the studies is indicated in the annexed scheme.

FRESHMAN YEAR.—Introductory to all the Courses:—First Term—*German*—Whitney's Grammar and Reader. *English*—Lounsbury's History of the English Language; Exercises in composition. *Mathematics*—Plane Analytical Geometry. *Physics*—Atkinson's Ganot, with experimental lectures. *Chemistry*—Recitations and Laboratory practice. *Elementary Drawing*—Practical Lessons in the Art School.

Second Term—*Language, Physics, and Chemistry*—as stated above. *Mathematics*—Spherical Trigonometry (Wheeler's); Elements of Mechanics. *Physical Geography*—Lectures. *Botany*—Elementary, with Lectures. *Drawing*—Isometric drawing, with application to drawing from models and structures by measurement. Shading and tinting. Principles of orthographic projection. Reading of working drawings and isometric construction of objects from their orthographic projections. Sections.

For the Junior and Senior years the students select for themselves one of the following courses:

(a.) IN CHEMISTRY—*Junior Year*—First Term—*Theoretical Chemistry*—Lectures and Recitations. *Qualitative Analysis*—Fresenius's. *Laboratory Practice. Blowpipe Analysis. German. French.*

Second Term—*Laboratory Practice*—Qualitative Analysis, and experimental work in Organic Chemistry. *Mineralogy*—Blowpipe Analysis and determination of species. Lectures. *French. German.*

SENIOR YEAR—First Term—*Organic Chemistry*—Lectures and Recitations. *Agricultural Chemistry*—Recitations (optional). *Laboratory Practice*—Volumetric and Mineral Analysis. *Geology*—Dana's. *Zoology*—Lectures. *French.*

Second Term—*Laboratory Practice*—Analysis of Minerals and Technical Products. *Assaying* (optional). *Geology*—Dana's Manual. *Metallurgy* (optional) *Mineralogy* (optional). *French.*

(b.) IN CIVIL ENGINEERING—*Junior Year*—First Term—*Mathematics*—Analytical Geometry of Three Dimensions; Elements of the Theory of Functions; Numerical Equations; Differential Calculus. *Surveying*—Field Operations. *Drawing*—Descriptive Geometry, begun. *German. French.*

Second Term—*Mathematics*—Integral Calculus. Rational Mechanics. *Drawing*—Descriptive Geometry, concluded. Topographical. *Surveying*—Topographical. *German. French.*

SENIOR YEAR—First Term—*Field Engineering*—Laying out Curves. Location of Line of Railroad, with calculations of Excavation and Embankment. Henck's Field Book for Railroad Engineers. *Civil Engineering*—Resistance of Materials. Bridges and Roofs, begun. Stone Cutting, with Graphical problems. *Geology*—Dana's. *Mineralogy*—Blowpipe Analysis and Determinative Mineralogy. *French.*

Second Term—*Civil Engineering*—Bridges and Roofs. Building Materials. Stability of Arches and Walls. Mahan's Civil Engineering. *Dynamics*—Principles of Mechanism. Steam Engine. *Hydraulics*—Hydraulics and Hydraulic Motors. *Drawing*—Graphical Statics. *Astronomy*—Loomis's Astronomy with practical problems. *Mineralogy.*—Continued. *Geology*—Dynamic. *French.*

(c.) IN DYNAMIC ENGINEERING—*Junior Year*—First Term—*Mathematics*—Analytical Geometry of Three Dimensions; Elements of the Theory of Functions; Numerical Equations; Differential Calculus. *Surveying*—Field Practice. *Drawing*—Descriptive Geometry, begun. *German. French.*

Second Term—*Mathematics*—Integral Calculus. Rational Mechanics. *Kinematics*—General Theory of Motion and Principles of Mechanism; Elementary Combinations of Pure Mechanism; Pulleys and Belts; Gearing and forms of teeth for Wheels; Parallel Motions. *Drawing*—Descriptive Geometry, concluded. *German. French.*

Senior Year—First Term—*Statics*—Application of the Principles of Statics to Rigid Bodies; Elasticity and Strength of Materials; Forms of Uniform Strength; Stability of Structure; Construction of Roof Trusses, Girders, and Iron Bridges. *Machine Drawing*—Bolts and Nuts; Riveting; Journals, Axles, Shafts, Couplings, Pillow Blocks; Shaft-hangers, Pulleys; Connecting Rods and Cranks; Cross-Heads; Pipe connections; Valves; Steam Cylinders; Stuffing Boxes, Glands, etc. Shop Visits. *Blowpipe Analysis. French.*

Second Term—*Hydrostatics and Hydrodynamics*—Equilibrium and Pressure of fluids: Hydrometers, Manometers, Gauges, etc.; Water Pressure Engines and Water Wheels; Construction of Water Reservoirs and Conduits; Measurement of Water Supply; Discharge of Pipes. *Thermodynamics*—General principles of Heat employed as a source of power; Theory of the Steam Engine; Hot Air Engines; Gas Engines. *Machine Designing*—Proportioning of Machine Parts, continued. Designing of Hoisting Engines; Shearing and Pumping Engines; Complete working drawings for a high speed Steam Engine. Shop Visits and Reports. *Metallurgy.*

IN STUDIES PREPARATORY TO MINING AND METALLURGY:—Young men desiring to become Mining Engineers, can pursue the regular course in Civil or Mechanical Engineering, and at its close can spend a fourth year in the study of Metallurgical chemistry, mineralogy, etc.

(b) IN THE SELECT STUDIES PREPARATORY TO OTHER HIGHER STUDIES:—*Junior Year.*—FIRST TERM—*Mineralogy* — Blowpipe Analysis and Determinative Mineralogy. *Astronomy. English*—Early English. *History*—Green's Short History of the English People. *French. German.*

SECOND TERM—*Mineralogy*—Lectures. *Physical Geography*—Guyot; Lectures. *Botany*—Lectures; Excursions; Laboratory Practice. *English*—Chaucer, Bacon, Shakspere. *History*—Green's History, continued; History of the United States. *German. French.*

Senior Year.—FIRST TERM.— *Geology*—Recitations and Excursions. *Zoology*—Lectures and Excursions. *Linguistics*—Whitney's Life and Growth of Language. *English*—Shakspere. *Constitutional Law of the United States. French.*

SECOND TERM—*Geology*—continued. *Meteorology*—Lectures. *Political Economy*—Recitations and Lectures. *English*—Shakspeare, Milton, Dryden, Pope, Gray, and later authors. *French.*

Exercises in English Composition are required during the entire course from all the students. The preparation of graduating theses is among the duties of the Senior Year. Lectures on Military Science and Tactics are annually given by General Abbot, and other officers of the Engineer Corps of the United States Army.

Drawing.—The course in Drawing extends through the three years. During the first term of the Freshman year, the students practice free-hand drawing at the Art School building, under the direction of Professor Niemeyer, of the Yale School of the Fine Arts. After the Completion of the course in free-hand drawing, instruction is given by Mr. F. R. Honey, during the second term in the elementary principles of instrumental drawing, embracing Elementary projection drawing, Isometric drawing, and Descriptive Geometry as far as Warped Surfaces. This course is obligatory upon all. During the Junior and Senior years, instruction in drawing is obligatory only on the students in Civil and Mechanical Engineering. In the former year the system of instruction embraces shades and shadows, tinting, perspective, and warped surfaces. By this method all the problems in Descriptive Geometry are required to be worked out on the drawing-board instead of the black-board. The course extends through the entire year, and is under the direction of Mr. Honey. In Senior year, students are required to apply the principles of drawing already obtained to works of construction, under the general supervision of the Professors of Civil and of Dynamic Engineering.

METHODS OF INSTRUCTION.—The instruction of this institution is given chiefly in small class rooms, in connection with recitations and by familiar lectures, illustrated by the apparatus at the command of the various teachers. In many studies weekly excursions are made for the purpose of collecting specimens and examining natural phenomena. In Chemistry and Metallurgy the students work several hours daily in well-appointed laboratories, under the direct superintendence of the instructors, and are guided through systematic courses of quantitative and qualitative analysis, assaying, and the blow-pipe determination of minerals and ores.

In Geology excursions are made for the purpose of examining geological phenomena and making special collections of rocks and minerals. Each student is required to pass a satisfactory examination on his collections at the end of the first term of Senior year. In Civil Engineering the students, besides attending on Class recitations and lectures, pursue a systematic course of exercises in the different branches of Geometrical Drawing and Graphical Statics, and in the application of the principles of drawing to works of construction; and have good practice in the operations of Surveying and Field Engineering—acquiring facility in the use and adjustment of Surveying and Engineering Instruments. In Topographical Surveying they are instructed in the use of the Plane Table for topographical work, and are required to prepare a detailed chart of the ground surveyed—exhibiting the contour lines and all its topographical features. Numerous problems of computation, and graphical exercises, are included in the Course of Construction pursued in the Senior year. A course of Blowpipe Analysis is also taken by the Senior Class, that a more thorough knowledge may be gained of minerals and building stones.

In Dynamic Engineering the method of instruction is by recitation and lectures, supplemented by work in the drawing room, by shop visits, and visits of inspection in and out of the city, and by tests with the indicator and dynamometer. The lectures are illustrated by models, by large cartoons adapted for the purpose, and by the complete collection of working drawings of the Novelty Iron Works, owned by the School. In the drawing room, detailed working drawings of various machines are made. A general sketch of the proposed machine is given and complete detailed drawings are required, in proper shape for the pattern-maker or machinist. The student is taught the best practice, and his judgment is trained in choosing relative proportions. The student is required to describe the steps to be followed in building the machine, and to make as nearly as possible an estimate of its cost. Pattern, foundry, blacksmithing and machine work are studied in detail. In the visits, machinery and processes are critically examined in detail, and sketches of important machines with written descriptions are required. In addition to the above, a course of lectures is given every winter by the professors of the schools and others, on topics of popular interest.

Tuition Charges.—The charge for tuition for undergraduate students is $150 per year, payable, $55 at the beginning of the first and of the second term, and $40 at the middle of the second term. The student in the Chemical course has an additional charge of $70 per annum for chemicals and use of apparatus. He also supplies himself at his own expense with gas, flasks, crucibles, etc., the cost of which should not exceed $10 per term. A fee of $5 is charged members of the Freshman Class for chemicals and materials used in their laboratory practice, and the same fee is required from all (except Chemical students) who take the practical exercises in Blow-pipe Analysis and Determinative Mineralogy. A fee of $5 a term will also be charged to the students in the Zoological laboratory, for materials and use of instruments. An additional charge of $5 is annually made to each student for the use of the College Reading Room and Gymnasium. For graduate students the charge for tuition is $100 per year.

Church Sittings.—Free sittings for students in this department of Yale College are provided as follows: in the Central Church (Congr.); in the Trinity (Episc.); and in the First Methodist Church. Those who prefer to pay a sitting for a year, more or less, in the churches above mentioned, or in any other church of any denomination, will be aided on application to the Secretary of the School. Sittings in the Gallery of the College Chapel are free as heretofore to the students of this department.

Faculty and Assistants.—*President:* Rev. Noah Porter, D.D., LL.D. *Chairman and Executive Officer:* George J. Brush. *Professors:* (arranged in the order of their graduation) William A. Norton, Civil Engineering. Chester S. Lyman, Physics and Astronomy, Theoretical and Practical. William D. Whitney, Linguistics and French. George J. Brush, Mineralogy. Samuel W. Johnson, Theoretical and Agricultural Chemistry. William H. Brewer, Agricultural (Norton Professor). John E Clark, Mathematics. Daniel C. Eaton, Botany. Thomas R. Lounsbury, English. Oscar D. Allen, Analytical Chemistry and Metallurgy. Addison E. Verrill, Zoology and Geology. Sidney I. Smith, Comparative Anatomy. William G. Mixter, Chemistry. A. Jay Dubois, Dynamical Engineering (Higgin Professor). Henry W. Farnam, Political Economy and History. Albert S. Wheeler, German. Mark Bailey, Elocution. John H. Niemeyer, Professor in Yale School of Fine Arts, Free Hand Drawing. Frederick R. Honey, Descriptive Geometry and Projection Drawing. Herbert Miller, French. Thomas W. Mather, Kinematics and Machine Design. Allen B. Howe, Analytical Chemistry. Russell H. Chittenden, Physiological Chemistry. Charles Hildebrand, Mathematics. Samuel L. Penfield, Mineralogy. Marcus D. Munn, Analytical Chemistry.

Degrees.—Students of this department, on the recommendation of the Governing Board, are admitted by the Corporation of Yale College to the following degrees. They are thus conferred: 2. *Civil Engineer and Dynamical Engineer.*

Calendar.—September 12, 13, 1882, Tuesday, Wednesday, Examination for admission; September 14, 1882, Thursday, first term begins; December 21, 1882, first term ends.

LAWRENCE SCIENTIFIC SCHOOL, HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS.

THE Lawrence Scientific School of Harvard College offers a complete course of instruction in various departments of science training. The faculty is as follows: Charles W. Eliot, LL. D., President; Henry L. Eustis, A. M., Dean and Professor of Engineering; Joseph Lovering, LL. D., Professor of Mathematics and National Philosophy; Josiah D. Whitney, LL. D., Professor of Geology; Wolcott Gibbs, M. D., LL. D., Professor of Physics; Josiah P. Cooke, A. M., Professor of Chemistry and Mineralogy, and Director of the Chemical Laboratory; James M. Pierce, A. M., Professor of Mathematics; George L. Gondale, A. M., M. D., Professor of Botany, and Director of the Botanic Garden; Charles H. Moore, Instructor in Drawing and Principles of Design; Nathaniel S. Shaler, S. D., Professor of Palæontology; John Trowbridge, S. D., Professor of Physics; William G. Farlow, A. M., M. D., Professor of Botany; William James, M. D., Assistant Professor of Philosophy; Charles L. Jackson, A. M., Professor of Chemistry; William M. Davis, M. E., Instructor in Geology; Henry B. Hill, A. M., Assistant Professor of Chemistry; Walter Faxon, A. B., S. D., Assistant Professor of Zoölogy; Edward L. Mark, Ph. D., Instructor in Zoölogy; Harry B. Hodges, Instructor in German; Francis W. Dean, S. B., Tutor in Engineering. Assistants, Leonard P. Kinnicutt, S. B., Assistant in Chemistry; William H. Melville, Ph. D., Assistant in Mineralogy; Charles F. Mabery, S. D., Assistant in Chemistry; Harold Whiting, A. M., Assistant in Physics; John Eliot Wolff, A. B., Assistant in Geology; Henry Champion Jones, A. M., Assistant in Botany; Charles Henry Morss, A. B., Assistant in Biology; Charles Robert Sanger, A. B., Assistant in Organic Chemistry.

Courses of Instruction—*I. Civil and Topographical Engineering—Spherical Trigonometry and Analytic Geometry*—Wheeler's and Howison's.—Lectures. Additional examples. Five times a week. Mr. Dean.

Descriptive Geometry and Perspective—Church's. Three times a week. Prof. Eustis.

Elementary Physics—One lecture a week. Prof. Lovering.

Surveying, Plotting, and Topographical Drawing—Gillespie's Land Surveying.—Gillespie's Higher Surveying.—Field-work. Seven hours a week. Mr. Dean.

Mechanical Drawing—Six hours a week. Mr. Dean.

SECOND YEAR—*Differential and Integral Calculus* - Church's, with numerous additional examples. Five times a week. Prof. Eustis.

Elementary Physics—One lecture a week. Prof. Lovering.

Elementary Chemistry—(Twenty lectures). Once a week. Prof. Jackson.

German—Sheldon's Grammar.—Translation from German into English, and Elementary Exercises in translating into German. Three times a week. Messrs. Sheldon and Lutz.

(Required of students who did *not* offer German at their examination for admission.)

French—Brachet (Grammaire francaise).—Bocher's Reader.—French Prose. Three times a week. Asst. Prof. Jacquinot.

(Required of students who did *not* offer French at their examination for admission.)

Mechanical Drawing—Six hours a week. Mr. Dean.

Levelling, Topographical Drawing—Searle's Field Engineering—Wellington's Economic Theory of the Location of Railways. Six hours a week. Mr. Dean.

THIRD YEAR.—*Mechanics.*—Weisbach's Mechanics.—Wood's Bridges and Roofs. Five times a week. Prof. Eustis.

French—French Novels and Plays.—Exercises in Conversation and Composition. Three times a week. Asst. Prof. Jacquinot.

German—German Plays, Stories, and Essays.—Advanced Grammar. Three times a week. Asst. Prof. Cook.

Mechanical Drawing—Four hours a week. Mr. Dean.

Free-hand and Water-color Drawing—Four hours a week. Mr. Moore.

FOURTH YEAR—*Applied Mechanics and Constructive Engineering.* Building Materials, and their applications in Railroads, Canals, Bridges, etc.—Graphical Statics.—Hydraulics.—Discussions of existing structures and working out of projects.—Rankine's Applied Mechanics and Rankine's Civil Engineering. Five times a week. Prof. Eustis.

Applications of Descriptive Geometry to Masonry and Stone-Cutting. Lectures and Drawing. Prof. Eustis.

Determinative Mineralogy and Lithology (with study in the Mineral Cabinet). Three times a week. Dr. Melville.

Preparation of Thesis.

Students who complete this course, pass the required examinations, and present a satisfactory thesis, receive the degree of Civil Engineer, and are prepared to enter on the practice of their profession.

CHEMISTRY.

FIRST YEAR—*Descriptive Chemistry (with laboratory work).* Three times a week. Prof. Jackson and Dr. Mabery.

Elementary Physics. One lecture a week. Prof. Lovering.

German. Sheldon's Grammar.—Translation from German into English, and Elementary Exercises in translating into German. Three times a week. Messrs. Sheldon and Lutz.

(Required of Students who did *not* offer German at their examination for admission.)

French. Brachet (Grammaire francaise).—Bocher's Reader.—French Prose. Three times a week. Asst. Prof. Jacquinot.

(Required of students who did *not* offer French at their examination for admission.)

Quantitative Analysis, as the regular laboratory work of the first half year. Eighteen hours a week. Asst. Prof. H. B. Hill and Dr. Mabery.

Quantitative Analysis, as the regular laboratory work of the second half year. Eighteen hours a week. Mr. Kinnicutt.

SECOND YEAR.—*Technological Chemistry*, including the manufacture of chemical products, organic as well as inorganic, dyeing, calico printing, etc. Recitations and Excursions. Three times a week.

Elementary Physics. One lecture a week. Prof. Lovering.

German. German Plays, Stories, and Essays.—Advanced Grammar. Three times a week. Asst. Prof. Cook.

Quantitative Analysis, as the regular laboratory work for the year. Twenty hours a week. This includes assaying, water and gas analysis, and the more important commercial tests. Mr. Kinnicutt.

THIRD YEAR.—*Physics.* **Practical exercises in the Laboratory, including the use of instruments of precision in testing the laws of Mechanics, Acoustics, Optics, Magnetism, and Electricity; and an extended course in Electrical Measurements.* Three times a week. Prof. Trowbridge.

French. French Novels and plays.—Exercises in conversation and composition. Three times a week. Asst. Prof. Jacquinot.

Determinative Mineralogy and Lithology (with work in the Mineral Cabinet). Three times a week. Dr. Melville.

Organic Chemistry, as the regular laboratory work for the year. Eighteen hours a week. Asst. Prof. H. B. Hall.

FOURTH YEAR.—*Crystallography and the Physics of Crystals (with work in the Mineral Cabinet).* Three times a week. Prof. Cooke.

Mechanical Drawing. Four hours a week. Mr. Dean.

Laboratory Work. Twenty-three hours a week in preparation of thesis.

This course is intended for students preparing to become practical chemists or teachers of the science; and a student who completes the four years course, passes the required examinations, and presents a satisfactory thesis, receives the degree of Bachelor of Science.

The course is also open to "special students," not candidates for a degree. It has been so arranged that the studies of the first two years constitute a special course in practical chemistry, including all the details of chemical analysis. To those who finish satisfactorily this partial course, and prove their competency by laboratory work and by examination, certificates will be given stating the length of time they have been members of the school, and the extent of their preparation in Practical Chemistry.

Natural History.—These courses are designed to furnish a special training in the departments of Geology and Biology. The studies of the first year are common to both departments. Students are required to designate at the beginning of the second year the departments in which they intend to take their degrees.

FIRST YEAR.—*Physical Geography and Meteorology.* Three times a week. Mr. Davis.

Descriptive Chemistry (with laboratory work). Three times a week. Prof. Jackson.

Physics. Ganot's Physics—Lectures. Twice a week. Dr. Hall.

Botany. Three times a week. Prof. Farlow.

Zoology. Twice a week. Dr. Mark.

German. Sheldon's Grammar—Translation from German into English, and Elementary Exercises in translating into German. Three times a week. Messrs. Sheldon and Lutz.

(Required of students who did not offer German at their examination for admission.)

French.—Brachet (Grammaire francaise)—Bocher's Reader.—French Prose. Three times a week. Asst. Prof. Jacquinot.

(Required of students who did not offer French at their examination for admission.)

SECOND YEAR.—*German.* German Plays, Stories, and Essays.—Advanced Grammar. Three times a week. Asst. Prof. Cook.

French. French Prose.—Exercises in Conversation and Composition. Three times a week. Asst. Prof. Jacquinot.

Geology. Three times a week. Prof. Shaler.

Biology. Three times a week. Prof. Farlow and Asst. Prof. Faxon.

Free-hand and Water-color Drawing. Four hours a week. Mr. Moore.

GEOLOGY.—*Determinative Mineralogy and Lithology (with work in the Mineral Cabinet.)* Three times a week. Dr. Melville.

BIOLOGY.—*Logic.* Three times a week. Asst. Prof. James.

THIRD YEAR.—*Qualitative Analysis (with laboratory work).* Three times a week. Asst. Prof. H. B. Hill and Dr. Mabery.

Palæontology (with laboratory work). Twice a week. Prof. Shaler.

Free-hand and Water-color Drawing. Four hours a week. Mr. Moore.

GEOLOGY.—*Advanced Geology.* Three times a week. Prof. Shaler and Mr. Davis.

Topographical Surveying. Seven hours a week. Mr. Dean.

BIOLOGY.—*Advanced Zoology.* Three times a week. Asst. Prof. Faxon.

Advanced Botany. Lectures and laboratory work. Three times a week. Prof. Farlow.

FOURTH YEAR.—During the fourth year the student will be expected to devote a considerable part of his time to some special investigation, the results of which will be embodied in his thesis: in the selection of a subject he will be advised by the Professors whose courses he has followed in previous years. Students of geology will be encouraged to give as much time as possible to work in the field, and a report of such work will form the best thesis that can be presented.

The following courses, selected from those offered in the University during the present year, will serve to indicate the character of the instruction of which the student may avail himself during the last year of the Natural History course.

GEOLOGY.—*Historical Geology (with laboratory work).* Twice a week. Prof. Shaler.

Geological Field-work; for training in the principles of Geological Surveying, with work in the field and in the preparation of reports. Nine hours a week. Mr. Davis.

Economical Geology. Twice a week. Prof. Whitney.

Lithology. Lectures (with practical instruction in the Laboratory). Once a week. Prof. Whitney.

Quantitative Analysis (in the Laboratory). Three times a week. Mr. Kinnicutt.

BIOLOGY.

Advanced Morphology and Histology of Phanerogams. Three times a week. Prof. Goodale.

Anatomy and Development of Higher Cryptogams. Three times a week. Prof. Farlow.

Embryology (with laboratory work). Once a week. Dr. Mark.

Agricultural Chemistry. Twice a week at the Bussey Institution. Prof. Storer.

General Entomology (with laboratory work). Twice a week. Prof. Hagen.

*Students who are not qualified for this course will take in place of it the course in Physics prescribed for the first year's students in Natural History.

Applied Zoology (Anatomy and Physiology of Domestic Animals). Twice a week at the Bussey Institution. Prof. Slade.

Human Anatomy and Physiology. At the Medical School. Professors Holmes and Bowditch and Doctors Beach and J. W. Warren. Students are advised to attend Asst. Prof. James's lectures on Physiology and Hygiene during some part of their residence in Cambridge. Students who make good use of the opportunities afforded by the summer schools or who, during the long vacation, pursue studies under the direction of the professors in their departments, may shorten this course of study to three years. Students who complete either of the above courses, pass the required examinations, and present a satisfactory thesis, will receive the degree of Bachelor of Science.

Admission.—Candidates for admission to any one of the regular courses in Engineering, Chemistry, Natural History, *or* Mathematics, Physics, and Astronomy, will be examined in the following subjects:—

Modern Geography.—Miss Hall's Our World, No. 2.

English Composition.—Every candidate will be required to write a short English composition, correct in spelling,* punctuation, grammar, division by paragraphs, and expression, upon a subject announced at the the time of examination. In 1882, the subject will be drawn from one of the following works:—

Shakspeare's Othello, and King John; Goldsmith's Vicar of Wakefield, and Deserted Village; Carlyle's Essay on Scott; Scott's Bride of Lammermoor; George Eliot's Mill on the Floss.

Every candidate is expected to be familiar with *all* the books in this list.

Every candidate will also be required to *correct specimens of bad English* given him at the time of the examination.

In 1883, the subject will be drawn from one of the following works:—Shakspeare's Julius Cæsar, and As You Like It; the Sir Roger de Coverley Papers in the Spectator; Macaulay's Essay on Addison; Thackeray's Henry Esmond; and Scott's Marmion.

In 1884, the subject will be drawn from one of the following works:—Shakspeare's Julius Cæsar, and Merchant of Venice; Thackeray's Henry Esmond; Irving's Sketch Book; Scott's Lady of the Lake; Carlyle's Essay on Burns; Burns's Cotter's Saturday Night.

French or German.—Translation at sight of easy French prose, or of easy German prose, if the candidate prefer to offer German. It is expected that a knowledge of the language itself will be shown in examination, rather than a knowledge of the grammar; but proficiency in elementary grammar, a good pronunciation, or facility in speaking, will be accepted as an offset for some deficiency in translation. There will be no required examination in pronunciation, but it is recommended that attention be given to pronunciation from the outset. Candidates who offer German will be required to study French, and those who offer French will be required to study German, during the Freshman year.

Latin.—Four books of Cæsar's Commentaries, and four books of the Aeneid of Virgil, or their equivalents; Latin Grammar, as much as is contained in either Allen and Greenough's or Harkness's Elementary Latin Grammar.

Arithmetic (including the metric system of weights and measures, and the use and rudiments of the theory of logarithms).—The examples requiring the use of logarithms at the examinations will be adapted to a four-place table.

Elementary Algebra.—Through quadratic equations.

Elementary Geometry.—The first five books of Chauvenet's Geometry.

Plane and Analytic Trigonometry.—As much as is contained in the first eight chapters of Chauvenet's Trigonometry, or Wheeler's Elements of Plane Trigonometry.

Elementary Descriptive Chemistry.—As much as is contained in Nichols's abridgement of Eliot and Storer's Manual.

Elementary Physics.—As much as is contained in Balfour Stewart's Lessons in Elementary Physics.

For the Course in Engineering or *in Mathematics, Physics, and Astronomy.*—In addition to the above requisitions, candidates who propose to take either of these courses will be examined in—

Advanced Algebra.—As much as is contained in the larger works of Olney, Robinson, Todhunter, or Greenleaf.

* Worcester's Dictionary is the Standard.

Solid Geometry.—The last four books of Chauvenet's Geometry.

Every candidate for admission to advanced standing will be further examined in all the studies already pursued by the class for which he offers himself. Graduates of Harvard College who have passed a satisfactory examination while in College on the subjects of the first and second years of the Engineering course, except Drawing and Surveying, will be admitted to the third year of that course. Undergraduates who intend to study Engineering are recommended by the Scientific Faculty to take, as extras, the courses in Drawing and Surveying in the Scientific School; but these subjects may be made up in the third and fourth years. The successful study of any subject in College will be taken as an equivalent for the same subject in the Scientific School. Two regular examinations for admission are held each year, —one at the beginning of the summer vacation, and the other at the beginning of the academic year in the autumn.

In 1882 the first examination will be held at the following places on Thursday, Friday, and Saturday, June 29, 30, July 1: in *Cambridge*, in Lawrence Hall; in *Exeter*, in rooms of the Phillips Exeter Academy; in *New York*, in the lecture-room of the Young Men's Christian Association, Twenty-third Street, corner of Fourth Avenue; in *Philadelphia*, in the library hall of the Academy of Natural Sciences, S. W. corner of Nineteenth and Race Streets; in *Cincinnati*, in the rooms of the Literary Club, 24 West Fourth Street, second floor; in *Chicago*, in the rooms of the Chicago Athenæum, 50 Dearborn Street; in *San Francisco*, in rooms of the Boys' High School, on Luther Street, between Gough and Octavia Streets: the second examination will be held in Cambridge only, on Wednesday, Thursday, and Friday, September 27, 28, and 29. For each examination attendance on the three days is required. Candidates will assemble punctually at 8 o'clock, A. M.

Degrees.—The Degrees of Civil Engineer and Bachelor of Science.—As already stated, the degree of CIVIL ENGINEER may be conferred upon any student who has completed the prescribed course of study in Civil Engineering, passed the required examinations, and presented a satisfactory thesis; and the degree of BACHELOR OF SCIENCE may be conferred upon any student who has fulfilled the above requirements in Chemistry, Natural History, *or* Mathematics, Physics, and Astronomy. The grades of the degree of Bachelor of Science are *cum laude*, *magna cum laude*, and *summa cum laude*. The grade of the degree and the course of study for which the degree is given will be specified in the Diploma. The degree of DOCTOR OF SCIENCE is open to Bachelors of Science of Harvard University, and to Bachelors of Science and Bachelors of Philosophy of other institutions who shall have satisfied the Faculty of the Lawrence Scientific School, by examination, that the course of study for which they received the Bachelor's degree is equivalent to that for which the degree is given in Harvard University, or shall have passed such additional examinations as that Faculty may prescribe. The Academic Council will recommend for the degree of Doctor of Science candidates otherwise properly qualified, who, after taking their Bachelor's degree, shall reside at least two years at the University, and pursue during three years a course of scientific study, embracing at least two subjects, and approved by the Council, and shall pass a thorough examination upon that course, showing in one of the subjects special attainments, and shall also make some contribution to science or some special investigation, to be embodied in a thesis; provided, however, that a course of study of two years only shall suffice for candidates who are both Bachelors of Arts and Bachelors of Science of Harvard University. In special cases the Academic Council is authorized to remit the requisition of residence at the University to Bachelors of Arts or of Science of Harvard University. For the standing rules of the Academic Council, relating to the higher degrees, see Harvard University Catalogue, or application may be made to Professor C. J. White, Registrar, Cambridge, Mass.

INSTRUCTION FOR TEACHERS.—1. The school also offers facilities to teachers and to persons preparing to be teachers, who desire to qualify themselves in the modern methods of teaching science by observation and experiment. A one-year's course of study, adapted to this purpose, may be selected from the elements of Natural History, Chemistry, and Physics, including any of the following subjects: Physical Geography and Elementary Geology; General Chemistry and Qualitative Analysis; Mineralogy; Physics; Botany; Comparative Anatomy and Physiology; Zoölogy. This course is flexible and comprehensive, the instruction is mainly given in the laboratories and museums of the University, and is of the most practical character, every student being taught to make experiments and study specimens. Botanical instruction is given at the botanical laboratory. Dissecting microscopes are provided for students, and the garden and greenhouses afford ample material for the practical study of the science. All work is under the special supervision of Professors Goodale and Farlow. Similar facilities are afforded for the study of Zoölogy, Comparative Anatomy and Physiology, Geology, and Paleontology, at the laboratories of the Museum of Comparative Zoölogy, and of Mineralogy, at the Mineral Cabinet. The instruction in Experimental Chemistry and Physics is given in the laboratories, and the students are shown the best methods of illustrating experimentally the principles of these sciences.

2. Special courses in Botany, Chemistry, and Geology are given during the vacation to teachers and others who are unable to attend during term time.

3. There is no examination for admission to the Teachers' Course.

Special Students.—Persons who are not candidates for a degree, may enter the School as Special Students at any time, without examination, and pursue any of the courses of instruction, given in the school for which they are found competent. Such students, who have been members of this School for at least one year, shall be entitled to a certificate, specifying the subjects in which they have proved themselves proficient either by examination or laboratory work.

Instruction in Other Departments of the University.—All students of the Scientific School may, if found competent, pursue any of the courses of instruction given in the other departments of the University, except exercises carried on in the special laboratories, without additional charge.

Scholarships.—Four University Scholarships, of the annual value of one hundred and fifty dollars each, have been established in the Scientific School. They are assigned at the beginning of each academic year to meritorious students standing in need of such assistance, who have been in the School the whole of the preceding year, and propose to remain in it the whole of the ensuing year. The award is made by the Corporation on the recommendation of the Faculty. One-third of the annual value of the Scholarships is paid at the time of the award, one-third on January 12, and one-third on April 12, following. Applications for these scholarships must be addressed in writing, to the Dean, by the first of June. There are also scholarships in the Scientific School, not exceeding eight at any one time, of the annual value of one hundred and fifty dollars each, for the benefit of graduates of the State Normal Schools. The manner in which these scholarships are divided among the Normal Schools is determined by the State Board of Education. The incumbents are originally appointed for one year on the recommendation of the principals of the schools from which they have been severally graduated; these appointments may be annually renewed on the recommendation of the Faculty of the Scientific School.

Fees and Expenses.—The tuition fee for the academic year in any of the above departments or courses is $150. The tuition fees for candidates for the degree of Doctor of Science are stated in the Harvard University Catalogue, and in the Circular relating to the Graduate Department. The other expenses of a student for an academic year may be estimated as follows:—

Room	from $30 to $100
Board for thirty-eight weeks	from 133 to 304
Books	from 20 to 25
Fuel and lights	from 15 to 35
Washing	from 19 to 38
Total	$217 to $502

Scientific School bills are payable in each year on January 12, April 12, and October 10; but the third bill of all candidates for degrees must be paid at least one day before Commencement. Each bill will contain one third of the annual charges. When a student severs his connection with the School, his whole bill becomes payable at once. Deductions from the full year's tuition fee will be made as follows: If a student joins or leaves the School between January 1 and April 1, one third will be deducted. If a student joins the School between April 1 and Commencement, or leaves the School before January 1, two thirds will be deducted. But no deduction will be made in case of a student leaving the School, unless he gives immediate notice thereof, in writing, to the Dean and to the Bursar. Students in the Scientific School may obtain rooms in the College buildings by applying to the Bursar, either by mail or in person. They may also join the Harvard Dining Association, and board at cost at Memorial Hall. Students in Chemistry are supplied with all needed apparatus, but are required to restore it in as good condition as when received. They are charged for all damage or breakage, and also from ten to thirty dollars per annum for chemicals and use of apparatus. Students in Engineering provide their own drawing materials. The Hemenway Gymnasium, the Scientific School Library, and the College Library are open to members of this School without extra charge.

Testimonials and Bonds.—All students admitted to the Lawrence Scientific School must furnish satisfactory evidence of good moral character; give bonds in the sum of $200, signed by two bondsmen, one of whom must be a citizen of Massachusetts, for the payment of all dues to the University; and register their names with the Dean of the Faculty of the School. Instead of filing a bond, a student may deposit with the Bursar such a sum of money as may be deemed sufficient to secure the payment of all dues to the University. Students engaging College rooms, or boarding at Memorial Hall, will be required to file the same bond as undergraduates of the College ($400), or to pay rent for the year in advance, and deposit the sum of $200 as security for the payment of their board; and they hold the rooms subject to the regulations of the Parental Committee, in the same manner as if they were undergraduates. No officer or student of the University will be accepted as bondsmen.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON.

THE Massachusetts Institute of Technology provides a series of scientific and literary studies and practical exercises, embracing pure and applied mathematics, the physical and natural sciences, with their applications, drawing, the English language, history, political economy, international and business law, French and German, with other modern languages, if desired. These studies and exercises are so arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for most of the scientific professions. The following regular courses have been established:

1. A Course in Civil and Topographical Engineering. 2. A Course in Mechanical Engineering. 3. A Course in Mining Engineering, or Geology and Mining. 4. A Course in Building and Architecture. 5. A Course in Chemistry 6. A Course in Metallurgy. 7. A Course in Natural History. 8. A Course in Physics. 9. General Courses (A, B, and C).

The first five of these courses are of a distinctly professional character, the one in Metallurgy is similar to that in Chemistry, but has more particular reference to the production and working of the metals. The course in Natural History affords an appropriate general training for those whose ulterior object is the special pursuit of geology, mineralogy, botany, zoology, pharmacy, or rural economy. It is specially suitable for those who intend subsequently to enter the medical profession. The course in physics is based on the mathematical and physical sciences, and offers a suitable preparation for persons desirous of fitting themselves to teach physical science, as well as for those desiring to enter upon the pursuit of the various practical applications of Physics, as in electrical engineering, or in making physical tests of materials. In addition to the foregoing, certain general courses have been established for such as may not intend to adopt a distinctly scientific profession, yet desire to obtain an education through studies of a predominantly scientific character. These courses are especially recommended in the case of young men whose purpose it is to become merchants, manufacturers, or bankers, and who desire a preparation for active life, which shall be liberalizing in its tendencies, but without any influence to alienate them from the ideas, tastes, and habits which are appropriate to practical business pursuits.

Each of these courses contains a solid body of scientific study, and of scientific field or laboratory work. In the first, Physics, with the requisite Mathematics, predominates among the scientific studies; in the second, Chemistry, with the closely related sciences of Botany and Physiology; in the third, Geology, with Botany and Zoölogy, forming a thorough course in Biology, with field work and laboratory practice, especially with the microscope. While, in all the courses, it is intended to secure to the student a liberal culture, as well as the more strictly techical education which may be his chief object, in the courses under consideration, far more time will be devoted to the study of language, literature, history, and political, social, and industrial science than is found compatible with the requirements of the professional courses. The time which, in the latter, is given to the special technical study and work essential to the architect, the engineer, the naturalist, or the chemist will, in the courses under consideration, be given to more general studies which are of a nature to enlarge the views and enrich the life of the man of businesss. All the regular courses of the Institute, whether professional or general, extend through four years, and for proficiency in any one of them the degree of S. B., Bachelor of Science, is conferred. Students who find it advantageous to take fewer studies in any year than are prescribed in a single course may continue in the school a fifth year to make up the studies required for a degree. Advanced courses of study may be pursued, and the granting of the degree of Doctor of Science has been authorized by a vote of the Corporation. Provision is also made for persons who desire to pursue special portions only of any of the regular courses. At the request of the Woman's Education Association of Boston, and with their generous co-operation, special laboratories have been provided for the instruction of women. The design is to afford them facilities for the study of Chemical Analysis, Industrial Chemistry, Mineralogy, and Biology. The instruction is arranged for such students as may be able to devote their whole time to the work, as well as for those who, by reason of other engagements, can spend only a few hours a week in the exercises. Instruction will also be given to women in other subjects so far as suitable arrangements can be made for them. The Institute also provides afternoon and evening courses of instruction, scientific and literary, open to both sexes. At present the courses are free, being supported by the Trustees of the Lowell Institute. Fuller details are given under "Free Courses of Instruction.

FIRST TERM.

REGULAR COURSES.—*All Courses—First Year.*—Algebra continued; Solid Geometry; General Chemistry; Chemical Laboratory; Rhetoric; English Composition; French; Mechanical Drawing. Free Hand Drawing; Military on drill.

SECOND TERM.

Plane and Spherical Trigonometry; General Chemistry; Qualitative Analysis; Chemical Laboratory; English History; English Literature; French; Mechanical Drawing; Free Hand Drawing; Military Drill.

CIVIL ENGINEERING.

SECOND YEAR.—*First Term.*—Elementary Surveying. Field Practice. Plotting from Notes. Topography. Analytic Geometry. Descriptive Geometry. Physics. Descriptive Astronomy. English History and Literature. German.

Second Term.—Advanced Surveying. Leveling. Field Practice. Plans and Profiles. Differential Calculus. Physics. Physical Geography. English History and Literature. German.

THIRD YEAR.—*First Term.*—Roads and Railroads. Field Practice. Engineering Drawing. Integral Calculus. General Statics. Physics; Lectures and Laboratory work. Structural Geology. Constitutional History. German.

Second Term.—Graphic Statics. General Hydraulics. Rivers and Harbors. Locks, Dams, and Canals. Field Practice. Engineering Drawing. Strength of Materials. Kinematics and Dynamics. Physics; Laboratory Work. Historical Geology. Political Economy. German.

FOURTH YEAR.—*First Term.*—Framed Structures. Water Supply. Sewerage of Cities and Towns. Drainage and Irrigation. Details of Construction. Study of actual works. Practice in Design. Strength of Materials. Metallurgy.

Second Term.—Details of Construction. Study of actual works. Specifications and Contracts. Practice in Design. Theory of Elasticity. Dynamics completed. Building Materials. History of Engineering, Thesis Work.

MECHANICAL ENGINEERING.

SECOND YEAR.—*First Term.*—Setting of Machines. Transmission and Production of Power. Machine Drawing. Carpentry (shopwork). Analytic Geometry. Descriptive Geometry. Physics. Descriptive Astronomy. English History and Literature. German.

Second Term.—Kinematics of Machines. Graphical Kinematics of Machines. Machine Drawing. Pattern and Foundry Work (shopwork). Differential Calculus. Physics. Physical Geography. English History and Literature. German.

THIRD YEAR.—*First Term.*—Combustion of Fuel. Steam Generators and Steam Engines. Machine Drawing. Steam Engineering Laboratory. Blacksmithing (shopwork). Integral Calculus. General Statics. Physics; Lectures and Laboratory Work. Constitutional History. German.

Second Term.—Machine Design. Elements of Thermodynamics. Machine Drawing. Steam Engineering Laboratory. Chipping Filing (shopwork). Perspective. Strength of Materials. Kinematics and Dynamics. Physical Laboratory. Political Economy. German.

FOURTH YEAR.—*First Term.*—Machine Design. Measurement and Regulation of Power. Machine Drawing. Abstracts from Memoirs. Steam Engineering Laboratory. Blacksmithing (shopwork). Strength of Materials. Hydraulics. Metallurgy.

Second Term.—Thermodynamics of Steam and other Heat Engines. Pumping Engines, Hydraulic Motors, Machines, and Regulators. Steam Engineering Laboratory. Machine Design. Machine Drawing. Engine Lathe work (shopwork). Hydraulics. Theory of Elasticity. Dynamics completed. Building Materials. Thesis Work.

MINING ENGINEERING.—A.

SECOND YEAR.—*First Term.*—Blowpipe Analysis, Crystallography, and Determinative Mineralogy. Qualitative Chemical Analysis. Use of Surveying Instruments. Surveying. Field Practice. Drawing. Analytic Geometry. Physics. German.

THIRD YEAR.—*Second Term.*—Quantitative Chemical Analysis, Lectures and Laboratory work. Differential Calculus. Physics. Physical Geography. English History and Literature. German.

First Term.—Quantitative Chemical Analysis. Mining Engineering, Sinking, Timbering, Hoisting, Pumping, Ventilating, etc. Integral Calculus. General Statics. Physics; Lectures and Laboratory work. Structural and Chemical Geology. Constitutional History. German.

Second Term.—Mining Engineering continued. Assaying by Fire and by Wet Methods. Quantitative Chemical Anaylsis. Strength of Materials. Kinematics and Dynamics. Physical Laboratory. Historical Geology. Political Economy. German.

FOURTH YEAR.—*First Term.*—Quantitative Chemical Analysis. Mining Laboratory:—work upon Gold, Silver, Copper and Lead Ores in Quantity. Metallurgy, Lectures. Drawing. Strength of Materials. Dynamics completed. Memoirs.

Second Term.—Quantitative Chemical Analysis. Mining Laboratory as in 1st term. Metallurgy, Lectures. Ore dressing, Lectures. Welding and Tempering (shop-work).

GEOLOGY AND MINING.—B.

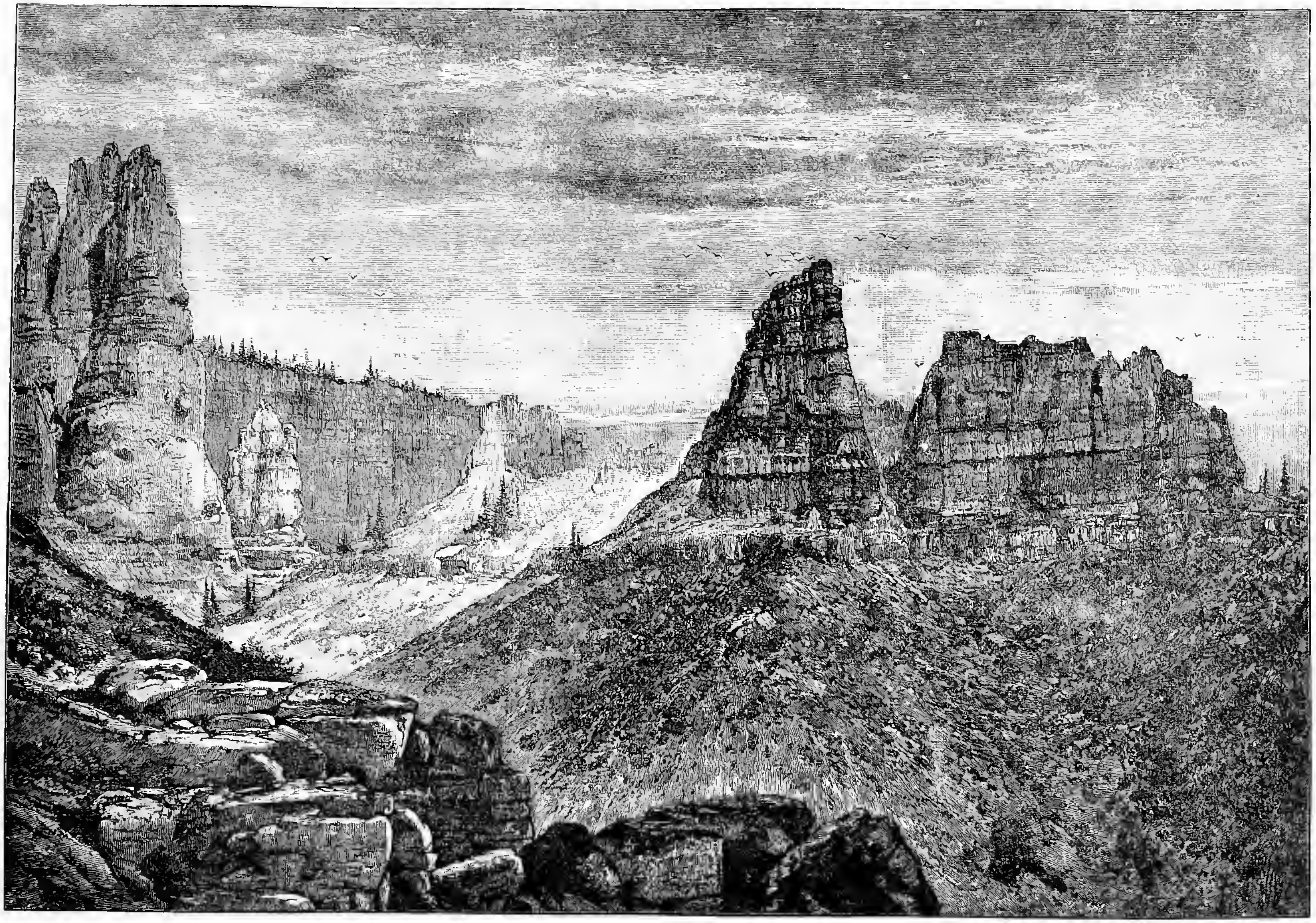
SECOND YEAR.—*First Term.*—Blowpipe Analysis, Crystallography, and Determinative Mineralogy. Qualitative Chemical Analysis. Use of Surveying Instruments. Surveying. Field Practice. Drawing. English History and Literature. Physics. German.

Second Term.—Quantitative Chemical Analysis, Lectures and Laboratory work. Physics. Physical Geography. Zoology. Palæontology. Botany. English History and Literature. German.

THIRD YEAR.—*First Term.*—Mining Engineering. Sinking Timbering, Hoisting, Pumping, Ventilating, etc. Quantitative Chemical Analysis. Zoology. Palæontology. Physics. Lectures, and Laboratory work, Structural and Chemical Geology. Constitutional History. German.

Second Term.—Mining Engineering continued. Assaying by Fire and Wet Methods. Quantitative Chemical Analysis. Industrial Chemistry. Physical Laboratory. Historical Geology. Political Economy. German.

FOURTH YEAR—*First Term*—Quantitative Chemical Analysis. Mining Laboratory:—work upon Gold, Silver, Copper, and Lead Ores in quantity. Metallurgy, Lectures. Drawing. Applied Physics. Memoirs.



WESTERN SCENERY—FINK CLIFFS—EOCENE—PAUNSAGUNT—GRAND CAÑON DISTRICT.

SEE PART X.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

Second Term—Quantitative Chemical Analysis. Mining Laboratory as in 1st term. Metallurgy, Lectures. Ore Dressing, Lectures. Welding and Tempering (shopwork). Building Materials. Thesis work.

CHEMISTRY.—A.

SECOND YEAR—*First Term*—Qualitative Analysis, Blowpipe Analysis, Crystallography and Determinative Mineralogy, Analytic Geometry, Physics, English History and Literature, German.

Second Term—Quantitative Analysis, Lectures, and Laboratory work, Chemical Philosophy, Differential Calculus, Physics, English History and Literature. German.

THIRD YEAR—*First Term*—Quantitative Analysis, Laboratory work, Quantitative Analysis, Special Methods, Work with the Microscope, Physics; Lectures and Laboratory work. Constitutional History, German.

Second Term—Quantitative Analysis, Laboratory work, Industrial Chemistry, Lectures, Drawing, Assaying, Physical Geography, Physical Laboratory, Political Economy, German.

FOURTH YEAR—*First Term*—Organic Chemistry, Lectures, Organic Chemistry, Laboratory work, Metallurgy, Lectures, Abstracts of Memoirs, Applied Physics, Optional Studies.

Second Term—Studies for this term, including Thesis work, will be specially assigned to each student.

CHEMISTRY.—B and C.—Second Year—*First Term*—Qualitative Analysis. Blowpipe Analysis. Crystallography, and Determinative Mineralogy. Descriptive Astronomy. Physics. English History and Literature. German.

Second Term—Quantitative Analysis, Lectures, and Laboratory work. Chemical Philosophy. Botany, Systematic and Structural. Physical Geography. Physics. English History and Literature, German.

THIRD YEAR.—*First Term.*—Quantitative Analysis, Laboratory work. Quantitative Analysis. Special Methods. Biology, Physics; Lecture and Laboratory work. Structural and Chemical Geology. Constitutional History, German.

Second Term.—Quantitative Analysis, Laboratory work. Industrial Chemistry, Lectures. Drawing. Assaying. Physical Laboratory. Historical Geology. Political Economy. German.

FOURTH YEAR—FIRST TERM.—*Course B.*—Organic Chemistry, Lectures. Chemistry. Laboratory work. Metallurgy, Laboratory work. Metallurgy, Lectures, Abstracts of Memoirs, Applied Physics, Optional studies.

Course C.—Organic Chemistry, Lectures. Chemistry, Laboratory work. Industrial Chemistry, Laboratory work. Metallurgy, Lectures. Abstracts of Memoirs. Applied Physics. Optional Studies.

FOURTH YEAR—*Second Term*—Studies for this term, including Thesis work, will be specially assigned to each student.

Candidates for the degree in Chemistry may elect either of the courses A, B, or C. Course A is for those who wish to continue the study of mathematics beyond the first year. Course B is for those who prefer a larger amount of the natural science; and course C for those whose aim is the pursuit of Industrial Chemistry.

METALLURGY.—Second Year.—*First Term*—Blowpipe Analysis, Crystallography, and Determinative Mineralogy. Qualitative Chemical Analysis. Descriptive Astronomy. Physics. English History and Literature. German. Drawing.

Second Term—Quantitative Analysis; Lectures, and Laboratory work. Chemical Philosophy. Botany. Zoology and Palæontology. Physical Geography. Physics. English History and Literature. German.

THIRD YEAR—*First Term*—Quantitative Analysis, Lectures. Quantitative Analysis, Laboratory work. Biology. Physics; Lectures, and Laboratory work. Structural and Chemical Geology. Drawing. Constitutional History. Zoology. Palæontology. German.

Second Term—Quantitative Analysis, Laboratory work. Industrial Chemistry, Lectures. Physical Laboratory. Historical Geology. Political Economy. German. Assaying.

FOURTH YEAR.—*First Term.*—Quantitative Analysis, Laboratory work. Metallurgy. Metallurgical Laboratory:—Work upon Gold, Silver, Copper, and Lead Ores in quantity. Drawing. Applied Physics. Blacksmithing (shopwork), Abstracts of Memoirs.

Second Term.—Quantitative Analysis. Laboratory work. Metallurgy and Ore-dressing. Mining Laboratory as in 1st term. Thesis Work. Building Materials. Drawing.

Advanced Courses.—The particular course of study which a candidate for the degree of Doctor of Science wishes to pursue must be submitted to the Faculty in writing, and must meet their approval. The minimum term of residence of candidates for this degree will be two years; but occasional short absences, when the time is spent upon professional work by advice of the Faculty, will not be considered as interruptions of the student's residence. Final examinations will be held, and the candidate will be required to present at least one printed thesis on some subject embraced in his course.

Conditions of Admission.—Regular Courses.—To be admitted as a regular student of the first year's class, the applicant must have attained the age of sixteen years, and must pass a satisfactory examination in:—

Arithmetic—(Including the metric system of weights and measures);

Algebra—Through equations of the second degree;

Plane Geometry.

French—Grammar through irregular verbs*; and the first two books of Voltaire's "Charles XII.," or an equivalent;

English grammar and composition;

Geography.

In general, the training given in the best high schools and academies will be a suitable preparation for this school; but applicants must be thoroughly prepared in the three Mathematical subjects above named.

Students will find their progress in Physics and Chemistry facilitated by making themselves thoroughly familiar with so much of Physics as is contained in Balfour Stewart's Primer of Physics.

A knowledge of the Latin language is not required for admission; but the study of Latin is strongly recommended to persons who purpose to enter this school, as it gives a better understanding of the various terms used in sciences, and greatly facilitates the acquisition of the modern languages. Those who intend to take a course in Natural History will find it advantageous to acquire also the elements of Greek.

In June, 1883, the requirements adopted by the New England Association of Colleges in Algebra; viz.: Algebra through Quadratics, including Arithmetical and Geometrical Progressions, the Binomial theorem with positive integral exponents and proportion; will be adopted as requirements for admission to the Institute. To be admitted as a regular student of the second year's class, the applicant must be at least seventeen years of age, and, besides passing the examination for admission to the first year's class, must pass a satisfactory examination in the first year's studies; and a like rule applies to the case of applicants for admission into the classes of the succeeding years. Graduates of Colleges will, in general, be presumed to have the requisite attainments for entering the third year as regular students, and may do so on satisfying the Faculty that they are prepared to pursue the proposed studies to advantage. Such students, if deficient in any of the scientific studies of the first two years, will have opportunities for making them up without extra charge, and will be required to pass an examination in them before entering upon the studies of the fourth year. Should they be already proficient in any of the general studies of the third and fourth year, they may be excused from attendance on the exercises in these subjects.

Special Students will be allowed to enter special divisions of either of the courses—as, for example, the classes of mathematics, chemistry, physics, drawing, engineering, metallurgy, architecture, natural history, etc.—on giving satisfactory evidence to the Faculty that they are prepared to pursue with advantage the studies selected. Information respecting the requirements for admission to each special course of study may be obtained on application to the Secretary. Examinations for the above-mentioned class of students will be held at the times of the regular entrance examinations as stated below. An examination for admission to the first year's class will begin at 9 A. M., on the Tuesday preceding the last Monday in September, and continue two days. Attendance on both days is required. Applicants for advanced standing must present themselves for further examination at 9 A.M., on the Thursday following the entrance examination. Applications for admission to the regular or special courses at other times than the above will be received only when sickness or some other equally good cause has prevented attendance on the days prescribed.

Advanced Courses.—Graduates of the Institute may enter on these courses without examination. Bachelors of Arts, Science, or Philosophy, of any other Institution, may enter on giving satisfactory evidence, by examination or otherwise, that they are qualified to pursue the course selected.

Methods and Apparatus of Instruction—*Ordinary Exercises.*—Instruction is given by lectures and recitations, and by practical exercise in the field, the laboratories, and the drawing-rooms. Text-books are used in many, but not in all departments. A high value is set upon the educational effect of laboratory practice, drawing, and field work.

Written Examinations.—Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. Near the close of the months of

*Part 1 of Otto's French Grammar represents what is required.

January and May general examinations are held. After the examinations, the standing of the student in each distinct subject is reported to his parent or guardian. The examinations of January and May form the basis of admonition or advice from the Faculty in the cases of students who are not profiting by their connection with the school.

The Instruction in Mathematics.—Great importance is attached to the study of mathematics both as a means of mental discipline and as affording a necessary basis for farther instruction in the professional courses. In the first year all regular students continue Algebra, and also study Solid Geometry, Plane and Spherical Trigonometry. In the following years, students in most of the courses receive instruction in Analytic Geometry, and in the Differential Integral Calculus.

The Instruction in Drawing.—During the first year, instruction is given to all regular students in the principles of Free-Hand and Mechanical Drawing and a large amount of time is devoted to practice in the drawing room, to enable the student to acquire the necessary skill and to prepare him for his future work. In subsequent years, Drawing is continued in connection with the professional studies.

The Instruction in Descriptive Geometry and Stereotomy.—The exercises in Descriptive Geometry are of two kinds. In the lecture room instruction with models and diagrams is combined with testing the student's knowledge as gained from the text book. In the drawing room the student aims to construct such problems, each week, from the lessons for that week, as shall, during the course, give him practice in all the usual operations belonging to the subject. The instruction in Stereotomy is given by means of lectures, and drawing exercises, illustrating a variety of problems in Stone Cutting, on plane, double-curved, and warped surfaces. The application of Descriptive Geometry is extended to the construction of the oblique arch, and winding staircases of various forms, so as to include a large number of useful and practical problems.

The Instruction in Chemistry,—In the laboratories provision is made for teaching General Chemistry, Qualitative Analysis, Quantitative Analysis, Organic Chemistry, Assaying, Determinative Mineralogy, Metallurgy, and Industrial Chemistry, the use of the blowpipe, as well as the use of the microscope, spectroscope, and other optical apparatus. Instruction in General Chemistry is given to all regular students by recitations and lectures, and by practical exercises in the laboratory, where every one is provided with a desk and the necessary apparatus, and is required to perform, under the supervision of the professor, a large number of experiments, selected to illustrate the laws of chemical action and the properties and relations of all the more important chemical elements. This is followed by a systematic course of instruction in Qualitative Analysis, with laboratory practice. In the second year those who require a fuller knowledge of chemistry continue Qualitative Analysis, and take up Chemical Philosophy, and Mineralogy with the use of the blowpipe. The principal subjects of study in the third and fourth years are Volumetric and Gravimetric Analysis, Organic Chemistry, Gas Analysis, Assaying, the Preparation of Chemical Products, Metallurgy, and Industrial Chemistry. A large portion of the time is alloted to work in the laboratories. In the third year, lectures are given on Quantitative Analysis, and on Physiological and Industrial Chemistry. In the fourth year the lecture room exercises are devoted to Organic Chemistry and Metallurgy. During the last two years the student is required to make reference to standard works and original memoirs in English, French, and German. Both regular and special students are encouraged to undertake experimental researches, and assist in bringing them to useful results. Arrangements will be made, as far as practicable, for the accommodation of students who wish to devote themselves to special subjects, such as Toxicology, Food and Water Analysis, Gas Analysis, Dyeing, Tanning, and other chemical arts. Special provision has been made for giving women ample opportunities for laboratory work in Chemistry, Mineralogy, and Biology. Each study may be pursued by itself, or in connection with studies in other departments of the Institute.

The Instruction in Theoretical and Applied Mechanics.—This instruction, which is given to all regular students of the courses of Engineering and Architecture, is begun about December 1st of the third year. During the third year the subjects studied are the composition and resolution of forces, the general laws of Kinematics and Dynamics mathematically discussed, the principles governing the determination of the stresses in the different members of trusses, centre of gravity, moment of inertia, and the ordinary principles of the strength of materials, this latter subject occupying fully half the time devoted to Applied Mechanics in the third year, and being subsequently completed in the fourth year. In this course the methods of the differential and integral calculus are freely used whenever they are the most convenient. In the fourth year's classes the subjects pursued by the students of each professional course are arranged with reference to the special wants of that course, and then two or more classes are taught together whenever the instruction to be given covers the same ground. This instruction embraces the completion of the study of Strength of Materials; Theory of Elasticity; main principles of the stability of arches and domes; Hydraulics, Thermodynamics, and special study of Dynamics. Through the kindness of certain friends of the Institute, a testing machine of 50,000 pounds capacity has been provided, capable of testing the tensile strength of specimens not more than 20 inches long, as well as the compression of small cubes, and it is now being arranged to test the transverse strength of beams 25 feet long. The classes are divided into small sections for the purpose of making, by the use of this machine, investigations on the strength and elastic properties of the materials used in construction.

The Instruction in Civil Engineering is given by means of lectures and recitations, and by practice in the field and in the drawing rooms. The use of the various instruments for measuring lines and angles, and of the level, plane-table, etc., is taught mainly by actual work in the field. The field-work embraces the various kinds of land surveying, Topography, Hydrography, and the several operations with the level and transit involved in Railroad, Hydraulic and Sanitary engineering. The work in the drawing room consists in representing upon paper the surveys made in the field, and in making both working drawings and finished plans from direct measurements of actual engineering structures, a large number of which are found in the immediate neighborhood of the Institute. The regular course in Civil Engineering embraces Roads, Railroads, Bridges, Rivers, Harbors, Canals, Water Supply and Sewerage, Drainage and Irrigation. In the lower classes, the student is held closely to the best text-books, but, as he advances, he works more and more without these aids; and during the last part of his course, while he makes constant reference to the best engineering books of this and other countries, he is, at the same time, brought into continual and direct contact with actual works in process of construction, and is made to see the exact connection between his theoretical acquirements and the real engineering practice of the day. In this manner he not only becomes familiar with the practical details of construction, but a new interest is given to the purely theoretical part of his studies.

The Instruction in Mechanical Engineering is given by means of lectures and recitations, and by practice in the drawing rooms, and in the Laboratory of Steam Engineering. Occasional excursions are made to enable students to witness running machinery, and manufacturing processes. The instruction in Mill-work treats of placing machinery in the manufactory, and of the distribution, measurement, and regulation of force and power. The instruction in the Kinematics of Machines treats of the motions and changes of motions which occur in machines, of those problems in machine design which relate to motions that machines are to produce, and of the comparative examination of equivalent mechanisms. The first term instruction in Machine Design treats of those dimensions of elements of machines that depend upon the force which a pair of elements may transmit, or upon the work-shop processes by which the elementary parts are produced. It also involves the application of principles of kinematics and dynamics of machines, in determining stresses and their fluctuations in machines and motors, and the applications of the principles of strength of materials, and of work-shop practice to the proper proportioning of the various parts. The instruction in Steam Engineering treats of the fundamental laws of thermodynamics, and their application to steam and other heat engines, of the combustion of fuel, of steam generators and their construction, of the mechanism of the steam engine, and of the characteristic features of typical steam, and other heat engines. The instruction in designing the parts of the steam engine is given under the head of Machine Design. The instruction in Hydraulic Motors and Machines treats of water-wheels, and of water pressure engines and machines. The practice in Drawing is carried on in conjunction with the lectures, and text-book study. It comprises tracing, copying, sketching from the structure, machine or motor, scale drawing from sketches, and the representation by curves of the results of experiments or of mathematical investigations; to which is added the reproduction of drawings by the "Blue Process." The Laboratory of Steam Engineering affords an opportunity of becoming acquainted, by experiment, with fundamental laws which underlie the practice of Steam Engineering. It also provides practice in adjusting, testing, and managing steam machinery and apparatus.

The Instruction in Mining is given to students of the third year by a course of eighty lectures on the general character of the various deposits of useful minerals, and on the theory and practice of mining operations, such as prospecting, boring, sinking of shafts, driving of levels, different methods of working, hoisting, pumping, ventilation, etc. These lectures are illustrated by drawings, and by a set of models from Freiberg, Saxony, which show in detail the methods of working underground, by underhand and overhand stoping, the timbering and walling of shafts and levels, the arrangement of pumps, man engines, ladder ways, hoisting ways, the sinking of shafts, etc. In the fourth year ore-dressing and metallurgy are taken up in a course of sixty lectures. This is accompanied by a series of continuous practical exercises in the concentration and smelting of ores in the Mining and Metallurgical laboratories. The professors in this department hope to give each student of Mining and Metallurgy at least one chance during his course of study to join a party organized for visiting some of the more interesting mining regions. The valuable scientific library of the late Prof. Henry D. Rogers, of the University of Glasgow, presented to the Institute by Mrs. Rogers, is accessible to the students in Geology and Mining.

The Mining and Metallurgical Laboratories.—These laboratories furnish to students in Mining and Metallurgy the means for studying experimentally the various processes of ore-dressing and smelting. Ores of different kinds may be here subjected, on a small scale, to the same modes of treatment as have been adopted at the best mining and metallurgical establishments. The experimental work of the laboratory is carried on by the students, under the immediate charge of an instructor. A sufficiently large quantity of ore is assigned to each student, who first examines it for its component minerals, sorts and samples it, and determines its character and value by analysis and assays, and makes such other preliminary examinations as serve to indicate the proper method of treatment. He then treats the given quantity, makes a careful examination of the products at each step of the process, ascertains the amount of power, water, chemicals, fuel, and labor expended, wherever practicable, and thus learns approximately the effectiveness and economy of the method adopted. Each student is assisted in working his ore by his classmates, who have an opportunity in this way to run the boiler, engine, machines, and furnaces. The Institute is from time to time receiving ores of gold, silver, lead, copper, antimony, zinc, iron, etc., from various localities. These ores are worked, and reports sent to those who contribute them; and it is hoped that, by the co-operation of those who wish to have examinations made, the laboratory will continue to receive the necessary amount and variety of ores.

Models etc., relating to the Engineering courses.—The collections under this head consist of models in wood, in metal, and in plaster, besides lithographs, photographs, and drawings collected in the United States and in Europe. They illustrate the following subjects:—General descriptive Geometry, Linear Perspective, Shades, Shadows and Reflections, Masonry and Stone Cutting, Joints, Girders and Trusses for wood and Iron Structures, Furnaces and Boilers, Steam and Water Motors, Machines and their details.

The Instruction in Mineralogy.—Determinative Mineralogy is taught by the study of crystalline forms and the physical properties of minerals, and use of the blowpipe, and by the handling of specimens. The collection of minerals in use for instruction is placed in the study room of the Mining department, and is thus ready for reference at any time.

The Instruction in Geology and Physical Geography.—The instruction in these branches has been so arranged that the topics to be taught may be presented in the order of their logical succession.

I. Forty-five lessons in Physical, including Dynamical Geology, are given during the second term of the second year. It is the aim of these lessons to lead the student to a scientific knowledge of the principal features of the earth's surface, their characteristics, classification, geographical relation, and the changes which they have experienced within the historic period. Frosts, glaciers, rains, streams, tides, volcanoes, earthquakes, plants, animals, etc., are considered as geological agencies, and also in their bearing upon navigation, the construction and maintenance of roads, and various works of improvement. The instructions of this term are likewise an important preparation for the studies in Structural and Historical Geology of the next year.

II. Thirty exercises in Structural Geology, including a systematic course in Lithology, are next given during the first term of the third year. Oral instruction and laboratory work are combined, the aim being to place in the hands of each student a specimen of each type to be considered. The principal structural features characterizing large masses of rocks, embracing stratification, joint structure, faults, folds, slaty cleavage, veins, dikes, etc., are taught as practically as circumstances will allow. This instruction is supplemented by frequent excursions to localities of geological interest in the vicinity of Boston. Fifteen lessons in Chemical Geology and the history of crystalline formations are then given, which comprise the formation, alteration, and decay of rocks, the origin of vein-stones and ore deposits, of rock-salt and mineral waters, and of coal and petroleum, also a general sketch of the chemical forces which co-operated with physical agencies in the formation of the earth.

III. Forty-five lessons in Historical Geology are then given during the second term of the third year. In these the outlines of the physical history of the earth are taught, and special attention is given to American geological history. The geological positions of ores and other economic products, and the modes of their occurrence, are taught in connection with the geological formations in which they are found. The instruction is made as practical as its limits will admit. A collection of specimens and a series of pictorial representations are employed in the illustration of this branch. During the summer vacations excursions of a few weeks are often made to regions where the fossiliferous formations are well developed. The instruction in Meteorology and Industrial Geography provides for an advanced course of study in the fourth year. It includes the outlines and industrial applications of Meteorological science, also the influences of geographical positions, physical features, climates, etc., upon the resources of countries, and upon the character and prosperity of nations.

The Instruction in Shop Work.—Shops or laboratories have been provided, and furnished with the more important hand and machine tools, so that the student may acquire a direct knowledge of the nature of metals, and woods, and some manual skill in the use of tools. Practical instruction in the nature of the materials of construction, and in the typical operations concerned in the arts, is considered a very valuable adjunct to the theoretical treatment of professsional subjects. Students in the course of Mechanical Engineering are required to devote a considerable amount of time to work in Carpentry, Wood Turning, Pattern Making, Moulding and Casting, Forging, Chipping and Filing, and Planing and Turning the metals, the design being to learn the principles, and not to manufacture articles for sale or use. Students in other departments will be allowed to take shop work when the time can be arranged so as not to interfere with their regular studies.

Excursions.—In aid of the practical studies of the school, and as a means of familiarizing students with the actual details of work, they are required, in term time, to make visits of inspection to machine-shops, engines, mills, furnaces, and chemical works, and to important buildings and engineering constructions within convenient reach. In the vacations more extended excursions are made for the survey of mines and geological features, and for the study of metallurgical works and noted specimens of engineering. In past years parties of students have in this way visited mines, furnaces, and engineering works in Nova Scotia, Vermont, New York, Western Massachusetts, Pennsylvania, Colorado, Missouri, and the Lake Superior copper and iron regions. During the past summer the students of Mining Engineering and Metallurgy, accompanied by two of the professors, made an excursion to the zinc mines of Franklin, N. J., the zinc and iron works at Bethlehem, Pa., the zinc mines at Friedensville, the burning coal mine at Summit, the coal mines and washers at Drifton, Pa., the coal mines and breakers at Wilkesbarre, the wire-cable works at Wilkesbarre, the Ashley Planes, the iron and steel works at Steelton, the extensive works of the Cambria Iron Co. at Johnstown, iron, steel, and glass-works at Pittsburg, the great iron-ore banks at Lebanon, the extensive bridge-works, the pottery, and the copper-works at Phœnixville, Pa., the copper, zinc, and chemical works at Bergenpoint, N. J.

Occasional Lectures.—In addition to the instruction given by the permanent corps of teachers, gentlemen in active life who are eminent in their respective professions will, from time to time, be invited to give courses of lectures on subjects of practical importance.

Scholarships.—A scholarship for regular students has been founded by the English High School Association, in memory of the late Thomas Sherwin, who, for more than thirty years, was the distinguished Master of the English High School in the City of Boston. Mr. Sherwin was also an active and influential member of the Corporation of the Institute. The pupil, to receive the benefit of this scholarship, is to be a graduate of the English High School in the city of Boston. Two scholarships were founded by the late James Savage, LL.D., the benefit of which is given to meritorious students on recommendation of the Faculty. Five advanced scholarships have been established, and will be awarded to such applicants as are recommended by the Faculty.

Degrees and Diplomas.—The degrees corresponding to the regular courses are as follows:—I. A Degree in Civil and Topographical Engineering. II. A Degree in Mechanical Engineering. III. A Degree in Mining Engineering, or in Geology and Mining. IV. A Degree in Building and Architecture. V. A Degree in Chemistry. VI. A Degree in Metallurgy. VII. A Degree in Natural History. VIII. A Degree in Physics. IX. A Degree in the General Course. To be entitled to any one of these degrees, the student must have passed satisfactory examinations in all the prescribed studies and exercises; and, in addition, a final or degree examination, embracing all the subjects which particularly relate to his course. He must, moreover, prepare a dissertation on some subject included in his course of study; or an account of some research made by himself; or an original report upon some machine, work of engineering, industrial works, mine, or mineral survey; or an original architectural design accompanied by an explanatory memoir. This thesis or design must be approved by the Faculty. Persons who have been admitted to departments of instruction in the school may, should they so desire, be examined for a degree, and, if found qualified to pass, under the prescribed conditions, they will be entitled to the appropriate diploma. The examinations for Degrees are held in the month of May. The title of the degree in each of the courses is S. B., or Bachelor of Science. The degree of S. D., or Doctor of Science, is awarded for proficiency in complete Advances of study. Besides the diplomas of the Regular and Advanced Courses, certificates of attainment in special subjects are given to such students as, on examination, are found to have the required proficiency in them.

Regulations of the School.—*School-year.*—The first term begins on the last Monday in September. There is a recess of one week after the semi-annual examinations, and the second term begins on the first Tuesday in February. On legal holidays, and on the Friday and Saturday following Thanksgiving day, the exercises of the school are suspended.

Bond or Deposit.—Every student is required, on entering the school, either to give a bond for two hundred dollars to pay all charges accruing under the regulations of the school, or to deposit, if he prefer so to do, the sum of two hundred dollars with the Bursar, to be accounted for at the end of the school-year, or whenever the depositor leaves the school, in case he leaves it before the end of the year. This deposit must be renewed at the beginning of each year. The bond must be executed by two bondsmen, satisfactory to the Bursar, one of them being a citizen of Massachusetts; and it must be filed within ten days after the date at which the student joins the school.

Fees.—The fee for regular students is $200 per year, $125 at the beginning, and $75 at the middle (First Tuesday in February) of the school-year. For one-half, or any less fraction, of the school-year, the fee is $125. Payment is also required of the cost of apparatus broken, or used up in the laboratories. Special students pay, in general, the full fee; but when a few branches only are pursued, and the time required for instruction is limited, some deduction may be made. The fee for students in the advanced courses is the same as that for regular students.

Attendance.—Regular students are expected to attend all the exercises of their several courses. Special students are expected to attend all the exercises in the subjects they have selected, unless excused by special vote of the Faculty. Students entering a lecture room, drawing room, or laboratory more than five minutes after the hour designated for the beginning of the exercise will be marked tardy. Students are, in general, expected to devote themselves to the work of the school between the hours of 9 A. M. and 4.30 P. M., except during the interval for dinner. There are no exercises on Saturday afternoon, and the rooms are closed.

Discipline.—While within the limits of the Institute, students are expected to behave with decorum, to obey the regulations of the school, and to pay a due respect to its officers. Every student will be held responsible for the furniture which he uses, and the cost of repairing any damage thereto will be charged to him. In case of injury to the building, or to any of the furniture, apparatus, or other property of the Institute, the damage will be charged to the student or students known to be immediately concerned; but if the persons who caused the damage are unknown, the cost of repairing the same will be assessed equally upon all the students of the school. Conduct inconsistent with the general good order of the school, if repeated after admonition, will be followed by suspension or dismissal. It is the aim of the Faculty so to administer the discipline of the school as to maintain a high standard of integrity, and a scrupulous regard for truth; and the attempt of any student to present as his own the work of another, or to pass any examination by improper means, is regarded as a most serious offence, and renders the offender liable to immediate expulsion.

Residence and Expenses.—As the exercises of the school begin at nine o'clock in the morning, and end at half-past four or five o'clock in the afternoon, students may conveniently live in any of the neighboring cities or towns on the lines of the various railroads, if they prefer to do so. The cost of board and rooms in Boston, and the neighboring cities and towns need not exceed from six to eight dollars a week. The cost of board at the Institute restaurant is three dollars and fifty cents per week, and conveniently located rooms may be found at a cost of two dollars and upwards additional per week. The cost of books, drawing instruments, paper, exclusive of chemical breakage, is from twenty-five to thirty-five dollars a year.

School of Mechanic Arts.—A School of Mechanic Arts, in which special prominence is given to *manual* instruction, has been established for those who wish to enter upon industrial pursuits rather than to become scientific engineers. This school is designed to afford such students as have completed the ordinary grammar-school course an opportunity to continue the elementry scientific and literary studies, together with mechanical drawing, while receiving instruction in the use of the typical tools for working iron and wood. The shop is conducted upon a plan designed at the Imperial Technical School of Moscow, Russia, and carried out there with satisfactory results. Its exact and systematic method affords the direct advantages of training the hand and eye for accurate and efficient service with the greatest economy of time; and the instruction in the use of tools and materials has also proved a valuable aid in intellectual development. The shop courses of the school are as follows:—

First year:—I, Carpentry and Joinery; II, Wood Turning; III, Pattern making; IV, Foundry Work.

Second year:—I, Iron Forging; II, Vise Work; III, Machine Tool Work.

The full course includes two years of theoretical and practical studies combined, and students who successfully complete it will receive a certificate, Students will be received for shorter times, and for special portions of the course. When it is desired, such provision will be made for advanced and specific shop work as is consistent with due attention to the regular classes. Students in this school are recommended to attend the exercises in Military Drill, and hours will be so arranged as to allow them to do so without detriment to their studies.

Applicants for the regular course must be at least fifteen years of age, and must pass a satisfactory examination in arithmetic, geography, and English composition. The tuition is $150 a year, with no extra charge for the use of tools, or materials, used in regular exercises. Special students, taking the same amount of shop work only as the regular class shop work, will be charged less. The student is entitled to the products of his work. Students while on the premises of the Institute, are expected to remain in the study room, except when at recitations or in the work shops. A monthly return of absences is made to the parent or guardian.

FIRST YEAR.—*First Term.*—Shop Work. Carpentry. Algebra commenced. English composition. Mechanical and Free hand Drawing.

Second Term.—Shop Work. Wood Turning, Pattern Making, Foundry Work. Plane Geometry. English Composition. Mechanical and Free hand Drawing.

SECOND YEAR.—*First Term.*—Shop Work.—Forging. Algebra completed. Elementary Physics. English Composition. Mechanical Drawing.

Second Term.—Shop Work.—Vise Work, Machine Tool Work. Geometry. Physics. English Composition. Mechanical Drawing.

The beginning and ending of the school-year and the days of entrance examinations are the same as in the School of Industrial Science. The two scholarships, founded by this Association, are awarded to sons of present or past members of the Association, on recommendation by the President and Secretary of the Association. The scholarship entitles the student to free tuition in the School of Mechanic Arts.

Free Courses of Instruction.—The Trustee of the Lowell Institute has established, under the supervision of the Institute of Technology, courses of instruction, generally given in the evening, and open to students of either sex, free of charge. These courses are more or less varied from year to year by the omission or interchange of particular subjects, but include in their entire scope instruction in mathematics, mechanics, physics, drawing, chemistry, geology, natural history, biology, English, French, German, history, navigation, and nautical astronomy, architecture, and engineering. The subjects, and the extent of the several courses, will be made known in October of each year. As it is the object of these courses to provide substantial teaching rather than merely popular illustrations of the subjects treated, it is expected that all persons attending these courses will come with a serious purpose of improvement, and that they will cheerfully comply with such rules as may be prescribed in regard to attendance and to order in the class or lecture-room. The conditions of attendance on these gratuitous courses are as follows:—

1. Candidates must have attained the age of eighteen years.
2. Their applications must be made in writing, addressed to the Secretary of the Faculty, specifying the course or courses they desire to attend; mentioning their present or prospective occupations; and, when the course is of a nature demanding preparation, stating the extent of their preliminary training.

The number of students in each class is necessarily limited.

CALENDAR.—Entrance Examinations, Tuesday, Sept. 19, 1882, and Wednesday, Sept. 20, 1882. Examinations for Advanced Standing, Thursday, Sept, 21, 1882. The next School year will begin Monday, Sept. 25, 1882.

Officers of Instruction.—Francis A. Walker, Ph. D., LL. D., President. William B. Rogers, LL. D., Professor Emeritus of Physics and Geology. John D. Runkle, Ph. LL. D., Walker Professor of Mathematics. William P. Atkinson, A. M., Professor of English and History. George A. Osborne, S. B., Professor of Mathematics. John M. Ordway, A. M., Professor of Metallurgy and Industrial Chemistry. Robert H. Richards, S. B., Professor of Mining Engineering, and Director of the Mining and Metallurgical Laboratories. William Ripley Nichols, S. B., Professor of General Chemistry. Charles P. Otis, A. M., Ph. D., Professor of Modern Languages. Charles H. Wing, S. B.. Professor of Analytical and of Organic Chemistry. Alpheus Hyatt, S. B., Custodian of Boston Society of Natural History, Professor of Zoölogy and Palæontology. William H. Niles, Ph. B., A. M., Professor of Geology and Geography. Channing Whitaker, S. B., Professor of Mechanical Engineering. Charles R. Cross, S. B., Thayer Professor of Physics. Gaetano Lanza, S. B., C. E., Professor of Theoretical and Applied Mechanics. George L. Vose, A. M., C. E., Hayward Professor of Civil and Topographical Engineering. Theodore M. Clark, A. B., Professor of Architecture. Eugene Letang, Assistant Professor of Architecture. Jules Luquiens, Ph. D., Assistant Professor of Modern Languages. William P. P. Longfellow, Adjunct Professor of Architectural Design. Charles Kastner, Lowell Instructor in Practical Design. Henry K. Burrison, S. B., Instructor in Mechanical and Free-Hand Drawing. Clarence W. Fearing, A. M., Instructor in the School of Mechanic Arts. Ellen H. Richards, A. M., S. B., Instructor in Chemistry and Mineralogy in the Woman's Laboratory. Silas W. Holman, S. B., Instructor in Physics. William O. Crosby, S. B., Instructor in Geology, Palæontology, and Mineralogy. Colonel John C. Chadwick, Instructor in Military Tactics. George F. Swain, S. B., Instructor in Civil Engineering. Wm. Henry Beeching, S. B., Assistant in Mechanical Engineering. W. Keltner Robbins, M. S., Assistant in Quantitative Analysis. Wm. H. Pickering, S. B., Assistant in Physics. Charles L. Adams, Instructor in Drawing in the School of Mechanic Arts. John Duff, Jr., S. B., Assistant in the Mining and Metallurgical Laboratory. William B. Lindsay, S. B., Assistant in General Chemistry and Qualitative Analysis. James Lund, S. B., Assistant in Quantitative Analysis. Evelyn M. Walton, S. B., Assistant in Chemistry and Biology. Frank W. Whitney, A. B., Assistant in General Chemistry and Qualitative Analysis. Artemas L. Tyler, Assistant in General Chemistry and Qualitative Analysis. George L. Perry, S. B., Assistant in Drawing. Charles M. Wilkes, S. B., Assistant in Applied Mechanics. Thomas Foley, Instructor in Iron Working. George Smith, Instructor in Wood Working. Arthur W. Sanborn, Assistant in Iron Working. William C. Fisher, Assistant in the Weaving Department of the Lowell School of Practical Design.

The instruction in Political Economy and in International Law is given by the President; that in Descriptive Geometry and Stereotomy by Professor Osborne; that in Descriptive Astronomy by Prof. Cross; and that in Botany and Biology by Prof. Ordway. The instruction in Quantitative Analysis in the Woman's Laboratory is also in charge of Prof. Ordway.

FACULTY.—Francis A. Walker, President, William B. Rogers, John D. Runkle, Willian P. Atkinson, George A. Osborne, John M. Ordway, Chairman, Robert H. Richards, Secretary, William Ripley Nichols, Charles P. Otis, Charles H. Wing, Alpheus Hyatt, William H. Niles, Channing Whitaker, Charles R. Cross, Gaetano Lanza, Jules Luquiens, George L. Vose, Theodore M. Clark.

A MINING LABORATORY.

A CLEARER insight into the work being accomplished at the Massachusetts Institute of Technology is afforded by the following paper on the Mining Laboratory connected with the Institute, read before the American Institute of Mining Engineers, by R. H. Richards, Professor of Mining, at the Institute.

Whether it was wise or not to establish a mining school so far from the principal mining centres, does not now enter into the question. Given, a mining school already begun, how shall it be made most efficient in developing engineers who are trained to think for themselves as well as versed in the works of others? This is the question with which we have had to deal. In considering the bearing of this laboratory work upon the students' preparation, it will be convenient to take it up under five different heads:

1. The methods and aims of the laboratory.
2. The advantage to students of having a part, at least, of their practical work in the curriculum of their school.
3. The advantage to be derived by mines and works.
4. Degree of accuracy which may be attained in working ores on a small scale.
5. Results of work in the laboratory.

1. *The Methods and Aims of the Laboratory.*—Perhaps the aims of the laboratory can be most clearly shown by illustration. Many young engineers leave school thinking that they know everything. They go to the works, and expect to teach the superintendent something and the men a good deal, regardless of the fact that it is this spirit that has prejudiced workmen against schoolmen. They are often more trouble than they are worth for a considerable period of time. They have simply learned metallurgical processes from books, but they have not derived from them a realizing sense of the meaning of the word economy, nor do they understand how to carry it out in actual practice. They are too apt not to perceive that the profit of works lies in the little savings in material, in labor, in time and power, etc., and that the difference between making these little savings and in not making them is almost always the difference between profit and loss, or between success and failure. In fact, our young engineers are not, as a rule, fully enough aware of the fact that failures in mines and works are quite as often the resnlt of errors in judgment as they are from poverty of the deposit or process. The aim of this laboratory is to correct this state of things, and to turn out men who have learned somewhat of the value of economy; who have found out by *their own* experience that little losses, taking place here and there and everywhere in their work, mount up enormously in their final account of stock.

For the sake of example, we will suppose that a silver-lead ore is given to a student who is entirely inexperienced in such matters, and who is inclined to be self-sufficient. On reading up, he finds that such ores, when worked on the large scale, are subject to a loss, which we will say is 15 per cent. of the silver, and which takes place largely in the smelting. He is surprised at this, and thinks it is a large loss, and expects to do as well or better. On taking account of stock, however, we will suppose he finds his losses are: silver in dust while crushing and handling, 2 per cent.; roasting, 15 per cent.; agglomerating, 3 per cent.; smelting, 15 per cent.; fume in refining, 2 per cent.; handling in refining, 6 per cent.; fume in cupelling, 4 per cent.; parting and recovering, 3 per cent.; total, 50 per cent. He is astonished to find that his total loss amounts to 50 per cent. and that by carelessness in handling alone, he has lost 11 per cent., the whole of which might have been obviated as well as not; that in roasting he used too high a heat, and in cupelling the same; that by having large condensing flues, he might have saved a large portion of the loss in smelting and refining. In fact, this man has either learned a lesson in the economy of metal working that will last him his life, or he has failed to learn it. In either case, whatever may be the risk incurred by a works in taking an untried man from a school, the risk is in some degree lessened by this test of the man. We believe that ability to offer to works a selection of men is all the incentive we need for developing this laboratory. We hold that the school owes a duty to the works as well as to the student, and that the supplying of works with good men is fully as important a duty of the school as the finding of places for the student.

The methods of working the laboratory will best be given by a brief description of the last year's work. The course began in February with a class of thirteen students. The work was allotted so that each student had the entire responsibility of a whole process or of a part of a process. A quantity of low grade ore from the Merrimac Mine, weighing $4\frac{1}{2}$ tons, was treated first. Two students, A and B, took charge of the mineral examination, and of the crushing and washing. They were assisted in the washing by their whole class, who had this opportunity to operate the washers, and to make themselves familiar with the principles on which they work. The class came on, five men at a shift, and they worked ten shifts of four hours each; in this way every man had an opportunity to work and to study every machine. The captains, A. and B., meantime took charge on the alternate shifts, so that one of them was always on hand to keep watch, and to see that waste did not take place, that samples were taken at the proper intervals, and that everything went on as it should. When the work was through, they dried, weighed, sampled, and assayed all the final products. They found out then whether the refuse was poor enough to throw away. They found out which machine did the greatest work, and which the least. In fact, they were in condition to report upon the economy of the process from beginning to end. They afterward made numerous tests on sands falling into water, and speculated on possible alterations which would be desirable if the washers were to be used exclusively for the ore in question. These tests were rendered possible by means of a series of samples which had been taken at every stage of the process. A, reported especially upon the crushing machines and the washing jigs, while B, reported upon the spitzkasten and on the tables which were used in washing. Three products were the result of this treatment:

1. Smelting ore. 2. Middle-grade ore. 3. Refuse.

C. and D. took charge of the smelting ore; this was first roasted in reverberatory furnaces. The whole class came on by shifts of four hours each, and the operation went on night and day continuously until finished. The total time required was 52 hours. C. and D. then agglomerated the ore, sampled it, analyzed it, and also their fluxes (limestone, tap cinder, magnetic iron ore, etc). They planned their smelting to obtain a given slag, matte, and metal. When it was smelted in the shaft furnace all the class came on by shifts, and by means of this run, and several others during the term, every man was able to serve in every place, and thus to learn the principles which underlie the whole operation, as well the details by which it is carried on in the laboratory. This smelting yielded—

1. Lead. 2. Matte. 3. Slag.

C. followed up the metal, and turned out silver, lead, and gold. D. followed up the matte, and turned out copper, lead, and silver. Their reports consist of a detail of the operations, results of analyses, and tables showing where, when, and how the losses took place, with suggestions as to how they would mitigate them another time. E. and F. undertook to work the middle-grade ore, and they tried the Ziervogle, Augustin, Von Patera, as well as roast, chlorination with amalgamation, and a number of other methods. They divided the processes, one taking the responsibility of a part, the other of the rest. They report moderate success in some and dead failures in others. A sulphuretted ore was allotted to G. and H. This ore, as a matter of course, required to be first roasted. We have two methods of roasting, by reverberatory furnace and by kiln. But as a kiln had never been tried in the laboratory, and as it was to a certain extent doubtful whether it could be made to work, a division was made. G. took the kiln roasting followed by the subsequent smelting, roasting and smelting, etc., while H took the method by reverberatory furnace, followed by the subsequent processes. This work was carried on in the same spirit as before indicated.

K. took up nickel, looked up the published methods, and experimented upon its extraction

L. worked a gold ore by Atwood's amalgamators, concentration, and gas chlorination. This method is still in its experimental condition with us.

M. had a barrel of quartz galena assigned to him.

N. had a barrel of silver ore assigned him, which was to be treated by pan amalgamation.

O. worked out a problem on a copper ore from a mine at Santa Fe. The question to be settled was whether it would pay best to turn out a slag lean in copper, and at the same time a pure copper pig, or to turn out a pure copper pig, and at the same time allow some metal to enter the slag. His results are very interesting.

Thus it will be seen that every student who has worked in the laboratory during the last year has not only had a definite work of his own to do, but has also had the opportunity to watch or to assist in a very considerable variety of other work.

2. *Advantage to the Student of having a part of his Practical Work in the curriculum of his School.*—We learn by our mistakes. Men can try, and fail; can find out usually why they failed; can repeat the work with the failure in part or in whole corrected. They can learn economy by their own lack of it. Large works cannot afford to spoil a charge to show a student what happens from a little carelessness. A well-regulated establishment may go on a long time without such a slip, and unless the superintendent is used to giving instruction, and takes pleasure in it, the student may be months at a works without finding out what the key to the success of the establishment is. Again, a student learns the value of chemistry as a check upon metallurgical work. Who would attempt to run a blast furnace on lead ores or on iron ores without knowing something about the composition of slags and of the fluxes at hand? The students here plan the proportion of the fluxes to be used from their own analyses of the same. And if they find from their reading that a slag of 30 per cent. SiO_2, 45 per cent. FeO, 15 per cent. CaO, 10 per cent. Al_2O_3, should give a good fusion and a slag clear of lead, they put in fluxes containing these elements in the above proportions, and when they get through they analyze their slag, to see if they got what they tried for and to see if it was as lean in lead as they wished it to be. But perhaps the greatest advantage of all to the student, and the one which will stay with him through his whole life long, is the spirit of investigation which is awakened by his work, and which is made evident by the questions he asks, and by the zest and intelligence with which he carries on his work. This we consider has been proved beyond all question. We wish to disclaim any pretensions which we may be supposed to have that this laboratory is in any sense of the word a substitute for the works. What we do claim is that it prepares students to go into works and profit by them.

3. *Advantage to Works.*—We have already noticed one advantage, viz., that the men have had a chance to test themselves and find out where they are weak. There is, however, another advantage which may grow out of their experience in the laboratory. These men are used to testing processes on a small scale, and if they are, when older, called upon to erect costly works and to devise new and expensive processes, they will naturally spend a thousand or two dollars in trying the process practically. Most of us are familiar with large and costly failures which might have been prevented if the process had been studied in this way. For while work on the small scale does not pretend to deal with the relation between the cost of production, of transportation, and the market value, it does test most thoroughly the chemical and mechanical principles on which the process must depend. Again, this practical work enables us to make a far more just division of hand-men from head-men than could possibly be made from recitations and examinations alone. And if we have an application for a man who may by-and-by be needed to superintend, we recommend a very different man from what we do when we were asked for an analyst or a surveyor.

Advantage to Mines of having their own Ores treated in the Laboratory.—We will cite one example. The Merrimac Mine of Newburyport has recently called an engineer from a distance to systematize their smelting works. He informs me that the figures furnished by the students were of very great value to him in planning his ore charge. And again, as soon as the mine is prepared to establish washing-works, and the matter is under consideration at the present time, the results of our washers will be at their service. To sum up what has been said: We believe that such a course of instructions will bring out latent originality if a student has anything of it in his composition, and that, if he is nothing but a copyist, his instructors, as well as the man himself, will be convinced of the fact before he leaves his school; and again, that such instruction will enable him to profit far more by his visits to works, or studies in them, than he otherwise would. The testimony of graduates of the school and of their employers bear us out in the above statements.

4. *Degree of Accuracy of working Ores on the Small Scale as compared with the Large Scale.*—On the large scale the operations are continuous. If a little is left by one charge, it is taken up by the next one, and does not affect the total. On the small scale, however, what is lost in one charge by carelessness is not picked up by the next, because there is no next charge to follow it. In large works men are chosen to fill places by their skill or aptness for those places. On the same scale the students spend a part of the time of doing the work in learning how to do it. To be sure they learn vastly quicker than the ordinary hands who are usually employed for such work; but still this does not wholly make up for their lack of skill in the first instance, nor does it make the small works quite on a par with the large ones in this respect.

5. *Results of Work in the Laboratory.*—The following examples will serve to show the kind of work that is done by the students, as well as the scale of it and the degree of accuracy attained. A lot of poor ore from the dump heap of the Merrimac Mine of Newburyport, weighing 8485 pounds, was crushed and washed to separate the argentiferous materials from the gangue rock, and yielded these proportions:

1. A smelting ore . .	weighing	624¼	pounds.
2. A middle-grade ore .	"	1823½	"
3. Refuse . . .	"	6016⅛	"

Referring this yield to one ton of crude ore, the intrinsic value of the metals in the products obtained from it would be:

1. Smelting ore, 147.14 lb., containing					
	39.4	per cent. lead, or	57.92	lb., or	$3 47
	0.7	" silver, or	.103	"	1 73
	.0024	" gold, or	.00353	"	1 06
					$6 26
2. Middle-grade ore, 429.8 lb., containing					
	9.11	per cent. lead, or	39.15	lb., or	$2 35
	.031	" silver, or	.133	"	2 13
	.00114	" gold, or	.0049	"	1 47
					$5 95
3. Refuse, 1418.06 lb. containing					
	1.25	per cent. lead, or	17.72	lb. or	$1 06
	.0116	" silver, or	.1645	"	2 63
					$3 69
				Total	$13 37

The ore itself was valued for lead and silver, but not for gold, with this result:

1 ton contained	5.23 per cent. lead,	104.6 lb.	$6 28	
	.02 per cent. silver,	.4 "	6 42	
				$12 70

The values of the above products would be:

1 ton smelting ore,	39.4	per cent. lead,	788 lb.	$47 28	
	.07	" silver,	20.41 oz.	23 47	
	.0024	" gold,	.6998 oz.	14 42	
					$85 17
1 ton middle-grade ore,	9.11	per cent. lead,	182 lbs.	$10 92	
	.031	" silver,	9.039 oz.	9 94	
	.00114	" gold,	.3324 "	6 85	
					$26 49
1 ton refuse .	1.25	per cent. lead,	25 lb.	$1 50	
	.0116	" silver,	3.382 oz.	3 72	
					$5 22

A lot of lead ore, composed chiefly of galena with a little pyrite, blende, quartz, and feldspar, from ore of the veins crossed by the Burleigh tunnel of Georgetown, Colorado, was roasted, agglomerated, smelted, refined, and cupelled. It gave the following results:

Ore, ...	1100 lb. at 67.37 per cent. lead, 675-07 lb.	.095 " silver, 15.24 oz.
After roasting and agglomerating . . .	996¼ lb. at 60.68 per cent. lead, 604.52 lb.	.086 " silver, 12.48 oz.
After smelting and refining to soft lead . .	429.75 lb. at 98.95 per cent. lead 425.24 lb.	1.97 " silver, 12.33 oz.

From which it appears that the loss in roasting and agglomerating was 70.55 pounds lead and 2.76 ounces silver; smelting and refining was 179.28 pounds lead, and .15 ounce silver. This loss in silver is too little to represent the truth, as 12.33 ounces is known to be too high, the sample was taken from the tops of the pigs. The zincing was accomplished by stirring in one per cent. of zinc with melted lead and then casting it in ingots and sweating it. This operation was repeated three times, and each time yielded a rich argentiferous zinc dross and a poorer zinciferous lead; the actual weight of silver in each of these six products is here given:

429.75 pounds refined lead, at .197 per cent. contains 12.33 oz. silver.
1st. Argentiferous dross, 9.73 oz. silver (a little high), sample poor.
1st. Sweated lead, - 3.09 " by assay.
2d. Argentiferous dross, 2.895 " (by difference).
2d. Sweated lead, - .195 " by assay.
3d. Argentiferous dross, .145 " (by difference).
3d. Sweated lead, - .059 " by assay.

This last sweated lead contained but .001 per cent. of silver. The distilling and final cupelling were not as successful as the rest, as from breaking of the cupel and other mishaps only 9.73 ounces of pure silver were obtained. A copper ore from Santa Fe was worked by a student who was preparing himself to go to the mine. His main object was to experiment on slag, to find out a suitable composition that would yield soft, clean copper in the blast furnace. The ore was composed of malachite, chrysocolla, cuprite, atacamite, with a very large quantity of grossularite (lime garnet), and also quartz, calcite, and a little pyrolusite. Its chemical composition is given in the table below. The run was divided into halves; after the first was through, the furnace was run out and then charged up again with a new mixture. During the first run the slag was planned to carry a high per cent. of iron, during the second run it was planned for a high per cent. of lime. The results are as follows:

		First-run Slags.		Second-run Slags.	
	Ore.	As planned.	As obtained.	As planned.	As obtained
SiO_2, . . .	38.40	40	46.07	46.	49.90
Al_2O_3, . . .	14.95	16	20.92	17.5	10.53
Fe_2O_3, . . .	13.11	..	....	....	.....
FeO,		34	16 65	15.	14.17
Cao, . . .	10.63	10	7.01	21.05	20.61
MgO . . .	trace	..	trace	....	.20
MnO, . . .	.80	..	2.35	....	.43
Cu, ...	12.32	..	1.23	....	1.55
H_2O & CO_2, etc. undetermined.					

It will be noticed at once in the first-run slag as obtained a monstrous deficiency in FeO. This will be accounted for by the pig copper from this run, which contained 18 per cent. iron. The second run was much more nearly adjusted to suit the furnace reactions, as is shown by the slag, which is not very far from the plan, and also by the copper, which was soft and malleable, and contained but .3 per cent. iron.

CORNELL UNIVERSITY, ITHACA, N. Y.

THE existence of Cornell University is due to the bounty of the United States and of Ezra Cornell. On the second of July, 1862, Congress passed an act granting public lands to the several states which should "provide at least one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts." Thirty thousand acres for each of its senators and representatives in Congress were appropriated to every state; and the share of the State of New York was nine hundred and ninety thousand acres in land scrip. On the twenty-seventh of April, 1865, the legislature of New York incorporated "The Cornell University," appropriating to it the income arising from the sale of this land scrip. The most important conditions were, that Ezra Cornell should give to the University five hundred thousand dollars; that it should give instruction in branches relating to agriculture, mechanic arts, and military tactics; and that it should receive, without charge for tuition, one student annually from each assembly district. Mr. Cornell fulfilled the first requirement of the charter, and made an additional gift of more than two hundred acres of land, with buildings, to be used as a farm in connection with the department of agriculture. The act of incorporation satisfies the condition of the congressional grant by providing for instruction in such branches of learning as are related to agriculture and the mechanic arts, and in military tactics, "in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." And it further declares that "such other branches of science and knowledge may be embraced in the plan of instruction and investigation pertaining to the University, as the trustees may deem useful and proper." The University, organized in accordance with the requirements of its charter, was opened on the seventh of October, 1868.

FACULTY.—(Arranged, with the exception of the Officers of the Faculty, in the order of seniority of appointment), Hon. Andrew Dickson White, LL.D., President, Professor of History. Rev. William Dexter Wilson, DD., LL.D., L.H.D., Registrar, Professor of Moral and Intellectual Philosophy. Daniel Willard Fiske, A.M., Ph.D., Librarian, Professor of North European Languages. George Chapman Caldwell, B.S., Ph.D., Professor of Agricultural and Analytical Chemistry, and Secretary of the Faculty. Burt Green Wilder, B.S., M.D., Professor of Physiology, Comparative Anatomy, and Zoölogy. James Law, F.R.C.V.S., Professor of Veterinary Medicine and Surgery. Albert Nelson Prentiss, M.S., Professor of Botany, Horticulture, and Arboriculture. John Lewis Morris, A.M., C.E., Sibley Professor of Practical Mechanics and Machine Construction. Thomas Frederick Crane, A.M., Professor of Spanish and Italian, and Acting Professor of French. Ziba Hazard Potter, A.M., M.D., LL.B., Assistant Professor of Mathematics, and Medical Examiner. Charles Ashmead Schaeffer, A.M., Ph.D., Professor of General and Analytical Chemistry, and of Mineralogy. Frederick Otto Louis Rœhrig, Ph.D., M.D., Professor of Sanskrit and Living Asiatic Languages, and Assistant Professor of French. Hiram Corson, A.M., LL.D., Professor of Anglo-Saxon and English Literature. Waterman Thomas Hewett, A.M., Ph.D., Assistant Professor of German. Bela Phillips Mackoon, A.M., Associate Professor of German. Alfred Stebbins, A.M., Assistant Professor of South European Languages. Lucien Augustus Wait, A.B., Associate Professor of Mathematics. Isaac Flagg, Ph. D., Professor of the Greek Language and Literature. Charles Chauncy Shackford, A.M., Professor of Rhetoric and General Literature. Rev. Charles Babcock, A.M., Professor of Architecture. James Edward Oliver, A.M., Professor of Mathematics. William Arnold Anthony, Ph.B., Professor of Physics and Experimental Mechanics. Estevan Antoni Fuertes, Ph.B., C.E., Professor of Civil Engineering. Edwin Chase Cleaves, B.S., Associate Professor of Freehand Drawing and Mechanical Drawing. Isaac Phillips Roberts, M.Agr., Professor of Agriculture. Abram Adam Breneman, B.S., Professor of Industrial Chemistry, and Assistant Professor of Analytical Chemistry. Charles Lee Crandall, C.E., Assistant Professor of Engineering. Irving Porter Church, C.E., Assistant Professor of Engineering. Horatio Stevens White, A.B., Professor of the German Language and Literature. John Henry Comstock, B.S., Assistant Professor of Entomology, and Lecturer on the Zoölogy of Invertebrates. William Russell Dudley, M.S., Assistant Professor of Botany. James Brattle Burbank, Brevet Maj. 3d Art., U.S.A., Professor of Military Science and Tactics. George William Jones, A.M., Assistant Professor of Mathematics. Samuel

Gardner Williams, A.M., Ph.D., Professor of General and Economic Geology. Henry Shaler Williams, Ph.D., Assistant Professor of Palæontology. William Rufus Perkins, A.B., Assistant Professor of Latin and Greek. George Sylvanus Moler, B.M.E., Assistant Professor of Physics William Gardner Hale, A.B., Professor of the Latin Language and Literature. Walter Craig Kerr, B.M.E., Assistant Professor of Mechanics. John Burkitt Webb, C.E., Professor of Applied Mathematics and Theoretical Mechanics. Simon Henry Gage, B.S., Assistant Professor of Physiology, and Lecturer on Microscopical Technology. William Edward Lucas, Ph.B., Assistant Professor of Rhetoric and Composition. Charles Francis Osborne, Assistant Professor of Architecture. Moses Coit Tyler, LL.D., Professor of American History and Literature.

Lecturers and Non-Resident Professors.—Goldwin Smith, LL.D., L.H.D., Lecturer on English Constitutional History. Charles Hallet Wing, B.S., Non-Resident Professor of Organic Chemistry. Herbert Tuttle, A.M., Non-Resident Professor of International Law. Henry Carter Adams, Ph.D., Non-Resident Professor of Political Economy. Charles Kendall Adams, LL.D., Non-Resident Professor of English Constitutional History. Edward Augustus Freeman, D.C.L., Oxon., Lecturer (for the current year) on General European History.

Instructors.—Madison Monroe Garver, B.S., Instructor in Chemistry and Mineralogy. Stephen Moulton Babcock, Ph.D., Instructor in Chemistry. George Lincoln Burr, A.B., Instructor and Examiner in Modern History.

Other Officers.—Wesley Newcomb, M.D., Curator of the Newcomb Collection of Shells. George William Harris, Ph.D., Assistant Librarian. Spencer Baird Newbury, E.M., Ph.D., Chemical Analyst to the Agricultural Station. Benjamin Hermon Smith, Director of the University Press. George W. Tailby, Foreman of the Farm. Miles Lorin Clinton, Foreman of the Machine Shop. Albert Franklin Matthews, Master of the Chimes. William Ogden Kerr, Meteorological Observer. Ernest Emmery Russell, Janitor.

Chemistry and Physics.—The President, Professor Schaeffer, Professors Anthony, Caldwell, Breneman, and Moler.

Civil Engineering.—The President, Professor Fuertes, Professors Anthony, Babcock, Morais, Oliver, Schaeffer, Church, and Crandall.

Mathematics.—The President, Professor Oliver, Professors Anthony, Babcock, Fuertes, Morris, Webb, Wait, Jones, and Potter.

The Sibley College of Mechanic Arts.—The President, Professor Morris, Professors Anthony, Babcock, Fuertes, Webb, Oliver, Kerr, and Cleaves.

ADMISSION.—All candidates for admission, except those provided with certificates or diplomas as specified below, are examined as follows:

1. In *English Grammar;* Whitney's Essentials of the English Grammar is the standard. A short composition is required as a test of the candidate's knowledge of spelling, punctuation, the use of capitals, and elementary English construction.

2. In *Geography,* political and physical; as much as is contained in Harper's School Geography, or in Warren's Common School Geography.

3. In *Physiology;* as presented in the smaller text-books upon the subject, exclusive of the nervous system and the names of bones and muscles.

4. In *Arithmetic,* including the metric system of weights and measures; as much as is contained in the larger text-books.

5. In *Plane Geometry;* as much as is contained in the first five books of Chauvenet's Treatise on Elementary Geometry, or in the first five books of Wentworth's Elements of Plane and Solid Geometry, or in the first five books of Newcomb's Elements of Geometry.

6. In *Elementary Algebra,* through quadratic equations, and including radicals and the theory of exponents; as much as is contained in the first twelve sections of Loomis's Treatise on Algebra, or in Olney's Elementary Course in Algebra, or in the first five sections of Robinson's University Algebra.

In place of these examinations certain certificates or diplomas are received as follows:

1. *Certificates* issued by the *Regents* of the State of New York are accepted instead of the examinations in English Grammar, Geography, and Arithmetic.

2. *Certificates* issued by the *Superintendent of Public Instruction* of the State of New York, and *Diplomas* issued by the state normal schools, and by those academies and high schools of the State of New York whose requirements for graduation have been approved by the Faculty, and whose course of study requires Physiology and Plane Geometry, are accepted instead of the examinations in all the subjects named above *except Algebra.*

3. *Diplomas* issued by the *Regents* to graduates from the high schools and academies of the State of New York are accepted instead of the examinations in all the subjects named.

Candidates must be of good moral character and at least *sixteen* years of age, or, if women, *seventeen.*

The requirements for admission to the courses in *Agriculture, Architecture, Civil Engineering* and *Mechanic Arts,* are the same as those for admission to the University; but for admission to any of the other regular courses of study, the examinations, *in addition to the Primary Examinations* are as follows:

To the Courses in Science, Science and Letters, Mathematics, and Chemistry and Physics.

In addition to the primary Examination, an examination in *any one* of the following sets of subjects;

1. In *French,* the principles of French Grammar, the translation of English into French, and three books of Voltaire's Charles XII or its equivalent; *or,*

2. In *German,* the whole of Whitney's German Grammar, translation of German at sight, the translation of English into German, and one hundred pages of Whitney's Reader, including two of the longer prose extracts or an equivalent, *or*

3. In *Mathematics,* Solid Geometry and Conic Sections, as much as is contained in Newcomb's Elements of Geometry; Advanced Algebra, as much as is contained in Olney's University Algebra, or in Newcomb's Algebra; and Trigonometry, Plane and Spherical, as much as is contained in Wheeler's Elements of Trigonometry, or in the unstarred portions of Oliver, Wait, and Jones's Treatise on Trigonometry.

Admission to Special Departments.—Any person at least twenty-one years of age, and having satisfactory attainments, may be admitted without examination, by a vote of the Faculty, to any of the Departments in which either laboratory work or drafting is required, on the recommendation of the professor in charge of the department. Such special students are required to devote at least fifteen hours a week to the work of the department which they have entered, and to renew their application for admission at the end of each year.

Admission to Advanced Studies.—Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations* for that course, examinations in the work already performed by the classes which they design to enter.

Candidates from Other Colleges.—Certificates of honorable dismissal from other colleges are received in place of the *Primary Examination* only, and when offered by those who *have passed at least one term's examinations* at the institution granting such dismissal. No person, whether from another college or not, is admitted to *advanced* studies except after examination as above stated.

Admission to Graduate Study.—Students are admitted to graduate study after having taken a baccalaureate degree in this University, or on presenting the diploma of any equivalent degree conferred elsewhere; they are at liberty to attend lectures, recitations, or other exercises of undergraduates, and to use the library, museums, etc. They are expected to pursue some study of advanced character under the direction of a professor or a special faculty.

MECHANIC ARTS.—In 1870, Hon. Hiram Sibley, of Rochester, N. Y., provided for the erection of a suitable building for the Department of Mechanic Arts. He also gave ten thousand dollars for increasing its equipment of tools, machines, etc., and has since made a further gift of thirty thousand dollars for the endowment of the professorship of the Practical Mechanics and Machine Construction. Still later, he provided the means for erecting and fitting up a brass and iron foundry, and a blacksmith shop. Closely connected with the lecture-rooms are the rooms for freehand and mechanical drawing, the designing of machinery, and pattern-making, and the machine shop. The shop practice embraces work requiring the use of all hand-tools and the machines employed in the ordinary machine shops. Each student in the department is required to devote two hours a day to work in the shop; but such students as have, before entering, acquired sufficient practical knowledge, are admitted to advanced standing. Attendance is required upon ten lectures or recitations a week, or their equivalent, in addition to two hours daily drawing, two hours daily shop-work, and the passing of the examinations at the close of each term.

The machine shop is used for the sole purpose of giving instruction in practical work. It is supplied with lathes of various kinds, planers, grinding machinery, drilling machines, shaping machines, a universal milling machine fitted for cutting plane, bevel, and spiral gears, spiral cutters, twist drills, with additional tools and attachments for graduating scales and circles, and for working various forms and shapes. In addition to the hand and lathe tools of the usual kinds there are tools of the greatest accuracy, consisting of standard surface-plates, straight-edges, and squares of various sizes, a standard measuring machine, measuring from zero to twelve inches by the ten-thousandth of an inch, a universal grinding machine for producing true cylindrical and conical forms, and a set of Betts's standard gauges. In the iron and brass foundry and the blacksmith shop, instruction is given in molding, casting, and forging. The cupola used is one of Colliau's improved, with a capacity of melting one ton of iron per hour. For the purpose of instruction in experimental work there is a twenty-ton Riehle testing machine, arranged for testing the strength of materials by tension, compression, and transverse strain; Richards's and Thompson's steam-engine indicators, and Amsler's planometer; Schaeffer & Budenberg's revolution counter, steam-gauges, injector, inspirator, pop-valve, steam pump; Baldwin's link and valve motion, experimental valve motion, together with a large collection of brass, iron, and wooden models illustrative of mechanical principles. The course of instruction in mechanical drawing is progressive, from geometrical drawing to the designing of machines and the making of complete working drawings. The appliances for instruction consist of several hundred drawings selected from those of technical schools abroad, and from representative American steam-engine makers and others; of photographs, models, and machines; and of apparatus used in copying by the "blue print process."

THE COURSE IN MECHANIC ARTS.—Leading to the Degree of Bachelor of Mechanical Engineering.

FIRST YEAR—*First Term*—German, 5; geometry and conic sections, 5; freehand drawing, 3; shop-work, 3.

Second Term—German, 5; algebra, 5; freehand drawing, 3; shop-work, 3.

Third Term—German, 5; trigonometry, 5; geometrical drawing, 3; shop-work, 3.

SECOND YEAR.—*First Term*—German, 3; rhetoric, 2; analytical geometry, 5; experimental mechanics and heat, 3; shop-work, 3.

Second Term—German, 3; rhetoric, 2; calculus, 5; electricity and magnetism, 3; shop-work, 3.

Third Term—Calculus, 5, descriptive geometry, text and drawing, 4; mechanical drawing, 2; building materials, 3; shop-work, 3.

THIRD YEAR—*First Term*—Calculus and analytical geometry, 5; descriptive geometry, text and drawing, 6; mechanism, 3; shop-work, 3.

Second Term—Mechanics of engineering, 5; mechanism, 3; physics, laboratory work, 3; chemistry, 3; shop-work, 3.

Third Term—Mechanics of engineering, 5; mechanical drawing, with shades, tinting, and perspective, 3; physics, laboratory work, 3; chemistry, 3; shop-work, 3.

FOURTH YEAR.—*First Term*—Mechanics of engineering, 5; mechanical and working drawings, 3; physics, laboratory work, 3; steam-engine, 3; shop-work, 3.

Second Term—Mechanical drawing, 4; steam-engine, 3; metallurgy, 2; experimental work with indicators, governors, pumps, and injectors, 3; shop-work, 3.

Third Term—Graphical statics, 3; field practice and the use of instruments, 3; industrial chemistry, 3; technical reading and preparation of thesis, 3; shop-work, 3.

GRADUATE COURSE.—*First Term* — Machines for regulating, counting, etc., 3; mechanical or physical experiments, or chemistry, 3; riparian laws, contracts, patent office laws, etc., 2. *Elective*, 7.

Second Term—Machines for change of form, 3; mechanical or physical experiments, or chemistry, 3; technical reading, 2. *Elective* 7.

Third Term—Locomotive machines, hoists, cranes, etc., 3; mechanical or physical experiments, or chemistry, 3; shop systems and accounts, 2. *Elective*, 7.

The elective studies are hydraulics, assaying, mineralogy and blow-pipe analysis, chemical laboratory practice, physics (acoustics and optics), motors other than steam, architecture, civil engineering, shop-work, mathematics, botany, French, rhetoric, history, literature.

The White Architectural Library contains over one thousand volumes, and the photographic gallery nearly two thousand prints, all accessible to the student. Seven hundred drawings, and about two hundred models in wood and stone have been prepared to illustrate the constructive forms and peculiarities of the different styles.

CIVIL ENGINEERING.—The instruction is given by means of lectures and recitations, with drafting and field laboratory practice. The field work embraces the usual operations and the more recent methods of land, railroad, and subterranean surveying, together with hydrography and geodetic practice; and since 1874 the Department of Civil Engineering has been engaged in the surveys of the hydrographic basin of central New York, as a contribution to the goedetic surveys of the United States Government. Laboratory practice is provided in chemistry, mineralogy, metallurgy, geology, physics, and civil engineering. The students of this department receive instruction in an extended course of mechanics, as applied to engineering, and their professional preparation comprises the following subjects: The location and constructions of railroads, canals, and water-works; the construction of foundations, in water and on land, and of superstructures and tunnels; the surveys, improvements, and defenses of coasts, harbors, rivers, and lakes; the determination of astronomical co-ordinates; the application of mechanics, graphical statics, and descriptive geometry to the constructions of the various kinds of right and oblique arch bridges, roofs, trusses, and suspension bridges; the design, construction and application of wind and hydraulic motors; air, electric, and heat engines, and pneumatic works; the drainage of towns and the reclaiming of lands; the preparation of plans and specifications, and the proper selection and tests of the materials used in constructions. As a part of their instruction, students have frequent practice in the preparation of papers on subjects of professional importance. An elementary course of lectures is given in engineering and mining economy, finance and jurisprudence. To meet the growing demand for special training, the five-year course has been arranged, allowing considerable option and diversity of studies to students wishing to pursue special lines of study in bridge architecture, or in railroad, mining, topographical, sanitary, geographical, electrical, or industrial engineering. The five year course also offers lines of continuous study of a historical, literary, or scientific character, which may alternate with the prescribed studies, and with architecture, general science and technology. The special library of the department possesses many valuable works, among them the extensive publications recently presented to it by the French government; and in addition, the resources of the general library are available for the purposes of the department. The engineering laboratories contain various machines, models, and appliances for engineering investigations. The engineering museum contains the following collections, which receive regular additions from yearly appropriations:

1. The Muret collection of models in descriptive geometry and stone-cutting.
2. The De Lagrave general and special models in topography, geognosy, and engineering.
3. A nearly complete collection of the Schroeder models in descriptive geometry and stone-cutting, with some of the Oliver models, and others made at the University.
4. The Grund and Sohn collections of bridge and track details, roofs, and trusses, supplemented by similar models by Schroeder and other makers.
5. A complete railroad bridge of one-hundred feet span, the model being one-fourth of the natural scale.
6. The Digeon collection of working models in hydraulic engineering.
7. Several collections of European photographs of engineering works during the process of construction; and many other photographs, diagrams, and models.

8. The following instruments of precision for astronomical purposes: a Troughton & Simms' transit, a universal instrument by the same makers reading to single seconds, three sextants, two astronomical clocks, chronographs, chronometers, two small equatorials, the larger of four and a half inch aperture, made by Alvan Clark, and other instruments necessary to the equipment of a training laboratory.

9. For geodetic work, a secondary base-line apparatus, made under the direction of the Geodetic and Coast Survey Office, and all the portable astronomical and field instruments needed, including sounding machines, deep-water thermometers, heliotropes, etc.

10. Among the coarser field instruments there is nearly every variety of engineers transits, theodolites, levels and compasses; such modern instruments as omnimeters, tacheometers, and tachometers, with a large number of special instruments, such as planimeters, pantographs, eliptographs, arithmometers, pocket altazimuths and sextants, hypsometers, and meteorological instruments of all descriptions.

THE COURSES IN CIVIL ENGINEERING.

I. A Four-Year Course.—Leading to the Degree of Bachlelor of Civil Engineering.

FIRST YEAR.

First Term.—French or German, 5; rhetoric, 2; geometry and conic Sections, 5; freehand drawing, 3; hygiene, six lectures.

Second Term.—French or German, 5; rhetoric, 2; algebra, 5; freehand drawing, 3; linear drawing, 2.

Third Term.—French or German, 5; trigonometry, 5; descriptive geometry, text and drawing, 4; botany, 3; experimental mechanics and heat, 3.

SECOND YEAR.

First Term.—French or German, 3; analytical geometry, 5; descriptive geometry, text and drawing, 6; experimental mechanics and heat, 3.

Second Term. French or German, 3; calculus, 5; pen topography, 2; tinting and shading, 2; electricity and magnetism, 3; chemistry, 2.

Third Term. Calculus, 5; land surveying, 4; acoustics and optics, 3; Chemistry, 3; technical essays, 1.

THIRD YEAR.—*First Term.* Calculus, 5; shades, shadows and perspective. 3; topographical, mapping and sketching, 2; lettering, 1; kinematics, or physics, laboratory work, 3; technical essays, 1.

Second Term. Mechanics of engineering, 5; detail drawing and graining, 2; physics, laboratory work, 3; mineralogy or metallurgy, 2; geology, 3.

Third Term. Mechanics of engineering, 5; railroad surveying, 5; colored topography, 3; lettering, 2.

FOURTH YEAR.—*First Term.* Mechanics of engineering 5; spherical astronomy, 5; practical astronomy, night observations, 2; Egyptian, Greek and Roman architecture, or physics, laboratory work, 3; stereotomy and original problems, 3; civil engineering, 2; technical essays, 1.

Second Term. Hydraulics, 5; higher geodesy, 5; mineralogy or metallurgy, 2; stone-cutting and original problems and practice, 5.

Third Term. Hydraulic motors, 2; civil engineering, 3; engineering economy, 2; bridge stresses, 5; hydrographic surveying, chart-making and geodesy, field-work, 3; preparation of thesis.

Students in the courses in civil engineering are required to write memoirs upon professional subjects of their own selection before the close of the spring term, and these memoirs are presented on the first Friday of the following term. The memoir of the last two years must contain original investigations. On the satisfactory completion of the above four-year course, students take the degree of Bachelor of Civil Engineering, and become entitled to all the privileges of resident graduates.

II. A FIVE-YEAR COURSE.—Leading to the degree of Civil Engineer.—The first four years are the same as in the four-year course. The choice of electives in the fifth year is subject to the approval of the dean of the department. Students in the fifth year pay no tuition fees and have all the privileges of resident graduates.

FIFTH YEAR.—*First Term.* Riparian rights and law of contracts, 3; bridge construction and details, 3; projects, designs and specifications, 3.

Elective, 9; Greek history, 2; modern history, 3; psychology, 2; American history, 2 or 3; physiology and zoology, 5; languages, 2; technical reading, 2; renaissance architecture, 3; chemistry, laboratory work, 3; engineering, laboratory work, 3; physics, laboratory work, 3; rock drills and air compressors, 3; the steam-engine, 3; mining projects, 3; geology, 3; industrial chemistry, 3; mathematics, 3.

Second Term. River and harbor improvements, 3; advanced astronomy and geodesy, 3; technical reading, 2; projects, designs and specifications, 2.

Elective, 8; Roman history, 2; American history 2 or 3; political economy 2; languages, 2; pure or applied mathematics, 5; zoology, 3; metallurgy, or mineralogy, 3; chemistry, laboratory work, 3; Engineering, laboratory work, 3; Physics, laboratory work, 3; Romanesque architecture, 3; the steam-engine, 3; mining projects, 2; industrial chemistry, 3; geology, 3.

Third Term. Sanitary engineering, 3; locomotive machines, etc., 3; projects, designs and specifications, 2.

Elective, 6; Roman history, 3; American history, 2 or 3; languages, 3; pure or applied mathematics, 4; historical or technical reading, 3; geology, 3; chemistry, laboratory work, 3; Engineering, laboratory work, 3; Physics, laboratory work, 3; Gothic architecture, 3; pumps and small machinery, 2; industrial chemistry, 3; mining projects, 4; arch ribs, 3; geodesy, field-work.

MINING ENGINEERING.—Although no department of Mining Engineering has yet been formally established, all the main instruction required by a mining engineer is now given, as follows: The professor of civil engineering and his associates pay special attention to the needs of those intending to connect themselves with the mining industries, giving lectures on tunneling and on the theory and practice of such constructions as are common to the professions of the civil and mining engineer; the professor of mechanical engineering and his associates pursue a like course, giving instruction in mining machinery; the professors of general chemistry and mineralogy, of analytical chemistry, and of industrial chemistry, give instruction in metallurgy, assaying, chemical analysis, and cognate subjects; the professors of geology and palæontology give instruction in the theory and classification of ores, and in those branches relating to chemical geology. It is intended, at an early day, to supplement the existing force by the appointment of such additional professors and lecturers as are necessary to the establishment of a mining school for the most advanced work, both as regards theory and practice. As it is, the University, by its existing provision in the departments named above, is enabled to give such instruction that a student graduating in them can, in a very short time, make himself acquainted with the practical processes; and, in all probability, by the time any student now entering the existing departments shall be sufficiently advanced to need instruction in the more elaborate special processes connected with mining, provision will have been fully made to give it.

THE COURSE OF MATHEMATICS—Leading to the Degree of Bachelor of Science—*First Term*—French, 5, and German, 3, or German, 5, and French, 3; rhetoric, 2; geometry and conic sections, 5; hygiene, six lectures.

Second Term—French, 5, and German, 3, or German, 5, and French, 3; rhetoric, 2; algebra, 5; linear drawing, 2.

Third Term—French, 5, and German, 3, or German, 5, and French, 3; rhetoric, 2; trigonometry, 5.

SECOND YEAR—*First Term*—Analytical geometry, 5; mathematical essays, 1; freehand drawing, 3; experimental mechanics and heat, 3; physiology, 3; composition and elocution, 1.

Second Term—Calculus, 5; mathematical essays, 1; freehand drawing, 3; electricity and magnetism, 3; chemistry, 3; composition and elocution, 1.

Third Term—Calculus, 5; mathematical essays, 1; descriptive geometry, text and drawing, 4; acoustics and optics, 3; chemistry, 3; composition and elocution, 1.

THIRD YEAR—*First Term*—Calculus and analytical geometry, 5; determinants, 2; descriptive geometry, text and drawing, 6; physics, laboratory work, 3; essays, 1.

Second Term—Differential equation, 5; projective geometry, 3; descriptive astronomy, 3; mathematical essays, 1; physics, laboratory work, 3; essays and orations, 1.

Third Term—Differential equations and finite differences, 5; physical astronomy, 3; mathematical essays, 1; physics, laboratory work, 3; botany, 3; essays and orations, 1.

FOURTH YEAR—*First Term*—Imaginaries and elliptic functions, 3; mecanique analytique, 2; mathematical essays, 1; shades, shadows, and perspective, 3; geology, 1; modern history, 3; English literature, 2.

Second Term—Imaginaries and elliptic functions, 3; mecanique analytique, 2; quaternions, or modern methods in analytical geometry, or applied mathematics, 5; mathematical essays, 1; philosophy of history, 3; English literature, 2.

Third Term—Imaginaries and elliptic functions, 3; mecanique analytique, 2; quaternions, modern or methods in analytical geometry, or applied mathematics, 3; mathematical essays, 1; logic, 3; Constitution of the United States, twelve lectures; English literature, 2.

For most of the studies not closely connected with the Mathematics substitutes are allowed.

To graduates and special students, instruction is offered in theory of numbers, quantities, and celestial mechanics.

I. DESCRIPTIVE AND THEORETICAL CHEMISTRY.

Chemistry and Mineralogy.—The instruction begins with lectures on inorganic chemistry in the second year, and continues through two terms. Three lectures a week are given on the theoretical principles and the general study of the chemistry of inorganic bodies. During the first term of the third year, a course of lectures is given on the chemistry of organic bodies. In addition to the final examination at the end of the term, occasional examinations are held during the term, of which no previous notice is given, the students being expected to hold themselves in readiness for such an examination at all times. For laboratory instruction in this branch of the subject a course of introductory practice is given in the third term of the second year. This course is required of students in the course in Science, and of students in the course in Chemistry and Physics, and in Agriculture; it is required, further, of all students in other courses who take chemical practice as an optional study, in the beginning of their practice, except those who can give only the minimum amount of the time (seven and a half hours a week) for two or three terms, and who for sufficient reasons desire to devote all that time to chemical analysis. This introductory practice consists in the performance by the student of a series of experiments illustrating the more important general principles of the science. The details of the manipulation of each experiment are carefully described, but the results to be obtained are not given. For the better cultivation of the student's powers of observation he is required to observe and describe these results for himself, and trace their connection with the principles which they are intended to illustrate. The instruction in theoretical chemistry is continued in the course in Chemistry and Physics by recitations in chemical philosophy, and by lectures on organic chemistry.

Metallurgy and Mineralogy.—During the second term two lectures a week are devoted to each of these subjects in alternate years. The course in Metallurgy is intended to give the students in the technical courses a general idea of fuels, ores, and the most important methods of extracting the various metals which are especially used in construction, the metallurgy of iron claiming naturally the most attention. A certain amount of laboratory work in blowpipe analysis, with practice in the identification of crystalline forms, is required in connection with the lectures on mineralogy. In the course in Civil Engineering a course of practice in blowpipe analysis is provided, which is intended to give to engineers such facility in the use of the blowpipe in determinative mineralogy as will enable them to avail themselves of this useful instrument in their field work, for the determination of the character of rocks and minerals.

Chemical Laboratory.—A new building for the department of Chemistry and Physics has recently been begun, and will be ready for occupation about January, 1883. This building will contain all the necessary space for a museum, a library, laboratories, lecture-rooms, and other rooms, and will be thoroughly equipped with the most recent and approved appliances for the proper prosecution of the work of the department. The chemical laboratory now in use contains, besides two lecture-rooms and the private laboratories of the professors, laboratories for students, with accommodations for two hundred. It is provided with gas and a full supply of apparatus for wet analysis, dry assaying, blowpipe, spectroscopic, and all other branches of chemical analysis. Its reading-room contains the best English, French, and German works of reference, and the current numbers of the chemical journals.

THE COURSE IN CHEMISTRY AND PHYSICS.—Leading to the Degree of Bachelor of Science.

FIRST YEAR.—*First Term*—French, 5, and German, 3, or German, 5, and French, 3; rhetoric, 2; geometry and conic sections, 5; hygiene, six lectures.

Second Term—French, 5; and German 3, or German, 5, and French, 3; rhetoric, 2; algebra, 5.

Third Term—French, 5, and German, 3, or German, 5, and French, 3; rhetoric, 2; trigonometry, 5.

SECOND YEAR.—*First Term*—French or German, 3; composition and elocution, 1; analytical geometry, 5; experimental mechanics and heat, 3; chemistry, laboratory work, 3.

Second Term—French or German, 3; electricity and magnetism, 3; chemistry, lectures, 3; laboratory work, 8.

Third Term—French or German, 3; acoustics and optics, 3; chemistry, lectures, 3, laboratory work, 5; botany, 3.

THIRD YEAR.—*First Term*—Physics, laboratory work, 3; chemical philosophy, 3; chemistry, laboratory work, 7; geology, 3.

Second Term—Physics, laboratory work, 3; chemical philosophy, 3; organic chemistry, 1; chemistry, laboratory work, 5; mineralogy or metallurgy, 2; economic geology, 3.

Third Term—Physics, laboratory work, 3; chemical philosophy, 3; industrial chemistry, 2; chemistry, laboratory work, 7.

FOURTH YEAR.—*First Term*—Physics, laboratory work, 4; organic chemistry, 1; chemistry, laboratory work, 8; history of philosophy, 3.

Second Term—Physics, laboratory work, 4; organic chemistry, 2; chemistry, laboratory work, 8; metallurgy *or* mineralogy, 2.

Third Term—Industrial chemistry, 2; chemistry, processes, 2, laboratory work, 8; organic chemistry, 1.

Instruction is given in general and economic Geology and Lithology by means of lectures, laboratory practice, and field work. The lectures consist of a course on general Geology in the first term, a course on economic Geology in the second term; and, in the third term, a course on physical geography, designed to show the action of geological agencies in fitting the earth for human habitation. The laboratory work consists of a progressive series of exercises in determinative mineralogy and lithology; and of exercises in the preparation of geological sections and maps from the data furnished by government reports. During the first and third terms there are frequent excursions and lessons in field work. To advanced students, opportunities are offered for the microscopic investigation of minerals and rocks, and for the extended study of important mineral districts, with the preparations of reports thereon, and discussions of the metallurgical methods and appliances adapted to their products. The rocks of Ithaca and its neighborhood afford ample material for study and original research.

LABORATORY.—The laboratory is furnished with the appliances needful for successful study, and these appliances have been greatly increased during the past year. Among other things, it has numerous maps, wall tablets, engravings of geological objects, and magic-lantern slides. Large and important additions have also been made to the lithological collections.

THE LIBRARY.—The Library contains about forty thousand volumes, besides fifteen thousand pamphlets. It is made up chiefly of the following collections: A selection of about five thousand volumes purchased in Europe in 1868, embracing works illustrative of agriculture, the mechanic arts, chemistry, engineering, the natural sciences, physiology, and veterinary surgery, The Anthon Library, of nearly seven thousand volumes, consisting of the collection made by the late Professor Charles Anthon, of Columbia College in the ancient classical languages and literature, besides works in history and general literature; the Bopp Library, of about twenty-five hundred volumes, being the collection of the late Professor Franz Bopp, of the University of Berlin, relating to oriental languages, oriental literature, and comparative philology; the Goldwin Smith Library, of thirty-five hundred volumes, presented in 1869 to the University by Professor Goldwin Smith, comprising chiefly historical works, and editions of the English and ancient classics—increased during later years by the continued liberality of the donor; the publications of the Patent Office of Great Britain, about three thousand volumes, of great importance to the student in technology and to scientific investigators; the White Architectural Library, a collection of over a thousand volumes relating to architecture and kindred branches of science, given by President White; the Kelly Mathematical Library, comprising eighteen hundred volumes and seven hundred tracts, presented by the late Hon. William Kelly, of Rhinebeck; the Cornell Agricultural Library, bought by the Hon. Ezra Cornell, chiefly in 1868; the Sparks Library, being the library of the late Jared Sparks, President of Harvard University, consisting of upwards of five thousand volumes and four thousand pamphlets, relating chiefly to the history of America; the May Collection, relating to the history of slavery and anti-slavery, the nucleus of which was formed by the gift of the library of the late Rev. Samuel J. May, of Syracuse. By the establishment of the McGraw Library Fund, the income of which will be available after the present year, and which is to be applied to the support and increase of the University Library, the efficiency of the Library, both as regards the number of books and the facilities for their use, will be greatly enlarged. Beginning this year, it is proposed to issue a serial containing classified lists of recent accessions and of books in various departments, as well as other bibliographical matter intended to assist students in their use of the Library. The Library is a circulating one, so far as the members of the Faculty are concerned, and a library of reference for students. Undergraduates have free access to a collection of cyclopædias, dictionaries, and works of reference in the various departments of study, but they apply to the librarians for other works desired. Graduate students are admitted to the alcoves.

GRADUATION.—No person may receive a baccalaureate degree who has not spent four entire years in the University, unless he has pursued elsewhere part of the studies of his course Students admitted to advanced studies must, before the close of their first year, pass examination on the previous work of the classes they enter. Each student is required, before taking a degree, to submit to the Faculty a satisfactory oration, poem or essay on some subject in science or literature, and to deposit a copy in the Library. The degree of Bachelor of Science is conferred after the satisfactory completion of any one of the following courses: Science, Science and Letters, Chemistry and Physics, Mathematics, and Natural History. The particular course is specified in the diploma. The degrees of Bachelor of Arts, of Literature, of Philosophy, of Agriculture, of Architecture, of Civil Engineering, and of Mechanical Engineering are conferred after the satisfactory completion of the corresponding courses. The degree of Bachelor of Philosophy is also conferred after the satisfactory completion of the course in History and Political Science. The degree of Bachelor of Veterinary Science is conferred only after the completion of a full course of four years in that department. No person is allowed to receive more than one degree at the same Commencement.

ADVANCED DEGREES.—Graduate courses of study leading to advanced degrees are provided for in the following general departments: Chemistry and Physics, Mathematics, Natural History; History and Political Science; Comparative Philology, Ancient Classical Languages and Literature, Modern European Languages and Literature, Oriental Languages and Literature; Philosophy and Letters. A graduate who desires to take an advanced degree should apply to the Faculty to be admitted as a candidate for that degree and in his application should state in what departments he wishes to work. The degree of Master of Arts or Master of Science is conferred on those who have taken the corresponding baccalaureate degree here, or elsewhere where the requirements for that degree are equal to those of this University, on the following conditions:

1. The candidate must spend at least one year at the University in a course of study marked out for him by the Faculty, must present a satisfactory thesis, and pass an examination.

2. The same degrees are conferred without residence on graduates of this University only, on conditions the same in all respects as above, except that the degree is not given until three years after the baccalaureate degree has been conferred

3. Any person who has taken a baccalaureate degree in this University may become a candidate for either of the above second degrees by passing such additional examination as may be required for the corresponding first degree.

The degree of Master of Science is conferred on graduates in the course in Philosophy on the same conditions as if they had been graduated in the course of Science. The degree of Civil Engineer is conferred (1) on bachelors of Civil Engineering, after two years of study and practice, on passing the requisite examination and presenting a satisfactory thesis; (2) on those who have completed the five-year course, at their graduation. The degree of Doctor of Veterinary Medicine is conferred on bachelors of Veterinary Science after two years of additional study, on passing the requisite examination. The degree of Doctor of Physiology is conferred on graduates of this University, and of other universities and colleges whose requirements for the baccalaureate degree are equal to those of this University, on the following conditions:

1. In order to become a candidate the applicant must have, over and above what is required for graduation in the course in Philosophy, a knowledge of Greek equal to that required for admission to the course in Arts.

2. The candidate must spend at least two years at the University pursuing a course of study marked out by the Faculty as leading to this degree.

3. He must, at least six weeks before Commencement, present a meritorious thesis upon some subject included in the course, and pass the requisite examination.

The degree of Doctor of Science is conferred on graduates of this University, and of other universities and colleges whose requirements for the baccalaureate degree are equal to those of this University, on the following conditions:

1. In order to become a candidate the applicant must have a knowledge of Latin and Greek at least equal to that required for admission to the course in Natural History; a knowledge of French and German equal to that required for graduation in the course in Science; a knowledge of science, of literature, and of philosophy equal to that required for graduation in the course in Philosophy.

2. The candidate must spend at least three years, two of them at this University, in the study of not less than two scientific subjects, approved by the Faculty, in one or more of the departments of Chemistry and Physics, Mathematics, and Natural History.

3. He must pass an examination upon these subjects, showing in one of them special attainments, and must present a meritorious thesis based on special investigations, or make some other contribution to science.

Candidates for the degree of Doctor are required to print their thesis and deposit ten copies in the Library. Other candidates for advanced degrees are required to deposit one copy. No student in a graduate course is allowed to take two degrees for the same course, to take any inferior degree for any part of the study that leads to a higher one, or to be a candidate for more than one degree at the same time. Candidates for a second degree are required to make application to the Registrar and present their thesis at least twenty days before Commencement. The examinations for advanced degrees are held during the second week before Commencement.

Miscellaneous Information.—The academic year is divided into three terms, and there are three vacations. Commencement day is the third Thursday in June. The first term begins, after a vacation of thirteen weeks, on the Tuesday following the eleventh day of September, and ends on the Friday after the fourteenth day of December. The second term begins on the Tuesday after the second day of January; except when, in leap-year, that Tuesday is the third day of January, in which case it begins on the Tuesday after the third day. It ends on the Friday after the twenty-third day of March. The third term begins on the second Saturday after the end of the second term, the instruction begins on the Monday following, and continues until Commencement. For the terms and vacations of the present academic year, see the calendar. Persons wishing more detailed information than is given here as to courses of study, methods of instruction, and the like, may address the professor in charge of the department concerned. Candidates for admission will obtain permits for examination at the Registrar's office (in the south University building), and the results of examinations may be ascertained from the Registrar. Each person, upon admission, receives a copy of the "Rules for the Guidance of Students," and is thereafter supposed to be acquainted with its contents. The registration day for each term is indicated in the calendar. On that day each student qualified for admission, whether previously a member of the University or not, is required to give notice of his studies for the term to the Registrar in person and obtain a ticket of registration. No person is allowed to register at any other time, except by permission of the Faculty. In order to join any class, the student must show his registration ticket to the instructor in charge. A printed schedule of the University exercises is issued at the beginning of each term. Most of the lectures and recitations occur between the hours of 8 A. M. and 1 P. M., from Monday to Friday inclusive. Every student is required to take the equivalent of fifteen hours of recitations a week, exclusive of military drill. Two and a-half hours of laboratory practice, or three hours of drafting or shop-work, are regarded as the equivalent of one recitation. The regular examinations in all studies are held at the end of each term. Failure at examination entails forfeiture of position in the class, or exclusion from the course, or, in some cases, from the University. The *course-book* affords the student an opportunity of preserving a record of his examination; it is procurable at the bookstores, and the entries in it are made by the Registrar, or by the heads of departments. The fee for tuition is $25 a term, payable within ten days after registration. Tuition is free to *state students*, to *resident graduates*, and to students pursuing either of the prescribed courses in *Agriculture*, and *intending to complete* that course. Every person taking laboratory practice in Chemistry, Physics, Zoölogy, or Entomology, must deposit with the Treasurer security for the materials to be used in the laboratory. Students residing in the University buildings are required to pay their room-bills one term in advance. All members of the University are held responsible for any injury done by them to its property. A fee of $5, to cover expenses of graduation, degrees, etc., is charged to each person taking the baccalaureate degree; a fee of $10, to each person taking an advanced degree. These fees must be paid at least three days before Commencement.

Expenses of Residence—The following is a fair estimate of the yearly expenses: Tuition, $25 a term, $75; Room, board, lights, fuel, and laundry, about $200; Text-books, etc., about $25; Total, $300.

The cost for board, rent of furnished room, fuel and lights at the Sage College, varies from $5 to $6.50 a week. A student occupying alone one of the most desirable rooms, pays $6 50 a week. If two occupy such a room together, the price is $5.75. Those occupying less desirable rooms, with two in a room, pay $5 a week each. The entire building is warmed by steam, and, in most cases, the sleeping apartment is separate from the study-room. The expense of living in Ithaca varies, for board, room, fuel, and lights, from $4 to $7 a week. In many cases students, by the formation of clubs, reduce their expenses to sums ranging from $2.50 to $3.50 a week for board. In the year 1881, the sum of forty-five thousand dollars was bequeathed by Mrs. Jenny McGraw Fiske as a provision for the care of students who may fall ill during their attendance at the University. It is proposed that a portion of this sum be devoted to the erection of a cottage hospital, made comfortable and attractive, and thoroughly equipped in all respects; and that a trained nurse be attached to it, who shall be ready to give attention the moment it is needed.

State Scholarships.—The laws of the State of New York [chap. 585, §9, chap. 654, §1] provide that the University "shall annually receive students, one from each assembly district in the State, to be selected as hereinafter provided, and shall give them instruction in any or in all the prescribed branches of study in any department of said institution, free of any tuition fee, or of any incidental charges, to be paid to said university, unless such incidental charges shall have been made to compensate for damages needlessly or purposely done by the students to the property of said university." There are one hundred twenty-eight assembly districts, and therefore one hundred twenty-eight free scholarships, each good for four years. The law provides that "the candidates in each county or city shall meet at such place and time in the year as the school commissioner or commissioners of the county and the boards of education of the cities in those counties which contain cities, shall appoint; and the said commissioner or commissioners, and the said board of education, or such of them as shall attend and act, shall proceed to examine said candidates and determine which of them are the best scholars. The law is mandatory and imposes upon school commissioners of counties and boards of education of cities the duty, which they cannot avoid, of holding such competitive examinations once each year. It is understood to confer a right upon every person who is qualified to enter the examination, and who desires to obtain the scholarship, to have such an examination held; and it is believed that any such candidate for the scholarship can enforce his right, if need be, by an appeal to the proper state authorities. The law which requires the examination to be held, requires also, by implication, that due public notice shall be given of the time and place. When it shall be held and where it shall be held, is left to the discretion of the commissioners and the boards of education; but doubtless it ought to be held in the summer after the close of the public schools for the season, and before the beginning of the fall term of the University. Only one examination can be held during the year in any one county, and, except to fill vacancies as below, appointments can be made but once a year. The law does not designate the studies upon which candidates shall be examined, nor have the trustees of the University expressed any opinion on the subject.

The law provides that "the said free instruction shall moreover be accorded to said students in consideration of their superior ability, and as a reward for superior scholarship in the academies and public schools of this state. . . . In making these selections preference shall be given (where other qualifications are equal) to the sons of those who have died in the military or naval service of the United States; consideration shall be had also to the physical ability of the candidate. . . . But in no case shall any person having already entered the said university be admitted as one of such candidates." The trustees of the University understand the law to mean that candidates must have been educated in the academies or public schools of the state, and in the county in which they offer themselves for the competition. Not that they must necessarily be residents of the county in which they seek the scholarship, but only that they have attended an academy or public school long enough to be entitled to be regarded as having obtained their education, or at least a large part of it, in the county. The length of time is not fixed by law. They do not understand that a person otherwise qualified to be a candidate, can be debarred from entering the examination, in consequence of having finished his studies and been out of school for one or two years; especially if during this time he has been occupied in providing the means of defraying his expenses while attending the University. Nor do they think that the fact of his having been engaged out of the county during this time and for the purpose above mentioned ought to work to his disadvantage.

If, however, a person has been attending school, whether a public or a private school, out of the county, for the period which intervenes between his attendance upon the schools in the county and his application to be received as a candidate, this, they think, ought to exclude him from the examination in that county.

The law provides that the school commissioners of counties and boards of education of cities shall determine by the competive examination above noted which of the duly qualified candidates "are the best scholars." It says: "And they shall then select therefrom to the number of one from each assembly district in said county or city, and furnish the candidates thus selected with a certificate of such election, which certificate shall entitle said student to admission to said university, subject to the examination and approval of the faculty of said university." In deciding upon the merits of the competitors and awarding the certificates, no regard need be paid to the assembly district in which the candidate has his residence, or has attended school, but the certificate must name the district for which the appointment is made. The certificate of scholarship must in all cases be awarded on the basis of the competitive examination, and not on any examination held otherwise or elsewhere, or on any testimonials obtained from any other source. In all cases of contested or duplicate certificates, the trustees have decided, and instructed their treasurer, to accept the first certificate that is regular on its face and granted by the proper authorities. The University proposes to leave all questions as to the regularity of the proceedings and the rights of the respective claimants to be adjusted in the county from which the student comes. No allowance is made for absence or non-attendance upon the University by a student holding a state scholarship. His certificate secures him free tuition for only that part of the four years during which he is in attendance upon his University duties. Whenever any student selected as above described shall have been from any cause removed from the University before the expiration of the time for which he was selected, then one of the competitors to his place may be selected to succeed him therein, as the school commissioner or commissioners of the county or the board of education of the city may direct. Preference is rightly given to competitors in the order of the superiority of their scholarship. A certificate is good for four years from the time when the examination is held, and in case of a new certificate to fill a vacancy, that certificate will be accepted for only that portion of the four years which remains unexpired. No appointment can be made from one county to fill a vacancy in another county. Neglect to appoint does not create a vacancy which can be legally filled.

CALENDAR.—Sept. 19–21, Tuesday–Thursday, Entrance Examinations. Sept. 21, Thursday, Registration Day, Sept. 22, Friday, Instruction begins.

UNIVERSITY OF MICHIGAN, ANN ARBOR.

IN 1875 the State Legislature took the first step towards organizing at the University a school to be called "The School of Mines," but subsequently a different arrangement was effected and the instruction designed for those students who intend to become mining engineers is now given in connection with that given to other students of engineering.

Members of the Faculties.—James B. Angell, LL. D., President. Henry S. Frieze, LL. D., Acting President, and Professor of the Latin Language and Literature. Alonzo B. Palmer, M. D., LL. D., Professor of Pathology and the Practice of Medicine and Clinical Medicine. Corydon L Ford, M. D., LL. D., Professor of Anatomy and Physiology. Hon. James V. Campbell, LL. D., Marshall Professor of Law. Hon. Thomas M. Cooley, LL. D., Jay Professor of Law, and Professor of Constitutional and Administrative Law in the School of Political Science. Edward Olney, LL. D., Professor of Mathematics. Charles K. Adams, LL. D., Professor of History. Charles A. Kent, A. M., Fletcher Professor of Law. Rev. Benjamin F. Cocker, D. D., LL. D., Professor of Psychology, Speculative Philosophy, and Philosophy of Religion. Albert B. Prescott, M. D., Professor of Organic and Applied Chemistry and Pharmacy. Rev. Martin L. D'Ooge, Ph. D., Professor of the Greek Language and Literature. Charles E. Greene, A. M., C. E., Professor of Civil Engineering. George E. Frothingham, M. D., Professor of Materia Medica, Ophthalmic and Aural Surgery, and Clinical Ophthalmology. Donald Maclean, A. M. M. D., Professor of Surgery and Clinical Surgery. Edward S. Dunster, A. M. M. D., Professor of Obstetrics and Diseases of Women and Children, and Clinical Gynæcology. William H. Pettee, A. M., Professor of Mineralogy, Economic Geology, and Mining Engineering. Jonathan Taft, M. D., D. D. S., Professor of the Principles and Practice of Operative Dentistry. John A. Walting, D. D. S., Professor of Clinical and Mechanical Dentistry. John W. Langley, S. B., M. D., Professor of General Chemistry. William P. Wells, A. M., Kent Professor of Law. Charles I. Walker, LL. D., Filling the Chair of Kent Professor of Law in the absence of Professor Wells. Edward C. Franklin, M. D., Professor of Surgery and Clinical Surgery in the Homœopathic Medical College. Mark W. Harrington, A. M., Professor of Astronomy, and Director of the Observatory. Joseph B. Steere, Ph. D., Professor of Zoölogy, and Curator of the Museum. Edward L. Walter, Ph. D., Professor of Modern Languages and Literatures. Alexander Winchell, LL. D., Professor of Geology and Palæontology. William H. Payne, A. M., Professor of the Science and the Art of Teaching. Hon. Alpheus Felch, LL. D., Tappan Professor of Law. Thomas P. Wilson, M. D., Professor of the Principles and Practice of Medicine, Ophthalmology, and Otology in the Homœopathic Medical College. Isaac N. Demmon, A. M., Professor of English and Rhetoric. George S. Morris, Ph. D., Professor of Ethics, History of Philosophy, and Logic. William H. Dorrance, D. D. S. Professor of Prosthetic Dentistry and Dental Metallurgy. Elisha Jones, A. M., Associate Professor of Latin. Albert H. Pattengill, A. M., Associate Professor of Greek. Mortimer E. Cooley, Assistant Engineer, U. S. N., Professor of Mechanical Engineering. Charles K. Wead, A. M., Acting Professor of Physics. Byron W. Cheever, A. M., M. D., Acting Professor of Metallurgy. Volney M. Spalding, A. B., Acting Professor of Botany. Joseph B. Davis, C. E., Assistant Professor of Civil Engineering. Wooster W. Beman, A. M., Assistant Professor of Mathematics. Charles N. Jones, A. B., Assistant Professor of Mathematics. Richard Hudson, A. M., Assistant Professor of History. Otis C. Johnson, A. M., Assistant Professor of Applied Chemistry. William J. Herdman, Ph. B., M. D., Assistant Professor of Pathological Anatomy, and Demonstrator of Anatomy. Victor C. Vaughan. Ph. D., M. D., Assistant Professor of Physiological Chemistry. Charles H. Stowell, M. D.. Assistant Professor of Histology and Microscopy. Benjamin C. Burt, A. M., Assistant Professor of English and Rhetoric. Calvin Thomas, A. M., Assistant Professor of German and Sanskrit. Charles S. Denison, M. S., C. E., Acting Assistant Professor of Mechanical and Free Hand Drawing. Raymond C. Davis, A. M., Librarian. Henry C. Adams, Ph. D., Lecturer on Political Economy. Henry C. Allen, M. D., Lecturer on Materia Medica, Pharmacology, and Clinical Medicine in the Homœopathic Medical College. Henry Sewall, M. D., Lecturer on Physiology. P. R. B. de Pont, A. B.. B. S., Instructor in French. Alfred Hennequin, A. M., Instructor in French and German. Calvin B. Cady, Instructor in Music. Charles M. Gayley, A. B., Instructor in Latin. Theodore John Wrampelmeier, A. B., Instructor in Analytical Chemistry. Louis Reed Stowell, M. S., Assistant in Microscopical Botany. Elizabeth M. Farrand, Assistant Librarian. Dennie J. Higley, A. M., Assistant in Museum. Douglas A. Joy, E. M., M. D., Asssistant in General Chemistry. John M. Schaeberle, C. E., Assistant in the Observatory. George A. Hendrics, M. D., Assistant Demonstrator of Anatomy, and Curator of the Medical Museum of the Department of Medicine and Surgery. Aaron R. Wheeler, M. D., Resident Physician and Surgeon in the Homœopathic Hospital. Uriah D. Billmeyer, D. D. S., Assistant to the Professor of Clinical Dentistry, George F. Heath, M. D., Resident Physician and Surgeon in the University Hospital. Arthur W. Potter, Assistant in Mathematics. Geordie Z. Whitney, A. B., Assistant in Mathematics. Joseph F. Geisler, Ph. C., Assistant in Qualitative Chemistry. George L. Field, D. D. S., Demonstrator of Continuous Gum Dentures. Lorin Hall, M. D. Assistant to the Professor of Obstetrics and the Diseases of Women and Children. Thomas J. Sullivan, M. D., Assistant to the Professor of Surgery. John G. Kennan, M. D., Assistant to the Professor of Materia Medica and Ophthalmic and Aural Surgery. Calvin S. Case, D. D. S., Assistant in Prosthetic Dentistry. Lucius L. Van Slyke, A. M., Assistant in Chemical Laboratory. Seward W. Williams Ph. C., Asssistant in Chemical Laboratory. Oscar Textor, Ph. C., Assistant in Quantitative Analysis. Richard Gay De Puy, A. B. M. D., Asssistant to the Professor of Surgery in the Homœopathic Medical College. Charles P. Pengra, M. D., Assistant in the Chemical Laboratory. Albert R. Halsted, M. D., Assistant to the Professor of the Principles and Practice of Medicine in the Homœopathic Medical College. Willis P. Polhemus, M. D., Assistant to the Lecturer on Materia Medica in the Homœopathic Medical College. Kate Crane Johnson, Ph. C., Dispensing Clerk in the Chemical Laboratory. Charles F. Dight, M. D., Assistant to the Professor of Pathology, and the Practice of Medicine. Schuyler C. Graves, M. D., Assistant Demonstrator of Anatomy. Lena C. Leland, M. D., Assistant Demonstrator of Anatomy.

The University of Michigan is a part of the public educational system of the State. The governing body of the Institution is a Board of Regents, elected by popular vote for terms of eight years, as provided in the constitution of the State. In accordance with the law of the State, the University aims to complete and crown the work that is begun in the public schools, by furnishing ample facilities for liberal education in Literature, Science, and the Arts, and for thorough professional study of Medicine, Pharmacy, Law, and Dentistry. Through the aid that has been received from the United States and from the State it is enabled to offer its privileges, without charge for tuition, to all persons, of either sex, who are qualified for admission. Its relation to the public schools of the State has been, since the year 1871, when students were for the first time admitted on diploma from approved high schools, even closer and more vital than ever before. While Michigan has endowed her University primarily for the higher education of her own sons and daughters, it must be understood that she also opens the doors of the Institution to all students, wherever their homes. It is in this broad, generous, and hospitable spirit, that the University has been founded, and that it endeavors to do its work. The University comprises the Department of Literature, Science, and the Arts (including the School of Political Science), the Department of Medicine and Surgery, the Department of Law, the School of Pharmacy, the Homœopathic Medical College, and the College of Dental Surgery. Each of these Departments and Colleges has its Faculty of Instruction, who are charged with the special management of it. The University Senate is composed of all the Faculties, and considers questions of common interest and importance to them all. In the Department of Literature, Science and the Arts, different lines of study lead to the attainment of the degrees of Bachelor of Arts, Bachelor of Science, Bachelor of Letters, the corresponding Masters' degree, the degree of Doctor of Philosophy, and the degree of Civil Engineer, Mechanical Engineer, and Mining Engineer. When the same degree is given for different lines of study, this fact is indicated in the diploma. Students that do not wish to become candidates for a degree may, if they are prepared to enter the University, pursue selected studies for such time, not less than one semester, as they may choose. In the Professional Schools the instruction is given largely by lectures.* Degrees are given to graduates as follows: In the Department of Medicine and Surgery, the degree of Doctor of Medicine; in the Department of Law, the degree of Bachelor of Laws; in the School of Pharmacy, the degree of Pharmaceutical Chemist and of Master of Pharmacy; in the Homœopathic Medical College, the degree of Doctor of Medicine; in the College of Dental Surgery, the degree of Doctor of Dental Surgery. Students in any Department of the University may enter the classes in any other, upon obtaining permission from the Faculties of the respective Departments.

The Libraries.—The Libraries of the University accessible to the students contain in the aggregate about 39,150 volumes, and 10,000 pamphlets. The General Library contains about 32,250 volumes, and 9,000 pamphlets. In 1871 it was enlarged by the addition of the library of the late Professor Rau, of the University of Heidelberg, Germany. The Rau library was purchased and presented to the University by Mr. Philo Parsons, of Detroit. It contains, with the recent additions made by Mr. Parsons, about 4,325 volumes and over 5,000 pamphlets. It is especially rich in European works on the Science of Government, Statistics, Political Economy, and the cognate subjects. An appropriation of five thousand dollars for the increase of the University Library was made by the Legislature at its last session. The catalogue consists of two parts, a catalogue of titles on slips arranged in the alphabetical order of the names of the authors, and a catalogue of the subjects treated in all the books, reviews, and magazines in the Library. The catalogue is accessible to readers. One hundred and forty-three American and European periodicals are taken; and sixty magazines and newspapers, representing nearly every part of the country, are kept upon the tables by the Students' Lecture Association. The Library is open every day except Sundays and holidays, from 9 o'clock A. M. to 5 P. M., and from 7 P. M. to 9½ P. M., during the academic year, and for a large part of the day during the summer vacation. It is free to all persons.

The Museums.—The collections in the University Museums are illustrative of Natural History, Agriculture, Archæology, Ethnology, The Fine Arts, History, Anatomy, and Materia Medica, and are constantly increasing. The whole of the valuable collection made by Professor Steere during his five years' exploration in South America, Formosa, and the East Indies, has become the property of the University. A considerable addition to this collection was made by Professor Steere, as a result of his visit to the mouth of the Amazon in the summer of 1879. The collections are arranged in such a way as to render them accessible both to students and to visitors. The University affords a secure depository for objects of value and curiosity, and it is therefore hoped that frequent gifts will be made to its several Museums. The new Museum building, erected in 1879-80, by means of a special legislative appropriation, now contains the collections in Mineralogy, Geology, and Zoölogy. The following description will indicate the character of the several collections belonging to the University: I. The Mineralogical Collection comprises about 6,000 specimens. It embraces about 2,500 specimens (principally European) purchased of the late Baron Lederer, and known as the Lederer Collection; and, besides others, a rich collection of the Mineral Species of Michigan, including all varieties of copper ore and associated minerals from the different localities of the Lake Superior mining district

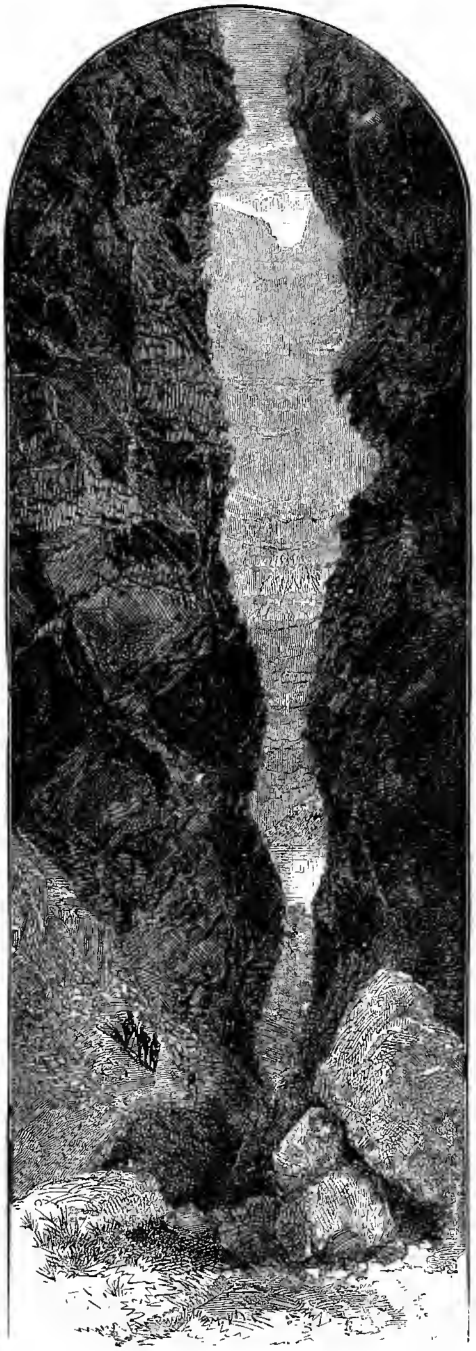
The Geological Collection consists of: 1. The large and complete series of lithological and palæontological specimens, brought together by the State Geological Surveys, of which over a hundred fossil species have already become the types of original descriptions. 2. The White Collection, consisting of 1,018 distinct entries, 6,000 specimens. 3. The Rominger Collection, embracing about 2,500 entries, 6,000 specimens, mostly from the mesozoic formations of central Europe. This collection embraces about 500 specimens of mesozoic ammonites. 4. Smithsonian Deposits, consisting, for the present, of a collection of specimens of foreign and domestic building stones, and twenty-three specimens of fossils from the Upper Missouri. 5. Miscellaneous Donations and Collections, including a series illustrative of the metalliferous regions of the Upper Peninsula, collected by Professor Winchell, and an interesting collection of fossils, chiefly cretaceous, from the Yellowstone Valley, presented by the late General Custer, U. S. A. The entire Geological Cabinet is estimated to contain about 14,000 distinct entries, 41,000 specimens.

The Laboratories.—In the several Laboratories of the University opportunities are provided for practical instruction in Physics, Chemistry, Geology, Zoölogy, Botany, Physiology and Histology, Mechanical Engineering, and Dentistry.

I. The Physical Laboratory.—This Laboratory was established in the year 1877 with the aid of a special appropriation of the Legislature. It is in charge of the Acting Professor of Physics, and is now used principally by students of the Department of Literature, Science, and the Arts. Apparatus has already been provided for the accurate determination of weights and measures, specific gravity, elasticity, strength and stiffness of beams and simple structures, such as trusses and bridges; for determining the laws regulating the flow of liquids and gases; for measuring rates of vibration in sounding bodies, for measuring indices of refraction, length of waves of light, intensity of light, strength of galvanic batteries, electricity resistance, and specific and latent heat; and for the investigation of other physical problems. The course of instruction is designed to give the student familiarity with the manipulation of physical apparatus, and a clear understanding of the methods used in the construction of physical tables. Provision is made to meet the wants of advanced students, as well as of undergraduates.

II. The Chemical Laboratory.—In this Laboratory, which was enlarged in the summer of 1880 by the addition of a second story, better facilities than ever before are now provided for systematic instructions in laboratory methods of study, general chemistry, analytical and applied chemistry, physiological chemistry, pharmacy, metallurgy, and assaying, and for original investigations in nearly all of these branches. Earnest encouragement and coöperation are promised to all those, who, with due preparation, will enter upon original work. In addition to the lecture-rooms and balance-rooms, there are eleven distinct working-rooms, independent of those used by the officers, or required for the storage of material and apparatus. Two hundred and sixty-nine students can be provided with tables for work at the same time. The Laboratory is open to all students of the University, and is regularly used by all Departments excepting the Department of Law. The Laboratory is also open to any person who wishes to pursue special studies therein, provided he comply with the requirements for admission, and with the regulations of that Department of the Univer-

*A knowledge of stenography, though not indispensable, and not insisted on as a condition for admission, will be of great advantage to students of these schools. Students of the Department of Literature, Science and the Arts, will also find such knowledge useful.



WESTERN SCENERY—A SIDE CAÑON—CAÑONS OF THE COLORADO.

—FROM REPORT OF J. W. POWELL.

sity to which the desired special studies properly belong. In all these courses of instruction there are recitations and lectures in the class-room, giving direction daily to the student at his table, and demanding constant study of the work undertaken. This method of teaching makes it indispensable that the student begin with a class. The Laboratory is open to students through the college year in the afternoon from one to five o'clock, and, after the first of April, from one to six o'clock.

THE GEOLOGICAL AND ZOÖLOGICAL LABORATORIES.—Opportunity for practical work in Geology and Zoölogy is provided in rooms set apart for this purpose in the new Museum. The rooms are furnished with microscopes, photographic instruments, cutting and polishing lathes, and other apparatus for the preparation of specimens. Special encouragement and assistance are given to students wishing to carry on original investigations.

THE MECHANICAL LABORATORY.—With the aid of a special appropriation of the Legislature, a building has been erected and furnished for the accommodation of students desiring instruction in the use of tools for working in wood and in metal, as well as on the nature of the most common materials used for manufacturing purposes. Complete sets of hand tools have been provided for pattern-making, machinists' and blacksmiths' work, and moulding. Steam-power and a few of the most essential machine tools have also been provided. A cupola and brass furnace have been added, so that students may have the actual charge of both during operations of casting in iron and in composition. The instruction is made thoroughly practical.

The Hospitals.—During the past few years the facilities for clinical instruction in the two Medical Schools connected with the University have been largely increased. By the liberality of successive Legislatures, aided by contributions from the city of Ann Arbor, ample hospital accommodations have been provided. The University Hospital is under the direction of the Faculty of the Department of Medicine and Surgery; the Homœopathic Hospital is connected with the Homœopathic Medical College. Further information in regard to the Hospitals is given in connection with the descriptions of the Medical Schools.

Fees and Expenses.—Every student, before entering any Department of the University, is required to pay a matriculation fee. This fee, which, for residents of Michigan, is ten dollars, and, for those who come from any other state or country, twenty-five dollars, is paid but once and entitles the student to the privileges of permanent membership in the University. In addition to the matriculation fee, every student has to pay an annual fee for incidental expenses. This fee is paid the first year of residence at the University, and every year of residence thereafter. Resident graduates are required to pay the same annual fee as under-graduates. Beginning with the academic year, 1882-83, the annual fee in the several departments of the University will be, in accordance with action taken by the Board of Regents since the publication of the last annual calendar, as follows: Department of Literature, Science, and the Arts: for residents of Michigan, twenty dollars; for non-residents, thirty dollars. The matriculation fee and the annual fee must be paid at the beginning of the college year. A By-Law of the Board of Regents provides that no student or graduate shall be allowed to enjoy the privileges of the University until he has paid all fees that are due. The fee for the diploma given on graduation is ten dollars, and the By-Laws of the Board of Regents prescribe that no person shall be recommended for a degree until he has paid all dues, including the fee for diploma. Students who pursue laboratory courses of study are also required to pay for the materials and apparatus actually consumed by them. The deposits required in advance are different for the different courses, ranging from one dollar to twenty dollars. The laboratory expenses of students will vary with their produce and economy. Experience has shown that in the Chemical Laboratory the average expense is about one dollar and twenty cents a week for all courses. Students obtain board and lodging in private families for from three to five dollars a week. Clubs are also formed, in which the cost of board is from one dollar and a half to two dollars and a half a week. Room-rent varies from seventy-five cents to two dollars a week for each student. There are no dormitories and no commons connected with the University. Students on arriving at Ann Arbor can obtain information in regard to rooms and board by calling at the Steward's office. The annual expenses of students in the Literary Department and in the Medical Schools, including clothing and incidentals, has been, for the last few years, on the average, about three hundred and seventy dollars. The expenses of the Law students and the Dental students are from one hundred and fifty to two hundred dollars for a term of six months. It is proper to say, in answer to numerous inquiries, that the University does not undertake to furnish manual labor to students; yet a small number find opportunities in the city for remunerative labor.

Relation of Students to the City Government.—Students are temporary residents of the city, and, like all other residents, are amenable to the laws. Whenever guilty of disorder or crime, they are liable to arrest, fine, and imprisonment, and can claim no peculiar exemption from public disgrace and legal penalties.

ADMISSION.—Candidates for admission must be at least sixteen years of age, and must present satisfactory evidence of good moral character. They must be provided with credentials from their last instructor, or from the last institution with which they have been connected. These credentials must be presented to the President, at his office, before the candidate can enter upon the examination. Students who desire to pursue studies in this Department, and do not desire to become candidates for a degree, will be admitted on the following conditions:

1. All persons under twenty-one years of age must pass the entrance examinations required of candidates for some degree.

2. Persons over twenty-one years of age must pass the entrance examination in English required of candidates for the degree of A. B. Students thus admitted may then enter any of the classes upon first giving satisfactory evidence to the Professor in charge that they are prepared to pursue profitably the study they may desire to take up.

ADMISSION OF CANDIDATES FOR A DEGREE.

Students who desire to become candidates for a degree must, unless admitted on diploma, pass examinations * as follows:

Candidates for the Degree of Bachelor of Science.—The University provides different lines of study leading to this degree: 1. A Course in General Science. 2. Courses in Engineering, Civil, Mechanical, and Mining. The diplomas given in the latter courses indicate the line of study pursued.

1. THE COURSE IN GENERAL SCIENCE.

Candidates will be examined in the following subjects:

1. ENGLISH LANGUAGE, GEOGRAPHY, AND MATHEMATICS.—In all, the same as for the degree of Bachelor of Arts.

2. HISTORY.—An outline of General History; an Outline of the History of the United States, to the close of the Revolutionary War. A year's study ought to be given to preparation in History.

3. FRENCH, GERMAN, AND LATIN.—Candidates may offer either French or German; French and Latin; or German and Latin;—two of these three languages being required. The requirements in each are as follows:

French.—The whole subject of French Grammar. The candidate will be expected to be thoroughly familiar with the formation and use of French verbs, to read at sight easy French, and to translate correctly into French simple English sentences. Two years ought to be given to this purpose, the first year being spent on the grammar, and the second devoted to reading good modern French, accompanied by grammatical analysis and exercises in writing. Hennequin's French text-books are especially recommended; preparation in Fasquelle or Otto will be accepted.

German.—The whole subject of German Grammar. The candidate will be expected to read easy German at sight and to translate simple sentences from English into German. To this end he should have devoted two years to the study; one year to the grammar, reader, and the writing of exercises, and a second year to the reading of complete works of literary art. As a text for the second year's study works in dramatic form, and especially the classical plays of Schiller, are recommended.

* Requests for specimen copies of examination papers are often made to the University authorities. As the examinations for admission are chiefly oral, it is not practicable to comply with these requests.

Latin.—Jones' First Latin Book, or Harkness's Latin Reader, or an equivalent amount in any other text-book; four books of Cæsar's Commentaries, and one of Cicero's Orations. It is expected that about two years will be given to preparation in Latin.

4. NATURAL PHILOSOPHY.—An amount represented by one year of study, with experimental illustrations. Avery's Natural Philosophy is recommended as a text-book.

5. BOTANY.—The elements of Vegetable Anatomy and Physiology, as given in the first twenty-seven chapters of Gray's Lessons, or the First and Second Parts of Wood's Class Book of Botany; also an analysis and written descriptions of fifty species of Phanerogams.

6. CHEMISTRY, GEOLOGY, ZOOLOGY, AND PHYSIOLOGY.—The candidate may offer any one of these subjects. The requirements, intended to cover a half year's work in each subject are as follows:

Chemistry.—Nichols's Abridgment of Elliot and Storer's Manual, or an equivalent.

Geology.—Candidates who offer themselves in Geology must have a good acquaintance with the subjects treated in at least the first three parts of Dana's Text-book of Geology.

Zoology.—Packard's Zoology, or Nicholson's Manual of Zoology

Physiology.—Martin's The Human Body.

COURSES OF INSTRUCTION.—The University provides a large number of courses of study in the various branches of learning, from which the student may choose his studies. The studies chosen may be pursued in any order, subject only to certain regulations prescribed by the faculty. The courses offered are subject to change from year to year. Those offered for the year 1882–83 are as follows:

MATHEMATICS.—*First Semester.*—1 Advanced Algebra. Monday, Tuesday, Wednesday, and Thursday, Sec. I., 5; Sec. II., 4–5. Assistant Professor Beman.

2. General Geometry and Calculus. Monday, Tuesday, Wednesday, and Thursday. Sec. I. 3–4; Section II. 4–5. Professor Olney.

3. Advanced General Geometry and Calculus. Five times a week, 5-6. Professor Olney.

4. Determinants. Tuesday and Thursday, 11½–12½. Assistant Professor C. N. Jones. 10. Plane and Spherical Trigonometry- Monday and Wednesday, Sec. I,, 9½–10½; Sec. III,, 10½–11½; Sec. V., 11½–12½; Tuesday and Thursday, Sec. II;, 9½–10½; Sec. IV.; 10½–11½. Assistant Professor C. N. Jones.

12 *Loci of Equations*—Friday, Sec. I., 9½–10½; Sec. II., 10½–11½; Sec. III., 11½–12½. Assistant Professor C. N. Jones.

13 *General Geometry and Calculus*—Five times a week, 3–4. Assistant Professor Beman.

17 *Mathematical Reading*—Five times a week, 2–3.

SECOND SEMESTER.

5 *Advanced Geometry;* Plane and Spherical Trigonometry. Monday, Tuesday, Wednesday and Thursday, Sec. I., 4–5; Sec. II., 5–6. Assistant Professor Beman.

6 *General Geometry and Calculus*—continuation of Course 2. Monday, Tuesday, Wednesday and Thursday, Sec. I., 3–4; Sec. II., 4–5. Professor Olney.

7 *Modern Geometry and Trilinear Co-ordinates*—Tuesday and Thursday, 2–3. Assistant Professor Beman.

8 *Calculus of Variations*—Not given this year. Professor Olney.

9 *Quaternions*—Tuesday, Wednesday and Thursday, 5-6. Professor Olney.

11 *Analytical Mechanics*—Five times a week, 9½–10½. Assistant Professor C. N. Jones.

14 *Advanced Algebra*—Monday, Wednesday, Sec. I., 10½–11½; Sec. II., 11½–12½; Sec. III., 2–3. Assistant Professor C. N. Jones.

15 *Geometry*—Tuesday and Thursday, Sec. I., 10½–11½; Sec. II., 11½–12½; Sec. III., 2–3. Assistant Professor C. N. Jones.

16 *General Geometry and Calculus*—continuation of Course 13. Five times a week, 3–4. Assistant Professor Beman.

17 *Mathematical Reading*—Five times a week, 2–3.

Courses, 2, 4, and 13 cannot be taken till after Courses 10, 12, 14 and 15, or Courses 1 and 5 have been completed. Course 3 cannot be taken till after Course 6 or Course 16 has been completed. Course 7 cannot be taken till after Course 4 and either Course 6 or Course 16 have been completed. Course 8 cannot be taken till after Course 3 has been completed. Course 9 cannot be taken till after Course 6 or Course 16 has been completed. Course 11 requires a knowledge of Integral Calculus; it will be given hereafter in the first semester, and will be followed in the second semester by a more extended Course in Dynamics. Course 17 is designed to give advanced students an opportunity to read with members of the Mathematical Faculty such standard Mathematical works as Salmon's Higher Algebra, Frost's Solid Geometry, Scott's Determinants, Price's Integral Calculus, Tait's Quaternions, and Routh's Rigid Dynamics.

MINERALOGY AND GEOLOGY.

FIRST SEMESTER.

1 *Short Course*—Tuesday and Thursday, 10½–12½. Professor Pettee.

2 *Mineralogy and Lithology*—Five times a week, 2–4. Professor Pettee.

SECOND SEMESTER.

2 *Mineralogy and Lithology*—Five times a week, 8½–10½. Professor Pettee.

For Course 1 an elementary knowledge of Chemistry is desirable. Course 2 can be taken only by those who are taking or have taken, a Course in Analytical Chemistry; it will not be given in the first semester hereafter.

II. GEOLOGY—FIRST SEMESTER.

1 *Succession of Geological Events*—Embracing in their relations, the elements of geological dynamics, continent-building and sculpturing, rock-classification, geographical geology, time divisions, and palæontology. Part I, Facts and Doctrines. Monday and Wednesday, 3–4. Professor Winchell.

2 *Oral Exercises*—Supplementary to Course 1, and parallel with it; being a review, with exercises on the geological map, and in various specific geological problems. Friday, 3–4. Professor Winchell.

3 *Advanced Geology and Palæontology*—Lectures, reading, and museum study. Tuesday and Thursday, 3-4. Professor Winchell.

4 *Palæontological Investigations*—Laboratory work, with reading, and such instruction as the student may require. Five times a week, 2–4. Professor Winchell.

[8 *Economic Geology*—Twice a week. Not given this year. Professor Pettee.]

9 *Geology of the United States*—Tuesday and Thursday, 4-5. Professor Pettee.

SECOND SEMESTER.

5 *General Geology*—Part II. Theories. Monday, 3–4. Professor Winchell.

6 *Oral Exercises*—Parallel with Course 5. Friday, 3–4. Professor Winchell.

7. *Palæontological Investigations,* as in course 4. Professor Winchell.

Course 2 is intended to accompany Course 1; it may be taken, however, by any person somewhat acquainted with the elements of Geology. Course 3 is intended for students who have taken Course 1, or who enter the University with thorough preparation in the elements of Geology. Course 5 can be taken only by those who have had Course 1, or an equivalent. Course 6 is intended to accompany Course 5; it may be taken, however, by any person somewhat acquainted with the elements of Geology. Course 7 is intended for students aspiring to proficiency in Geology; it must follow Course 1, and also Courses 1 to 5 in Zoology. Course 8 must be preceded by Course 2 in Mineralogy. Course 9 requires some previous knowledge of General Geology. Course 3 or 5 may be taken as an advanced Course by students who have passed an entrance examination in Geology.

SURVEYING.

FIRST SEMESTER.

1 *Surveying*—Use of Transit and Level. Monday, Wednesday, Friday, 8½–12½. Assistant Professor Davis.

2 *Surveying with Compass*—Solar Compass; U. S. Surveys. Tuesday and Thursday, 8½–12½. Assistant Professor Davis.

SECOND SEMESTER.

3 *Higher Surveying*—Plane Table; Sextant; Earth-work. Five times a week, 2–6. Assistant Professor Davis.

4 *Field Work*—Four weeks entire, 8–12 and 1–5. Assistant Professor Davis.

Courses 1 and 2 presuppose a knowledge of Plane Trigonometry. Course 3 must be preceded by Courses 1 and 2.

ENGINEERING.

I. CIVIL ENGINEERING—FIRST SEMESTER.

1 *Strength and Resistance of Materials*—Monday and Wednesday, 9½–10½. Professor Greene.

2 *Engineering*—Theory of Construction. Friday, 9½–10½ Professor Greene.

3 *Graphical Analysis of Structures*—Tuesday and Thursday 9½–10½. Professor Greene.

4 *Engineering Design*—Daily, three hours a day; to count as one full course. Professor Greene.

5 *Mechanism and Machine Drawing*—Tuesday and Thursday, 8½–10½. Assistant Professor Denison.

6 *Machinery and Prime Movers*—Water Wheels and Steam Engines. Monday, Wednesday, and Friday, 10½–11½. Professor M. E. Cooley.

SECOND SEMESTER.

3 *Graphical Analysis of Structures*—Tuesday and Thursday, 10½–11½. Professor Greene.

8 *Engineering*—Theory of Construction. Monday, Tuesday, Thursday, and Friday, 9½–10½. Professor Greene.

9 *Hydraulics*—Water Supply and Sewerage. Wednesday, 9½–10½. Professor Greene.

10 *Stereotomy.*—Tuesday and Thursday, 8½–10½. Assistant Professor Denison.

Course 4 accompanies 1, 2, and 8. Course 10 must be preceded by Course 5 in Drawing.

II. MECHANICAL ENGINEERING—FIRST SEMESTER.

1 *Workshop Appliances and Processes, Pattern Making, Moulding, and Founding.* Monday and Friday, 11½–12½. Professor M. E. Cooley.

[2 *Mechanical Laboratory work*—Tuesday and Thursday, 2–4. Not given this year. Professor M. E. Cooley.]

5 The same as Course 5 in Civil Engineering.

6 The same as Course 6 in Civil Engineering.

7 *Machine Design*—Monday, Wednesday, and Friday, 8½–11½. Professor M. E. Cooley, and Assistant Professor Denison.

[10 *Naval Architecture*—Tuesday and Thursday, 4–5. Not given this year. Professor M. E Cooley.]

SECOND SEMESTER.

8 *Mechanical Laboratory work*—Tuesday and Thursday, 2–4. Professor M. E. Cooley.

4 *Machinery, Machine Construction, and Drawing*—Monday, Wednesday, and Friday, 8½–11½. Professor M. E. Cooley, and Assistant Professor Denison.

[8 *Thermodynamics*—Monday, Wednesday, and Friday, 11½–12½. Not given this year. Professor M. E. Cooley.]

9 *Original Design, Estimates, Specification, and Contracts.* Tuesday and Thursday, 8½–10½. Professor M. E. Cooley.

11 *Naval Architecture*—Tuesday and Thursday, 4–5. Professor M. E. Cooley.

Course 5 precedes Course 6. Course 6 and 10 must be preceded by Course 11 in Mathematics. Course 7 must be preceded by Courses 4 and 5, and must precede Course 9. Course 10 precedes Course 11.

III. MINING ENGINEERING—SECOND SEMESTER.

1 *Mining.*—Five times a week. Professor Pettee.

METALLURGY.

FIRST SEMESTER.

1 *Fuel and Refractory Material, Iron, Steel, Copper, and Zinc.* —Tuesday and Thursday, 10½–11½; Wednesday, 11½–12½; Friday, 4–5. Professor Cheever.

SECOND SEMESTER.

2 *Lead, Silver, Gold, Mercury, and other metals.*—Twice a week Hours to be arranged with the instructor. Professor Cheever.

Requirements for Graduation.—Five exercises a week during a semester, whether in recitations, Laboratory work, or lectures, constitute a *Full Course of Study.* The completion of *Twenty-four Full Courses* is necessary to obtain the recommendation of the Faculty for the degree of Bachelor of Arts, or of Bachelor of Science (for the courses in Civil, Mechanical, or Mining Engineering). The completion of *Twenty-six Full Courses* is necessary to obtain the recommendation for the degree of Bachelor of Science (for the course in General Science), or of Bachelor of Letters. It is not essential that the exercises constituting a *Full Course* shall be in one and the same branch of study. Thus, a part (two for instance) may be in Mathematics, a part (say two) in Greek, and a part (say one) in Latin, making a total of five.

THE DEGREE OF BACHELOR OF SCIENCE.—Of the *twenty-six Full Courses* that the student is required to complete before he will be recommended by the Faculty for the degree of Bachelor of Science for the course in General Science *thirteen and four-fifths Full Courses* are prescribed as follows:

Courses 10, 12, 14, 15, in Mathematics, Courses 2, 6, in French, Course 1, 3, in German, Courses 1 or 7, and 2 or 8, in English, Course 3, in Philosophy, One Full Course in Physics, One Full Course in General Chemistry, One Full Course in Zoology, or in Botany, Five Full Courses in Organic Sciences, or Five Full Courses in Inorganic Sciences.

In addition to these the student must choose and complete from the other Courses offered enough to make in all *Twenty-Six Full Courses.*

Some of the Courses in Professional Studies.—It is thought desirable to add fuller statements than are given on the preceding pages concerning certain branches of study that lead to the professions of Engineer, Chemist, and Teacher.

I. *Engineering.*—The University is now better prepared than ever before to give complete courses of instruction in all branches of engineering, civil, mechanical, and mining. In *Civil Engineering* the University offers to persons that wish to become professional engineers a thorough course of study extending over about four years. The aim in this course of study is to lay a foundation of sound theory, sufficiently broad and deep to enable its graduates to enter understandingly on the further investigation of the several specialties of the profession; and at the same time to impart such a knowledge of the usual practice of an office, and of an engineering party, as shall make its students useful in any position to which they may be called. While the adaptation of theory to practice can be thoroughly learned only by experience, there are many matters in which the routine work of an engineering field party, office, or drafting room can be carried out on a greater or less scale in a training school. In all such particulars the civil engineering course of the University will embody as close an imitation of the requirements of active labor as the instructors who have the several branches in charge can devise. All the technical branches are under the direct care of those who have had professional experience as well as a full scientific training. In *Mechanical Engineering* the course of study though to some extent parallel with that in civil engineering, includes such a range of special studies as will enable the graduate to enter understandingly on the practice of his profession. Theory and practice are combined as far as possible, and no efforts are spared to make the relation between them plainly evident. The special work will be mainly under the direction of Professor Mortimer E. Cooley, assistant engineer in the United States navy, who has been recently detailed by the Navy Department for this purpose. In *Mining Engineering and Metallurgy* the course of instruction, which is intended to cover about four years of study, includes a part of that provided for students in civil and in mechanical engineering, though more especial attention is paid in the latter part of the course to mineralogy, geology, and Chemistry. The instruction in the technical branches is arranged so as to meet the wants, both of those whose purpose it is to confine their professional work more closely to metallurgy, and of those who intend to engage in the practice of mining and metallurgy combined.

Requirements for Admission.—Candidates for a degree in any of the courses in engineering must pass examinations for admission as follows:

1. *English Language, Geography, and Mathematics.*—In all, the same as for the degree of Bachelor of Arts.

2. *History and Natural Philosophy.*—In both, the same as for the degree of Bachelor of Science.

3. *English Literature.*—The same as for the degree of Bachelor of Letters.

4. *Chemistry, Geology, Zoölogy, or Physiology.*—In any *two* of these subjects, the same as for the degree of Bachelor of Science.

5. *French or German.*—The same as for the degree of Bachelor of Science. A candidate who has had no opportunity for preparation in French or German will not be rejected for lack of knowledge of those subjects. If satisfactory examinations are passed in the other subjects, the candidate may be admitted, but will be required to make up the deficiency in French or German.

Students not candidates for a degree may be admitted to pursue such studies as they prefer, provided they are found prepared to join the classes in those studies. They will be expected to attend all the lectures, recitations and examinations in the branches prescribed for the regular students, and will be required to take enough work to occupy them profitably.

Courses of Instruction.—The studies pursued in the earlier parts of the course, common to all students in engineering, will comprise, *in Mathematics*, algebra, geometry, plane and spherical trigonometry, general geometry, and the elements of differential and integral calculus; *in French and German*, an amount covering in all about two years of study, the choice depending upon the language presented at the examination for admission; *in English*, a course in higher English grammar and composition; *in Physics* and *in General Chemistry*, the study of the elementary principles; and, *in Drawing*, practice in geometrical and in mechanical drawing, and the study of descriptive geometry. The more technical subjects are taken up in the latter part of the course. Some of these subjects are of equal value to all classes of engineering students, such as analytical and applied mechanics, the strength and resistance of materials, and the metallurgy of the useful metals, especially iron and steel; others are adapted more particularly to the wants of the special students in the several courses. Their general scope may be seen from the following descriptive outline:

1. *Drawing.*—A very complete course in mechanical drawing is given, embracing plane projection drawing, isometric drawing, descriptive geometry, and the elementary principles of coloring and shading, with original problems executed in the drawing room. Students of mechanical engineering are required to sketch pieces of machinery, and afterwards to make working drawings suitable for use in the shop. Problems peculiar to mining practice are also given. Examples from numerical data are always given in all branches, and copying from the flat is avoided. Instruction is also given in free-hand drawing, topographical drawing, ornamentation and lettering, shades and shadows, linear perspective, and drawing for stone-cutting. The plans of surveys, plane-table work, maps, designs in engineering construction, and the thesis drawings naturally come under this head. The work in drawing occupies the student a part of almost every day throughout the course.

2. *Surveying.*—The work in surveying combines theory and practice. A course of lectures and text book work, in daily exercises, covers so much of one year as is not given to field work: the theory of instruments, and all the operations of surveying, laying out work, and computing are explained in detail. Every student is afforded abundant opportunity for becoming familiar, by actual use, with the excellent and full assortment of instruments owned by the University, embracing those usually employed in actual work, and numbering enough to well equip the parties. The classes in surveying are drilled in all the field work that pertains to that branch of engineering; they make surveys, traverse them, calculate contents, divide areas, and solve problems in heights and distances from data taken by themselves. They also determine the meridian, and take observations for latitude. This work is done during the fall months; the finished plans of the surveys are made during the winter. The classes in railroad engineering have practice in running levels and curves of different kinds, and in the measurement of earthwork. In the month of June they are taken into the field as a railroad party, for a space of four weeks continuously, where, under competent supervision, they go through all the field-work for a projected line; doing all the work up to the point of actual construction, such as reconnoissance, preliminary and location surveys, cross-sectioning, staking out, contouring, and topography. A plan and profile, carefully made in the field by each student from the notes of the party, completes this portion of the subject, and serves to fix the practical application of the principles obtained from the text-books and lectures. In the above work are usually included a plane-table survey, triangulation, and some hydrography when the selected locality is favorable. The principal text-books used in this work are Henck's Field-Book for Engineers, and Rankine's Civil Engineering.

3. *Civil Engineering: Theory of Structures.*—The study of the strength of materials and the theory of construction covers a course of recitations and lectures for an entire year. The text-book used is Rankine's Manual of Civil Engineering, supplemented with full explanations, additional lectures, examples, and problems. A complete course of instruction is also given in the graphical analysis of roof and bridge trusses and arches, as recently developed and applied. The student is made familiar with both the analytical and graphical methods of treatment, and thus possesses ready proof of the accuracy of his calculations.

4. *Machinery and Prime Movers.*—A course of instruction is given in mechanism, or the general principles of machinery, involving the study of gearing, cams, screws, cranks and levers, the dynamics of machinery, the strength and construction of machinery, and the materials used in construction. Careful attention is given to the principles of mechanics as applied in the construction of various kinds of machinery, and in the erection of blast-furnaces, foundries, rolling mills, and steel-works. In the study of the prime movers special attention is given to turbines and other water-wheels, and to the steam engine. Lectures are given on the different types of engines and boilers, links and valve motions, condensers, pumps, and propelling instruments, the theory and practice of the use of steam, combustion and fuel, and the efficiency of furnace, boiler, and engine. The care and management of engines and boilers, both in use and out of use, are also discussed. Additional lectures are given on the designing of the different parts of both the simple and the compound engine and boiler, and their various attachments.

5. *Designs in Engineering and in Machine Construction.*—Contemporaneously with the study of theory, students are required to work out problems in design. They are furnished with the usual data for a design, and the kind or type of structure or machine will be indicated. They are then expected to make the necessary calculations, paying particular attention to proportioning the different parts, so as to secure strength, simplicity, and effect, and to present, at a specified date, complete working drawings, giving full details, accompanied by bills of materials, estimates, and specifications.

6. A course in *Thermodynamics* embraces the study of the principles governing the action of heat engines in general.

7. *Mechanical Engineering and Laboratory work.*—The elementary courses in mechanical engineering embrace the explanation of the principles governing the action of cutting tools, and a description of the principal machine and hand tools used in the work-shop. They also treat of the usual and more important processes employed in the shop. Lectures are given on pattern making, moulding, and founding, covering the principal features of each. The *Laboratory work* is intended to cover the application of principles previously studied. It comprises the actual manipulation of the tools used in working metal and wood, and in moulding. The student is required to do work in pattern making, and moulding in green sand, in dry sand, and in loam, and will charge and have the management of the cupola and brass furnace during the operations of casting. Careful attention is given to the selection of sands for different purposes, and to making composition metals for specific purposes. The student is also required to put in practice, at the blacksmith's forge, his knowledge of the elementary principles of forging, and to forge and temper his own cutting tools. By working with iron and steel of different qualities, the student becomes familiar with all grades of those materials. Practice is also afforded in soldering, brazing, and steam-fitting. The principal text-books and books of reference used in the work in mechanical engineering are Rose's Practical Machinist and Pattern Maker's Assistant, Shelley's Workshop Appliances, Spretson's Casting and Founding, Rankine's Machinery and Mill-work, Rankine's Steam Engine, Sonnet's Dictionnaire des Mathematiques Appliquées, Unwin's Elements of Machine Design, Marks's Proportions of the Steam Engine.

9. *Economic Geology.*—Particular attention is paid to the geology of mines and mineral districts, and to the modes of occurrence and distribution of mineral substances that have an economic or commercial importance.

10. *Mining.*—In this branch the instruction is given mainly by lectures. The machines in use at the best mines are described, and the mutual relations of parts explained and illustrated with the aid of plates and diagrams. The different operations connected with the discovery, opening, development, and working of mines are all studied in their proper order.

11. *Metallurgy.*—A complete course of instruction by lectures and recitations is given upon the subjects of fuel, refractory material, iron and steel, copper, zinc, lead, gold, silver, and other metals, extending over an entire year. The lectures are illustrated by charts and drawings of the furnaces and appliances used, and by samples of furnace products. In connection with this course of study, the student is required to work out problems in heat, furnace construction, ore mixtures, blast furnace slags, and blast engines, and to write out the chemical reactions that take place in the different metallurgical operations. Certain days are devoted to laboratory work, and the student is required to determine by actual tests the heating value of different fuels, to make tests of fire-proof material, and, from data and material

furnished, to produce slags whose composition shall correspond to a given formula.

12. *Visits of Inspection.*—As often as may be practicable, visits will be paid to the neighboring manufacturing establishments for the purpose of acquiring a knowledge of the methods employed in building, and in the construction of machinery and ships. It is hoped, also, that provision will soon be made for a regular course of study, during the summer vacation, among the mines and furnaces of the Upper Peninsula.

Facilities for Instruction.—The collections for illustrating the instruction given comprise models, drawings, photographs, and lithographs, representing trusses, arches, and details of construction in iron, wood, and stone; also shapes of iron, working models of turbines and engines, and working drawings of a number of bridges. These collections are receiving additions from year to year, by gift and purchase, and are invaluable to the student. The mechanical laboratory, for the erection and equipment of which the sum of twenty-five hundred dollars was appropriated by the last Legislature, has been built and is now ready for occupancy. There is also a large and convenient metallurgical laboratory connected with the chemical laboratory, amply supplied with assay furnaces and other appliances such as are usually found in laboratories of this description. The latest and best books on professional subjects are added yearly to the library, where they are accessible to all; and frequent references are made to them in the class-room as the various subjects are brought forward.

Examinations.—Examinations, usually in writing, are held at the end of each semester; but the classes are liable to be examined at any time, without notice, on any portion of their previous work.

REQUIREMENTS FOR GRADUATION.—Upon the completion of a prescribed course of study, amounting to twenty-four Full Courses, as given below, and the presentation of a satisfactory thesis, the student receives the degree of Bachelor of Science. The diploma given indicates the line of study pursued. Bachelor of Arts, of Science, and of Letters, of this University, and graduates of any other reputable University or College, will be recommended for the same degree with the regular students, after attendance on, and a satisfactory examination in, the technical subjects alone of the several courses. These studies can be completed in two years. The culture imparted by classical or other liberal training will be found to have its uses for one engaged in engineering work, and the previous discipline of the faculties in exact research will enable the professional student to master more easily the requirements of the course. All the time the student can devote to general studies before taking up specialties will be well spent. The requirements for the several degrees as follows:

1. *Civil Engineering.*—To obtain the recommendation of the Faculty for the degree of Bachelor of Science, for a course in Civil Engineering, the student must complete

Courses 1, 3, 5, 11, 13, 16, in Mathematics.
Courses 2, 6, in French.
Courses 1, 3, in German.
Course 1 or 7, in English.
Course 10, in Physics.
Course 2, in General Chemistry.
Course 1, in Mineralogy.
Course 3, in Astronomy.
Courses 1, 2, 4, 5, 6, in Drawing.
Courses 1, 2, 3, 4, in Surveying.
Courses 1, 2, 3, 4, 5, 6, 8, 9, 10, in Civil Engineering.

These make *twenty and four fifths Full Courses.* From the other Courses offered he must choose and complete *three and one fifth Full Courses*, making *twenty-four Full Courses* in all. He must also prepare a satisfactory thesis.

2. *Mechanical Engineering.*—To obtain the recommendation of the Faculty for the degree of Bachelor of Science, for a course in Mechanical Engineering, the student must complete

Courses 1, 3, 5, 11, 13, 16, in Mathematics.
Courses 2, 6, in French.*
Courses 1, 3, in German.*

*For students who passed an admission examination in German instead of French the prescribed Courses are 1 and 5 in French, and 2 and 6 in German

Course 1 or 7, in English.
Course 10, in Physics.
Course 2, in General Chemistry.
Course 1, in Mineralogy.
Courses 1, 2, 4, 5, 6, in Drawing.
Courses 1, 3, 10, in Civil Engineering.
Courses 1 to 9 inclusive, in Mechanical Engineering.
Course 1, in Metallurgy.

These make *twenty and two-fifths Full Courses.* From the other Courses offered he must choose and complete *three and three-fifths Full Courses*, making *twenty-four Full Courses* in all. He must also prepare a satisfactory thesis.

3. *Mining Engineering.*—To obtain the recommendation of the Faculty for the degree of Bachelor of Science, for a course in Mining Engineering, the student must complete one of the two following sets of requirements:

I.

Courses 1, 3, 5, 11, 13. 16, in Mathematics
Courses, 2, 6, in French.*
Courses 1, 3, in German.*
Course 1 or 7, in English.
Course 10, in Physics.
Course 2, in General Chemistry.
Courses 1, 5*a*, 9, 10, in Analytical Chemistry.
Course 2, in Mineralogy.
Courses 8, 9, in Geology.
Courses 1, 5, in Drawing.
Courses 1, 2, in Surveying.
Courses 1, 3, 5, 6, in Civil Engineering.
Course 1, in Mining.
Course 1, in Metallurgy.

These make *twenty-three Full Courses.* From the other Courses offered he must choose and complete *one Full Course*, making *twenty-four Full Courses* in all. He must also prepare a satisfactory thesis.

II.

Courses 10, 12, 14, 15, in Mathematics.*
Courses 2, 6, in French.†
Course 1, in German.†
Course 1 or 7, in English.
Course 10, in Physics.
Course 2, in General Chemistry.
Courses 1, 5*a*, 5*a′*, 9, 10, in Analytical Chemistry.
Course 2, in Mineralogy.
Courses 8, 9, in Geology.
Courses 1, 3, 5, in Drawing.
Courses 1, 2, 3, in Mechanical Engineering.
Course 1, in Mining.
Courses 1, 2, in Metallurgy.

These make *nineteen and three fifths Full Courses.* From the other Courses offered he must choose and complete *four and two-fifths Full Courses* making *twenty-four Full Courses* in all. He must also prepare a satisfactory thesis.

REQUIREMENTS FOR THE DEGREES OF CIVIL ENGINEER, MECHANICAL ENGINEER, AND MINING ENGINEER.—The conditions on which the degree of Civil Engineer, as a second degree, is conferred, are as follows: The degree of Civil Engineer may be conferred upon Bachelors of Science of this University who have taken the degree for a course in Civil Engineering, if they furnish satisfactory evidence that they have pursued further technical studies for at least one year, and, in addition, have been engaged in professional work, in positions of responsibility, for another year. The first of the above requirements may be satisfied by pursuing at the University, under the direction of the Faculty, a prescribed course of study for an amount of time, not necessarily consecutive, equivalent to a college year. If the candidate does not reside at the University, his course of study must be approved in advance by the Professor of Civil Engineering, and he must prepare a satisfactory thesis on some engineering topic, to be presented, together with a detailed account of his professional work, one month, at least, before the date of the Annual Commencement at which he expects to receive the degree. The conditions on which the degrees of

* Instead of these Courses the student may take Courses 1 and 5.

† For students who passed an admission examination in German instead of French, the prescribed Courses are 1 and 5 in French, and 2 and 6 in German.

Mechanical Engineer and Mining Engineer, as second degrees, will be conferred are not yet fully determined, though they will probably be similar to those required for the degree of Civil Engineer.

ANALYTICAL AND APPLIED CHEMISTRY.—Students desiring to qualify themselves for research and educational service in chemical science, or for the profession of an analytical and consulting chemist, can, by making a judicious choice of elective studies, accomplish this object, and at the same time satisfy the requirements for the degree of Bachelor of Science. The prescribed *general studies*, those namely, in Mathematics, French, German, English, Philosophy, Physics, and Zoölogy or Botany, amount to *seven and four-fifths Full Courses*, and leave *eighteen and one-fifth Full Courses* to be completed by the student, of which *one Full Course* must be taken in General Chemistry, and *five Full Courses* either in Organic or in Inorganic Sciences.

Students wishing to complete a professional course in Chemistry are recommended to take the following Courses, which amount in all to *twelve and four-fifths Full Courses*:

Course 3, in Physics.
Courses 3, 6, in General Chemistry.
Courses 1, 2, 4, 5a, 5a′, 7, 9, 10, 11, 14, in Analytical [Chemistry.
One Full Course, in Drawing.

To those students who wish to pursue special subjects, the following Courses, in addition to the above, are recommended:

I. For Mineralogical and Metallurgical Chemistry:
Course 2, in Mineralogy.
One Full Course, in Geology.
One Full Course, in Metallurgy.
These make *three Full Courses.*

For Manufacturing Applications:—Course 13, in Analytical Chemistry. Course 2, in Mineralogy. One Full Course, in Metallurgy. These make *two-and four-fifths Full Courses.*

3. *For Medical Chemistry and Biology*: - Course 8, in Analytical Chemistry. One Full Course in Zoology. Course 1, 2 in Physiology. These make *two and three-fifths Full Courses.*

4. *For Sanitary Chemistry*, the examination of foods, and the detection of adulterations:—Courses 4, 5a″ in Analytical Chemistry. Course 2 in Botany. These make *Three Full Courses.*

CALENDAR.—September 21-25. Examination of Candidates for admission to the department of Literature, Science and the Arts.

September 25, 26. Examination for admission to the School of Pharmacy. First year's work begins.

September 25-30. Examination for admissions to the Department of Law.

September 27. First Semester begins.

September 28-30. Examination for admission to the Department of Medicine and Surgery, the Homœopathic Medical College, and the College of Dental Surgery.

October 2. Professional school opens.

November —. Thanksgiving Recess of three days, beginning Tuesday evening, in the Department of Literature. Science and the Arts, the department of Medicine and Surgery, the School of Pharmacy, and the Homœopathic Medical College; recess of one day, Thursday, in the department of Law, and in the College of Dental Surgery.

December 22. (Evening.) Holiday Vacation begins for all departments.

1883.

January 9. Exercises resumed.

February 16. (Evening.) First Semester closes.

February 18. Second Semester begins.

March 28. Commencement in the department of Law, and in the College of Dental Surgery.

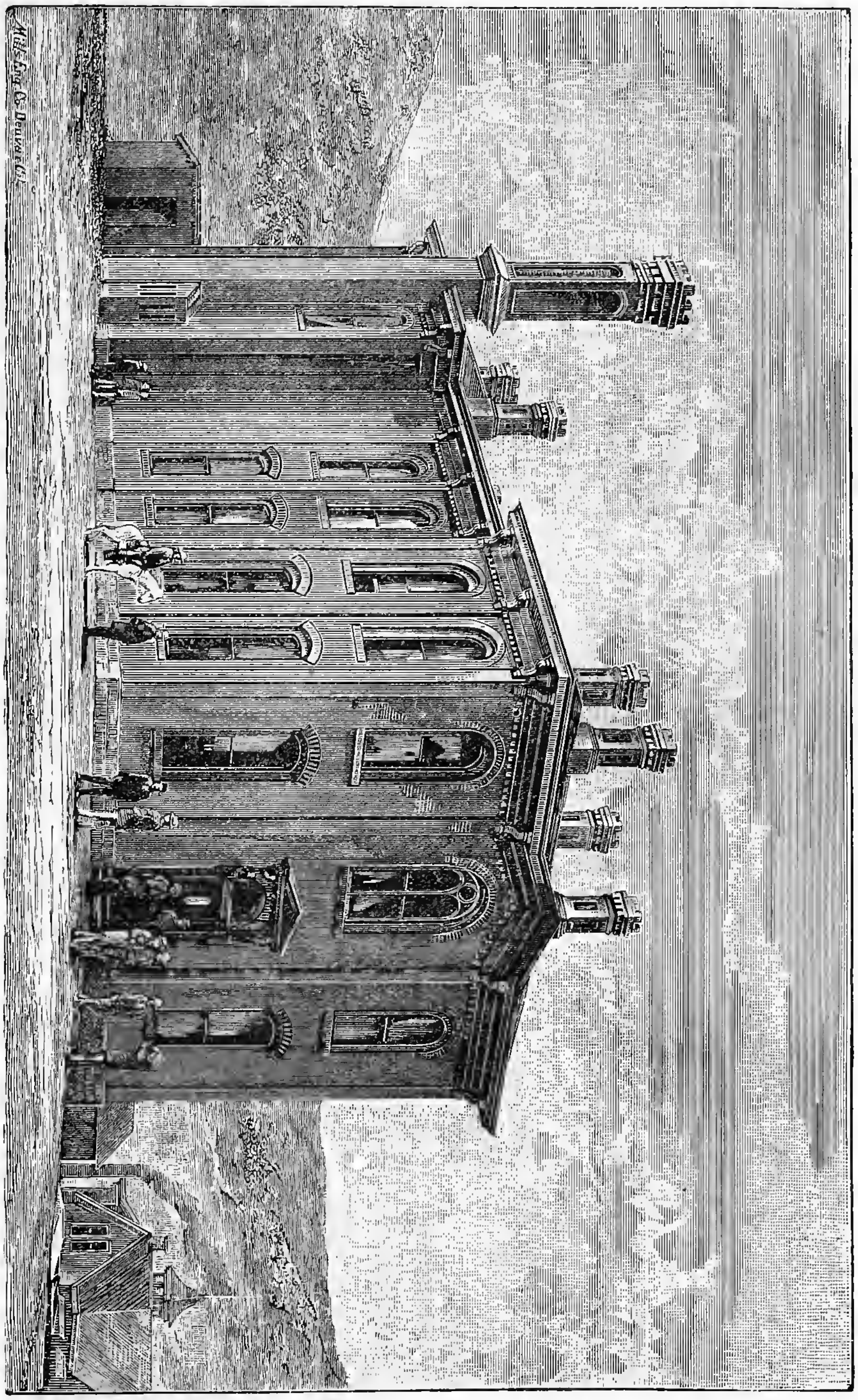
COLORADO STATE SCHOOL OF MINES, GOLDEN, COLORADO.

THE State School of Mines of Colorado was established by act of the Legislative Assembly, approved February 9th, 1874. The General Assembly of 1879 recognizing that the highest interests of the State were best subserved by enabling the School of Mines to occupy a position and accomplish a work worthy of its object and aims, wisely granted a decided increase to the former appropriation for the Institution, thus putting it into the power of the Board of Trustees to re-organize and equip the School on a basis which would insure a competent preparation of its students to fill any department of practical work in Mining and Metallurgy. In harmony with this action the Board of Trustees during the summer of 1880, erected a new and commodious building in Golden, within three minutes' walk of the centre of business, in a convenient location, and supplied it with every facility requisite for the most successful prosecution of work in the various departments of study The faculty was at the same time re-organized and greatly increased. Large additions were made to the library and chemical apparatus and the Assay and Chemical Laboratory were fitted up according to the most approved plans, and a scale sufficient to meet the increased demands made upon the Institution. The School re-opened in the new building, which is illustrated on the next page, on Wednesday, October 13th, 1880, and has already met with the most unqualified success under its present organization. An additional building is now in process of erection to be connected with the present one, making the capacity of the whole *three* times that of the building represented in the cut. This has been necessitated by the rapid increase in the number of students during the past two years, and by the present enlarged sphere of work of the institution.

The building represented in our cut is of brick manufactured from the excellent clay of the neighborhood. Its location, style and proportions give it a very pleasing effect: while its windows command views in every direction of surpassing beauty. The plan of its interior was the result of careful study on the part of the Board of Trustees, under the advice of the Faculty, and, in points of convenience and adaptation to the purposes in view, is well-nigh perfect. Two stories in height, the front, on each floor, is devoted to halls, offices and recitation rooms. The main part below affords a spacious chemical laboratory, besides three rooms in the rear occupied by the Assay department. The corresponding space upon the upper floor constitutes a large lecture room, the center being furnished with seats, sides and one end occupied by cases containing the various cabinets, while the remaining end furnishes room for the lecture-stand, fitted with pneumatic cisterns and every modern convenience. The advantages of location at Golden are threefold, viz.: 1st, it is easily accessible by rail from all parts of the State; 2d, Golden is situated at the very foot of the mountains, at a point affording most remarkable opportunities for illustrating studies in geology, nearly all the formations known to the geology of Colorado being well represented in the neighborhood. Mines, also of coal, fireclay lead, silver and gold are either immediately at hand or to be reached within a few miles by rail. 3d. The establishment here of various reduction works for treating ores—access to which is freely accorded the students—furnishes invaluable aid in acquiring a knowledge of metallurgy that shall not be merely theoretical but eminently practical.

FACULTY.—Albert C. Hale, A. M., E. M., Ph. D., President, Professor of Chemistry and Assaying. Milton Ross, Ph. D., Professor of Mineralogy and Metallurgy. Arthur Lakes, Professor of Geology and Drawing. Gregory Board, E. M. Treatment of Colorado Ores. Magnus C. Ihlseng, E. M., C. E., Ph. D., Professor of Engineering, Mathematics and Physics. Eri P. Rice, Secretary, and Assistant in Chemistry. Carlton H. Hand, Assistant in Assaying.

Admission.—Candidates for admission to any of the regular courses are expected to be at least seventeen years of age, to have had a liberal education in the English branches, and to sustain a thorough examination on the first five chapters of Peck's Manual of Algebra and on the first four books of Wentworth's Geometry or an equivalent of Davies' Legendre. Candidates for advanced standing will be examined upon all the studies of the course below the class they purpose to enter, as well as upon the subjects required for admission. A certificate from other institutions bearing satisfactory evidence that the candidate has completed any or all of the required subjects, will be accepted in lieu of an examination upon the same. Special students are received at any time during the regular sessions, provided their age and attainments are sufficient for the studies they wish to pursue.



COLORADO STATE SCHOOL OF MINES, GOLDEN, COLORADO.

Courses of Study.—There are three regular courses of study, viz: Mining Engineering, Civil Engineering and Metallurgy—each covering a period of four years. Students who complete any of the courses and pass the required examination in all the studies of the same will be entitled to receive a State Diploma in recognition of their attainments. Those in the course of Mining Engineering receive the degree Engineer of Mines (E. M.) in Civil Engineering, that of Civil Engineer (C. E.), and those in Metallurgy the degree Bachelor of Philosophy (Ph. B.)

Special Courses of Study.—It being the aim of the Institution to adapt itself to the Mining and Metallurgical interests of the State, students who wish to pursue special courses of study in Assaying, Chemical Analysis, Geology, Mineralogy or Surveying, will find *superior* advantages for doing so under the advice and direction of the Faculty, and every opportunity for study and practice will be afforded those who wish to prepare themselves thoroughly to do successful work as prospectors, assayers or surveyors. Special students attend lectures with the regular classes so far as possible, and *all receive individual instruction* in the laboratories.

Expenses.—The charges are twenty dollars ($20 00) per term for the regular courses of study, and the same for special courses in which the student is engaged in laboratory work. As *tuition is free* the fee is simply to defray the cost of chemicals, apparatus, fuel, etc. Students can obtain board and suitable accommodations in Golden at a cost averaging from six to seven dollars per week.

Course in Mining Engineering.—First Year.—*First Term.* Algebra, Physics, Chemistry, Drawing, free hand, French.

Second Term.—Algebra, Physics, Chemistry, Drawing, free hand, French.

Third Term.—Algebra, Geometry, Physics, Chemistry, Drawing free hand, Botany (optional), French.

Vacation.—Memoir on subject assigned by the Faculty.

Second Year—*First Term*—Geometry, Qualitative Analysis, Assaying, Drawing, Crystallography, German.

Second Term—Trigonometry, Mensuration, Conic Sections, Qualitative Analysis, Drawing, Assaying, Mineralogy, Blowpipe Analysis, German.

Third Term—Descriptive Geometry, Surveying, Stoichiometry, Qualitative Analysis, Drawing, Determinative Mineralogy, Zoology, (optional) German. Vacation Memoir.

Third Year—*First Term*—Analytical Geometry, Surveying, Quantitative Analysis, Applied Chemistry, Drawing, Shades, Shadows and Perspective, Geology.

Second Term—Calculus, Geodesy, Quantitative Analysis, Applied Chemistry, Drawing, Civil Engineering, Stone Cutting, Geology.

Third Term—Calculus, Mechanics, Metallurgy, Applied Chemistry, Drawing, Civil Engineering, Economic Geology, Spanish (Optional). Vacation Memoir.

Fourth Year—*First Term*—Kinematics, Mechanics, Metallurgy, Practical Mining, Drawing, Mining Law, Theory of Strains and strength of materials, Spanish, (optional.)

Second Term—Dynamics, Hydraulic Engineering, Metallurgy, Practical Mining, Drawing, Mining Engineering, Plans, Constructions, and Estimates.

Third Term—Mechanical Engineering, Ore Dressing, Mining Engineering, Thesis Work, including Plans, Estimates and Drawings.

Course in Civil Engineering—First Year—*First Term*—Algebra, Physics, Chemistry, Drawing, free hand, French.

Second Term—Algebra, Physics, Chemistry, Drawing, free hand, French.

Third Term—Algebra, Geometry, Physics, Chemistry, Drawing, free hand, Botany, (optional,) French.

Vacation—Memoir on subject assigned by the Faculty.

Second Year—*First Term*—Geometry, Qualitative Analysis, Assaying, Drawing, Crystallography, German.

Second Term—Trigonometry, Mensuration, Conic Sections, Qualitative Analysis, Drawing, Assaying, Mineralogy, Blowpipe Analysis, German.

Third Term—Descriptive Geometry, Surveying, Stoichiometry, Qualitative Analysis, Drawing, Lithology, Zoology, (optional), German.

Vacation Memoir.

Third Year—*First Term*—Analytical Geometry, Surveying, Quantitative Analysis, Quarrying, etc., Drawing, Shades, Shadows and Perspective, Geology.

Second Term—Calculus, Geodesy, Excavation and Tunneling, Applied Chemistry, Drawing, Civil Engineering, Stone Cutting, Geology.

Third Term—Calculus, Mechanics, Metallurgy, Architecture, Drawing, Civil Engineering, Economic Geology, Spanish, (optional.)

Vacation Memoir.

Fourth Year.—*First Term.* Kinematics, Mechanics, Railroad Equipment, Architecture, Spanish, (optional), Drawing, Lectures on Laws pertaining to railroads and their management. Theory of Strains and Strength of Materials.

Second Term. Dynamics, Hydraulic Engineering, Problem in Graphics, Drawing, Mining Engineering, Plans, Constructions and Estimates.

Third Term. Mechanical Engineering, Sewage and Sanitary Engineering, Thesis Work, including Plans, Estimates and Drawings, Bridges, Aqueducts, etc.

Course in Metallurgy.—First Year.—*First Term.* Algebra, Physics, Chemistry, Drawing, free hand, French.

Second Term. Algebra, Physics, Chemistry, Drawing, free hand, French.

Third Term. Algebra, Geometry, Physics, Chemistry, Drawing, free hand, Botany, (optional), French.

Vacation. Memoir on subject assigned by the Faculty.

Second Year—*First Term*—Geometry, Qualitative Analysis, Assaying, Drawing, Crystallography, German.

Second Term—Trigonometry, Mensuration, Conic Sections, Qualitative Analysis, Drawing, Assaying, Mineralogy, Blowpipe Analysis, Analysis, German.

Third Term—Descriptive Geometry, Metallurgy, Stoichiometry, Quantitative Analysis, Drawing, Determinative Mineralogy, Zoology (optional), German. Vacation Memoir.

Third Year—*First Term*—Analytical Geometry, Metallurgy, Quantitative Analysis, Applied Chemistry, Drawing, Determinative Mineralogy, Shades, Shadows and Perspective, Geology.

Second Term—Calculus, Metallurgy, Quantitative Analysis, Drawing, Stoichiometry, Geology, Applied Chemistry.

Third Term—Calculus, Mechanics, Metallurgy, Applied Chemistry, Drawing, Quantitative Analysis, Economic Geology, Spanish (optional). Vacation Memoir.

Fourth Year—*First Term*—Kinematics, Mechanics, Furnace Products, Practical Mining, Drawing, Mining Law. Theory of Strains and Strength of Material, Spanish (optional).

Second Term—Dynamics, Hydraulic Engineering, Problems in Graphics, Drawing, Constructions and Estimates, Practical Mining.

Third Term—Mechanical Engineering, Ore Dressing, Thesis Work, including Plans, Estimates and Drawings.

Mathematics and Mechanics.—In this department the student is given such an accurate knowledge of mathematics, pure and applied, as will enable him readily to solve difficult practical problems. The subjects are pursued in the following order, viz.: Review and completion of Algebra and Geometry; Trigonometry and Mensuration; Conic Sections; Analytical Geometry; Calculus and Analytical Mechanics.

Drawing.—Both Free Hand and Mechanical Drawing are taught. The object of Free Hand Drawing is to furnish that skill of the hand and eye which will enable the student promptly and effectively to illustrate any object with suitable sketches. In Mechanical Drawing the aim is to render the student a reliable and efficient draughtsman. The various methods of graphical expression are carefully investigated, and the principles therein embodied are put into practice in the formation of plans and in the execution of detailed drawings both from copies and original designs.

After devoting one year to Free Hand Drawing, the student is taught lettering, coloring, and the use of instruments. This is succeeded by a thorough course in Mechanical Drawing. Descriptive Geometry; Shades, Shadows and Perspective; Masonry and Stone-Cutting are taken up in their proper order. The students are also instructed in Topographical and Architectural Drawing and in the reproduction of drawings by the "Blue Process." The last year will be employed in making plans and designs for furnaces, mills, engines, machinery, etc., which are executed upon paper in the most careful and detailed manner in connection with Thesis work. These drawings are required to be presented upon paper 19 x 27 inches, to be preserved in the Institution for subsequent reference and inspection. The public will be allowed to examine and make copies of these, subject to such conditions as will insure their careful preservation.

Physics.—The students of the first year will be occupied for three hours per week with this subject. During this time the class will have, by lectures and recitations, amply illustrated by experiments, a complete course, embracing the following: The Principles of Mechanics; Elementary Machines; Optics, Acoustics, Heat, and Electricity, and also the application of the same to practical questions of every day life.

Surveying.—Surveying is taught in the most practical manner, the student becoming thoroughly familiar with the use of compass, transit, aneroid and hypsometer. Instruction is given in railroad and canal surveying, in sewage and street extension, in chain and underground surveying, and in Geodesy. The student learns to anticipate the various problems which he is likely to encounter in subsequent experience, and is carefully prepared by the selection of such as will be of special importance in his work as mining or civil engineer. His field and underground work are plotted under the personal supervision of the Professor.

Engineering.—This subject is systematically pursued through three years under the following heads: Strength of Materials; Civil Engineering; Hydraulic Engineering; Kinematics; Dynamics of Machinery, and Mining Engineering. Strength of Materials will occupy a term in the determination of dimensions of parts of roof, bridge, trusses, etc., by means of the stresses to which they are subjected. Civil Engineering will embrace the nature, elasticity and tests of materials; construction of retaining walls; trestles, bridges, canals, etc., estimation of quantities of materials required for the same; sewage and Sanitary Engineering. Hydraulic Engineering includes mechanics of fluids, gauging of streams, and the calculation for water supply, reservoirs, conduits, pipes, etc. In the study of *Kinematics* and *Dynamics* the student investigates the theory and construction of boilers, machinery, motors, pumps, teeth, cams, and also the transmission of power. The distinction between Mining Engineering and Civil Engineering being only in the difference of application, *Mining Engineering* proper will embrace, apart from the general subjects of engineering, the following branches, viz.: Practical Mining, which will consist of lectures and recitations upon prospecting, excavations, blasting, tunneling, shafting and timbering, hydraulic and placer mining, with details of construction and economy of pipes; also riffles, sluices, ditches, dams, etc; and Mine Engineering, which treats of the modes of exploitation, drainage and ventilation of mines; machinery for hoisting and pumping, ground plant and ore dressing in principle and detail, which is treated according to both the American and European methods and plans. The class accompanied by the Professor will visit prominent mines and mining regions after which each student is required to hand in a written report of his observations.

Chemistry.—A large amount of time is devoted to Chemistry, general, analytical and applied. A knowledge of the principles of the science, the nature of the most important elements and their compounds, their behavior with re-agents, and their deportment in Assaying and Metallurgical processes is regarded as indispensable to the successful metallurgist, and of great value to the engineer, prospector, and practical miner. It also affords a solid foundation upon which to build the sciences of Mineralogy and Geology. The Chemical Laboratory is capable of accommodating forty-five students at a time. Each student is provided with a convenient desk with shelves of re-agents and drawers and cupboards for apparatus. The more rare and costly chemicals are kept in special cases in the Laboratory rooms, and are accessible to students as they need them. The Laboratory is well lighted and ventilated, and is furnished with hoods to carry off poisonous and offensive gases. The building is furnished throughout with gas and water. Theoretical and Experimental Chemistry are taught during the whole of the first year, the students repeating in the Laboratory so far as possible the experiments shown in the Lecture room, and also testing the behavior of the most important elements and compounds towards the ordinary re-agents, thus preparing the way for the strictly analytical work which follows, and which, with Applied Chemistry is continued until the fourth year—students in Civil Engineering, however, do not pursue the subject so far. In Qualitative Analysis the most reliable and direct methods are adopted. The student is required to write out accurately the formula expressing the reaction and also to give a full explanation of the same. In Quantitative Analysis the student first analyzes salts of known composition, thus being able to test the accuracy of his work by comparing his results with the *true* percentages calculated from the chemical formula. When sufficient skill is acquired in this way, more complex substances are investigated, the accuracy of work being determined by comparing the results of duplicate analyses. The substances analyzed are principally ores, metallurgical products, comprising slag, matte, etc., products of economical geology, such as building stone, cement, clays, mineral waters, and other substances of commercial importance.

Assaying.—A course in assaying following the most approved and practical methods for the determination of gold, silver, lead, copper, zinc and iron, may be completed in two months. During the same time instruction is given in the assay of coals and in Blowpipe Analysis sufficient to enable the student to determine the presence of valuable metals contained in minerals and approximately the quantity of silver. Those pursuing the regular courses of Mining Engineering and Metallurgy are expected to acquire a more extended knowledge of the subject. The instruction is principally oral in connection with Laboratory work. The furnace can be used any time from 8:30 A.M. until 5 P.M.

Mineralogy, Crystallography and Blowpiping.—This course embraces instruction in Crystallography, in Descriptive Mineralogy and in the determination of minerals by actual examination of the physical properties of individual specimens and by Blowpipe tests. In Blowpiping the student first becomes familiar with the oxidizing and reducing flames and their effects. He is then given simple substances of known composition and, after he has studied their deportment under the Blowpipe, unknown mixtures of the same compounds, and finally, alloys and minerals—the latter comprising all the important ores of the various metals. A certain amount of time is also devoted to the determination of minerals by sight, aided only by such tests as can be made without the use of special apparatus and re-agents. A carefully selected collection of mineral is kept on hand for the use of the students who are allowed to make upon them such tests as are necessary in studying the nature and properties of the specimens. The School possesses also a good collection of models to illustrate the forms and systems in which the different minerals crystallize. These models are at all times accessible to the students.

Metallurgy.—Metallurgy is taught by class-room lectures and conferences, also by frequent visits to the smelting works under the guidance of the Professor. The various processes for the reduction of gold, silver, lead, and copper ores are in this way learned by observation as well as theoretically, and samples of the products are collected for examination. The course of metallurgy begins with the study of fuels and refractory materials. Then follows the discussion of furnaces, engines, and the various other constructions and appliances of metallurgical establishments When the student is familiar with these, the treatment of the ores of the different metals is taken up successively in detail, all the well-known and important processes being thoroughly studied, and their relation and applications to the reduction of the ores of the western states and territories are particularly considered. Students in Civil Engineering attend the lectures on fuel, refractory materials, furnace constructions, etc., devoting one term to the work. Those in Mining Engineering pursue a more complete course, becoming familiar with the most important processes used in the reduction of the principal ores; while those in the Metallurgical course devote four terms to an exhaustive study of the whole subject, and after acquiring a comprehensive knowledge of Metallurgy and having considerable experience in Chemical work, one term is spent in the examination of the nature of the different furnace products, and in making quantitative analyses of the same.

Geology.—The advantage of a thorough knowledge of Geology can hardly be over-estimated. It is important for the prospector and the practical miner to be able to distinguish properly the different rocks in which the minerals lie. Mining is not wholly of a haphazard nature. Every district has its own special character and certain formations in which the ore principally occurs, and in which it is distributed according to certain laws. The knowledge of this local character can be more readily acquired when the general principles of Geology are understood. Few regions present greater advantages for the study of this science than the Rocky Mountains. The appreciation of this fact and of the mineral importance of this region is evinced by the many expeditions sent out here by the United States Government and by Eastern Colleges. The State School of

Mines of Colorado is particularly favored by being located in one of the most remarkable Geological sections of this region. Nearly the whole series of the Rocky Mountains is represented in this vicinity. It abounds in fossils, and amongst them the enormous Dinosaurs discovered by Professor Arthur Lakes and brought into world-wide celebrity through his labors in connection with Professor Marsh and others. Our Table Mountains, capped with basaltic lava, abounding in zeolites and other volcanic minerals, beneath which lie the finest typical fossil impressions of leaves of the Lignitic group that have been discovered, afford rare opportunities for the geologist and the mineralogist. Economic Geology is also well represented by beds of coal, fire-clay, and quarries of freestone and limestone. The course pursued at the School of Mines comprehends Theoretical Geology supplemented by a study of specimens characteristic of the different rock formations, also field work to verify the instruction of the class-room, and to encourage original research. Connected with this is the collecting of specimens, and making geological sections and maps of the surrounding country. The weekly excursions, which have proven an unfailing source of healthful and instructive enjoyment, will be continued every Saturday as heretofore. During the past year the most important points of the "Foot Hills" and adjacent formations from Morrison to Fort Collins, a distance of eighty miles, were carefully studied by students who took part in these excursions. The Geology of Colorado thus receives special attention, and frequent reference is made to materials gathered by the Professor and students.

Botany and Zoology.—These two subjects are studied mainly as aids to the better understanding of the fossils found in the various rock formations described in Geology. Each is pursued but one term, and the lectures have constant reference to the practical end to be attained.

Meteorology.—There is, connected with the department of Physics, a recording observatory in communication with the U. S. Signal Service, to which monthly reports are sent.

Modern Languages.—No separate professorships have as yet been established in this department. French and German are taught, however, by members of the Faculty in other departments, who have enjoyed special facilities for perfecting themselves in these languages by many years of study and travel in the respective countries. The object of instruction in French and German is to teach the students to read works on science in these languages, and to this end elementary scientific works in French and German will be read in the class-room as soon as sufficient knowledge of the grammar is acquired. The study of Spanish is made optional in all the regular courses for the purpose of enabling those students who desire it to acquire the means of ready communication with the Spanish speaking population of Colorado and adjacent territories.

Museum.—Large additions have been made to the Museum during the past year. A choice collection of the most important minerals and ores, arranged according to Dana, has been procured lately, and is displayed in suitable cases. The geological collection, which includes many of the best fossil specimens found in the formations along the base of the "Foot Hills," is exhibited in a suitable manner, and there are separate cases for the ores from the different mining sections of the State. It is proposed that this department of the Museum shall represent the typical fossils and rocks of Colorado. Owners of mines and others are invited to contribute to this collection. Specimens of both the average and richest yields of the mines are desired, also of crystals and associated minerals. Contributions of the gangue and of the ore with inclosing contact rock are likewise solicited. These should be plainly labeled with the name of the mine, its location, and the name of the donor, that the various mining interests of the State may be fairly represented. Such a collection would be of great interest and importance both to the scientist and to the capitalist desirous of investment. Quite a good beginning has already been made in this direction, but it is specially desired that all the prominent mining properties of the State be well represented. Fossils, characteristic rock from any portion of the State, specimens of coal, clay, etc., are desired for the Geological section; and all specimens should be clearly and fully labeled and of uniform size, preferably 4 by 5 inches.

Library and Apparatus—The Institution possesses a good library of standard scientific works, and is liberally provided with apparatus. Among the most important pieces of apparatus may be enumerated the following, viz.: A full set of surveying instruments, including an aneroid barometer and two very superior mining transits; a fine projection apparatus, consisting of lantern with triple condenser and vertical attachment for use either with the oxy-hydrogen lime light or with the electric arc, for which a battery of fifty Grove cells has been purchased; 21 inch Toepler Holtz machine; a large Ruhmkorff coil, length of wire forty-four miles; hydraulic ram; air pump; dipping battery; full set of meteorological apparatus; Crooke's tubes; Geissler's tubes; large gasometers for oxygen and hydrogen; several very accurate chemical and bullion balances; ore balances; Blake's laboratory crusher; and a full equipment of muffle and wind furnaces provided with all necessary appliances.

Lectures.—Prominent members of the legal profession will be engaged to deliver a series of lectures upon mining and railroad law, with special reference to the wants of the students. During the school year a course of scientific lectures is delivered upon subjects of popular interest by the members of the Faculty and others. These lectures, to which the public are invited, are given in the evening and are illustrated by experiments, drawings and lantern pictures.

Memoirs and Thesis—Each student in the regular course is required, during the summer vacation, to execute a Memoir on some subject assigned by the Faculty. The subject is chosen so far as possible, with direct reference to the practical end the student has in view in his course of study. A minimum of actual work, adequately described and illustrated by drawings, is insisted upon. Careful inspection of mines, metallurgical works, etc., furnishes the student material from which to make his estimates and calculations. Early in the fourth year the student is assigned a subject for a graduating thesis. Such data are given as would be met with in practical experience. The student after careful consideration, selects what he regards as the best method of treatment, giving his reasons for the same with estimates and drawings. When finally completed, the thesis is presented to the Faculty for approval.

Scientific and Literary Society.—A Society known as the School of Mines Athenæum has been organized for the purpose of scientific and literary culture. This society, which is composed of students, members of the Faculty and prominent persons in the city, holds its regular meetings in the lecture hall of the School of Mines every Friday evening. Special entertainments, both literary and social, are occasionally given.

1882–83.

Calendar. Fall Term begins September 27th, 1882; ends December 15th, 1882. Winter Term begins January 3d, 1883; ends March 21st, 1883. Spring Term begins March 26th, 1883; ends June 1st, 1883.

UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA.

THE University of California is an integral part of the public educational system of the State. As such it aims to complete the work begun in the public schools. It offers the best opportunities in the State for a higher education. Through aid from the State and the United States, and by private munificence, it furnishes ample facilities for instruction in Science, Literature, and the professions of Law, Medicine, Dentistry, and Pharmacy. In the undergraduate courses, *i. e.*, in the Colleges of Letters, Agriculture, Mining, Mechanics, Civil Engineering, and Chemistry, in the Literary Course, and in the Course in Letters and Science, these privileges are offered without charge for tuition, and to all persons residents of the State, who are qualified for admission. Persons from other States are admitted to equal privileges upon the payment of a small matriculation and tuition fee. The professional courses, being self-sustaining, require as reasonable tuition fees as possible. All courses are open to all persons without distinction of sex. The Constitution of the State provides for the perpetuation of the University under its present form of government. With this guarantee of security from change, it looks forward to an era of ampler development and greater usefulness. The departments of instruction comprise the following:

(1.) *Letters and Science*, including the College of Letters or Classical Course, and Colleges of Agriculture, Mechanics, Mining, Civil Engineering, and Chemistry, the Literary Course, the Course in Letters and Science, and certain irregular courses.

(2.) *Law.*—The Hastings College of the Law.

(3.) *Medicine.*—The Toland College of Medicine.

(4.) *Dentistry.*—The College of Dentistry.

(5.) *Pharmacy.*—The College of Pharmacy.

The general funds of the University are devoted to the Colleges of Letters and of Science. The Colleges of Medicine, Dentistry, and Pharmacy are self-supporting. The College of Law has a separate endowment. The distinctive characteristics of the various Colleges are given, both in general statements and in detail, upon subsequent pages of the Register.

The University was instituted by a law which received the approval of the Governor, March 23, 1868. Instructions were commenced in Oakland in the Autumn of 1869. The commencement exercises of 1873 were held at Berkeley, July 16th, when the University was formally transferred to its permanent home. Instructions began at Berkeley in the Autumn of 1873. The College of California, which had been organized several years before the University, transferred its property and students upon terms which were mutually agreed upon, and closed its work of instruction in 1869. This College was incorporated in 1855, and through its agency a part of the Oakland property of the University, and the Berkeley site, now owned and occupied by the University of California, were secured. The site of the University, at Berkeley, is a domain of about two hundred acres, situated on the slope of the Contra Costa hills, about five miles from Oakland, facing the Golden Gate. It is traversed by two water-courses, is much diversified in aspect, and is adapted to a great variety of culture. A part of the site is reserved to illustrate the work of agriculture and horticulture, and is now under cultivation. The undergraduate colleges were the only ones included in the original organization; the professional colleges were added from time to time. These latter are all located in San Francisco.

The University of California is a State institution, established by the Legislature in accordance with the Constitution, and intrusted to the care of a Board of Regents, which includes the Governor, the Lieutenant-Governor, the Speaker of the Assembly, the State Superintendent of Public Instruction, the President of the State Agricultural Society, the President of the Mechanics' Institute of San Francisco, the President of the University, and sixteen other Regents appointed by the Governor and approved by the Senate. To this body of Regents the State has committed the administration of the University, including the finances, care of the property, appointment of teachers, and determination of the interior organizations in all particulars not already determined by law. The Provisions of the Constitution, of the laws of the State, and of the Congressional enactment of July 2, 1862, which pertain to the government of the University, together with the terms of affiliation of the professional colleges, and other regulations, are published in a separate pamphlet. The instruction and Government of the students at Berkeley are intrusted to two Faculties, which have hitherto acted as one body—the Faculty of Science and the Letters. The Faculties of Law, Medicine, Pharmacy, and Dentistry, in San Francisco, are distinct bodies. All the Professors and Instructors of the University constitute what is termed by law the Academic Senate, the meetings of which are expected to be infrequent, and restricted to matters of general concern.

Funds.—The resources from which the University is maintained are derived from various sources, and include the following endowments: 1. The Seminary Fund and Public Building Fund, granted to the State by Congress. 2. The property received from the College of California, including the site at Berkeley. 3. The fund derived from the Congressional land grant of July 2, 1862. 4. The Tide Land Fund, appropriated by the State. 5. Specific appropriations by the Legislature, for buildings, current expenses, etc. 6. The gifts of individuals.

Faculties of Colleges of Science and of Letters.—William T. Reid, A. M., President of the University; William Ashburner, Honorary Professor of Mining; Geo. Woodbury Bunnell, A. M., Professor of the Greek Language and Literature; George Davidson, A. M., Honorary Professor of Geodesy and Astronomy; Stephen J. Field, LL. D., Honorary Professor of Law; Frederick G. Hesse, Professor of Industrial Mechanics; Eugene W. Hilgard, Ph. D., Professor of Agriculture, Agricultural Chemistry, General and Economic Botany; Martin Kellogg, A. M., Dean, and Professor of the Latin Language and Literature; John LeConte, M. D., LL. D., Professor of Physics; Joseph LeConte, M. D., LL. D., Professor of Geology and Natural History; Bernard Moses, Ph. D., Professor of History and Political Economy. Willard B. Rising, Ph. D., Professor of Chemistry; Edward R. Sill, A. M., Professor of the English Language and Literature; Frank Soulé Jr., (U. S. Military Academy), Professor of Civil Engineering and Astronomy; ——— ———, Agassiz Professor of Oriental Languages and Literatures; ——— ———, Mills Professor of Mental and Moral Philosophy and Civil Polity; John W. Bice, Ph. B., Instructor in Engineering; Ross E. Browne, Instructor in Mechanical and other Branches of Instrumental Drawing; Samuel B. Christy, Ph. B., Instructor in Mining and Metallurgy; John B. Clarke, Ph. B., Assistant Instructor in Mathematics; George C. Edwards, Ph. B., Instructor in Mathematics and Colonel Commanding University Corps of Cadets; A Wendell Jackson, Jr., Ph. B., Instructor in Mineralogy, Petrography, and Economic Geology; Henry B. Jones, Instructor in French; Wm. Carey Jones, A. M., Recorder of the Faculties and Instructor in Latin; Edmund C. O'Neil, Ph. B., Assistant Instructor in Chemistry; Albin Putzker, Instructor in German; Joseph C. Rowell, A. B., Librarian; Josiah Royce, Jr., Ph. D., Instructor in the English Language and Literature; E. H. Sears, A. B., Instructor in Latin and Greek; F. Slate, Jr., Superintendent of the Physical Laboratory, and Instructor in Physics and Mechanics; John M. Stillman, Ph. B., Instructor in Chemistry; George B. Willcutt, Ph. B., Assistant Instructor in Chemistry; Charles H. Dwinelle, Ph. B., Lecturer on Practical Agriculture; Myer E. Jaffa, Ph. B., Assistant in Agricultural Chemistry; Frederick W. Morse, Ph. B., Assistant in Viticultural Laboratory; J. J. Rivers, Curator of the Museum; Abel Whitton, Manager of University Press.

Library.—The General Library, a very valuable collection, particularly for reference, contains nineteen thousand five hundred volumes. It receives a large number of periodical publications—literary, scientific, and general. It is being constantly augmented, by gift and purchase, especially from the income of the Reese Fund of $50,000. The private collection presented by Mr. H. D. Bacon has been shelved, and is now ready for use. It comprises twelve hundred volumes, bound, with few exceptions, in full yellow calf, hand-tooled, with fine examples of tree and grained calf, full gilt, bound by Bedford, Riviere, and others. The Library is placed in the new Bacon Library and Art building.

The Collections of the University.—The collections belonging to the University, though still incomplete, are both large and valuable. Those at Berkeley are made up from material derived mainly from the following sources: The *State Geological Collection*, the entire material of which has been placed at the disposal of the University; the *Voy Collection*, consisting of a large number of California fossils, minerals, rocks, etc., collected by Mr. C. D. Voy, and presented to the University by D. O. Mills, Esq.; the *Pioche Collection*, an extensive miscellaneous collection of minerals, rocks, ores, shells, etc., from all parts of the world, and especially from South America, presented to the University by the late F. L. A. Pioche; the *Hank's Collection*, consisting of miscellaneous minerals and rocks, presented by James R. Keene, Esq., of San Francisco; selections from the *Ward Series of Casts*, purchased by the University; and current donations. The following description will show the general character of the collections at Berkeley:

The Museum of Historical Geology is in process of formation. The Museum of Palæontology contains a full suite of the fossils of California, both animal and vegetable. Most of these have been already described and figured; the animals in the State Geological Reports of Professor J. D. Whitney, and the plants, recently, by Mr. Lesquereux, in the Memoirs of the Museum of Comparative Anatomy of Harvard. The palæontological material from the Voy Collection has, however, never been worked up, and offers, consequently, to the student an excellent field for original work. There are, also, selections from the series of *Ward Casts.* The Museum of Petrography contains many foreign rocks, but is especially rich in California material, collected by the corps of the State Geological Survey and by Mr. C. D. Voy. Plenty of case room is at disposal, and the rocks are being arranged as fast as determined. The rocks are arranged systematically and geographically, so that, as the collection becomes more complete, the geographical distribution of the rocks of the Pacific Coast will be known with great accuracy and detail. It is designed to issue, as soon as possible, a descriptive catalogue of the rocks of California. The Museum of Economic Geology, although so recently founded, is already assuming proportions, and is in frequent receipt of valuable acquisitions from all parts of the Pacific Coast. The importance and value of this collection can scarcely be overestimated. It will subserve two purposes; on the one hand, it renders possible a course of instruction in ore deposits, which is of essential importance to those who intend to pursue the profession of mining engineer; and on the other hand, the ore deposits of this coast will be collected together, for the first time in one institution, where they can be subjected to careful and critical comparative investigation, to the end that the laws of their occurrence may, as far as possible, be determined. To this end an elaborate blank book has been devised, in which are carefully tabulated the name, locality, form, thickness, dip, strike, wall rocks, etc., of every ore deposit on the coast, as soon as accurate information upon these points can be obtained. The mass of statistics thus obtained will be made the basis of the above mentioned investigations. The Museum of Mineralogy is very large and fully arranged, and is supplied with ample case room. It fully illustrates the instruction in Mineralogy and offers inexhaustible material for investigation, facilities for which are freely placed at the disposal of the student. All of the foregoing museums are open at all times to the public, Mr. Rivers being in constant attendance to show visitors through the various collections.

Chemical Laboratories.—The chemical Laboratories were planned after the most careful study of the newest and best arranged laboratories of this country and of Europe, with the aid and advice of many experienced teachers of analytical chemistry. They are commodious, convenient, well lighted, well ventilated, and adapted to the study of analytical chemistry in all its branches, and to the carrying on of original research. There are two principal laboratory rooms, one for qualitative analysis, the other for quantitative analysis, each having accommodations for thirty-two students. They contain a number of evaporating niches, sand and steam baths, drying ovens, filter apparatus, etc.; there are rooms all well equipped for fusions, organic analysis, gas analysis, etc.; also, a balance room supplied with balances from the best makers. Such apparatus as is needed for the study of analytical chemistry is loaned to the students without charge, if returned in good order. There is a good supply of apparatus for carrying on original investigations.

Metallurgical Laboratories.—These laboratories are designed to offer every facility for the assays of ores, bullion, slags, mattes, etc., and for experiments in treating ores. They contain rooms devoted to special work, as will appear from the following enumeration: A crushing and sampling room, provided with large iron mortars, rubbers, sieves, and a sampling table; a furnace room, containing four iron-clad crucible furnaces built into the wall, three muffle furnaces constructed in a similar manner, together with all the necessary work benches and tools; besides these permanent furnaces there is a full assortment of movable French clay, muffle tubs, and crucible furnaces; a weighing room, containing ore scales for weighing out charges, also hoods and sand bath for parting gold and silver; two separate balance rooms for the finer assay balances; one room specially arranged with yellow glass windows for the humid or mint assay of silver bullion; two rooms devoted to volumetric work and special investigations. All the appliances are of the most improved pattern, and the laboratories offer excellent facilities for instruction and original research.

Mineralogical Laboratory.—This laboratory is provided with a large collection of unlabeled minerals, which students determine by their physical properties. A separate course on blowpipe analysis is offered by the Chemical Department.

Petrographical Laboratory.—Every facility is furnished for the study of rocks, both by the ordinary processes of mineralogical investigations and by the preparation of thin rock sections and examination under the microscope. The laboratory possesses six first class microscopes. The student has access at all times to the facilities provided for this work, and the material to be investigated is practically inexhaustible.

Courses of Instruction.—The Colleges of Letters and of Science comprise the College of Letters, embracing a classical course; the College of Science, embracing Agriculture, Mechanics, Mining, Engineering, and Chemistry; a Literary Course; a Course in Letters and Science; and certain irregular courses not leading to a degree. The completion of any of the following named courses requires four years.

The *Courses in Science:* Agricultural, Mechanics, Mining, Engineering and Chemistry lead to the degree of Bachelor of Science, and are founded for training those who wish to prepare themselves for the industrial professions. Each College gives to the student a good English education, such instruction in either French or German as will insure a reading power of one of the modern languages, and an introduction to the principles of modern science, together with special instruction preparatory to a fuller course of professional study in the particular department he may choose. Neither Latin nor Greek is required for these courses, but a preparatory course in Latin is recommended.

The *Course in Mechanics* is designed for students who wish to become mechanical engineers or machinists (so far as they are constructors of machinery), or to devote their energies to such technical and industrial pursuits as involve a knowledge of machinery.

The *Course in Mining* is designed for students who wish to become mining or metallurgical engineers, or to engage in one of the many pursuits connected with the mining industries, such as the surveying and mapping of mines, the assaying and working of ores, the designing and use of mining machinery, or the exploitation of mines.

The *Course in Engineering* is designed for students who wish to adopt civil engineering as a profession, and to engage in such work as the survey of lands, leveling, topographical engineering, triangular or geodetic surveying, the location and construction of roads, railways, and canals, the designing and construction of bridges of wood, iron, or stone, the building of dams, reservoirs, and systems of water supply, drainage, and sewerage, and the improvement of rivers, harbors, and sea coasts.

The *Course in Chemistry* is designed for students who wish to become professional chemists, either as teachers or investigators, or manufacturers in chemical industries, and also for those who wish to become expert chemists preparatory to the pursuits of medicine, pharmacy, etc.

IRREGULAR COURSES NOT LEADING TO A DEGREE.

N. B.—Written application to be allowed to take either of the three following named courses must, in all cases, and from year to year, be made at the Recorder's office. In this application the reasons for wishing to take the course must be given, and no student will be admitted to either of these courses without a certificate from the President. Students pursuing either of these courses are not enrolled in either of the college classes. Students who wish a thorough and systematic education are advised to take one of the eight regular courses.

The *Student at large Course* does not lead to any degree; but students in this course may, by vote of the Faculty, be recommended to a degree upon the satisfactory completion of studies equivalent to those pursued in one of the regular courses. It is designed for students who wish to take a full, but a purely elective course. They may select studies from any of the courses, provided they satisfy the Faculty that they are fitted to take the studies selected. Candidates for this course are required to pass one of the regular admission examinations, and, upon admission, to take studies enough to make up the full number of exercises required of students pursuing a regular course. Students who fail to maintain their standing as regular students will not be admitted to this course.

The *Special Course* does not lead to a degree, but students in this course may, upon leaving the University, receive a certificate of proficiency in the studies which they have pursued and in which they have attained marked scholarship. It is designed for students who are mature, and who wish to pursue some one line of *special* study and correlated branches. Students under age will not ordinarily be admitted to this course. Applicants who fail on the admission examinations, or students who fail to maintain their standing as regular students, will not be admitted to this course. The *Partial Course* does not lead to a degree, but students in this course may, upon leaving the University, receive a certificate of proficiency in the studies which they have pursued and in which they have attained marked scholarship. It is designed for students who, because of ill health or other disability, are able to pursue only a limited number of studies, or to remain at the University only a short time. Applicants will not be admitted to this course until they have passed a satisfactory examination on such preparatory subjects as may be thought necessary to fit them for the studies they wish to pursue. Certificates of proficiency must be presented to the President before he will issue permission to be enrolled in this course. Applicants who fail on the admission examinations, and students who fail to maintain their standing as regular students, will not be admitted to this course, and the privileges of the course will be summarily withdrawn from students whose attainments or conduct indicate a want of earnestness.

NOTE.—Before entering upon the examinations for admission, candidates will be asked to make known the course they wish to take. It is very desirable that the choice should be made as early in their preparation as possible, and under the best advice attainable. After entering upon their University Course students will not be allowed to change their course except for the most urgent reasons; and students will not under any circumstances, be allowed to change until all deficiencies in the course previously taken are made up.

Admission.—N. B.—All examinations are conducted in writing, except such as must of necessity be oral, such as reading and the pronunciation of a foreign language. Candidates must be at least sixteen years of age, and must present certificates of good moral character. All candidates for courses leading to a degree, and candidates for the Student at Large Course, must pass a satisfactory examination in the five following named subjects:

1. *English.*—Candidates will be required to write a composition of about two pages (foolscap), correct in spelling, punctuation, grammar, and division into paragraphs, upon a subject announced at the time of the examination. It is suggested that the candidate write such a composition or essay as he would write to a friend who knows nothing of the subject, and to whom he wishes to give as clear and as enjoyable an idea of it as possible. The candidate should have acquired the elements of grammar, so as to distinguish the parts of speech and explain the relations of words and phrases in ordinary sentences, and the elements of prose composition, as found in such a book as Kellogg's Text Book on Rhetoric. Much composition writing is indispensable. The subjects for 1882 will be taken from one of the following works: Tom Brown's School Days at Rugby, Scott's Marmion, Charles and Mary Lamb's Tales from Shakspeare, Shakspeare's Merchant of Venice. As the examination will be given upon subjects taken from but one of the books, candidates must be familiar with all the books in the list. In 1883 the subjects will be taken from one of the following works: Tom Brown's School Days at Rugby; Charles and Mary Lamb's Tales from Shakspeare; Irving's Sketch Book; Dickens' Christmas Stories and David Copperfield; Scott's Marmion and Quentin Durward; Shakspeare's Merchant of Venice and Julius Cæsar. 2, 3, 4. *Mathematics.* (2) *Arithmetic.* Higher Arithmetic, including the metric system, but omitting the technical parts of commercial arithmetic. (3) *Algebra*, through quadratic equations, except for applicants for the Classical and the Literary Courses, who will be examined to quadratics. (4) *Plane Geometry*, as much as is contained in Wentworth's Plane Geometry, omitting Isoperimetrical Polygons and Symmetry, except for applicants for the Classical and the Literary Courses, who will be examined in the equivalent of four books of Wentworth's Geometry. 5. *History and Geography.* History of the United States, the general facts of Physical and Political Geography. Barnes's Brief History of the United States, and the geographies used in first grade grammar schools, will serve to indicate the amount of knowledge expected.

(6) MINERALOGY.—The elements of Mineralogy. A good knowledge of the physical properties of minerals in general. Ability to determine, by their physical properties alone, twenty-five of the commonest minerals, and to give reasons for determination: First seventy-two pages of Nicol's Manual of Mineralogy, or first seventy-five pages of Dana's third edition. Applicants who pass with honors in Chemistry will be put in an advanced division.

Course in Letters and Science and the Courses in Science.—Candidates for the Course in Letters and Science, and for either of the Courses in Science, viz.: Agriculture, Mechanics, Mining, Engineering, and Chemistry, must pass a satisfactory examination on subjects 1, 2, 3, 4, 5, 11, and 12, as above, and subjects 13 and 14, as follows:

13. HISTORY.—History of England; Anderson's, Lancaster's or Dickens' will indicate the amount.

14. ENGLISH.—The examination in English will be of a more critical character than that given under Subject 1, and will include whatever geographical, biographical, historical, grammatical, or other questions (including derivation and definition) may be necessary to a full understanding of the selection. The candidate must, in addition, be prepared to write in good English such an essay on any one of the selections, including biographical sketches, as would convey to one not acquainted with the selection named a clear idea of its character and scope. A bad failure in this examination alone will be considered sufficient to reject a candidate for admission to the course in Letters and Science. The examination will be given upon the following named selections: American Prose, American Poems, Shakspeare's King Lear, Hawthorne's Our Old Home, Milton's L'Allegro and Il Penseroso, Byron's Prisoner of Chillon, Goldsmith's Deserted Village and Traveller, Burns' Cotter's Saturday Night, To a Mouse, and To a Mountain Daisy, Scott's Lay of the Last Minstrel, Bacon's Essay of Truth, of Revenge, of Envy, of Boldness, of Travel, of Riches, and of Studies, and Macaulay's Essay on The Pilgrim's Progress. In 1882, American Prose, American Poems, and King Lear will be accepted.

[American prose, and American poetry published, by Houghton, Mifflin & Co., Boston; any well annotated edition of Shakspeare, such as the single play editions of the Clarendon Press, Rolfe, etc. The selections are found in a series entitled "English Classics," at ten cents a copy, published by Clark & Maynard, New York; most of the selections may be found in the text-books on English literature used in most High Schools.]

In 1884, readings from English history, by J. R. Green, will also be required. Candidates who pass without conditions will be credited with honors on subjects on which they pass with special excellence; but honors will not be given to a student who enters with a condition.

PRELIMINARY EXAMINATIONS.—Any candidate for admission to the University may, at his option, pass the entire examination at one time as heretofore, or he may pass a preliminary examination on a part of the requirements and be examined on the remaining subjects the following year; but neither the preliminary examination nor the final completion of the examination may be divided between the June and the August examinations. Candidates will not be admitted to the preliminary examinations without certificates from their teachers that they are prepared. These certificates should be sent to Recorder Wm. Carey Jones, Berkeley, at least two weeks before the examination. No certificate of proficiency will be given by the University unless the candidate passes upon at least six of the eight subjects prescribed for the preliminary examinations.

Expenses.—Tuition in the Colleges of Sciences and of Letters is free to residents of California. Students from other States pay a matriculation fee of twenty-five dollars, and a tuition fee of fifty dollars a year. A small charge is made for chemicals in the chemical laboratory. This is often met by rendering services. Upon graduating, a fee of ten dollars is charged for a diploma. Board and lodging may be obtained in private families at Berkeley and Oakland, at from eighteen dollars to thirty dollars a month. The hours of recitation are such that many students reside in Oakland and San Francisco. Steam connection brings San Francisco within fifty minutes of the University. The gymnasium, erected by Mr. A. K. P. Harmon, at his own expense, and presented to the University, is well equipped and provides all the students with opportunities for exercise. Students in the College of Agriculture can frequently find work in connection with the instruction in Agriculture and Horticulture. Some students are employed in the University printing office at a fair compensation. It is expected that students may earn something by work upon the grounds. Work is often obtained on Saturdays and in vacations away from the University.

Examinations.—Examinations are held at the close of each term and of each year. For students taking the complete course the four annual examinations constitute the examinations for degrees. Students from other colleges, academies, or schools may present themselves for a general examination for degrees. The degree for the classical course is A. B., Bachelor of Arts. For all the scientific courses it is B. S., Bachelor of Science. For the Literary Course, and for the Course of Letters and Science it is L. B., Bachelor of Letters. The higher professional degree of Ph. D., C. E., M. E., Mech. E., etc., will be given only on the completion of prescribed courses of higher study. The University Medal, by direction of its founders, is bestowed upon the most distinguished scholar of the graduation class of each year.

THE EARLY ENGLISH TEXT SOCIETY and the NEW SHAKSPEARE SOCIETY, through the courtesy of Mr. A. G. Snelgrove, Honorary Secretary of the two societies, offer an annual prize of certain of their publications, for the encouragement of studies in those lines. The prize is open to all regular students, and is awarded upon written examination under the direction of the Professor of English Literature.

THE MATHEMATICAL PRIZE OF FIFTY DOLLARS is offered by Mr. John B. Clark, Instructor in Mathematics, for the best essay on any subject connected with the advanced courses in Modern Higher Algebra and the Calculus of Quaternions.

College of Mechanics.— *Objects of the Course.*—This College will educate mechanical engineers, and others who wish to devote their energies to such professional pursuits as involve a knowledge of machinery. If such is not the aim of the student, he will receive the advantage of such instruction as will enable him to follow any vocation based on the applied or pure exact sciences.

Course of Study.—The course of instruction directly related to the College during the junior and senior years, will be as follows:

Junior Year.—1. Kinematics of a point, plane, system, and rigid system in space; that is, motion considered in the abstract, without reference to its cause. 2. Dynamics of a material point, and of a system of masses, considering the actual causes which produce motion. 3. Statics of a material point, and of a rigid body or system of bodies. The subject is treated as a special application of Dynamics. 4. Application of number three to the determination of strains in structures. 5. Graphostatics, applications in the determination of centers of gravity, moment of inertia, and stresses on structures.

Senior Year.—1. Strength of materials, entering in detail upon the analysis of inner strains. 2. Hydrostatics and Hydrodynamics. Theory of hydraulic motors and their construction. 3. Regulators and accumulators of motion. 4. Kinematics and applications in the construction of machines.

Post-Graduate Year.—1. Thermo-Dynamics. Theory and construction of steam and heat engines. Heat engines in general. 2. Theory and construction of machines for transmission. Mining machines, etc.

Department of Drawing.—The instruction in this department is a direct application of the course, especially in Graphostatics as applied to the analysis of stresses in roof and bridge structures, and in the designing of simple machines, water-wheels, etc.

College of Mining.—*Object of the College.*—This College is designed for students who wish to become Mining or Metallurgical engineers, or to engage in one of the many pursuits connected with the mining industry, such as the surveying and mapping of mines, the assaying and working of ores, the designing and use of mining machinery, or the exploitation of mines.

Undergraduate Course.—This course includes a thorough preparation in the modern physical sciences, training in English, and in a reading power of German. It may be completed by the average student in four years. It leads to the degree of Bachelor of Science. Instruction is given according to the nature of the subject, either by lectures and recitations, or by practical exercises. The lectures are illustrated by numerous experiments, apparatus, tables, collections, drawings and sketches, whenever required by the nature of the subject. The practical exercises consist of laboratory and field work with instruments, apparatus and collections, in which each student does the work for himself, under proper guidance. The following is an outline of the course in addition to English and German:

Mathematics, including Algebra, Geometry, Trigonometry, Analytical and Descriptive Geometry, Differential and Integral Calculus. The whole course is illustrated by numerous practical problems and applications.

Physics.—A general course which will be supplemented during the coming year, as soon as the physical laboratory is established, by a special course in heat and electricity.

Chemistry.—Lectures and recitations on Inorganic Chemistry, particular attention being paid to the chemistry of the metals as introductory to metallurgy. Both this course and the one on Physics are illustrated by experiments. Also, laboratory practice in Qualitative and Quantitative Analysis of rocks, ores and metallurgical products. Blowpipe Analysis is taught in connection with this work.

Mineralogy.—Lectures on Crystallography and the Physical Properties and uses of the most important ore, gangue, and rock-forming minerals. The course is illustrated by numerous crystal models and a collection of over ten thousand minerals. Considerable time is devoted to practice in the Determination of Minerals by the use of the knife, lens, and streak plate. The working collection for this purpose alone contains over two thousand specimens.

Geology.—A course of lectures on Dynamical, Structural, and Historical Geology. The course is illustrated by numerous drawings, casts, and models of fossils.

Mechanics.—Lectures on Analytic Mechanics, Strength of Materials with applications to framing, timbering, and machine construction. Hydraulics, pressure of water in dams and reservoirs, flow of water in pipes and ditches, hydraulic motors. The course is illustrated by numerous problems and applications.

Mechanical Drawing and Construction.—These are made, as far as possible, an application of the course in Mechanics to Mining Engineering. Instruction is given in Designing Machinery and Fixed Structures for mining and metallurgical work.

Surveying.—This course includes: Land and Topographical Surveying and Leveling; Laying out roads, tramways, ditches, pipe lines, mining claims; Underground work; extensive Practice in the Field with compass, transit, level, and plane table, and the Plotting of Field Notes and Construction of Maps and Sections. The instruments and grounds of the University furnish excellent facilities for this work.

Mining.—Nature and mode of occurrence of Ores; Prospecting and Exploring Ore Deposits; United States laws, governing location of claims; Open Cut and Quarry Work; Hand and Machine Drilling; Explosives; Blasting; Tunneling, with methods of Excavation and Timbering; Shaft-sinking, Timbering, and Walling; Stoping; Tramming; Hoisting; Pumping, and Drainage; Lighting; Hydraulic Mining; General Organization and Administration. The course is illustrated by drawings, sketches, data, and reference to typical mines in operation on the coast.

Metallurgy.—General Part: Classification of ores and processes; Crushing and sampling ores; Fuels; Fluxes; Refractory Materials; Furnaces; Accessory Machinery; Metallurgical Products. Special Part: The metals selected are the ones at present most important on this coast—Gold, Silver, Lead, and Quicksilver. Both wet and dry methods of reduction are taken up and discussed in detail. The illustrations and data are drawn, as far as possible, from actual work on the coast.

Assaying.—The fire assays accompany each metal in the course in Metallurgy, and the instruction is made, as far as possible, to illustrate the methods used on the large scale. Each student has sufficient practice to become skilled in the assays of the above metals. The Metallurgical Laboratory is well equipped for such work, and contains four crucible furnaces, three muffle furnaces, and all the necessary apparatus.

Thesis.—The undergraduate course concludes with the preparation of an original Thesis on some subject connected with Mining or Metallurgy.

Excursions.—Students are urged to use their holidays and shorter vacations throughout the course to visit and study the many large machine shops, foundries, rolling mills, powder, smelting, and other technical works in the vicinity of Berkeley, Oakland, and San Francisco. They are also urged to use their Summer vacation of two months, and their Winter vacation of three weeks, to visit and study various typical mines and reduction works at a greater distance. The importance of the above is insisted upon. Students who earnestly and systematically pursue the above plan not only do better and more intelligent work at college, but make acquaintances and acquire a fund of information that is afterwards of great practical use to them.

Post-Graduate Course.—This course is intended for those students who have completed the previous course. It comprises such special technical studies as are necessary for the professional degrees. Information concerning this course will be furnished in the next Register.

College of Civil Engineering —*Object of the College.*—The object of this College is to give thorough instruction in those studies which pertain to the profession of the Civil Engineer. To a very considerable extent, these studies are likewise preliminary to the profession of an Architect. They are also serviceable to all who wish proficiency in the application of Mathematics and Physics.

Special instruction in Engineering begins with the Surveying Course in the Junior year, and includes Land Surveying, Levelling, Topographical Surveying, Use of the Plane Table, Road and Railroad Surveying and Construction, and computations of earth-work required by excavations, tunnels, and embankments. A large amount of time is allotted to practice in the field, and to the use of instruments, such as the compass, level, field transit, plane table. etc., and to the working up and plotting of field notes. Topographical drawing and map-making are taught in connection with this part of the course. During the present year an accurate topographical survey has been made, by the class, of the ground immediately surrounding the University buildings. This will be mapped by them, and the work continued by successive classes till the entire tract shall have been accurately plotted. The use of the Aneroid and Mercurial Barometers is taught, and practice given in the determination of heights, etc. Journeys over the adjacent roads are made for the purpose of constructing itineraries, and of measuring and estimating distances by the eye alone, or by ordinary available means. Sketches will be made of the surrounding country, and directions of hill ranges, streams, etc., will be taken as the bases of reconnoissance maps. Students proficient in this course will be well fitted to undertake the work of the field Engineer. In the Senior year the characteristics and properties of the various building materials, wood, stone, iron, steel, mortar, mastic, etc., their strengths, uses, and different methods of employment in structures, are discussed. The rules governing the construction of works of masonry, including foundations in dry and wet soils, and under water, of stone bridges, dams, sewers, culverts, and retaining walls, are acquired. Problems relating to the more difficult constructions of masonry, such as groined, cloistered, askew and rampant arches, domes, and walls bounded by warped surfaces, etc., are solved in the engineering draughting room. The principles and practice of framing, bridge and truss building, and of the construction of estimates and working plans, are investigated; and the solution of a problem in engineering, selected or approved by the Professor of Engineering, terminates the undergraduate course, leading to the Degree of Bachelor of Science (B. S.) A practical bearing is given to the instruction of this year by the solution of interesting problems, connected with the subjects taught; and by visits to important accessible structures, completed or in process of construction. A post-graduate course of three years' length, embracing the higher subjects of engineering study, leads to the degree of Civil Engineer (C. E.) A valuable collection of surveying instruments, including rods, steels, tapes, chains, hand and Y levels, theodolites, transits, solar and surveyor's compasses, plane tables, etc., is in the possession of this department. There is an excellent assortment of models in wood of the various bonds of masonry, and of different walls, arches, gate ways; of joints and fastenings in carpentry, and framework, and of bridge and roof trusses. Diagrams of various European and American engineering structures and the hypsometrical and surveying apparatus formerly belonging to the California Geological Survey, are in the collection. Advantage is taken of the beautifully varied nature of the grounds at and about the University, for practice in the various kinds of surveying.

College of Chemistry.—*Objects of this College.*—The course of instruction in the College of Chemistry is designed for those who wish to become professional Chemists, either as teachers and investigators, or as analytical chemists and manufacturers in chemical industries; and also for those who wish to become expert chemists preparatory to the pursuits of medicine, pharmacy, mining, etc. The special teaching in Chemistry may be thus described: Instruction will be given in General and Theoretical Chemistry, by lectnres, recitations, and laboratory practice. This elementary course will extend through a whole year. An advanced course of lectures will be given to the members of the Sophomore Class on General and Theoretical Inorganic Chemistry, embracing a discussion of the general principles of the science, and their application to Analytical and Metallurgical Chemistry, and to Mineralogy. A like advanced course will be given to the Senior Class on Organic Chemistry. Each course will extend through the whole year, and will be given with the expectation of presenting to students, in a comprehensive form, the fundamental principles of the science.

Analytical Chemistry.—The chemical laboratories will be open daily to students. The course of instruction in qualitative analysis will include the analysis of simple and complex substances in the wet way, their analysis by the use of the blow-pipe and flame reactions. Students will be required to keep a careful record of their work, and to submit the same to the inspection of the Professor. Upon passing a satisfactory examination in qualitative analysis, students may pass to the quantitative laboratory. In the quantitative laboratory instruction will be given in the quantative gravimetric analysis of simple and complex salts, minerals, ashes of plants, mineral waters, etc.; in volumetric analysis, including acidimetry, alkalimetry, chlorimetry, etc.; in organic analysis; in gas analysis; in the preparation of inorganic and organic compounds, and in the carrying out of original investigations. Practical instruction in electro-metallurgy will be given to such students as desire it. Students in agriculture will receive special instruction in the analysis of manures, including the determination of phosphoric acid and nitrogen, etc. So far as practicable, students will be employed in the preparation of chemicals used in the laboratories, the object being to give them as much practice in Manufacturing Chemistry as is possible. Special training in the analysis of mineral waters will be given to such of the advanced students in Chemistry as may desire it. Careful lists of waste products, minerals, etc., which may be utilized, will be kept, and students instructed in methods of saving them.

Organic Chemistry.—This course is by lecture—about seventy lectures in the course. It comprises the Chemistry of the Compounds of Carbon; Organic Analysis; Principles of Chemical Structure; General Properties, Methods of Preparation, and characteristic reactions of the principal classes of Organic Compounds; Relations of Chemical Structure to Physical and Chemical Properties; and the more important technical processes connected with the manufacture or use of organic compounds.

Visits to Chemical Establishments.—It is the intention of the Professor of Chemistry to encourage the students to visit the various chemical and metallurgical works in the vicinity, so far as this is practicable. Among the special advantages which such students may avail themselves of at the University may be mentioned a special course of lectures on Physiological Chemistry; also one on Toxicology and Urine Analysis. Opportunities for laboratory practice in the last named subjects will be given.

Special Students in Chemistry.—The advantages of the laboratory and lectures are open not only to those who pursue a full course of instruction, but to those who wish for a short period to pursue some special course, or carry on some special iuvestigation. For admission to the Chemical Department they will be required to pass an examination in the elements of chemistry, and to show that they have sufficient general culture to profit by the opportunities here afforded.

Advanced Instruction.—Courses of lectures on Inorganic Chemistry; Organic Chemistry; Physiological Chemistry; Agricultural Chemistry; Toxicology; Urine Analysis; Thermo-Chemistry; Fundamental Principles in Analytical Chemistry. Laboratory Instruction and Assistance.

Laboratory Facilities.—Convenient Rooms, with suitable equipment and apparatus for carrying on quantitative analysis and special experiments of various kinds. A very complete supply of *pure reagents,* including many rare ones. A good supply of apparatus, balances, glassware, etc. The equipment is ample for the investigation of minerals, mineral waters, and organic products.

PETROGRAPHY.—The instruction covers the following ground: (1) The different methods of rock investigation, viz., physical and chemical; (2) rock texture and rock structure; (3) the different forms in which rock masses occur; (4) classification and nomenclature of the leading systems proposed; (5) descriptive petrography, special attention being given to the rocks of California; (6) petrogenesis, or the origin of rocks; (7), changes and decompositions which rocks undergo. The laboratory is well equipped, and the student has every opportunity for practice in the determination of minerals by the microscope and ordinary mineralogical methods. A large field for original research is open to the student in the museum of Petrography. The course is open to all students who have completed the university course in mineralogy, or an equivalent course elsewhere. A course of lectures is in preparation. It will consist, (1) of a consideration of the geological nature of ore deposits; (2) a special description of the ore deposits of this country, with references to the most instructive examples of foreign ore deposits. The first part will be delivered during the first term of 1882-3.

CALENDAR.—August 9, 10, 11—Examinations for admission to Colleges of Science and of Letters, in Berkeley; to College of Law, in San Francisco.
August 10—First Term in Colleges of Science, of Letters, and of Law begins.
August 11—Assignment of exercises to upper classes in Colleges of Science and of Letters.
August 15—Assignment of exercises to Freshman class in Colleges of Science and of Letters.
October 9-16.—Fall Recess of one week in Colleges of Science, of Letters, and of Law.
October 21.—Semi-annual Field Day.
October 27.—Junior Day in Colleges of Science and of Letters.
October 30—Regular term in Colleges of Medicine, Dentistry, and Pharmacy ends.
November —Commencement in College of Medicine.
November —Commencement in College of Pharmacy.
November 23, 24, 25—Thanksgiving Recess of three days.
December 20—End of First Term in Colleges of Science, of Letters, and of Law. Vacation of three weeks.

AMERICAN STUDENTS OF MINING IN GERMANY.

AS AMERICAN students of mining, philosophy, philology, music, history, or art have found it necessary or highly advantageous to supplement their course of study at home by a residence of some years at a foreign university, so, ever since mining has been practiced in this country in any other than a rude and wasteful manner, many American students of mining have sought in London or Paris, but chiefly in the Academy of Freiberg, Clausthal, or Berlin, such information and experience as would give them confidence in themselves, and make them worthy of the confidence of those wishing the services of mining engineers. But a broad distinction must be observed. Medicine, philosophy, philology, history, and art are universal sciences; their theories and applications are much the same throughout the civilized world; moreover, the principles of justice which underlie law, and the principles of mathematics, mechanics, chemistry, and geology, upon which the sciences of civil, mechanical, and mining engineering are founded, are also universal, but their practical application depends upon local conditions. The economy of mining is a function of such variables as government, labor, wages, distance, quantity and kind of ore, timber, water, and transportation, and to many it seems as absurd to attempt to obtain in any other country the knowledge to fit one to practice mining in America, as it would be to attempt, by studying law in a German university, to fit one's self for practice in the New York courts.

A young man who has decided to fit himself as a mining engineer is at a loss how to begin. On the one hand, he is told that our schools are not practical enough, that practical miners do not find the graduates capable of doing what they profess, and that he should study abroad, where theory and practice are united. On the other hand, he is informed that American methods differ from the foreign so fundamentally that, if he studies abroad, he must afterwards unlearn, everything, and to learn mining he is advised to "go West,' which now celebrated advice is somewhat indefinite. Truer but hardly less sweeping and discouraging is the opinion of the Commissioner of Mining Statistics, who said of the graduates of foreign schools, "Every such graduate has to reconstruct, alone and for himself, the whole art which he has learned—a work requiring genius as well as intelligent perseverance." It is, nevertheless, a fact that a large part of the prominent mining and metallurgical engineers and professors of our country have been students abroad, mostly in Germany, and it is fair to assume that their training was an important element or cause of their success; and since the annual exodus still continues, the belief is evidently widespread that our schools do not yet furnish all that is necessary, nor even the most important part. In view of the immense mineral wealth of the country, in view of the present enormous production and the more enormous waste, in view of the fact that mining industries will always remain among the most important sources of our national wealth and prosperity, the subject of the education of miners and mining engineers demands of this society earnest thought, thorough discussion, and, what is not to be forgotten, subsequent action. Moreover, the subject should be considered by itself, and not in connection with mechanical and civil engineering. In discussing education in general, we may come to general conclusions; in discussing technical education, to more definite conclusions, and in discussing mining technical education, we may reach still more definite and directly applicable results.

If civil, mechanical, and mining engineering are distinct enough to form three independant professions, the proper preparatory courses for each have points of distinction enough to warrant an independent discussion. We have had the general discussion—what we need is the special. How, then, do our schools correspond to our mineral resources and existing appliances? Are American methods of mining and metallurgy, or foreign methods, or any definite methods taught in them? Are the attractive courses of the various catalogues and prospectuses given to students in reality? Are the requirements for the degree of mining engineer sufficiently exacting in theories and practice? These questions are asked in no spirit of criticism, but for information, with the hope of obtaining it for the benefit of present and future students, on the one hand from engineers of the Institute who are in practical life, and on the other hand from the professors in our schools. These questions are suggested to promote discussion, that the students may learn what is desired and will be expected of them as young engineers; that they may be told where and from whom they may learn what they lack; that the faculties of our schools may know what changes to introduce to make the courses more efficient, and that out of this discussion may be devised some means of establishing some connection between the schools and the mines and metallurgical works, so that our students may enjoy some such advantages as they are favored with abroad. It may be well to consider some of the advantages and disadvantages of the German instruction, and to give some of the actual experiences of the American student in Germany. For this purpose the academy at Freiberg will be considered, because it is there that the greater number of our past students have studied; the greater number of those now abroad are there, and it is the school with which the writer is best acquainted.

Admission to the academy is very easily obtained. If the applicant from a foreign country can understand what the director says to him when he makes personal application, and can speak a very moderate amount of German, and can produce a diploma awarded to him by any college or technical school, that is sufficient. Not having a diploma, he may, instead, pass an easy examination, much similar to that required by our own technical schools for admission. In the statutes we read, "In suitable cases, especially in the case of applicants from foreign countries, the director may dispense with the admission examination." We also read "Older and independent persons, and such as have already completed higher technical studies elsewhere, may be permitted by the Director to attend lectures and practical exercises, upon the payment of the regular fees," etc. Such students are called Hospitanten, and correspond to our special students. Under these liberal regulations, there is no difficulty in entering. I have heard of one American, some years ago, who could not gain admission, but he was so totally deficient that he has not learned anything to this day. It seems to be the desire to make the entrance easy, not for the sake of securing students, but to avoid throwing hindrances in the way of those wishing to learn; and, in general, the kindness of the director and of the professors to all foreign students is very marked and gratefully acknowledged. This leniency, often a desirable accommodation for the mature student, is often a serious disadvantage to the young student not familiar with the German language. Not being able to understand much of the lectures, and his previous education not having been such as to enable him to pursue intelligently the mathematical studies of the course, he quickly becomes discouraged and lazy, and often yields to the manifold temptations of Freiberg life. At all events the foundation being poorly laid, the superstructure is insecure. Too easy entrance examinations are not a peculiarity of foreign schools.

The theoretical instruction is mainly imparted by lectures, a system which is perhaps the best for highest instruction of the universities, but which in a technical school, where hardly more than the elements can be given, is very wasteful of time and unsatisfactory. If a professor has something original or new to offer, or if his subject is one on which good books are rare or expensive, then lectures are justifiable and necessary; but to give entirely by lectures a course on ordinary mathematics, mechanics, surveying, mining, theoretical chemistry, or any subject on which there are scores of good and inexpensive books, is a wicked waste of the time of professor and students. To illustrate, let us suppose the subject is mining, and the particular subject for the day is power drills. The lecturer gives, perhaps, a short history of the invention of the steam or compressed-air drill, and then proceeds to discuss the various systems; he makes elaborate freehand drawing of a steam drill, and lectures while he draws. Now the student may take his choice; either he may copy the drawing as well as he may, being, perhaps, a poor draughtsman, or he may write the description and criticism; but, recognizing the uselessness of having one without the other, he generally tries to get both, and if he writes an intelligible description he may have time to copy half the drawing itself before the figure is rubbed out to make room for something else. Or perhaps the student devotes his main energy to the drawing and keeps pace with the professor, when suddenly the latter discovers that he is making his drawing out of proportion, and with a stroke he erases a third of his work. The student, who is working with ink or pencil, cannot introduce changes so easily and neatly. He scratches or rubs out or begins again, and perhaps gets a passable drawing and a fair description. Meanwhile the professor has drawn and described another drill, and closes his lecture with the remark: this last drill is in general use; the one before it has long since gone entirely out of use. Let us suppose the student hears lectures on some mathematical study. At his room he conscientiously rewrites and studies his notes, and finds that he has omitted important steps in the reasoning; be misses a lecture perhaps, and not being able to make good the deficiency without copying the probably imperfect notes of some friend, he loses his enthusiasm, goes to lectures less frequently, or finally not at all. These are not fanciful examples, but such as are occurring constantly. It requires much more determination and perseverance than can reasonably be expected of a young student, though he starts with resolution and enthusiasm, to write, rewrite, and annotate a whole treatise on each of the studies he pursues. And when he has it all done, he may find nine-tenths of it more fully given and better expressed in any of the excellent text-books. Add to these objections, which apply in the case of all students, the fact that the art of writing German rapidly, of paraphrasing a lecture, is not easy for a foreigner to acquire, and we may imagine how little good our students would acquire if the main benefit of a residence at Freiberg were to be gained from the lectures.

Connected with some of the courses of lectures there are weekly recitations which are very thinly attended, sometimes as few as two or three or even none out of a lecture division of thirty or forty being present. This non-attendance proceeds from various causes; some students may have been irregular at lectures, many do not take the trouble to read their notes, at least for months or till just before the final examinations; some are not willing to make an exhibition of bad German, and some have not been able to get enough out of the lectures to be questioned on.

As regards discipline, the school is conducted on the most liberal principles, the student being allowed to select such lectures and practical exercises as he wishes, and to attend or not as he may choose. The only exception to voluntary attendance which appears in the statutes is contained in the following extract, "Students who receive scholarships, or from whom the fees have been entirely or in part remitted, are required (*verpflichtet*) to attend the recitations," which significant clause implies that recitations are important, and so important that mild coercion is justifiable. As foreign students receive no pecuniary assistance, but are charged $25 a year more than other students, this restriction does not apply to them. Moreover, students are not required to give any proof of progress unless they are candidates for a degree, and then only at the end of their course. In consequence of this freedom, many who are registered as students scarcely ever attend any lectures or other exercises. Sometimes an example is made and a young man is sent away, ostensibly for neglect, but in such cases it will be found that he was otherwise a bad character, and had made himself notorious in the town. This *laissez faire* principle may be allowable for the oldest and best students, but for the greater number, especially for those away from the supervision of home and the more exacting social restraints of our country, it is certainly pernicious. It is seeking for itself a foothold here, but it is to be hoped we shall stand by our practice of requiring proof of progress, regularly and frequently. It is said that a student who is required to prepare a certain number of pages for a recitation, or a certain subject for an examination, does not have the proper object of study placed before him; that he ought to be encouraged to study for the love of knowledge. This is perhaps the kind of suasion to apply to those who are destined to become ardent lovers and devotees of abstract science; but becoming a successful engineer is probably as lofty an object as the ordinary student of mining will appreciate, and the advisability of showing him from time to time just how far advanced he ought to be, and whether he is actually up to the mark, is a sufficient reason for recitations and examinations. Habits of industry, as well as facts and theories of science, are to be inculcated and maintained. The German school acts on the assumption that such habits have already been inculcated in the preparatory school, an assumption not justified by experience. We cannot afford to allow a promising but lazy fellow to go to ruin through neglect, and we ought, for the interest of all concerned, to weed out, long before the end of the course, such as nature plainly intended to shine in some other sphere of usefulness. It is also said that our young men are too old and manly to be treated longer as schoolboys, and, now that it has been suggested to them, the young men themselves feel that their dignity as gentlemen is wounded. But at West Point or at the Naval School, where honor is generally assiduously cultivated and carefully guarded, the young men still continue to bear up under the degradation of being obliged to turn out early and make their own beds, or stand up stiff and straight before a blackboard and demonstrate a proposition in military style. A certain amount of discipline is necessary for efficiency in any body of men, be they men or really boys, and especially is strict discipline necessary for those who expect afterwards to exercise authority.

In what, then, does the superiority of the German mining schools consist? Why do our young men pass by our magnificently endowed and appointed schools without entering, or pass from them to spend two or three years at considerable expense and discomfort at Freiberg? It is mainly because the Freiberg Academy gives its students the union of science and art; because it furnishes them with ample facilities for learning, either within its walls or in the neighboring works, or somewhere in Saxony, or somewhere in Germany, the *practice* of the various processes of mining, concentration and smelting. Moreover, it is distinctly a school for mining and metallurgy, untrammelled by any connection with mechanical or civil engineering; its professors are specialists, generally of the highest ability; there are no fancy courses in its instruction, and no more than two or three courses which might perhaps be considered superfluous. The following is a list of the professors, the subjects of instruction, the number of hours of lecture given weekly in each subject, and the practical exercises:

Gretschel.—Higher Mathematics (Trigonometry, Analytic Geometry, and Calculus), 6; Selections from the Higher Mathematics, 2; Descriptive Geometry, 4; Introduction to the Theory of Determinants, 1; Graphic Calculation, 1.

Undeutsch.—Mechanics, 6; Mining Machinery, 4; Machine Drawing, part first, 4; Machine drawing, part second, 4.

Viertel.—Geodesy and Mine Surveying, 3; Practical Exercises in the field (Summer term), ½ day; Practice in Surveying, including Mine Surveying, ½ day.

Winkler.—Inorganic Chemistry, 4; Organic Chemistry (Summer term), 2; Chemical Technology, 2; Quantitative Analysis, 1; Practice in Qualitative and Quantitative Analysis, from 9 to 6 daily except Saturday; Volumetric Analysis, 1.

Richter.—General Metallurgy, 4; Assaying, 1; Practice in Assaying, ½ day; Blowpipe Analysis, 2; Practice in Blowpipe Analysis, 2.

Ledebur.—Metallurgy of Iron, 4; Metallurgical Technology, 4; Salt Works (Summer term), 1; Assaying of Iron (Winter term), 1; Practice in Iron Assaying (Summer term), ½ day.

Weisbach.—Mineralogy, with one hour recitation, 5; Practice in Determining Minerals, 4; Mathematical Crystallography (Winter term), 1; Practice in Determining Crystals (Summer term), 1; Pseudo-morphology (Summer term,) 1.

Stelzner—Geology, with one hour recitation, 5; Ore Deposits, 2; Petrifaction, 2; Microscopic Examination of Minerals and Stones, 1; Practice in the same, 1; Practice in Determining Rocks (Summer term), 1.

Erhard.—Experimental Physics, 5; Practice in Physical Manipulations, 2; Fuels and Furnaces, 2; Meteorology (Winter term), 2; Mathematical Examination of the Physical Properties of Gases, 2.

Kreischer.—Mining, part first, with one hour recitation, 5; Mining, part second, with one hour recitation, 5.

Muller.—Construction of Buildings (Winter term), 3; Estimates for Mining and Smelting Buildings (Summer term), 3; Designing and Drawing of Mining and Smelting Buildings, 4.

Freiesleben.—General Law (Winter term), 4; Mining Law (Summer term), 4.

Schober.—Political Economy, 2.

Walther.—Hygiene of Miners and Smelters, 2.

Ostuckenberg.—Freehand Drawing, 4.

Great satisfaction is universally expressed with the lectures and practical exercises under Richter, Gretschel, Winkler, Weisbach, Stelzner, Viertel, and Ledebur. These departments are the strong attractions of the school, and better instruction than is given in the practice of wet and dry assaying, blowpipe analysis, chemical analysis, mineralogy, geology, surveying, and survey plotting, could not be asked. Moreover, the large and valuable collections of minerals, geological specimens, and models of machinery are accessible for inspection or study. With the professor of mining, or machinery, or geology, or iron, the students occasionally perhaps two or three times in a year with each, have the opportunity of visiting works or making geological tours in and out of Saxony.

These trips are sometimes of profit professionally, but a crowd of twenty students spending several hours only in large and complicated works, passing rapidly from one thing to another, cannot be expected to carry away much definite information or many lasting impressions. The geological trips are perhaps the most useful and enjoyable; the study of Quadersandstein of Saxon Switzerland is not so engrossing that the beauties of this charming region pass unadmired; the wonderful formation of the Prebisthor does not preclude an appreciation of its beer, and the tramp over its wooded hills or through its cultivated valleys is enlivened by those glorious German student songs.

But thus far our schools offer as much, and there is no reason why they may not actually give as much, as the Freiberg Academy. We have larger, more convenient, and better appointed buildings; we have more money; we have equal facilities for laboratory and field practice, except in mine surveying; we have visits to works, geological trips, and summer excursions. Nay even, our schools ought, for the American student, to be very superior to any German school. American methods and machinery are hardly mentioned at Freiberg, and certainly do not receive the attention and discussion which their importance and the presence of a large number of American students might justify. American pumps, drills, engines, waterwheels, amalgamating machinery, and metallurgical processes are quite ignored, and American hydraulic mining is disposed of in about five minutes, with some apparently fabulous accounts of hundreds of miles of ditches and the washing away of whole hills. In fact, the student gets nothing peculiarly American from his course, and hence what he learns outside of general principles he must unlearn, or at least reconstruct. But the one great advantage overtopping all others and outweighing all deficiencies is the intimate connection of the academy with the works of the vicinity and the permission to visit and study similar works, which is granted throughout Germany, and also in Austria, to the holder of the Freiberg student's card. Almost no limits or restrictions are placed upon the student; he may, on proper application, either before his theoretical course or during it, make what is called a practical course. In this case he is placed under the direction of a mining captain, who puts him through all the different operations of mining, giving him information on each operation, answering cheerfully all questions, and assigning him a place to work in this or that gang of miners, who are also invariably very kind and willing to assist by information or example. Or he may make an independent course, and visit any of the mines in the vicinity every day, or as often as he likes. In the same way he has perfect liberty to visit and work in the ore-dressing establishments about Freiberg, or in the excellently managed coal mine and washer at Zaukeroda, near Dresden. He may study in similar manner at the Muldner and Halsbrückner smelting works, and as a good foundation for such study a practical smelting course is given during the first two weeks in August at the works by the professor of metallurgy or his assistant, which any student upon application may attend. Nor are less advantageous facilities granted outside of Saxony. It was the privilege of the writer, with one or two companions, to spend some two or three weeks in the summer of 1875 in the ore-dressing works of the Harz, at Clausthal and the neighboring towns, Grund, Lautenthal, and St. Andreasberg, and in the summer of 1876 some two weeks in the mines and ore-dressing works at Pzibram, in Bohemia; again two weeks in the Harz, and about the same length of time in works near the Rhine, at Laurenburg, Ems, Mechernich, and Cologne. At no place was permission to examine the works refused. On the contrary, the directors and overseers were everywhere willing to impart any information in regard to their works, and spent much time and pains in so doing. Permission was given to make sketches, take notes and dimensions, copy working drawings of machines, and statistics as regards cost of working and working capacity. The Germans and Austrians are particularly kind to foreigners, and they ask and expect nothing in return except the appreciation on the part of the student. Other young men, who were studying coal and iron in other places, were equally well received; the testimony from all sources is the same. Herein lies the great advantage of studying in Germany, and in spite of discomforts and expense, and objections such as have been mentioned, our students will continue to go thither till some definite, sure, and permanent connection is established between our schools and the mines and metallurgical works.

In 1876 there were at Freiberg Academy 139 students, as follows: from Germany 64, including 42 Saxons; from Wallachia, Spain, Portugal, Holland, Asiatic Turkey, 1 each; from Switzerland and Japan, 2 each; from Italy and Norway, 3 each; from Greece, 5; from England, 9; from Russia and Poland together, 11; from Austria-Hungary, 11; from America, 24. Of the 24 from America, 1 was from Canada, 2 were from Chili, 3 from Mexico, and 18 from the United States. Of these 18, 1 came from each of the States of Alabama, Connecticut, Iowa, Louisiana, Maryland, Massachusetts, Michigan, and Ohio; 2 came from California, 3 from Pennsylvania, and 5 from New York. Of the 18, one was pursuing especially the study of mineralogy, one the study of iron, two of coal, four general metallurgy, and ten mining and concentration, or were not pronounced. Of the 18 perhaps a half were hard workers, a part of the remainder worked easily, the rest made no pretensions, but were going to begin. In general, the reputation of the students from the United States is good among the professors, at the works, and in the town. Together with the English and Canadian students, with whom they stand on terms of intimacy and friendship, they form the largest distinct foreign element, being about one-fifth of the whole number—a very creditable element, exhibiting the robustness and energy which characterize the English-speaking people everywhere. Thither, also, they carry their fondness for, and proficiency in, outdoor athletic sports, which are not cultivated by the other students. In skating they have no rivals or competitors, and in other games, such as base-ball and foot-ball, they have the field alone. Although this muscular development is not mental training, it is nevertheless conducive to mental activity, and the vigor and originality of the English race are largely due, perhaps, to physical health and freshness caused by the active outdoor sports practiced from boyhood up to and into manhood.

The principal subjective drawbacks to the progress of the American student in Germany are youth, an insufficient previous training in habits of study, and want of a working knowledge of the language. The first two generally go together, and often all three are combined; in which case the young man easily falls into ways of idleness and dissipation, which make his stay in Germany worse than useless, if they do not prove his utter ruin. To obviate these objections, it may be allowable to suggest as a course of study a collegiate course followed by two years in a mining school at home, and then one or two years abroad; or, what would be a saving of time and obviate the course abroad, a college course followed by two years in one of our mining schools, the time from the first of May or June till October in each of these years being spent at mines or works. It is now generally acknowledged that a liberal education is the best foundation for a professional training, and certainly, if the profession of mining engineering is to rank with the other liberal professions and be acknowledged by them, such a foundation is necessary, even if it does require as much time as is required by the other professions. Under the first plan a young man would be ready to reconstruct his art at the age of 25 or 26, and in the second case to begin work at 23 or 24, or one year later if it should be considered expedient to require another year of steady work after the two summer courses already indicated. The preparatory schools for our best colleges are the best training schools for boys, for the one reason, if no others, that they not only have a definite and not insignificant amount of instruction to impart, but that this instruction is to be tested by the broad and strict examination for admission to college, and it is a fact, unpalatable indeed, that those who, by reason of physical or mental weakness or indolence, are not capable of being brought up to this standard, deviate to a technical school, where they are nursed for a year or two till they are strong enough to leave and go into business. While in college the student may, besides attending faithfully to his literary subjects, anticipate the mathematics, chemistry, physics, modern languages, a part of the geology and mechanics, and some other studies, so that in two years at most he may finish the course in one of our mining schools. Then, if he wishes to study in Germany, he has a character all formed, a liberal and technical drill, and a good knowledge of the language.

The devising of a plan for the union of the schools and works is full of difficulties. The conditions are so widely different here from what they are in Germany that the introduction of the German system without important modification is practically impossible. There both schools and mines are, to a great extent, directly under the control of the government. It grants to the student the right to assume the responsibility of an engineer only after he has served as "practicant," and requires the mines to receive its students in such capacity. As our schools and works are all private enterprises no other than a voluntary arrangement can be made here. There competition is not so sharp and speculation is not so wild as here; the richness of good mines does not have to be concealed to freeze out undesirable owners, poor mines do not have to be puffed to effect a sale, and patent machines and secret processes are not so common, consequently permission to visit works is more readily obtained. Moreover, our schools are more numerous, and are already established far distant from the important works, which are scattered far and wide, separated by many hundreds or thousands of miles, and often difficult of access. Very strong arguments were presented, as you remember, by the United States Commissioner of Mining Statistics, in 1868, and again in 1869, in favor of a national school of mines. As yet the government has not seen fit to act according to the suggestions, and I am not aware that the subject is likely to receive the attention of Congress. It would be impossible to locate such a school anywhere in this country as advantageously as the German institutions are situated, from which in a few hours, or in a day or two at most, any of the large mines or works may be reached. In consideration of this fact, and the possibility that, on account of State or local jealousy or interests, or political jobbing, or for other reasons, the foundation of a national school west or east of the Rocky Mountains may be delayed indefinitely, and of the fact that we already have millions of dollars invested in magnificently equipped mining schools, is it not advisable, instead of seeking other millions, to endeavor to increase the usefulness of those already invested? We certainly have schools enough, more perhaps than we have teaching ability to supply. One great and just criticism on American education is that we have so many institutions that the instruction is too dilute. Two or three good professors in a mining school cannot of themselves make that school satisfactory, and drawing away a good professor from this school and that to found another weakens those drawn upon, and generally adds another to the long list of moderately efficient attempts.

The works generally consider that they only grant favors and receive no good in return, and perhaps from their previous experience they have reason to consider the students nuisances. But it is not so abroad, and there is no reason why it should be so here. The labor of the study would not be worthless, and, indeed, to secure the owners against imposition or loss, and to insure diligence on the part of the student, the power of discharging an unfaithful young man would, of course, be one of the rights reserved by the works. Moreover, the works, always having several young men making a practical course, would have an excellent opportunity to select from the number some who would be valuable men to employ permanently, first as assistants and eventually as engineers. Moreover, as part of the compact, the schools might agree, as some return for the kindness of the owners, to furnish essays, or analyses, or geological opinions, or surveys, or plans, or drawings, or render some other assistance to the engineer of the works. It is by no means a case in which the favors are of necessity all on one side. To begin on something definite, the circular might contain a preliminary plan of operations, and might ask each mine on industrial work and each school whether, on the proposed basis or on any basis, it would co-operate; it might invite criticism and suggestions for improvements on the plan, and from the discussions before the Institute, and from the answers to the circulars, a final arrangement might be made and put into operation.

Compiled from a paper by J. C. Bartlett, A.M., Transactions American Institute of Mining Engineers.

THE AMERICAN INSTITUTE OF MINING ENGINEERS.

THIS now famous Institute that has done so much for the mines and miners of this country had its origin in the following:

WILKES-BARRE, PA., April, 1871.

The great development of the mines and metallurgical works of this country during the last few years, accompanied as it has been by the investment of enormous sums of money in purchasing lands, and in the erection of improvements, requires that advantage should be taken of the accumulated knowledge of engineers, superintendents, and others, in mastering the problems which are constantly presenting themselves for our action. Among those may be mentioned the consideration of more economical systems of mining in our coal and metalliferous mines, improved methods of transportation above and below ground, unwatering and ventilating mines, the mechanical preparation of coal and other minerals, the various metallurgical processes, and, in fact, every question tending to the attainment of two great objects:

1st. The more economical production of the useful minerals and metals.

2nd. The greater safety and welfare of those employed in these industries.

In European countries, where the arts of mining and metallurgy have long been the subject of the most careful study, no means have been found so effectual in attaining the end above proposed as the free interchange of experience among those actually engaged in these industries, and this object has been accomplished, mainly, through the medium of institutes, associations or societies, composed of those engaged in these occupations, and by the periodical publication of essays or papers communicated to such societies by their members. It must be evident to all practical men that the interchange of the varied experience of those engaged in such occupations in this country could not fail to advance very materially the desired objects; it is, therefore, proposed to establish an *American Institute of Mining Engineers*, which will hold its meetings periodically in the great mining and metallurgical centres, where works of interest, such as mines, machine shops, furnaces, and other metallurgical works, can be inspected, and the members exchange their views, and consult for mutual advantage upon the difficulties encountered by each; these transactions or proceedings, when published, would form a most valuable and greatly-needed addition to our professional literature. It is proposed that a meeting of those sympathizing with the object above mentioned shall be called for the purpose of organizing such an association, the place and time of meeting being Wilkes-Barre, Pa., and the month of April or May.

Communications indicating the opinion and wishes of all, both as to these points, and also as to the organization and objects of the Institute, will be gladly received by any of the undersigned, and a notice of the date of meeting, which will be arranged to suit the greater number, will be duly communicated. Any one who may have devoted himself to a particular subject connected either with mining or metallurgy, and who may be possessed of new facts in reference to it, would greatly aid in furthering the object of the proposed association by preparing a paper giving the result of his experience, to be communicated at the first meeting. It is expected that the desire for the advancement of professional knowledge, combined with the attractions of a visit to the most beautiful of our coal fields, the Wyoming Valley, will insure a large attendance from all parts of the country.

Signed,

ECKLEY B. COXE, Drifton, Pa.
R. P. ROTHWELL, Wilkes-Barre, Pa.
MARTIN CORYELL, Wilkes-Barre, Pa.

The foregoing circular having been extensively circulated by mail, and also by publication in the leading engineering papers, the following named gentlemen assembled in Wilkes-Barre, Pa., May 16th, 1871, and organized the American Institute of Mining Engineers:

Bramwell, J. H.,	Fairchance, Fayette Co., Pa,
Daddow, S. Harries,	St. Clair, Pa.
Drinker, H. S.,	Philadelphia, Pa.
Drown, Thomas M.,	Philadelphia, Pa.
Gaujot, E.,	Pottsville, Pa.
Haight, Ogden,	New York.
Hick, W. B.,	Wilkes-Barre, Pa.
Hoffman, Daniel,	Pottsville, Pa.
Jones, Lewis S.	Wilkes-Barre, Pa.
McNair, Thomas S.,	Hazleton, Pa.
Mercur, Fred.,	Wilkes-Barre, Pa.
Neal, R. C.,	Bloomsburg, Pa.
Petherick, Thomas,	Pottsville, Pa.
Raymond, R. W.,	New York.
Rothwell, R. P.	Wilkes-Barre, Pa.
Silliman, Prof. J. M.,	Easton, Pa.
Sturdevant, W. H.,	Wilkes-Barre, Pa.
Symons, W. R.,	Pottsville, Pa.
Thomas, James,	Wilkes-Barre, Pa.
Timpson, James, A.,	Wilkes-Barre, Pa.
Ward, Willard P.,	New York.
Williams, T. M.,	Wilkes-Barre, Pa.

Mr. R. P. Rothwell was elected temporary Chairman, and Mr. R. W. Raymond temporary Secretary.

A Committee appointed to prepare rules for the Institute reported a series of rules, which, after some discussion, were adopted in the following form:

RULES.

Adopted May 16th, 1871.

1. The objects of the American Institute of Mining Engineers are to enable its members, comprising Mining Engineers and other persons interested in mining and metallurgy, to meet together at fixed periods for the purpose of reading papers upon and discussing subjects which have for their aim the economical production of the useful minerals and metals, and the safety and welfare of those employed in these industries, and to circulate among its members, by means of its publications, the information thus obtained.

2. The Institute shall consist of Members, Honorary Members, and Associates. Members and Honorary Members shall be mining Engineers. Associates includes other persons interested in mining and Metallurgy. All these classes shall be equally entitled to the privileges of Membership except as herein provided.

3. The annual subscription of each member and associate shall be ten dollars, which shall be payable in advance at each annual meeting or immediately after his election.

4. Any member who shall make a donation of one hundred dollars, or upwards, shall become a Life Member, and any associate who shall make a like donation shall become a Life Associate, and shall not be liable for any further annual subscription.

5. Honorary members shall not be called upon to pay any annual subscription. The number of honorary members shall not exceed twenty.

6. Persons desirous of becoming members or associates of the Institute shall be proposed by at least three members or associates, approved by the Council, and elected by ballot at a regular meeting upon receiving at least three-fourths of the votes cast.

7. Every person proposed as an honorary member shall be recommended by at least ten members of the Institute, approved by the Council, and be elected by ballot on receiving nine-tenths of the votes cast.

8. The officers who shall constitute a Council for the direction of the affairs of the Institute, shall consist of a President, who shall be a Mining Engineer, six Vice-Presidents, at least four of whom shall be mining Engineers (the word "Mining Engineers" in these rules comprehend Engineers connected either with mining or metallurgy), nine Managers, at least six of whom shall be Mining Engineers, a Secretary and Treasurer. All these officers shall be members or associates of the Institute, and shall be elected at the annual meeting (except in cases of vacancies), and shall be eligible for re-election, with the exception of any President or Vice-President who may have held office for the three immediate preceding years, and such two Managers of the Mining Engineers and one other Manager who shall attend the fewest Council meetings during the past year, but such members shall be eligible for re-election after being one year out of office; and such election shall be made in the manner following: A.—Any member of the Institute shall be at liberty to nominate in writing, and send to the Secretary, not less than thirty days prior to the annual meeting, a signed list of such persons as are considered suitable to fill the various offices; which list, having been duly stamped, with the Institute seal, together with the list of such officers as shall be eligible for re-election, and a copy of this Rule, shall be posted, at least ten days previous to the annual meeting, to all members of the Institute, who must strike out or add to such list so as to leave a record of their votes for Officers, not exceeding the number to be elected; but nothing shall prevent any member nominating in writing subsequently (specifying the classes as aforesaid), and up to, and on the day of, and prior to the election taking place, any other member or members to fill the various offices, nor shall anything prevent the members, whether present or absent, from having power to vote for any other member or members, although he may not be nominated as before provided for. The voting papers, being so filled up, must be returned through the post, addressed to the Secretary, or be handed to him or to the Chairman, in all cases so as to be received before the hour fixed for the election of officers. B.—The Chairman shall, in all cases of voting, appoint scrutineers of the lists, and the scrutiny shall commence on the conclusion of the other business of the meeting, or at such other time as the Chairman may appoint. On the conclusion of the scrutiny the voting papers shall be destroyed, and the List, prepared and verified by the scrutineers, shall be kept until the next annual meeting. C.—In the event of any vacancies occurring in the number of officers subsequent to the annual meeting, such vacancy or vacancies shall be filled by the Council. D.—At meetings of the Council five shall be a quorum.

9. General meetings of the Institute shall take place on the third Tuesday of February, May, August and November, and the May meeting shall be considered the annual meeting, at which a report of the proceedings of the Institute and an abstract of the accounts shall be furnished by the Council. Special meetings may be called whenever the Council see fit; and the Secretary shall call a special meeting on a requisition signed by fifteen or more members. The notices for special meetings shall state the business to be transacted, and no other shall be entertained.

10. Every question which shall come before any meeting of the Institute shall be decided by the votes of the majority of the members then present.

11. The funds of the Institute shall be deposited in the hands of

the Treasurer, and shall be disbursed by him according to the directions of the Council.

12. All Papers sent for the approval of the Council shall be accompanied by a short abstract of their contents.

13. The Council shall have power to decide on the propriety of communicating to the Institute any papers which may be received, and they shall be at liberty, when they think it desirable, to direct that any paper read before the Institute, shall be printed in the Transactions. Intimation, when practicable, shall be given at each general meeting of the subject of the paper or papers to be read and of the questions for discussion at the next meeting, and notice thereof shall be posted to all members. The reading of papers shall not be delayed beyond such hour as the President shall think proper, and if the election of members or other business shall not be despatched soon enough, the President may adjourn such business until after the discussion of the subject for the day.

14. Members elected at any meeting between the annual meetings shall be entitled to all papers issued that year.

15. The copyright of all papers communicated to and accepted by the Institute shall be vested in it, unless otherwise agreed upon between the Council and the author; and such communications shall not be published for sale or otherwise without the permission of the Council.

16. All proofs of discussion forwarded to members for correction must be returned to the Secretary not later than seven days from the date of their receipt, otherwise they will be considered correct and printed.

17. The Institute is not, as a body, responsible for the facts and opinions advanced in the papers which may be read, nor in the abstracts of the conversations which may take place at the meetings of the Institute.

18. The author of each paper read before the Institute shall be allowed twelve copies of such paper (if ordered to be printed) for his own use, and shall have the right to order any number of copies at the cost of printing and paper, provided they are not intended for sale.

19. Any member of the Institute shall have power to introduce a stranger to any meeting, but the latter shall not take part in any discussion without the consent of the meeting.

20. Any member who has not paid his subscription for the space of one year after it is due, shall not be entitled to vote at elections, or to receive a copy of the Transactions of the Institute.

21. The place of holding the general meetings for the ensuing year shall be fixed at each annual meeting, by a vote of the Institute; or, in default of such determination, by the Council; the place for special meetings shall be fixed by the Council; and notice of all such meetings shall be given by mail or otherwise to all members and associates, at least twenty days before the time appointed for said meeting.

22. No alteration shall be made in any of the Laws, Rules, or Regulations of the Institute except at the annual meeting.

The following resolution was then offered and passed:

Resolved, That the Chairman appoint a committee of five, to whom all applications from persons not present at this meeting, desiring to be connected with the Institute, shall be presented, and the said committee shall report at the meeting to-morrow a list of suitable names so nominated; and that all persons who have recorded their names at this meeting, and all persons who shall be so reported by the said committee, and all persons elected at the present series of sessions, constituting the May meeting of the Institute, shall be considered as Associates of the Institute; and the Council to be hereafter elected under the rules shall report at the August meeting the said persons in two lists, as Members and Associates, for adoption by the Associates then present; and that all persons to be permanently classed as Members or Associates shall signify the same to the Council before the August meeting.

The committee appointed, as provided by this resolution, reported at the subsequent sessions, May 17th and 18th, the following names with approval:

Robert Allison, Pottsville, Pa.; Jesse Beadle, Shickshinny, Pa.; W. P. Blake, New Haven, Conn.; John F. Blandy, Philadelphia, Pa.; David Coghlan, Scranton, Pa.; Martin Coryell, Wilkesbarre, Pa.; W. S. Coulter, Ashley, Pa.; W. M. Courtis, Wyandotte, Mich.; Eckley B. Coxe, Drifton, Pa.; A. B. De Saules, Orange, N. J.; Prof. T. Egleston, New York; Anton Eilers, New York; E. B. Ely, New York; Prof P. Frazer, Jr., Philadelphia, Pa.; N. Friedrich, Drifton, Pa; J. H. Harden, Wilkes-Barre, Pa.; C. E. Hawley, Wilkes-Barre, Pa.; J. R. Hoffman, Pottsville, Pa.; John Hoise, Tamaqua, Pa.; Theo. P. Jenkins, New York; George Johnson, Pittston, Pa.; W. W. Kenrich, Wilkes-Barre, Pa.; Prof. G. W. Maynard, Troy, N. Y.; Arthur McClellan, Drifton, Pa.; Paul A. Oliver, Wilkes-Barre, Pa.; Chas. Parrish, Wilkes-Barre, Pa.; C. W. Parsons, Wilkes-Barre, Pa.; Edmund C. Pechin, Dumbar, Pa.; Prof. W. B. Potter, St. Louis. Mo.; Prof. F. Prime, Jr., Easton, Pa.; Prof. Raphael Pumpelly, Cambridge, Mass.; C. E. Richter, Philadelphia, Pa.; R. Bruce Ricketts, Wilkes-Barre, Pa.; W. H. Roberts, Mauch Chunk, Pa.; I. H. Stearns, Wilkes-Barre, P.; W. S. Stewart, Wilkes-Barre, Pa.; J. H. Swoyer, Wilkes-Barre, Pa.; David Thomas, Catasauqua, Pa.; Samuel Thomas, Catasauqua, Pa.; H. Wentz, Wilkes-Barre, Pa.; John White, New York, S. B. Whiting, Pottsville, Pa.; Pryor J. Williams, Wilkes-Barre, Pa.; Morgan B. Williams, Wilkes-Barre, Pa.; W. D. Zehner, Summit Hill, Pa.

An election for permanent officers of the Institute resulted in the choice of the following:

President:—David Thomas, Catasauqua, Pa.

Vice-Presidents:—R. W. Raymond, New York; E. B. Coxe, Drifton, Pa.; W. R. Symons, Pottsville, Pa.; W. P. Blake, New Haven, Conn.; J. F. Blandy, Philadelphia, Pa.; J. H. Swoyer, Wilkes-Barre, Pa.

Managers:—R. P. Rothwell, Wilkes-Barre, Pa.; T. S. McNair, Hazleton, Pa.; G. W. Maynard, Troy, N. Y.; Raphael Pumpelly, Cambridge, Mass.; Thomas Petherick, Scranton, Pa.; T. M. Williams, Wilkes-Barre, Pa.; Thomas Egleston, Jr., New York; E. Ganjot, Pottsville, Pa.; Frederick Prime, Jr., Easton, Pa.

Secretary:—Martin Coryell, Wilkes-Barre, Pa.

Treasurer:—J. Pryor Williamson, Wilkes-Barre, Pa.

Since that time, the Institute has prospered exceedingly. It numbered on July 1st 1882, six honorary members, 914 members, 121 associates, 51 foreign members. The officers in July 1st, were as follows:

President.—R. P. Rothwell. Vice-Presidents.—J. P. Kimball, W. H. Pettee, C. O. Thompson, (Term expires February, 1883.) T. N. Ely, Charles Macdonald, J. W. Powell, (Term expires February, 1884.) Managers.—James C. Bayles, W. S. Keyes, Percival Roberts, Jr., (Term expires February, 1883.) J. S. Alexander, H. S. Munroe, J. C. F. Randolph, (Term expires February, 1884.) William Burnham, Anton Eilers, A. S. McCreath, (Term expires February, 1885.) Secretary.—Thomas M. Drown, Easton, Pa. Treasurer.—Theodore D. Rand, Philadelphia.

The following are the rules as amended to July 1, this year:

I. OBJECTS.—The objects of the "American Institute of Mining Engineers" are to promote the Arts and Sciences connected with the economical production of the useful minerals and metals, and the welfare of those employed in these industries, by means of meetings for social intercourse, and reading and discussion of professional papers, and to circulate, by means of publications among its members and associates, the information thus obtained.

II. MEMBERSHIP.—The Institute shall consist of Members, Honorary Members, and Associates. Members and Honorary Members shall be professional mining engineers, geologists, metallurgists, or chemists, or persons practically engaged in mining, metallurgy, or metallurgical engineering. Associates shall include all suitable persons desirous of being connected with the Institute and duly elected as hereinafter provided. Each person desirous of becoming a member or associate shall be proposed by at least three members or associates, approved by the Council, and elected by ballot at a regular meeting upon receiving three-fourths of the votes cast, and shall become a member or associate on the payment of his first dues. Each person proposed as an honorary member shall be recommended by at least ten members or associates, approved by the Council and elected by ballot at a regular meeting on receiving nine-tenths of the votes cast; *Provided*, that the number of honorary members shall not exceed twenty. The Council may at any time change the classification of a person elected as associate, so as to make him a member, or *vice versa*, subject to the approval of the Institute. All members and associates shall be equally entitled to the privileges of membership; *Provided*, that honorary members shall not be entitled to vote or to be members of the Council.

Any member or associate may be stricken from the list on recommendation of the Council, by the vote of three-fourths of the members and associates present at any annual meeting, due notice having been mailed in writing by the Secretary to the said member or associate.

III. DUES.—The dues of members and associates shall be ten dollars per annum, payable in advance at the annual meeting; *Provided*, that persons elected at the meeting following the annual meeting shall pay eight dollars, and persons elected at the meeting preceding the annual meeting shall pay four dollars as dues for the current year. Honorary members shall not be liable to dues. Any member or associate may become, by the payment of one hundred dollars at any one time, a life member or associate, and shall not be liable thereafter to annual dues. Any member or associate in arrears may at the discretion of the Council be deprived of the receipt of publications, or stricken from the list of members when in arrears for one year; *Provided*, that he may be restored to membership by the Council on payment of all arrears, or by reelection after an interval of three years.

IV. OFFICERS.—The affairs of the institute shall be managed by a Council, consisting of a President, six Vice-Presidents, nine Managers, a Secretary and a Treasurer, who shall be elected from among the members and associates of the Institute at the annual meetings, to hold office as follows:

The President, the Secretary, and a Treasurer for one year (and no person shall be eligible for immediate re-election as President who shall have held that office subsequent to the adoption of these rules, for two consecutive years), the Vice-Presidents for two years, and the managers for three years; and no Vice-President or Manager shall be eligible for immediate re-election to the same office at the expiration of the term for which he was elected. At each annual meeting a President, three Vice-Presidents, three Managers, a Secretary and a Treasurer shall be elected, and the term of office shall continue until the adjournment of the meeting at which their successors are elected.

The duties of all officers shall be such as usually pertain to their offices, or may be delegated to them by the Council or the Institute; and the Council may in its discretion require bonds to be given by the Treasurer. At each annual meeting the Council shall make a report of proceedings of the Institute together with a financial statement.

Vacancies in the Council may occur by death or resignation; or the Council may by vote of a majority of all its members declare the place of any officer vacant, on his failure for one year, from inability or otherwise, to attend the Council meetings or perform the duties of his office. All vacancies shall be filled by the appointment of the Council, and any person so appointed shall hold office for the remainder of the term for which his predecessor was elected or appointed; *Provided*, that the said appointment shall not render him ineligible at the next annual meeting.

Five members of the Council shall constitute a quorum, but the Council may appoint an Executive Committee, or business may be transacted at a regularly called meeting of the Council, at which less than a quorum is present, subject to the approval of a majority of the Council, subsequently given in writing to the Secretary, and recorded by him with the minutes.

V—ELECTIONS.—The annual election shall be conducted as follows: Nominations may be sent in writing to the Secretary, accompanied with the names of the proposers, at any time not less than thirty days before the annual meeting; and the Secretary shall, not less than two weeks before the said meeting, mail to every member or associate (except honorary members), a list of all the nominations for each office so received, stamped with the seal of the Institute, together with a copy of this rule, and the names of the persons ineligible for election to each office. And each member or associate qualified to vote, may vote, either by striking from or adding to the names of the said list, leaving names not exceeding in number the officers to be elected, or by preparing a new list, signing said altered or prepared ballot with his name, and either mailing it to the Secretary, or presenting it in person at the annual meeting *Provided*, that no member or associate, in arrears since the last annual meeting, shall be allowed to vote until the said arrears shall have been paid. The ballots shall be received and examined by three Scrutineers, appointed at the annual meeting by the presiding officer; and the persons who shall have received the greatest number of votes for the several offices, shall be declared elected, and the Scrutineers shall so report to the presiding officer. The ballots shall be destroyed, and a list of the elected officers, certified by the Scrutineers, shall be preserved by the Secretary.

VI—MEETINGS.—The annual meeting of the Institute shall take place on the third Tuesday of February, at which a report of the proceedings of the Institute, and an abstract of the accounts, shall be furnished by the Council. Two other regular meetings of the Institute shall be held in each year, at such times and places as the Council shall select. Special meetings may be called whenever the Council sees fit, and the Secretary shall call a special meeting on a requisition signed by fifteen or more members. The notices for special meetings shall state the business to be transacted, and no other shall be entertained.

Every question which shall come before any meeting of the Institute, shall be decided, unless otherwise provided by these Rules, by the votes of the majority of the members then present. The place of meeting shall be fixed in advance by the Institute, or, in default of such determination, by the Council, and notice of all meetings shall be given by mail, or otherwise, to all members and associates, at least twenty days in advance. Any member or associate may introduce a stranger to any meeting, but the latter shall not take part in the proceedings without the consent of the meeting.

VII—PAPERS.—The Council shall have power to decide on the propriety of communicating to the Institute any papers which may be received, and they shall be at liberty, when they think it desirable, to direct that any paper read before the Institute shall be printed in the Transactions. Intimation, when practicable, shall be given at each General Meeting, of the subject of the paper or papers to be read, and of the questions for discussion at the next meeting. The reading of papers shall not be delayed beyond such hour as the presiding officer shall think proper; and the election of members or other business may be adjourned by the presiding officer, to permit the reading and discussion of papers.

The copyright of all papers communicated to, and accepted by the Institute, shall be vested in it, unless otherwise agreed between the Council and the author. The author of each paper read before the Institute shall be entitled to twelve copies, if printed, for his own use, and shall have the right to order any number of copies at the cost of paper and printing, provided said copies are not intended for sale. The Institute is not, as a body, responsible for the statements of fact or opinion, advanced in papers or discussions, at its meetings, and it is understood that papers and discussions should not include matters relating to politics, or purely to trade.

VIII—AMENDMENTS.—These rules may be amended, at an annual meeting, by a two-thirds vote of the members present, provided that written notice of the proposed amendment shall have been given at a previous meeting.

THE NATIONAL MINING EXHIBITION AT DENVER, COLORADO.

THE National Mining and Industrial Exhibition, which opened at Denver on Tuesday, August 1, 1882, with an address by the Hon. William D. Kelley, of Pennsylvania, was first suggested by Mr. J. W Ryckman in the Chicago *Industrial World*. The suggestion was adopted readily and the work of organizing began. The reason for this is found in the National ignorance upon mining matters. Denver was particularly interested. It was felt that the necessity existed for removing the many erroneous impressions prevalent, and showing in the most convincing and satisfactory manner that Colorado instead of being in one portion a barren desert, and in another a mass of snow-clad mountains, really contains a soil encouraging to the agriculturist, and a marvelous diversity of native minerals. only awaiting the introduction of manufacturing facilities to find an active market. It was believed too that in mining, inventors would be stimulated by the demand for new processes that will make low grade ores more profitable; in manufactures, capitalists and skilled labor would find every inducement for the establishment of new industries. The remoteness from Eastern sources of supply acts as a protective tariff to the producer in Colorado, where crude material exists in profusion, and it is comparatively neglected. To bring capital face to face with these opportunities for investment, and with skilled labor, to more rapidly develop the country, is the aim and purpose of the Exposition, and the display now shown is designed especially to hasten the establishment of extensive and flourishing industrial communities.

The principal events in the history of the Great West—more particularly those events which induce exploration and settlements—are of comparatively recent date. California, as described by Mr. Dana in "Two Years Before the Mast," treats of no commerce save that in hides, and suggests no idea of auriferous wealth. When the results of the Mexican war changed the boundary line between the United States and Mexico, and the discovery of placer gold in California became known, the bright visions of sudden wealth drew thousands towards the Pacific slope by the tedious sea voyages "around the Horn" or through the pestilential and deadly marshes of the Isthmus route. Those who feared the one or dreaded the other sought the overland routes and found ample opportunities to test their skill and endurance. Many perished by the way, but the movement did not cease. In 1858 news reached the East of gold discoveries in what was known as the Pike's Peak region, and a fresh impetus was given to immigration. The most important advance was made when railway facilities were inaugurated and the country became easily accessible to all who chose to visit it. With these facilities available the tide has continued year after year. Explorers have been and are still seeking new fields and announcing fresh discoveries The country west of the Missouri river is now easy of access, and in its striking contrasts and glorious scenery, furnishes fresh sensations to the pleasure seeker; while its great natural resources and remarkable climate are a strong inducement to those seeking new homes. It can be visited easier and more comfortably than Europe, even from the Atlantic seaboard, and every citizen of America should be conversant with the attractions of his own land before seeking recreation abroad. The population, as a class, combine all that is energetic and effective in pushing to satisfactory results whatever it undertakes. Intelligence is the rule, and public schools, equal to any in the country, exist in profusion. These remarks apply to the entire region covered by the great mineral belt. In natural resources the Rocky Mountains contain a varied and practically inexhaustible supply. The number is only limited by the incomplete examinations which have been made from time to time. Each year brings to light new deposits, not only of precious metals but of other mineral substances of great commercial value. There is no portion of the world that possesses equal advantages or surer highways to fortune than these mountain States, and many of these paths are to-day awaiting their particular pioneers. There is a reason for this, and an honest reason, too. It is because everything has been made subordinate to mining for precious metals. That prompted the early settlement and induced the following immigration to a great extent. All miners are not successful, and necessity has driven those who failed in mining into other pursuits. Horace Greeley declared the country capable of great things in agriculture, and received only jeers in return, until the harvests of Weld, Larimer, Boulder and other Counties in Colorado, portions of Utah, New Mexico and otherTerritories, to say nothing of the vast crops of cereals annually produced in California, justified his opinion in the most positive manner. Farmers in the great valleys of the Mississippi and its tributaries contend with frosts, drought, floods and hurricanes; all prominent factors in his annual calculations, but entirely unknown to the husbandman here. The dry atmosphere prevents killing frosts, and removes the danger from floods; the lofty mountain ranges send the hurricanes high overhead, and the extensive systems of irrigation that are constantly increasing, enable him to feed his growing crops as regularly as he feeds himself. When his grain is ready for the harvest he fears no danger from soaking rains. His wheat is always of high grade, his barley clean and bright, and his root crops swell to enormous proportions in the rich virgin soil. His market is at home—because, in spite of the annual increase in acreage, the rapid increase in population keeps in the lead and absorbs more than has been produced. There are thousands of acres yet laying idle, capable of splendid crops. The value of the cereals annually produced in the Pacific Seaboard States is far in excess of that of the precious metals, and other portions of the mountain region have equal advantage. Within this wide region there are many native products, besides precious metals, all with more or less commercial value, that are now wholly or partially neglected. With a view to bringing these hidden treasures to light, and to learn their full value is one of the great purposes of the Mining and Industrial Exposition. With their worth ascertained, it is confidently believed that new industries will be established convenient to the sources of supply and a market. Practical men will be encouraged to embark in these new enterprises wherever they may choose to locate them in our midst, and will have the benefit of the distance and cost of transportation from other sources of supply to protect their wares from competition.

In the selection of Denver as the place for the Exposition, many weighty reasons justify the choice. It is the largest city between the Mississippi Valley and the Pacific Coast. It has railway facilities radiating in every direction, affording easy communication with Wyoming, Utah, Idaho, Montana, New Mexico, Arizona, Nevada, California, Kansas and Nebraska. It is the objective point of summer travel from the Eastern States, and is visited by thousands of Americans and Europeans annually. It thus possesses superior opportunities for displaying our undeveloped means where they can be critically examined by capitalists and their values carefully tested. These considerations should prompt every one resident in the west to strive earnestly for a complete representation from his own locality, and thus make a fitting exhibit for the benefit of investors.

That an idea may be obtained of the size of these mining States and territories, a few comparative figures may be given. The area of the great western territory interested in mining, aggregates 1,196,084 square miles, or nearly one third of the whole area of the United States, Alaska included. Colorado, New Mexico, Arizona, Utah and Wyoming together have an area of 521,976 square miles, or over one seventh of the entire nation. With the Exposition replete with exhibits of crude material, accompanied by the necessary statements of locality and quantity, many neglected deposits will be brought into prominence, and lay the foundations for industrial advancement. As the Exposition is repeated year after year, it will become a vivid record of progress not only of the general prosperity of the great west, but it will also show that the people are constantly being taught to know new uses for crude material existing in Colorado, and are adding to their prosperity by all the rapid methods of manufacture, that spring from the inventive brain of an intelligent people.

As soon as the matter was actively pushed, Congress (on April 7th, 1882) passed the following law:—"That all articles which shall be imported for the sole purpose of exhibition at the National Mining and Industrial Exposition to be held in the city of Denver, in the year 1882, shall be admitted without the payment of duty or custom fees, or charges, under such regulations as the Secretary of the Treasury shall prescribe. Provided, that all such articles as shall be sold in the United States, or withdrawn for consumption therein, at any time after such importation, shall be subject to the duties, if any, imposed upon like articles by the revenue laws in force at the date of importation. And provided further, that in case any articles imported under provisions of this act shall be withdrawn for consumption, or shall be sold without payment of duty as required by law, all the penalties prescribed by the revenue laws shall be applied and enforced against such articles, and against the persons who may be guilty of such withdrawal or sale."

Officers for 1882.—H. A. W. Tabor, President; Herman Silver, Vice-President; W. A. H. Loveland, Treaserer; S. T. Armstrong, Secretary; H. D. Perky, General Manager; Hon. F. W. Pitkin, Governor of Colorado, and State and Territorial Governors, Honorary Vice-Presidents. *Directors.*—W. A. H. Loveland, H. A. W. Tabor, H. D. Perky, H. S. Wicks, John W. Knox, S. T. Armstrong, O. L. Haskell, Herman Silver, J. T. Cornforth, A. C. Hunt. *Executive Committee.*—O. L. Haskell, S. T. Armstrong, H. D. Perky. Geo. A. Crofutt, Sole Agent for the Bureau of Tourists and Excursions.

The exposition building, of which the accompanying engraving is a literal *fac-simile*, is a superb edifice of brick and stone, in the shape of a Maltese cross, having about two hundred thousand square feet of exhibition space. It is a permanent structure of 500 feet in length and 316 feet wide, designed particularly for the purpose. It will be furnished with the proper refreshment and retiring rooms necessary to the comfort of visitors and exhibitors. It is a great ornament to Denver and occupies an elevated position in the picturesque suburbs of the city, overlooking a stretch of three hundred miles of the Rocky Mountains. The Mineral exhibit will be a permanent feature; increased from time to time as new discoveries will demand, and is intended to present a faithful object lesson of the mineral deposits, not only of the Western States, but of the whole Union. It is under the immediate supervision of Prof. J. Alden Smith, State Geologist of Colorado. The following were the rules adopted at the outset:

1. The building will be open for the reception of articles on and after July 15th, and all exhibits must be in position, and machinery ready for operation on the opening day.

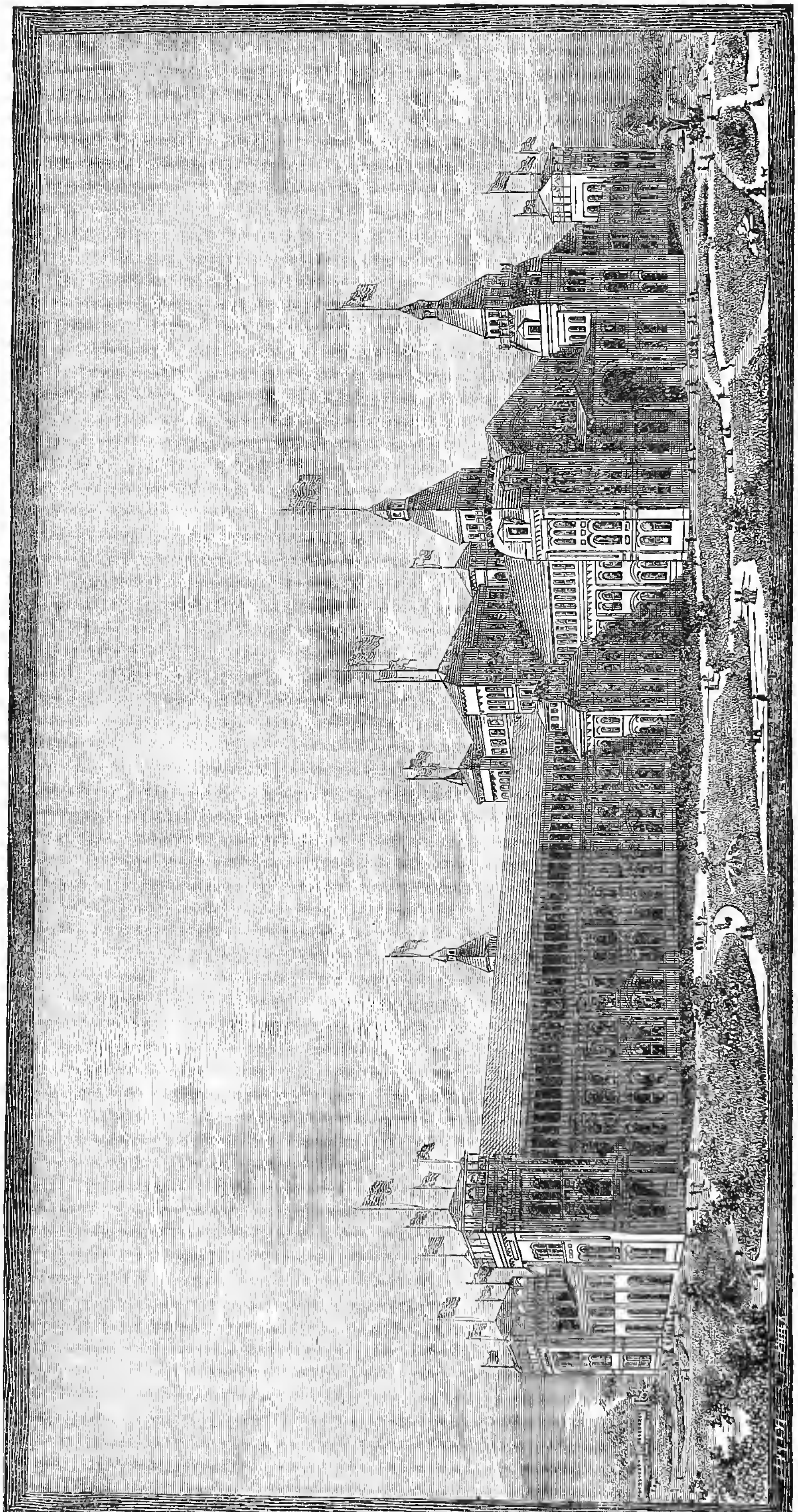
2. Machinery and manufactured articles must be entered in the name of the manufacturer. Entries will be permitted by manufacturers' agents. Mineral specimens may be entered by mine owners and through their accredited representatives.

3. The driving engines will be ready to furnish power to the main shafts ten days before the opening free of charge; but exhibitors must make their own attachments.

4. The entry clerk will furnish each exhibitor with an original and duplicate tag, the duplicate to be securely attached to the article exhibited when it is placed in position, the original will be kept by the exhibitor during the Exposition, and be surrendered to the entry clerk when the articles are removed from the building.

5. All articles on exhibition must remain until the Exposition closes. Removal will not be permitted except upon the written consent of the Board of Directors. Every facility for making sales of articles to be delivered at the close of the Exposition will be extended.

6. An efficient police will be provided for the care of arti-



THE NATIONAL MINING AND INDUSTRIAL EXPOSITION BUILDING, DENVER, COLORADO.

cles both day and night, but exhibits will be entirely at the owner's risk. Insurance against loss by fire will be effected when desired at the cost of the exhibitor.

7. To preserve harmony in the general effect of the display the Board reserves the right to regulate the position of all articles and the size of signs.

8. Space will be allotted in the order of application, and exhibitors notified as early as practicable. But space not occupied, either by the arrival of the goods or otherwise, one week before the opening day will be reassigned by the board.

9. As there will be no charge made to exhibitors, for entries or space, admission tickets will only be furnished to such exhibitor or to one employé, or both, when it is shown that the attendance of the exhibitor or employé is actually necessary. For these tickets five dollars each will be charged. These tickets will be registered, and forfeited if used by any other person than the one to whom they are issued.

10. The Board of Directors will take charge of all articles upon which the freight is prepaid, and remove them to the Exposition building at the expense of the exhibitor.

11. All unclaimed articles left by exhibitors fifteen days after the close of the Exposition will be stored and disposed of according to law.

12. All platforms and other temporary structures erected by exhibitors must be removed from the building by them within fifteen days after the close of the Exposition. No attachments to the floor by nails, screws, or otherwise, will be permitted. This does not include permanent exhibits.

13. There will be three lines of shafting in Power Hall, one $2\frac{7}{16}$ inches in diameter, for light machinery, will be driven at a speed of 150 revolutions per minute. The others will be $2\frac{1}{1}\frac{5}{6}$ inches in diameter, with a speed of 200 revolutions per minute. Driving pulleys as required, also counter-shafts and pulleys, belts and hangers, will be furnished for exhibitors at cost, if timely notice is given. They should be ready to be placed on the shafts before the 25th July.

The custom of awarding premiums has been so freely condemned that it has been omitted here. The action of ignorant or biased jurors will thus be avoided. Exhibitors will appreciate this feature, as it leaves them free to win success among the people, who will prove the claims of inventors by actual tests.

CLASSIFICATION.

DEPARTMENT A—*Mineralogy*—Gold ores, class 1; Silver ores, class 2; Iron ores, class 3; Lead ores, class 4; Copper ores, class 5; Fire, potters', and other clays, class 6; Bituminous coals, class 7; Anthracite coals, class 8; Cannel coal, class 9; Lignite, class 10; Other metalliferous specimens not enumerated above, class 11.

DEPARTMENT B—*Geology*—Marbles, class 1; Lithographic stone, class 2; Limestone, class 3; Miscellaneous building stone, class 4; Fossils, class 5; Gypsum, class 6; Precious stones and crystals, class 7; Native chemicals, class 8.

DEPARTMENT C—Hardware, edge tools, cutlery, and all cast and wrought iron goods, including stoves, safes, and metallic household utensils. Foundry productions, including all heavy castings, stoves, ranges, etc., class 1; All the light cast products, builders' hardware, plumbers' goods, brass goods, iron fencing, etc., class 2; House furnishing goods, edge tools, cutlery, iron safes, and other wrought iron goods, class 3; Grates and mantels, lamps and gas fixtures, class 4.

DEPARTMENT D—*Metallurgical Machinery*—Reverberatory roasting furnaces, blast and reverberatory smelting furnace, cupel, retort and other furnaces for separating base and precious metals, class 1; Stamp mills for free gold ores, stamp mills for free silver ores, stamp mills for dry crushing, and furnaces for roasting refractory gold or silver ores, class 2; Pans and settlers for amalgamation, leaching vats for leaching process, concentrators for crude ore or tailings, class 3; Other devices not included in the above classification, class 4.

DEPARTMENT E—*Agricultural and Horticultural Products and Floral Displays*—Cereals in half bushel samples, class 1; Fruits and roots, class 2; Plants and shrubbery, class 3; Cut flowers and transient exhibits, for which special arrangements will be made, class 4; Dairy products, class 5; Miscellaneous, class 6.

DEPARTMENT F—*General Machinery including Steam Engines and Machine Tools*—Stationary and portable engines and locomotives, class 1; Metal and wood working machinery, tools and appliances, class 2; Printing machinery, leather working machinery, pneumatic machinery, class 3; Miscellaneous machinery and machines tool, class 4; Laundry Machinery, class 5.

DEPARTMENT G—*Agricultural and Horticultural Implements and Machinery, Carriages, Wagons, and other vehicles*—Threshing machines, mowers, reapers, harvesters, ditching machines, hay rakes, feed cutters, etc., class 1; Plows, drills, planters, and other implements used in seeding, class 2; Farm vehicles of all descriptions, carriages, etc., class 3; Miscellaneous agricultural tools, class 4.

DEPARTMENT H—*Textile Fabrics, Leather and their products*—Wools (in fleeces) and other crude textile materials, class 1; Cotton, linen and woolen goods, bagging, rope and twine, class 2; Manufactured articles, clothing, hats, caps, etc., class 3; Leather, boots, shoes, harness, belting, furs and their manufactured products, class 4.

DEPARTMENT I—*Household Goods, Watches, Jewelry, Ornamental Articles, Optical and Scientific Instruments, Ceramics, etc*—Furniture and bedding, etc., class 1; Watches, jewelry, ceramics, bronze ornaments, etc., class 2; Optical and scientific instruments, class 3; China, glass and stone table ware, class 4; Wooden, willow, and wire goods, class 5; Paper hanging, etc, class 6.

DEPARTMENT K—*Liberal Arts, Natural Science, and Education*—Typography and bookbinders' work, class 1; Musical instruments, class 2; Photography, lithography, etc., class 3; Stationers' goods, class 4; Books and miscellaneous prints, educational devices, etc., class 5.

DEPARTMENT L—*Food Preparations and Miscellaneous Articles used in Domestic Economy, Miners' Supplies, etc.*—Flour, meal, etc., in sacks, class 1; Canned goods, class 2; Special food preparations not otherwise classified, class 3.

DEPARTMENT M—*Chemical and Medicinal Preparations (Patent Medicines excepted) Illuminating and Lubricating Oils*—Chemical preparations, class 1; Medicinal articles, class 2; Illuminating and lubricating oils, class 3; Miscellaneous articles in chemistry, not enumerated above, class 4.

DEPARTMENT M—*Miscellaneous Unclassified Articles.*

THE U. S. GEOLOGICAL SURVEY AND ITS WORK.

THE literature of geology has grown to large proportions. To obtain a detailed and comprehensive knowledge of the reported facts and the discussions based thereon is a task of magnitude. In territories governed by civilized nations geologic research is actively prosecuted, and geologists are penetrating the lands inhabited by savage and barbaric tribes; and thus a large body of men are engaged in geologic investigations. From year to year more refined methods of study are introduced, and new classes of facts are discovered; and the old fields are ever becoming new fields for examination. So the literature, already great, is rapidly increasing, and its prospective magnitude is such as to demand of geologists the adoption of all methods and devices that will secure economy of time and thought to scholars and students. The U. S. Geological Survey is working exactly within the limits and ambitions of this spirit. The last published report by the able director of the survey, Mr. John W. Powell, of Illinois, is for the fiscal year ending June 30th, 1881, and forms the second annual report. From its pages we learn that the following reports exhaustively made were printed or about to be printed.

TERTIARY HISTORY OF THE GRAND CANON DISTRICT OF COLORADO by Captain C. E Dutton. In his report he does not undertake to give an exhaustive account of the entire range of the geology of the district, but limits himself to the discussion of its Tertiary history and of the problems of physical geology involved therein. This work is illustrated by Mr. W. H. Holmes.

THE HISTORY OF LAKE BONNEVILLE by Mr. G. K. Gilbert. Mr. Gilbert's study of Lake Bonneville, the lake which during Quaternary time occupied the desert basin of western Utah, was begun ten years ago, at which time he was attached to the geographic corps of Capt. George M. Wheeler, of the United States Engineers. Since that time his duties as a member of the Survey of the Rocky Mountain Region have carried him repeatedly to the same district and permitted him to continue his study of the ancient lake. He had thus accumulated before the organization of the present Survey a considerable body of facts, and had already published an outline of the subject. As a member of the new organization he has devoted his time almost exclusively to this research, complementing the material previously gathered and setting at rest the greater number of the questions that had been raised. His field investigation was completed in 1880, and he has now finished a monograph on the subject.

GEOLOGY OF THE EUREKA DISTRICT by Mr. Arnold Hague. The field of Mr. Hague's researches, known as the "Eureka District," is in Central Nevada, and embraces a tract about twenty miles square. Mr. Hague's report will constitute an important contribution to structural geology and will contain valuable information in economic geology.

GEOLOGY OF LEADVILLE by Mr. S. F. Emmons. From the date of its organization the Geological Survey has been engaged in prosecuting investigations in economic geology; that is, in researches having in view questions of immediate and direct importance to the mining industries of the country. All wisely conducted geologic investigations ultimately result in a practical benefit to mining and correlated industries. The influence of general geology—that is, structural geology, with the aid of paleontology—is indirect, while that of mining geology is direct. But mining geology is superficial and almost valueless unless it has a solid foundation in structural geology. The occurrence, magnitude, and value of all ore deposits are primarily related to geologic structure. The laws of this relation are but partly known, as the science of mineral deposits is but imperfectly developed, but every year adds new facts, and many of these which will be contributed during 1882 will be from the admirable researches of Mr. Emmons. An abstract of his work can be found in another part of this volume.

GEOLOGY OF THE COMSTOCK LODE by Mr. G. F. Becker. The Comstock Lode is in every respect a remarkable occurrence. The fact of its enormous production is familiar, but it is not equally well known that its vertical workings are carried to a greater depth than any in the world except those of Przibram, in Bohemia. It also presents scientific problems of equal obscurity and interest, which have attracted great attention. It would be a reproach to American geology to leave the character of so prominent a mining district unsettled, and the present investigation was undertaken in the hope that the additional facilities presented by the great extension of the mine workings during late years and by recent advances in science would permit a more satisfactory solution than has yet been reached.

NEW METHOD OF HYPSOMETRY by Mr. G. K. Gilbert. Not only the present Geological Survey but its predecessors in the same field have been compelled to make maps for their own use, and in this way have come to perform an amount of geographic work which has proved even more expensive than the geologic investigations to which it is accessory. Although a geologist by profession, Mr. Gilbert has been called upon from time to time, and especially as a member of the Survey of the Rocky Mountain Region, to conduct geographic work, and this paper is the embodiment of the results of a series of investigations initiated in connection with those duties.

The adoption of a nomenclature is to an important extent an attempt to establish the categories of classification; but every stage in the progress of knowledge is marked by a stage in the progress of classification, and any attempt to fix permanently the categories for a nascent science must be futile. In so far, then, as proposed uniform methods of nomenclature and representation are designed to establish the fundamental categories, no good can be accomplished. On the other hand, useful results can be obtained by the employment of a uniform nomenclature and system of representation in the presentation of like facts. From time to time new classifications will be advanced, and new terms for more refined distinctions must be multiplied *pari passu* with the growth of the science, but diverse terms for the same classes and distinctions should be eradicated. A multiplication of means for like purposes in the presentation of scientific subjects is a characteristic of low development, in the same manner as is the multiplication of organs for like purposes in a living being. Economy of time and thought is the goal to be attained. As of interest, in this connection, we present here the General Scheme adopted in all of its work and publications:

ERA OR SYSTEM.	*Period or Group.*	Epoch or Formation.
Era of Man	Quaternary	To be formulated in various districts as the facts demand.
Cenozoic or Tertiary	Pliocene	
	Minocene	
	Eocene	
Mesozoic	Cretaceous	
	Jurassic	
	Triassic	
Paleozoic	Permian	
	Carboniferous	
	Devonian	
	Silurian	
	Cambrian	
Archæan	Huronian?	
	Laurentian?	

The cost of the work prosecuted by the Survey was given as follows during the fiscal year, June 30, 1880, to June 30, 1881.

Amount appropriated by Congress for the use of the Geological Survey for the fiscal year ending June 30, 1881	$156,000 00
Expended during the fiscal year	150,948 47
Remaining on hand June 30, 1881 (required to meet outstanding liabilities)	5,051 53

The following is a classification of the expenditures:

	Amount.
Salary of Director	$6000 00
Services of assistants and employes	101,392 43
Rent of offices	3,760 93
Repair of offices	101 35
Office furniture	2,495 52
Fuel	1,034 04
Gas	217 80
Ice	53 47
Telegrams	858 14
Rent of telephones	82 00
Rent of post-office boxes	50 00
Stationery	1,695 62
Drawing material	277 45
Books	171 35
Instruments purchased	1,171 03
Instruments repaired	285 30
Laboratory supplies	1,998 63
Photographic material	256 03
Publication of maps	175 00
Illustrations for reports	727 00
Job printing	36 00

Transportation of assistants and properties	7,825 40
Traveling expenses	6,768 94
Purchase of horses	240 00
Purchase of mules	930 00
Camp and field equipage	1,190 51
Subsistence	6,626 90
Forage	2,338 83
Pasturage	597 94
Tollage	32 47
Storage	331 93
Apprehension and delivery of lost public property	95 00
Miscellaneous	1,131 46
Total	150,948 47

THE MINING AND SCIENTIFIC PRESS OF THE UNITED STATES.

SOME of our readers will doubtless want to know just where to lay their hands on the publications that pertain strictly to mining interests and matters of science. We therefore furnish here some facts concerning the mining and mechanical press of the United States, which is not, perhaps, as full as it could be made. We also add some notes upon publications that can hardly be said to belong to the mining press and yet are of great importance. The publications of the Government are very elaborate works abounding in exact scientific information, but the volumes are often exceedingly difficult of attainment, and their size prevents any general circulation. Some documents are to be had for the asking, in cases where the applicant is the least bit interested. Prominent among these are the

ANNUAL REPORT UPON THE PRODUCTION of PRECIOUS METALS IN THE UNITED STATES, by Horatio C. Burchard, Director of the Mint. This volume is full of information gathered by Government officials. It will be published in September, 1882, and covers the production of precious metals between Jan. 1, 1881 and Jan. 1, 1882. To be had free at Washington.

THE ANNUAL REPORT OF THE DIRECTOR OF THE MINT. Covering the coinage of the country, and various reports on the coinage of other countries. This is issued in November of each year for the fiscal year, ending on the previous 30th of June. To be had free at Washington.

ANNUAL REPORT OF THE AMERICAN IRON AND STEEL ASSOCIATION. Prepared by James M. Swank, Secretary, and published annually in June. This is always able and reliable. To be had at 261 south Fourth street, Philadelphia, price, $2.00. Tenth annual issue this year.

THE COAL TRADE—By Frederick E. Saward. A handy compilation containing facts and figures regarding the Coal Trade. Issued annually in April. This year is the ninth year of publication. Price 50 cents. Published at 111 Broadway, New York.

ANNUAL REVIEW OF THE COPPER AND IRON PRODUCTION OF LAKE SUPERIOR.—Issued annually in July by A. P. Swineford & Co., Marquette, Michigan. Price 50 cents.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.—These very valuable publications are issued yearly by the Institute. Now in the tenth year of publication. Contains the papers read by the Members of the Institute at the different meetings. To be had from the Secretary, Easton, Pa. Price $5.00 per volume.

THE IRON AGE.—A Review of the Hardware, Iron and Metal Trades. Published every Thursday by David Williams, 83 Reade Street, New York City. Now in its 29th volume. This in the Iron Trade is the leading paper. Price $4.50 a year.

THE ENGINEERING AND MINING JOURNAL.—Published every Saturday by the Scientific Publishing Company, 27 Park Place, New York City, Richard P. Rothwell, C. E. M. E., Rossiter W. Raymond, Ph. D., Charles Kirchoff, J. M. E., editors. In the 34th volume. The leading paper in its line. $4.00 a year.

THE MINING RECORD.—Published every Saturday by A. R. Chisolm, at 61 Broadway, Mr. Thomas Jordan, editor. Publishes a good deal of news and is an ardent advocate of Bi-Metalism. Now in its 12th volume. $4.00 a year.

VAN NOSTRAND'S ENGINEERING MAGAZINE.—Published monthly. Now in its 26th volume. Established in 1869. Published by D. Van Nostrand, 23 Murray and 27 Warren Streets, New York City. $5.00 a year.

BULLION.—Published monthly at 42 Broad Street, New York City. A Monthly Statistical Review of labor, trade and money. In its 7th volume. $3.00 a year.

MAINE MINING JOURNAL.—Published every Friday at 28 West Market Square, Bangor, Maine. $2.00 a year. A paper representing the Mining Interests of Maine, New England and Nova Scotia.

THE ECONOMIST.—Published every Saturday at Boston and New York. A financial, political, railway, trade and mining weekly. In its 7th volume. $3.00 a year. R. E. Straine Proprietor, 31 Milk Street, Boston.

THE BULLION MINER.—Published every Saturday by The Bullion Miner Publishing Co., 123 S. 3d street, Philadelphia. In its 5th volume. $3.00 a year.

THE MINING JOURNAL.—Published every Saturday by The Mining Journal Co., 330 Walnut street, Philadelphia. In its 3d volume. $2.50 a year.

CHICAGO MINING JOURNAL.—Published monthly by the Western Mining Bureau, 78 Dearborn street Chicago. In its 2d volume. $1.00 a year.

THE MINING REVIEW.—Published every Saturday by the Mining Review Co., Times Building, Chicago. In its 7th volume. $3.00 a year.

THE MINING JOURNAL.—Published every Saturday by A. P. Swineford & Co., Marquette, Michigan. Devoted to the Iron and Industrial Industries of the County of Marquette. Established in 1846. $3.00 a year.

MINING INDEX.—Published every Saturday by A. F. Wuensch, No. 300 Harrison Avenue, Leadville, Colorado. In its 2d volume. $4.00 a year.

ROCKY MOUNTAIN MINING REVIEW.—Published every Thursday by James R. Ives, 422 Curtis Street, Denver, Colorado. In its 6th volume. $4.00 a year.

MINING AND SCIENTIFIC PRESS.—An illustrated Journal of mining, popular science and general news. Published every Saturday by Dewey and Co., 202 Sansom street, San Francisco. In its 40th volume. $4.00 a year.

COAL.—A weekly Journal of the coal trade. Published every Wednesday by the Scientific Publishing Co., 27 Park Place, New York City. In its 1st volume. $2 a year.

THE COAL TRADE JOURNAL.—Published every Wednesday by Frederick E. Saward, at 111 Broadway, New York City. A valuable organ of the coal trade. Established in 1869. Now in its 21st volume. $3.00 a year.

THE SCIENTIFIC AMERICAN AND SCIENTIFIC AMERICAN SUPPLEMENT.—Published every Saturday by Munn & Co., 261 Broadway, New York City. Now in its 47th volume. Scientific American $3.20 a year. Supplement $5.00 a year.

THE VIRGINIAS.—Published monthly by Jed Hotchkiss at 346 E. Main street, Staunton. Virginia. A Mining Industrial and Scientific Journal. In its 4th volume. $2.00 a year.

In addition to these all of the daily papers of the extreme Western States, furnish Mining News and most of the Eastern dailies do the same. A further list of somewhat similar publications to the above is furnished here:

American Journal of Science and Arts (monthly), Scien., New Haven. Forest, Forge and Farm (monthly), Mech., Ilion, N.Y. American Gaslight Journal (semi-mo.), Scien., New York. Engineering News, Mech., New York; Illustrated Scientific News (monthly), Sci. and Mech., New York. Mechanical Engineer (bi-weekly), Mech., New York. Mechanical News (semi-mo.), New York. Mechanics, Mech., New York. Metal Worker, Mech., New York. Science, Scien., New York. Scientific Man, Scien., New York. Transactions of the American Society of Civil Engineers (monthly), Eng., New York. Young Scientist (mo.), Scien., New York. Journal of the Franklin Institute (monthly), Scien., Philadelphia. North American Manufacturer, Mech., Philadelphia. American Manufacturer and Iron World, Mech., Pittsburg. Brick, Tile, and Metal Review (monthly), Pittsburg. Mechanic, Mech., Smithville. Mechanical Journal (mo.), Mech., Indianapolis.

American Engineer (monthly), Mech., Chicago. Journal of Science (mo.), Scien., Chicago. Northwestern Mining Journal, Mech., Hancock. Portage Lake Mining Gazette, Mech., Houghton. Miner, Mech., Ontonagon. Review of Science and Industry (monthly), Scien., Kansas City. Age of Steel, St. Louis. Wood and Iron (mo.), Mech., Minneapolis. Scientific Canadian, Mech., Montreal.

THE CALIFORNIA MINING BUREAU.

THE California State Mining Bureau is the creation of the twenty-third Legislature of the State of California. The bill—which is given in full below—originated in the Assembly. It was introduced by Honorable Joseph Wasson, representing the counties of Mono and Inyo:

AN ACT TO PROVIDE FOR THE ESTABLISHMENT AND MAINTENANCE OF A MINING BUREAU.—Approved April 16, 1880.

The People of the State of California, represented in Senate and Assembly do enact as follows:—

SECTION 1. There shall be and is hereby established in this State, a Mining Bureau, the principal office of which shall be maintained in the City of San Francisco, at which place there shall be collected by the State Mineralogist, and preserved for study and reference, specimens of all the geological and mineralogical substances, including mineral waters, found in this State, especially those possessing economic or commercial value, which specimens shall be marked, arranged, classified, and described, and a record thereof preserved, showing the character thereof, and the place from whence obtained. The State Mineralogist shall also, as he has opportunity and means, collect, and in like manner preserve at said office, minerals, rocks, and fossils of other States, Territories, and countries, and the collections so made shall at all reasonable hours be open to public inspection, examination and study.

SEC. 2. It shall be the duty of the Governor to appoint a citizen of this State having a practical and scientific knowledge of mining and mineralogy, to the office of State Mineralogist, to hold his said office for the term of four years, or until the appointment and qualification of his successor, who shall take and subscribe the oath of office prescribed by the Constitution, and who shall receive for his services a salary of three thousand dollars per annum, to be paid as other officers of the State are paid, and shall also receive his necessary travelling expenses, when travelling on the business of his office, to be allowed and audited by the State Board of Examiners, the whole to be paid out of the Mining Bureau Fund hereinafter provided for, and not otherwise.

SEC. 3. In addition to the collection, classification, arranging, and preservation of specimens, as provided in the first section of this Act, it shall be the duty of the State Mineralogist to make analytical assays as required; and when the funds in the Mining Bureau Fund are sufficient therefore, to provide and maintain a library of works on mineralogy, geology, and mining; to arrange in cases such specimens as he may collect; to procure and preserve models and drawings of mining machinery, and of milling machinery used in the production of ores; to correspond with established schools of mining and metallurgy, and obtain and preserve for public inspection and use, such information respecting improvements in mining and mining machinery as will be of practical value to the people of this State; to visit the several mining districts of each county of the State, from time to time, ascertain and record their history, describe their geological formation and altitudes, the character of the mines and ores, and the general development of the district. At the close of each year he shall make a report in detail to the Governor, showing the amount of disbursements of the Bureau under his charge, the number of specimens collected, and giving such statistical information in reference to mines and mining as shall be deemed important.

SEC. 4. The State Mineralogist may, from time to time, and as the funds in the Mining Bureau Fund will permit, appoint such assistants as he may deem necessary and proper for the carrying out of the objects of this Act, and the efficient provision and maintenance of a Bureau of mining information and statistics, and may procure and maintain the necessary rooms and furniture for the office and uses of the Bureau in San Francisco; but the entire expenses of the Bureau for salaries, assistance, rents, furniture, fuel and all other things pertaining to the Bureau, must not, in any one year, be greater than can be paid out of the mining Bureau Fund herein provided for.

SEC. 5. For the purpose of establishing a fund for the maintenance of the said Mining Bureau, it shall be the duty of the Tax Collectors in the several counties in this State, and of the License Collector of the City and County of San Francisco, on the second Monday in January, April, July and October, in each year, to transmit by express to the State Treasurer all money collected by them from mining corporations, or from corporations formed for milling ores, or for supplying water for mining purposes, under or by virtue of the Act entitled "An Act imposing a tax on the issue of certificates of stock corporations," approved April first, eighteen hundred and seventy-eight, and to forward to the State Controller by mail a certificate showing the amount of money so forwarded to the State Treasurer, and the date when the same was transmitted, and also showing the names of the several corporations from which the same was received, and the amount received from each. The State Treasurer shall receive the amounts so transmitted, and give duplicate receipts therefor, one of which shall be filed with the State Controller, and the other shall be returned by mail, or return express, to the Collector from whom the money was received; and after paying out of the money so received the charges for the transmission thereof, the amount of which shall be noted on the receipt filed with the State Controller, he shall retain the remainder in his hands as a separate fund, to be known as the Mining Bureau Fund, to be used only in payment of drafts made for the expenses of the Mining Bureau established under the Act, and out of which all the expenses of said Bureau shall be paid.

SEC. 6. Such Tax Collectors and License Collectors shall hereafter be required to pay into the county treasuries of their respective counties only that portion of the moneys collected by them under the Act of the Legislature mentioned in the last preceding section, which is collected from corporations other than those mentioned in section five of this Act.

SEC. 7. This Act shall take effect and be in force from and after its passage.

The present State Mineralogist, Henry G. Hanks, was appointed by the Governor in May following the passage of the bill, his commission bearing the date of May fifteenth, eighteen hundred and eighty. The first step taken toward the establishment of the Bureau was the temporary occupation of a small room, in the building number six hundred and nineteen Montgomery street. It was found difficult to obtain rooms suitable for the use of the Bureau. After examining many, a suite was finally selected which, although falling far below the requirements of a Museum worthy of the great State of California, is perhaps the best available at the present time for the purpose. The rooms at present occupied by the Bureau are on Pine street, number three hundred and thirteen, south side, between Sansome and Montgomery. They consist of a large main hall, lighted from above by a skylight, a spacious office and reception room for the State Mineralogist, an adjoining room, containing the nucleus of the reference library, a large storeroom, and one serving the double purpose of a chemical laboratory and for the preparation of specimens for the Museum. As it is expressly understood that the building is soon to be torn down and rebuilt, the occupation is considered as temporary, and no cases or fixtures have been or will be constructed which cannot be readily removed. Immediately on taking possession of the Pine street rooms, the following circular was prepared and extensively distributed, not only in California but also in the adjoining States and Territories. Another setting forth briefly the objects and plans of the State Mining Bureau, and containing the full text of the bill, was sent to scientific institutions and individuals, both in the United States and in foreign countries:

CALIFORNIA STATE MINING BUREAU,
Office of State Mineralogist, San Francisco.

DEAR SIR: By an Act of the Twenty-third Legislature there has been established in the City of San Francisco a State Mining Bureau, and a State Mineralogist appointed by the Governor, authorized to carry out the provisions of the law. As it is an institution new to the people, this circular is prepared to set forth the objects and aims of the Bureau, and at the same time to request the co-operation of all who are interested in the development of the mining interests of the State. The law would on first thought seem exclusive, yet its scope is liberal as to the mining interests of "other States, Territories, and countries," as the tax for the support of the institution comes from the stock of the companies operating in the world at large, but who have their transfer and chief offices in the mining metropolis and cosmopolitan city of California. It is proposed to make the State Bureau of Mining a depository of useful and interesting information in every department.

Heretofore, mining in California, and throughout the country generally, has been chiefly confined to the precious metals, while the State and coast at large are rich in many other minerals possessing great economic value in connection with the arts and manufactures. Now that railroads are being built which offer increased facilities for transportation, the utilization of mineral substances hitherto considered worthless, is no longer a problem. Old mines and mining districts that were abandoned because inaccessible, and for want of cheap and rapid transportation, are again attracting attention. As speedily as possible everything bearing on these subjects in the way of practical and reliable information will be gathered into the State Bureau, to which the public will have free access at reasonable hours during every legal day of the year. The State Mineralogist is empowered to employ scientific and practical assistants, as the funds will permit, to operate in the field, and there will be new and interesting matter constantly added, such as maps, statistics, reports, surveys, etc., besides a collection of all the ores, minerals, fossils, rocks, metallurgical products, building stones, etc., of the Pacific Coast, with models of mining machinery in use and newly invented, and a general collection of ores and minerals of other countries for reference. It is intended to include everything that pertains to practical and legitimate mining.

The Bureau will constitute an historical repository, and all maps, reports, volumes of newspapers, copies of district laws and records, however old and seemingly out of date, will be sought for and preserved; many, if not all such documents, will be found to possess value outside of their rarity, involving as they may, questions of title to valuable property, neglected or idle. The Museum of Practical Geology will be made a special feature of the Bureau, and all contributions will be duly accredited, displayed, and preserved. A feature of leading interest will be the procuring and exhibiting of models of mining machinery; all that is interesting, whether old or new, will be carefully preserved and shown. Inventors are specially requested to exhibit models in the rooms of the Bureau, which will also include a reading-room, where the press will be represented, and a reference library of works on mineralogy, geology, metallurgy, and kindred subjects will be collected. The State Mineralogist has secured for an indefinite period the central, commodious, and well appointed rooms formerly occupied by the San Francisco Art Association, No. 313 Pine street, near Sansome, which he will occupy on the first of June. Satisfactory arrangements with the principal transportation and express companies have been made, whereby persons contributing articles of value and interest can forward such without expense to themselves. The law requires that all mineral waters or springs throughout the State be examined, their value and characteristics ascertained, and the information duly published. This will materially increase the interest of the world at large in California as a health resort.

It is desired to make the ethnology of the Pacific Coast a feature of the Museum. All Indian relics, recent or prehistoric, will find a place, and their collection will no doubt throw much light on the ancient history of the State. It is the intention of the Bureau to make sooner or later, a thorough industrial survey of the State. As every county is, to a certain extent, a mining county, all should be represented, and the prominent men of each are requested to see that the State Museum is provided with a full representation of the mineral resources of the county in which they reside. As every article of value sent to the Bureau will become the property of the State for the use and benefit of the public, and will be carefully preserved in the State Museum, and as it is desirable to make it as instructive and attractive as may be, donations of other articles of interest, such as views, pictures, paintings, curiosities, and works of art—in short, anything which would add to the general interest of the Bureau and tend to make the Museum a popular resort for information and study, are solicited. The Bureau commences with a large and valuable donation of ores, rocks, fossils, reports, books, etc., the entire collection and property of the State Geological Society. Miners and prospectors are requested, when new finds are made, for better determination as to value and character, to always accompany ores with samples of the wall and country rocks, with written descriptions of the same. It is desirable that every mine in the State and adjoining States and Territories, which has a name, should be represented in the Bureau.

When anything occurs in the working of the Bureau that is of special or immediate interest, it will be given to the public through the medium of the press. Annual reports to the Governor will be printed for general distribution. These reports should be valuable for permanent reference.

The California State Geological Society was organized in January, 1877, and incorporated under the laws of the State. The following is an extract from the By-Laws of the Society:

Article I—Name. The Society shall be known as the "California State Geological Society."

Article II—Objects. The objects of the Society are:

1. To make a Pacific Coast geological collection, to be offered to the State of California gratis, upon such terms and conditions as the Society may determine, and as may be agreed upon.

2. To encourage the study of geology in all its branches.

Article III—Conditions. Among the conditions which shall be required by the Society before such collection mentioned in the preceding article shall be presented to the State of California, are the following:

The State of California shall provide suitable rooms where the collection may be kept, and shall provide cases to contain the same.

The collection shall remain in the City and County of San Francisco, and shall not be removed therefrom.

It shall always be open to the inspection of the public free of charge, during seasonable hours.

It becoming possible for the State to accept the collection upon these terms by the institution of the State Museum the whole property, including the collection aforesaid and the valuable library, were turned over to the State by the Society. The collection embraces one thousand three hundred and twenty-seven specimens from all parts of the Pacific Coast; many of them are of special value. The library numbers seventy-eight volumes and twenty-five pamphlets, including testimony, arguments, and decisions in the case of the Eureka Consolidated Mining Company vs. Richmond Mining Company, of Nevada, a large volume, of which there were but twelve copies published. The identical specimens used in Court in this important suit are included in the mineral collection, and have been placed in a separate case for ready reference. The collection represents a large amount of labor and money expended in acquisition and preparation of the specimens. The donation is therefore very valuable, and it is to be hoped will be followed by others. The Geological Society retains its organization, but all specimens, publications, and other collections made in the future will revert to the State Museum. The mineral interests of the State were represented at the Paris Exposition of eighteen hundred and seventy-eight. The collections attracted much attention, and won for the State a gold medal. The greater portion was donated to the French Government, in the name of the State of California, and is now in the Museum of the Ecole des Mines, in Paris. The specimens returned to the State after the Exposition naturally came into the possession of the Bureau. Both collections above referred to were delivered to the Mining Bureau packed in boxes. Although partially arranged, it required considerable labor to prepare them for the new Museum. This work was immediately commenced by the State Mineralogist and Lewis G. Larsen, who had been appointed Janitor.

The following is a correct showing of the contents of the cases: Four cases California minerals, two cases California gold ores, one case California silver ores, one case California lead ores and products of lead manufacture, one case California quicksilver ores, one case California chromic iron and products, one case California fossils, five cases California rocks, one case California copper ores and products, two cases Nevada minerals, one case Nevada rocks, one case Nevada ores, one case Nevada ores, Comstock mines; one case Nevada ores, illustrating suit between Eureka Con. and Richmond; one case Oregon and Washington Territory ores, minerals, and fossils; two cases Arizona ores and minerals, two cases ethnological, including Egyptian and other antiquities; two cases foreign minerals, three cases Eastern States minerals and ores, one case foreign paleontology, one case casts of rare fossils, two cases corals and shells, three cases not classified, owing to lack of case room.

On the tenth of June, Mr. Joseph Perkins was appointed Secretary and Accountant. From the commencement specimens of minerals began to come in and a general interest on the part of the citizens became manifest. Correspondence has also gradually increased, and questions on matters within the province of the Bureau are asked and answered daily. On the first of August, Mr. Edward Booth was appointed chemist, and the foundation of a chemical laboratory laid, which should be made in the future the best possible, as this department is of the highest importance. It has been the policy of the Bureau to collect maps of the counties of the State, and geological and mining maps generally, which has resulted in the acquisition of a large number. Some of them are now placed on the walls of the Museum, Library, and Office, for reference. While the work of the Bureau has been in progress several scientific gentlemen have been employed to prepare manuscript for publication on various subjects, all within the requirements of the Mining Bureau bill. The science of geology, to which all others are tributary, is so vast in its scope that no one human mind can fully grasp it in detail. It has been found necessary to divide the science into departments, and in many cases to subdivide into specialties. There are, in California, gentlemen who have devoted their lives to these departments, and to them the special work of the Bureau should be intrusted. Owing to the great amount of time and labor required to institute the Bureau, and to set the

Museum in operation, but little field work has been attempted. The State Mineralogist has, however, found time to visit the locality of "*roscoelite,*" near Coloma, Eldorado County, (a new mineral, of which but little is known), and to commence the study of the valuable iron deposits near Clipper Gap, in Placer County. He also visited a number of limestone quarries in the same county, the granite quarries at Penryn, and at Rocklin, the Thermal Springs, at Calistoga, in Napa County, and a number of mines in the counties of Placer and Eldorado, reports of which will appear in future publications.

In obtaining information relating to mines and mineral deposits in California, care has been taken to obtain the exact locality—section, township and range—with a view to place them eventually on a sectional map of the State. When any new discovery is announced in the columns of the press, or any information obtained otherwise by the Bureau, it has been the custom to write for specimens and more accurate information. Experience has shown that while many are willing to send desired specimens, but few are competent to do so. Many important things are overlooked that would attract the attention of a person of experience. Still the Museum has received many valuable additions by carrying out this plan. When any feature of special interest is thus developed, a memorandum has been made with a view to a thorough personal examination when time and the condition of the funds will permit. There have been many visitors to the Museum, but there is no way of estimating the number. Visitors do not register unless specially requested to do so. When the Museum becomes more important and extensive, there will be an attendant in charge, whose duty it will be to receive visitors, give information, and to keep a general supervision. When this is the case, no person will enter without registering name and residence. There seems to have been an impression that the Museum is a place suited only for mining men, while it is specially desirable that ladies and children, students of both sexes, strangers in the city, and the public generally, should make free use of it.

PART V.

STATISTICS OF AMERICAN COINAGE—HOW MONEY IS MADE —THE MONEY QUESTION—MONEY AND BI-METALISM —GOLD PRODUCTION—RELATIVE VALUES OF GOLD AND SILVER.

PERHAPS that thing among the vital necessities of our daily life about which we know the least is money. That is, for an object so precious and so striven after, it is singular how little is known concerning what it is and how it is made, and what effect it has upon the course of progress from an economic standpoint. The high-sounding platitudes that are constantly being uttered in daily papers upon the question of "remonetization," "double standard," "single standard," "bi-metalism" and "monometalism," are seldom understood by the writers of them, to say nothing of the readers.

In Part V. of the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES we present our readers with the last annual report of the Director of the Mint, the Hon. Horatio C. Burchard, which furnishes a good deal of information concerning coinage, both here and abroad. From Mr. Burchard's report we pass naturally to the silver question, which we endeavor to present clearly. The proceedings of the Assay Commission are also given, and the laws authorizing it. A number of important tables from various sources which supplement the coinage question conclude the part.

THE REPORT OF THE DIRECTOR OF THE MINT.

THE annual report of Horatio C. Burchard, Director of the Mint for the year ending June 30, 1881, contains the following: The bullion and coin received and operated upon during the year, at all the mints and assay offices, including redeposits, contained $193,371,101.01 of gold and $32,854,421.45 of silver, a total $226,225,522.46, exceeding in value the receipts of any previous year by more than $50,000,000. The reports and accounts submitted to this bureau show, during the year, deposits of gold of domestic production, $35,815,036.55; of plate jewelry, and worn coin, $1,784,207.90; and of foreign coin and bullion, $93,233,858; being a total of $130,833,102.45, and thirty-two millions in excess of the gold deposits of last year. The silver bullion deposits and purchases, including partings from gold, amounted at the coining value to $30,791,146.66, of which $28,477,059.21 consisted of domestic bullion, $2,046,576.80 of foreign coin and bullion, and $267,510.65 of plate, jewelry, and American coin. The following table shows the amount and character of the deposits:

	Gold.	Silver.	Total.
Domestic production	$35,815,036 55	$28,477,059 21	$64,292,095 76
United States coin . .	440,776 97	7,307 40	448,084 37
Foreign bullion	37,771,472 26	1,312,144 58	39,083,616 84
Foreign coin	55,462,385 74	734,432 22	56,196,817 96
Old jewelry, plate, &c.	1,343,430 93	260,203 25	1,603,634 18
Total . . .	$130,833,102 45	$ 30,791,146 66	$161,624,249 11

A portion of these deposits were manufactured at the institutions receiving them into bars, which were again deposited or transferred to other institutions for treatment or coinage. The redeposits for this purpose amounted to $62,537,998.56 in gold, and to $2,063,274.79 in silver. At the commencement of the fiscal year the coinage mints and assay offices held $40,724,337.91 of uncoined gold bullion. The deposits of the year, amounting to $130,833,102.45, increased the stock of bullion available for coinage to $171,557,440.36. The value of the total gold coinage of the year was $78,733,864, and of the gold bullion uncoined at its close, $86,548,696.96, a portion of the deposits having been paid in fine bars. The silver coinage amounted to $27,649,966.75, of which $27,637,955 were silver dollars, and 12,011.75 proof silver coins of other denominations. The coinage of gold into smaller denominations than heretofore executed was continued, only $15,345,520 in double eagles having been struck, while the eagles and half eagles amounted to $63,371,230. Nearly all the gold produced on the Pacific coast was deposited and coined at the San Francisco Mint, while the principal part of the gold coined at the Philadelphia Mint consisted of New York Assay Office bars manufactured from imported bullion and coin. The number of pieces and the value of the total coinage were as follows:

	Pieces.	Value.
Gold . .	10,111,115	$78,733,864 00
Silver	27,698,820	27,649,966 75
Minor . .	38,335,665	405,109 95
Total . .	76,145,600	$106,788,940 70

The comparative values of the coinage of gold, silver, and minor coins executed during the fiscal year and the calendar year 1880 are as follows:

	Calendar Year 1880.	Fiscal Year 1881.
Gold	$62,308,279 00	$78,733,864 00
Silver	27,409,706 75	27,649,966 75
Total . .	$89,717,985 75	$106,383,830 75
Minor	391,395 95	405,109 95
Total coinage	$90,109,381 70	$106,788,940 70

The gold coinage of the mints prior to the year 1873 has been grouped and tabulated into three divisions. The first embracing the forty years from the commencement of coinage at the Philadelphia Mint in 1834 to the time of the change in the ratio of gold and silver and the reduced valuation of the gold dollar to correspond therewith, during which period $11,915,890 of gold were coined. The second from 1834 to 1849, when gold from California first began to arrive at the mints, adding $64,425,550 to the gold coinage. The third from 1849 to 1873, during which time $740,564,438.50 were coined. The coinage of silver before 1873 is separated into two periods: The first containing the coinage prior to 1853, during which time all the silver coins amounting in value to $79,213,371.90, were full weight and unlimited legal tender. The second from 1853 to 1873, when fractional silver of reduced weight and limited tender to the amount of $60,389,564.70 was coined on government account; but, although the mints were open to individuals for the coinage of full-weight silver dollars, only $5,538,948 of the latter were coined. Fine, standard, sterling, and unparted bars were manufactured during the year to the value of $100,750,649.94 in gold and $6,542,232.35 in silver. At the New York Assay Office $89,643,135.29 of gold deposits were made into bars for conversion into coin at the mint at Philadelphia. The value of fine gold bars manufactured at the mints and assay offices was $10,041,482.78 and of the unparted bars $1,066,031.87. Of the silver bars $5,857,276.98 were fine, $77,611.39 were standard and sterling, $88,296.45 unparted and $519,047.53 made at the New York Assay Office and transmitted to Philadelphia for coinage. During the year, 11,449,704.19 gross ounces of bullion, containing both gold and silver or base metals, were sent to the acid refineries of the coinage mints and assay office at New York for parting or refining, from which were separated or refined 1,295,443.259 ounces of standard gold and 9,774,730.86 ounces of standard silver. The following table exhibits in detail the gross ounces of bullion sent to the respective refineries and the ounces of standard gold and silver received therefrom:

Ounces.

Mint or assay office.	Gross.	Standard gold.	Standard silver.
Philadelphia	535,770 27	125,700 460	389,617 83
San Francisco . . .	6,507,762 50	612,429 779	5,591,629 12
Carson	525,785 05	27,819 475	607,723 00
New Orleans . . .	13,886 37	2,793 545	11.860 91
New York	3,866,500 00	526,700 000	3,273,900 00
Total	11,449,704 19	1,295,443 259	9,774,730 86

Value.

Mint or assay office.	Gold.	Silver.	Total.
Philadelphia	$ 2,338,613 21	$ 453 373 47	$2,791,986 68
San Francisco . .	11,394,042 40	6,506,622 98	17,900,665 38
Carson	517,571 62	590,804 94	1,108,376 56
New Orleans	51,972 93	13,801 78	65,774 71
New York	9,799,069 76	3,809,629 09	13,608,698 85
Total . .	$24,101,269 92	$11,374,232 26	$35,475,502 18

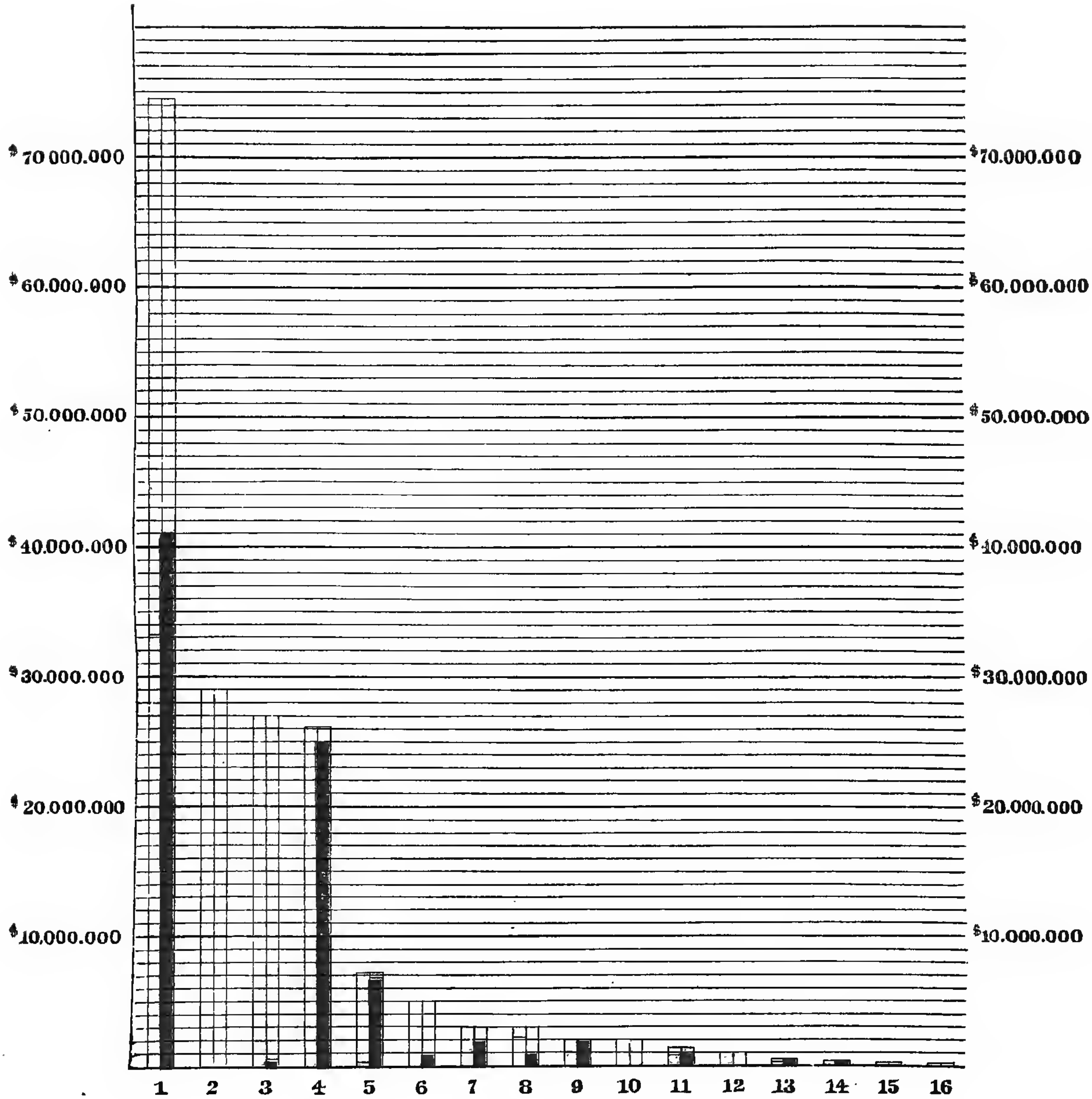
At the commencement of the last fiscal year there were on hand in the coinage mints and New York Assay Office 5,403,980 ounces of standard silver bullion, worth at its coining value, $6,283,613. This bullion in part consisted of 1,750,000 standard ounces procured prior to the passage of the resumption act, under the provisions of section 3545 of the Revised Statutes, and held as part of the bullion fund for the immediate payment of silver deposits in Silver bars. A further portion, amounting to 2,500,000 standard ounces, had been purchased subsequent to January 14, 1875, the date of the resumption act, for the coinage of subsidiary silver, under the provisions of that act, or had been parted from gold or received in payment of charges on silver bullion, under sections 3520 and 3506. The remainder, about 1,400,000 standard ounces, was obtained by direct purchase for the coinage of the standard dollar, or in the settlement for silver parted from gold, and in payment of charges on silver deposits. Notwithstanding the regular monthly coinage of 2,300,000 and upwards of silver dollars, the purchases and deposits had increased the silver bullion on hand January 1, 1881, to 6,553,350 standard ounces, the cost of which was $7,145,487, and its coinage value $7,625,717. Of this amount, 2,928,752.49 standard ounces were at the Philadelphia Mint. The limit of subsidiary coinage having been reached, no necessity existed for keeping on hand any silver for such coinage. It was, therefore, considered advisable by the Secretary of the Treasury to use in the silver-dollar coinage the balance of silver that had been procured for the subsidiary coinage, and to reduce the amount of monthly purchases, especially at the Philadelphia Mint, where, in view of the heavy amount of gold coinage required, it was thought that sufficient silver bullion had already been accumulated for the probable silver coinage of that mint during the remainder of the fiscal year. By including the 2,250,000 ounces of standard silver as belonging to the account of purchased silver, to be used in the coinage of the standard dollar, it became necessary to reduce the amount on hand, so that not more than $5,000,000 above the resulting coinage should be invested in such purchases. The weekly purchases of the department were, therefore much lighter during February and the succeeding months of the year. In the month of May, owing to the higher prices asked and the small amounts offered for delivery at the Pacific coast mints, the weekly purchases of silver bullion were reduced for San Francisco and resumed at the Philadelphia Mint. To enable the Philadelphia Mint to employ as much of its force as possible in the coinage of gold, the monthly allotment of silver coinage for the New Orleans Mint was increased and that for the Philadelphia Mint lessened, and to procure sufficient bullion to execute the required coinage at the New Orleans Mint, the owners of silver bullion were solicited to bid and send their bullion for delivery at that mint.

The prices for delivery in lots of less than ten thousand ounces at the New Orleans Mint were also fixed from time to time by the Director of the Mint, slightly below the equivalent of the London price, and notices of the rates and changes were given to the smelting and refining works in the Western States nearest to the mint, with the hope of inducing them to deliver their silver bullion at New Orleans. Two of these refineries have availed themselves of the advantages of direct shipment, saving the previous expense of double transportation to and from the Atlantic sea-board and benefiting the Government as well as themselves. The purchases during the year, of silver bullion, were 21,904,351.54 standard ounces, at a cost of $22,339,728.67. The silver received for charges and parted from gold and paid for as provided by sections 3520 and 3506 of the Revised Statutes, costing $239,183.05, was 232,568.85 standard ounces, making the total amount purchased 22,136,920.39 standard ounces, at the cost of $22,578,911.72. From the silver purchases of the year and the 2,250,000 standard ounces, directed to be used and carried into the silver purchase account, 23,751,368 standard ounces, exclusive of silver bullion wasted and sold in sweeps, were consumed in the coinage of 27,633,955 standard dollars, being an average monthly coinage of $2,303,166. The London price of silver, during the year, averaged 51$\frac{15}{16}$ pence, which with exchange at par ($4.8665) equals $1.13852 per ounce, and at the New York average monthly price of sight exchange on London (4.847) equals $1.13508 per ounce fine. The New York average price of silver during the year was $1.12957 per ounce fine. The following statement shows the purchases at the coining mints and the New York Assay Office.

Mint or assay office at which delivered.	Purchases.		Partings and received for charges.		Total purchased.	
	Standard ounces	Cost.	Standard ounces.	Cost.	Standard ounces.	Cost.
Philadelphia .	6,322,103 90	$ 6,458,604 34	21,726 01	$ 21,726 01	6,343,829 91	$ 6,480,330 35
San Francisco	10,236,685 17	10,412,523 54	73,373 57	73,629 04	10,309.968 74	10,486,152 58
New Orleans .	4,839,852 28	4,964,753 78	957 11	957 47	4,840,809 39	4,955,711 25
Carson City . .	505,810 19	613,847 01	1 912 89	1,912 89	507,723 08	515,759 90
New York .	. .	. . . .	134,599 27	140,957 64	134,599 27	140,957 64
Total .	21,904,351 54	$22,339,728 67	232,568 85	$239,183 06	22,136,920 39	$22,578,911 72

ANNUAL PRODUCT of the WORLD.

(POLITICAL DISTRIBUTION.)



1. UNITED STATES. 2. AUSTRALIA. 3. RUSSIA. 4. MEXICO. 5. GERMANY. 6. COLOMBIA. 7. AUSTRIA. 8. SOUTH AMERICA, EXCEPTING COLOMBIA AND THE ARGENTINE REPUBLIC. 9. EUROPE, EXCEPTING RUSSIA, GERMANY, AUSTRIA, NORWAY, ITALY AND SWEDEN. 10. AFRICA. 11. JAPAN. 12. BRITISH COLUMBIA. 13. ARGENTINE REPUBLIC. 14. NORWAY. 15. ITALY. 16. SWEDEN.

The areas in old gold indicate gold, those in light blue, silver; the relative totals being shown by the extreme height of each column.

Including the amounts paid out at the mints and exchanged for gold as provided by law, $17,706,924 of the 27,637,955 silver dollar coinage of the year, have been transmitted and distributed. The amount of standard dollars in the mints at the close of the fiscal year, including $2,000,000 received at the New Orleans Mint, and $1,000,000 at the Philadelphia Mint from assistant treasurers, was $23,341,000.60, of which nearly $16,000,000 was in the San Francisco Mint. The coinage and distribution at each mint, as shown by their statements to this bureau, appear in the following table:

	Philadelphia.	*San Francisco.*	*Carson.*	*New Orleans.*	*Total.*
On hand June 30, 1880	$ 875,942	$ 5,469,769	$1,119,700	$2,944,618	$10,410,629
Coinage of year	9,113,955	11,460,000	539,000	6,525,000	27,637,955
Total	$9,989,897	16,929,769	$1,658,700	$9,469,618	$38,047,984
In mints June 30, 1881	* 1,250,802	15,941,135	1,060,991	†5,088,132	23,341,060
Distributed	$9,739,095	$ 988,634	$ 597,709	$ 6,381,486	$17,706,924

* Includes $1,000,000 transferred from the Treasury. † Includes $2,000,000 transferred from the Treasury.

Besides the standard dollars remaining in the mints at the close of the year, considerable amounts had been deposited in the Treasury for the payment of outstanding silver certificates. The following table, compiled from the Treasurer's monthly statements of assets and liabilities, shows in six months' periods from the commencement until the close of the last fiscal year and up to November 1st, 1881, the amount (including that in the mints) in the Treasury, held for the payment of silver certificates and for other purposes and the amount in general circulation:

Period.	*Total coinage.*	*In the Treasury.*			*In circulation.*
		Held for payment of certificates outstanding.	*For distribution.*	*Total.*	
July 1, 1880	$63,734,750	$5,789,569	$38,635,746	$44,425,315	$19,309,435
January 1, 1881	77,453,005	36,127,711	12,062,807	48,190,518	29,262,487
July 1, 1881	91,372,705	39,110,729	23,433,993	62,544,722	28,827,983
November 1, 1881	100,672,705	58,838,770	7,737,608	66,576,378	34,096,327

The total appropriations for the support of the mints and assay offices during the fiscal year ending June 30th, 1881, amounted to $1,178,250, out of which the sum of $1,160,347.71 was expended. In addition $97,311.60 was expended on account of the mints and $7,440.14 at the Treasury Department, a total of $104,751.74 from the appropriation contained in the act of February 28th, 1878, authorizing the coinage of the standard silver dollar.

During the year $255,939.78 was collected from depositors, and $274,784.64 paid on account of parting and refining bullion. The following statement shows the amount collected for parting and refining, and the payments for expenditures in those operations, including that portion of the operative officers' wastages and the loss on sale of sweeps properly chargeable to that fund. A much larger amount, consisting of undeposited refinery earnings of previous years, was deposited in the Treasury to the credit of the appropriation. Included in the payments are expenses for railroad freight incurred in prior years, the bills for which were not rendered until the last fiscal year.

Institution.	*Charges collected.*	*Expenditures.*
Philadelphia Mint	$5,399 89	$9,753 05
San Francisco Mint	161,441 22	170,276 94
Carson Mint	9,008 33	10,397 79
New York Assay Office	80,090 34	84,356 86
Total	255,939 78	274,784 64

The net excess of the earnings of the refineries over the expenses, from the 1st of July, 1876, to June 30, 1881, as shown by the books of the Treasury Department, amounted to $121,238.90.

The commission appointed by the President to test the weight and fineness of the coins reserved for the annual assay, performed the duty at the time designated by law, and the records of their proceedings show that all the coins tested by them were found to be within the limits of exactness required by law, as to weight, and that very few varied from the standard by one-half the tolerance.

As to fineness, the record states that in all cases, both in mass and single pieces, the coins from Philadelphia, San Francisco, and New Orleans were found to be correct, and safely within the limits of tolerance. But the committee on assaying reported that, in the case of the Carson Mint, they found the assay of mass melt of silver to be very low, but within tolerance, and that one single piece showed a fineness below the limits of tolerance. This fact was reported to the President, as required by law.

The assayer of the Mint Bureau, in October, 1880, in his assay of the coins required monthly to be forwarded to the Director for test, had discovered that a silver coin of the Carson Mint, from the coiner's July delivery of that year, was below the legal limit of tolerance. The superintendent of that mint was immediately directed not to pay out, but to retain in his possession all of the coins of that delivery, and to seal up, until further orders, all packages which might contain any of such coins, after selecting and forwarding to the Director sample coins from each package for further test. Ninety-six packages, each containing one thousand dollars, were thus sealed up and reserved for further assays at the bureau, and a special examination made by Andrew Mason, melter and refiner of the New York Assay Office, in conformity with the order of the President to investigate the matter, confirmed the previous assays, and demonstrated that the fineness of a certain bar of bullion, about to be melted for coinage, had been incorrectly stated to the melter and refiner of the Carson Mint, and that ingots of defective fineness made therefrom had afterward passed the assay department of that mint without detection. It did not appear that the error had occurred through the neglect of the assayer's subordinates, and as the assayer himself had died shortly after the first discovery of the defective coinage, it became unnecessary to take any further action, except to order all the coins contained in the 96 packages to be remelted for coinage, which was done.

Estimation of the Values of Foreign Coins.—The values of foreign coins were estimated by the Director of the Mint, and proclaimed by the Secretary of the Treasury on the first of January of the current year, as required by law. The computation of their values was made in the same manner as that of the previous year. No change in the value of the gold coins will be found, excepting that resulting from more accurate information or recent modifications of the law prescribing their weight and fineness. The commercial value of silver bullion for the time the estimation was made having fallen about 1.56 per cent. from its value for a like period of the preceding year, the value of silver coins based on the market rate of silver were correspondingly reduced. The usual examinations and settlements were made at the close of the fiscal year at all the mints and at the New York Assay Office. The magnitude and importance of these settlements are evident when it is known that they covered for the last year transactions and actual transfers between the superintendent and operative officers of gold and silver bullion to the value of $603,230,121, and that bullion and funds amounting at the time of settlement to $128,318,274 were examined, counted, or weighed, and their value ascertained. At each institution the superintendent, after the delivery to him of the bullion in the hands of the operative officers, was, upon taking account of the coin, bullion, and other moneys in his possession, found to hold the amount required by his accounts with the Treasury. The wastage of each of the operative officers was found to be within the legal limit, and the total wastage during the year was, considering the amount received and worked, much less than that of the preceding year. The total amount operated upon in the melter and refiner's department of the mints and the New York Assay Office was, of gold bullion, 16,319,460 standard ounces, on which the legal limit of wastage was 16,319 standard ounces and the actual wastage 1,608 standard ounces, and, of silver bullion, 54,798,707 standard ounces, on which the legal limit of wastage was 82,198, and the actual wastage only 4,453 standard ounces. The amount operated upon in the coining department of the mints was, of gold bullion, 10,514,159 standard ounces, upon which the legal limit of wastage was 5,257 standard ounces, and the actual wastage 367 standard ounces; and of silver bullion, 48,182,982, upon which the legal limit of wastage was 48,183 standard ounces, while the actual wastage was only 4,021 standard ounces, being heavier in gold and less in silver than that of last year. The total wastage during the year was $36,767.14 gold and $8,576.83 silver, a total of $45,343.97, which was no greater than that of the previous year, although three times as much gold was melted. Bullion, however, of the value of $8,406.12 was recovered during the year, from the deposit melting-rooms, and the melter and refiner of the New York Assay Office returned, on settlement, surplus bullion of the value of $24,733.24, making a total of $33,139.36 bullion gained. The net actual loss to the government on the immense amount received, redeposited, and reworked during the year, was only $12,204.16. Loss and wastage in the handling, melting, separating, refining, and coinage of the precious metals is unavoidable. It is contemplated and provided for by law, which limits and authorizes an allowance to be made in favor of the melter and refiner's accounts, to the extent of one thousandth of gold and one and a half thousandths of the silver, and, of the coiner's accounts, one-half thousandth of the gold and one thousandth of the silver delivered to them, respectively, during the year, if the superintendent is satisfied there has been *bona fide* waste of the precious metals. At the last, as well as the preceding settlement, the melter and refiner's gold wastages at the Philadelphia and San Francisco Mints, although far within the legal limits, were heavier than the usual loss of those officers. During the last two years large amounts, aggregating $90,000,000 of foreign coin and bullion, received and melted at the New York Assay Office, were transmitted to the Philadelphia Mint in the form of gold mint-bars alloyed with copper. The melter and refiner of that mint attributed his wastage, in part, to insufficient deductions on these bars for oxide of copper and other adhering impurities, the weight of which would occasion a loss in his accounts, but increase, to a corresponding extent, the surplus at the New York Assay Office, and, therefore, cause no real loss to the government. The melter and refiner's wastage at the San Francisco Mint can, in part, be accounted for by greater deposits during the year of brittle, fine gold bars and unrefined gold bullion, containing refractory and volatile base metals, in the elimination of which loss of gold is a frequent, if not a necessary consequence. How far this cause has operated to produce the wastage of that mint is under consideration; but, as yet, sufficient examination and analysis have not been made of the records and transcripts obtained for a comparison of the character of the deposits and the methods of weighing, assaying, and reporting the fineness of gold bullion, with those of previous years and of other mints and assay offices.

Philadelphia Mint.—On account of the continued heavy import of foreign gold coin and the payment of its value immediately upon assay in American coin, it became necessary to increase the monthly gold coinage at the Philadelphia Mint to supply the Treasury with coin thus paid out. Its gold coinage had averaged previous to the heavy gold import of 1880 less than $10,000,000, but in 1881, besides coining $9,125,966.75 silver and $405,109.95 minor coins, its gold coinage amounted to $49,809,274, and at the close of the fiscal year the mint held $23,023,206.62 of uncoined gold bullion. This increased coinage necessitated the employment of a larger working force and extra hours of labor, and also much heavier purchases of copper and other supplies. By reason of these greater expenditures and in order to execute the monthly silver coinage required by law, it became necessary to make advances to the mint and use during the year $78,712.48 from the appropriation contained in the act authorizing the coinage of the standard silver dollar. The following presents a comparison of the operations of the last and preceding fiscal year:

	1880.	1881.
	Value.	*Value.*
Deposits	$53,309,250 60	$70,651,442 91
	Pieces.	*Pieces.*
Gold coinage	3,789,820	7,275,928
Silver coinage	15,223,400	9,174,820
Minor coinage	26,831,850	38,335,665
Total coinage	45,845,070	54,786,411
	Value.	*Value.*
Gold coinage	$27,639,445 00	$49,809,274 00
Silver coinage	15,194,437 50	9,125,966 75
Minor coinage	269,971 50	405,109 95
Total coinage	43,103,854 00	59,340,350 70
	Value.	*Value.*
Gold bars	$145,200 85	$236,141 78
Silver bars	83,688 67	60,123 09
Total bars	228,889 52	296,264 87
	Standard ozs.	*Standard ozs.*
Gold operated upon by melter and refiner	3,951,316	7,669,139
Silver operated upon by melter and refiner	26,640,003	16,551,054
Gold operated upon by coiner	3,694,227	7,233,415
Silver operated upon by coiner	26,326,668	16,259,728
Gold wastage of melter and refiner	577	352
Silver wastage of melter and refiner	....	1,050
Gold wastage of coiner	....	197
Silver wastage of coiner	3,047	1,869

On the large amount operated upon during the last year the wastage of the melter and refiner was, on gold, 4.5 per cent. of the legal limit of the allowance and 4.2 per cent. on silver, and of the coiner on gold 5.4 per cent., and on silver 11.4 per cent.

San Francisco Mint.—A much larger amount of work was executed at this mint, both in coinage and in the refinery, during the past fiscal year than in 1880, the number of pieces of gold coined being nearly half a million more, and of silver about three and a half millions more. The comparative values of the deposits, number of pieces coined, and bullion operated on in the refinery during the last and preceding years are:

	1880.	1881.
	Value.	*Value.*
Deposits	$39,387,949	$41,959,062 71
	Pieces.	*Pieces.*
Gold coinage	2,284,950	2,774,000
Silver coinage	7,910,000	11,460,000
Total coinage	10,194,950	14,234,000
	Value.	*Value.*
Gold coinage	$28,143,000	$28,500,000
Silver coinage	7,910,000	11,460,000
Total coinage	36,053,000	39,960,000
	Value.	*Value.*
Gold Bars	....	$8,700 55
Silver bars	$2,355,252 07	1,110,045 74
Total bars	2,355,252 07	1,118,746 29
	Standard ozs.	*Standard ozs.*
Gold received from the refinery	524,229	612,429
Silver received from the refinery	4,887,291	5,591,629
Gold operated upon by melter and refiner	2,902,878	3,236,755
Silver operated upon by melter and refiner	15,733,815	22,471,852
Gold operated upon by the coiner	2,918,714	3,230,718
Silver operated upon by the coiner	13,497,415	20,969,005
Gold wastage of the melter and refiner	283	1,228
Silver wastage of the melter and refiner	18,654	2,498
Gold wastage of the coiner	118	168
Silver wastage of the coiner	102	942

At the annual settlement, the melter and refiner's wastage in gold was 40 per cent. of the legal limit of allowance, and his silver wastage was 7 per cent. His silver wastage was much less, but the gold wastage heavier than that of the preceding year. The coiner's gold wastage was 13¾ per cent., and his silver wastage 4½ per cent. of the amount allowed by law. Improvements have been made at this mint in refining bullion by the use of the sulphuric acid process. The charges for parting and refining the higher grades of bullion were, near the beginning of the year, reduced, yet, as a greater amount of bullion requiring to be parted or refined was deposited during the year, the charges collected for these operations exceed those of the preceding year. The expenses of the refinery, however, owing to the large amount of work performed, were slightly increased. Besides this heavier expenditure, the sum of $6,000 was expended in procuring apparatus and fixtures and making the necessary arrangements for operating the sulphuric acid refinery, and nearly $4,000 was paid on account of freight bills of the previous year. These necessary but unusual expenditures made the payments during the year for expenses on account of parting and refining some $8,000 more than the charges collected.

Carson Mint.—Coinage at the Carson Mint, which had been suspended in May, 1880, was resumed July 1, 1880, and was continued from that date until April 1, 1881, during which period $883,590 were coined, when, from lack of sufficient bullion, it was again discontinued, and so remained until the close of the year. The mint, however, was kept open for the reception and purchase of bullion, and payment was made, as usual, on deposits and purchases as soon as the value could be ascertained. No inconvenience or delay was therefore occasioned to depositors or to the mining interests of that portion of the country. The work at this mint during the year compares with that of the previous year, as follows:

	1880.	1881.
	Value.	*Value.*
Deposits	$990,460 39	$1,108,376 65
	Pieces.	*Pieces.*
Gold coinage	39,567	53,189
Silver coinage	408,000	539,000
Total coinage	447,567	592,189
	Value.	*Value.*
Gold coinage	$246,790 00	$344,590 00
Silver coinage	408,000 00	539,000 00
Total coinage	654,790 00	883,590 00
	Standard ozs.	*Standard ozs.*
Gold operated upon by melter and refiner	35,421	49,133
Silver operated upon by melter and refiner	869,478	1,129,355
Gold operated upon by coiner	25,735	40,467
Silver operated upon by coiner	704,486	1,010,406
Gold wastage of melter and refiner	7	24
Silver wastage of melter and refiner	135	249
Gold wastage of coiner	2	3
Silver wastage of coiner	138	148

At the annual settlement the wastages of the operative offices were as follows: of the melter and refiner, on gold, 49.3 per cent. of the legal limit. and on silver, 14.7 per cent.; of the coiner, 15.7 per cent. on gold and 14.7 per cent. on silver. The assayer of the mint, William P. Prescott, died December 5th, 1880, and Josiah M. Hetrich was appointed to the position December 21, 1880 and entered upon duty January 4, 1881.

New Orleans Mint.—The work of this mint has been principally confined to the manufacture of standard silver dollars, for which the demand through the South continued heavy during the year and nearly equalled the coinage. The monthly allotment of silver coinage was raised to 500,000, and occasionally to 600,000 standard dollars, and executed with dispatch and little additional expense under the efficient management of the officers of the mint. The following table exhibits the deposits and purchases of bullion and coinage of the year compared with the fiscal year of 1880:

	1880.	1881.
	Value.	*Value.*
Deposits	$4,599,895 64	$6,439,652 39
	Pieces.	*Pieces.*
Gold coinage	10,525	8,000
Silver coinage	4,430,000	6,525,000
Total coinage	4,410,525	6,533,000
	Value.	*Value.*
Gold coinage	$128,500	$80,000
Silver coinage	4,430,000	6,525,000
Total coinage	4,558,500	6 605,000
	Standard ozs.	*Standard ozs.*
Gold operated upon by melter and refiner	16,325	11,850
Silver operated upon by melter and refiner	7,925,875	9,976,250
Gold operated upon by coiner	15,316	9,564
Silver operated upon by coiner	7,773,352	9,952,845
Gold wastage of melter and refiner	. .	4
Silver wastage of melter and refiner	. . . .	656
Gold wastage of coiner	. . . . .	. . . . .
Silver wastage of coiner	807	1,062

The wastage during the year of the melter and refiner was, on gold, 31.5 per cent. of the legal limit, and on silver 4.3; and of the coiner, nothing on gold, and on silver 10.6 of the legal limit. Notwithstanding the amount of work performed at this mint during the year many necessary repairs were made in the rolling and coining rooms, and to the machinery; and it is expected that other repairs will be completed during the present fiscal year.

New York Assay Office.—The business of the New York Assay Office assumed immense proportions during the year, owing to the continued and increased importation of foreign gold. The gold deposits were the largest in the history of the institution, $91,497,168.61 of the amount being foreign coin and bullion The following table exhibits the value of deposits and bars manufactured at the New York Assay Office during the fiscal year ended June 30, 1880, and June 30, 1881:

Deposits and bars.	1880.	1881.
Gold deposits	68,273,628	$99,635,644 46
Silver deposits	4,491,416	5,285,715 57
Total deposits	72,765,044	104,921,360 03
Gold, fine bars, manufactured	11,378,980	9,805.028 07
Gold, mint bars, manufactured	57,368,761	89,643,135 29
Silver, fine bars, manufactured	4,372,705	4,763,189 08
Silver, sterling bars, manufactured	24,347	1,418 03
Silver, mint bars, manufactured	. . . .	619,047 53
Total bars manufactured	73,144,795	104,731,818 00

There were paid during the year to depositors $99,603,-605.42 in gold coin and bars, and $4,976,641.10 in silver coin and bars, making the aggregate payments $104,580,246,52, and gold bullion of the value of $61,560,816.10 was transferred to the mint at Philadelphia, for conversion into coin. On the annual settlement of his accounts the melter and refiner returned 1,329,100 standard ounces of gold bullion of the value of $24,727,44, and 498 standard ounces of silver bullion, valued at $5.80, in excess of the amounts with which he was charged, having recovered the same in his operations. The aggregate of these sums, $24,733.24, has been deposited in the Treasury of the United States. But, although the amount appears as an earning of the assay office, it is not available for payment of expenses, and was not credited to the appropriation for parting and refining, as, by law, only the charges collected from depositors for parting and refining bullion are authorized to be used for defraying the expenses of those operations.

Denver Mint and Assay Offices at Charlotte, Helena, Boise City and St. Louis.—The assay offices were established for the local convenience and development of the mining interests in their vicinity and to afford miners and those owning, operating and prospecting for mines facilities for ascertaing the value of ores and bullion, and for the exchange of their gold bullion for coin. The work done by each during the year, including the Denver Mint (which, by law, can only be operated as an assay office) was;

	Denver.	*Charlotte.*	*Helena.*	*Boise.*	*Total.*
Gold deposits . .	$235,137 15	$86,919 59	$568,525 13	$163,469 86	$1,059,051 73
Silver deposits . .	3,805 77	6,626 80	84,314 97	2,828 50	81,576 04
Unparted bars mfd	238,942 92	87,546 39	652,840 10	166,298 36	1,145,527 77
Charges collected:					
On deposits .	239 17	133 94	666 05	185 10	1,224 26
On ore assays	921 00	260 35	1,718 00	186 00	3,085 35
Total earnings. . .	1,643 21	995 37	2,551 77	441 69	5,631 88
Total expenses . .	24,968 37	3,750 00	25,163 81	7,940 15	61,821 83

The St. Louis Assay Office was established so near the close of the fiscal year that nothing could be done except to have suitable rooms set apart in the United States building at St. Louis, and to commence fitting them up and procuring the necessary fixtures and apparatus for the use of the office. Mr. E. C. Jewett was appointed assayer July 1, 1881, and has been placed in charge. The appointment of melter was delayed until his services should be required, and the office ready for the reception of bullion.

Coin Circulation of the United States.—In the last annual report of the United States coin was estimated from the amount previously on hand, and the annual coinage and import of United States coin to have been on the 30th of June, 1880, $358,958,691 of gold and $142, 597,020 of Silver. The net gain during last year from coinage and import was, in gold coin, $84,118,062, and in silver coin, $28,937,746. This would make the total circulation of United States coin on the 30th of June, 1881, $443,077,023 gold, and $171,534,766 silver. Heretofore no reduction has been made for coin used in manufactures and the arts, as it was believed that it should be offset by the excess of United States coin brought by immigrants upon their persons above the sums in like manner taken out of the country by travelers; but the circulation of United States gold coin, and its consequent abrasion and use in the arts, have largely increased, while the amount held abroad has, as shown by its diminished import, become depleted, so that much less American coin than heretofore is obtained and brought into the country by immigrants. It seems proper, therefore, that allowance should be made for use in the arts to the extent of the sum reported to this bureau to have been used by manufacturers, which was, for the last fiscal year, in round numbers, $3,300,000 gold, and $75,000 silver. This would reduce the circulation of United States gold coin at the close of the fiscal year to about $440,000,000, and of silver coin to $175,500,000. During the first four months of the current fiscal year there has been a further coinage of $26,544,000 and a net import of $2,172,474 gold, and a coinage of $9,300,000 and net import of $310,858 United States silver coin, making a total gain to the first of November, 1881, in the circulation, of $28,609, 000 gold and $9,600,000 silver. This, added to the amount estimated to be in circulation June 30, 1881, makes the coin circulation of the country, November 1, about $469,000,000 gold and $181,000,000 silver, a total of $650,000,000. At the latter dates the mints and assay office at New York held of bullion $94,075,744 gold and $4,966, 741 silver, swelling the stock of coin and bullion available for coinage to $563,000, 000 gold and $186,000,000 silver, a total of $749,000,000, being a *per capita* of $14.93.

The following table shows the gain in the coin circulation of the United States from June 30, 1880, to June 30, 1881, and to October 31, 1881:

United States coin.	*Gold.*	*Silver.*	*Total.*
Circulation June 30, 1880.	$358,958,691	$142,597,020	$501,555,711
Coinage, less deposits for recoinage.	78,293,087	27,642,660	105,935,747
Net import.	5,824,975	1,295,086	7,130,061
Total.	443,076.753	171534,766	614,611,519
Less amount used in the arts .	3,300,000	75,000	3,375,900
Circulation July 1, 1881.	439,776,753	171,459,766	611,236,519
Coinage to November 1, 1881 . . .	26,544,000	9,300,000	35,844,000
Net imports to November 1, 1881 . . .	*2,172,474	310,858	2,483,332
Circulation November 1, 1881	468,493,227	181,070,624	649,563,851

* Imports for October at the port of New York only.

The coin circulation of the country, according to the reports of the Treasurer for the amount of coin in the Treasury on the 1st of November, and of the Controller of the Currency for the amount held by National banks on the 1st of October, 1881, estimated for other banks, appears to have been held by the banks, Treasury, and private parties as follows:

Held in—	Gold.	*Silver.*		*Total.*
		Legal tender.	*Subsidiary*	
Treasury	$ 76,036,377	* $7,737,608	$25,984,787	$109,758 672
National banks .	102,000,369	3,000,000	2,450,387	107,450,756
Other banks .	20,000,000	} † 89,862,392	51,964,926	432,790,572
Private hands. .	270,963,254			
Total	469,000,000	100,600,000	‡ 80,400,000	650,000,000

* Excess above amount held for payment of outstanding silver certificates.
† Including amount for which silver certificates are outstanding.
‡ Includes $7,000,000 trade dollars.

Deposits and Purchases of Gold and Silver Bullion during the fiscal year ended June 30, 1881.

Description.	*Mints.*					*Assay offices.*				*Total.*
	Philadelphia.	*San Francisco.*	*Carson.*	*Denver.*	*New Orleans*	*New York.*	*Boise.*	*Helena.*	*Charlotte.*	
GOLD.										
United States bullion (domestic production)	$184,062 47	$27,196,124 35	$517,571 62	$ 235,137 15	$2,639 72	$6,875,980 43	$ 163,469 86	$ 556,322 08	$ 83,728 87	$35,815,036 55
United States coin	177,254 16	990 56	. . . . .	. . . . .	7,427 48	254,674 36	. .	. . . . .	430 31	440,776 97
Foreign bullion	44,276 69	368,162 96	. . . . .	. . . . .	2,393 10	37,356,639 51	. . . .	. . . . .	. . . . .	37,771,472 26
Foreign coin	124,240 45	1,128,727 24	. .	. . . .	66,401 34	54,142,529 10	. . . .	. . . . .	487 61	55,462,385 74
Jewelers' bars, old plates, &c	435,485 21	28,534 10	. . . . .	. . . . .	29,171 42	849,015 31	. . . .	. . . . .	1,224 89	1,343,430 93
Total.	965,318 98	28,722,539 81	517,571 62	235,137 15	108,033 06	99,478,838 71	163,469 86	556,322 08	85,871 68	130,833,102 45
Redeposits { Fine bars . .	61,560,816 09	. . . . . .	. . . .	. . . . .	. . . . .	. . . . . .	. . . . .	. . . . .	. . . . .	61,560,816 09
Redeposits { Unparted bars	682,767 03	124,358 73	. . . . .	. . . . .	. . . . .	156,805 75	. . . . .	12,208 05	1,047 91	977,182 47
Total gold received and operated upon	63,208,902 10	28,846,898 04	517,571 62	235,137 15	108,033 06	99,635,644 46	163,469 86	568,525 13	86,919 59	193,371,101 01
SILVER.										
United States bullion, domestic production	6,958,320 51	11,172,525 92	590,805 03	3,805 03	5,029,261 85	4,635,027 41	2,828 50	83,946 77	537 45	28,477,059 21
United States coin . .	4,392 19	1,268 85	. . . .	. .	1,638 70	. . . . . .	. . . . .	. . . .	7 66	7,307 40
Foreign bullion	3,237 05	1,038,398 85	. . . . .	. . . . .	18,281 44	252,227 24	. . .	. . . .	. . . . .	1,312,144 58
Foreign coin, ...	45,798 62	164,370 43	. . . .	. . . . .	402,507 42	121,747 47	. . . .	. . . .	8 28	734,432 22
Jewelers' bars, old plates, &c	54,021 76	1,511 62	. . . . .	. . . . .	25,095 46	179,403 78	. . . . .	. . . . .	70 64	260,203 25
Total.	7,065,770 12	12,378,175 67	590,805 03	3,805 77	5,476,784 87	5,188,405 90	2,828 50	83,946 77	624 03	30,791,146 66
Redeposits. { Fine bars . .	373,828 26	733,633 14	. . . . .	. . . . .	854,834 46	21,556 40	. . . . .	. . . . .	. . . . .	1,983,852 26
Redeposits. { Unparted bars	2,942 43	355 86	. . . . .	. . . .	. . . .	75,753 27	. . . . .	368, 20	2 77	79,422 53
Total silver received and operated upon.	7,442,540 81	13,112,104 67	590,805 03	3,805 77	6,331,619 33	5,285,715 57	2,828 50	84,314 97	626 80	32,854,421 45
Gold and silver deposits and purchases	8,921,089 10	41,106,714 98	1.108,376 65	238,942 92	5,585,817 93	104,667.244 61	166.298 36	640,268 85	85,495 71	161,624,249 11
Redeposits. { Gold	62,243,583 12	124,358 73	. . . . .	. . .	. . . . .	156,805 75	. . .	12,203 05	1,047 91	62,537,998 56
Redeposits. { Silver	376,770 69	733,989 00	. . .	. . . . .	854,834 46	97,309 67	. . . . .	368 20	2 77	2,063,274 79
Total gold and silver received and operated upon	70,651,442 91	41,959,062 71	1,108,376 65	238,942 92	6,439,652 30	104,921,366 03	166,298 36	652,840 10	87,546 39	226,225,522 46

Deposits of Gold of Domestic Production during the fiscal year ended June 30, 1881.

Locality.	Mints.					Assay offices.				Total.
	Philadelphia.	San Francisco.	Carson.	Denver.	New Orleans.	New York.	Boise.	Helena.	Charlotte.	
Alabama	$ 451 26					$ 147 76				$ 599 02
Alaska		$ 1.353 06								1,353 06
Arizona		351,930 46				14,827 98				366,758 44
California	30.064 54	7,439,516 68	$ 75,630 73			20,418 94				7,565,629 89
Colorado	1,103 29			$ 225,535 12		1,687,982 23				1,914,620 64
Dakota	14.687 59			9,602 03		3,385,241 49	$ 208 78			3,409,739 89
Georgia	18,734 59					79,875 61			$19,155 29	117,765 49
Idaho	6,100 35	361,875 30			$1,673 06	65,292 86	111,995 93			545,937 59
Indiana	40 13									40 13
Maryland						190 94				195 91
Montana	2,401 73	24,051 69				808,816 02	669 09	$ 556,322 08		1,462,261 11
Nevada	315 78	103,507 88	441,883 22			161,026 53				706,733 41
New Mexico	4,630 99	776 16				49,534 73				54,940 88
North Carolina	8,200 48					2,847 18			46,999 53	58,047 19
Oregon	5,249 25	723,693 45					50,595 46			779,538 16
South Carolina	313 56								17,574 05	17,887 61
Tennessee	1,358 44					130 88				1,489 32
Utah		15,155 78				6,957 19				22,112 97
Virginia	5,616 20					5,152 80				10,768 00
Washington Territory		27,904 99								27,904 99
Wyoming	4,964 50	359 61	57 67		852 89	380 47				6,615 14
Refined gold		16,157,523 91				151,179 05				16,308,702 96
Parted from silver	4,335 11	1,940,590 14			113 77	376,977 77				2,321,025 79
Other sources	76,494 68	47,878 25								124,372 93
Total gold	184,062 47	27,196,124 35	517,571 62	235,137 15	2,639 72	6,875,980 43	163,469 86	556,322 08	83,728 87	35,815,036 55

Deposits and Purchases of Silver of Domestic Production During the Fiscal Year Ended June 30, 1881.

Locality.	Mints.					Assay Offices.				Total.
	Philadelphia	San Francisco.	Carson.	Denver.	New Orleans.	New York.	Boise.	Helena.	Charlotte.	
Alaska		$50 08								$50 08
Arizona	$2,515 96	3,414,392 68				$227.925 21				3,644,833 85
California	13 31	618,135 75	$9,820 33			9,228 88				637,198 27
Colorado	1 23			$526 18		974,029 30				974,566 71
Dakota	154 68									154 68
Georgia	11 71								$68 78	79 78
Idaho	67 02	24,559 33				52,413 00	$447 11			77,486 46
Michigan (Lake Superior)	2,843 38					40,800 86				43,644 24
Montana	248 20	209,344 08				862,974 02		$83,946 77		1,156,513 07
Nevada	4,866 45	4,634,292 36	580,984 25			108,569 01				5,328,712 07
New Mexico	3 46	17 77				262,191 43				262,212 66
North Carolina	7 80								427 58	435 38
Oregon	28 88	15,280 21				13,969 44				29,278 53
South Carolina	2 13								41 80	43 93
Tennessee	1 99									1 99
Utah		93,526 25				1,157,854 72				1,251,380 97
Vermont						43 50				43 50
Virginia	30 65									30 65
Washington Territory		110 96								110 96
Wyoming	3 69		45							4 14
Refined silver	6,928,536 20	1,497,652 12			$5,028,150 71	813,618 63				14,267,957 66
Parted from gold	16,964 90	48,486 80			1,111 14	111,409 51				177,972 35
Contained in gold				3,279 59			2,381 39			5,660 98
Other sources	2,018 87	616,722								618,741 40
Total silver	6,958,320 51	11,172,525 92	590,805 03	3,805 77	5,029,261 85	4,635,027 41	2,828 50	83,946 77	537 45	28,477,059 21

Coinage Executed During the Fiscal Year Ended June 30, 1881.

Denomination.	Philadelphia.		San Francisco.		Carson.		New Orleans.		Total.	
	Pieces	Value.	Pieces.	Value.	Pieces.	Value.	Pieces.	Value.	Pieces.	Value.
GOLD.										
Double-eagles	2,276	$45,520 00	766,000	$15,300,000 00					767,276	$15,345,520 00
Eagles	2,684,176	26,841,760 00	631,000	6,310,000 00	15,729	$157,290 00	8,000	$80,000 00	3,338,905	33,389,050 00
Half-eagles	4,580,976	22,904,880 00	1,378,000	6,890,000 00	37,460	187,300 00			5,996,436	29,982,180 00
Three dollars	1,566	4,698 00							1,566	4,698 00
Quarter-eagles	3,656	9,140 00							3,656	9,140 00
Dollars	3,276	3,276 00							3,276	3,276 00
Total gold	7,275,926	49,809,274 00	2,774,000	28,500,000 00	53,189	344,590 00	8,000	80,000 00	10,111,115	78,733,864 00
SILVER.										
Dollars	9,113,955	9,113,965 00	11,460,000	11,460,000 00	539,000	539,000 00	6,525,000	6,525,000 00	27,637,955	27,637,955 00
Half-dollars	9,355	4,677 50							9,355	4,677 50
Quarter-dollars	14,555	3,638 75							14,555	3,638 75
Dimes	36,955	3,695 50							36,955	3,695 50
Total silver	9,174,820	9,125,966 75	11,460,000	11,460,000 00	539,000	539,000 00	6,525,000	6,525,000 00	27,698.820	27,649,966 75
MINOR.										
Five cents	3,555	177 75							3,555	177 75
Three cents	1,080,555	32,416 65							1,080,555	32,416 65
One cent	37,251,555	372,515 55							37,251,555	372,515 55
Total minor	38,335,665	405,109 95							38,335,665	405,109 95
Total coinage	51,786,411	59,340,350 70	14,231,000	39,960,000 00	592,189	883,590 00	6,533,000	6,605,000 00	76,145,600	106,788,910 70

Coinage Executed during the calendar year ended December 31, 1880.

Denomination.	Philadelphia.		San Francisco.		Carson.		New Orleans.		Total.	
	Pieces.	Value.	Pieces.	Value.	Pieces.	Value.	Pieces.	Value.	Pieces.	Value.
GOLD.										
Double-eagles	51,456	$1,029,120 00	836,000	$16,720,000 00	. . . .	. . . .	. . . .	. . . .	887,456	$17,749,120 00
Eagles	1,644,876	16,448,760 00	506,250	5,062,500 00	11,190	$111,900 00	9,200	$92,000 00	2,171,516	21,715,160 00
Half-eagles	3,166,436	15,832,180 00	1,348,900	6,744,500 00	51,017	255,085 00	. . . .	. . . .	4,566,353	22,831,765 00
Three dollars	1,036	3,108 00	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	1,036	3,108 00
Quarter-eagles	2,996	7,490 00	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	2,996	7,490 00
Dollars	1,636	1,636 00	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	1,636	1,636 00
Total gold	4,868,436	33,322,294 00	2,691 150	28,527,000 00	62,207	366,985 00	9,200	92,000 00	7,630 993	62,308,279 00
SILVER.										
Dollars	12,601,355	12,601,355 00	8,900,000	8,900,000 00	591,000	591,000 00	5,305,000	5,305,000 00	27,397,355	27,397,355 00
Half-dollars	9,755	4,877 50	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	9,756	4,877 50
Quarter-dollars	14,955	3,738 75	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	14,956	3,738 75
Dimes	37,356	3,735 50	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	37,355	3,735 50
Total silver	12,636,420	12,613,706 75	8,900 00	8,900,000 00	591,000	591,000 00	5,305,000	5,305,000 00	27,459,420	27,409,706 75
MINOR.										
Five cents	19,955	997 75	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	19,955	997 75
Three cents	24,956	748 65	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	24,955	748 65
One cent	38,964,955	389,649 55	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	38,964,955	389,649 55.
Total minor	39,009,865	391,395 95	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	39,009,865	391,395 95
Total coinage	56,541,721	46,327,396 70	11,591,150	37,427,000 00	653,207	957,985 00	5,314,200	5,397,000 00	74,100,278	90,109,381 70

Proof trade dollars, 1,987.

Bars Manufactured during the fiscal year ended June 30, 1881.

Description.	Mints.					Assay offices.				Total.
	Philadelphia.	San Francisco.	Carson.	Denver.	New Orleans.	New York.	Boise.	Helena.	Charlotte.	
GOLD.										
Fine bars	$236,141 78	. . . .	. . . .	. . . .	$312 93	$9,805,028 07	. . . .	. . . .	. . . .	$10,041,482 78
Unparted bars	. . . .	8,700 55	. . . .	$238,416 74	. . . .	. . . .	163,469 86	$568,525 13	86,919 59	1,066,031 87
Mint bars	. . . .	. . . .	. . . .	. . . .	. . . .	89,643,135 29	. . . .	. . . .	. . . .	89,643,135 29
Total gold	236,141 78	8,700 55	. . . .	238,416 74	312 93	99,448,163 36	163,469 86	668,525 13	86,919 59	100,750,649 94
SILVER.										
Fine bars	60,123 09	1,033,964 81	. . . .	. . . .	. . . .	4,763 189 08	. . . .	. . . .	. . . .	5,857,276 98
Standard bars	. . . .	76,080 93	. . . .	. . . .	112 43	1,418 03	. . . .	. . . .	. . . .	77,611 39
Unparted bars	. . . .	. . . .	. . . .	626 18	. . . .	. . . .	2,828 50	84,314 97	626 80	88,296 45
Mint bars	. . . .	. . . .	. . . .	. . . .	. . . .	519,047 53	. . . .	. . . .	. . . .	519,047 53
Total silver	60,123 09	1,110,045 74	. . . .	526 18	112 43	5,283,654 64	2,828 50	84,314 97	626 80	6,542,232 35
Total gold and silver	296,264 87	1,118,746 29	. . . .	238,942 92	425 36	104,731,818 00	166,298 36	652,840 10	87,546 39	107,292,882 29

Statement of Earnings and Expenditures of the United States Mints and Assay Offices for the fiscal year ended June 30, 1881.

EARNINGS.

	Mints.					Assay Offices.				Total.
	Philadelphia.	San Francisco.	New Orleans.	Carson.	Denver.	New York.	Boise.	Charlotte.	Helena.	
Parting and refining charges	$5,399 89	$161,441 22	$200 00	$9,008 33	. . . .	$80,090 34	. . . .	. . . .	. . . .	$256,139 78
Melting, alloy, and bar charges	926 24	4,669 66	632 77	60 65	$239 17	4,513 40	$185 10	$133 94	$666 05	12,016 88
Profits on standard and silver dollars coined	1,079,104 25	1,431,130 65	771,023 73	65,691 36	. . . .	. . . .	. . . .	. . . .	. . . .	3,346,949 99
Profits on subsidiary silver coined	2,120 65	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	2,120 65
Profits on the manufacture of minor coins	274,423 73	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	274,423 73
Profits on the manufacture of medals and proof coins	2,519 06	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	2,519 06
Amount received from assays of ores	228 50	151 00	24 00	16 00	921 00	490 00	186 00	260 35	1,718 00	3,993 85
Grains, fluxes, and sweepings from deposit melting room	1,345 43	1,414 51	215 33	. . . .	462 76	5,430 85	70 69	326 64	77 28	9,343 29
Surplus bullion returned by melter and refiner in settlement	. . . .	. . . .	. . . .	. . . .	. . . .	24,733 24	. . . .	. . . .	. . . .	24,733 24
Grains on bullion shipped the mint for coinage	. . . .	. . . .	. . . .	. . . .	19 28	. . . .	. . . .	241 74	90 38	351 40
Proceeds of sale of old material	811 60	1,251 56	143 00	. . . .	. . . .	. . . .	. . . .	32 80	. . . .	2,239 05
Total	1,366,879 44	1,600,058 50	772,238 83	74,765 34	1,642 21	115,257 83	441 69	995 37	2,551 71	3,934,839 92

EXPENDITURES.

	Philadelphia.	San Francisco.	New Orleans.	Carson.	Denver.	New York.	Boise.	Charlotte.	Helena.	Total.
Salaries of officers and clerks	34,850 00	24,900 00	21,236 88	23,345 61	10,835 80	32,900 00	3,000 00	2,750 00	5,946 73	159,765 02
Wages of workmen	345,061 18	265,296 97	84,938 76	71,606 30	9,998 75	21,776 00	. . . .	. . . .	10,958 66	809,636 62
Contingent expenses, not including wastage and loss on sweeps	111,148 73	86,754 92	40,832 22	22,261 88	4,133 82	8,563 90	4,916 30	1,000 00	8,257 92	287,869 69
Parting and refining expenses, not including wastage and loss on sweeps.	9,574 63	164,108 09	. . . .	10,217 17	. . . .	84,350 86	. . . .	. . . .	. . . .	268,256 75
Expense of distributing standard silver dollars	67,950 61	5,720 77	14,102 55	2,702 34	. . . .	. . . .	. . . .	. . . .	. . . .	90,476 38
Wastage of the operative officers	13,125 41	29,481 90	1,632 94	903 73	. . . .	. . . .	. . . .	. . . .	. . . .	45,343 98
Loss on sale of sweeps	7,362 07	11,126 48	. . . .	. . . .	. . . .	4,437 62	. . . .	. . . .	. . . .	22,926 17
Expense of distributing minor coins	23,763 46	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	23,763 46
Loss on bullion shipped the mint for coinage	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	23 85	. . . .	. . . .	23 85
Total	612,836 09	687,389 13	162,943 46	131,037 03	24,968 37	152,031 38	7,940 15	3,750 00	26,163 31	1,708,061 92

Wastages and Loss on Sale of Sweeps, 1881.

Losses.	*Philadelphia Mint.*	*San Francisco mint.*	*Carson Mint.*	*New Orleans mint.*	*New York assay office.*	*Total.*
Melter and refiner's gold wastage	$6,542 66	$22,863 89	$446 71	$69 64	. . . . . .	$29,922 90
Coiner's gold wastage	3,663 98	3,118 85	59 64	1 87	. . . . . .	6,844 24
Melter and refiner's silver wastage	1,049 67	2,540 97	249 41	672 20	. . . . . .	4,512 25
Coiner's silver wastage	1,869 10	958 19	148 06	1,089 23	. . . . . .	4,064 58
Loss on sale of sweeps	7,362 07	11,126 48	. . . . . .	. . . . . .	$4,437 62	22,926 17
Total	20,487 48	40,608 38	903 72	1,832 94	4,437 62	68,270 14
Paid as follows:						
From contingent appropriation	14,358 38	24,132 36	387 98	. . . . . .	. . . . . .	38,876 72
From parting and refining appropriation	272 47	6,168 85	180 62	62 68	. . . . . .	6,684 62
From profit and loss	. . . . . .	1,414 50	. . . . . .	8 83	4,437 62	5,860 95
From silver profit fund	5,858 63	8,892 67	335 12	1,761 43	. . . . . .	16,847 85
Total	20,487 48	40,608 38	903 72	1,832 94	4,437 62	68,270 14

Statement of the Number of Melts of Ingots made and the number condemned at each mint from 1874 to 1881.

GOLD.

Fiscal years.—	*Philadelphia.*		*San Francisco.*		*Carson.*		*New Orleans.*	
	Number made.	*Number condemned.*	*Number made.*	*Number condemned.*	*Number made.*	*Number condemned.*	*Number made.*	*Number condemned.*
1874	1,204	226	813	6	92	2	. .	.
1875	191	89	925	15	100	. . . .	. .	. . .
1876	260	14	942	6	125	6	. .	. . .
1877	306	13	1,141	3	77	3	. .	. . .
1878	327	2	1,393	19	36	. . . .	. .	. . .
1879	314	7	981	4	15	. . . .	. .	. . .
1880	722	4	931	3	10	. . . .	6	. .
1881	1,328	2	1,033	8	14	. . . .	6	. . .
Total	4,652	307	8,159	61	469	11	14	. . .
Average per year	. . .	6.5.p.ct.	. .	.7 p. ct.	. . .	2.3 p. ct.	. .	.

SILVER.

Fiscal years.—	*Philadelphia.*		*San Francisco.*		*Carson.*		*New Orleans.*	
	Number made.	*Number condemned.*	*Number made.*	*Number condemned.*	*Number made.*	*Number condemned.*	*Number made.*	*Number condemned.*
1874	3,678	401	2,648	10	323	17	. .	. .
1875	2,677	127	4,378	15	2,709	138	. .	. . .
1876	4,429	103	9,454	11	2,996	79	. .	. . .
1877	6,670	62	13,210	8	2,963	46	. .	. .
1878	6,970	57	13,610	14	2,410	14	. .	. . .
1879	7,057	85	12,789	14	1,680	6	195	2
1880	8,646	61	8,104	14	392	2	971	11
1881	5,315	20	12,617	38	555	12	1182	10
Total	45,442	906	76,810	124	14,028	314	2348	23
Average per year	. . .	1.9 p. ct.	. . . .	.1 p. ct.	. . .	2.2 p. ct.	. .	.9 p.ct

Percentage of Coin produced from Gold and Silver operated npon by the Coiners of the mints, 1874 to 1881.

GOLD COIN.

Fiscal year.	*Philadelphia.*	*San Francisco.*	*Carson.*	*New Orleans.*
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
1874	40.1	55	50.4	. . . .
1875	41.5	51	52.7	. . . .
1876	46.1	51.5	53.2	. . . .
1877	41 6	50	52.9	. . . .
1878	41.1	51.2	50.9	. . . .
1879	41.5	53.2	47.7	. . . .
1880	40.2	52.9	51.1	45.1
1881	37.1	48.2	45.7	44.9
Average	41.16	51.62	50.57	45

SILVER COIN.

Fiscal year.	*Philadelphia.*	*San Francisco.*	*Carson.*	*New Orleans.*
1874	42.8	54	51.4	. . . . . .
1875	49.4	52	52.9	. . . .
1876	47.1	49	48.3	. .
1877	47.8	50	52.8	. . . .
1878	48	52.7	48.6	. . . . .
1879	48.2	52.2	45.9	44.9
1880	49.5	51.6	49.7	49.1
1881	48.2	47.8	46.7	56.3
Average	47.62	51.16	49.53	50.1

Gold and Silver of Domestic Production Deposited at the Mints and Assay Offices from their Organization to the close of the fiscal year ended June 30, 1881.

Locality.	*Gold.*	*Silver.*	*Total..*
Alabama	$220,471 97	. . . .	$220,471 97
Alaska	31,225 53	$5 08	31,330 61
Arizona	2,623,500 50	5,761,551 49	8,385,051 99
California	709,624,600 24	2,314,748 72	711,939,348 96
Colorado	37,332,138 18	21,158,446 27	58,400,584 45
Dakota	10,644,852 78	21,276 22	10,666,129 00
Georgia	7,815,847 52	537 98	7,816,385 50
Idaho	24,683,354 70	804,781 96	25,488,136 66
Indiana	40 13	. . . .	40 13
Maryland	593 06	. . . .	593 06
Massachusetts	. . . .	917 56	917 56
Michigan (Lake Superior)	123 99	3,477,319 02	3,477,443 01
Montana	50,141,267 20	5,527,897 19	55,669,164 39
Nevada	15,139,055 96	77,435,742 76	92,574,798 72
New Hampshire	11,020 55	. . . .	11,020 55
New Mexico	1,624,413 02	2,483,697 29	4,108,110 31
North Carolina	10,671,398 29	46,016 71	10,717,415 00
Oregon	16,194,047 73	33,684 91	16,227,732 64
South Carolina	1,419,732 91	74 37	1,419,807 28
Tennessee	85,755 57	1 99	85,757 56
Utah	467,246 58	10,288,337 98	10,755,584 56
Vermont	10,981 27	43 50	11,024 77
Virginia	1,683,436 70	30 65	1,683,467 35
Washington Territory	236,864 36	110 96	236,975 32
Wyoming	723,581 61	11,798 00	735,379 61
Refined bullion	217,364,618 22	57,057,970 43	274,422,588 65
Parted from silver	16,295,800 68	. . . .	16,295,800 68
Contained in silver	9,322,268 97	. . . .	9,322,268 97
Parted from gold	. . . .	6,991,451 19	6,991,451 19
Contained in gold	. . . .	526,284 79	526,284 79
Other sources	10,367,104 26	31,955,945 16	42,323,049 42
Total	1,144,735,442 48	225,898,672 18	1,370,634,114 66

Statement of Coinage from the Organization of the Mint to the Close of the fiscal year ended June 30, 1880.

GOLD COINAGE.

Period.	*Double Eagles.*	*Eagles.*	*Half Eagles.*	*Three Dollars.*	*Quarter Eagles.*	*Dollars.*
1793 to 1795	. . . .	$27,950	$43,535	. .	$2,470 50	. . . . .
1796	. . . . .	69,340	30,980	. . . .	2,147 50	. . . . .
1797	. . . . .	83,230	18,045	. . . .	1,535 00	. . . . .
1798	. . . . .	79,740	124,335	. .	1,200 00	. . . . .
1799	. . . . .	174,830	37,255	. . . .	. . . . . .	. . . . .
1800	. . . . .	269,650	68,110	. .	. . . . . .	. . . . .
1801	. . . . .	292,540	130,030	. .	6,530 00	. . .
1802	. . . . .	150,900	265,880	. .	1,057 50	. . .
1803	. . . . .	89,790	167,530	. .	8,317 50	. . . .
1804	. . . . .	97,950	152,375	. . . .	4,452 50	. . . .
1805	. . . . .	. . . .	165,915	. . . .	4,040 00	. . . .
1806	. . . . .	. . . .	320,465	. . . .	17,030 00	. . .
1807	. . . . .	. . . .	420,465	. . . .	6,775 00	. . . . .
1808	. . . . .	. . . .	277,890	. . . .	. . . . . .	. . . .
1809	. . . . .	. . . .	169,375	. . . .	. . . . . .	. . . .
1810	. . . . .	. . . .	501,435	. . . .	. . . . . .	. . .
1811	. . . . .	. . . .	497,905	. . . .	. . . . . .	. . . .
1812	. . . . .	. . . .	290,435	. . . .	. . . . . .	. . . .
1813	. . . . .	. . . .	477,140	. . . .	. . . . . .	. . . .
1814	. . . . .	. . . .	77,270	. . . .	. . . . . .	. . . .
1815	. . . . .	. . . .	3,175	. . . .	. . . . . .	. . . .
1816	. . . . .	. . . .	. . . .	. . . .	. . . . . .	. . . .
1817	. . . . .	. . . .	. . . .	. . . .	. . . . . .	. . . .
1818	. . . . .	. . . .	242,940	. . . .	. . . . . .	. . . .
1819	. . . . .	. . . .	258,615	. . . .	. . . . . .	. . . .
1820	. . . . .	. . . .	1,319,030	. . . .	. . . . . .	. . . .
1821	. . . . .	. . . .	173,205	. . . .	16,120 00	. .
1822	. . . . .	. . . .	88,980	. . . .	. . . .	. . . .
1823	. . . . .	. . . .	72,425	. . . .	. . . . . .	. . . .
1824	. . . . .	. . . .	86,700	. . . .	6,500 00	. . . . .
1825	. . . . .	. . . .	145,300	. . . .	11,085 00	. . . .

Statement of Coinage from the Organization of the Mint to the Close of the fiscal year ended June 30, 1880.—*Continued.*

GOLD COINAGE.

Period.	*Double-eagles.*	*Eagles.*	*Half-eagles.*	*Three-dollars.*	*Quarter-eagles.*	*Dollars.*
1826			90,345		1,900 00	
1827			124,565		7,000 00	
1828			140,145			
1829			287,210		8,507 50	
1830			631,755		11,350 00	
1831			702,970		11,300 00	
1832			787,435		11,000 00	
1833			968,150		10,400 00	
1834			3,660,845		293,425 00	
1835			1,857,670		328,505 00	
1836			2,765,735		1,369,965 00	
1837			1,035,605		112,700 00	
1838		72.000	1,600,285		137,310 00	
1839		382,480	802,745		170,660 00	
1840		473,380	1,048,360		153,562 50	
1841		656,310	380,725		64,562 50	
1842		1,089,070	655,330		89,770 00	
1843		2,506,240	4,275,425		1,327,132 50	
1844		1,250,610	4,088,275		89,345 00	
1845		736,530	2,743,640		276,277 50	
1846		1,018,750	2,736,155		279,272 50	
1847		14,337,640	5,401,685		482,060 00	
1848		1,813,340	1,863,560		98.612 50	
1849		6,775,180	1,184,645		111,147 50	$936,789
1850	$26,225,220	3,489,510	860,160		895,547 50	511,301
1851	48,043,100	4,393,280	2,651,955		3 867,337 50	3,658,820
1852	44,860,520	2,811,060	3,689,635		3,283,827 50	2,201,145
1853	26,646,520	2,522,530	2,305,095		3,519,615 00	4,384,149
1854	18,052,340	2,305,760	1,513,195	$491,214	1,896,397 50	1,657,012
1855	24,636,820	1,487,010	1,257,090	171,465	600,700 00	824,883
1856	30,277,660	1,484,900	1,751,665	181,530	1,213,117 50	1,788,996
1857	14,056,300	129,160	673,610	38,496	320,465 00	693,532
1858	28,038,300	629,900	772,775	66,177	515,632 50	230,361
1859	16,236,720	146,000	406,710	34,572	213,010 00	259,065
1860	15,458,800	342,130	361,145	61,206	128,980 00	93,215
1861	69,316,420	662,050	452,690	18,216	336,440 00	15,521
1862	36,247,500	972,990	3,287,160	17,355	3,208,122 50	1,799,259
1863	20,387,720	126,580	117,010	117	62,475 00	1,950
1864	21,465,640	85,800	61,500	16,470	23,185 00	6,750
1865	24,879,600	93,750	86,075	10.065	30,502 50	7,225
1866	27,494,900	376,100	300,750	12,090	122,975 00	7,130
1867	27,925,400	61,150	154,475	7,875	73,002 50	6,225
1868	17,705,800	155,500	153,750	14,700	74,125 00	10,550
1869	21,270,500	209,850	228,925	7,575	105,862 50	5,925
1870	22,018,480	89,130	94,625	10.605	35,137 50	9,335
1871	20,919,240	163,250	158,625	4,020	53,400 00	3,940
1872	19,798,500	254,600	243.700	6,090	72,675 00	1,030
1873	34,766,500	204,650	237,525	75	39,062 50	2,525
1874	48,283,900	383,480	809,780	125,460	616,150 00	323,920
1875	32,748,140	699,840	203,655	60	2,250 00	20
1876	37,896,720	153,610	71,800	135	63,052 50	3,645
1877	43,941,700	66,200	67,835	4,464	5,780 00	2,220
1878	51,406,340	155,490	688,680	137,850	408,900 00	1,720
1879	37,234,340	1,031,440	1,442,130	109,182	1,166,800 00	3,020
1880	21,515,360	18,836,320	16,790,860	9,090	3,075 00	3,030
Total	919,754,480	76,730,470	87,334,485	1,556,154	28,374,525 00	19,353,208

Statement of Coinage from the Organization of the Mint, &c.,—*Continued.*

SILVER COINAGE.

Period.	*Trade-dollars.*	*Dollars.*	*Half-dollars.*	*Quarter-dollars.*	*Twenty-cents.*	*Dimes.*	*Half-dimes.*	*Three-cents.*
1793 to 1795		$204,791	$161,572 00				$4,320 80	
1796		72,920	1,959 00	$1,473 50		$2,213 50	511 50	
1797		7,776		63 00		2,526 10	2,226 35	
1798		327,536				2,755 00		
1799		423,515						
1800		220,920				2,176 00	1,200 00	
1801		54,454	15,144 50			3,464 00	1,695 50	
1802		41,650	14,945 00			1,097 50	650 50	
1803		66,064	15,857 50			3,304 00	1,892 50	
1804		19,570	78,259 50	1,684 50		826 50		
1805		321	105,861 00	30,348 50		12,078 00	780 00	
1806			419,788 00	51,531 00				
1807			525,788 00	55,160 75		16,500 00		
1808			684,300 00					
1809			702,905 00			4,471 00		
1810			638,138 00			635 50		
1811			601,822 00			6,518 00		
1812			814,029 50					
1813			620,951 50					
1814			519,537 50			42,150 00		
1815				17,308 00				
1816			23,575 00	5,000 74				
1817			607,783 50					
1818			980,161 00	90,293 50				
1819			1,104,000 00	36,000 00				
1820			375,561 00	31,861 00		94,258 70		
1821			652,898 50	54,212 75		118,651 20		
1822			779,786 50	16,020 00		10,000 00		
1823			847,100 00	4,450 00		44,000 00		
1824			1,752.477 00					
1825			1,471,583 00	42,000 00		51,000 00		
1826			2,002,090 00					
1827			2,746,700 00	1,000 00		121,500 00		
1828			1,537,600 00	25,500 00		12 500 00		
1829			1,856,078 00			77,000 00	61,500 00	
1830			2,382,400 00			51,000 00	62,000 00	
1831			2,936,830 00	99,500 00		77,135 00	62,135 00	
1832			2,398,500 00	80,000 00		52,250 00	48,250 00	
1833			2,603,000 00	39,000 00		48,500 00	68,500 00	
1834			3,206,002 00	71,500 00		63,500 00	74,000 00	
1835			2,676,003 00	488,000 00		141,000 00	138,000 00	
1836		1,000	3,273,100 00	118,000 00		119,000 00	95,000 00	
1837			1,814,910 00	63,100 00		104,200 00	113 800 00	
1838			1,733,000 00	208,000 00		239,493 00	112,750 00	
1839		300	1,717,280 50	122,786 50		229,471 50	106,457 50	
1840		61.005	1,145,054 00	153,331 75		253,358 00	113.954 25	
1841		173,000	355,500 00	143,000 00		363,000 00	98,250 00	
1842		184,618	1,484,882 00	213,250 00		390,750 00	58,250 00	
1843		165,100	3,056,000 00	403,400 00		152,000 00	58,250 00	
1844		20,000	1,885 500 00	290,300 00		7,250 00	32,500 00	
1845		24,500	1,341 500 00	230,500 00		198,500 00	78,200 00	
1846		169,600	2,257,000 00	127,500 00		3,130 00	1,350 00	
1847		140,750	1,870,000 00	280,500 00		24,500 00	63,700 00	
1848		15,000	1,880,000 00	36,500 00		45,150 00	63,400 00	
1849		62,600	1,781,000 00	85,000 00		113,900 00	72,450 00	
1850		47,500	1,341,500 00	150,700 00		244,150 00	82,250 00	
1851		1,300	301,375 00	62,000 00		142,650 00	82,050 00	$186,022 00
1852		1,100	110,565 00	68,265 00		196,550 00	63,025 00	559,905 00
1853		46,110	2,430,354 00	4,146,555 00		1,327,301 00	785,251 00	342,000 00
1854		33,140	4,111,000 00	3,466,000 00		624,000 00	365,000 00	20,130 00

Statement of Coinage from the Organization of the Mint, &c. (*Continued.*)

SILVER COINAGE.

Period.	*Trade-dollars.*	*Dollars.*	*Half-dollars.*	*Quarter dollars.*	*Twenty-cents.*	*Dimes.*	*Half-dimes.*	*Three-cents.*
Brought over								
1855		28,000	2,284,725 00	861,350 00		207,500 00	117,600 00	4,170 00
1856		63,500	1,903,500 00	2,129,500 00		696,000 00	299,000 00	43,740 00
1857		94,000	114,000 00	683,000 00		489,000 00	197,000 00	
1858			4,430,000 00	3,019,760 00		226,000 00	327,000 00	37,980 00
1859		288,500	4,005,500 00	1,428,000 00		229,000 00	195,000 00	41,400 00
1860		600,530	1,627,400 00	330,450 00		98,600 00	96,500 00	16,440 00
1861		559,900	969,650 00	771,550 00		167,300 00	139,350 00	7,950 00
1862		1,750	1,786,425 00	730,937 50		158,405 00	117,627 50	18,256 50
1863		31,400	983,630 00	113,965 00		34,071 00	8,223 00	2,803 80
1864		23,170	483,985 00	22,492 50		14,037 00	4,518 60	11 10
1865		32,900	553,100 00	27,650 00		17,160 00	4,880 00	618 00
1866		58,550	579,525 00	9,712 50		21,065 00	10,732 50	679 50
1867		57,000	897,450 00	18,175 00		13,670 00	435 00	141 00
1868		54,800	946,750 00	37,475 00		73,315 00	24,290 00	120 00
1869		231,350	561,675 00	23,137 00		23,905 00	527 50	151 50
1870		588,308	1,009,375 00	23,047 50		98,185 00	48,222 50	115 75
1871		657,929	1,242,771 00	29,971 75		10,707 50	14,396 25	129 05
1872		1,112,961	1,486,492 50	55,096 25		222,471 50	152,751 75	61 60
1873		977,150	1,189,775 00	174,362 50		419,040 00	175,442 50	25 50
1874	$3 588,900		1,438,930 00	458,515 50		497,255 80		
1875	5,697,500		2,853,500 00	623,950 00	$5,858 00	889,560 00		
1876	6,132,050		4,985,525 00	4,106,262 50	263,560 00	3,639,105 00		
1877	9,162,900		9,740,350 00	7,584,175 00	1,440 00	2,055,070 00		
1878	11,378,010	8,673,500	3,875,255 00	3,703,027 50	142 00	760,891 00		
1879		27,227,500	225 00	112 50		45 00		
1880		27,933,750	3,275 00	3,837 50		1,575 00		
Total	35,959,360	71,780,588	122,748,295 50	38,481,090 00	271,000 00	16,904,207 30	4,906,946 90	1,281,850 20

Period.	*Minor coinage.*					*Total coinage.*			
	Five-cents.	*Three-cents.*	*Two-cents.*	*Cent.*	*Half-cents.*	*Gold.*	*Silver.*	*Minor.*	*Total.*
1793 to 1795				$10,660 33	$712 67	$71,485 00	$370,685 80	$11,373 00	$453,541 80
1796				9,747 00	577 40	102,727 50	79,077 50	10,324 40	192,129 40
1797				8,975 10	535 24	103,422 50	12,591 45	9,510 34	125,524 29
1798				9,797 00		205,610 00	330,291 00	9,797 00	545,698 00
1799				9,045 85	60 83	213,285 00	423,515 00	9,106 68	645,906 68
1800				28,221 75	1,057 65	317,760 00	224,296 00	29,279 40	571,335 40
1801				13,628 37		422,570 00	74,758 00	13,628 37	510,956 37
1802				34,351 00	71 83	423,310 00	58,343 00	34,422 83	516,075 83
1803				24,713 53	489 50	258,377 50	87,118 00	25,203 03	370,698 53
1804				7,568 38	5,276 56	258,642 50	100,340 50	12,844 94	371,827 94
1805				9,411 16	4,072 32	170,367 50	149,388 50	13,483 48	333,239 48
1806				3,480 00	1,780 00	324,505 00	471,319 00	5,260 00	801,084 00
1807				7,272 21	2,380 00	437,495 00	597,448 75	9,652 00	1,044,595 96
1808				11,090 00	2,000 00	284,665 00	684,300 00	19,090 00	982,055 00
1809				2,228 67	5,772 86	169,375 00	707,376 00	8,001 53	884,752 53
1810				14,585 00	1,075 00	501,435 00	638,773 50	16,6[illegible]0 00	1,155,868 50
1811				2,180 25	315 70	497,905 00	608,340 06	2,495 95	1,108,740 95
1812				10,755 00		290,435 00	814,029 50	10,755 00	1,115,219 50
1813				4,180 00		477,140 00	620,951 50	4,180 00	1,102,271 50
1814				3,578 30		77,270 00	561,687 50	3,578 30	642,535 80
1815						3,175 00	17,308 00		20,483 00
1816				28,209 82			28,575 75	28,209 82	56,785 57
1817				39,484 00			607,783 50	39,484 00	647,267 50
1818				31,670 00		242,940 00	1,070,454 50	31,670 00	1,345,064 50
1819				26,710 00		258,615 00	1,140,000 00	26,710 00	1,425,325 00
1820				44,075 50		1,319,030 00	501,680 70	44,075 50	1,864,786 20
1821				3,890 00		189,325 00	825,762 45	3,890 00	1,018,977 45
1822				20,723 39		88,980 00	805,806 50	20,723 39	915,509 89
1823						72,425 00	895,550 00		967,975 00
1824				12,620 00		93,200 00	1,752,477 00	12,620 00	1,858,297 00
1825				14,611 00	315 00	156,385 00	1,564,583 00	14,926 00	1,735,894 00
1826				16,174 25	1,170 00	92,245 00	2,002,090 00	16,344 25	2,110,679 25
1827				23,577 32		131,565 00	2,869,200 00	23,577 32	3,024,342 32
1828				22,606 24	3,030 00	140,145 00	1,575,600 00	25,636 24	1,741,381 24
1829				14,145 00	2,435 00	295,717 50	1,994,578 00	16,580 00	2,306,875 50
1830				17,115 00		643,105 00	2,495,400 00	17,115 00	3,155,620 00
1831				33,592 60	11 00	714,270 00	3,175,600 00	33,603 60	3,923,473 60
1832				23,620 00		798,435 00	2,579,000 00	23,620 00	3,401,055 00
1833				27,390 00	770 00	978,550 00	2,759,000 00	18,160 00	3,765,710 00
1834				18,551 00	600 00	3,954,270 00	3,415,002 00	29,151 00	7,388,423 00
1835				38,784 00	705 00	2,186,175 00	3,443,003 00	39,489 00	5,668,667 00
1836				21,110 00	1,990 00	4,135,700 00	3,606,100 00	23,100 00	7,764,900 00
1837				55,583 00		1,148,305 00	2,096,010 00	55,583 00	3,299,898 00
1838				63,702 00		1,809,595 00	2,333,243 00	63,702 00	4,206,540 00
1839				31,286 61		1,355,885 00	2,176,296 00	31,286 61	3,563,467 61
1840				24,627 00		1,675,302 50	1,726,703 00	24,627 00	3,426,632 50
1841				15,973 67		1,091,597 50	1,132,750 00	15,973 67	2,240,321 17
1842				23,833 90		1,834,170 00	2,332,750 00	23,833 90	4,190,753 90
1843				24,283 20		8,108,797 50	3,834,750 00	24,283 20	11,967,830 70
1844				23,987 52		5,428,230 00	2,235,550 00	23,987 52	7,687,767 52
1845				38,948 04		3,756,447 50	1,873,200 00	38,948 04	5,668,595 54
1846				41,208 00		4,034,177 50	2,558,580 00	41,208 00	6,633,965 50
1847				61,836 69		20,221,385 00	2,379,450 00	61,836 69	22,662,671 69
1848				64,157 99		3,775,512 50	2,040,050 00	64,157 99	5,879,720 49
1849				41,785 00	199 32	9,007,761 50	2,114,950 00	41,984 32	11,164,695 82
1850				44,268 44	199 06	31,981,738 50	1,866,100 00	44,467 50	33,892,306 00
1851				98,897 07	738 36	625,614,492 50	774,397 00	99,635 43	63,488,524 93
1852				50,630 94		56,846,187 50	999,410 00	50,630 94	57,896,228 44
1853				66,411 31	648 47	39,377,909 00	9,077,571 00	67,059 78	48,522,539 78
1854				42,361 56	276 79	25,915,918 60	8,619,270 00	42,638 35	34,577,826 85
1855				15,748 29	282 50	28,977,968 00	3,501,245 00	16,030 79	32,495,243 79
1856				26,904 63	202 15	36,697,768 50	5,135,240 00	27,106 78	41,860,115 28
1857				63,334 56	175 90	15,811,563 00	1,477,000 00	63,510 46	17,352,073 46
1858				234,000 00		30,253,725 50	8,040,730 00	234,000 00	38,528,455 50
1859				307,000 00		17,296,077 00	6,187,400 00	307,000 00	23,790,477 00
1860				342,000 00		16,445,476 00	2,760,920 00	342,000 00	19,557,396 00

Statement of Coinage from the Organization of the Mint, &c. (Continued.)

Period.	Minor Coinage.				Total coinage.				
	Five-cents.	*Three-cents.*	*Two-cents.*	*Cents.*	*Half-cents.*	*Gold.*	*Silver.*	*Minor.*	*Total.*
1861	. . . .	. . . .	. . . .	101,660 00	. . . .	60,693,237 00	2,606,500 00	101,660 00	63,400,597 00
1862	. . . .	. . . .	. . . .	116,000 00	. . . .	45,532,386 50	2,812,401 50	116,000 00	48,560,788 00
1863	. . . .	. . . .	. . . .	478,450 00	. . . .	20,695,852 00	1,174,082 80	478,450 00	22,348,304 80
1864	. . . .	. . . .	$36,450 00	427,350 00	. . . .	21,640,345 00	548,214 10	463,800 00	22,661,359 10
1865	. . . .	$105,930 00	535,600 00	541,800 00	. . . .	25,107,217 50	636,308 00	1,183,330 00	26,926,855 50
1866	$66,240 00	270,270 00	122,980 00	187,080 00	. . . .	28,313,945 00	680,264 50	646,570 00	29,640,779 50
1867	1,562,500 00	133,410 00	69,880 00	113,750 00	. . . .	28,217,187 50	986,871 00	1,879,540 00	31,083,598 50
1868	1,445,100 00	108,390 00	61,330 00	98,565 00	. . . .	18,114,425 00	1,136,750 00	1,713,385 00	20,964,560 00
1869	1,101,250 00	64,380 00	34,615 00	78,810 00	. . . .	21,828,637 50	840,746 50	1,279,055 00	23,948,430 00
1870	487,500 00	42,690 00	22,890 00	58,365 00	. . . .	22,257,312 50	1,767,253 50	611,445 00	24,636,011 00
1871	171,950 00	27,630 00	22,105 00	62,075 00	. . . .	21,302,476 00	1,955,905 25	283,760 00	23,542,140 25
1872	89,200 00	18,330 00	6,170 00	9,320 00	. . . .	20,376,495 00	3,029,834 05	123,020 00	23,529,349 05
1873	352,400 00	34,320 00	. . . .	107,330 00	. . . .	35,249,337 50	2,945,795 50	494,050 00	38,089,183 00
1874	244,350 00	29,640 00	. . . .	137,935 00	. . . .	50,442,690 00	5,983,601 30	411,925 00	56,838,216 30
1875	94,650 00	12,540 00	. . . .	123,185 00	. . . .	33,553,965 00	10,070,368 00	230,375 00	43,854,708 00
1876	132 700 00	7,560 00	. . . .	120,090 00	. . . .	38,178,962 50	19,126,502 50	260,350 00	57,565,815 00
1877	25,250 00	. . . .	. . . .	36,915 00	. . . .	44,078,199 00	28,549,935 00	62,165 00	72,690,299 00
1878	80 00	48 00	. . . .	30,566 00	. . . .	52,798,980 00	28,290,825 50	30,694 00	81,120,499 50
1879	1,175 00	984 00	. . . .	95,639 00	. . . .	40,986,912 00	27,227,882 50	97,798 00	68,312,592 50
1880	1,247 50	982 50	. . . .	267,741 50	. . . .	56,157,735 00	27,942,437 50	269,971 50	84,370,144 00
Total	5,775,502 50	857,104 50	912,020 00	5,608,523 94	39,926 11	1,133,103,322 00	292,333,436 90	13,283,167 05	1,438,719,925 95

Estimate of Values of Foreign Coins.

Country.	*Monetary unit.*	*Standard.*	*Value in U. States money.*	*Standard coin.*
Austria	Florin	Silver	$0 40.7	
Belgium	Franc	Gold and silver	19.3	5, 10 and 20 francs.
Bolivia	Boliviano	Silver	82.3	Boliviano.
Brazil	Milreis of 1,000 reis	Gold	54.6	
British Possessions in North America	Dollar	do	1 00	
Chili	Peso	Gold and silver	91.2	Condor, doubloon, and escudo.
Cuba	do	do	93.2	1/16, 1/8, 1/4, 1/2, and 1 doubloon.
Denmark	Crown	Gold	26.8	10 and 20 crowns.
Ecuador	Peso	Silver	82.3	Peso.
Egypt	Piaster	Gold	04.9	5, 10, 25, 50, and 100 piasters.
France	Franc	Gold and silver	19.3	5, 10, and 20 francs.
Great Britain	Pound sterling	Gold	4 86.6½	½ sovereign and sovereign.
Greece	Drachma	Gold and silver	19.3	5, 10, 20, 50, and 100 drachmas.
German Empire	Mark	Gold	23.8	5, 10, and 20 marks.
India	Rupee of 16 annas	Silver	39	
Italy	Lira	Gold and silver	19.3	5, 10, 20, 50, and 100 lire.
Japan	Yen	Silver	88.8	1, 2, 5, 10, and 20 yen; gold and silver yen.
Liberia	Dollar	Gold	1 00	
Mexico	do	Silver	89.4	Peso or dollar, 5, 10, 25, and 50 centavo.
Netherlands	Florin	Gold and silver	40.2	
Norway	Crown	Gold	26.8	10 and 20 crowns.
Peru	Sol	Silver	82.3	Sol.
Portugal	Milreis of 1,000 reis	Gold	1 08	2, 5, and 10 milreis.
Russia	Rouble of 100 copecks	Silver	65.8	¼, ½, and 1 rouble.
Sandwich Islands	Dollar	Gold	1 00	
Spain	Peseta of 100 centimes	Gold and silver	19.3	5, 10, 20, 50, and 100 pesetas.
Sweden	Crown	Gold	26.8	10 and 20 crowns.
Switzerland	Franc	Gold and silver	19.3	5, 10, and 20 francs.
Tripoli	Mahbub of 20 piasters	Silver	74.3	
Turkey	Piaster	Gold	04.3	25, 50, 100, 250, and 500 piasters.
United States of Colombia	Peso	Silver	82.3	Peso.
Venezuela	Bolivar	Gold and silver	19.3	5, 10, 20, 50, and 100 Bolivar.

Average Monthly Price of Fine Silver Bars at London, &c.

Date.	*Price per ounce British standard, 925 thousandths fine.*	*Equivalent in United States money per ounce fine with exchange at par, $4.86.65.*	*Average monthly price at New York of exchange on London.*	*Equivalent in United States money of fine bar silver, 1,000 fine, based on average monthly London quotations with exchange at average monthly rate.*	*Average monthly New York price of fine bar silver.*
1879.	*Pence.*				
July	51⅝	$1 13.167	$4 87.7	$1 13.412	$1 13.468
August	51 9/16	1 13.030	4 84.5	1 12.534	1 12.600
September	51 9/16	1 13.030	4 84.1	1 12.439	1 12.192
October	52 5/16	1 14.674	4 83.7	1 13.98	1 13.810
November	53⅜	1 17.003	4 83.8	1 16.319	1 16.818
December	52 9/16	1 15.222	4 84.7	1 14.761	1 14.404
1880.					
July	52 11/16	1 15.496	4 86.1	1 15.348	1 15.125
August	52 3/16	1 14.400	4 84.5	1 14.873	1 14.524
September	52 5/16	1 14.674	4 84.3	1 14.246	1 13.376
October	52 3/16	1 14.400	4 84.4	1 13.798	1 12.932
November	51¾	1 13.441	4 83.4	1 12.698	1 11.906
December	51 13/16	1 13.578	4 82.6	1 12.669	1 11.650
1881.					
January	51¼	1 12.345	4 83.6	1 11.821	1 11.604
February	51 13/16	1 13.578	4 85.7	1 13.407	1 12.818
March	52 3/16	1 14.400	4 83.2	1 13.616	1 13.226
April	52 1/16	1 14.126	4 84.7	1 13.697	1 13.019
May	51 11/16	1 13.304	4 87.1	1 13.396	1 13.020
June	51 5/16	1 12.482	4 86.7	1 12.532	1 12.285
Average	51 15/16	1 13.852	4 84.7	1 13.508	1 12.957

Table Showing the Relative Market Value of Gold to Silver, from the Date of the Passage of the Resumption Act by monthly and yearly averages.

[*Based on London price of silver bullion.*]

Date.	1875.	1876.	1877.	1878.	1879.	1880.
January	1 to 16.38	1 to 16.10	1 to 16.35	1 to 17.51	1 to 18.81	1 to 17.96
February	16.41	17.48	16.61	17.31	18.90	18.02
March	16.33	17.66	17.14	17.35	19.02	18.11
April	16.47	17.54	17.36	17.44	18.93	18.13
May	16.61	17.79	17.42	17.63	18.71	18.11
June	16.93	18.49	17.55	17.73	18.13	17.96
July	16.91	19.48	17.42	17.91	18.26	17.90
August	16.74	18.09	17.40	17.91	18.28	17.91
September	16.62	18.25	17.33	18.22	18.28	18.00 18.08
October	16.56	17.95	17.11	18.69	18.02	. . . .
November	16.60	17.43	17.30	18.65	17.66	. .
December	16.72	16.59	17.46	18.86	17.94	
Average	16.606	17.739	17.204	17.934	18.411	18.18

EXPORTS (DOMESTIC.)

Ports.	Gold. Bullion.	Gold. Coin.	Silver. Bullion.	Silver. Coin. Trade dollars.	Silver. Coin. Other.	Total.
NEW YORK.						
July, 1879	649	6,000	307,451			313,100
August, 1879	971	3,325	182,600			186,896
September, 1879	600	108,400	155,612		65,650	330,172
October, 1879		5,650	196,415		82,885	284,950
November, 1879		7,000	135,000		48,053	190,053
December, 1879		381	305,315		67,100	372,796
January, 1880		112,700	245,000		9,350	367,050
February, 1880		12,400	192,000		7,515	211,916
March, 1880	43,667	14,025	108,000		22,525	188,217
April 1880		15,000	15,000			30,000
May, 1880		8,000	95,000		5,000	108,000
June, 1880		25,413	311,500		15,000	351,913
Total	45,787	317,294	2,248,893		323,088	2,935,062
SAN FRANCISCO.						
July, 1879	1,280	39,360	155,009	7,962	21,400	225,011
August, 1879	3,080	26,788	804,622	7,390		841,880
September, 1879	2,645	11,398	629,838	13,325		557,206
October, 1879	13,635	40 230	347,804	11,900	240	413,809
November, 1879	8,615	63,872	192,718	1,406		256,611
December, 1879	8,801	91,800	1,154,738	400	1,000	1,256,739
January, 1880		11,915	419,665		500	432,080
February, 1880	1,367	18,207	269,125	1,000	19,226	308,925
March, 1880	286	14,373	17,700		102,600	134,959
April, 1880	550	31,042	74,001		500	104,093
May, 1880		48,513	669,299		9,000	723,812
June, 1880	1,020	65,534	34,452		21,600	112,606
Total	41,279	443,032	4,663,971	43,383	176,066	6,367,731
ALL OTHER PORTS.						
July, 1879		300,000			1,641	301,641
August, 1879		316,500			670	317,170
September, 1879		8,500			725	9,225
October, 1879		226,311			3,857	230,168
November, 1879		34,762			1,800	36,562
December, 1879		30,822			315	31,137
January, 1880		4,600			20,336	24,936
February, 1880		838			29,368	30,206
March, 1880		2,314			14,426	16,740
April, 1880		500			6,857	7,357
May, 1880		2,500			12,703	15,203
June, 1880					24,755	24,755
Total		927,647			117,453	1,045,100
Total domestic exports	87,066	1,687,973	6,912,864	43,383	616,607	9,347,893

EXPORTS (FOREIGN.)

Ports.	Gold. Bullion.	Gold. Coin.	Silver. Bullion.	Silver. Coin.	Total.
NEW YORK.					
July, 1879	$1,500		$46,703	$162,493	$210,696
August, 1879			199,725	70,923	270,648
September, 1879		$1,000	40,000	144,089	185,089
October, 1879				239,803	239,803
November, 1879		1,750	17,681	458,424	477,855
December, 1879		300		267,058	267,358
January, 1880		96,990	4,500	352,729	454,219
February, 1880		118,800	2,000	274,307	393,107
March, 1880	102,704	989,310		349,481	1,441,495
April, 1880		42,100		122,533	164,633
May, 1880		47,484		323,285	370,709
June, 1880		459,394		203,508	662,902
Total	104,204	1,755,128	310,609	2,968,633	5,138,574
SAN FRANCISCO.					
July, 1879		1,990	13,900	167,490	173,380
August, 1879				212,421	212,421
September, 1879				149,308	149,308
October, 1879				324,730	234,730
November, 1879				146,205	146,205
December, 1879		2,452		251,522	253,974
January, 1880				140,214	140,214
February, 1880				325,913	325,913
March, 1880				205,231	205,231
April, 1880				110,300	110,300
May, 1880				487,747	487,747
June, 1880				102,819	102,819
Total		4,442	13,900	2,613,900	2,632,242
ALL OTHER PORTS.					
July, 1879					
August, 1879				1,325	1,325
September, 1879					
October, 1879					
November, 1879					
December, 1879		212		173	385
January, 1880					
February, 1880					
March, 1880				22,500	22,500
April, 1880					
May, 1880					
June, 1880					
Total		212		23,998	24,210
Total foreign exports	104,204	1,759,782	324,509	5,606,531	7,795,026

Statement of Imports and Exports of Gold and Silver during the fiscal year ended June 30, 1881. (Reported by the Chief of the Bureau of Imports Statistics.)

Ports.		Gold. Bullion.	Gold. Coin. American.	Gold. Coin. Foreign.	Silver. Bullion.	Silver. Coin. American. Trade dollars	Silver. Coin. American. Other.	Silver. Coin. Foreign.	Total.
NEW YORK.	July, 1880	$25,680	$49,603	$82,370	$312	$27	$213,067	$181,213	$552,272
	August, 1880	542,294	159,833	8,300,631	3,239		125,096	341,432	9,472,525
	September, 1880	2,690,854	88,100	15,853,819	1,373		96,699	119,175	18,850,020
	October, 1880	194,160	1,716,887	14,038,372		12,316	97,524	189,276	16,248,535
	November, 1880	2,649,231	2,482,195	3,273,882	2,500	6,689	96,946	737,234	9,248,677
	December, 1880	8,409,791	804,586	6,358,126	42	22,299	77,181	530,422	16,202,447
	January, 1881	3,527,662	58,787	925,346	384	19,466	71,078	120,704	4,723 427
	February, 1881	94,534	64,662	82,336	1,404		87,642	269,037	589,615
	March, 1881	5,495,004	37,953	1,462,697			157,226	155,108	7,307,988
	April, 1881	6,197,766	271,642	8,662,389	2,946		101,707	147,288	16,383,738
	May, 1881	15,731	55,336	1,142,558			105,900	90,048	1,409,573
	June, 1881	9,128	44,086	27,419			105,522	127,941	314,096
	Total	29,851,835	5,823,670	60,209,945	12,200	60,797	1,335,588	3,008,878	100,302,913
SAN FRANCISCO.	July, 1880	14,219	47,017		67,905		6,755	143,551	279,447
	August, 1880	113,439	3,672		60,175		11,954	89,076	278,316
	September, 1880	127,719	6,205		270,516	16,000	13,351	138,583	572,374
	October, 1880	126,784	17,892	139,961	252,946	13,600	32,175	343,065	926,423
	November, 1880	491,108		174,241			12,745	123,700	801,794
	December, 1880	43,875	4,147	112,248	140,282		26,050	147,765	474,367
	January, 1881	30,414	3,190	186,435	209,192	1,000	39,295	336,506	806,332
	February, 1881	49,913	15,591	68,060	201,192		74,252	247,384	646,332
	March, 1881	16,764		53,257	165,452		10,493	188,389	434,355
	April, 1881			150,495	193,630	1,000	5,071	323,683	673,879
	May, 1881	36,779		40,500	164,808		6,085	118,318	366,490
	June, 1881	63,410		150,755	212,029		2,389	35,894	464,477
	Total	1,111,424	98,014	1,065,892	1,938,127	31,600	240,615	2,235,914	6,724,586
ALL OTHER PORTS.	July, 1880	1,233	1,250	22,958	54,097		10,300	123,553	213,391
	August, 1880	3,957	3,063	18,501	20,053		14,925	38,398	98,897
	September, 1880	4,541	62,240	23,520	41,050		6,704	119,444	247,499
	October, 1880	2,552	1,310	18,140	13,813		10,391	154,900	201,106
	November, 1880	2,758	471,542	10,434	4,535		11,466	50,567	551,302
	December, 1880	1,187	725,326	46,740	74,826		39,109	222,701	1,100,889
	January, 1881	2,297	1,690	3,781	53,723		19,445	80,029	160,965
	February, 1881	880	215,300	6,262	23,249		8,873	44,538	299,102
	March, 1881	861	100,210	3,028	23,159		10,718	94,533	232,509
	April, 1881		65,593	4,095	17,780		6,789	54,756	149,013
	May, 1881	11,788	7,406	6,679	22,997		30,604	21,881	100,355
	June, 1881	606	10,808	15,943	8,863		4,526	148,224	183,970
	Total	32,660	1,655,738	179,081	353,145		173,850	1,153,524	3,547,998
	Total imports	30,998,919	7,577,422	61,454,918	2,303,472	92,397	1,750,053	6,398,316	110,575,497

Statement of Imports and Exports, &c.—*Continued.*

EXPORTS (DOMESTIC).

Ports.	*Gold.*		*Silver.*			*Total.*
	Bullion	*Coin.*	*Bullion.*	*Coin.*		
				Trade dollars	*Other.*	
NEW YORK.						
July, 1880		$5,760	$238,000	. .	$41,227	$284,987
August, 1880	. . .	. . .	76,000	. .	. . . .	76,000
September, 1880	.	4,000	71,000	. .	25,581	100,581
October, 1880	. . .	11,100	694,100	. . .	2,100	707,300
November, 1880	. . .	5,500	460,500	. . .	22,500	488,500
December, 1880	. . .	61,600	1,232,320	. . .	17,700	1,311,620
January, 1881	. . .	17,100	855,650	. . .	27,500	900,250
February, 1881	. . .	190,400	815,400	. . .	28,342	1,034,142
March, 1881	. . .	139,100	1,001,800	. . .	52,085	1,192,985
April, 1881	. . .	39,200	1,016,600	. . .	3,458	1,059,258
May, 1881	. . .	8,900	486,200	. . .	500	495,600
June, 1881	50,000	27,559	918,100	. . .	. . . .	995,659
Total	50,000	510,219	7,865,670	. . .	220,993	8,646,882
SAN FRANCISCO.						
July, 1880	816	31,942	67,243	. . .	. . . .	100,001
August, 1880	600	50,961	83,416	. . .	1,000	135,977
September, 1880	9,170	43,623	75,443	. . .	25,000	153,236
October, 1880	7,780	121,291	1,246,557	. . .	. . . .	1,375,628
November, 1880	10,544	164,160	52,347	. . .	500	227,561
December, 1880	3,373	82,381	58,960	. . .	3,000	147,714
January, 1881	500	4,820	304,855	. . .	. . . .	310,175
February, 1881	300	15,610	377,496	$20	15,000	408,426
March, 1881	. . .	21,236	14,800	. . .	2,000	38,036
April, 1881	170	39,069	569,530	. . .	10,000	618,769
May, 1881	600	35,450	865,300	. . .	. . . .	901,350
June, 1881	20	23,343	270,378	. . .	20,000	313,741
Total	33,883	633,886	3,986,325	20	76,500	4,730,614
ALL OTHER PORTS.						
July, 1880	. . .	18,368	. . . .	. . .	1,722	20,090
August, 1880	. . .	15,087	. . . .	. . .	4,258	19,345
September, 1880	. . .	2,000	. . . .	. . .	990	2,990
October, 1880	. . .	27,700	. . . .	. . .	6,582	34,282
November, 1880	. . .	24,500	. . . .	. . .	3,637	28,137
December, 1880	. . .	1,500	. . . .	. . .	7,686	9,186
January, 1881	. . .	4,135	800	. . .	3,817	8,752
February, 1881	. . .	569	200	. . .	20,363	21,132
March, 1881	. . .	. . .	. . . .	. . .	134,774	134,774
April, 1881	. . .	1,000	. . . .	. . .	12,672	13,672
May, 1881	. . .	. . .	. . . .	. . .	45,408	45,408
June, 1881	1,060	502,400	. . . .	. . .	8,220	511,680
Total	1,060	597,259	1,000	. . .	250,129	849,448
Total domestic exports	84,943	1,741,364	11,852,995	20	547,622	14,226,944

Statement of Imports and Exports, &c.—*Continued.*

EXPORTS (FOREIGN).

Ports.	*Gold.*		*Silver.*		*Total.*
	Bullion.	*Coin.*	*Bullion.*	*Coin.*	
NEW YORK.					
July, 1880	. . .	$5,000	. . . .	$168,530	$173,530
August, 1880	. .	24,261	. . .	299,768	324,029
September, 1880	. .	22,121	. . .	121,663	143,784
October, 1880	.	2,000	. . . .	485,743	487,743
November, 1880	.	16,045	. . . .	177,946	193,991
December, 1880	.	. . . .	$55,900	300,442	356,342
January, 1881	.	3,860	. . . .	114,499	118,359
February, 1881	.	64,600	5,400	70,441	140,341
March, 1881	. . .	450	. . . .	103,487	103,937
April, 1881	$2,157	6,997	4,260	134,312	147,726
May, 1881	. . . .	569,548	. . . .	104,950	674,498
June, 1881	. .	12,166	. . . .	30,736	42,902
Total	2,157	726,948	65,560	2,112,517	2,907,182
SAN FRANCISCO.					
July, 1880	. . . .	. . . .	. . . .	135,663	135,663
August, 1880	. . . .	. . . .	. . . .	56,048	56,048
September, 1880	. . . .	. . . .	. . . .	162,218	162,218
October, 1880	. . . .	. . . .	. . . .	218,973	218,973
November, 1880	. . . .	. . . .	. . . .	288,719	288,719
December, 1880	. . . .	9,720	. . . .	187,967	197,687
January, 1881	. . . .	. . . .	. . . .	70,245	70,245
February, 1881	. . . .	. . . .	. . . .	285,815	285,815
March, 1881	. . . .	. . . .	. . . .	59,514	59,514
April, 1881	. . . .	. . . .	. . . .	282,665	282,665
May, 1881	. . . .	. . . .	. . . .	271,538	271,538
June, 1881	. . . .	. . . .	. . . .	120,713	120,713
Total	. . . .	9,720	. . . .	2,140,078	2,149,798
ALL OTHER PORTS.					
July, 1880	. . . .	. . . .	. . . .	6,388	6,388
August, 1880	. . . .	. . . .	. . . .	. . . .	. . . .
September, 1880	. . . .	. . . .	. . . .	3,535	3,035
October, 1880	. . . .	. . . .	. . . .	. . . .	. . . .
November, 1880	. . . .	. . . .	. . . .	. . . .	. . . .
December, 1880	. . . .	. . . .	. . . .	. . . .	. . . .
January, 1881	. . . .	. . . .	. . . .	. . . .	. . . .
February, 1881	. . . .	. . . .	. . . .	107,968	107,968
March, 1881	. . . .	. . . .	. . . .	. . . .	. . . .
April, 1881	. . . .	. . . .	. . . .	. . . .	. . . .
May, 1881	. . . .	. . . .	. . . .	5,532	5,532
June, 1881	. . . .	. . . .	. . . .	. . . .	. . . .
Total	. . . .	. . . .	. . . .	122,923	122,923
Total for'n exports.	2,157	736,668	65,560	4,375,518	5,179,903

Statement by Countries of the Net Imports of American Silver Coin for the Fiscal Year Ended June 30, 1881.

[*From the Report of the Bureau of Statistics.*]

Countries.	*Dollars.*	*Countries.*	*Dollars.*
Central American States	188,184	Mexico	116,701
China	40,279	Dutch West Indies	22,376
Danish West Indies	82,760	Azore, Madeira, and Cape Verde Islands	898
France	1,267	San Domingo	106,214
French possessions, all other	1,783	Cuba	49,659
Germany	90,591	Porto Rico	80,720
England	83,268	United States of Colombia	120,205
Nova Scotia, New Brunswick, and Prince Edward's Island	31,420	Venezuela	75,435
Quebec, Ontario, Manitoba, and the Northwest Territory	6,417	All other countries and ports in South America not elsewhere specified	300
Newfoundland and Labrador	2,679	All other countries and ports in Africa not elsewhere specified	1,850
British West Indies	136,505	Total imports	*1,842,450
British Honduras	3,843	Total exports	†1,842,450
British possessions in Africa and adjacent islands	60,543		1,294,808
Hawaiian Islands	7,800		
Hayti	713,362		
Japan	7,291		

* Includes 82,397 trade dollars. † Includes 20 trade dollars.

Table Exhibiting the Value and Character of the Gold and Silver used in Manufactures and the Arts in the United States During the Fiscal Year Ended June 30, 1881, as Reported by Persons and Firms engaged in the Manufactures named, in Response to Circular Inquiries Addressed from the Bureau of the Mint.

Manufactures.	*Number of letters sent.*	*Number of replies.*	*Number manufacturing.*	*Not replying.*	*Gold.*			
					United States coin.	*Fine bars.*	*Foreign coin, old jewelry, Native grains, &c.*	*Total gold.*
Instruments	197	77	22	120	$1,520	$522	$1,969	$4,011
Chemicals	328	142	17	186	4,851	12,031	1,620	18,502
Leaf and foil	53	28	28	25	95,692	434,927	55,459	586,078
Pens	34	18	9	16	27,111	15,652	3,240	46,003
Plate	390	159	119	231	56,062	41,269	5,527	102,858
Spectacles	229	98	28	131	10,199	22,232	7,260	39,691
Watch-cases	48	17	17	31	593,450	1,795,600	39,309	2,428,359
Jewelry, &c	5,138	1,900	903	3,238	2,526,997	3,849,084	485,140	6,881,221
Total	6,417	2,439	1,143	3,978	3,315,882	6,171,317	599,524	10,086,723

Table exhibiting the Value and Character of the Gold and Silver used in Manufactures and the Arts in the United States, &c.—*Continued.*

Manufactures.	*Silver.**				
	United States coin.	*Fine bars.*	*Foreign coin, old plate, &c.*	*Total silver.*	*Grand totals.*
Instruments	$696	$1,744	$1,188	$3,628	$7,639
Chemicals	17	351,133	27,188	378,338	896,840
Leaf and foil	3,336	22,903	4,344	30,583	616,661
Pens	85	4,027	1,045	5,157	61,160
Plate	788	1,035,241	46,369	1,082,398	1,185,256
Spectacles	1,443	3,303	1,489	6,235	45,926
Watch-cases	4,312	1,418,985	42,944	1,466,241	3,894,600
Jewelry, &c	61,613	290,096	64,232	415,841	7,277,062
Total	72,190	3,127,432	188,799	3,388,421	13,475,144

*Silver calculated at its coining value, 1.16\frac{4}{11}$ per ounce, standard (900 fine).

UNITED STATES ASSAY OFFICE AT NEW YORK,

September 14, 1881.

SIR:—Deposits of gold and silver bullion, for bars which have probably been issued in the arts and manufactures during the fiscal year from July 1, 1880, to June 30, 1881, appears as follows, viz:

	Gold.	*Silver.*
Of foreign coin	$167,368 00	$120,791 00
Of foreign bullion	1,380,416 00	250,207 00
Of domestic bullion	3,653,136 00	4,579,994 00
Of plate, &c	522,918 00	177,940 00
Total	5,723,838 00	5,128,932 00

Very respectfully,

THOS. C. ACTON, *Superintendent.*

HOROLOGICAL PRODUCTIONS OF VARIOUS COUNTRIES.—Watches to the value of $2,135,000 were imported into Great Britain in 1880. From a Swiss journal we learn that in 1880 there were produced at Besançon, France, 146,047 gold and 267,783 silver watches, being 3,860 gold and 26,618 silver watches less than during the preceding year. The total value of this trade for 1880 is estimated at 19,108,170 francs. The falling off in the product is attributed to increased importations of watches from Switzerland into France, the Swiss having been able to reduce the wages of mechanics considerably, owing to the falling off of the American demand for Swiss watches. In 1872 there were imported into the United States 366,000 watches; in 1876 only 75,000. In these four years the industry had been so developed, and its products so cheapened, that we had become large exporters of watches, and could beat the Swiss watchmakers on their own ground. This led the Swiss manufacturers to change their tactics. As the Americans could surpass them in the finer grades of watches, they began to cheapen their productions, and were thus able again to bring up their export trade quite largely, until in 1880 that country excelled her best previous record, her exportations of watches having reached a total value of $2,000,000. There were imported into France in 1880, 32,082 gold and 51,592 silver watches, exceeding by 20 per cent. the importations of 1879. The total number of watches represented in the Geneva trade of 1880 was:

Watches from Besançon	413,832
Watches from other French towns	800
Foreign	83,674
Total	498,306

Formerly, Switzerland sent to France watches to the value of over 4,000,000 francs; but France now sends a large number of watches into Switzerland. The value of the entire clock and watch trade of France in 1880 is estimated at 57,000,000 francs, and something like 60,000 workmen are engaged in this industry, of which the greater part are employed at Besançon. In Paris there are 6,000 watchmakers.

* * * * * * *

According to M. Saûnier, England contributes to this art in money value about one-fifteenth of the production of the world. The following table, showing the total annual manufacture of horological instruments in the various nations, does not give the year covered by the estimate:

France, clocks and watches	$13,000,000
Switzerland, watches	12,000,000
America, clocks and watches	6,400,000
Germany, clocks	5,000,000
England, chronometers and watches	3,200,000
Austria, clocks	2,000,000
Total	41,700,000

—*Watchmaker & Metal Worker.*

Average and Comparative Prices of the Principal Domestic Commodities Exported from the United States from declared values at time of export.

Commodities.		*Average price during month of June—*		*Average price during year ended June 30—*		*Percentage of the prices of year 1880 to prices of the years—*	
		1880.	1881.	1880.	1881.	1870.	1880.
Acids . . .	pound.	$0 2.8	$0 04.2	$0 02.9	$0 03.0	56.5	103.3
Hogs	piece.	5 89.7	11 95.3	5 04.6	7 38.6	46.8	146.3
Horned cattle .	do .	72 34.6	71 19.6	73 01.6	77 02.2	49.3	105.4
Horses	do .	144 61.0	165 89.2	220 63.3	111 07.5	132.7	50.3
Mules . .	do .	90 00.0	76 69.2	102 41.6	110 35.9	78.2	107.7
Sheep	do .	2 50.4	4 51.6	4 26.8	4 23.8	76.2	99.2
Ashes, pot and pearl . .	pound.	07.6	06.3	8.9	8.0	111.1	89.8
Beer:							
In bottles	dozen.	1 74.8	1 38.0	1 78.8	1 77.9	61.3	99.5
In casks	gallon.	37.8	35.7	32.6	27.4	76.7	84.0
Bones and bone-dust .	cwt.	2 68.0	2 50.0	1 42.0	2 68.7	163.3	189.2
Bone-black, lamp-black	pound.	07.4	23 2	5.2	3.2	68.0	61.5
Barley	bushel.	46.5	56.1	69.5	62.0	112.9	89.2
Bread and Biscuit . . .	pound.	4.2	4.3	4.6	4.6	80.7	100.0
Indian corn	bushel.	51.5	56.7	54.2	55.2	59.7	101.8
Indian-corn meal	barrel.	2 78.1	2 90.5	2 79.8	2 92.0	58.3	104.3
Oats	bushel.	42.2	47.2	40.2	43.9	69.7	104.2
Rye	do .	83.6	1 11.5	81.1	97.7	86.3	120.4
Rye-flour	barral.	4 26.0	5 93.8	4 76.4	5 40.8	98.0	113.5
Wheat	bushel.	1 27.3	1 17.2	1 24.3	1 11.3	86.3	89.5
Wheat-flour . . .	barrel.	6 69.9	5 75.4	5 87.6	5 66.9	92.7	96.4
Bricks . . .	M.	8 01.0	7 76.0	7 78.4	8 32.0	74.9	106.8
Candles	pound.	12.1	11.2	12.1	11.8	71.9	97.5
Coal:							
Anthracite	ton.	4 33.0	4 57.4	3 47.1	4 52.6	68 2	130.4
Bituminous	do	3 67.2	2 99.0	3 12.2	3 87.1	82.1	123.9
Copper, pigs and bars	pound.	20.3	16.3	15.6	16.1	92.5	101.9
Cordage, rope, twine . . .	do .	14.3	11.4	11.0	11.5	56.0	104.5
Cotton:							
Sea-island . . .	pound.	25.2	24.6	33.2	29.6	55.1	89.1
Other . .	do .	11.6	10.9	11.5	11.2	47.6	97.4
Colored	yards.	8.0	7.0	7.8	7.3	42.9	93.5
Uncolored	do .	8.6	7.9	8.4	. . .	. . .	. . .
Apples, dried	pound.	7.1	6.1	6.0	5.4	94.9	90.0
Ginseng	do .	1 35.8	1 62.3	1 36.2	1 66.0	174.7	121.1
Glue	do .	15.7	14.3	15.0	16.0	64.0	106.6
Hay	ton.	18 06.4	18 54.3	15 05.3	18 44.3	105.8	122.4
Hemp cables, cordage . . .	cwt.	$11 01.9	$12 91.3	$10 91.4	$11 14.7	73.0	102.1
Hops	pound.	25.3	19.1	26.4	22.4	146.4	84.8
Ice	ton.	2 97.5	3 00.1	2 99.3	2 97.8	73.2	99.5
India-rubber boots, &c . . .	pair	1 95.3	1 46.6	2 00.8	1 40.7	43.3	70.0
Iron:							
Pig	pound.	1.1	1.5	1.8	1.4	87.5	77.7
Bar	do .	3.9	3.7	3.4	3.7	75.0	108.8
Boiler-plate . . .	do .	3.5	5.2	3.5	3.2	69.5	91 4
Railroad bars	do .	1.6	3.7	2.1	2 2	61.1	104.7
Sheet, band, &c.	do .	5.4	3.7	5.2	4.6	85.1	88.4
Car-wheels	piece	9 96.8	10 93.2	7 92.5	. . .	. . .	. . .
Nails and spikes . . .	pound.	3.6	3.3	3.9	3 4	59.6	87.1
Steel, ingots.	do .	14.4	11.4	11.5	10.8	90.7	93.9
Leather, sole and upper . .	do .	22.1	20.2	23.2	22.5	79.2	96.9
Boots and shoes	pair.	1 17.7	1 25.4	1 16.6	1 26.3	83.1	108.3
Lime and cement . . .	barrel.	1 30.5	1 52.0	1 25.2	1 45.2	73.5	115.9
Rosin and turpentine . . .	do .	2 70.5	2 81.1	2 27.6	2 47.0	81.1	108.5
Tar and pitch . . .	do .	2 15.9	2 51.2	2 05.5	2 34.1	77.3	113.9
Oil cake	pound	1.3	1.5	1.3	1.4	69.0	107.6
Mineral oil, crude . . .	gallon	7.7	7.4	6.8	7.6	36.8	111.7
Naphthas, Benzine, &c.	do .	6.6	9.2	6.4	9.8	94.2	153.1
Illuminating oil	do .	9.2	9.0	8.6	10.3	33.7	119.7
Lubricating oil .	do .	21.0	21.7	20.2	21.7	. . .	107.9
Lard oil	do	54.0	77.8	54.1	66.7	48.5	123.2
Neat's-foot oil	do .	79.2	63.5	77.4	77.8	60.0	100.5
Sperm oil	do .	1 02.2	86 6	1 01.0	96.4	60.6	95.4
Whale oil	do .	35.9	42 5	34.1	38.2	52.0	112.0
Cotton-seed oil. .	do	44.6	30.5	46.0	45 0	.	99.8
Linseed oil . .	do .	78.0	67.4	81.2	67 1	63.4	82.6
Gunpowder . . .	pound.	13 4	16 7	14.7	16.2	103.1	110.2

Average and Comparative Prices, &c.—(*Continued.*)

Commodities.		*Average price during month of June—* 1880.	1881.	*Average price during year ended June 30—* 1880.	1881.	*Percent. of the prices of year 1881 to prices of the years—* 1870.	1880.
Bacon and hams	pound.	6.8	9.0	6.7	8.1	51.5	120.8
Fresh beef	do.	8.6	9.6	8.7	9.3	129.1	106.8
Salted beef	do.	6.4	7.6	6.3	6.5	147.7	103.1
Butter	do.	17.5	17.2	17.0	19.8	67.5	116.4
Cheese	do.	11.4	10.1	9.5	11.0	71.8	115.7
Eggs	dozen.	11.8	17.3	16.4	17.1	43·2	104.2
Fish:—Dried	cwt.	3 96,9	4 21.5	4 11.9	3 95.2	76.1	95.9
Pickled	barrel.	5 29.7	5 58.1	5 23.1	5 08.1	62.0	97.1
Lard	pound.	7.4	10.9	7.4	9.3	56.3	125.6
Mutton, fresh	do.	6.9	8.1	7.5	7.8	...	104.0
Pork	do.	6.3	8.1	6.1	7.6	55.8	124,6
Onions	bushel.	1 43.9	1 02.9	90.7	1 29.6	77.3	142.8
Potatoes	do.	76.5	79.5	74.9	72.0	103.3	94.1
Quicksilver	pound.	38.3	38.6	38.0	41.4	101.9	108.9
Rags	do.	1.4	2.0	1.8	2.0	22.4	111.1
Rice	do.	7.0	6.1	7.2	6.6	111 8	91.6
Salt	bushel.	41.0	1 30.7	29.8	33.1	82.5	111.1
Cotton seed	pound.	.8	1.0	1.1	1.3	...	118.1
Soap	do.	4.4	5.0	4.7	4.8	60.0	102.1

Average and Comparative Prices, &c.—(*Continued.*)

Commodities.		*Average price during the month of June—* 1880.	1881.	*Average price during year ended June 30—* 1880.	1881.	*Percent. of the prices of year 1881 to prices of the years—* 1870.	1880.
Spermaceti	pound	20.1	19.6	22.7	34.1	103.6	150.2
Spirits:—Grain	gallon.	20.0	21.4	25.5	20.6	100.1	80.7
Molasses	do.	33.1	34.9	30.9	35.4	47.3	114.5
Spirits turpentine	do.	27.4	37.7	30.0	35.0	83.7	116.6
Starch	pound.	4.8	4.6	4.3	4.6	56.0	160.9
Sugar:—Brown	pound.	6.8	18.1	6.3	8.1	72.3	128.5
Refined	do.	9.2	8.9	9.0	9.2	73.6	102.2
Molasses	gallon.	21.1	21.2	15.0	24.7	82.3	164.6
Tallow	pound.	6.7	6.3	6.2	7.0	69.3	112.9
Tobacco, leaf	do.	8.9	8.9	7.5	8.2	72.6	109.3
Varnish	gallon	2 61.8	2 22.7	2 11.6	1 79.5	113.1	84.8
Wax, bees	pound.	33.1	27.4	25.2	24.5	61.8	97.2
Boards, planks	M. feet.	15 84.3	18 34.8	14 80.8	16 19.7	78.1	109.3
Timber, sawed	cubic feet.	14.1	15.8	13.5	14.5	84.8	107.4
Wool, raw	pound	16.7	...	37.5	26.8	74.6	71.4
Zinc:—Ore	cwt.	3 60.0	1 60.5	3 22.7	1 44.0	27.0	44.6
Plates, bars	pounds.	8.9	8.8	8.7	8.9	92.7	102.3
Average		...	...	...	...	77.3	105.3

Table showing the Annual Average Gold and Currency Prices of Staple Articles in the New York Market from 1825 to 1880, and the Mean Gold Price of each for the Whole Period.

[Currency prices in black figures.]

Date.	*Flour.* *Sup'rfine*	*Flour.* *Western.*	*Rye Flour.*	*Corn Meal.*	*Wheat.* *Northern*	*Wheat.* *Western.*	*Rye.*	*Oats.*	*Corn.*	*Barley.*	*Candles* *Mould.*	*Candles* *Sperm.*	*Coal.* *Anthracite.*	*Coal.* *Liverpool.*	*Coffee.* *Rio.*	*Coffee.* *Java.*	*Copper pig.*
	Per bbl.	*Per bbl.*	*Per bbl.*	*Per bbl.*	*Per bush*	*Per bush*	*Per bush.*	*Pr. bush.*	*Pr. bush.*	*Per bush*	*Pr. lb.*	*Pr. lb.*	*Pr. ton.*	*Pr. chald*	*Pr. lb.*	*Pr. lb.*	*Pr. lb.*
1825	$5 13,0	$3 79.5	$2 93.0	$2 88.0	$0 92.0	...	$0 53.8	$8 31.7	$) 55.0	...	$0 11.5	$0 34.0	$9 16.5	$12 10.0	$8 17.0	$0 19.4	$0 20.0
1826	4 81.0	4 86.0	3 66.0	3 90.5	94.0	...	70.7	47.5	76.5	...	12.2	33.0	10 91.5	10 91.5	15.0	16.6	18.5
1827	5 14.0	5 33.5	3 53.5	3 24.5	99.2	...	68.0	40.5	61.0	...	13.0	20.0	11 33.5	10 44.5	14.2	16.1	17.8
1828	5 58 0	5 74.0	2 98.0	2 88.0	1 21.8	...	53.6	30.0	52.5	...	11.7	26.0	10 91.5	11 40.5	13.0	15.0	18.1
1829	6 45.2	6 72.5	3 76.0	2 77.0	1 24.5	...	66.0	35.5	56.5	...	10.5	23.0	10 72.5	11 15.5	12.3	14.4	18.2
1830	4 98.5	5 31.0	3 39.5	2 75.0	1 07.0	...	65.0	29.5	56.0	...	09.6	23.0	9 05.0	9 43.5	11.2	14.0	17.7
1831	5 71.0	6 01.0	3 97.2	3 60.5	1 18.5	...	78.2	37.5	69.5	...	11.2	28.0	7 08.5	10 20.5	11.2	11.5	18.0
1832	5 77.0	6 23.5	4 44.0	3 44.5	1 26.0	...	83.0	45.5	68.0	...	12.5	31.5	10 21.0	12 02.0	12.5	13.1	17.5
1833	5 56.5	5 89.0	3 93.0	3 85.0	1 19.3	...	80.0	40.5	73.5	...	12.6	33.5	6 82.0	10 16.0	12.3	12.7	16.5
1834	4 98.0	5 2[illegible].5	3 44.0	3 45.0	1 05.8	...	66.2	35.7	65.9	...	12.1	30.6	6 00.0	9 12.0	11.5	12.3	16.2
1835	5 85.5	6 23.0	4 39.5	4 07.5	1 22.0	...	91.0	48.2	90.5	...	11.3	32.3	6 71.0	9 59.5	11.9	12.5	16.5
1836	7 49.5	8 12.0	5 81.0	4 72.0	1 78.0	...	1 04.0	52.9	95.0	...	12.5	33.5	8 54.5	10 97 5	11.5	13.2	20.5
1837	8 74.7	9 64.0	...	4 66.5	1 69.8	...	1 07.6	50.2	1 00.0	...	12.5	30.6	9 26.3	10 12.5	10.1	13.0	17.7
	9 14.0	**10 08.0**	...	**4 87.5**	**1 77.5**	...	**1 12.5**	**52.5**	**1 04.5**	...	**13.1**	**32.0**	**9 68.0**	**10 58.0**	**10.6**	**13.6**	**18.5**
1838	7 88.4	...	5 13.8	3 82.5	1 90.2	...	1 03.6	39.1	83.4	...	14.8	32.0	7 81.9	10 26.0	10.3	12.2	16.8
	7 95.6	...	**5 18.5**	**3 86.0**	**1 92.0**	...	**1 04.5**	**39.5**	**84.2**	...	**15.0**	**32.3**	**7 89.0**	**10 36.0**	**10.4**	**12.4**	**17.0**
1839	7 30.0	...	4 83.5	4 04.0	1 24.5	...	96.8	47.0	86.5	...	15.0	39.5	8 10.0	10 15.5	10.8	12.5	17.5
1840	5 29 5	...	3 15.5	3 22.5	1 05.5	...	59.8	34.0	67.0	...	12.8	39.5	7 14.5	8 26.0	10.1	12 8	18.2
1841	5 58.5	...	3 36.5	3 10.0	1 18.5	...	63.8	44.0	62.5	...	12.5	37.8	7 56.0	8 67.5	10.0	11.7	18.0
1842	5 57.0	...	3 52.5	2 72.0	1 14.0	...	65.5	36.5	59.5	...	10.5	28.0	6 35.0	6 93.5	08.3	11.0	17.0
1843	4 85.5	...	3 17.5	2 76.5	98.1	...	62.1	29.0	65.0	...	10.1	25.5	5 11.0	7 97.5	07.2	11.0	17.0
1844	4 67.0	...	3 22.0	2 60.0	97.5	...	67.5	31.8	60.0	...	10.5	30.3	6 06.0	8 61.5	06.5	10.0	17.5
1845	4 93.5	...	3 36.0	2 70.5	1 04.0	...	68.5	38.0	64.8	...	10.1	28.0	4 83.0	9 30.5	06.7	08.2	17.2
1846	5 96.0	...	3 60.5	3 55.0	1 08.5	...	74.6	39.5	68.0	...	10.0	27.0	5 72.5	7 58.0	07.0	08.3	17.8
1847	6 68.5	...	4 82.5	4 19.5	1 36.5	...	99.0	49.0	85.5	...	11 0	30.0	5 70.5	7 84.5	07.0	07.7	18.1
1848	5 96.0	...	3 75.5	2 86.0	1 17.5	...	73.5	41.4	63.5	...	12.3	31.5	5 39.0	8 72.0	06.0	07.1	18.0
1849	4 51·	...	3 05.0	2 95.0	1 24.0	...	60.1	38.7	62.7	...	11.5	85.0	5 69.0	8 29.0	06.9	06.6	17.1
1850	5 56.0	...	2 99.0	2 97.0	1 27.5	...	64.7	43.0	62.5	...	11.5	41.5	5 73.0	8 31.5	10.6	12.0	17.2
1851	4 52.0	...	3 47.5	3 08.5	1 07.5	...	73.0	43.5	61.7	...	11.5	44.0	5 22.0	7 43.0	09.0	11.5	17.5
1852	5 00.5	...	3 60.5	3 43.5	1 10.5	...	81.5	43 0	67.5	...	11.6	39.5	5 44.5	7 99.5	08.5	10.8	19.5
1853	6 78 0	...	4 15.0	3 42.5	1 39.0	...	92.0	47.5	71.0	...	12.2	31.8	5 72.0	9 63.5	09.2	11.2	23.6
1854	8 94.5	...	5 86.5	00.0	2 21.0	...	1 19.5	54.0	84.5	...	14.5	29.4	6 91.5	11 18.0	10.1	13.1	29.3
1855	8 76.0	...	6 66.0	4 64.5	2 43.6	...	1 33.6	59.5	99.0	...	14.8	32.0	6 36.0	8 32.0	10.0	13.5	24.0
1856	6 42.0	...	3 95.5	3 54.6	1 75.5	...	96.0	43.2	70.5	...	14.2	39.0	6 87.5	7 81.0	10.7	14.2	25.0
1857	5 78,5	...	4 09.5	3 62.5	1 67.5	...	94.0	52.6	81.0	...	12.0	41.5	6 11.0	7 69.5	11.0	15.4	24.7
1858	4 29.5	...	3 23.5	3 60.0	1 32.5	...	72.0	45.0	80.5	...	...	39.5	5 22.5	7 34.0	10.3	16.8	23.2
1859	5 11.0	...	3 81.0	3 89 0	1 43.5	...	85.5	48.0	86.2	...	...	40.7	6 31.0	7 97.0	11.2	14.5	...
1860	5 19.0	...	3 67.5	3 67.5	1 49.5	...	82.5	41.7	74.0	...	...	[illegible]7.7	5 52.0	8 87.0	13.5	15.5	...
1861	4 69.5	...	3 17.0	2 88.0	1 42.5	...	70.0	35.5	61.0	...	...	31.0	5 24.5	6 19.5	13.7	17.5	...
1862	4 56.0	...	3 26.7	2 80.3	1 29.7	...	70.1	42.3	65.2	...	...	25.6	6 02.8	5 34.6	19.4	23.9	...
	5 16.5	...	**3 70.0**	**3 17.5**	**1 30.0**	...	**79.5**	**48.0**	**62.5**	...	...	**29.0**	**5 69.5**	**6 05.5**	**22.0**	**27.0**	...
1833	3 92.0	4 63 0	2 99.0	3 01.0	1 12.9	...	73.3	52.9	61.3	...	...	25.6	6 97.0	5 86.3	20.8	25.1	...
	5 69.0	**6 72.0**	**4 34.0**	**4 37.0**	**1 64.0**	...	**1 03.5**	**76.8**	**80.0**	...	...	**3.72**	**8 66.5**	**8 51.0**	**30.3**	**36.5**	...
1864	3 96.6	4 03.5	3 82.9	3 43 8	95.5	$0 98.4	77.4	45.6	73.9	$0 84.4	...	...	4 93.5	...	20.4	23.4	...
	8 06.2	**8 20.2**	**7 78.3**	**6 98.9**	**1 94.2**	**2 00.0**	**1 57.5**	**92.7**	**1 50.2**	**1 71.6**	...	...	**10 03.1**	...	**41.5**	**47.6**	...
1865	4 90.1	5 52.0	4 30.4	3 76.2	1 37.3	1 25.2	75.8	46.9	78.0	90.3	...	...	7 26.0	...	15.6	19.2	...
	7 70.6	**8 68.9**	**6 76.8**	**5 91.6**	**2 16.0**	**1 96.9**	**1 91.2**	**73.8**	**1 23.6**	**1 42.1**	...	...	**11 41.6**	...	**24.5**	**30.3**	...
1866	6 62.3	7 20.1	4 35.3	3 36.7	2 09.0	1 67.9	74.5	38.0	64.2	76.9	...	...	6 76.5	...	14.6	18.6	...
	7 92.0	**10 14.3**	**6 13.1**	**4 74.3**	**2 94.5**	**2 36.6**	**1 05.0**	**53.6**	**00.4**	**1 08.4**	...	...	**9 50.0**	...	**20.7**	**26.2**	...
1867	6 63.4	8 18.9	5 65.8	4 35.5	2 05.9	1 62.7	1 07.2	65.3	87.6	86.4	...	...	5 21.2	...	13.4	17.9	...
	9 16.4	**11 31.2**	**7 81.6**	**6 01.6**	**2 84.4**	**2 24·8**	**1 48.1**	**75.0**	**1 21.0**	**1 19.4**	...	...	**7 20.0**	...	**18.5**	**24.8**	...
1868	5 66.4	6 67.8	6 96.3	4 24.6	1 81.9	1 53.4	1 35.0	68.4	84.6	1 60.7	...	...	5 63.9	...	12.0	16.7	...
	7 91.2	**9 32.7**	**8 32.9**	**5 93.1**	**2 54.1**	**2 14.5**	**1 76.1**	**81.6**	**1 18.2**	**2 10.5**	...	...	**7 75.0**	...	**16.9**	**23.4**	...
1869	4 30.6	4 84.0	4 32.5	[illegible] 68.0	1 24.1	1 08.3	97.0	64.8	76.2	1 24.3	...	...	6 64.2	...	09.3	17.3	...
	5 72.5	**6 43.7**	**5 75.2**	**4 89.4**	**1 65.1**	**1 44.1**	**1 29.8**	**73.0**	**1 61.4**	**1 65.5**	...	...	**8 83.3**	...	**12.6**	**23.1**	...
1870	4 37.5	4 73.9	4 61.4	4 38.9	1 19.4	98.4	88.9	52.2	84.8	84.6	...	...	4 38.1	...	13.3	18.3	...
	5 02.9	**5 44.8**	**5 30.4**	**5 04.5**	**1 37.3**	**1 13.2**	**1 02.2**	**60.0**	**97.5**	**97.2**	...	...	**5 03.6**	...	**15.4**	**21.1**	...
1871	6 23.8	6 69.2	4 72.2	4 62.2	1 41.4	1 36.2	89.4	63.7	68.1	86.3	...	...	6 48.8	...	14.7	18.3	...
	5 85.2	**6 36.0**	**5 27.7**	**4 04.8**	**1 58.1**	**1 52.2**	**90.9**	**60.0**	**76.1**	**96.5**	...	...	**7 25.0**	...	**16.5**	**20.5**	...
1872	5 62.6	6 13.2	4 40.2	3 16,4	1 68.4	1 49.6	81.8	42.7	60.7	77.6	...	...	4 83.6	...	17.3	18.0	...
	6 21.0	**6 89.**	**4 94.7**	**3 55.6**	**1 78.0**	**1 68.0**	**92.0**	**48.0**	**68.3**	**87.1**	...	...	**4 87.3**	...	**19.5**	**21.3**	...
1873	6 13.4	6 92.5	4 83.8	2 95.6	1 58.0	1 47.0	84.2	43.0	55.0	1 11.0	...	...	4 36.5	...	47.5	19.7	...
	5 84.1	**6 74.1**	**5 50.4**	**3 36.4**	**1 78.7**	**1 67.3**	**05.9**	**49.0**	**62.6**	**1 26.3**	...	...	**4 96.6**	...	**19.9**	**22.3**	...
1874	4 61.2	6 13.3	4 77.5	3 74.7	1 36.3	1 29.7	91.8	67.4	80.6	1 56.9	...	...	5 10.3	...	19.7	23.0	...
	5 30.2	**5 71.0**	**5 31.2**	**4 16.8**	**1 51.7**	**1 44.3**	**1 02.2**	**75.0**	**89.7**	**1 70.1**	...	...	**5 67.7**	...	**22.0**	**25.5**	...
1875	4 28.1	4 76.7	4 03.2	3 47.4	1 22.0	1 07.7	84.9	64.6	70.2	1 18.3	...	...	5 02.8	...	16.0	22.6	...
	4 02.1	**5 48.0**	**4 63.5**	**3 09 4**	**1 40.3**	**1 23.9**	**97.6**	**62.8**	**80.7**	**1 36.0**	...	...	**5 78.0**	...	**18.4**	**26.0**	...
1876	3 92.6	4 76.5	4 01.9	2 55.3	1 18.5	1 06.0	71.[illegible]	36.1	61.2	86.6	...	...	4 19.0	...	14.0	18.8	...
	4 37.3	**5 30.7**	**4 47.6**	**2 84.3**	**1 32.0**	**1 18.1**	**79.5**	**40.2**	**57.1**	**96.5**	...	...	**4 66.7**	...	**15.6**	**27.0**	...
1877	5 40.3	6 32.5	4 27.4	2 82.2	1 60.7	1 43.4	76.0	42.4	68.3	60.6	...	...	3 38.7	...	15.8	22 5	...
	5 66.4	**6 63.0**	**4 48.1**	**2 05.9**	**1 68.5**	**1 50.4**	**70.7**	**44.5**	**61.2**	**63.6**	...	...	**3 55.1**	...	**16.6**	**23.6**	...
1878	3 92.4	4 76.3	3 11.8	2 41.4	1 24.2	1 12.6	64.1	32.8	51.3	46.7	...	...	3 54.9	...	13.5	22.2	...
	3 95.6	**4 80.2**	**3 14.4**	**2 43.4**	**1 25.2**	**1 13.6**	**64.7**	**33.1**	**51.8**	**47.1**	...	...	**3 57.8**	...	**13.7**	**22.4**	...
1879	4 10.6	4 38.1	2 90.9	2 43.6	4 22.3	1 12.9	68.3	38.5	49 0	67.0	...	...	2 89.8	...	14.7	24.0	...
1880	4 13.5	4 66.3	3 61.6	2 80.4	1 25.3	1 21.3	93.4	43.8	54.7	75.8	...	...	4 08.9	...	12.8	21.6	...
Aver.	5 44.8	5 72.5	3 99.9	3 40.0	1 34.9	1 28.2	79.4	43.7	70.0	92.9	12.0	32.6	6 35.6	8 98.0	12.2	16.3	190

Table showing the Annual Average Gold and Currency Prices of Staple Articles, Continued.
[Currency prices in black letters.]

Date.	Copper. Bolts.	Copper. Sheathing.	Cotton, upland.	Fish. Cod.	Fish. Mackerel.	Flax.	Fruit. Almonds.	Fruit. Raisins.	Fruit. Figs.	Fruit. Prunes.	Furs, beaver.	Glass.	Gunpowder. Rifle.	Gunpowder. English.	Gunpowder. Blasting.	Hemp. Dressed.	Hemp. Undressed.
	Pr. lb.	Pr. lb.	Pr. lb.	Pr. cwt.	Pr. bbl.	Pr. lb.	Pr. lb.	Pr Box.	Pr. lb.	Pr. lb.	Pr. lb.	Pr 100 ft	Pr 25 lb	Pr 95 lb	Pr. 25 lbs.	Pr. ton.	Pr. ton.
1825	...	$0 30.4	$0 18.2	$2 49.0	$5 33.5	...	...	$3 56.5	$0 08.5	$011.5	4 93.5	$6 17.5	$4 54.0	$5 61.5	...	...	...
1826	...	29.7	11.1	2 26.0	5 19.5	...	...	3 25.0	09.6	14.7	5 28.5	6 24.0	4 52.0	5 42.5	...	...	...
1827	...	26.2	09.7	2 97.5	5 32.5	...	...	2 46.0	09.2	11.1	4 86.5	6 12.5	4 50.0	5 37.5	...	...	...
1828	...	24.7	10.0	2 88.5	5 35.5	...	...	2 74.0	07.5	11.2	5 81.0	6 12.5	4 50.0	5 20.5	...	...	...
1829	...	23.5	09.0	2 51.5	5 51.0	...	...	2 96.5	08.3	19.1	7 10.0	6 12.5	4 50.0	4 87.5	...	...	...
1830	...	22.0	10.0	2 33.0	5 83.0	...	...	2 48.0	06.5	17.7	6 45.5	6 12.5	4 50.0	4 87.5	...	...	...
1831	...	22.2	09.0	2 77.5	6 30.0	...	...	2 47.5	07.0	17.2	5 34.0	6 12.0	4 50.0	4 87.5	...	...	...
1832	...	22.5	09.5	2 87.5	5 64.5	...	...	2 96.0	09.5	16.5	4 65.5	6 12.0	4 50.0	4 87.5	...	...	...
1833	...	23.0	12.5	2 72.0	6 62 0	...	...	2 10.5	04.5	16.2	4 27.0	6 12.0	4 50.0	4 87.5	...	...	...
1834	...	23.5	12.5	2 38.5	6 24.5	...	...	1 51.0	05.1	09.8	4 35.0	5 75.0	4 50.0	4 87.5	...	...	...
1835	...	23.5	16.7	2 79.5	7 15.0	...	...	2 69.5	07.5	12.5	4 50.0	5 10.0	4 50.0	4 87 5	...	...	...
1836	...	27.0	16.6	3 36.5	9 61.5	...	...	2 32.0	06.8	10.1	5 20.5	5 37.0	4 50.0	4 87.5	...	...	...
1837	...	25.8	11.5	3 27.7	9 40.7	...	...	1 04.3	05.2	07.6	4 30.6	5 50.2	4 30.6	4 66.5	...	...	...
	...	**27.0**	**12.0**	**3 42.5**	**9 83.0**	...	...	**1 09.0**	**05.5**	**08.0**	**4 50.0**	**5 75.0**	**4 50.0**	**4 87.5**	...	...	...
1838	...	25.2	10·6	3 47.8	11 23.3	...	...	1 63.0	08.2	11.8	4 45.9	5 69.8	4 45.9	4 83.1	...	...	...
	...	**25.5**	**10.7**	**3 51.0**	**11 33.5**	...	...	**1 64.5**	**08.3**	**12.0**	**4 50.0**	**5 75.0**	**50.0**	**4 87.5**	...	...	...
1839	...	24.5	13.3	3 74.5	13 51.0	...	...	1 32.5	12.1	11.5	4 50.0	5 75.0	4 50.0	4 87.5	...	...	...
1840	...	24.5	08.7	2 51.0	12 82.0	...	...	1 52.0	08.6	09.2	3 50.0	5 75.0	4 00.0	18 50.0	...	...	...
1841	...	25.0	09.8	2 58.5	13 55 0	...	...	1 85.0	07.1	...	3 37.0	5 75.0	3 87.5	18 50.0	...	...	...
1842	...	22.7	08.0	2 27.0	10 55.0	...	...	1 34.5	07.1	...	3 00.0	5 75.0	3 87.5	18 50.0	...	...	...
1843	...	21.2	06.6	2 46.0	9 25.0	...	...	1 70.0	08.6	...	3 00.0	5 75.0	3 87.5	18 50.0	...	...	...
1844	...	21.5	06.6	2 67.0	10 78.5	...	...	2 25.5	09.1	...	3 00.0	5 75.0	3 87.5	18 50.0	...	...	...
1845	...	22.7	06.1	2 62.5	12 56.5	...	...	2 45.0	08.7	12.5	3 06.0	...	3 12.0	17 57.5	...	...	...
1846	...	23.5	07.3	2 82.5	10 64.5	...	...	2 03.5	10 8	10.8	2 54.0	...	2 75.0	17 32.5	...	...	...
1847	...	23.2	10.3	3 58.0	9 99.0	...	...	1 71.5	10.1	...	2 25.0	6 12.0	2 75.0	17 50.0	...	...	...
1848	...	21.5	06.1	2 95.5	8 44.5	...	...	1 56.5	10.6	...	2 25.0	6 12.0	2 75.0	17 50.0	...	...	...
1849	...	21.5	08.0	5 52.0	10 55.5	...	...	1 97.0	12.0	...	2 25.0	6 12.0	2 75.0	17 50.0	...	...	...
1850	...	21.5	12.3	2 60.0	10 79.5	...	...	2 55.5	17.6	...	2 25.0	6 12.0	2 75.0	17 50.0	...	...	...
1851	...	20.5	10.2	2 74.0	9 94.0	...	$0 16.5	2 01.5	...	...	2 25.0	6 12.0	2 75.0	17 50.0	...	...	...
1852	...	23.5	09.0	3 44.5	10 06.0	...	14.0	1 95.0	...	...	2 25.0	6 12.0	2 75.0	17 50.0	...	...	...
1853	...	29.1	10.6	3 32.0	13 45.5	...	13.5	2 88.0	...	...	2 00.0	5 75.0	2 64.5	...	...	...	...
1854	...	30.2	09.0	3 40.5	16 91.5	...	14.5	2 75.0	...	...	1 35.5	5 75.0	2 62.5	...	...	...	...
1855	...	29.7	09.2	3 84.0	20 10.0	...	15.3	2 71.5	...	...	1 30.5	5 75.0	3 29.0	...	...	...	...
1856	...	31.2	10.6	3 86.0	20 89.5	...	15.5	3 36.0	...	...	1 42.0	5 83.0	4 46.5	...	...	...	...
1857	...	30.1	14.0	3 77.5	20 60.0	...	22.5	4 65.0	...	...	1 78.5	6 39.0	5 37.5	...	$3 69.5	...	...
1858	...	26.0	13 0	3 38.0	11 68.0	...	15.0	2 26.5	...	...	1 12.0	6 49.0	5 28.5	...	3 58.0	...	...
1859	...	26.1	11.4	4 11.5	15 93.0	...	12.3	2 25.5	...	...	1 29.5	6 25.0	5 30.5	...	3 06.0	...	...
1860	...	26.2	10.5	3 48.5	16 71.0	...	12.7	2 46.0	...	...	1 10.0	6 25.0	5 12.5	...	3 14.0	...	...
1861	...	24.2	16.1	3 05.0	11 63.5	...	12.5	1 82.5	...	...	1 10.0	6 25.0	5 12.5	...	3 25.0	...	...
1862	...	26.5	36.3	3 42.6	13 52.7	...	14.5	2 94.0	...	...	1 29.8	5 55.4	5 69.0	...	3 46.1	...	...
	...	**30.0**	**41.2**	**3 88.0**	**15 32.0**	...	**16.5**	**3 34.0**	...	...	**1 47.0**	**6 29.0**	**6 45.5**	...	**3 92.0**	...	...
1863	...	28.6	51.2	3 98.5	12 02.9	...	15.9	2 80.0	10.3	...	1 90.5	6 44.2	4 76.4	...	2 95.5	...	...
	...	**41.6**	**74.3**	**5 78.5**	**17 .0**	...	**23.2**	**4 06.5**	**15.0**	...	**2 76.5**	**9 35.0**	**6 91.5**	...	**4 29.0**	...	...
1864	$0 27.7	27.4	65.8	3 70.1	7 00.5	$0 10.9	...	...	...	...	...	5 35.6	4 03.8	...	2 89.9	$151 72.0	$94 35.6
	56.3	**55.8**	**1 13.5**	**7 52.4**	**14 23.9**	**22.2**	...	...	...	...	...	**10 88.6**	**8 20.8**	...	**5 89.3**	**308 37.5**	**171 45.7**
1865	31.7	34.0	37.6	5 34.6	11 07.0	13.2	...	...	...	...	...	8 21.4	5 51.1	...	4 23.9	195 03.9	116 33.4
	49.9	**55 0**	**59.2**	**8 40.6**	**18 82.2**	**20.8**	...	...	...	...	...	**12 91.6**	**8 66.6**	...	**6 66.6**	**306 66.6**	**182 91.6**
1866	32.9	32.9	28.2	4 98.8	13 80 0	14.5	...	...	...	...	...	9 08.0	5 50.2	...	3 81.6	244 80.1	178 38.7
	46.4	**46.4**	**39.8**	**7 02.6**	**19 43.7**	**20.5**	...	...	...	...	...	**12 79.0**	**7 75.0**	...	**5 37.5**	**344 79.1**	**251 25.0**
1867	26.7	25.9	19.7	4 91.9	13 93.1	13.9	...	...	...	...	...	9 12.5	5 00.7	...	3 22.7	264 56.1	193 57.0
	36.9	**35.9**	**27.3**	**6 79.6**	**19 24.3**	**19.4**	...	...	...	...	...	**12 60.4**	**6 91.6**	...	**4 45.8**	**365 41.6**	**267 50.0**
1868	23.8	22.8	19.3	4 70.5	15 08.0	14.1	...	...	...	...	...	8 36.6	4 66.4	...	2 86.4	219 57.2	138 57.6
	33.3	**31.9**	**27.0**	**6 57.2**	**21 06.2**	**19.7**	...	...	...	...	...	**11 68.6**	**6 50.0**	...	**4 00.0**	**306 66.6**	**193 54.1**
1869	25.2	24.4	22·4	5 50.2	20 44.4	15.7	...	...	...	...	...	10 59.0	4 88.8	...	3 00.8	225 50.2	148 83.2
	33.6	**32.5**	**29.9**	**7 43.7**	**27 18.7**	**20.9**	...	...	...	...	...	**14 08.3**	**6 50.0**	...	**4 00.0**	**298 54.1**	**197 91.6**
1870	27.2	25.7	18.5	5 93.1	22 18.5	12.7	...	...	...	...	...	12 83.2	5 38.2	...	3 11.7	247 04.9	166 82.2
	31.0	**29.6**	**21.3**	**6 81.8**	**25 50.0**	**14.7**	...	...	...	...	...	**14 75.0**	**6 18.7**	...	**3 58.3**	**281 66.6**	**191 75.0**
1871	29.0	27.2	16.0	5 18·2	13 79.7	13.2	...	...	...	...	...	13 20.1	5 14.6	...	2 68.5	245 75.1	155 87.8
	32 5	**30.4**	**17.9**	**5 79.1**	**15 41.6**	**14.8**	...	...	...	...	...	**14 75.5**	**5 75.0**	...	**3 00.0**	**274 58.3**	**174 16.6**
1872	38.6	37.2	18.4	5 10.7	11 92.1	14.6	...	...	...	...	...	13 62.7	5 24.6	...	2 96.6	201 36.2	121 44.7
	43.4	**41.9**	**20.7**	**5 73.9**	**13 39.5**	**16.5**	...	...	...	...	...	**15 31.2**	**5 89.5**	...	**3 33.3**	**226 25.0**	**136 45.8**
1873	37.0	35.6	16.5	5 32.4	15 71.2	14.9	...	...	...	...	...	15 96.7	3 88.1	...	3 25.9	185 32.2	107 31.1
	42.1	**40.5**	**18.8**	**6 05.7**	**17 87.5**	**17.0**	...	...	...	...	...	**18 16.6**	**4 41.6**	...	**3 70.8**	**210 83.3**	**122 08.3**
1874	29.5	24.2	14.8	4 77.2	12 75.4	14.3	...	...	...	...	...	17 22.8	5 51.0	...	3 27.3	184 48.2	130 91.6
	32.9	**27.0**	**16.5**	**5 30.9**	**14 18.7**	**16.0**	...	...	...	...	...	**19 16.4**	**6 12.9**	...	**3 64.1**	**205 20.8**	**145 62.5**
1875	26.1	25.2	13.0	5 43.4	16 10.3	12.7	...	...	...	...	...	17 09.5	4 28.4	...	2 46.8	195 81.9	139 26.9
	30.0	**29.0**	**15.0**	**6 24.7**	**17 36.0**	**14.7**	...	...	...	...	...	**19 65.0**	**4 92.5**	...	**2 83.7**	**225 08.0**	**160 08.0**
1876	28.7	27.8	10.5	5 79.2	16 88.2	12.5	...	...	...	...	...	17 78.0	4 84.9	...	2 60.4	172 95.4	115 12.3
	32.0	**31.0**	**11.7**	**6 45.1**	**18 80.0**	**14.0**	...	...	...	...	...	**10 80.0**	**5 46.0**	...	**2 90.0**	**192 60.0**	**128 20.0**
1877	29.5	27.6	11.1	6 03.8	19 55.7	14.3	...	...	...	...	...	15 83.6	5 15.1	...	3 00.5	171 40.5	126 99.2
	31.0	**29.0**	**11.7**	**6 33.0**	**20 50.0**	**15.0**	...	...	...	...	...	**16 60.0**	**5 40.0**	...	**3 15.0**	**179 67.0**	**133 00.0**
1878	27.7	25.8	10.7	5 65.4	18 55.0	14.8	...	...	...	...	...	13 39.2	5 45.3	...	3 12.4	171 12.0	129 45.6
	28.0	**26.0**	**10.8**	**5 70.0**	**18 70.0**	**15.0**	...	...	...	...	...	**13 50.0**	**5 49.7**	...	**3 15.0**	**172 50.0**	**130 50.0**
1879	25.1	23.1	11 4	5 27.7	19 40.0	...	...	...	...	...	...	14 62.0	5 65.0	...	3 15.0	155 85.0	128 00.0
1880	30.0	28.0	12.1	5 99.6	17 20.0	...	...	...	...	...	...	13 02.0	6 00.0	...	3 15.0	261 00.0	168 00.0
Aver.	29.2	25.9	14.6	3 71.5	12 26.6	13.7	15.0	2 32.7	8.7	12.8	3 24.8	8 07.3	4 37.4	10 97.8	3 16.6	205 48.8	138 19.2

Table exhibiting the Value and Character of the Gold and Silver used in Manufactures and the Arts in the United States during the fiscal year ended June 30, 1880, as Reported by Persons and Firms Engaged in the Manufactures Named, in response to circular inquiries addressed from the Bureau of the Mint..

Manufactures of	Number of letters sent.	Answers.	Number manufacturing.	Not replying.	Gold. United States coins melted and worked up.	Gold. Fine bars used.	Gold. Foreign coins and old manufactured articles made into new work.	Gold. Total.	Silver. United States coins melted and worked up.	Silver. Fine bars used.	Silver. Foreign coins and old manufactured articles made into new work.	Silver. Total.	Grand total.
Watches and jewelry	6,444	2,451	1,172	2,821	$2,005,983	$3,901,352	$610,651	$6,517,986	$104,460 00	$777,483	$77,699 00	$959,642	$7,477,628
Watch cases and manufactures	309	110	77	122	203,180	947,641	52,051	1,202,872	420,912 50	1,361,901	44,434 50	1,817,248	3,020,120
Gold leaf and plate	333	153	103	77	183,520	623,369	44,040	850,929	14,746 00	541,696	49,887 00	606,329	1,457,258
Chemicals	84	35	9	40	14,575	34,635	6,200	55,410	25 00	76,494	...	76,519	131,929
Instruments	120	42	20	68	1,510	4,050	1,436	6,996	1,691 00	1,616	1,125 00	4,432	11,428
Totals	7,290	2,791	1,381	3,118	2,408,768	5,511,047	714,378	8,634,193	541,834 50	2,749,190	173,146 50	3,464,170	12,098,363

Table showing the Annual Average Gold and Currency Prices of Staple Articles, &c. (*Continued*).

(*Currency prices in black figures.*)

Date.	Hemp-Russia.	Hides. South American.	Hides. Mexican.	Hops.	Indigo.	Iron. Scotch.	Iron. English bar.	Iron. Sheet.	Iron. Russia.	Lead, pig.	Leather.	Liquors. Brandy.	Liquors. Whiskey.	Molasses. New Orleans.	Molasses. Sugar house.	Molasses. West Indies.	Nails, cut.
	Per ton.	Per lb.	Per lb.	Per lb.	Per lb.	Per ton.	Per ton.	Per lb.	Per lb.	Per cwt.	Per lb.	Per gal.	Per gal.	Per gal.	Per gal.	Per gal.	Per lb.
1825		$0 17.7	$0 13.2	$0 17.7	$2 19.7	$60 10.0	$106 00.0	$0 07.9		$6 86.0	$0 23.2	$1 27.2	$0 26.6	$0 35.0	$0 42.5	$0 29.0	
1826		16.7	12.0	16.7	1 63.5	61 04.0	94 47.5	08.3		6 00.0	21.0	1 24.6	29.0	33.0	45.5	26.7	
1827		16.6	10.7	13.5	1 71.5	61 50.0	85 43.0	07.5		6 00.0	20.1	1 53.5	29.5	35.5	45.1	30.5	
1828		16.5	11.5	6.5	1 31.5	62 21.0	80 10.0	07.0		5 12.5	21.0	1 41.0	22.5	33.0	38.2	29.2	$0 07.5
1829		15.0	11.0	7.4	1 05.5	49 37.5	79 48.0	07.3		3 75.0	20 2	1 25.5	23.3	29.7	38.5	24.5	0.71
1830		16.3	11.3	13.0	92.0	43 96.0	74 93.5	07.3		3 00.0	20.0	1 28.0	25.2	29.7	37.2	23.6	05.5
1831		16.0	13.2	11.5	90.7	43 33.0	72 12.5	07.3		4 12.5	21.7	1 84.5	31.5	28.5	26.5	24.7	05.6
1832		14.4	11.3	18.5	93.5	43 23.0	72 62.5	07.3		5 60.0	20.2	1 63.5	30.5	30.0	27.8	26.0	05.8
1833		13.8	10.7	28.2	92.5	41 69.0	74 64.5	07.0		5 43.7	17.6	1 65.0	30.7	32.0	31.0	28.5	05.0
1834		12.7	09.7	14.9	99.0	41 39.5	71 71.0	03.5		4 87.5	16.2	1 58.0	25.0	29.0	27.1	23.5	05.5
1835		13.7		14.5	1 01.5	40 25.0	69 37.0			6 00.0	17.1	1 65.0	33.6	31.7	30.0	26.9	06.0
1836		13.4		14.6	1 02.5	52 68.5	94 04.0	07.0		6 87.5	18.5	1 76.5	37.0	44.0	39.2	36.1	06.5
1837		13 0		07.1	99.0	59 74.0	91 60.8	06.9		5 74.2	18.1	1 45.4	34.9	35.4	33.9	33.0	06.2
		13.6		**07.5**	**1 03.5**	**51 97.5**	**95 72.5**	**7.2**		**6 00.0**	**19.0**	**1 52.0**	**36.5**	**37.0**	**35.5**	**34.5**	**06.5**
1838		14.1		08.1	1 06.1	43 14.8	87 43.5	97.4			18.4	1 56.0	35.8	36.6	34.1	30.4	05.9
		14.3		**08.2**	**1 07.1**	**43 54.0**	**88 23.0**	**06.5**			**18.6**	**1 57.5**	**36.2**	**37.0**	**34.5**	**30.7**	**06.0**
1839		15.0		15.9	1 23.5	38 62 0	88 44.0	06.5			21.6	1 68.5	36.5	34.5	29.0	31.7	06.2
1840		14.6		37.5	1 07.5	35 18.5	70 62.5	06.5			18.6	1 70.0	25.0	26.1	22.0	25.5	05.5
1841		14·3	13.3	24 3	99.0	34 85.0	68 35.0	06.5		4 12.5	20.7	1 61.5	21.4	25.6	23.5	19.6	05.5
1842		12.5	11.2	13.5	76.5	28 66.0	57 08 8		$0 13.5	3 06.2	17.1	1 60.5	18.5	20.7	18.1	15.9	04.0
1843		12.3	10.9	09.7	74.5	26 12.5	55 98.0		11.5		16.2	2 16.5	22.0	22.5	21.5	19.0	04.5
1844		12.1	10.8	08.6	76.0	32 56.0	61 09.0		12.4		15.6	2 46.5	23.8	29.7	27.0	24.5	04.5
1845		12.6		15.1	70.5	37 97.5	74 58.0		11.7	3 37.5	14.5	2 68.0	23.0	29.7	27.7	24.0	04.5
1846		11.5	09.8	19.6	61.5	38 21.5	78 25.0		11.5	4 15.5	12.8	2 82.5	21.7	29.5	24.5	18.8	04.5
1847		11.5	10.3	09.8	73.0	34 44.0	72 29.0		11.5	4 31.5	15.7	2 80.5	28.3	33.7	27.0	21.8	04.5
1848		09.1	07.8	05 0	64.5	29 10.5	69 06.0		11.7	4 18.5	13.7	2 62.0	23.0	24.5	21.5	18.5	04.5
1849		10.0	08.3	08.8	62.5	24 37.0	47 12.5		11.9	4 55.5	15.6	2 60.5	24.0	26.0	23.6	20.6	04.9
1850		12.5	10.6	13.8	69 4	22 33.0	41 87.5		13.5	4 71.5	15.7	2 78.0	25.3	27.0	24.3	21.0	03.5
1851		13.6	11.6	37.5	72.0	21 31.0	36 49.5		13.5	4 69.5	14.5	2 73.0	23.3	30.7	24.0	19.5	03.5
1852		14.7	11.7	30.6	72.0	22 71.5	39 80.5		10.8	4 73.0	16.2	2 78.0	22.5	29.2	22.5	18.5	03.2
1853		17.5	15.0	25.2	74.5	34 62.0	85 14.0		11.2	6 68.0	18.5	4 77.0	24.5	28.5	22.5	21.0	04.6
1854		21.2	16.0	33.6	81.0	38 47.5	71 12.5		02.6	6 75.0	21.0	6 36.0	32.1	24.5	23.5	22.3	04.1
1855		21.4	17.0	19.1	82.0	28 75.0	58 75.0		15.9	6 44.5	22.5	6 10.0	37.7	30.5	29.0	27.2	04.0
1856		26.5	21.7	07.7	81.8	32 41.5	59 39.0		15.3	7 02.5	26.5	6 29.0	32.5	51.0	41.5	38.2	03.5
1857		32.7	20.9	08.5	76.0	31 12.5	58 14.0		12.0	7 03.0	26.6	6 19.0	27.1	65.5	45.5	40.0	03.3
1858		24.3	20.1	06.5	73.0	24 47.5	51 89.0		12.0	5 70.5	23.0	4 85 5	22.2	38.8	26.5	22.6	03.0
1859		25.5	22.7	11.8	85.5	25 27.0	45 46.0		10.7	5 69.5	24.5	4 94.0	26.5	39.0	26.5	23.0	03.0
1860		23.5	20.7	13.2	84.0	23 51.0	42 44.0		13.2	5 70.0	21.5	5 60.0	22.2	46.5	27.5	21.5	03.0
1861		19 5	16.5	20.5	87.5	22 25.0	43 89.5		16.1	5 50.5	19.5	5 60.0	18.1	39.5	18.3	22.0	03.0
1862		31.6	18.9	14.5	1 02.4	22 95.3	52 09.7		13.6	6 24.8	20.3	5 19.6	24 9	37.0	20.7	24.7	02.7
		24.5	**21.5**	**16.5**	**1 16.0**	**25 99.5**	**59 00.0**		**15.5**	**7 07.7**	**23.1**	**5 88.5**	**28.3**	**42.0**	**23.5**	**28.0**	**03.1**
1863		19.7	16.6	15.1	76.8	25 60.6	50 68.9		12.0	6 01.7	20.0	5 25.0	35.3	33.9	29.9	25.5	33.4
		28.6	**24.1**	**22.0**	**1 11.5**	**37 16.5**	**73 57.0**		**17.5**	**8 73.3**	**29.1**	**7 62.0**	**51.3**	**49.3**	**43.4**	**37.0**	**05.0**
1864	$251 12.4	15.6	15.0	12.5	68.8	26 15.7	77 38.7			8 59.3	18.3			46.4	37.4	31.2	0.38
	510 41.6	**31.8**	**30.6**	**25.5**	**1 40.0**	**53 16.6**	**157 29.1**			**13 30.5**	**37.2**			**94.3**	**76.1**	**63.5**	**07.8**
1865	303 42.4	15.7	14.0	22.9	83.5	32 58 0	82 41.4			7 11.8	23.0			72.3	34.0	28.4	04.7
	477 08.3	**24.8**	**22.1**	**30.1**	**1 31.4**	**51 22.7**	**129 58.3**			**11 19.2**	**36.2**			**1 13.7**	**53.6**	**44.7**	**07.4**
1866	254 26.8	14.0	12.1	34.7	71.1	34 52.4	78 54.3			5 74.8	24.4			68.7	35.6	29 7	04.9
	358 12.5	**19.8**	**17.1**	**48.9**	**1 00.2**	**48 62.5**	**110 62.5**			**8 09.7**	**34.4**			**96.8**	**50.2**	**41.9**	**07.0**
1867	257 47.2	15.1	13.9	41.3	60.7	31 31.3	71 87.1			4 89.8	22.1			61.4	35.9	3.30	04.3
	355 62.5	**20.9**	**19.2**	**57.2**	**84.1**	**43 25.0**	**99 27.0**			**6 78.0**	**30.6**			84.8	**51.0**	**45.7**	**06.0**
1868	201 82.1	14.8	14.7	26.8	59.4	29 59.4	63 39.5			4 75.2	20.1			69.3	34.6	30.7	03.7
	281 87.5	**20.8**	**20.6**	**37.6**	**83.1**	**41 33.3**	**88 54.1**			**6 63.8**	**28.3**			**82.9**	**48.5**	**43.0**	**05.2**
1879	191 44.6	16.8	16.4	11.5	67.5	30 36.2	66 74.0			4 95.7	22 5			59.9	37.9	34.4	03.6
	254 58.3	**22.4**	**21.9**	**15.3**	**89.8**	**40 37.5**	**88 75.0**			**6 59.2**	**30.0**			**79.7**	**50.5**	**45.8**	**04.8**
1870	215 32.5	19.8	19.7	14.7	91.0	30 01.5	66 33.7			5 60.4	30.4			72.2	33.3	29.2	03.8
	247 50.0	**22.8**	**22.7**	**17.0**	**1 04.7**	**34 50.0**	**76 25.0**			**6 44.2**	**35.0**			**83.0**	**38.3**	**33.6**	**04.4**
1871	207 52.6	22.7	21.4	14.4	1 00.4	30 36.1	63 24.6			5 66.1	25.5			60 4	31.7	28.0	04.1
	231 87.5	**25.4**	**24.0**	**16.1**	**1 12.1**	**33 81.2**	**70 66.6**			**6 32.5**	**28.5**			**56.4**	**35.5**	**31.3**	**04.6**
1872	193 94.5	23.8	23.3	45.1	88.7	43 38.7	88 42.5			5 84.2	25.2			58.4	27.4	24.8	04.3
	217 01.6	**26.8**	**26.2**	**50.7**	**99.7**	**48 75.0**	**99 35.4**			**6 50.5**	**28.4**			**65.7**	**30.8**	**27.9**	**04.9**
1873	191 18.2	22.9	22.9	38.6	69.9	45 03.0	77 71.7			6 04.6	24.5			60.3	26.6	24.6	04.3
	217 50.0	**26.1**	**26.1**	**44.0**	**70.6**	**51 22.9**	**88 41.6**			**6 87.9**	**27.9**			**68.7**	**30.3**	**28.1**	**04.9**
1874	202 88 7	22.6	21.7	25.5	67.4	38 18.1	67 89.2			8 00.0	24.8			68.5	25.8	24.8	03.6
	225 68.1	**25.2**	**24.2**	**28.4**	**75.0**	**42 47.1**	**75 52.0**			**6 67.5**	**27.6**			**76.3**	**28.7**	**27.6**	**04.0**
1875	192 36.5	19.7	18.8	14.9	61 5	29 78.0				5 12.2	23.4			58.5		38.0	03.3
	221 11.0	**22.7**	**21.6**	**17.2**	**70.7**	**34 23.0**				**5 88.8**	**20.0**			**67.3**		**43.7**	**03.8**
1876	183 37.1	17.7	16.6	17.5	64.6	25 87.1				6 70.2	19.7			52.7			03.1
	204 20.0	**19.8**	**18.5**	**19.5**	**72.0**	**28 81.0**				**0 45.1**	**22.0**			**58.7**			**03.5**
1877	196 50.7	21.3	19.6	11.4	69.9	25 98.7				6 26.7	22.4			49.1			03.0
	205 98.3	**22.4**	**20.6**	**12.0**	**73.3**	**27 24.0**				**5 52.1**	**23.5**			**51.5**			**03.2**
1878	200 88.0	20.2	18.4	10 6	72.7	24 23.8				3 68.0	20.1			44.1			02.8
	202 50.0	**20.4**	**18.6**	**10.6**	**73.3**	**24 43.4**				**3 71.0**	**20.3**			**44.5**			**02.9**
1879	196 80.0	24.1	22.6	27.5	75.0	27 13.4				5 13.6	24.1			53 6			04 3
1880	179 32.8	21 1	19.6	19.7	75.0	24 48.9				4 23.3	21.2			37.0			03.1
Aver.	212 92.2	17.2	15.4	17.9	88.1	34 01.3	68 14.3	06.9	12.6	5 32.3	20.3	2 92.8	27.1	40.3	30.1	26.2	04.3

Table showing the Annual Average Gold and Currency Prices of Staple Articles, &c., Continued.

[Currency prices in black figures.]

Date.	*Nails.*	*Naval stores.*		*Oil.*					*Paint.*		*Petroleum.*		*Pork.*		*Beef.*		
	Wrought.	*Turpentine.*	*Rosin.*	*Whale.*	*Summer sperm.*	*Winter sperm.*	*Olive.*	*Linseed.*	*Red lead.*	*White lead.*	*Crude.*	*Refined.*	*Mess.*	*Prime.*	*Mess.*	*Prime.*	*Hams.*
	Per lb.	*Per gal.*	*Per bbl.*	*Per gal.*	*Per gal.*	*Per gal.*	*Per gal.*	*Per gal.*	*Per cwt.*	*Per cwt.*	*Per gal.*	*Per gal.*	*Per bbl.*	*Per bbl.*	*Per bbl.*	*Per bbl.*	*Per lb.*
1825	. . . .	$0 40.5	$1 49.5	$0 25.8	$0 58.5	$0 66.5	$0 93.5	$0 78.5	$9 47.5	. . . .	. . . .	. . . .	$13 73.6	$10 15.0	$8 78.5	$5 81.0	$0 09.2
1826	. . . .	30.2	1 46.0	27.5	65.5	71.5	83.0	76.0	9 81.0	. . . .	. . . .	. . . .	11 39.5	7 86.5	9 16.0	4 91.5	09 0
1827	. . . .	36.5	1 49.6	32.5	63.0	72.0	97.0	73.5	9 47.0	. . . .	. . . .	. . . .	12 96.0	8 47.0	9 02.0	6 27.0	10.6
1828	$0 13.5	37.6	1 45.5	32.5	61.5	70.0	79.0	72.7	9 25.0	. . . .	. . . .	. . . .	13 50.0	9 81.5	9 14.5	6 44.5	09.5
1829	13.1	36.0	1 43.5	31.0	66.5	76.0	80.0	78.0	7 32.0	. . . .	. . . .	. . . .	12 55.0	10 10.5	8 21.5	7 13.5	09.5
1830	13.0	29.2	1 41.0	34.0	09.7	80.2	95.5	79.5	6 74.0	. . . .	. . . .	. . . .	13 21.5	9 65.0	8 99.5	5 90.0	09.8
1831	13.0	29.2	1 37.0	33.0	74.5	90.0	92.5	96.0	6 55.0	. . . .	. . . .	. . . .	13 90.5	10 81.5	8 49.0	6 53.0	10.7
1832	13.0	36.5	1 37.0	28.5	83.5	95.5	97.2	91.0	6 75.0	. . . .	. . . .	. . . .	13 46.0	11 04.5	9 46.5	5 59.5	09.5
1833	13.0	41.5	1 43.5	26.1	90.0	1 01.3	1 03.5	91.2	6 64.5	. . . .	. . . .	. . . .	14 68.0	11 26.5	9 38.5	5 75.5	09.3
1834	12.0	47.1	1 68.5	26.7	76.8	94.1	94.0	90.5	6 50.0	. . . .	. . . .	. . . .	13 71.5	9 74.0	9 17.5	5 85.0	09.0
1835	12.0	64.8	1 71.0	37.0	84.5	96.6	1 17.5	1 09.5	7 00.0	. . . .	. . . .	. . . .	16 39.0	12 61.5	11 08.0	7 66.0	09.7
1836	12.5	65.0	1 73.5	46.6	89.5	98.7	1 11.6	1 02.5	7 87.5	. . . .	. . . .	. . . .	22 46.5	17 16.5	10 97.5	7 15.5	12.7
1837	12.9	37.3	1 61.2	33.1	83.2	61.4	91.8	78.9	8 61.3	. . . .	. . . .	. . . .	20 17.3	14 96.9	12 91.4	8 11.5	11.9
	13.5	**39 0**	**1 68.5**	**34.6**	**87.0**	**95.6**	**96.0**	**82.5**	**9 00.0**	. . . .	. . . .	. . . .	**21 08.0**	**15 64.2**	**13 49.5**	**8 48.0**	**12.5**
1838	13.0	31.7	1 65.0	31.9	83.4	92.6	1 09.5	78.2	8 42.3	. . . .	. . . .	. . . .	21 18.2	15 88.5	14 66.2	10 98.0	12.1
	13.2	**32.0**	**1 66.5**	**32.2**	**84.2**	**93.5**	**1 10.5**	**79.0**	**8 50.0**	. . . .	. . . .	. . . .	**21 37.5**	**16 03.0**	**14 69.5**	**11 08.0**	**12.2**
1839	13.5	33.5	1 83.1	32.6	1 07.4	1 16 1	75.2	1 05.5	7 88.0	. . . .	. . . .	. . . .	19 35.5	15 46.0	14 31.0	10 45.5	12.0
1840	13.5	27.6	1 50.5	30.0	1 02.8	1 12.8	69.9	1 09.0	7 50.0	. . . .	. . . .	. . . .	14 30.5	12 58.0	12 25.0	8 86.5	. . . .
1841	13.5	30.9	1 35.0	32.3	94.7	1 07.6	86.3	1 31.6	7 50.0	. . . .	. . . .	. . . .	11 12.5	9 12.0	9 01.0	5 62.5	07.6
1842	11.5	35.0	1 17.5	34.5	72.1	85.3	89.0	92.0	6 12.6	. . . .	. . . .	. . . .	8 41.5	6 25.5	7 39.0	4 98.5	06.5
1843	11.0	34.7	89.0	34.3	63.1	73.0	80.5	84.4	5 50.0	. . . .	. . . .	. . . .	9 90,0	8 17.0	7 15.5	4 87.5	. . . .
1844	11.0	34.7	69.0	36.4	90.2	94.5	76.0	92.6	6 50.0	. . . .	. . . .	. . . .	9 30.0	7 31.5	5 67.5	3 66.0	. . . .
1845	11.0	43.5	68.5	33.7	89.6	94.8	91.0	73.8	6 60.0	. . . .	. . . .	. . . .	12 46.0	9 63.0	8 27.0	5 32.5	08.0
1846	11.0	48.0	65.5	32.9	91.3	95.6	88.1	74.3	5 50.0	. . . .	. . . .	. . . .	10 78.0	8 87.5	7 54.0	5 30.5	07.6
1847	12.0	41.6	64.0	35.3	1 07.0	1 13.2	1 16.5	66.0	5 50.0	. . . .	. . . .	. . . .	14 43.5	11 41.0	11 44.0	8 23.5	10.7
1848	10.2	37.6	84.5	32.5	1 06.5	1 14.6	1 06.7	68.7	5 50.0	. . . .	. . . .	. . . .	11 11.0	8 44.0	9 88.5	5 78.0	07.8
1849	09.0	34.3	1 01.0	39.7	1 10.2	1 17.0	93.5	63.7	6 25.0	. . . .	. . . .	. . . .	10 78.5	8 95.0	11 68.5	8 50 0	08.5
1850	09.0	32.6	1 16.0	48.5	1 18.5	1 23.5	94.2	78.5	6 60.0	. . . .	. . . .	. . . .	10 62.5	8 48.7	9 08.5	5 79.6	08.0
1851	09.0	36.0	2 48.5	46.1	1 24.5	1 30.0	86.0	74.0	5 50.0	. . . .	. . . .	. . . .	14 01.5	11 60.0	8 86.0	5 09.6	08.1
1852	07.0	45.3	3 36.0	68.7	1 27.5	1 31.7	1 05.0	63.7	5 50.0	. . . .	. . . .	. . . .	17 20.0	15 55.0	10 72.0	5 34.5	09.1
1853	08.5	61.0	3 79.5	58.0	1 31.4	1 35.6	1 24.5	65.5	7 25.0	. . . .	. . . .	. . . .	16 09.5	13 65.5	9 37.0	5 31.5	08.8
1854	09.3	56.5	3 36.0	68.0	1 56.0	1 60.2	1 25.5	77.6	7 76.0	. . . .	. . . .	. . . .	13 77.5	11 96.0	10 94.6	6 50.0	07.6
1855	09.5	42.5	3 12.0	71·0	1 95.5	2 01.5	1 19.5	85.5	7 37.5	. . . .	. . . .	. . . .	16 06.0	16 48.0	11 47.0	8 86.5	09.0
1856	06.5	40.3	3 86.0	78.5	1 82.0	1 90.5	1 21.0	86.0	7 75.0	. . . .	. . . .	. . . .	18 56.5	16 22.5	9 46.5	7 72.5	09 1
1857	05.9	46.5	6 68.5	72.5	1 40.5	1 50.0	1 26.0	76.5	7 16.5	. . . .	. . . .	. . . .	21 89.5	18 47.5	12 37.5	9 78.0	10.5
1858	04.7	46.5	6 32.5	63.5	1 20.5	1 31.0	1 04.5	63.5	7 00.0	. . . .	. . . .	. . . .	17 01.0	13 87.0	10 48.5	7 18.0	08.4
1859	03.6	47.7	4 45.5	51.5	1 33.5	1 39.0	1 12.0	60.5	7 00.0	. . . .	. . . .	. . . .	16 38.5	11 99.6	7 59.0	6 06.0	08.7
1860	04 2	42.5	3 09.0	48.5	1 41.5	1 51.0	1 26.0	57.8	6 25.0	. . . .	. . . .	. . . .	17 98.5	13 22.5	6 17.0	4 14.5	09.6
1861	04.2	87.0	6 03.6	44.5	1 31.0	1 54.0	1 13.5	59.0	6 25.0	. . . .	. . . .	. . . .	15 89.5	11 16.5	6 67.0	4 45.5	06.2
1862	03.8	1 54.9	12 54.7	52.1	1 25.8	1 69.1	1 17.4	79.5	6 95.3	. . . .	. . . .	. . . .	10 84.8	8 79.9	6 92.2	4 89.1	04.8
	04 3	**1 75 5**	**14 21.0**	**59.0**	**1 42.5**	**1 91.5**	**1 33.0**	**99.0**	**7 87.5**	. . . .	. . . .	. . . .	**12 28.5**	**9 96.5**	**7 84.0**	**5 54.0**	**05.5**
1863	. . . .	2 12.9	19 48.1	66.1	1 11.9	1 34.1	1 24.9	94.0	7 40.6	. . . .	. . . .	. . . .	9 92.1	7 98.2	4 72.6	3 48.6	05.5
	. . . .	**3 09.0**	**28 27.5**	**9.0**	**1 62.5**	**1 94.5**	**1 80.0**	**1 36.5**	**10 75.**	. . . .	. . . .	. . . .	**14 40.0**	**11 58.5**	**6 86.0**	**5 06.0**	**08.0**
1864	. . . .	1 48.2	17 69.1	. . . .	. . . .	94.9	1 11.9	76.9	8 50.7	$8 13.8	$0 19.9	$0 33.6	15 03.8	. . . .	5 21.7	. . . .	07.8
	. . . .	**3 01.4**	**35 95.8**	. . . .	. . . .	**1 93.0**	**2 27.5**	**1 56.5**	**17 29.1**	**16 54.1**	**40 6**	**68.3**	**30 56.7**	. . . .	**10 60.4**	. . . .	**15.9**
1865	. . . .	1 05 9	7 97.6	. . . .	. . . .	1 40.9	1 67.3	88.7	9 76.5	10 14.9	26 0	48.3	19 00.6	. . . .	9 91.7	. . . .	12.2
	. . . .	**1 66.6**	**12 54.1**	. . . .	. . . .	**2 21.6**	**2 63.1**	**1 39.6**	**15 35.4**	**15 95.8**	**40.9**	**76.1**	**20 88.5**	. . . .	**15 59.3**	. . . .	**19.3**
1866	. . . .	69.9	2 88.6	. . . .	. . . .	1 79.8	1 27.9	1 11.1	8 91.9	11 47.7	19.1	42.9	20 93.5	. . . .	12 08.4	. . . .	12.1
	. . . .	**84.**	**4 06.6**	. . . .	. . . .	**2 53.3**	**1 80.2**	**1 56.5**	**12 56.2**	**16 1 6**	**27.0**	**60.5**	**29 48.6**	. . . .	**17 02.0**	. . . .	**17.1**
1867	. . . .	4.	2 75.4	. . . .	. . . .	1 71.2	1 17.6	91.8	8 45.5	10 31.7	12.7	32.2	16 18.2	. . . .	13 04.6	. . . .	10.0
	. . . .	**6.**	**3 80.5**	. . . .	. . . .	**2 36.6**	**1 62.5**	**1 26.0**	**11 67.7**	**14 25.0**	**17.6**	**44.6**	**22 35.2**	. . . .	**18 02.0**	. . . .	**13.8**
1868	. . . .	37.6	2 01.6	. . . .	. . . .	1 40.9	1 63.4	78.0	7 86 0	9 42.6	13.8	25.6	16 76.9	. . . .	11 67.9	. . . .	11.2
	. . . .	**52,6**	**2 81.7**	. . . .	. . . .	**1 96.8**	**2 28.3**	**1 09.0**	**10 .9**	**13 16.6**	**19.3**	**35.8**	**23 42.1**	. . . .	**16 31.2**	. . . .	**15.9**
1869	. . . .	35.2	1 71.9	. . . .	. . . .	1 40.1	1 19.5	75.1	8 16.2	9 99.4	17.0	24.2	21 29.8	. . . .	8 91.8	. . . .	13.4
	. . . .	**46·9**	**2 28.7**	. . . .	. . . .	**1 86.3**	**1 58.9**	**99.9**	**10 85.4**	**13 29.0**	**22.7**	**32.2**	**28 32.2**	. . . .	**11 86.0**	. . . .	**17.8**
1870	. . . .	37.4	1 73.6	. . . .	. . . .	1 17.8	1 21.1	80.3	8 44.9	9 91.8	15.8	22.7	23 59.3	. . . .	11 36.3	. . . .	15.3
	. . . .	**43.1**	**1 99.6**	. . . .	. . . .	**1 35.5**	**1 39.3**	**92.3**	**9 70.0**	**11 40.0**	**18.2**	**26.1**	**27 11.9**	. . . .	**13 06.2**	. . . .	**17.6**
1871	. . . .	49.2	2 76.0	. . . .	. . . .	1 16.6	1 08.7	74.9	8 09.1	10 14.3	12.7	22.0	14 97.9	. . . .	11 05.6	. . . .	11.0
	. . . .	**55.0**	**3 08.4**	. . . .	. . . .	**1 30.3**	**1 21.5**	**83.7**	**9 04.1**	**11 33.3**	**14.3**	**24.6**	**16 73.7**	. . . .	**12 35.4**	. . . .	**12.3**
1872	. . . .	56.1	3 57.2	. . . .	. . . .	1 32.9	1 16.0	74.3	7 93.5	10 15.1	15.4	21.2	12 29.1	. . . .	8 97.4	. . . .	09.3
	. . . .	**63.1**	**4 01.4**	. . . .	. . . .	**1 49.3**	**1 30.3**	**83.5**	**8 91.6**	**11 40.6**	**17.4**	**23.9**	**13 81.1**	. . . .	**9 07.2**	. . . .	**11.0**
1873	. . . .	44.2	2 77.6	. . . .	. . . .	1 31.0	1 06.3	74.5	7 99.8	10 10.8	07.3	16.4	14 73.6	. . . .	6 04.3	. . . .	09.8
	. . . .	**50.3**	**3 15.9**	. . . .	. . . .	**1 49.1**	**1 21.0**	**94.8**	**9 10.0**	**11 50.0**	**08.3**	**18.7**	**16 76.5**	. . . .	**6 87.5**	. . . .	**11.2**
1874	. . . .	36.1	2 18.4	. . . .	. . . .	1 44.0	1 05.8	79.0	8 09.1	10 15.8	0.54	12.3	16 53.7	. . . .	10 21.6	. . . .	10.4
	. . . .	**40.2**	**2 43.0**	. . . .	. . . .	**1 60.2**	**1 17.7**	**87.9**	**9 00.0**	**11 30.0**	**06.0**	**13.7**	**18 39.5**	. . . .	**11 36.4**	. . . .	**11.6**
1875	04.4	31.3	1 64.2	. . . .	. . . .	1 43.8	1 02 7	58 2	7 26.8	9 47.4	05.5	11.2	16 16.3	. . . .	9 89.5	. . . .	10.7
	05.1	**36 0**	**1 88.8**	. . . .	. . . .	**1 65.4**	**1 18.1**	**66.9**	**8 35.5**	**10 89.0**	**06.4**	**12.9**	**18 57.9**	. . . .	**11 37.4**	. . . .	**12.4**
1876	04.3	31.7	1 74.3	. . . .	. . . .	1 20.7	1 10.8	51.0	7 36.3	9 39.3	11.2	21.3	16 45.0	. . . .	10 12.0	. . . .	11.2
	04.8	**35.3**	**1 94.1**	. . . .	. . . .	**1 34.5**	**1 23.4**	**56.8**	**8 20.0**	**10 46.0**	**12.5**	**23.8**	**18 31.9**	. . . .	**11 27.0**	. . . .	**12 5**
1877	04.3	34.4	1 84,1	. . . .	. . . .	1 15.8	1 13.7	60.4	7 82.2	9 25.3	08.4	14.9	13 21.1	. . . .	12 84.0	. . . .	09.4
	0.46	**36.1**	**1 93.0**	. . . .	. . . .	**1 21.4**	**1 19.2**	**63.4**	**8 20.0**	**9 70.0**	**08 9**	**15.7**	**13 84.8**	. . . .	**13 46.0**	. . . .	**09.9**
1878	04.4	29.4	1 48.3	. . . .	. . . .	92.6	1 14.5	59.4	8 89.8	8 03.5	06.2	10.6	11 47.5	. . . .	11 93.0	. . . .	08.4
	04.5	**29.7**	**1 49.5**	. . . .	. . . .	**93.4**	**1 15.5**	**59.9**	**8 97.0**	**8 10.0**	**06.3**	**10.7**	**11 56.8**	. . . .	**12 03.0**	. . . .	**08.5**
1879	05.6	38.3	1 56.9	. . . .	. . . .	1 00.5	1 00.0	67.9	6 56.0	8 80.0	03.7	09.0	12 47.6	. . . .	10 50.0	. . . .	09.3
1880	04.5	30.8	1 39.7	. . . .	. . . .	83.8	1 06.6	66.1	7 90.0	7 40.0	04.7	08.0	10 14.3	. . . .	11 19.9	. . . .	08.4
Average.	09.2	49.0	2 98.3	42.0	1 03.2	1 17.6	1 05.9	79.3	7 36.3	9 54.9	12.0	22.1	14 87.0	11 41.0	9 66.4	6 37.0	09.5

Table Showing the Annual Average Gold and Currency Prices of Staple Articles &c.—Continued.

[Currency prices in black figures.]

Date.	Shoulder.	Lard.	Butter.	Cheese.	Rice.	Salt. Liverpool.	Salt. Turk's Islands.	Seeds. Clover.	Seeds. Timothy.	Soap. Brown.	Soap. Castile.	Spices. Pepper.	Spices. Nutmeg.	Spirits. Jamaica.	Spirits. Gin.	Sugar. New Orleans.	Sugar. Cuba.
	Per lb.	Per lb.	Per lb.	Per lb.	Per cwt.	Per sack.	Per bush.	Pr. lb.	Pr. bush.	Per lb.	Per lb.	Per lb.	Per lb.	Per gal.	Per gal.	Per lb.	Per lb.
1825	....	$0 08.6	$ 15.1	$0 07.3	$2 59.5	$2 65.0	$0 61.6	....	....	$0 06.5	$0 10.5	$0 17.6	$1 73.0	$0 89.7	$0 79.1	$0 08.2	$0 09.3
1826	....	07.7	15.7	08.0	2 87.5	2 31.5	50.0	....	....	06.7	10.5	16.5	1 38.5	97.0	78.5	08.3	08.2
1827	....	08.5	17.0	07.3	3 27.0	2 24.0	67.0	....	....	06.6	10.9	16.3	1 38.7	1 07.0	93.7	08.0	08.5
1828	....	06.8	15.5	06.1	3 15.0	2 56.5	49.7	....	....	05.8	11.5	15.6	1 33.0	1 22.5	97.0	07.8	08.6
1829	....	05.6	13.8	06.2	3 00.5	2 30.5	48.5	....	....	06.5	10.9	13.5	1 42.0	1 24.5	96.5	07.1	07.6
1830	....	08.0	13.5	06.7	2767.0	1 99.0	46.5	$0 08.2	....	05.0	10.0	13.8	1 42.0	1 13.0	1 02.5	07.2	07.0
1831	....	09.0	14.8	06.0	3 10.5	1 91.0	50.7	09.5	....	05.5	11.0	14.0	1 49.0	1 08.0	1 14.5	06.0	05.8
1832	....	08.5	15.5	06.0	3 35.5	2 00.0	48.5	09.5	$2 85.7	05.5	12.8	14.8	1 49.0	1 08.0	1 15.0	06.2	06.5
1833	....	08.6	15.6	07.0	3 22.0	1 83.5	43.5	11.7	3 07.7	05.5	11.5	09.6	1 27.0	1 03.2	1 15.5	06.3	07.2
1834	....	07.8	14 1	07.1	3 91.0	1 56.0	38.5	07.0	2 42.6	05.5	12.0	06.8	1 21.5	1 09.5	1 10.5	06 2	07.1
1835	....	09.4	17.3	07.2	3 49.5	1 77.5	36.2	08.0	2 74.4	05.5	14.5	07.3	1 40.5	1 13.5	1 11.5	07.2	07.8
1836	....	14.5	19.5	08.8	3 68.5	1 91.0	37.5	09.0	3 12.6	05.5	13.0	08.0	1 29.0	1 26.5	1 09.1	09.1	09.0
1837	....	10.0	17.2	09.0	3 83.7	1 90.9	36.8	09.9	2 78.6	05.2	12.4	06.9	1 16.1	1 25.3	1 14.8	06.3	06.7
	....	**10.5**	**18.0**	**09.5**	**4 01.0**	**1 99.5**	**38.5**	**10.4**	**2 94.2**	**05.5**	**13.0**	**07.2**	**1 21.4**	**1 31.0**	**1 20.0**	**06.6**	**07.0**
1838	....	10.5	19.8	07.9	4 31.5	1 93.7	39.1	11.4	3 06.7	05.4	12.8	07.1	1 10.6	1 32.3	1 18 9	06.6	06.8
	....	**10.6**	**20.0**	**08.0**	**4 35.5**	**1 95.5**	**39.5**	**11.5**	**3 09.5**	**05.5**	**13.0**	**07.2**	**1 11.7**	**1 33.5**	**1 20.0**	**06.7**	**06.9**
1839	....	11.8	19.0	09.1	4 36.5	1 74.2	37.3	21.5	3 42.8	06.0	12.8	08.7	1 02.8	1 42.5	1 15.5	06.8	06.8
1840	....	10.0	17.5	07.1	3 38.0	1 62.6	34.7	12.1	2 84.4	05.5	11.6	07.1	86.2	1 56.0	1 18.5	05.7	05.8
1841	....	07.3	11.9	05.7	3 46.0	1 59.0	30.0	08.3	3 96.2	05.5	13.7	07.1	79.2	1 60 5	1 13.6	06.0	06.0
1842	....	06.2	11.7	07.0	2 80.0	1 67.0	25.1	08.1	2 79.9	05.5	11.2	07.1	81.6	1 49.0	1 09.2	04 4	04.6
1843	....	06.2	08.6	05.2	2 64.5	1 46.5	....	06.9	2 55.8	05.6	11.7	08.1	86.7	1 45.0	1 22.5	05.3	05.7
1844	....	0.57	09.9	04.6	3 03.0	1 40.5	....	08.1	2 45.6	05.3	09.1	10.1	1 01.2	1 63.0	1 22.5	05.2	06.2
1845	....	07.3	13.5	06.8	3 81.0	1 37.0	37.5	07.1	2 33.0	07.4	08.1	10.0	1 19.0	1 62.5	1 23.5	05.8	05.9
1846	....	06.7	13.0	06.8	3 65.5	1 34.0	33.0	07 5	2 63.4	04.8	08.7	10.0	1 21.6	1 60.5	1 30.0	06.3	08.5
1847	....	09.5	16.0	06.9	4 12.5	1 35.5	30.0	06.9	3 18.5	04.4	11.1	06.4	1 29.5	1 66.0	1 36.5	06.5	07.7
1848	....	07.5	16.0	06.7	3 17.0	1 39.0	25.2	06.2	2 25.6	05.2	10.7	05.4	1 16.6	1 84.5	1 32.5	03.8	06.7
1849	....	06.5	15.0	05.0	2 96.5	1 29.0	24.2	06.0	3 34.1	04.5	09.6	06.0	93.9	1 68.0	1 21.6	04.7	06 9
1850	....	06.4	15.1	06.2	3 18.5	1 36.5	23.4	06.8	3 28.9	04.5	09.0	07.4	1 08.6	1 66.0	1 08.0	05.1	07.4
1851	....	08.1	14.2	05 7	3 02.5	1 34 0	22.5	08.6	3 15.7	04.5	09.0	08.5	99 5	1 45.0	91.0	05.2	07.5
1852	....	10.0	19.2	07.0	3 71.5	1 20.0	21.5	08.0	3 14.2	04.8	09.3	09.0	90.0	1 49.5	86.0	04.3	07.0
1853	....	10.5	18.0	08.5	3 93.5	1 34.5	34.0	09.7	3 11.4	06.0	10.7	10.5	1 03.5	1 39.5	1 17.5	04.7	07.2
1854	....	09.7	19.5	09.5	4 39.0	1 69.5	47.0	09.6	3 22.6	06.0	10.7	10.4	1 07.5	1 62.0	1 34.5	04.7	06.7
1855	....	10.3	21.8	99.5	4 51.5	1 03.5	44.5	10.9	2 99.5	05.7	40.5	10.6	94.0	1 86.0	1 37.5	05.6	07.2
1856	....	11.5	21.6	08.6	4 16.5	92.6	29.2	13.2	3 45.5	05.7	10.3	10.8	88.7	1 83.5	1 55 0	07.8	09.8
1857	....	13.6	21.5	09.4	4 34.0	79.7	23.1	11.5	3 75.5	05.5	11.1	11.3	73.3	1 95.5	1 29.0	10.0	11.8
1858	....	10.2	18.5	06.8	3 26.5	65.5	18·5	08.3	2 34.5	05,5	11.3	08.2	56.5	1 49.5	99.0	06.5	08.7
1859	....	10.7	19.0	08.3	3 66.5	83.0	18.5	08.7	2 60.5	05.7	09.2	08.2	49.6	1 37.5	94 5	06.3	07.8
1860	....	11.2	16.7	09.8	4 08.0	90.5	18 5	07.8	3 30.0	06.5	08.5	07.2	43.0	1 40.5	90.0	07.1	08.5
1861	....	09.0	15.0	07.2	5 02.5	73.0	20.1	07.8	2 75.0	05.5	18.8	08.1	43.6	1 39.5	1 07.5	06.0	07.6
1862	....	07.3	15.4	06.6	6 36.2	97.5	26.1	07.0	1 79.6	04.8	12.3	13.8	61.9	1 49.2	1 47.4	07.8	09.0
	....	**08.3**	**17.5**	**07.5**	**7 20.5**	**1 10.5**	**28.5**	**08.0**	**2 03.5**	**0 .5**	**4.0**	**15.7**	**70.2**	**1 69.0**	**1 67.0**	**08.9**	**10.2**
1863	....	07.0	15.1	68.0	4 19.2	1 01.9	27.3	06 5	1 66.3	....	11.3	18.4	58.1	1 90.9	2 05.3	07.4	07.2
	....	**10.2**	**22.0**	**11.6**	**6 08.5**	**1 48.0**	**39.7**	**09.5**	**2 40.0**	....	**16.5**	**2 60.7**	**84.3**	**2 77.1**	**98.0**	**10.8**	**10.5**
1864	06.5	08.3	18.7	08.2	5 41.2	1 27.4	33.3	08.3	2 06.2	....	....	....	....	....	....	....	08.6
	13.2	**17.0**	**38.2**	**16.8**	**11 00.0**	**2 59.1**	**67.8**	**17.0**	**4 19.3**	....	....	....	....	....	....	....	**17.5**
1865	09.9	13.2	19.3	10.1	7 70.4	1 32.8	34.7	14.6	3 19.8	....	....	....	....	....	....	....	09.1
	15.6	**20.9**	**30.4**	**15.9**	**12 11.4**	**2 08.9**	**54.7**	**23.0**	**5 02.9**	....	....	....	....	....	....	....	**14.3**
1866	10.8	12.5	23.5	12.6	9 10.3	1 32.2	34.6	08.6	3 42.3	....	....	....	....	....	....	....	07.4
	15.3	**17.7**	**33.2**	**17.7**	**12 82.2**	**1 86.2**	**48.8**	**12.2**	**4 82.2**	....	....	....	....	....	....	....	**10.5**
1867	07.3	09.3	15.5	11.0	7 83.6	1 42.0	36.7	09.7	2 31.0	....	....	....	....	....	....	....	07.6
	10.2	**12.9**	**21.5**	**15.2**	**10 82.3**	**1 96.2**	**50.8**	**13.4**	**3 19.1**	....	....	....	....	....	....	....	**10.6**
1868	08.2	11.6	22.1	10.2	7 34.0	1 51.2	33.2	08.8	1 98·7	....	....	....	....	....	....	....	07.8
	11.5	**16.3**	**31.0**	**14.3**	**10 20.2**	**2.**	**46.5**	**12.5**	**.77.5**	....	....	....	....	....	....	....	**11.0**
1869	10.6	13.7	19.3	12.3	6 54.0	1 39.2	35.2	10.3	3 12.2	....	....	....	....	....	....	....	08.3
	14.2	**18.3**	**25.8**	**16.5**	**8 69.7**	**1 85.2**	**46.8**	**13.7**	**4 15.0**	....	....	....	....	....	....	....	**11.1**
1870	10.7	13.7	20.1	12.8	6 53.4	2 04.5	34.8	11.6	·6 03.8	....	....	....	....	....	....	....	07.9
	12.3	**15.8**	**23.1**	**14.8**	**7 51.1**	**2 35.1**	**40.0**	**13.4**	**5 79.1**	....	....	....	....	....	....	....	**09.1**
1871	06.1	09.9	16.1	09.9	7 64.3	2 22.9	39.8	09.6	4 10.0	....	....	....	....	....	....	....	07.8
	06.9	**11.1**	**18.1**	**11.1**	**8 42.9**	**2 49.1**	**44.5**	**10.8**	**5 58.2**	....	....	....	....	....	....	....	**08.8**
1872	05.3	08.0	16.1	10.6	7 76.9	2 12.4	35.6	08.8	3 09.2	....	....	....	....	....	....	....	07.4
	06.0	**09.0**	**17.0**	**11.9**	**8 71.9**	**1 38.7**	**40.1**	**09.0**	**9 47.5**	....	....	....	....	....	....	....	**08.4**
1873	06.3	07.3	18.2	11.3	7 40.9	1 77.2	31.0	08.1	3 30.5	....	....	....	....	....	....	....	07.0
	07.2	**08.4**	**20.8**	**12.9**	**8 42.9**	**2 01.6**	**35.3**	**09.1**	**3 76.1**	....	....	....	....	....	....	....	**08.0**
1874	06.8	10.5	25.4	10.7	7 26.5	1 00.4	26.1	08.9	2 76.1	....	....	....	....	....	....	....	07.0
	07.6	**11.7**	**28.3**	**12.4**	**8 01.5**	**1 11.7**	**29.1**	**09.9**	**3 06.0**	....	....	....	....	....	....	....	**07.8**
1875	08.0	12.0	18.9	09.4	6 47.0	83.2	22.4	10.1	2 32.0	....	....	....	....	....	....	....	07.0
	09.2	**13.8**	**21.8**	**10.9**	**7 43.7**	**95.7**	**25.8**	**11.6**	**2 66.7**	....	....	....	....	....	....	....	**8.1**
1876	07.0	09.6	20.4	09.4	6 28.0	80.1	24.4	13.6	1 98.3	....	....	....	....	....	....	....	08.2
	07.8	**10.6**	**22.8**	**10.5**	**5 88.0**	**89.2**	**27.2**	**15.1**	**2 20.9**	....	....	....	....	....	....	....	**09.2**
1877	06.4	08.9	24.0	11.6	6 80.6	73.2	27.1	12.2	1 70.0	....	....	....	....	....	....	....	08.5
	.8	**09.4**	**25.2**	**12.2**	**6 08.5**	**76.8**	**28.4**	**12.8**	**1 78.2**	....	....	....	....	....	....	....	**08.9**
1878	04.9	06.9	23.3	09.9	6 16.0	65.0	26.3	07.3	1 30.0	....	....	....	....	....	....	....	07.2
	05.0	**07.0**	**23.5**	**10.0**	**6 20.0**	**65.6**	**26.6**	**07.4**	**1 32.0**	....	....	....	....	....	....	....	**07.3**
1879	05.7	0.78	23.7	11.2	6 60.0	73.8	28.8	07.7	2 76.7	....	....	....	....	....	....	....	07.6
1880	04.9	06.6	23.0	07.6	6 69.0	69.0	30.6	07.1	1 78.9	....	....	....	....	....	....	....	07.0
Aver.	07.3	09.1	17.5	08.2	4 60.7	1 45.7	33.6	09.2	2 85.1	06.5	10.9	10.1	1 05.2	1 42.3	1 15.3	05.4	07.4

Table Showing the Annual Average Gold and Currency Prices of Staple Articles, &c.—*Continued.*

[Currency prices in black figures.]

Date.	Sugar.	Tallow.		Tea.				Tobacco.			Wine.				Wool.		
	Loaf.	*American.*	*Foreign.*	*Young Hyson.*	*Oolong.*	*Souchong.*	*Imperial.*	*Kentucky.*	*Manufactured.*	*Havana.*	*Whalebone.*	*Port.*	*Madeira.*	*Claret.*	*Common.*	*Merino.*	*Pulled.*
	Per lb.	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*
1825 .	$0 18.0	$0 07.9	$ 0 07.5	$0 99.2	....	$0 62.5	$1 34.0	$0 05.8	$0 15.7	....	$0 23.5	$1 75.0	$2 75.0	$23 83.0	$0 33.5	$0 58.5	$0 32.6
1826 .	17.8	09.0	09.0	92.0	....	58.7	1 25.0	06.2	12.3	....	30.1	1 73.0	2 75.0	23 91.0	30.0	49.5	28.7
1827 .	18.0	09.3	09.0	96.5	....	66.5	1 28.0	04 6	11.5	....	40.6	1 06.5	2 75.0	22 46.6	25.0	39.0	21.6
1828 .	18.0	07.8	08.2	93.3	....	62.6	1 16.5	04.0	11.6	....	41.2	1 70 0	2 62.5	22 00.0	25.0	37.0	24.0
1829 .	18.0	06.4	07.7	92.0	....	62.0	1 18.5	05.5	11.6	....	30.3	1 34.0	1 99.5	19 33.0	21 5	34.5	25.0
1830 .	18.0	07.5	06.2	88.5	....	60.0	1 16.0	05.5	10.5	....	26.0	1 10.0	1 90.5	17 00.0	22.0	39.0	28.5
1831 .	16.8	09.0	07.5	97.7	....	63.5	1 22.0	04.5	10.7	....	22.5	1 10.0	1 87 5	24 37.0	27.5	53.5	55 0
1832 .	15.5	09.0	07.5	88.0	....	50.0	1 15.0	04.0	11.0	....	16.7	1 16.0	1 71.5	21 95.5	27.5	47.5	42.7
1833 .	15.8	09.2	07.5	74.5	....	36 5	92.0	04.7	11.0	....	15.7	1 28.5	1 68.5	17 20.5	31.5	49.0	48.7
1834 .	15.8	07.0	07.6	61.0	....	30.0	80.0	06.5	12.0	....	17.7	1 23.0	1 66.5	14 33.5	30.2	48.8	46.3
1835 .	15.0	08.2	08.5	62.8	....	27.5	81.5	08.0	13.0	....	23.5	1 23.7	1 67.0	15 25.0	33.7	53.9	47.1
1836 .	16.2	09.2	....	63.7	....	32.0	82.5	08.2	15.6	....	25.6	1 30 8	1 62.5	15 29.0	42.8	58.6	52.7
1837	14 8	09.9	....	58.8	....	29.1	77.7	06.2	16.3	....	20.0	1 61.2	1 55.5	16 06.8	41.6	40.5	40.3
	15.5	**10.4**	....	**61.5**	....	**30.5**	**81.2**	**06.5**	**16.0**	....	**21.0**	**1 68.5**	**1 62.5**	**15 74.5**	**43.5**	**42.4**	**42.2**
1838	15.3	10.2	....	57.4	....	27.2	76.8	07.5	15.5	....	19.4	1 29.4	1 65.1	15 60.8	30.4	37.7	34.3
	15.5	**10.3**	....	**58.0**	....	**27.5**	**77.5**	**07.6**	**15.7**	....	**19.6**	**1 30.6**	**1 66.6**	**15 75.0**	**30.7**	**38.1**	**34.7**
1839 .	15.5	11.6	11.3	63.3	....	27.5	77.5	13.0	20.5	....	19.1	1 30.0	2 00 0	20 00.0	38.5	51.2	42.5
1840 .	12.5	08.7	08.0	67.7	....	45.5	77.0	08.5	13.7	....	19.5	1 16.0	1 70.0	19 16.5	28.0	39.1	28.2
1841 .	12.0	07.5	....	74.9	....	58.9	75.5	08.2	13.5	....	20.3	1 06.0	1 67.0	15 00.0	27.0	44.2	33.0
1842 .	10.0	07.0	....	64.0	....	49.4	60.7	05.0	11 6	....	26.1	95.0	1 68.4	12 71.0	19.3	32.0	29.0
1843 .	10.7	06.8	08.5	60.0	....	43.0	60.0	04.7	12.5	....	35.5	87.5	1 25.0	12 75.0	20.5	30.5	23.0
1844 .	11.0	06.6	07.5	60.0	....	37.0	63.0	04.0	12.5	....	40.7	1 08.5	1 62.0	19 00.0	30.0	40.0	32.0
1845 .	11.4	06.7	07.5	59.5	....	36.5	67.2	04.5	12.5	....	35.3	97.5	1 44.5	22 50.0	27.0	35.1	29.7
1846 .	11.0	07.2	....	68.0	....	39.0	64.0	04.7	12.5	....	34.0	1 13.0	1 55.0	22 00.0	23.5	32.3	23.8
1847 .	10.0	08.7	....	52.0	....	56.0	56.0	04.8	13.1	....	30 7	1 52.5	1 80.5	25 77.0	26.2	35.2	28.0
1848 .	08.0	08.0	....	48.5	....	27.0	49.5	05.3	13.5	....	25.6	1 50.5	1 83.0	28 17.0	26.1	34.3	26.0
1849 .	08.5	07.5	....	47.5	....	34.7	51.5	06.1	14.0	....	32.3	1 60.5	1 88.5	23 60.0	29.2	36.1	27.6
1850 .	09.5	06.8	....	49.6	....	40.0	58.5	08.2	21.0	....	34.2	1 25.0	1 88.5	23 50.0	32.6	40.0	32.5
1851 .	09.0	06.7	....	51.3	....	34.3	57.5	08.1	25.5	....	34.5	1 33.5	1 90.0	23 50.0	35.5	42.5	34.7
1852 .	08.0	08.1	....	50.5	....	30.5	54.0	06.5	19.5	....	54.0	1 37.5	1 90.0	23 50.0	32.0	39.7	32.7
1853 .	08.3	08.8	....	45.0	....	27.0	43.5	07.0	20.2	....	....	1 38.0	1 92.0	23 50.0	41.0	50.0	40.0
1854 .	09.0	11.6	....	42.5	....	23.0	24.0	08.0	18.5	....	36.0	1 67.5	2 14.0	32 83.0	32.4	42.1	30.8
1855 .	08.6	11.7	....	36.8	....	21.0	22.5	09.4	19.7	....	41.0	2 21.0	2 33.0	43 33.0	29.8	37.0	25.0
1856 .	10.7	11.0	....	37.5	....	17.7	24.1	11.0	22.0	....	56.7	2 80.0	2 86.5	50 00.0	33.5	44.6	31.1
1857 .	12.6	10.7	....	42.0	....	28.7	33.2	14.1	27.7	....	89.0	3 00.0	3 37.5	50 00.0	36.8	49.0	32.8
1858 .	10.0	09.3	....	35.5	....	26.5	29.0	10.5	24.0	....	90.0	2 95.0	3 29.0	56 66.0	30.0	39.0	24.8
1859 .	09.5	10.5	....	22.7	....	29.5	28.8	08.8	23.0	....	79.5	2 92.5	3 60.0	52 50.0	38.0	49.2	32·0
1860 .	09.8	10.0	....	25.0	....	30.0	32.5	08.1	19.7	....	81.5	2 95.0	3 68.5	52 50.0	36.7	50.0	29.4
1861 .	08.0	08.8	....	43.0	....	27.0	47.5	09.1	24.0	....	69.5	2 80.0	4 25.0	52 50·0	32.5	43.0	26.5
1862	10.1	08.2	....	54.3	....	38.8	67.5	13.2	37.5	....	74.6	2 42.8	3 75.2	46 35.7	44.1	46.7	36.2
	11.5	**09.3**	....	**61.5**	....	**44.0**	**76.5**	**10.5**	**42.5**	....	**84.5**	**2 75.0**	**4 25.0**	**52 50.0**	**50.0**	**53.0**	**41.0**
1863	10.0	07.7	....	38.7	....	40.7	44.0	14.4	39.6	....	1 06.9	2 12.2	2 92.8	47 94.0	46.5	51.4	40.3
	14.6	**11.2**	....	**56.2**	....	**59.1**	**64.0**	**21.0**	**57.5**	....	**1 55.2**	**3 08.0**	**4 25.0**	**69 58.0**	**67.6**	**74.7**	**58.6**
1864	09.9	07.5	....	44.9	$0 53.4	47.1	....	13.1	....	$0 61.8	....	....	....	....	....	43.7	43.3
	20.2	**15.3**	....	**91.4**	**1 08.6**	**95.8**	....	**26.7**	....	**1 25.6**	....	....	....	....	....	**88.9**	**88.1**
1865	11.6	08.7	....	63.9	69.8	59.2	....	11.8	....	75.1	....	....	....	....	25.3	51.3	48 7
	18.3	**13.7**	....	**1 00.6**	**1 09.8**	**93.1**	....	**18.7**	....	**1 18.1**	....	....	....	....	**39.9**	**80.7**	**76.6**
1866	10.7	08.7	....	65.3	79.8	64.7	....	09.5	....	62.7	....	....	....	....	24.2	47.3	41.3
	15.1	**12.3**	....	**92.0**	**1 12.5**	**91.2**	....	**13.5**	....	**88.4**	....	....	....	....	**34.2**	**66.7**	**58.2**
1867	10.5	08.2	....	62.9	75.2	70.7	....	08.7	....	47.3	....	....	....	....	23.3	44.3	36.7
	14.6	**11.4**	....	**87.0**	**1 03.9**	**97.7**	....	**12.1**	....	**65.4**	....	....	....	....	**32.2**	**61.2**	**50 8**
1868	10.5	08·6	....	67.0	73.9	70.9	....	07.9	....	57.3	....	....	....	....	21.4	41.1	33.3
	14.8	**12.1**	....	**93.6**	**1 03.3**	**99.1**	....	**11.1**	....	**80.0**	....	....	....	....	**30.0**	**57.6**	**46.6**
1869	11.2	08.5	....	72.4	69.3	67.9	....	07.5	....	64.2	....	....	....	....	22.4	44.7	33 0
	15.0	**11.4**	....	**96.3**	**92.2**	**90.3**	....	**10.0**	....	**85.5**	....	....	....	....	**29.8**	**59.5**	**43.9**
1870	11.0	08.3	....	73.4	70.9	73.1	....	08.1	....	66.9	....	....	....	....	19.6	48 2	34.3
	12·7	**09.6**	....	**84.4**	**81.5**	**84.1**	....	**09.4**	....	**77.0**	....	....	....	....	**22.6**	**55.5**	**39.5**
1871	11.2	08.1	....	42.8	62.6	61.8	....	07.6	....	74.1	....	....	....	....	28.3	53.7	36·9
	12.6	**09.1**	....	**47.9**	**70.0**	**69.1**	....	**08.5**	....	**82.8**	....	....	....	....	**31.7**	**60.0**	**41.3**
1872	10.5	08.1	....	41.1	52.3	52.2	....	10.7	....	90.0	....	....	....	....	31.1	63.1	56.6
	11.8	**09.1**	....	**46.2**	**58.8**	**58.7**	....	**12.1**	....	**1 01.2**	....	....	....	....	**35.0**	**71.0**	**63.6**
1873	09.1	07.3	....	48.8	41.1	40.8	....	10.6	....	81.4	....	....	....	....	27.7	50.4	42.7
	10.4	**08.3**	....	**55.6**	**46.8**	**46.5**	....	**12.1**	....	**92.7**	....	....	....	....	**31.6**	**57.4**	**48.6**
1874	09·3	07.2	....	44.9	64.2	38.9	....	09.7	....	67.7	....	....	....	....	26.0	51.6	41.7
	10.4	**08.0**	....	**52.0**	**60.4**	**43.3**	....	**10.8**	....	**75.3**	....	....	....	....	**29.0**	**57.4**	**46.4**
1875	08.7	07.9	....	43.6	36.6	39.0	....	11.8	....	81.3	....	....	....	....	25.1	48.7	38.8
	10.1	**09.1**	....	**50.2**	**42.1**	**44.9**	....	**13.6**	....	**93.5**	....	....	....	....	**28.9**	**56.0**	**44.6**
1876	09.3	07.4	....	33.2	38.7	42.6	....	09.8	....	88.9	....	....	....	....	22.7	39.9	31.2
	10.4	**08.3**	....	**37.0**	**43.1**	**47.5**	....	**11.0**	....	**99.0**	....	....	....	....	**25.3**	**44.5**	**34.8**
1877	09.7	07.5	....	35.2	41.9	45.3	....	09.8	....	91.5	....	....	....	....	25.7	48.8	36.2
	10.2	**07.9**	....	**37.0**	**44.0**	**47.5**	....	**10.3**	....	**96.0**	....	....	....	....	**27.0**	**51.2**	**38.0**
1878	08.8	06.9	....	25.8	32.9	34.4	....	07.1	....	87.5	....	....	....	....	24.1	41.6	33.6
	08.9	**07.0**	....	**26.1**	**33.2**	**34.7**	....	**07.2**	....	**88.2**	....	....	....	....	**24.3**	**42.0**	**33.9**
1879 .	09.0	06.2	....	31.3	28.8	31.5	....	08.0	....	90.9	....	....	....	....	32.8	52.0	41.4
1880 .	08.6	06.3	....	23.4	29.8	32.6	....	07.7	....	92.2	....	....	....	....	25.4	41.4	34.9
Aver.	11.7	08.3	08.0	56.7	53.6	43.0	70.0	07.9	17.1	75.3	39·9	1 63.5	2 21.4	27 35.3	29.5	44.5	35.0

Table comparing the Percentage of Yearly Gold and Currency Prices to the Mean Gold Prices of Staple Articles in the New York Market for 56 years from 1825 to 1880, with the Circulation and its Ratio to the Population and Wealth of the United States as estimated for each year from the Census Returns of 1850, 1860, 1870, and 1880.

Years.	Percentage to mean gold price for 56 years of yearly—		Circulation, millions.			Population, millions.	Wealth, millions.*	Ratio of total circulation to—	
	Currency prices.	Gold prices.	Specie.	Paper.	Total.			Population.	$1,000 wealth.
1825	104.4	104.4	$19	. .	. . .	11.2	$3,273	. . .	. .
1826	102.2	102.2	17	. .	. . .	11.5	3,377	. . .	. .
1827	101.2	101.2	20	. .	. . .	11.9	3,484	. . .	. .
1828	98.9	98.9	22	. .	. . .	12.2	3,594	. . .	. .
1829	96.6	96.6	22	. .	. . .	12.5	3,708	. . .	. .
1830	92.6	92.6	25	$61	$86	12.9	3,825	6.66	.22.4
1831	97.4	97.4	32	. .	. . .	13.3	3,946	. . .	. .
1832	99.0	99.0	33	. .	. . .	13.6	4,071	. . .	. .
1833	96.1	96.1	35	86	121	14.0	4,200	8.64	.29.2
1834	88.6	88.6	41	95	136	14.4	4,333	9.44	.31.3
1835	99.1	99.1	67	104	161	14.8	4,470	10.87	.36.0
1836	109.6	109.6	64	140	204	15.2	4,612	13.42	.44.2
1837	104.7	100.2	73	149	222	15.7	4,759	14.14	.46.6
1838	101.9	101.0	77	116	193	16.1	4,900	11.98	.39.4
1839	108.8	108.8	92	135	227	16.6	6,066	13.67	.44.8
1840	95.3	95.3	88	107	195	17.1	5,226	11.40	.37.3
1841	92.6	92.6	89	107	196	17.6	6,392	11.13	.36.3
1842	81.0	81.0	84	84	168	18.2	5,563	9.23	.30.2
1843	80.0	80.0	83	59	142	18.7	5,739	7.59	.24.7
1844	82.7	82.7	103	75	178	19.3	6,922	9.22	.30.0
1845	86.3	86.3	102	90	192	19.9	6,109	9.64	.31.4
1846	85.7	85.7	98	106	204	20.5	6,302	9.95	.32.3
1847	92.6	92.6	98	106	204	21·2	6,501	9.62	.31.3
1848	82.8	82.8	125	129	254	21.8	6,707	11.65	.37.8
1849	83.5	83.5	120	115	235	22.5	6,918	10.44	.33.9
1850	88.9	88.9	134	131	265	23.2	7,136	11.42	·37.1
1851	89.3	89.3	172	155	327	24.0	7,981	13.62	.40.9
1852	91.9	91.9	205	170	375	24.8	8,838	15.12	.42.4
1853	99.4	99.4	228	196	424	25.7	9,708	16.50	.43.6
1854	107.0	107.0	266	205	471	26.5	10,591	17.77	.44.4
1855	111.1	111.1	295	187	482	27.3	11,488	17.65	.41.9
1856	112.2	112.2	295	196	491	28.1	12,396	17.47	.39.6
1857	119.8	119.8	315	215	530	28.9	13,318	18.33	.39.8
1858	99.7	99.7	287	155	442	29.8	14,252	14.83	.31.0
1859	100.6	100.6	307	193	600	30.6	15,200	16.33	.32.9
1860	100.3	100.3	280	207	487	31.5	16,160	15.46	.30.1
1861	98.0	98.0	248	202	450	32.1	17,013	14.01	.26.4
1862	126.4	111.6	310	218	628	32.7	17,906	16.14	.29.5
1863	173.3	119.4	341	539	880	33.4	18,838	26.34	.46.7
1864	223.8	110.1	336	636	972	34.1	19,809	28 50	.49.0
1865	193 4	123.0	269	888	1,167	34.8	20,820	33.24	.55.5
1866	167.8	119.1	248	945	1,193	35.5	21,869	33.60	.54.5
1867	156.1	113.0	216	858	1,074	36.3	22,958	29.58	.46.7
1868	150.3	107.6	206	757	963	37.0	24,086	26.02	.40.0
1869	143.9	108.2	166	752	908	37.8	25,253	24.02	.35.9
1870	135.6	118.1	159	743	902	38.6	†26,460	23.36	.34 0
1871	120.7	108.1	169	746	915	39.6	27,851	23.10	.32.8
1872	126.5	112.6	139	751	890	40.6	29,308	21.92	.30.3
1873	122.4	107.6	140	749	889	41.7	30,831	21.32	.28.8
1874	118.7	106.8	171	778	949	42.8	32,420	22.17	.29.2
1875	112.9	98.3	157	783	940	44.0	34,074	21.36	.27.5
1876	105.0	94.2	186	763	949	45.2	35,794	20.99	.26.5
1877	102.7	98.0	246	714	960	46.4	37,579	20.68	.25.5
1878	88.7	88.0	328	690	1,018	47.6	39,430	21.38	.25.8
1879	94 7	94.7	399	687	1,086	48.9	41,347	22.20	.26.2
1880	90.3	90.3	502	705	1,207	50.2	43,300	24.04	.27.9

*Estimated for 1825 to 1850 from census returns of 1850 and official valuation of houses, lands, and slaves in 1815, *vide* Pitkin's Statistics, p. 313.

†Reduced to gold valuation.

GREAT BRITAIN—GOLD IN THE ARTS.

Professor Suess, in his book, "Die Zukunft des Goldes," says: "In order to get some reliable information on the consumption of gold in the arts in Great Britain, I wrote to the chamber of commerce in Birmingham, a principal seat of that industry. Its secretary, Mr. H. J. Harding, has been kind enough to procure an answer from Mr. John Bragg, a very competent expert, who writes, under date of January 10, 1877, as follows: "The amount of bullion, including sovereigns, which are melted every day in large quanties, is from 250,000 to 300,000 ounces annually. In the year 1874 120,000 ounces passed the Birmingham assay office. This amount has risen for several years 20,000 ounces annually, and may be now from 150,000 to 160,000 ounces. As we know for certain that not one-half passes this office, it is reasonable to conclude that the amount is to-day near 300,000 ounces, to which figure an eminent bullion dealer consents. This single place consumes therefore about

Table comparing the Ratio of Circulation to Population and Wealth with the Currency and Gold Prices of Staple Articles in the New York Market for years named, taking the Ratios and Prices of 1850 as 100.

Years.	Percentage of ratio of circulation to—		Mean of preceding columns.	Percentage to average price of 1850 of yearly average—	
	Population.	$1,000 of wealth.		Currency prices.	Gold prices.
1850	100.0	100.0	100.0	100.0	100.0
1851	119.2	110.2	114.7	100.4	100.4
1852	132.4	114.2	123.3	103.3	103.3
1853	144.4	117.5	130.9	111.8	111.8
1854	165.6	119.6	137·6	120.3	120.3
1855	154.5	112.9	133.7	125.0	125.0
1856	152.9	106.7	129.8	126.2	126.2
1857	160.5	107.2	133.8	134.7	134.7
1858	129.8	83.5	106.6	112.1	112.1
1859	143.0	88.6	115.8	113.1	113.1
1860	135 3	81.1	108.2	112.8	112.8
1861	122.6	71.1	96.8	110.2	110.2
1862	141.3	79.5	110.4	142.1	125.5
1863	230.6	125.8	178.2	194.9	134.3
1864	249.5	132.0	190.7	251.7	123.8
1865	291.0	149.5	220.2	217.5	138.3
1866	294.2	146.9	220.5	188.7	134.0
1867	259.0	125.8	192.4	175.6	127.1
1868	227.8	107.8	167.8	169.0	121.0
1869	210.3	96.7	153.5	161.8	121.7
1870	204.5	91.6	148.0	152.5	132.8
1871	202.2	88.4	145.3	135.7	121.6
1872	191.9	81.6	136.7	142.2	126.6
1873	186.7	77.6	132.1	137.6	121.0
1874	194.1	78.7	136.4	133.5	120.1
1875	187.0	74.1	130.5	138.2	110.5
1876	183·8	71.4	127.6	118.1	106.0
1877	181.0	68.7	124.8	115.5	110.2
1878	187.2	69.5	128.3	99.7	98.9
1879	194.2	70.6	132.4	106.5	106.5
1880	210.5	75.2	142.8	101.5	101.5

30,000,000 of francs annually, with an increase of 2,000,000 per year. It seems to follow from this that the opinion of an annual consumption of gold in England of from 4,000,000 to 5,000,000 sterling for use in the arts, for abrasion and for recoining, is probably far below the truth."

Some information on this subject may be gathered from the hall marks, which are registered according to law, and from the amounts of duty on manufactures from gold and silver, which is 17s. for the ounce of gold. Manufactures of a low degree of fineness (of 15, 12, and 9 karats) are not subject to that duty, and not also gold used for the production of foil and thread, and that used in gilding porcelain, etc. It follows from this that the information cannot be exact, and is only apt to show the proportional increase in the course of years. There was subject to this duty on gold manufactures:

Years.	Total ounces.	Average ounces.
1807–1814	50,750	6,344
1815–1823	51,321	6,415
1831–1835	27,991	5,590
1836–1840	35,428	7,086
1841–1845	34,578	6,915
1846–1860	38,200	7,640
1851–1856	49,919	9,960
1856–1860	55,716	11,142
1861–1865	55,021	11,004
1866–1870	69,983	13,997
1871–1875	110,161	22,032
1876	. . . .	23,850
1877	. . . .	22,708

Table showing the Annual Consumption of Gold in the Arts.

Countries.	Gross gold consumption.	Deductions for old material reused.	Net gold consumption
	Kg. f.	Per cent.	Kg. f.
United States	15,000	10	13,500
Great Britain	20,000	15	17,000
France	21,000	20	16,900
Germany	14,700	20	11,760
Switzerland	15,000	26	11,250
Austro-Hungary	2,900	15	2,465
Italy	6,000	26	4,500
Russia	3,000	20	2,400
All above countries	97,600	. . . . .	79,775
Other civilized countries	5,000	20	4,000
Total	102,600	. . . . .	83,775

Proportion of production of gold and silver from 1493 to 1880.

Period.	*Years.*	*Silver.*	*Proportion of silver to total of precious metals.*	*Gold.*	*Proportion of gold to total of precious metals.*	*Total weight of precious metals, silver and gold.*	*Year.*	*Average ratio value of silver to gold for each period.*
		Pounds.		*Pounds.*		*Pounds*		
1493-1520	28	2,895,200	89	357,280	11	3,252,656	1493-1520	10.5—11. 1
1521-1544	24	4,762,560	93	378,048	7	5,140,608	1521-1544	11.25
1545-1560	16	10,968,320	97	299,552	3	11,267,872	1545-1560	11.30
1561-1580	20	13,178,000	98	300,960	5	13,478,960	1561-1580	11.50
1581-1600	20	18,431,600	98	324,720	2	18,756,320	1581-1600	12.1
1601-1620	20	18,607,800	98	374,880	2	18,982,480	1601-1620	12.5
1621-1640	20	17,318,400	98	365,200	2	17,683,600	1621-1640	14.0
1641-1660	20	16,117,200	98	385,880	2	16,503,080	1641-1660	14.50
1661-1680	20	14,828,000	97	407,440	3	15,235,440	1661-1680	15.0
1681-1700	20	15,043,600	97	473,660	3	15,517,260	1681-1700	14.96
1701-1720	20	15,646,400	97	564,080	3	16,210,480	1701-1720	15.21
1721-1740	20	18,972,800	96	839,520	4	19,812,320	1721-1740	14.71
1741-1760	20	23,458,380	96	1,082,640	4	24,541,220	1741-1760	14.71
1761-1780	20	28,720,560	97	911,020	3	29,631,580	1761-1780	14.64
1781-1800	20	38,678,040	98	782,760	2	39,461,400	1781-1800	14.76
1801-1810	10	19,67 ,300	98	391,116	2	20,062,416	1801-1810	15.42-15.61
1811-1820	10	11,896,940	98	251,790	2	12,148,730	1811-1820	15.54
1821-1830	10	10,132,320	97	312,752	3	10,445,072	1821-1830	15.80
1831-1840	10	13,121,900	97	446,358	3	13,568,258	1831-1840	15.77
1841-1850	10	17,169,130	93	1,204,698	7	18,373,828	1841-1850	15.75-15.60
1851-1855	5	9,747,265	82	2,172,665	18	11,919,930	1851-1855	15.42
1856-1860	5	9,954,890	81	2,266,638	19	12,221,528	1856-1860	15 30
1861-1865	5	12,112,650	86	2,036,353	14	14,149,003	1861-1865	15 36
1866-1870	5	14,729,935	87	2,110,900	13	16,840,835	1866-1870	15.55
1871-1875	5	21,663,675	92	1,877,425	8	23 541,100	1871-1875	15.98
1876-1880	5	21,756,250	92	1,668,750	8	23,425,000	1876-1880	18.20
	388	419,583,515	95	22,587,285	5	442,170,976		

Note.—The average price of silver in London for 1876–'80 may be taken as 52¾d. the ounce, and the value for that period is calculated at that ratio.

Table showing the Annual Consumption of Silver in the Arts

Countries.	*Gross consumption.*	*Deductions for old material —re-used.*	*Net silver consumption.*
	Kg. f.	Per cent.	Kg. f.
United States	120,000	15	102,000
Great Britain	90,000	20	72,000
France	100,000	25	75,000
Germany	10 ,000	25	75,000
Switzerland	32,000	25	24,000
Austro-Hungary	40,000	20	32,000
Italy	25,000	25	19,000
Russia	40,000	20	32,000
All above countries	547,000		431,000
Other civilized countries	53,000		40,000
Total	600,000		471,000

To an inquiry of the Chamber of Commerce, the following sums are given as representing the value of the industries named in Paris alone for 1860: Manufactures of gold and silver thread, 3,469,190 francs; gold and silver foil, 13,607,300 francs; fine jewelry, 69,213,700 francs; chains, 14,837,760 francs. In the official statistics for 1879, the following statements occur: Export of gold jewelry, 4,694 kilograms, value 25,798,000 francs; gold foil, 1,185 kilograms, value 3,793,000 francs; gold thread 3,882 kilograms, value 3,885,000 francs.

A note from an expert, in my possession, states that from 60,000,000 to 80,000,000 of francs, fine gold, is used in the arts annually in Paris.

The last figure may be too high, but it is clear that the consumption of gold has increased very much in France, which is in this respect much above almost every other country. This circumstance goes far to explain the great difference between import and export of gold in France. The following are the figures for it:

	1847-1856.	1857-1866.	1867-1876.
	Kilos.	*Kilos.*	*Kilos.*
Import	66,405	171,511	131,498
Export	17,086	83,888	66,752
Import greater by	49,319	87,623	64,746

[*Extract from Verwendung des Goldes und Silbers. Statistische Untersuchung von Dr. Adolf Soetbeer.*]

The French gold coinage from 1851 to 1875 reached the enormous sum of 5,464 millions of francs, for which were required 1,762,600 kilograms gold, on the average 70,000 kilograms annually. It is evident that for industrial uses coin was melted to a large extent. All these circumstances duly considered, it will come near the truth if we assume the use of gold in the arts at 21,000 kilograms for France.

Decrease of amount of precious metals in the civilized world by the absorption of Asia.

	Kilos.
1851-1860, annual average	10,000
1861-1870, annual average	30,000
1871-1880, annual average	12,000

France.—TABLE No. 1.—Statement of the total production of precious metals from 1493 to 1875.

[*Converting kilograms into pounds avoirdupois, as 2.2=1 pound.*]

Countries.	*According to weight.* Silver.	Gold.
	Pounds.	*Pounds*
Germany	17,390,802	
Austro-Hungary	17,094,297	1,018,430
Various European countries	16,240,400	
Russian Empire	5,343,868	2,274,041
Africa		1,609,520
Mexico	167,651,880	583,088
New Granada		2,671,900
Peru	68,688,400	359,810
Potosi (Bolivia)	182,978,720	646,800
Chili	5,739,800	579,920
Brazil		2,281,510
United States	11,597,300	4,457,420
Australia		3,986,400
Various countries	4,400,000	333,520
Total	3[illegible]7,125,267	20,797,359

Table showing the movement of Specie in France, Production, Consumption, and Increase per Annum, from 1850 to 1878.

GOLD.

Year.	*Excess of imports over exports.*	*Excess of exports over imports.*	*Pr'd'c'n of Metallurgical Works.*	*Consumed in arts and manufactures.*	*Gain during the year.*	*Loss during the year.*	*Total increase.*
	Francs.	Francs.	Francs.	Francs.	Francs.	Francs.	Francs.
1850	16,989,000				16,989,000		16,989,000
1851	84,602,000				84,602,000		101,591,000
1852	16,908,000				16,908,000		118,499,000
1853	289,059,000				289,059,000		407,558,000
1854	416,122,000				416,122,000		823,680,000
1855	218,243,000		823,000	35.330,000	183,736,000		1,007,416,000
1856	375,253,000		247,000	35,450,000	340,050,000		1,347,466,000
1857	445,822,000		260,000	48,485,000	397,597,000		1,745,063,000
1858	487,105,000		326,000	45,960,000	441,471,000		2,186,534,000
1859	539,343,000		263,000	40,815,000	498,791,000		2,685,325,000
1860	311,699,000		1,755,000	48,050,000	265,404,000		2,950,729,000
1861		23,734,000	1,590,000	46,505,000		68,649,000	2,882,080,000
1862	165,038,000		1,733,000	51,120,000	115,651,000		2,997,731,000
1863	11,976,000		1,700,000	54,615,000		40,939,000	2,956,792,000
1864	125,142,000		2,602,000	52,880,000	74,864,000		3,031,656,000
1865	150,824,000		2,723,000	51,225,000	102,322,000		3,133,978,000
1866	465,252,000		2,447,000	50,625,000	417,074,000		3,551,052,000
1867	408,674,000		2,531,000	49.920,000	361,285,000		3,912,337,000
1868	212,863,000		2,603,000	49,735,000	165,731,000		4,078,068,000
1869	274,354,000		2,591,000	49,500,000	227,445,000		4,305,513,000
1870	119,766,000		1,178,000	36,075,000	84,869,000		4,390,382,000
1871		213,814,000	1,213,000	31,245,000		243,846,000	4,146,536,000
1872		52,892,000	1,408,000	49,720,000		101,204,000	4,045,332,000
1873		108,639,000	3,001,000	43,415,000		149,053,000	3,896,279,000
1874	431,250,000		2,913,000	47,165,000	386,998,000		4,283,277,000
1875	470,320,000		3,288,000	49,550,000	424,058,000		4,707,335,000
1876	503,652,000			44,545,000	459,107,000		5,166,442,000
1877	455,736,000			44,625,000	411,111,000		5,577,553,000
1878	236,404,000			54,085,000	182,319,000		5,759,872,000

SILVER.

Year.	*Excess of imports over exports.*	*Excess of exports over imports.*	*Prod'ct'n of metallurgical works.*	*Consum'd in arts & manufactures.*	*Gain during the year.*	*Loss during the year.*	*Decrease.*
	Francs.	Francs.	Francs.	Francs.	Francs.	Francs.	Francs.
1850	72,584,000				72,584,000		
1851	77,959,000				77,959,000		
1852		2,447,000				2,447,000	
1853		116,885,000				116,885,000	
1854		163,694,000				163,694,000	
1855		197,160,000	1,982,000	18,395,000		213,573,000	
1856		283,623,000	7,013,000	20,970,000		297,580,000	
1857		359,820,000	10,197,000	18,690,000		368,313,000	
1858		14,940,000	11,716,000	18,205,000		21,429,000	
1859		171,523,000	10,959,000	18,350,000		178,914,000	
1860		157,243,000	10,091,000	19 615,000		165,867,000	
1861		61,813,000	9,140,000	19,360,000		72,033,000	
1862		86,181,000	4,931,000	19,110,000		101,260,000	
1863		68,341,000	9,766,000	18,655,000		77,230,000	
1864		42,474,000	7,441,000	15,550,000		50,583,000	
1865	72,586,000		7,072,000	15,235,000	64,423,000		
1866	44,965,000		7,096,000	15,515,000	36,546,000		
1867	189,649,000		6,996,000	15,245,000	181,401,000		
1868	109,275,000		9,585,000	15,875,000	102,985,000		
1869	111,425,000		10,112,000	14,815,000	106,722,000		
1870	35,467,000		8,070,000	9,910,000	33,627,000		
1871	15,516,000		6,209,000	11,586,000	10,140,000		
1872	102,250,000		7,577,000	19,065,000	90,762.000		
1873	181,498,000		7,095,000	22,005,000	166,588,000		
1874	360,934,000		10,155,000	15,250,000	355,839,000		
1875	185,343,000		9,787,000	16,965,000	178,165,000		
1876	140,355,000			16,435,000	123,920,000		
1877	105,960,000			15,800,000	90,160,000		
1878	118,834,000			16,250,000	102,584 000		35,404,000

Table showing the Specie and Paper Circulation in France from 1850 to 1878, together with Comparative Price of Exports and Imports for the years stated on the Basis of Prices for the same commodities in the year 1862.

Year.	Gold circulation.	Silver circulation.	Paper circulation.	Specie (gold and silver) circulation.	Total specie and paper circulation.	Fluctuation in price of imports. §	Fluctuation in price of exports. §	Average of imports and exports.
	Francs.	Francs.	Francs.	Francs.	Francs.			
1850	2,126,607,000	3,326,146,000	511,900,000	5,452,753,000	5,964,653,000	82	91	86.5
1851	2,111,209,000	3,404,105,000	602,900,000	6,615,314,000	6,218,214,000	80	90	85
1852	2,228,117,000	3,401,658,000	672,000,000	5,629,775,000	6,301,775,000	81	98	89.5
1853	2,517,176,000	3,284,773,000	632,000,000	5,801,949,000	6,433,049,000	88	109	98.5
1854	2,933,298,000	3,121,079,900	628,300,000	6,054,377,000	6,682,677,000	91	108	99.5
1855	3,117,034,000	2,907,506,000	592,800,000	6,024,540,000	6,617,340,000	95	104	99.5
1856	3,457,084,000	2,609,926,000	583,100,000	6,067,010,000	6,650,110,000	106.5	111.5	109
1857	3,854,681,000	2,241,613,000	532,300,000	6,096,294,000	6,628,594,000	105	110	107.5
1858*	4,296,152,000	2,220,184,000	687,300,000	6,516,336,000	7,203,036,000	92	102	97
1859	4,794,943,000	2,041,270,000	678,500,000	6,836,213,000	7,514,713,000	95	109	102
1860	5,060,347,000	1,875,403,000	747,200,000	6,935,750,000	7,682,950,000	98	105	101 5
1861	4,991,698,000	1,803,370,000	715,800,000	6,795,068,000	7,510,868,000	99	99	99
1862	5,107,349,000	1,702,110,000	781,600,000	6,809,459,000	7,591,059,000	†100	†100	†100
1863	5,066,410,000	1,624,880,000	754,900,000	6,691,290,000	7,446,190,000	102.5	100.8	101.6
1864	5,141,274,000	1,574,297,000	722,300,000	6,715,571,000	7,437,871,000	104.5	101.3	102.6
1865	5,243,596,000	1,638,720,000	879,700,000	6,882,316,000	7,762,016,000	99.2	97.8	98.5
1866	5,660,670,000	1,675,266,000	936,900,000	7,335,036,000	8,272,836,000	93.5	91.5	92.5
1867	6,021,955,000	1,856,666,050	1,122,600,000	7,878,621,000	9,001,221,000	89.7	87	88.3
1868	6,187,686,000	1,959,651,000	1,382,800,000	8,147,337,000	9,530,137,000	87.2	83 5	85.3
1869	6,415,131,000	2,066,373,000	1,398,600,000	8,481,504,000	9,880,104,000	86.6	82.9	84.7
1870	‡6,500,000,000	‡2,100,000,000	......	8,600,000,000	......	89.3	81.2	85.2
1871	6,256,154,000	2,110,140,000	2,325,400,000	8,366,294,000	10,691,694,000	93.9	81.4	87 6
1872	6,154,950,000	2,200,902,000	2,656,300,000	8,355,852,000	11,012,152,000	97.3	83.3	90.3
1873	6,005,897,000	2,367,490,000	2,807,700,000	8,373,387,000	11,181,087,000	96 1	80.3	88.2
1874	6,392,895,000	2,723,329,000	2,644,800,000	9,116,224,000	11,761,024,000	89.9	76.6	83.2
1875	6,816,953,000	2,901,494,000	2,438,000,000	9,718,447,000	12,156,447,000	86.7	73.8	80.2
1876	7,276,060,000	3,025,414,000	2,562,700,000	10,301,474,000	12,864,174,000	87.5	75.9	81.7
1877	7,687,171,000	3,115,574,000	2,468,300,000	10,802,745,000	13,271,045,000	85.2	72.9	79
1878	7,869,490,000	3,218,158,000	2,207,300,000	11,087,648,000	13,294,948,000	78.8	67.3	73

*War with Russia. † Comparison made on basis of 100 in 1862.
‡ Mr. Ernest Seyd, in his testimony before the Select Committee of Parliament on Depreciation of Silver, estimated the quantity of gold money present before 1871 at £260,000,000; full legal-tender silver £70,000,000, and subsidiary change £14,000,000. (Report of Committee, p. 56.)
§ Journal of the Statistical Society, December, 1879, p. 853.

The following seems to be a fair estimate of the use of gold in the arts in Germany:

	Kilograms.
Manufacture of gold wares in Southwestern Germany	10,000
In rest of Germany	2,000
Gold foil	1,400
Other gilding material	1,300
Total	14,700

As to export of gold manufactures, Germany is almost the first country in the world; the reason why it uses less gold in the arts than England and France is to be sought in the fact that it makes only few gold watch-cases, for which large quantities of gold are needed in the other countries.

[*Extract from Verwendung des Goldes und Silbers. Statistische Untersuchung von Dr. Adolf Soetbeer.*]

Germany.—Production of the precious metals in the years from 1876 to 1879. From official sources it appears that the production of gold and silver in Germany was as follows:

Years.	Gold.		Silver.		
	Weight.	Value.	Weight.	Value.	Price per kilogram.
	Kilog'ms.	Marks.	Kilograms.	Marks.	Marks.
1871–'75, average	284.4	778,921	143,080	24,929,200	174.19
1876, average	281.3	784,658	139,779	21,969,415	157.17
1877, average	307.9	857,845	147,612	23,812,056	161.32
1878, average	378.5	1,056,338	167,660	25,390,332	151.44
1879, average	466.7	1,302,398	177,507	26,518,123	149.39

Part of this production is from ores mainly imported from the west coast of South America. For the year 1879 there were produced from such ores 1,000 kilograms in Mansfeld, 19,500 in Stolberg, 12,000 kilograms in the Hartz, 10,000 kilograms in Freiberg, and in other places 1,000 kilograms. The proportion of reduction of silver from the two sources (native and foreign ores) is the following:

Years.	From native ores.		From foreign ores.	
	Kilograms.	Per cent.	Kilograms.	Per cent.
1871	90,886	92.7	7,216	7.3
1872	100,742	79.3	26,265	20.7
1873	92,253	52.1	84,958	47.9
1874	109.820	70.5	46,032	29.5
1875	134,066	86.3	23,152	14.7
1876	123,146	88.1	16,633	11.9
1879	134,000	75.5	43,500	24.5

NOTE.—Throughout the kilogram of gold is valued at 2,790 marks, and the kilogram of silver at 180 marks.

AUSTRIA. Statement of the Precious Metals used in Austria, from 1867-1880, inclusive, for the manufacture of different objects, and of gold and silver thread.

Designation.	Precious Metals. Sum total from 1867 to 1880.		Average Yearly.	
	Weight—kilos, fine.	Value in florins.	Kilos, fine.	Value in florins.
GOLD.				
Different objects	19,540.078	27,258,409.00	1,395,719	1,947,029.00
Thread	829,977	1,157,817.00	59 284	82,701.00
Total	20,370.055	28,416,226.00	1,455,004	2,029,730.00
SILVER.				
Different objects	290,712,767	26,164,148.00	20,765.196	1,868,867.04
Gold thread	50 220,488	4,519,843.92	3,587,177	322,845.99
Silver thread	13,904,535	1,251,408.15	893,181	89,386.20
Total	354,837,780	31,935,400.00	25,345,554	2,281,100.00

Manufactured Gold.—An imperial order of May 26, 1866, prescribes that every newly manufactured article of gold or silver is to be registered. The legal degrees of fineness are .920, .840, .750, and .580. No article is permitted to be made of less fineness than .580; the fineness of Austrian articles is on the average between .620 and .660. Foreign articles are likewise inspected as to their fineness. The following are the official figures:

Years.	Gold.	
	Home-made articles.	Imported articles.
	Kilograms.	Kilograms.
1870	2,041	630
1871	2,486	822
1872	3,618	1,489
1873	3,617	1,493
1874	2,490	1.001
1875	2,354	1,104
1876	1,805	812
1877	1,714	856
1878	1,913	1,046
1879	2,008	1,316

Gilded silver thread was declared at the main registering office to the amount of 4,183 kilograms in 1870, and 2,269 kilograms in 1879. Eight large establishments in Vienna and Prague, melted in 1870, 35,050 ducats (121 kilograms) for making gold foil. Gold for gilding may be used to the amount of 250 to 350 kilograms, annually. Schwicker estimates the value of gold and silver wares manufactured annually in Hungary, at 1,000,000 florins.

Years.	*Home-made silverware.*	*Foreign silverware.*	*Silver wire.*
	Kilograms.	*Kilograms.*	*Kilograms.*
1870	21,166	3,271	5,148
1871	25,584	4,209	5,140
1872	38,342	7,758	5,642
1873	35,224	8,300	5,341
1874	26,634	5,233	4,627
1875	25,664	4,901	3,764
1876	21,796	3,591	3,147
1877	20,888	4,673	2,620
1878	23,455	5,485	3,864
1879	27,199	6,584	2,924

Norway and Sweden.—In answer to the question presented by the honorable delegate of Switzerland Monsieur Lardy, (International Monetary Conference, held in Paris in 1881) at the meeting of the 10th of May, 1881: "What is the importance of the use, for industrial purposes, of the precious metals, especially of gold?" I, Dr. O. J. Broch, have the honor to present to the Conference the following table, upon the employment of silver and of gold, except their consumption by photography. The silver used always consists of bars; articles of silver, melted and remade into utensils or jewels, are not included. Gold usually consists of the coinage of the country, or of foreign coins. Neither imported silver nor gold jewelry is included.

Industrial Employment of Silver and Gold.

Years.	*Fine silver.*	*Fine gold.*
	Kilog.	*Kilog.*
1870	1,400	20
1871	1,340	18
1872	1,580	21
1873	1,940	20
1874	2,440	28
1875	2,200	29
1876	1,700	24
1877	1,680	22
1878	1,400	21
1879	1,480	19
1880	1,470	20
Annual average.	1,694	22

Statement of the monetary situation of the Kingdom of Norway, before and after the change from the standard of silver to the standard of gold.—The ancient monetary system of Norway was regulated by the law of the 14th of June, 1816. This system was based on the single standard of silver. The unit was the "speciesdaler," thirty-seven pieces of which, 875 thousandths fine, were made from four marks of Cologne of fine silver. The value of the mark of Cologne was fixed in Norway, by the law of weights and measures, of July 28, 1824, as follows: 1 pound=2 marks of Cologne, being equal to 123,144.5 gram, Norwegian weights of commerce, which gives for the mark of Cologne the value of 233.99335 grammes. In Denmark and in Hamburg the mark of Cologne was valued at a little less, that is 233.85489 grammes. In Prussia it is valued at 233.8555 grammes. The ancient ounce of Charlemagne was equivalent to 30.9504 grammes, and the mark of eight ounces was then originally equivalent to 244.752 grammes. The Norwegian "speciesdaler" thus would weigh 28.9104 grammes, 875 thousandths fine, and contain 25.2966 grammes fine silver. In comparison with the piece of five francs, silver, the "speciesdaler" is valued at 5 francs 62 centimes. As current moneys, having full circulating power, they still coin moneys of the same fineness, equivalent to $\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{10}$, and $\frac{1}{15}$. speciesdaler. The speciesdaler was divided into 120 skillings.

—*Extract from Verwenduug des Goldes und Silbers Statische Untersuchung, von Dr. Adolph Soetbeer.*

In Sweden and in Denmark they coin money similar to the Norwegian speciesdaler and of the same fineness; but the weight, and consequently the amount, of fine silver contained differ somewhat.

The Swedish species contain	25.5045 grammes fine silver.
The Danish species	25.2816 grammes fine silver.
The Norwegian species	25.2966 grammes fine silver.

The Danish species coincides with the reichsthaler Hamburger-banco, or 3 marks-banco, the unit of account, not coined; then $59\frac{1}{3}$ marks-banko represents 500 grams of fine silver. In Sweden the monetary unit being the "riksdaler" $=\frac{1}{4}$ Swedish speciesdaler, which they divide into 100 "ore." In Denmark the monetary unit is the "rigsdaler" $=\frac{1}{2}$ Danish "speciesdaler" that they divide into 6 "mark," and the mark into 16 "skilling," and the rigsdaler into 96 Danish skillings. In current moneys having full circulating power there was coined in Norway, in conformity with the law of 1816, until the end of the year 1873 a sum of 3,934,355 speciesdaler 16 skilling, as follows:

	Spd.	Sk.
In 1 speciesdaler for	2,518,155	
In $\frac{1}{2}$ speciesdaler for	439,462	50
In $\frac{1}{5}$ speciesdaler for	462,102	96
In $\frac{1}{10}$ speciesdaler for	462,860	60
In $\frac{1}{15}$ speciesdaler for	54,774	40
Total sum	3,934,355	16

This coinage was almost exclusively done on account of the Bank of Norway. The seignorage paid for the coinage of moneys at Konigsberg was 2 per cent. for the 1 and the $\frac{1}{2}$ "speciesdaler," and $2\frac{1}{2}$ per cent. for the $\frac{1}{5}$, $\frac{1}{10}$, and $\frac{1}{15}$ "speciesdaler." A part of the "speciesdaler" had from time to time been exported into Hamburg and transformed into bullion at the Bank of Hamburg. The current Swedish and Danish moneys circulate side by side. The real circulation, outside of the national bank, was almost exclusively on trust, with bank notes, reimbursable at sight, in 5, 10, 50, and 100 speciesdaler. The current coins of $\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{10}$ and $\frac{1}{15}$ speciesdaler are the only real circulation. Even the pieces of the $\frac{1}{2}$ "speciesdaler" are rare. In small transactions they often calculate in $\frac{1}{5}$ speciesdaler called "ort," which may thus be called the popular unit. In Sweden and Norway the real circulation was also, by preference, on trust. The smallest bank note then in Sweden was the note of the rigsdaler, and in Denmark the note of 5 rigsdaler. The cash in hand of the Bank of Norway was in a great part in Danish speciesdalers and in silver ingots. The bank is allowed to place even a third of its cash in circulation with its agents. The bank buys drafts upon a foreign bank, and then sends them at once to its correspondents to be cashed. At the same time the bank sells drafts, always short dated, upon its agents. The bank maintains by these operations an exchange of drafts upon the principal places with which Norway has trade, within certain restricted limits. When the payment of the commercial balance of the country demands exportations of silver, the bank itself often sends to its agents upon whom it sells time drafts. The paper circulation of the Bank of Norway the only bank of issue, was, toward the end of the year 1873, 11,794,633 speciesdaler. The monetary circulation outside of the bank, in current silver money, and in money of silver with copper, at the same time, can be valued at 1,000,000 speciesdaler, comprising Swedish and Danish moneys which circulate in Norway. The total circulation, outside of the cash in hand of the bank, was then 12,800,000 speciesdaler. The population of Norway was estimated at the same time at 1,780,000 inhabitants. The paper and coin circulation was therefore 7.2 speciesdaler, or 40 francs 40 centimes per each inhabitant. The cash in hand of the Bank of Norway at the same time was 8,593,435 speciesdaler, comprising the amount invested abroad. The change from the single standard of silver to the single standard of gold took place in Norway January 1, 1874, in accordance with a law of June 4, 1873. A law of June 17, 1869, the result of the international monetary conference at Paris in 1867, had already authorized the Bank of Norway to change a part of its cash in hand into gold. The administration of the bank profited by this to sell, from time to time, silver and buy gold. This change took place principally in sending silver money to Hamburg, where it was recoined into the "Hamburger-banco-mark" in the proportion of $118\frac{3}{5}$ mark to a kilogram of fine silver. By the monetary reform of Germany the "Hamburger-banco-mark" was afterward changed to gold in the proportion of 2 mark-banco=3 reichsmark, or in the proportion of 15.674 to 1. The cash of the bank, including the capital in the hands of the agents of the bank at Copenhagen, Hamburg and London, was, near the close of the years—

	1871.	1872.	1873.
	Spd.	*Spd.*	*Spd.*
Silver	6,483,136	6,839,308	1,535,448
Gold	105,827	722,002	7,057,987
Total cash	6,588,963	7,561,310	8,593,435

The transition to the single standard of gold took place simultaneously in the three Scandinavian kingdoms. Without discussion and without mention in the Scandinavian monetary convention of December 18, 1872, it was recognized as a right, also an unquestionable international duty, that each state was responsible for the money that was coined at its mint and that was stamped with its coat of arms, and that in case of demonetization and change from silver to gold, it should withdraw these current moneys, also the fractional money of silver or copper, and change them for gold. Thus already in the autumn of 1873 the Government of Denmark received from the Bank of Norway 2,200,000 speciesdaler of Danish silver that it redeemed in gold. By the law of June 4, 1873, the former silver moneys were, from January 1, 1874, reduced to fractional moneys with circulating power limited to 5 speciesdaler or 20 crowns. The Government is obliged, not only to receive them in unlimited payment, but also to change them for gold money.

The demonetization of the former circulation of silver and copper, and the coinage of new fractional currency appropriate to the new system of crowns, took place April 17, 1875. The "speciesdaler" was converted into 4 kroner, or crowns, according to the new monetary system. Pieces of gold of 10 or 20 crowns were struck according to the law of June 4th, 1873, and of April 17th, 1875, of the fineness of .900; there were, therefore, struck from a kilogram of fine gold 248 pieces of 10 crowns and 124 pieces of 20 crowns. Eight of these pieces of gold were then exactly equivalent to 9 German pieces of gold of designation similar to the mark. A Scandinavian crown is, then, exactly equivalent to 1⅛ mark of Germany. In comparison with the French gold pieces the Scandinavian crown is equivalent to $\frac{100}{72}$ francs. They thus have in gold: 100 francs=81 German marks=72 Scandinavian crowns. The conversion of silver into gold then took place according to the following proportion:

In Norway	25.2966×5×0.124=15.684
In Denmark	25·2816×5×0.124=15.675
In Sweden	25.5045×5×0.124=15.813

The difference between the former silver coinage of the three Scandinavian kingdoms disappeared by the conversion into gold according to these different proportions. At the time of the simultaneous proposition for the transition from the silver to the gold standard in the three kingdoms, in the month of December, 1872, that proportion was according to the London market, 15.79 to 1. In Norway they have successively withdrawn from circulation the following old coinage:

	Spd.	Sk.		Crowns.	Ore.
1 spd. for	765,986	00	converted into	3,063,944	00
½ spd. for	109,543	00	converted into	438,172	00
⅕ spd. for	322,422	24	converted into	1,289,688	00
$\frac{1}{10}$ spd. for	327,900	60	converted into	1,311,602	00
$\frac{1}{15}$ spd. for	17,469	00	converted into	69,876	00
Total in coined money	1,543,320	84	converted into	6,173,282	00
Amount in silver bars	148,075	76	converted into	592,302	54
Copper money	47,129	44	converted into	188,517	47
Total of old coinage	1,738,525	84	changed into	6,954,102	81

Current silver moneys were melted into ingots and sold at London—

In 1874 . . . . 2,636,000 crowns in proportion of *59d.* to 59¼*d* per st. oz.
In 1879 . . . 1,000,000 crowns in proportion of 52*d.* per st. oz.
In 1880 . . . 400,000 crowns in proportion of 52⅛*d.* per st. oz.

Total sum 4,036,000 crowns, or 1,009,000 speciesdaler sold in the form of ingots.

There has also been melted and sold the sum of 65,533 crowns 08 öre in ancient copper coinage. Finally, there has been used in the manufacture of new fractional money debased coin of silver and copper—

2,413,045 crowns 34 öre in ancient silver moneys.
38,983 crowns 67 öre in ancient copper moneys.

Sum realized, 6,553,562 81

The loss in weight of the current moneys produced by the circulation has been found to be as follows:

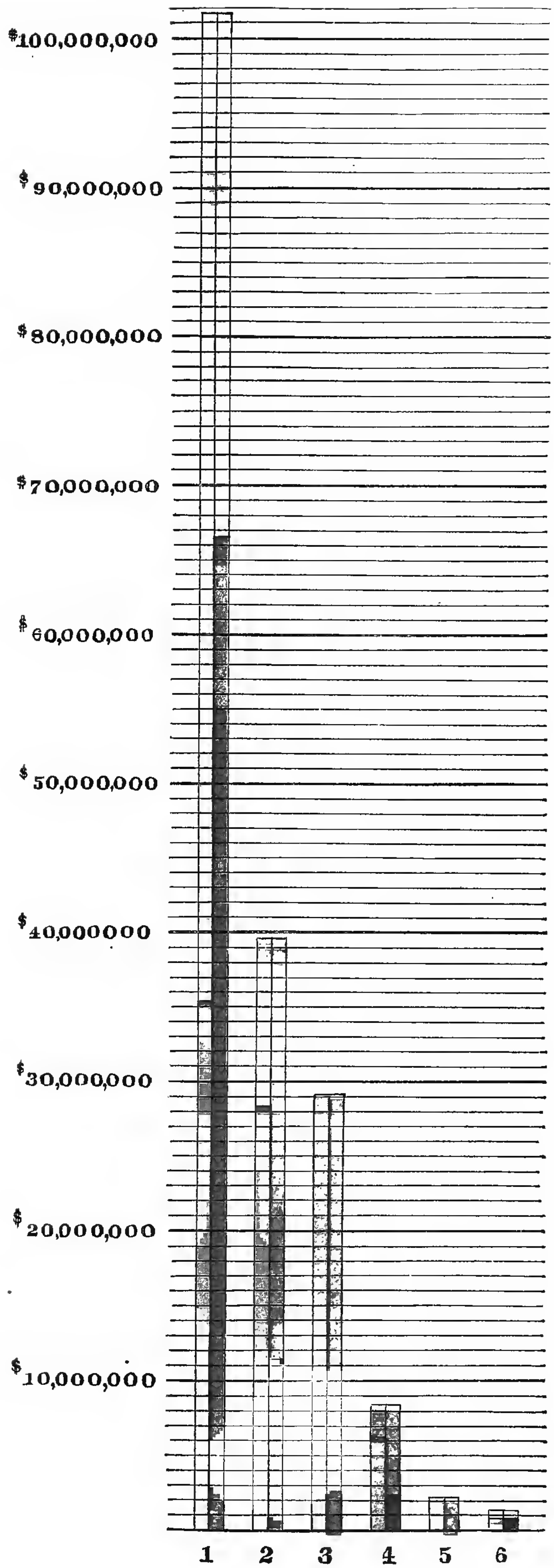
	Per cent.
For the 1 speciesdaler	0.188
For the ½ speciesdaler	0.416
For the ⅕ speciesdaler	1.749
For the $\frac{1}{10}$ speciesdaler	2.279

On the other hand, the standard has been found to average a little higher than it was according to the former legislation. The scale of 4,036.000 crowns in the old currency gave place to a loss of 319,179 crowns 05 öre, including commissions, expense of transportation, &c., The sale of copper accruing from 65,533 crowns 80 öre, in old copper money, caused a loss of 41,677,72. The sum of 2,413,045 crowns 34 öre, former circulation of silver, and 38,983 crowns 67 öre of debased copper coin, converted into change at the mint to be used as the basis of the new fractional money, was valued upon the basis of the price of silver at London, and of copper in trade, at the time of the different changes, caused a loss of 322,664,48. The usual expenses of collection of the former coinage, and transportation, were 3,376,72. Thus the total loss from the conversion of 6,553,562 crowns 81 öre of old system of coinage was estimated at 686,897,97. On the other hand, the profit of the manufacture during the years 1874–1879, of 5,040,000 crowns in new money of silver and copper, resulting from that monetary reform has been estimated upon the same bases at 774,172,84; therefore the excess of profit was 87,274 crowns 87 öre. The 400,540 crowns of the old coinage of silver and copper which still remained in the state treasury served for the coinage of the debased money of the new monetary system, and consequently gave place only to an insignificant profit or loss. The 1,009,000 speciesdaler, or 4,033,000 crowns, contain 25,000 kilograms of fine silver that the monetary reform in Norway during the years 1874–'79 threw upon the London market. The former current silver money contained 25,2966 grammes of fine silver to the speciesdaler, or 6.32415 grammes fine silver to the crown, while the new fractional silver money contains only 6 grams of fine silver to the crown. The exchange at the mint of the old silver coinage for the new fractional silver coinage thus gave place to a profit of 5⅛ per cent. The redemption took place according to the proportion of 15,684 to 1 for gold to silver, while the coinage of new fractional money was in the proportion of 14.880 to 1. The greatest paper circulation took place near the end of June, 1874: it was then 50,111,925 crowns. There were coined in Norway, previous to the end of the year 1880, in gold—

12,686,480 crowns in pieces of 20 crowns.
141,130 crowns in pieces of 10 crowns.

Total sum, 13,127,610 crowns in gold equivalent to 18,232,792 francs.

As material for coinage, ingots of gold purchased at London were exclusively used. The exchange of each coin was done at the mint. The paper circulation of the bank of Norway was, toward the end of the year 1880, 38,713,675 crowns in notes of 5, 10, 50, 100, 500, and 1,000 crowns. The metallic reserve of the bank in money and in gold ingots was at the same time 33,721,357 crowns of which 10,330,572 crowns were with the agents of the bank abroad. The monetary circulation outside of the bank might at the same time have been estimated at 7,000,000 crowns, the greatest part in fractional money. Thus the whole sum outside of the bank was 45,700,000 crowns. The population of the kingdom of Norway at that time was estimated at 1,890,000 inhabitants. Thus the paper and coin circulation was 24 crowns 18 öre, or 33 francs 58 centimes, per each inhabitant.



ANNUAL BULLION PRODUCT of the WORLD.

(CONTINENTAL DISTRIBUTION.)

1. North America.
2. Europe, including Russia in Asia.
3. Australia.
4. South America.
5. Africa.
6. Japan.

The areas in old gold indicate gold, those in light blue, silver, the relative totals being shown by the extreme height of each column.

Articles of gold manufactured in or imported into Sweden from 1848 to 1880, according to the rolls of the office of the comptroller.

GOLD.

Years.	Manufactured at Stockholm.	Imported at Stockholm.	Manufactured out of Stockholm.	Both manufactured and imported.
	Kilograms.	Kilograms.	Kilograms.	Kilograms.
1848	48.806	0.385	52.210	101.401
1849	47.446	3.768	52.318	103.532
1850	43.877	3 131	52.809	99.817
1851	43.651	8.459	53.924	106.034
1852	41.411	11.708	53.133	107.250
1853	42.485	4.859	54.980	101.324
1854	53.375	21.873	71.433	145.681
1855	53.207	26.479	78.659	158.345
1856	57.050	27.460	93.683	178.193
1857	55.820	9.489	88.813	154.122
1858	48.577	6.122	83.158	137.857
1859	52,804	14.684	96.388	163.876
1860	55.416	11.896	101.847	169.159
1861	50.893	16.427	114.078	181.398
1862	48.667	9.941	111.958	170.566
1863	50.292	4.123	113.959	168.374
1864	44.201	8.458	108.837	161.496
1865	42.239	12.083	110.673	164.995
1866	40.822	5.176	102.812	148.810
1867	31.601	11.730	88.559	131.890
1868	29.010	8.430	85.884	123.324
1869	32.378	5.306	103.544	141.228
1870	33.379	6.949	108.104	148.432
1871	40.092	22.313	131.784	194.189
1872	51.975	25.194	165.679	240.848
1873	68.632	34.893	196.824	300.349
1874	91.749	63.491	226.610	381.858
1875	92.651	33.671	218.403	344.725
1876	79.099	44.637	222.224	345.960
1877	77.460	26.651	218.592	322.703
1878	61.864	20.221	182.596	264.681
1879	55.026	22.789	161.574	239.789
1880	65.544	48.759	188.710	303.013

According to the protocol of the comptroller's office.

Articles of silver manufactured in or imported into Sweden from 1848 to 1880, according to the rolls of the office of the comptroller.

SILVER.

Years.	Manufactured at Stockholm.	Imported at Stockholm.	Manufactured out of Stockholm.	Both manufactured and imported.
	Kilograms.	Kilograms.	Kilograms.	Kilograms.
1848	2,211.452	19.947	2,187.621	4,419.020
1849	2,201.705	17.583	2,266.409	4,485.697
1850	2,163.671	18.831	2,195.588	4,378.090
1851	2,199.165	44.515	2,228.550	4,472.220
1852	1,985.519	25.471	2,292.292	4,303.282
1853	1,630.720	13.599	2,282.186	3,935.506
1854	1,975.320	73.996	2,768.672	4,817.988
1855	2,120.338	109.042	3,300.812	5,530.192
1856	2,379.763	86.108	3,778.593	6,244.434
1857	2,388.541	69.640	4,256.293	5,714.474
1858	1,644.202	39.181	2,474.781	4,157.164
1859	1,961.333	96.645	2,752.406	4,810.384
1860	1,854.437	25.462	2,835.848	4,715.747
1861	1,643.415	56.546	2,930.832	4,630.993
1862	1,392.356	31.391	2,722.970	4,146.916
1863	1,392.721	26.684	2,502.831	3,922.136
1864	1,339,209	44.179	2 064.656	3,448.044
1865	1,209.083	51.714	1,966.089	3,226.888
1866	976.931	16.983	1,800.179	2 794.093
1867	648.044	33.227	1,463.531	2,144.902
1868	446.849	62.156	1,376.775	1,885.780
1869	711.161	46.627	1,314.320	2,072.108
1870	742.139	82.097	1,495.613	2,319.849
1871	887.974	184.671	1,643.963	2,716.608
1872	889.262	216.678	2,002.619	3,108.559
1873	992.129	307.402	2,146.170	3,445.701
1874	178.827	590.657	2.331.627	4 101.111
1875	956.301	438.504	2,105.907	3,500.712
1876	880.553	352.257	1,943.765	3,176.575
1877	721.261	354.080	1,737.284	2,812.625
1878	567.069	270.670	1,362.160	2,199,899
1879	615 495	257.027	1,049.917	1,822.439
1880	704.935	313.752	1,081.617	2,100.304

According to the protocol of the comptroller's office.

Gold and Silver in Sweden.

GOLD.

Years.	Received from the mines.	Imported, in coin.	Imported, in ingots.	Used for arts and industry.	Coined.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
1869	9	415	420	136	88
1870	10	97	35	141	....
1871	6	99	635	171	14
1872	6	949	1,466	215	34
1873	5	2,049	1,338	265	928
1874	3	1,448	2,841	318	3,643
1875	4	852	2,151	311	3,052
1876	6	737	2,361	345	2,619
1877	4	262	1,152	323	1,728
1878	....	1,253	1,777	264	1,976

Years.	Exported, in coin.	Exported, in ingots.	Amount in treasury and banks.
	Kilos.	Kilos.	Kilos
1869	1	....	411
1870	3	....	388
1871	....	....	962
1872	....	....	2,684
1873	....	....	6,014
1874	814	....	6,406
1875	1,066	....	7,997
1876	504	....	7,783
1877	29	10	7.218
1878	302	....	6,072

As nearly as can be calculated, there must have been in the beginning of 1878 about 5,500,000 crowns gold in circulation in the country.

SILVER.

Years.	Received from the mines.	Imported, in coin.	Imported, in ingots.	Used for arts and industry.	Coined.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
1869	1,235	1,327	13,373	2,025	8,141
1870	1,190	7	9,619	2,237	4,360
1871	974	8,645	19,159	2,531	9,973
1872	742	36	28,953	2,871	76
1873	705	18,651	1,109	3,137	1,463
1874	739	1,557	2,336	3,510	4,738
1875	736	6,274	1,627	3,061	29,492
1876	797	4,177	1,539	3,176	23,719
1877	850	53	954	2,812	7,093
1878	....	234	1,044	2,199	4,539

Years.	Exported, in coin.	Exported, in ingots.	Amount in treasury and banks.
	Kilos.	Kilos.	Kilos.
1869	5,966	10,814	56,208
1870	5,899	627	56,340
1871	12,324	157	72,144
1872	528	43	97,290
1873	12,599	6,204	86,616
1874	15,150	23,888	53,432
1875	862	8	59,430
1876	5,400	8,536	23,652
1877	....	34	23,546
1878	90	255	31,224

As nearly as can be calculated, the amount of silver coin in circulation in the country at the beginning of 1878 was 11,000,000 crowns.

Amount of circulating Bank Notes.

	Crowns.		Crowns.
1869	61,868,000	1874	104,488,000
1870	69,400,000	1875	96,004,000
1871	79,000,000	1876	91,321,000
1872	102,600,000	1877	77,718,000
1873	111,938,000	1878	72,785,000

Gold, Silver and paper money in Norway.—The Bank of Norway had at the end of each year from 1872 to 1878, in balance of coined gold or gold in bars:

	Crowns.		Crowns.
1872	2,121,200	1876	22,286,800
1873	17,498,000	1877	14,652,000
1874	19,461,600	1878	12,064,800
1875	14,520,000		

Before 1872, coined gold or gold in ingots was not used in Norway. The treasury had no gold balance. The amount of gold then in the Bank of Norway, and in other banks of circulation, cannot be stated, but may be regarded as inconsiderable.

The Bank of Norway's balance of coined silver or silver in ingots at the end of each year from 1858 to 1878 was as follows:

	Crowns.		Crowns.
1858	11,950,000	1869	11,861,200
1859	9,987,200	1870	12,405,600
1860	9,921,600	1871	17,993,400
1861	8,755,600	1872	18,529,600
1862	10,178,400	1873	1,969,600
1863	11,844,800	1874	1,419,600
1864	12,300,400	1875	240,000
1865	16,575,600	1876	196,000
1866	12,720,400	1877	161,600
1867	14,827,600	1878	1,154,900
1868	11,885,200		

The treasury's balance of coined silver at the end of each year from 1875 to 1878 (before that time the treasury's metal balance was inconsiderable):

	Crowns.		Crowns.
1875	1,166,400	1877	1,499,300
1876	1,617,500	1878	770,500

The amount of silver in other banks and in the Norwegian Bank, or the amount of coined silver in circulation, which cannot with accurracy be given, may be said to be, approximately at the end of each year from 1874 to 1878, as follows:

	Crowns.		Crowns.
1874	4,600,000	1877	4,900,000
1875	4,450,000	1878	4,500,000
1876	4,600,000		

The amount of bank notes in circulation at the end of each year from 1858 to 1878, as follows:

	Crowns.		Crowns.
1858	26,323,300	1869	27,162,600
1859	24,207,000	1870	28,388,000
1860	25,847,000	1871	33,982,200
1861	24,648,800	1872	38,515,900
1862	27,819,200	1873	47,178,500
1863	26,643,300	1874	45,869,700
1864	25,596,600	1875	37,229,500
1865	28,524,200	1876	39,668,800
1866	27,944,800	1877	36,309,000
1867	29,094,600	1878	30,967,700
1868	26,436,900		

No gold is produced in Norway. The quantity of silver from Konigsberg silver mine—the only silver mine in Norway—was from 1858 to 1878 as follows:

	Kilograms.		Kilograms.
1858	4,970	1868	3,835
1859	4,818	1869	3,680
1860	4,259	1870	3,585
1861	3,469	1871	3 457
1862	3,091	1872	3,703
1863	3,216	1873	3,558
1864	3,053	1874	3,348
1865	3,682	1875	4,057
1866	3,498	1876	4,067
1867	3,487	1877	4,524

The coinage of gold commenced in 1874. There has been coined in—

	Kilograms.		Kilograms.
1874	1,696	1877	391
1875	847	1878	1,120
1876	882		

The amount of gold used in arts and industry from 1870 to 1878, as follows:

	Kilograms.		Kilograms.
1870	20	1875	29
1871	18	1876	24
1872	21	1877	22
1873	20	1878	21
1874	28		

It may be remarked here that a considerable portion of the gold articles sold in Norway are imported ready made, and are not included in the above estimate. The amount of silver coined from 1862 to 1878 is as follows:

	Kilograms.		Kilograms.
1862	2,242	1872	648
1864	3,063	1873	1,584
1865	2,765	1874	1,200
1867	1,696	1875	6,600
1868	2,126	1876	6,280
1869	1,703	1877	8,572
1870	360	1878	4,147
1871	1,282		

In the above coinage estimate were included about 14,700 kilograms manufactured from old coins remelted. The amount of silver used in art and industry from 1870 to 1878, is as follows:

	Kilograms.		Kilograms.
1870	1,400	1875	2,200
1871	1,340	1876	1,700
1872	1,680	1877	1,680
1873	1,940	1878	1,400
1874	2,440		

The information in regard to the importation and exportation of gold and silver which we are able to give is far from satisfactory, partly because we cannot distinguish between gold and silver, partly because the custom-house report of this question of foreign trade has shown itself to be unreliable. The following estimates are taken from the official table of commercial statistics, which gives our exportation and importation of gold and silver in the form of coin and ingots. It must therefore be used with care.

Imported Silver.

	Crowns.		Crowns.
1866	630,000	1869	2,432,000
1867	1,344,000	1870	1,425,000
1868	1,193,000	1871	4,947,000

Exported Silver.

1866	402,000	1870	34,000
1867	181,000	1871	30,000
1868	1,142,000	1872	284,000
1869	506.000	1873	14,997,000

Imported Gold.

1872	3,202,000	1876	768,000
1873	15,346,000	1877	1,306,000
1874	3,238,000	1878	3,646,000
1875	118,000		

Exported Gold.

1874	27,000	1877	5,000
1875	2,807,000	1878	568,000
1876	788,000		

Any reliable information as to the importation and exportation of gold and silver in other forms than as coins and ingots cannot be given.

Quantity of Gold in Sweden

Description		1878.	1879.
Received from the mines	kilograms	9	3
Imported:			
Coined	do.	1,253	4,175
In ingots	do.	1,777	1,075
Used for the arts, &c.	do.	264	217
Coined	do.	1,976	606

Quantity of Silver in Sweden.

Received from the mines	kilograms	1,268	1,502
Imported:			
Coined	do.	234	600
In ingots	do.	1,044	486
Used for the arts, &c.	do.	2,199	1,565
Coined	do.	4,539	464

Amount of gold in 1879 *exported.*—Coined in 1879, 443 kilograms; 1878, 302 kilograms; coin in state treasury and banks at end of 1879, 8,552 kilograms; in 1878, 6,072 kilograms. In circulation probably no particular change has taken place since the end of 1878, when it was estimated at 5,500,000 kronors.

Amount of silver in 1879 *exported.*—Coined in 1879, 447 kilograms; in 1878, 90 kilograms; 1879, in ingots, 15 kilograms; 1878, 255 kilograms; silver coin in the State treasury and banks at the end of 1879, 35,275 kilograms; in 1878, 31,224 kilograms. In circulation probably no particular change has taken place since the estimate at the close of 1878, when the total amount was 11,000,000 kronors. Amount of bank notes in circulation at the end of 1879, 80,811,090 kronors; at the end of 1878, 72,785,000 kronors.

Russia—Currency in Circulation.

Date.	Roubles.
January 1, 1874	770,319,056
January 1, 1875	764,660,008
January 1, 1876	751,117,547
January 1, 1877	707,505,904
January 1, 1878	1,014 255,694

Production of the Mines.

Date.	GOLD.			SILVER.		
	Poods.	Pounds.	Zolot.	Poods.	Pounds.	Zolot.
1874	2,020	31	17	720	14	80
1875	1,990	28	15	601	4	69
1876	2,053	8	70	683	7	
1877	2,501	30	70	681	17	85
1878	2,569	39	63	658	12	51

Imports and Exports of Gold and Silver.

GOLD.

Year.	Exported.		Total.	Imported.		Total.
	In bars.	In coin		In bars.	In coin.	
	Roubles.	Roubles	Roubles.	Roubles.	Roubles.	Roubles.
1874	.....	17,054,000	17,054,000	355,000	6,198,000	6,553,000
1876	.....	27,576,000	27,676,000	216,000	1,506,000	1,721,000
1876	8,826,000	93,018,000	101,844,000	176,000	1,313,000	1,488,000
1877	176,000	66,735,830	66,911,830	119,000	9,284,000	9,403,000

SILVER.

Year.	Exported in bars.	Exported in coin	Total.	Imported in bars.	Imported in coin.	Total.
1874	12,000	430,000	442,000	9,435,000	642,000	10,077,000
1875	.....	459,000	459,000	4,105,000	615,000	4,720,000
1876	82,000	1,328,000	1,410,000	3,242,000	695,000	3,935,000
1877	718,000	15,492,800	16,210,800	767,000	780,000	1,547,000

Gold and Silver Coined in the St. Petersburg Mint.

	1874.	1875.	1876.	1877.	1878.	Total.
	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.
Gold	24,810,027	20,300,024	30,189,040	33,150,024	34,582,048	143,031,163
Silver, 83⅓ proof	700,005 25	700,005 25	800,308 75	7,884,005 25	8,918,010 50	19,002,035
Silver, 48 proof	4,276,001 50	4,400,001 50	5,217,002 50	2,263,001 60	7,443,253	23,599,260

Deposits of Gold and Silver coin and bars on hand January 1, in the Treasury of the Empire, the Mint, the Government Bank, and Branches of these Institutions.

GOLD.

Date.	Belonging to imperial treasury, the different branches, and in St. Petersburg mint.		In Imperial Bank.		In St. Petersburg mint, belonging to different departments and different people.		Total.		Total.
	In coin.	In bars.	In coin.	In bars.	In coin.	In bars.	In coin.	In bars.	
	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.	Roubles.
1875	1,946,542	3,555,086	146,069,100	67,814,739	4,223,890	10,399,452	152,239,532	71,769,276	224,008,808
1876	2,043,479	4,468,196	150,166,142	57,482,667	783,300	14,672,930	152,992,921	76,614,793	229,607,714
1877	2,735,008	4,720,031	75,668,448	48,775,958	6,463,745	7,045,574	84,857,201	60,541,563	145,398,764
1878	6,455,466	167,733	90,168,284	41,830,079	6,406,215	8,020,010	103,029,965	50,017,822	153,047,787

SILVER.

Date.	In coin.	In bars.	In coin.	In bars.	In coin.	In bars.	In coin.	In bars.	Total.
1875	917,695	1,996,047	11,606,137	19,166,262	....	655,518	12,523,832	21,807,827	34,331,659
1876	824,122	2,104,549	11,663,404	17,858,306	....	645,318	12,387,526	20,608,172	32,995,698
1877	102,003	1,504,478	9,885,086	16,891,172	....	632,849	9,987,098	18,928,409	28,915,588
1878	1,130,528	....	6,050,638	11,709,557	6,011	83,839	7,187,177	11,793,396	18,980,573

NOTE 1.—In the above tables only banco silver of 83⅓ proof is taken into account.

NOTE 2.—Besides the silver shown in the above tables, there is other silver on hand, 48 proof, as follows:

	Roubles.
1874	1,186,624
1875	2,299,325
1876	3,434,283
1877	4,823,006
1878	4,421,466

Amount of coin in the Russian State Bank, which forms its circulation from the time of its establishment.

Years.	Amount.	Years.	Amount.
	Roubles.		Roubles.
1861	84,300,000	1871	141,800,000
1862	81,100,000	1872	156,300,000
1863	80,600,000	1873	196,000,000
1864	66,300,000	1874	217,300,000
1865	55,400,000	1875	229,400,000
1866	57,800,000	1876	229,400,000
1867	57,700,000	1877	149,000,000
1868	165,000,000	1878	147,800,000
1869	132,400,000	1879	147,000,000
1870	141,800,000	1880	173,200,000

The proportion in 1879 was: Gold, 137,200,000 roubles, or 92.8 per cent.; silver, 10,600,000 roubles, or 7.2 per cent. The quantity of paper money of the State Bank in circulation and in the bank was as follows:

Years.	Amount.	Years.	Amount.
	Roubles.		Roubles.
1871	715,800,000	1876	797,300,000
1872	724,200,000	1877	790,000,000
1873	774,700,000	1878	1,041,000,000
1874	792,300,000	1879	1,189,300,000
1875	797,300,000	1880	1,163,700,000

In the last two years the amounts in bank and in circulation were as follows:

Years.	Bank.	Circulation.	Bank.	Circulation.
	Roubles.	Roubles.	Per cent.	Per cent.
1879	35,600,000	1,153,700,000	3	97
1880	33,800,000	1,129,900,000	3	97

Gold has been the principal metal mined since 1825. Systematic mining of gold commenced in 1751. Since then the production has been 80,000 puds. During the ten years from 1868 to 1877 amounts have been—

Years.	Puds.	Years.	Puds.
1868	1,710	1873	2,020
1869	2,010	1874	2,030
1870	2,160	1875	2,000
1871	2,400	1876	2,050
1872	2,330	1877	2,520

Production of silver during the ten years from 1868 to 1877 as follows:

Years.	Puds.	Years.	Puds.
1868	1,120	1873	610
1869	1,770	1874	720
1870	870	1875	600
1871	830	1876	680
1872	750	1877	680

Imports and exports of gold and silver (not shown separately) as follows:

Years.	Imports.	Exports.
	Roubles.	Roubles.
1869	2,600,000	15,700,000
1870	2,700,000	23,900,000
1871	7,400,000	17,700,000
1872	13,000,000	7,900,000
1873	20,600,000	14,700,000
1874	16,600,000	17,500,000
1875	6,400,000	28,000,000
1876	5,400,000	103,300,000
1877	10,900,000	19,300,000
1878	16,500,000	14,200,000

The quantity of the precious metals consumed in the arts and manufactures cannot be ascertained.

Coinage of gold since 1800.

Period.	Roubles.	Period.	Roubles.
1800–1809	4,300,000	1840–1849	137,300,000
1810–1819	29,700,000	1850–1859	200,500,000
1820–1829	31,800,000	1860–1869	221,000,000
1830–1839	65,400,000	1870–1878	201,700,000

Coinage of gold from 1869 to 1878

Years.	Half imperials.		Three roubles.		Total.
	Pieces.	Value.	Pieces.	Value.	Roubles.
1869	3,900,000	19,500,000	140,000	420,000	19,920,000
1870	5,000,000	25,000,000	200,000	600,000	25,600,000
1871	800,000	4,000,000	200,000	600,000	4,600,000
1872	2,400,000	12,000,000	100,000	300,000	12,300,000
1873	3,000,000	15,000,000	80,000	240,000	15,240,000
1874	4,800,000	24,000,000	270,000	810,000	24,810,000
1875	4,000,000	20,000,000	100,000	300,000	20,300,000
1876	6,000,000	30,000,000	60,000	180,000	30,180,000
1877	6,600,000	33,000,000	50,000	160,000	33,150,000
1878	6,800,000	34,000,000	190,000	570,000	34,570,000

Silver coinage from 1869 to 1878.
83⅓ zolotinks fine.

Years.	Roubles.	Half-roubles.	Quarter-roubles.	Total.
	Roubles.	Roubles.	Roubles.	Roubles.
1869	300,000	10,000	5,000	315,000
1870	400,000	5,000	10,000	415,000
1871	900,000	10,000	5,000	915,000
1872	1,000,000	10,000	10,000	1,020,000
1873	700,000	20,000	10,000	730,000
1874	700,000	10,000	10,000	720,000
1875	700,000	5,000	5,000	710,000
1876	800,000	10 000	10,000	820,000
1877	6,900,000	520,000	450,000	7,870,000
1878	8,100,000	390,000	440,000	8,930,000
Total	20,500,000	990,000	955,000	22.445,000

Silver coinage from 1869 to 1878.
(48 zolotinks fine.)

Years.	Twenty copecks.	Fifteen copecks.	Ten copecks.	Five copecks.	Total roubles.
1869	3,400,000	1,220,000	370,000	10,000	5,000,000
1870	3.250,000	1,410,000	330,000	10,000	5,000,000
1871	3,370,000	1,420,000	420,000	10,000	5,220,000
1872	2,400,000	880,000	210,000	10,000	3,500,000
1873	3,040,000	1,190,000	260,000	10,000	4,500,000
1874	2,970,000	1,040,000	250,000	10,000	4,270,000
1875	2,910,000	1,120,000	360,000	10,000	4,400,000
1876	3,250,000	1,460,000	490,000	10,000	5,210,000
1877	1,390,000	650,000	210,000	10,000	2,260,000
1878	6,070,000	1,670,000	690,000	10,000	7,440,000
Total	31,050,000	12,060,000	3,590,000	100,000	46,800,000
Total silver coinage (roubles)	. . .	. . .	. . .	. . .	69,245,000

Table showing amount of Gold coined in Lisbon, Portugal.

Period.	In pieces of—				
	10,000 reis.	5,000 reis.	2,000 reis.	1,000 reis.	Total.
From December 12, 1855 to September 30, 1874*	. . . .	3,524,515,000	1,092,900,000	68,057,000	4,685,472,000
From October 1, 1874, to September 30, 1875	. . . .	45,000,000	7,000,000	. . . .	52,000,000
From October 1, 1875, to September 30, 1876	. . . .	61,000,000	4,000,000	. . . .	65,000,000
From October 1, 1876, to September 30, 1877	. . . .	76,000,000	6,500,000	. . . .	82,500,000
From October 1, 1877, to September 30, 1878	187,020,000	42,000,000	43,000,000	. . . .	272,020,000
From October 1, 1878, to September 30, 1879	243,010,000	. . . .	. . . .	. . . .	243,010,000
Total	430,030,000	3,748,515,000	1.153,400,000	68,057,000	5,400,002,000

* NOTE BY TRANSLATOR.—This amount is the aggregate of table published on p. 452, "Report of the Silver Commission," vol. 1, used for convenience.

Table showing amount of Silver coined in Lisbon, Portugal.

Period.	In pieces of—				
	500 reis.	200 reis.	100 reis.	50 reis.	Total.
From July 29, 1854, to September 30, 1874*	7,107,605,000	773,030,000	213,270,000	56,522,200	8,100,436,400
From October 1, 1874, to September 30, 1875	. . . .	14,000,000	25,000,000	3,000,000	42,000,000
From October 1, 1875, to September 30, 1876	210,000,000	16,000,000	22,000,000	. . . .	248,000,000
From October 1, 1876, to September 30, 1877	25,000,000	6,000,000	10,000,000	8 600,000	49,600,000
From October 1, 1877, to September 30, 1878	. . . .	3.4[illegible]0,000	5,000,000	1,600,000	9,950,000
From October 1, 1878, to September 30, 1879	343,990.000	1,560,000	18,000,000	4,000,000	367,550,000
Total	7 636.595,000	764,049,000	293,270.200	73,522,200	8,814,436,400

*NOTE BY TRANSLATOR.—This amount is the aggregate of table published on p. 453, "Report of the Silver Commission," vol. 1, used for convenience.

Statement showing Imports of Gold and Silver into Portugal.

Years.	Imports.			
	Bullion.		Coin.	
	Gold.	Silver.	Gold.	Silver.
	Reis.	Reis.	Reis.	Reis.
1869	498,000	2,051,000	301,087,500	7,123,000
1870	560,000	1,635,000	1,140,892,000	1,138,000
1871	. . . .	2,289,000	3,591,404,000	28,291,000
1872	. . . .	163,900	1,795,255,000	157,000
1873	1,200,00	1,671,000	3,907,193,000	21,137,000
1874	1,120,000	. . . .	1,448,234,000	67,766,000
1875	. . . .	5,320,000	2,493,653,000	38,696,000
1876	120,000	51,050,000	4,326,105,000	109,852,000
1877	2,590,000	16,765,000	718,824,000	42,326,000
1878	. . . .	9,120,000	3,252,380,000	326,595,000

Statement showing Exports of Gold and Silver from Portugal.

Years.	Exports.			
	Bullion.		Coin.	
	Gold.	Silver.	Gold.	Silver.
	Reis.	Reis.	Reis.	Reis.
1869	. .	117,235,000	126,256,700	226,498,000
1870	. .	34,055,000	68,763,000	192,665,000
1871	. .	18,467,000	44,627,000	101,050,000
1872	. .	18,115,000	2,620.000	20,673,000
1873	. .	8,359,000	32,896,000	28,411,000
1874	. .	67,747,000	39,781,000	3,403,000
1875	. .	32,626,000	66,455,000	17,937,000
1876	. .	1,224,000	1,654,005,000	26,986,000
1877	200,000	5,550,000	1,407,838,000	97,893,000
1878	. .	5,450,000	1,688,356,000	194,912,000

Table showing the amount of gold and silver coined under the metric decimal system in Italy.

Year.	Gold 900 fine.	Silver. 5-lire. 900 fine.	Silver. Fractional. 900 fine.	Silver. Fractional. 835 fine.	Total.
1803		49,735	7,155		56,890
1804		104,055	34,965		139,020
1805	16,760	57,280			57,280
1806	2,568,320	119,235	39,349.75		158,584.75
1807	195,080	196,385	35,889.25		232,274.25
1808	10,300,140	16,630,630	1,414,038.25		18,044,668.25
1809	2,668,760	13,596,956	1,653,635		16,150,590
1810	8,599,760	3,055,085	2,137,281.25		5,192,366.25
1811	5,731,660	17,640,110	3,824,607.25		21,434,617.25
1812	3,300,500	11,311,910	2,308,244		13,620,154
1813	3,037,220	5,567,150	3,440,214.50		9,007,364.50
1814	3,528,320	632,780	587,981.75		1,220,761.75
1815	4,717,700	468,220	658,171		1,126,391
1816	3,357,300	373,145	125,200		498,345
1817	7,227,600	868,180			868,180
1818	8,129,000	884,880			884,880
1819	5,329,600	325,680	98,544.75		424,204.75
1820	4,317,860	705,455			705,455
1821	4,720,480	290,780			290,780
1822	799,400	238,700			238,700
1823	1,034,300	177,160			177,160
1824	881,340	892,840	97,328		990,169
1825	3,647,180	2,059,580	915,939.50		2,975,519.50
1826	10,178,960	6,983,185	1,844,764.50		8,827,949.50
1827	7,299,000	14,306,200	2,431,457.50		16,737,657.50
1828	4,416,500	7,009,890	1,339,567.50		8,349,457.50
1829	2,451,240	4,544,305	689,003.50		5,233,308.50
1830	3,324,540	10,183,290	1,177,694		11,360,984
1831	3,221,040	2,550,130	298,406		2,848,536
1832	3,657,660	2,176,425	165,215.50		2,341,640.50
1833	3,013,610	1,674,230	41,556.25		1,715,786.25
1834	12,795 170	939,535	70,449		1,009,984
1835	4,638,860	2,026,740	70,329		2,097,069
1836	2,787,830	3,233,765	81,815.50		3,315,580.50
1837	1,840,460	1,972,685	51,584.50		2,024,269.50
1838	3,407,760	1,744,560	51,382		1,795,942
1839	3,221,220	1,731,460	37,082		1,768,542
1840	4,529,980	1,214,370			1,214,370
1841	5,973,370	1,639,950	43,804		1,683,754
1842	2,545,970	1,392,010	30,778		1,422,788
1843	1,687,260	4,120,310	46,462		4,166,772
1844	1,623,900	6,070,390	148,565		6,218,955
1845	1,678,440	1,723,675	154,031.50		1,877,706.50
1846	1,880,360	1,550,479	61,614		1,612,084
1847	1,697,090	895,070	45,567		940,637
1848	2,796,780	4,885,590	33,860		4,919,450
1849	3,391,660	4,207,100	9,355		4,216,455
1850	4,109,100	3,892,700	16,698		3,909,488
1851	9,175,600	1,828,460	40,106		1,868,566
1852	2,997,600	2,438,410	135,875.50		2,574,285.50
1853	3,593,250	977,270	64,498.50		1,041,768.50
1854	3,777,130	1,790,675	50,936		1,841,611
1855	3,820,600	680,850	35,278		416,128
1856	3,516,920	470,835	74,016		644,851
1857	2,591,290	270,700	38,988.50		309,688.50
1858	5,604,470	203,005	20,108		223,113
1859	12,811,500	302,810	17,047		319,857
1860	5,992,540	188,130	5,479,280.50		5,667,410.50
1861	3,209,410	979,565	1,412,222.50		2,391,787.50
1862	28,608,760	964,435		330,960.50	1,295,395.50
1863	76,514,100			31,751,913.20	31,751,913.20
1864	12,172,600	601,935		30,696,351.10	31,298,286.10
1865	68,705,190	4,010,835		41,937,106.80	45,947,941.80
1866	3,926,020	2,351,760		35,501,070.60	37,852,830.60
1867	5,525,830			16,530,145.80	16,530,145.80
1868	6,807,940			1,252,452	1,252,452
1869	3,707,100	19,975,230			19,976,230
1870	1,095,400	30,729,280			30,729,280
1871	470,160	35,116,695			35,116,695
1872	66,100	35,611,920			35,611,920
1873	20,404,140	42,273,936			42,273,935
1874	5,919,420	60,000,000			60,000,000
1875	2,244,440	50,000,000			60,000 000
1876	2,154 660	36,000,000			35,000,000
1877	4,947,960	18.000,000			18,000,000
1878	6,345,280	9,000,000			9,000,000
1879	2,929,320	20,000,000			20,000,000
	491,009,620	543,681,770	33,557,842	156,000,000	733,239,612

Circulation including the different kinds of notes of the company and institutions for emission to the close of the years 1877 and 1878.

Lire.	1877. Number.	1877. Value.	1878. Number.	1878. Value.
		Lire.		Lire.
0.50	22,755,358	11,377,679	22,745,842	11,372,921
1	38,743,338	38,743,338	38,427,733	38.427,733
2	32,634,724	65,269,448	32,076,123	64,152,246
5	40,562,393	202,811,965	40,781,731	203,908,655
10	25,686,289	256,862,890	24,845,841	248,458,410
20	2,287,875	45,757,500	2,203,801	44,076,020

Lire.	1877. Number.	1877. Value.	1878. Number.	1878. Value.
		Lire.		Lire.
25	149,357	3,733,925	74,791	1,869,775
40	5,937	237,480	3,992	159,680
50	1,891,167	94,558,350	2,071,754	103,587,700
100	2,376,881	237,688,100	2,275,814	227,581,400
200	102,009	20,401,800	90,912	18,182,400
250	317,840	79,460,000	342,943	85,735,750
500	502,901	251,450,500	518,789	259,394,500
1, 000	260,196	260,196,000	305,374	305,374,000
Bank of the Four Legations		2,128		2,128
Bills of the old form		9,489		
Total		1,568,560,592		1,612,283,318

[Copy of a note of the Minister of Agriculture, Industry, and Commerce, dated October 29, 1879. No. 13.030 gives information as to the amount of gold and silver in Italy, as reported by the Minister of Finance, in reply to letter of July 31, 1879.]

It is impossible to reply with entire certainty to all the inquiries of the Ministry as to the quantity of gold and silver, or ingots, supposed to be in circulation in the Kingdom of Italy, the production of the mines, and the annual consumption in the arts and manufactures. The reserve in gold and silver in the treasury, with which is included that of analogous institutions, amounts to a sum total of about 120,000,000 of lire. As to the reserve of gold and silver existing outside of the treasury, it would be impossible to furnish any positive information; even an estimate would have a purely hypothetical character.

If an amount should be required (taking into consideration all the researches made as to the approximate issue) of the reserve held by individuals, and of bank issues, it may be placed at something more than 100,000,000 of lire, making the total of gold and silver coin existing in Italy to be about 300,000,000 lire. As regards the production of the gold and silver from our mines, it may be stated that for the three years from 1875-'77 the production of gold and silver has been as follows;

1875.	£ 80,000
1876	286,000
1877.	375,000

The production of silver in Tuscany has been for—

1875.	£131,000
1876.	92,000
1877.	93,000

It would be impossible to furnish any approximate estimate of the annual consumption of gold and silver in the arts and manufactures.

Italian Coinage from 1862 till 1878.

Years.	Gold— Of $\frac{900}{1000}$. Pieces of 100, 50, 20, 10, 5 lire.	Silver— Of $\frac{900}{1000}$. Pieces of 5 lire.	Silver— Of $\frac{835}{1000}$. Pieces of 2 and 1 lire—50 and 20 cents.	Remarks.
1862	£28,608,760	£964,435	£330,960.50	From 1874 the circulation of 5-lire pieces was annually limited.
1863	76,514,100		31,751,913.20	
1864	12,177,600	601,935	30,696,351.10	
1865	68,705,190	4,010,835	41,937,106.80	
1866	3,926,020	2,351,760	33,501,070.60	
1867	5,525,830		16,530,145.80	
1868	6,807,940		1,252,452.	
1869	3,707,100	19,976,230		The circulation of silver coins of $\frac{835}{1000}$ is limited.
1870	1,095,400	30,729,280		
1871	470,160	35,216,695		
1872	66,100	35,611,920		
1873	20,404,140	42,273,935		
1874	5,919,420	60,000,000		
1875	2,244,440	60,000,000		
1876	2,154,560	36,000,000		
1877	4,947,960	18,000,000		
1878	6,345,280	9,000,000		
Total	249,615,000	344,637,925	156,000,000	

Switzerland—Summary of the coinage of the Swiss mints from the year 1850 to the end of 1879.

SILVER.

Value.	Fineness.	Number of pieces.	Nominal value.
			Francs.
5 francs	900–1,000	2,095,650	10,478,250
2 francs	900–1,000	2,500,000	5,000,000
1 franc	900–1,000	5,750,000	5,750,000
½ franc	900–1,000	5,500,000	2,250,000
2 francs	800–1,000	3,500,760	7,001,520
1 franc	800–1,000	3,517,568	3,517,558
2 francs	835–1,000	4,000,000	8,000,000
1 franc	835–1,000	6,055,500	6,055,500
½ franc	835–1,000	4,000,000	2,000,000
Total			50,052,828

BULLION.

20 centimes	Old alloyage.	15,883,608	3,176,721.60
10 centimes	do	17,694,848	1,769,484.80
5 centimes	do	25,524,566	1,326,228.30
Total			6,272,434.70
10 centimes	New alloyage	1,000,000	100,000
6 centimes	do	1,000,000	60,000
Total			150,000

COPPER.

2 rappen		14,513,300	290,266
1 rappen		23,053,997	230,539.97
Total			620,805.06

British India.—Imports, exports, and coinage of gold and silver of British India, and government paper circulation issued by Bengal, Madras, and Bombay presidencies.

Date.	Imports.		Exports.		Coinage.		Paper currency.
	Gold.	Silver.	Gold.	Silver.	Gold.	Silver.	
1835–'36	£333,399	£1,833,673	£3,481	£221,777	£197,494	£2,329,020	...
1836–'37	421,694	1,646,840	1,970	307,958	6,815	3,872,189	...
1837–'38	462,588	2,215,020	31,718	248,076	25,426	3,375,676	...
1838–'39	266,531	2,850,380	7,606	205,250	34,473	3,970,619	...
1839–'40	231,223	1,937,022	4,580	286,551	79,156	3,069,967	...
1840–'41	137,884	1,707,483	672	395,813	66,772	2,924,570	...
1841–'42	166,360	1,678,086	737	394,858	23,101	3,760,264	...
1842–'43	212,441	3,235,011	1,280	282,566	...	3,294,787	...
1843–'44	407,038	4,713,740	515	1,048,298	16,634	4,672,703	...
1844–'45	719,453	3,176,048	9,353	1,187,487	26,339	4,696,814	...
1845–'46	551 966	1,901,357	7,490	1,028,867	30,142	3,856,218	...
1846–'47	852,839	2,087,082	5,890	708,833	42,734	2,920,852	...
1847–'48	1,048,778	922,185	9,662	1,416,376	46,291	1,782,257	...
1848–'49	1,401,748	2,798,628	62,830	2,484,724	70,470	2,578,866	...
1849–'50	1,159,548	2,235,792	42,555	962,185	44,147	2,411,208	...
1850–'51	1,165,310	2,656,498	2,016	539,273	123,717	2,616,417	...
1851–'52	1,338,778	3,713,280	71,165	847,923	62,553	4,248,491	...
1852–'53	1,341,106	5,490,227	168,805	885,203	...	6,509,965	...
1853–'54	1,078,708	3,770,643	17,265	1,464,899	145,679	6 253,437	...
1854–'55	882,721	1,145,137	151,431	1,115.537	2,676	1,366,901	...
1855–'56	2,508,353	8,792,793	2,108	698,418	167,863	6,973,659	...
1856–'57	2,176,002	12 237,695	84,788	1,164,448	128,302	10,779,286	...
1857–'58	2,830,084	12,985,332	47,011	766,384	43,783	12,551,303	...
1858–'59	4,437,339	8,379,692	10,886	651.350	132,273	6,642,267	...
1859–'60	4,288,037	12,068,926	3,803	921,363	64,307	10,677,924	...
1860–'61	4,242,441	6,434,636	9,872	1,106,627	65,038	5,192,328	...
1861–'62	5,190,432	9,761,545	6,007	676,089	68,667	7,070,830	£3,690,000
1862–'63	6,881,566	13,627,398	33,410	1,077,243	130,666	9,251,468	4,926,000
1863–'64	8,925,412	14,037,167	27,106	1,240,352	54,354	11,477,426	5,360,000
1864–'65	9,876,032	11,488,320	35,068	1,409,622	95,672	10,358,423	7,427,327
1865–'66	6,372,895	20,184,408	648,419	1,515,234	17,665	14,507,049	6,898,481
1866–'67	4,927,339	9,670,712	739,144	1,734,019	27,725	6,118,867	8,090,868
1867–'68	4,773,786	6,997.937	166,457	839,948	21,534	4,313,285	9,069,669
1868–'69	5,176,976	9,978,978	17,624	1,377,966	25,156	4,207,031	9,959,296
1869–'70	5,690,399	8,264,408	98,282	946,264	78,510	7,473,560	10,472,883
1870–'71	2,785,976	2,662,237	600,453	1,720,313	4,143	1,718,197	10,437,291
1871–'72	3,673,778	8,007,625	8,434	1,487,209	15,412	1,690,394	13,167,917
1872–'73	2,622,371	1,934,214	79,009	1.219,070	31,795	3,980,927	11,136,061
1873–'74	1,648,807	4,143,726	266,169	1,647,902	15,498	2,370,007	9,249,761
1874–'75	2,089,236	6,051,810	215,701	1,409,608	14,034	4,896,884	11,236,438
1875–'76	1,836,381	3,484,341	291,260	1,908,986	17,160	2,650,218	10,999,927
1876–'77	1,443,712	0,992,408	1,236,362	2,793 636	...	6,271,122	11,617,811
1877–'78	1,578,927	15,774,622	1,110,798	1,100,197	16,636	16,180,326	13,574,760
1878–'79	1,463,049	6,593,699	2,359,223	1,623,005	...	...	11,423,646

Amount of gold and silver coin and bullion held in the government treasuries in British India on 31st March of each year from 1870 to 1879.

	Gold.			Silver.		
	Coin.	Bullion.	Total.	Coin.	Bullion.	Total.
1870	£4,720	£11,240	£15,960	£11,657,351	£248,531	£11,905,882
1871	797	34,081	34,878	13,719,363	437,161	14,156,514
1872	688	36,567	37,255	17,799,345	632,403	18,431,748
1873	868	36,725	37,593	14,904,716	538,612	15,443,328
1874	865	34,447	35,312	10,064,354	1,034,655	11,099,009
1875	507	34,629	35,136	12,011,850	571,984	12,583,834
1876	25,546	16,813	42,359	13,351,331	826,885	14,178,216
1877	19,894	27,380	47,274	10,278,857	823,517	11,102,374
1878	20,517	104	20,621	11,221,720	250,443	11,472,163
1879	17,398	18	17,416	9,733,467	238,362	9,971,829

Coin and bullion, almost all silver, held at the banks of Bengal, Madras, and Bombay, on the 31st March of each year from 1875 to 1879.

	Bengal.		Madras.		Bombay.		Total.	
	Gold and silver coins held at the head office.	Bullion.	Silver coin held at the head office.	Bullion.	Silver coin held at the head office.	Bullion.	Coin.	Bullion.
	Rupees.	Rupees.	Rupees.	Rupees.	Rupees.	Rupees.	Rupees.	Rupees.
1875	3,270,575	46,000	3,381,083	...	1,519,529	...	8,171,187	46,000
1876	3,654,005	20,000	2,065,840	...	3,585,961	...	9,305,806	20,000
1877	1,499,510	615,000	4,808,197	...	4,984,790	...	11,292,497	615,000
1878	1,742,570	...	2,166,391	...	1,672,035	...	5,580,996	...
1879	1,642,525	...	1,793,587	...	2,675,833	...	6,111,945	...

Cape of Good Hope—Imports and exports of specie.

Year.	Imports.			Exports.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.
1825–'65	£3,412,510	£280,980	£3,699,490	£1,067,738	£120,670	£1,188,409
1866	10,000	...	10,000	11,892	1,929	13,821
1867	35,000	...	35,000	19,162	2,053	21,215
1868	100,352	100	100,452	11,916	1,712	13,628
1869	25,000	...	25,000	40,162	1,314	61,476
1870	199,000	...	199,000	28,872	4,840	33,712
1871	661,735	10,700	672,425	51,812	2,576	54,387
1872	1,818,230	172,100	1,990,330	62,433	10,262	72.695
1873	310,570	33,847	344,417	99,679	3,737	103,416
1874	166,569	...	166,669	248,984	6,202	255,186
1875	19,677	11,647	31,324	180,973	4,753	185,726
1876	267,889	5,346	273,235	135,669	1,542	137,111
1877	282,776	15,304	298,080	26,245	2,132	28,377
1878	436,366	616	436,982	76,447	103	76,550
1879	580,666	3,210	583,876	261,949	131	262,080
1880	369,500	67,310	426,810	147,218	637	147,855
Total	8,696,840	597,160	9,293,000	2,471,052	164,692	2,635,644

Amount of coin in circulation (including copper and bronze):

Imports of coin to end of 1880	£9,302,280
Exports of coin to end of 1880	2,636,149
Balance	6,666,131
The coin in the coffers of the banks on 31st December, 1880, amounted to	1,492.432

Bank Reserve and Paper Circulation.

Date.	Coin in banks.			Notes outstanding.			Total.		
	£	s	d	£	s	d	£	s	d
Dec. 31, 1875	833,070	8	4	695,105	10	0	1,528,176	16	4
Dec. 31, 1876	1,038,176	16	1	480,106	0	0	1,518,282	16	1
Dec. 31, 1877	1,084,888	2	3	618,918	0	0	1,603,806	2	3
Dec. 31, 1878	1,057,025	0	3	685,206	0	0	1,742,231	0	3
Dec. 31, 1879	1,314,490	10	10	721,469	0	0	2,035,959	10	10
Dec. 31. 1880	1,492,431	17	8	858,501	0	0	2,350,932	17	8
Aggregate	6,820,082	15	6	3,969,305	10	0	10,779,388	6	5

Australasia.—Gold and silver coin, bullion, and paper currency in the banks of Australasia.

For the quarter ended June 30th, 1879.

Colony.	*Gold, silver, and other coin.*	*Gold and silver bullion.*	*Notes in circulation.*
Victoria	$11,810,436	$1,333,105	$5,622,452
New South Wales	11,891,760	372,711	5,389,439
New Zealand	7,810,411	800,223	4,905,086
South Australia	3,069,321	64,053	2,238,673
Queensland	3,866,454	496,188	1,583,778
Tasmania	1,429,758	....	637,142
Western Australia	387,782	....	90,035
Total	40,265,922	3,066,280	20,466,605

For the quarter ended September 30, 1879.

Colony.	*Gold, silver, and other coin.*	*Gold and silver bullion.*	*Notes in circulation.*
Victoria	$13,444,548	$1,211,029	$4,978,347
New South Wales	12,446,862	517,572	5,246,876
New Zealand	8,450,633	897,733	4,292,024
South Australia	3,129,534	26,479	2,090,517
Queensland	4,605,169	466,352	1,535,046
Tasmania	1,583,423	....	615,880
Western Australia	402,581	....	84,190
Total	44,062,750	3,119,165	18,842,873

For the quarter ended December 31, 1879.

Colony.	*Gold, silver, and other coin.*	*Gold and silver bullion.*	*Notes in circulation.*
Victoria	$16,351,691	$1,561,071	$5,308,184
New South Wales	13,229,473	442,511	5,592,830
New Zealand	9,401,494	893,295	4,298,550
South Australia	2,981,413	31,355	2,167,208
Queensland	5,151,117	512,136	1,585,919
Tasmania	1,574,917	....	612,352
Western Australia	461,490	....	96,488
Total	48,141,695	3,440,368	19,661,531

For the quarter ended March 31, 1880.

Colony.	*Gold, silver, and other coin.*	*Gold and silver bullion.*	*Notes in circulation.*
Victoria	$18,212,988	$1,427,846	$5,758,257
New South Wales	15,092,876	316,371	5,684,033
New Zealand	9,524,417	782,898	4,416,120
South Australia	3,349,841	38,737	2,485,881
Queensland	5,125,490	476,873	1,579,165
Tasmania	1,680,733	....	635,278
Western Australia	478,051	....	102,445
Total	53,464,396	3,042,725	2[illegible],661,179

Statement of average amount of coin held by the London Chartered Bank of Australasia in Victoria during the past three years.

Gold coin	£155,855
Silver coin	20,420
Total	176,275

Average coin held by the Colonial Bank of Australasia for each half year from April 1, 1876, to March 31, 1879.

For half year ending—

	Silver.	*Gold.*
September 30, 1876	£13,710	£96,630
March 31, 1877	14,140	132,710
September 30, 1877	12,230	140,990
March 31, 1878	13,250	111,570
September 30, 1878	14,870	89,140
March 31, 1879	16,820	84,700

Average of coined gold, silver, and copper held by the Oriental Bank Corporation, Victoria, during the years 1876, 1877, 1878 and 1879.

Year.	*Coin.*	*Half year ending—* *June 30.* £ s. d.	*December 30.* £ s. d.
1876	Gold	132,013 3 4	168,169 3 4
	Silver	5,138 13 7	4,331 7 10
	Copper	109 15 8	279 5 5
1877	Gold	177,842 0 0	130,612 11 8
	Silver	4,490 7 9	5,385 14 1
	Copper	215 14 8	210 18 1
1878	Gold	166,229 3 4	120,568 6 8
	Silver	5,037 6 7	6,879 5 6
	Copper	312 17 9	266 7 5
1879	Gold	136,838 0 0	......
	Silver	7,896 11 0	......
	Copper	225 14 0	......

Memorandum of average amounts of coin held by the Union Bank of Australia in Victoria for the following half yearly periods.

		£ s. d.	£ s. d.
1876.			
June 30.	Gold	223,506 00 00	
	Silver	10,614 3 1	234,120 3 1
Dec. 31.	Gold	233,693 00 00	
	Silver	9,912 19 10	233,605 19 10
1877.			
June 30.	Gold	202,672 00 00	
	Silver	9,347 10 00	212,019 10 00
Dec. 31.	Gold	175,020 00 00	
	Silver	7,487 18 11	182,507 18 11
1878.			
June 30.	Gold	225,130 00 00	
	Silver	8,646 2 8	233,776 2 8
Dec. 31.	Gold	215,397 00 00	
	Silver	9,028 18 00	224,425 18 00
1879.			
June 30.	Gold	317,800 00 00	
	Silver	9,567 16 2	327,367 16 1

Average amount of gold and silver coin held by the Commercial Bank of Australasia (limited) for the half years ending—

1876.			
Dec. 31.	Gold	£80,754	
	Silver	5,884	£86,638
1877.			
June 30.	Gold	86,258	
	Silver	5,699	91,957
Dec. 31.	Gold	74,498	
	Silver	5,361	79,859

New South Wales.—Imports and exports of gold by sea and land.

	1876.	1877.	1878.
Export:			
Gold coin	£1,575,876	£1,816,495	£1,653,911
Gold dust and bars	76,840	51,940	138,620
Total	1,652,716	1,868,435	1,792,532
Imports:			
Gold in bars	1,175,373	1,098,592	1,064,877
Gold coin	111,130	106,291	118,533
Total	1,286,503	1,204,883	1,183,410

The German consular reports from Sydney contain the following remarks, 1877: "During 1876 were received in the mint of Sydney, from the colony of New South Wales, 126,788 ounces = £479,133." This sum decreases with every year; the highest amount was delivered in 1872, viz: £1,513,186. 1878: "During 1877 were received only 97,582 ounces = £366,329." 1879: "The amount received in 1878 was 75,492 ounces = £279,166, all produced by the colony," the whole amount delivered in the mint of Sydney for coinage during 1878 was 107,347 ounces, of a value of £382,741.

The gold production of 1879 is given in the report of the department of mines as follows: "Delivered in the mint of Sydney, from the various mining districts, 106,900 ounces gold; there were exported 2,750 ounces gold, together 109,650 ounces, valued at £407,219, while the production of the previous year had been 119,655 ounces. Of the production of 1879, three-fourths came from the gravel mines, one-fourth from quartz veins. Up to the year 1878 there were produced 434,379 ounces of silver in New South Wales (mostly from copper ores). The production of 1878 was 60,563 ounces; that of 1879 already 83,164 ounces, and for 1880 more than 100,000 ounces have been produced in all probability; it is to be concluded with great certainty that many new gold-fields may still be found." The report for 1878 says: "Mining industry in Queensland is still in its infancy; nevertheless, the export of gold alone is nearly equal to that of wool, our staple article of export, viz: about £1,000,000." According to this, the expectations of a few years ago were not realized.

—*Extract from "Zur Statistik der Edelmetalle in den Jahren 1876-80," von Dr. Adolf Soetbeer.*

New Zealand.

	1876.	1877.	1878.
Export of gold . .	£1,268,599	£1,476,312	£1,244,192
Import of gold coin	104,802	425,059	333,135

Some gold still found in Tasmania.

On the total export of gold by the Australian colonies, and the net export after deduction of inter-colonial import, we find the following figures in the "Statistical Abstract:"

	1876.	1877.	1878.
Total gold export	£8,212,368	£10,248,024	£8,877,171
Gold export after deductions of colonial import . .	5,793,236	7,599,887	5,828,951

The direct import of gold into England from Australia was—

		Kilograms.
1871–1875, on the average,	£7,097,800	=52,000
1876, on the average,	4,956,800	=35,500
1877, on the average,	6,655,438	=48,700
1878, on the average,	5,680,600	=41,000
1879, on the average,	3,184,600	=23,300
1880, on the average,	3,614,200	=26,400

As the annual report of gold alone is no sure indication of the production of the corresponding year, I paid attention to other reports in making the following table of gold production in the Australian colonies:

	1876.	1877.	1878.	1879.
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*
Victoria	34,100	25,200	23,580	23,600
New South Wales	4,000	3,100	3,720	3,400
Queensland	11,700	13,200	8,900	?
New Zealand	9,300	10,800	9,100	?
Total	59,100	52,300	45,300	39,000

The following table shows the Australian gold production for twenty-four years:

	Kilograms.
1856–1860 . . .	86,700
1861–1865 . . .	77,700
1866–1870 . . .	70,400
1871–1875 . . .	59,900
1876 . . .	59,100
1877 . . .	52,300
1878 . . .	45,300
1879 (incomplete) . . .	39,000

The above table shows an extraordinary diminution of the Australian gold production during the last twenty years, which fact contributed a great deal to raise doubts respecting a full supply of gold in the future, as they found expression in the book of Professor Süss, "Die Zukunft des Goldes." It will be of interest to learn the views of a mineralogist on the future production of gold in Australia, which are in no way influenced by views on the question of standard. Mr. Ulrich writes from Dunedin, New Zealand, November, 1878, to the News Jahrbuch für Mineralogie, &c., 1879: "I cannot agree with Professor Süss when he speaks despondingly of the Australian gold production. It cannot be denied that the yield in Victoria has decreased since a number of years, and that it will continue to decrease. But it is just equally probable that the yield of New South Wales, South Australia, Tasmania, and above all of Queensland, will not only make up for the deficit of Victoria, but will swell the total amount of Australian gold production. In *Victoria* the alluvial gold deposits are nearly exhausted, and the quartz reefs are already worked. There are in all probability large deposits of gold under a thick layer of basalt, the working of which will be costly and can only take place slowly, not influencing much the annual yield of gold in Victoria. It has been proved that the richness of the strata diminishes with their depth. All things considered it seems probable that the yield of gold in Victoria will decrease down to 600,000 to 700,000 ounces; but at that point it will remain stationary for a longer time. All depends on the number of miners, which was diminished by 20,000 to 30,000, as new land laws made them take up land. This thirst for land being stilled, we may count upon a greater stability in the number of miners. As to New Zealand, I can state that the discovery of many new alluvial diggings may be foreseen with great certainty, and a large immigration is, of course, a good source for miners. For Queensland the prospects are all excellent. The veins of Gympie and Gilbert and other old mines still yield well, and promise well for the future, and every mail brings news of discovered alluvial and quartz mines. There seems to exist a broad gold-containing zone, of various breadth, through the whole of Queensland, up to the gulf of Carpentaria, where it meets the gold fields of Port Darwin, in the northern territory of South Australia. There is certainly a great improvement for vigorous working of these mines; the climate is unfavorable for white persons. The Chinese prosper there, but recent legislation has put obstacles in the way of a large Chinese immigration. Besides this the natives are troublesome.

In South Australia are the just mentioned mines of Port Darwin, remarkable for their rich quartz veins and for numerous alluvial mines, but the climate is even more unfavorable to white miners than that of Queensland. As the veins occur in primary rocks they may be considered of a stable nature. *Tasmania* is beyond doubt a colony rich in metals. Its richness in gold, doubted a few years ago, is now proved by new discoveries and great yields. The gold occurs mainly in rich quartz veins, yet alluvial diggings are by no means rare; they only wait for legislation, as they mostly occur on private lands. As to New Zealand, the reports of the State geologist promise an increase of gold production for the northern island. I know the province of Otago well, and am sure of an increased production of gold there. The older alluvial diggings are certainly well-nigh exhausted, but there are other deposits in conglomerates, so-called cements, which promise a good yield for a long time to come. The main cause of the decrease of the gold production in New Zealand is the fertile soil and climate favorable to agriculture which allured the miners to the easy task of the husbandman. Increased immigration, however, will bring new miners to the gold deposits. The report of the mining department in Sydney quoted above and dated September, 1880, goes far toward corroborating the views of Mr. Ulrich. It says that the decrease in the Australian yield is mainly caused by the preference for agriculture and industrial pursuits evinced by the miners. "The production would rise immediately if capital was applied to the mines in larger proportion, bringing with it new miners and more rational methods of mining. Old mines deserted for their unproductiveness could be restored in this way to new life, as we see it indeed not very rarely." Thus it will be seen that testimony is not wanting which may be opposed to the theory of an unavertable decline of the Australian gold fields.

Victoria.	1876.	1877.	1878
Export:			
Gold uncoined	£2,103,591	£2,090,112	£1,495,449
Gold coin . . .	1,587,104	2,814,907	2,399,741
Total . . .	3,690,095	4,905,019	3,895,190
Import:			
Gold uncoined	553,821	433,961	673,370
Gold and silver coin . . .	14,110	50,850	327,800

[*Extract from "Zur statistick der Edelmetalle in den jahern* 1876–1880, *von Dr. Adolf Soetbeer.*"]

The following figures on the gold production of Victoria are given in the German Consular Reports of Melbourne:

	1876.	1877.	1878.	1879.
	Ounces.	*Ounces.*	*Ounces.*	*Ounces.*
Production of quartz mines	605,859	518,899	493,587	465,637
Production of alluvial mines	357,901	289,754	264,453	293,310
Total production . .	1,095,787	809,653	758,040	758,947
Mined in quartz mines . .	14,452	14,690	14,132	14,784
Mined in alluvial mines . .	26.558	23,315	22,504	22,769
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Average annual earnings in quartz mines	160 17 9¾	139 12 0¼	138 7 7¼	118 8 7
Average annual earnings in alluvial mines	51 10 7	47 8 0¾	47 3 6¾	48 10 ⅛
New mining companies . .	94	60	81	167
Nominal capital	£1,349,696	£667,316	£791,960	£1,286,674
Estimated value of steam engines and other inventory in the gold mines . .	1.989,500	2,029,962	1,903,494	1,899,788

The quantity of gold exported from Victoria in a form other than coin and that coined in the colony from the discovery of gold to December 31, 1879, is officially given as 48,719,930 ounces, valued at £194,879,722. In 1879 mines of more than 2,270 feet depth were successfully worked. The production of gold during 1880 is estimated at 800,000 ounces, about 40,000 ounces more than in the two preceding years. The production of silver up to the end of 1879 was 151,267 ounces.

Queensland.	1876.	1877.
Export of gold dust	£1,284,165	£1,452,396
Export of gold bars	143,764	158,707
Total	1,427,929	1,611,103
Import of gold coin	181,550	

The German Consular Report for 1876 says: "Gold is the main metal exported from Queensland. The gold export amounted to 374,776 ounces, valued at £1,427,929. Gympie, on the Mary River, is here the oldest gold field. The shafts are now sunk deeper, and very rich strata have been found in this way. In the north, on the rivers Normanby, Laura, and Palmer, gold washing is prosecuted with good success, and some deep shafts have been sunk, which meet numerous gold veins in quartz. On the rivers are still found, besides dust, large chunks of gold of several pounds weight. Almost every day brings new gold discoveries, and since we have many hundreds of square miles in the mountains that have never been prospected, we may conclude that new gold fields will still be found.

Dominion of Canada.—*General abstract showing the notes and specie of the banks of British Columbia in circulation for the quarter ending 31st March*, 1880.

Name of Bank.	*Specie.*	*Dominion notes.*	*Notes in circulation.*
Total, Ontario and Quebec	$ 6,686,130 81	$ 8,713,914 46	$18,529,352 60
Total, Nova Scotia	448,955 10	676,745 90	1,509,760 41
Total, New Brunswick	162,808 62	221,083 00	664,662 50
Aggregate	6,297,894 63	9,511,743 36	20,793,775 41

Circulation and Specie.

	July 1, 1870.	*December* 31, 1879.	*March* 31, 1880.
Fractionals	$ 113,685 73	$118,423 48	$119,618 73
$1 and $2	2,890,830 75	3,445,841 75	3,295,903 25
$5, $10 and $20	89,059 98	85,721 58	84,242 65
$50 and $100	633,850 00	703,850 00	702,900 00
$500 and $1,000	7,327,000 00	7,957,000 00	8,270,000 00
Total	11,054,426 46	12,310,836 81	12,472,664 63

Fractional notes		$119,618 73
Provincial notes		202,010 15
Montreal issue		5,708,281 50
Toronto issue		4,018,097 0[illegible]
Halifax issue		1,600,111 50
St. John issue		750,583 75
Victoria issue		4,982 00
Notes in circulation according to the following dates		12,390,524 31
Specie held at Montreal February 7		$2,248,042 51
Specie held at Toronto February 7		717,054 11
Specie held at Halifax February 7		555,097 86
Specie held at St. John February 7		171,058 78
Specie held at Winnipeg January 31		2,486 66
		3,693,739 92
20 per cent. on $9,000,000	$1,800,000 00	
50 per cent. on $3,000,000	1,500 000 00	
100 per cent. on $390,524.31	390,524 31	
		3,690,524 31
Excess of specie		3,215 61

Japan.—Imports and Exports of Specie and Bullion into and from Japan during fiscal year ended June 30, 1881.

Imports.

Country.	*Gold.*					
	Coin.		*Bullion.*		*Total.*	
	Yen.	*Sen.*	*Yen.*	*Sen.*	*Yen.*	*Sen.*
Great Britain	. . .	. . .	150	00	150	00
United States	. . .	. . .	. . .	. . .	. . .	. . .
East Indies and Siam	. . .	. . .	. . .	. . .	. . .	. . .
China	593	19.5	. . .	. . .	593	19.5
Total	593	19.5	150	00	743	19.5

Country.	*Silver.*					
	Coin.		*Bullion.*		*Total.*	
	Yen.	*Sen.*	*Yen.*	*Sen.*	*Yen.*	*Sen.*
Great Britain	. . .	. . .	662	50	662	50
United States	*209,434	00	21,063	75	230,497	75
East Indies and Siam	390	00	. . .	. . .	390	00
China	634,169	30	599.494	38.8	1,233,561	68.8
Total	843,093	30	621,220	63.8	1,465,214	93.8

* Mexican dollars.

Exports.

Country.	*Gold.*					
	Coin.		*Bullion.*		*Total.*	
	Yen.	*Sen.*	*Yen.*	*Sen.*	*Yen.*	*Sen.*
Great Britain	578,349	68	225,853	82.1	804,203	50.1
United States:						
Japanese	853,399	00	. . .	. . .	. . .	
English	222	09.6	. . .	. . .	. . .	
American	4,553	73.4	. . .	. . .	. . .	. . .
French	1,745	64.1	. . .	. . .	859,920	46.5
East Indies and Siam	. . .	. . .	. . .	. . .	. . .	. . .
China	448,927	11.5	. . .	. . .	448,927	11.5
France	145	14.7	. . .	. . .	145	14.7
Russia	. . .	. . .	. . .	. . .	. . .	. . .
Total	1,887,342	40.7	225,853	82.1	2,113,196	22.8

Country.	*Silver.*					
	Coin.		*Bullion.*		*Total.*	
	Yen.	*Sen.*	*Yen.*	*Sen.*	*Yen.*	*Sen.*
Great Britain	. . .	. . .	. . .	. . .	. . .	. . .
United States:						
Japanese	. . .	. . .	. . .	. . .	. . .	. . .
English	. . .	. . .	. . .	. . .	. . .	. . .
American	1,505	92.3	. . .	. . .	1,505	92.3
French	. . .	. . .	. . .	. . .	. . .	. . .
East Indies and Siam	1,965,972	00	. . .	. . .	1,965,972	00
China	4,089,086	56.9	. . .	. . .	4,089,086	56.9
France	. . .	. . .	. . .	. . .	. . .	. . .
Russia	7,000	00	. . .	. . .	7,000	00
Total	6,063,564	59.2	. . .	. . .	6,063,564	59.2

Mexico.—Deposits of gold and silver at the mints of Mexico during the fiscal year ended June 30, 1878.

Locality of production.	*Gold.*		*Silver.*	
	Weight.	*Value.*	*Weight.*	*Value.*
	Kilograms.		*Kilograms.*	
Chihuahua	4.215	$2,713 31	27,060.793	$1,058,320 18
Durango	25.402	16,346 62	22,421.001	876,862 80
Guanajuato	448.156	288,401 48	110,509.028	4,321,897 57
Guerrero	.276	177 93	2,194.106	85,809 29
Hidalgo	74 985	48,255 51	85,398.428	3,339,847 11
Jalisco	. . .	. . .	35,619.728	1,393,051 80
Mexico	. . .	. . .	4,982.894	194,875 83
Michoacan	214.428	137,991 21	11,385.732	445,284 58
Oaxaca	4.201	2,703 45	3,2[illegible]3.375	126,845 13
Puebla	1.717	1,105 26	333.676	13,049 73
Queretaro	. . .	. . .	121.186	4,739 46
San Luis Potosi	56.287	36,222 76	53,514.190	2,092.886 41
Sinaloa	56.523	36,374 18	20,380 584	797,064 25
Sonora	54.355	34,979 01	49,090 117	1,919,865 37
Zacatecas	79.155	50,926 61	12[illegible],522.294	4,713,506 32
Plate, &c	8.061	5,188 46	1,735.625	67,878 65
Total	1,027.761	661 385 79	548,512.757	21,451,784 47

Deposits of gold and silver at the mints of Mexico during the fiscal year ended June 30, 1879.

Locality of production.	*Gold.*		*Silver.*	
	Weight.	*Value.*	*Weight.*	*Value.*
	Kilograms.		*Kilograms.*	
Chihuahua	72.169	$46,442 83	27,925.958	$1,[illegible]92,157 43
Durango	31.936	20,551 62	28 534.697	1,115,965 10
Guanajuato	422 047	271,559 48	105,311.621	4,118,632 27
Guerrero	.717	461 96	2,005.612	78,437 99
Hidalgo	78 845	50,739 03	95,501.983	3,734,986 90
Jalisco	5.644	3,632 66	34,222.216	1,338,392 70
Mexico	29.610	19,054 87	8,909.615	348,446 11
Michoacan	71.847	46,235 71	6,376.003	237,626 01
Oaxaca	7.029	4,522 94	3,810.244	149,014 81
Puebla	10.104	6,502 21	712.991	27,884 27
Queretaro	.003	2 21	230.872	9,029 15
San Luis Potosi	109.844	70,687 79	67,838.861	2,653,109 62
Sinaloa	19.046	12,256 42	11,705.015	457,771 44
Sonora	38.641	24,866 82	32,917.049	1,287,352 89
Zacatecas	63.649	40,958 15	117,417.861	4,592,097 90
Plate, &c	40.850	26,288 15	2,128.973	83,261 96
Parted	27.181	17,491 76	2,008.573	78,553 24
Unknown sources	.357	229 93	66.762	2,610 99
Total	1,029.519	662,524 42	547,324.905	21,405,330 78

Coinage of the mints of Mexico by fiscal years.

GOLD.

Mint.	1875.	1876.	1877.	1878.	1879.	*Total.*
Zacatecas	$42,999 00	$50,731 60	$30,765 00	$23,720 00	$50,111 00	$198,317 50
Guanajuato	386,000 00	323,900 00	307,500 00	299,000 00	207,840 00	1,524,240 00
Mexico	224,000 00	284,000 00	268,500 00	290,000 00	304,500 00	1,370,500 00
San Luis Potosi	...	...	...	...	...	...
Guadalajara	7,100 00	...	...	...	3,830 00	10,930 00
Alamos	16,440 00	6,420 00	5,520 00	5,235 00	13,700 00	47,315 00
Chihuahua	13,600 00	21,920 00	1,900 00	1,100 00	...	38,520 00
Culiacan	50,529 00	55,920 00	62,790 00	40,923 00	49,230 00	249,392 00
Durango	26,180 00	19,480 00	17,725 00	17,410 00	23,935 00	104,730 00
Hermosillo	87,640 00	40,270 00	6,830 00	11,730 00	1,360 00	147,830 00
Oaxaca	8,140 00	6,760 00	4,720 00	2,880 00	3,700 00	26,200 00
Total	862,619 00	809,401 50	695,750 00	691,998 00	658,206 00	3,717,974 60

SILVER.

Zacatecas	$5,013,000 00	$5,027,614 00	$4,791,600 00	$4,492,000 00	$4,775.000 00	$24,549,214 00
Guanajuato	4,297,000 00	4,301,976 00	4,464,000 00	4,525,000 00	4,321,000 00	21,908,976 00
Mexico	2,761,000 00	3,335,000 00	4,611,000 00	4,488,700 00	5,116,000 00	20,311,700 00
San Luis Potosi	2,275,855 00	1,936,500 00	2,091.964 00	2,010,126 00	2,519,110 00	10,833,565 00
Guadalajara	1,154,535 00	1,143,380 00	1,321,585 00	1,462,960 00	1,413,161 00	6,495,621 00
Alamos	948,804 75	771,480 50	920,114 00	1,050,583 75	756,598 15	4,447,581 15
Chihuahua	893,431 00	977,812 00	658,264 00	910,506 00	806,025 00	4,246,038 00
Culiacan	726,339 75	746,396 50	771,412 00	845,439 00	891,951 00	3,981,538 25
Durango	718,233 00	673,570 00	868,195 00	850,106 75	854,882 50	3,964,987 25
Hermosillo	469,929 00	410,641 00	783,065 50	866,268 00	555,650 00	3,085,553 50
Oaxaca	128,821 00	129,684 00	133,929 00	132,514 00	153,610 00	678,558 00
Total	19,386,958 50	19,454,054 00	21,415,128 50	22,084,203 50	22,162,987 65	104,503,332 15

Coinage of the Minta of Mexico by fiscal years (pieces and value).

GOLD.

Years.	*Twenty dollars.*	*Ten dollars.*	*Five dollars.*	*Two and a half dollars.*	*Dollars.*	*Total value.*
	Pieces.	Pieces.	Pieces.	Pieces.	Pieces.	
1875	37,940	8,363	3,223	400	3,074	$862,619 00
1876	37,316	5,065	1,736	821	1,699	809,401 50
1877	32,716	2,277	3,332	400	1,000	695,750 00
1878	31,768	3,656	2,816	1,100	3,248	691,998 00
1879	28,252	8,099	1,984	400	1,256	658,206 00

SILVER.

Years.	*Dollar.*	50 *centavos.*	25 *centavos.*	10 *centavos.*	5 *centavos.*	*Total value.*
	Pieces.	Pieces.	Pieces.	Pieces.	Pieces.	
1875	18,946,214	354,584	820,305	377,868	411,799	$19,386,958 50
1876	18 814,652	687,271	951,782	308,140	540,140	19,454,054 00
1877	20,886,007	473,620	970,002	382,740	230,740	21,415,128 50
1878	21,420,974	606,350	1,253,183	216,160	504,855	22,084,203 50
1879	21,488,699	586,855	1,129,142	620,508	740,497	22,162,987 65

Total Coinage of the Mints of Mexico from their establishment to June 30, 1879.

COLONIAL.

Date.	*Gold.*	*Silver.*	*Copper.*	*Total.*
Macuquina (col), 1537-1731	$8,497,950	$752,067,456 54	$200,000 00	$760,765,406 54
Columnaria (pillar), 1732-1771	19,889,014	441,629,211 45	...	461,618,225 45
Busto (head), 1772-1821	40,391,447	888,563,989 45	342,893 37	929,298,329 82
Total	68,778,411	2,082,260,657 44	542,893 37	2,151,581,961 81

INDEPENDENT.

Bust of Iturbide, 1822-23	$557,392 00	$18,576,569 69	...	$19,132,961 69
Republic (eagle), 1824 to June 30, 1874	45,907,372 11	759,092,552 58	$5,251,143 60	810,251,068 29
July 1, 1874, to June 30, 1879	3,717,974 50	104,503,332 15	119,066 04	108,340.372 69
Total	50,182,738 61	882,171,464 42	5,370,209 64	937,724,402 67

RECAPITULATION.

Colonial	$2,151,581,961 81
Independent	937,724,402 67
Total	3,089,306,364 48

MINES.

Value of the gold yielded by the mines of the republic, approximately $989,161
Value of the silver produced by the mines, approximately . . 25.167,763
Value of the gold coined at the various mints of the republic 589,161
Value of the silver coined at the same mints 23,667,763

The standard value of pure gold is $675.41 per kilogram. The standard value of pure silver is $40.91 per kilogram. These values have been deduced from the quantity of pure metal, which according to law, must be contained in a piece of gold of the value of $20 and the weight of silver.

Table showing the amount of gold and silver coined by the mints of the Republic during the year 1879.

Mints.	*Silver.*	*Gold.*
Almos	$770,776 50	$10,780 00
Chihuahua	827,339 00	. . . . . .
Culiacan	886,048 00	50,236 00
Durango	990,919 50	24,865 00
Guadalajara	1,480,619 00	2,000 00
Guanajuato	4,505,000 00	164,040 00
Hermosillo	576,135 00	. . . . . .
Mexico	5,616,300 00	290,500 00
Oaxaca	153,000 00	2,100 00
San Luis Potosi	2,666,555 00	
Zacatecas	5,285,000 00	. . . . .
Total	23,667,763 00	589,161 00
Silver	23,667,763 00	. . . . . .
Gold	589,161 00	. . . . .
Total	24,256,924 00	. . . .

Salvador.—Statement showing the gold and silver coined in the republic from the year 1829 to 1877.

Gold.

Years.	*Weight.* *Marcos "⅛ pound of 7,101 gr."*	*Onzas, "⅛ marcos."*	*Ocharas, "⅛ onzas."*	*Tomines, "⅙ ochar."*	*Granos, "1/12 tomin."*	*Value.*
1820 . .	22	5	7	3	07	
1830 . .	283	3	8	3	06	
1831 . .	327	4	5	3	06	
1832 . .	261	5	1	2	09	
1833 . .	179	7	3	4	10	
1834 . .	203	8	3	0	06	
1835 . .	235	2	4	1	00	
1836 . .	127	6	6	1	06	
1837 . .	162	0	7	3	06	
1838 . .	146	0	3	0	06	
1839 . .	101	1	1	0	04	
	2,051	4	2	1	08	$321,673 00
1840 . .	254	6	0	1	06	34,974 00
1841 . .	335	2	4	5	03	44,732 00
1842 . .	101	1	2	3	06	24,495 25
1844 . .	128	0	7	3	00	19,403 37
1845 . .	111	5	4	1	00	17,344 25
1846 . .	119	1	1	4	00	18,592 62
1847 . .	189	3	2	2	06	29,527 85
1848 . .	222	6	1	0	00	34,355 25
1849 . .	192	4	0	3	00	29,592 75
1850 . .	327	3	6	5	02	49,887 30
1851 . .	177	5	1	4	00	26,957 75
1852 . .	55	2	0	1	00	8,547 82
1853 . .	56	1	0	2	08	8,849 70
1854 . .	457	0	5	1	00	70,514 75
1855 . .	329	2	6	0	04	60,860 80½
1856 . .	129	6	7	6	05	20,048 30
1857 . .	2,085	3	4	3	09	321,623.00
1858 . .	99	2	6	5	07	15,362 70
1859 . .	179	2	3	2	02	27,642 00
1862–'63	57	0	6	3	00	.9017 80
1864–'65	40	1	3	1	04	6,383 00
1866–'67	391	4	6	4	09	60,739 00
1867–'68	992	1	7	0	00	217,910 00
1868–'69	351	0	1	4	01	55.020 00
1869–'70	1,780	2	6	3	00	278,905 00
1870–'71	1,981	4	6	6	01	310,695 00
1871–'72	368	5	5	0	07	68,288 00
1872–'73	123	1	0	2	09	24 270 00
1873–'74	251	1	0	2	03	37,427 50
1875–'76	407	6	1	0	03	63,897 00
1876–'77	132	3	6	5	06	20,845 00
Total . .	14,540	0	0	4	09	2,318,381,76

Silver.

Years.	*Weight.* *Marcos, "⅛ pound of 7,101 gr."*	*Onzas, "⅛ marco."*	*Ocharas, "⅛ onzas."*	*Tomines, "⅛ ochara."*	*Granos, "1/12 tomin."*	*Value.*
1829 . . } 1830 . . } 1831 . . }	22	4	2	3	02	
1832 . .	76	2	7	0	00	
1833 . .						
1834 . .						
1835 . .	68	5	4			
1836 . .	73	2	2			
1837 . .						
1838 . .	75	2	2			
1839 . .						
	306	1	1	3	02	$2,842 00
1840 . .	106	6	4	4	.	1,000 00
1841 . .	289	3	3	4	04	2,732 38
1842 . .	245	6	0	3	.	2,246 00
1844 . .	132	.	.	.	.	1,205 60
1845 . .	101	6	5	3	.	930 18
1846 . .	183	5	6	1	.	1,703 56
1847 . .	337	7	6	2	06	3,130 68
1848 . .	144	1	6	3	.	1,339 83
1849 . .	3,710	4	4	1	.	35,584 06
1850 . .	659	7	6	0	03	5,375 88
1851 . .	3	2	2	3	.	774 88
1852 . .	2,078	6	5	5	.	18,931 36
1853 . .	37	0	4	.	.	386 04
1854 . .	16	3	4	5	.	150 25
1855 . .	86	4	6	2	03	789 80
1856 . .	149	4	2	2	03	1,365 63
1857 . .	80	3	1	4	11	736 87
1858 . .	25	0	2	2	04	232 63
1862–'63	46	.	.	5	04	427 50
1864–'65	6,139	4	6	3	04	55,090 75
1865–'66	6,026	8	2	3	03	55.132 70
1866–'67	6,446	2	3	2	01	58,352 50
1867–'68	284	6	6	2	04	2,584 00
1869–'70	107	7	1	.	05	994 30
1870–'71	1,016	4	7	6	.	9,318 95
1871–'72	190	5	4	3	.	1,757 40
1874–'75	11,820	2	6	.	04	107,901 75
1876–'77	33	2	6	3	01	302 50
Total. .	40,708	0	0	2	02	373,919 88

Statement of Exports and Imports of Bullion from and into London from and to the underm ntioned places during the twelve months ending June 30, 1880 and 1881, compiled from semi annual circulars issued by Messrs. Pixley and Abell, rating the pound sterling at $5.

		Gold Bullion.				*Silver Bullion.*			
		Imports.	*Exports.*	*Excess of gold imports.*	*Excess of gold exports.*	*Imports.*	*Exports.*	*Excess of silver imports.*	*Excess of silver exports.*
Places—1880.	Belgium	$2,792,500	$88,100	$2,706,400	. . .	$84,500	$89,000	. . . . . .	$4,500
	France	9,770,000	2,590,750	7,179,250	. . . . . .	10,670,500	2,387,500	$8,283,000	. . . . . .
	Germany	1,002,500	8,173,000	. . . .	$7,170,500	1,751,750	3,831,500	. . . . . .	2,079,750
	Holland	124,000	567,600	. . .	443,600	30,885	722,250	. . . . .	691,366
	Sweden and Denmark	5,000	1,277,500	. . . . .	1,272,500	350	2,850	. . . . .	2,500
	Russia	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . . . . .	5,000	. . . . .	5,000
	Spain and Portugal	604,000	5 042,500	. . . . .	4,438,500	1,036,000	60,000	976,000	. . . . . .
	Gibraltar	243,650	115,000	118,650	. . . . .	111,850	. . .	111,850	. . . . . .
	Malta	56,250	556,050	. .	499,800	18,060	. . .	18,060	. . .
	Alexandria	253,360	11,696,900	. . . . . .	11,443,540	85,050	69,750	15,300	. . . .
	Aden	. . . . . .	25,000	. .	25,000	. . . . . .	. . . . . .	.	. . . . .
	India	427,750	2,261,640	. . . . .	1,833,890	499,000	33,150,035	. . . .	32,651,035
	China	958,500	. . . . . .	958,500	. . . . . .	338,850	4,617,405	. . . . . .	4,278,555
	Manilla	. . . . . .	. . . . . .	. . . . . .	. . . . . .	. . .	2,500	. . . . .	2,500
	Japan	4,128,500	312,500	3,816 000	. . . . . .	1,610	. . . . . .	1,610	. . . .
	Cape Verde, Cape of G. Hope, Sierra Leone, &c.	612,500	2,666,375	. . . .	2,053,875	458,000	617,500	. . . . . .	159,500
	United States	232,750	35,223,000	. . . .	34,990,250	4,944,500	776,250	4,168,250	. . . . .
	Mexico, South America, West Indies. &c.	3,952,500	6,197,125	. . . . .	2,244,625	16,056,000	1,276,500	14,779,500	. . . .
	Brazil	1,702,750	2,605.750	. . . . . .	903,000	873,500	2,500	871,000	. . . . .
	Australia and New Zealand	9,370,000	50,450	9,319,550	. . . . . .	635,500	1,002,500	. . . . . .	367,000
	British North America	2,250	776,000	. . . . . .	673,750	43,750	20,000	23,750	. . . . . .
	Total	36,238,000	80,223 240	24,098,350	67,892,830	37,639,655	48,633,040	29,248,320	40,241,705
Places—1881.	Belgium	$2,296,500	$24,000	$2,272,500	. . . .	$219,000	$129,000	$90,000	. . . . .
	France	15,235,000	3,593,500	11,641,500	. . .	9,127,500	2.667,250	8,460,250	. . . . . .
	Germany	1,577,000	342,600	1,224,400	. . . . .	1,711,000	4,579,500	. . . .	$2,868,500
	Holland	2,554,500	.17,245	2.537,255	. . . . . .	17,685	1,487,000	. . . . .	1,469,815
	Sweden and Denmark	4,250	258,000	. . . . . .	$253,750	. . . . . .	65,550	. . . . .	65,550
	Spain and Portugal	229,000	40,017,500	. . . . . .	3,786,500	149,500	1,135,000	. . . . . .	985,500
	Gibraltar	82,725	. . . . . .	82,725	. . . . .	30,500	250	30,250	. . . . . .
	Malta	355,500	337,750	17,750	. . . . . .	43,500	5,000	38,500	. . . . .
	Alexandria	1,713,950	3,499,500	. . . . . .	1,785,550	38,500	121,370	. . . . .	82,870
	India	35,900	4,867,680	. . . . . .	4,831,780	1,036,500	16,106,800	. . . . . .	15,070,300
	China	108,800	. . . . . .	108,800	. . . . . .	71,380	4,196,350	. . . .	4,124,970
	Japan	4,018,750	. . . . . .	4,018,750	. . . . . .	. . . . . .	69,000	. . . . . .	69,000
	Cape of G. Hope, Cape Verde, Sierra Leone. &c.	1,880,500	1,084,750	775,750	. . . . . .	319,500	696,600	. . . . . .	277,000
	United States	181,000	48,519,500	. . . . . .	48,338,500	10,958,000	194,600	10,763,400	. . . . .
	Mexico, South America, West Indies, &c.	3,110,635	4,001,250	. . . . . .	890,615	10,954,000	1,109,500	9,844,500	. . . . . .
	Brazil	816,750	2,491,900	. . . . . .	1,675,150	1,084 250	4,065	1,080,185	. . . . . .
	Australia and New Zealand	25,921,000	200	25,920,800	. . . . .	285,250	1,034,000	. . . . . .	748,750
	British North America	. . . . . .	. . . . . .	. . . . . .	443,000	21,150	703,500	. . . . . .	682,350
	Total	60,101,760	73,498,375	48,600,230	62,004,845	36,067,215	34,204,735	28,307,085	26,444,605

World's Production of Gold and Silver.

[Calendar years, except for United States and Japan.]

Countries.	1877				1878.			
	Gold.		*Silver.*		*Gold.*		*Silver.*	
	Kilos.	*Dollars.*	*Kilos.*	*Dollars.*	*Kilos.*	*Dollars.*	*Kilos.*	*Dollars.*
United States	70,565	46,897,390	957,321	39,793,573	77,048	51,206,360	1,089,343	45,281,385
Russia	40,967	27,226,668	11,295	476,844	*42,127	27,997,889	* 11,423	474,876
Australia	43,633	29,018,223	.....	.....	‡ 43,663	29 018.223	.....	.....
Mexico	† 1,509	996,898	† 650,000	27,018,900	‡ 1,500	999,898	† 650,000	27,018,940
Germany	308	294,697	147,612	6,135,877	§ a 313	208,019	§ a 125,745	5,227,219
Austria	* 1,800	1,196,278	* 51,000	2,119,948	§ 1,824	1,222,230	§ 48,662	2,022,879
Sweden	* 4	2,658	1,300	54,038	9	6,001	1,268	52,708
Norway	.....	.....	4,524	188,052	.....	.....	† 4,000	166,270
Italy	109	72,375	432	17,949	† 109	72,375	† 432	17,949
Rest of Europe	.....	.....	‡ 50,000	2,078,380	.....	.....	† 50,000	2,078,380
Argentine Republic	* 118	* 78,546	* 10,199	* 420,225	† 118	78,546	† 10,109	420,225
Colombia	6,019	4,000,000	24,057	1,000.000	6,019	4,000,000	24,057	1,000,000
Bolivia, Chili, Brazil, and Peru	‡ 3,000	1,993,800	‡ 250,000	1,039,100	† 259	172,135	§ 250,000	10,392,500
Japan	* 400	265,840	* 17,000	796,640	445	295,746	17,534	728,848
Africa	‡ 3,000	1,993,800	.....	.....	§ 3,000	1,993,800	.....	.....
Venezuela	.....	.....	.....	.....	2,741	1,821,564	.....	.....
Canada	.....	.....	.....	.....	.....	.....	.....	.....
Total	171,453	113,947,173	2,174,610	81,040,665	179,175	119,092,780	2,282,573	94,882,177

Countries.	1879.				1880.			
	Gold.		*Silver.*		*Gold.*		*Silver.*	
	Kilos.	*Dollars.*	*Kilos.*	*Dollars.*	*Kilos.*	*Dollars.*	*Kilos.*	*Dollars.*
United States	58,531	38 899,858	981,825	40,812,132	54,168	36,000,000	942.987	39,200,000
Russia	* 42,960	28,551,028	* 11,391	473,519	† 42,960	28,551,028	† 11,391	473,019
Australia	† 43,633	29,018,223	.....	.....	‡ 45,251	30,073,815	.....	.....
Mexico	1,488	989,161	605,469	25,167,763	‖ 1,488	989,161	‖ 605,469	25,167,763
Germany	§ a 388	257.865	§ a 134,007	5,570,389	a 359	232,610	a 134,152	5,576,699
Austria	1,598	1,062,031	48,180	2,002,727	‖ 1,598	1,062,031	‖ 48,180	2,002,727
Sweden	3	1,194	1,502	62,435	‖ 3	1,994	‖ 1,502	62,435
Norway	.....	.....	† 4,000	166.270	.....	.....	‖ 4,000	166,270
Italy	† 109	72,375	† 432	17,949	‖ 109	72,375	§ 432	17,949
Rest of Europe	.....	.....	50 000	2,078,380	.....	.....	† 50,000	2,078,380
Argentine Republic	118	78,546	10,199	420,225	‖ 118	78,546	‖ 10,109	420,225
Colombia	6,919	4,000,000	24,057	1,000,000	‖ 6,019	4,000,000	‖ 24.057	1,000,000
Bolivia, Chili, Brazil, and Peru	† 569	378,157	§ 250,000	10,392,500	‖ 569	† 378,157	† 250,000	10,392,500
Japan	792	466,548	22,046	916,400	‖ 702	466,548	‖ 22,046	916,400
Africa	§ 3,090	1,193,800	.....	.....	† 3,000	1,993,800	.....	.....
Venezuela	2,431	1,615,835	.....	.....	3,423	2,274,692	.....	.....
Canada	.....	.....	.....	.....	1,226	815,089	1,641	68,205
Total	161,579	107,385,421	2,143,018	89,080,680	160,984	106,989,846	2,105,966	87,543,072

* Official estimate "L'Economiste Français," July, 1881, p. 112.
† Estimated.
‡ Victoria and New South Wales official; the other colonies estimated as producing the same amounts reported officially for 1877.
§ Dr. A. Soetbeer.
‖ Estimated as the same as 1879.
a From total production 17 per cent. of gold and 25 per cent. of silver deducted for foreign ores.

Coinage of Various Countries.

[Calendar years, with the exception of Japan, India, and Portugal. Foreign coins converted into United States money at the values estimated by the Director of the Mint, January 1, 1881.]

Countries.	1877.		1878.		1879.		1880.	
	Gold.	*Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*
United States	$43,999,864	$28,393,045	$49,786,052	$28,518,859	$39,080,080	$27,668,235	$62,308,279	$27,409,706
Mexico	695,750	21,415,128	691,998	22,084,203	658,206	22,162,987	.....	.....
Colombia	334,720	157,273	58,320	309,973	.....	.....	.....	.....
Central America	20,845	302	.....	.....	.....	.....	.....	.....
Great Britain	4,776,314	2,048,543	10,376,571	2,090,104	170,571	2,671,971	20,196,228	3,705,878
Australia	15,168,881	.....	16,998,684	.....	20,210,574	.....	22,151,334	.....
India	.....	30,518,415	760,927	78,741,556	402	28,122,004	69,670	40,002,173
Germany	26,784,401	7,210,788	29,742,879	1,562,463	11,643,120	.....	6,662,153	.....
Austria	3.725,861	8,036,093	2,600,563	13,906,258	1,001,592	12,860,784	2,468,929	8,373,563
France	49,249,960	3,177,607	35,766,393	351,534	5,494,834	.....	.....	.....
Belgium	22,797,430	.....	9,863,844	.....	.....	.....	.....	150,639
Italy	954,956	3,474,000	1,224,639	1,737,000	565,355	3,860,090	.....	.....
Netherlands	4,488,341	58,160	199,250	58,160	2,403,223	44,896	259,313	40,200
Russia	26,432,484	5,265,030	27,564,735	5,974,170	.....	.....	.....	.....
Denmark	.....	.....	.....	.....	* 9,314,143	* 4,863,725	.....	.....
Norway	259,858	356,317	744,352	172,381	.....	.....	.....	.....
Sweden	1,447,099	300,035	1,317 555	252,397	.....	.....	.....	.....
Portugal	89,109	53,460	293,762	10,746	262,451	396,954	262,440	192,240
Japan	690,602	3,895,136	396,987	4,522,118	609,942	2,327,847	460,365	2,076,955
Total	201,616,466	114,350,332	188,386,611	161,191,913	90,714,493	104,888,313	114,837,811	81,951,354

* Coinage for 1876, 1877, and 1878, to March 31, 1879.

Circulation.

Countries.	Population. Year.	Population. Latest census or estimate.	Date for which circulation is stated.	Paper.	Specie. Gold.	Specie. Silver, full legal tender.	Specie. Silver, limited tender.	Specie. Total.	Total paper currency and specie.	Per capita. Paper.	Per capita. Specie.
United States	1880	50,152,866	Nov. 1, 1881	$780,506,128	$563,075,743	$106,566,741	$80,400,000	$740,042,484	$1,529 548,612	$15 56	$14 93
Great Britain	1871	31,628,338	July —, 1881	207,001,444	602,331,571	...	92,263,973	694,595,544	901,596,088	6 55	21 95
Canada	1880	*4,075,000	Dec. 31, 1880	41,562,711	0,026.000	...	1,020,000	10,046,000	51,608,711	10 20	2 46
Australia	1880	2,749,852	Mar. 31, 1881	a23,606,739	†60,440,708	...	...	†60,440,708	84,047,447	8 58	22 00
India	1880	191,096,603	Jan. —, 1881	b55,874,880	...	c1,015,000,000	...	c1,015,000,000	1,070874,880	29	5 31
Germany	1880	45,194,172	Dec. 31, 1880	276,897,658	387,143,742	119,000,000	101,648,835	607,792,577	884,190,235	6 11	13 45
France	1876	36,905,788	Oct. 6, 1881	d511,328,021	e874,876,000	e545,286,000	57,900,000	1,478,062,000	1,989,390,021	13 85	40 05
Belgium	1878	5,476,668	Sept. 29, 1881	63,434,827	43,000,000	55,438,000	8,562,000	f107,000,000	170,434,827	11 58	19 53
Switzerland	1880	2,846,102	July —, 1881	16,594,000	20,000,000	10,000,000	4,700,000	g34,700,000	51,294,000	5 83	12 19
Greece	1879	1,679,775	June —, 1879	12,890,000	4,500,000	...	3,000,000	h7,500,000	20,390,000	7 67	4 46
Italy	1880	*27,769,475	Sept. —, 1881	323,975,402	24,000,000	20,900,000	13,000,000	57,900,000	381,875,402	11 66	2 08
Austria	1880	37,741,413	Sept. 30, 1881	295,611,587	50,000,000	40,400 000	...	†90,400,000	386.011,587	7 83	2 39
Sweden	1870	4,568,901	Dec. 31, 1879	21,657,372	7,158,000	...	4,523,616	11,681,616	33,338,988	4 74	2 55
Norway	1875	1,806,900	Dec. 31, 1880	i10,375,265	9,037,324	...	1,870,000	10,913,324	21,288,589	5 74	6 05
Denmark	1880	1,980,675	Dec. 31, 1879	19,028,000	9,316,000	...	4,863,000	j14,179,000	33,207,000	9 61	7 16
Netherlands	1877	3,866,456	Dec. 31, 1880	83,836,001	29,304,722	26,488,551	...	55,793,273	169,630,174	21 68	22 18
Russia	1876	86,952,347	Aug. 31, 1881	126,237,000	119,209,784	...	...	k119,209,784	245,446,784	1 46	1 37
Spain	1877	16,625,869	Aug. 31, 1881	k53,867,288	130,000,000	40,000,000	30,000,000	l200,000,000	253,867,288	3 24	12 03
Portugal	1881	4,160,000	Jan 1, 1879	5,023,360	48,000,000	...	12,000 000	60,000,000	m65,023,360	1 21	14 42
Turkey	1880	*21,000,000	Mar. 31, 1880	21,871,289	15,000,000	...	*589,828	15,589,828	37,461,117	1 00	71
Mexico	1873	9,343,470	Nov. —, 1879	1,500,000	10,000,000	40,000,000	...	h50,000,000	51,500,000	16	5 35
Colombia	1870	2,951,311	Aug. —, 1879	1,895,343	500,000	...	4,000,000	4,500,000	6,395,343	64	1 53
Peru	1876	2,703,070	Mar. —, 1879	13,098,820	62,085	1,819,933	...	1,882,018	14,980,838	4 84	70
Brazil	1872	10,108,291	June 30, 1879	91,000,000	...	...	...	...	91,000,000	9 00	...
Venezuela	1880	2,080,000	Sept. —, 1881	250,900	*10,000,000	...	*1,000,000	11,000,000	11,250,900	12	5 29
Central America	1880	*2,600,000	June 30, 1880	163,347	2,318,381	373,919	...	2,692,300	2,855,647	63	1 00
Argentine Republic	1880	*2,000,000	Mar. —, 1880	373,470,000	4,000,000	2,000,000	...	6,000,000	379,470,000	186 70	3 00
Cuba	1877	1,394,516	Mar. 29, 1881	n48,943,457	n49,000,000	1,000,000	...	50,000,000	98,943,457	35 08	35 79
Japan	1874	33,623,319	June 30, 1880	147,288,081	99,852,138	50,661,878	...	150,514,016	297,802,697	4 38	4 47
Algiers	1877	2,867,626	July —, 1881	11,194,000	10,071,773	6,234,975	...	16,306,748	27,500,748	3 90	5 68
Hayti	1877	*572,000	Dec. 31, 1880	...	...	5,000,000	...	5,000,000	5,000,000	...	8 75
Cape of Good Hope	1875	720,984	Dec. 31, 1880	4,129,230	30,000,000	...	*2 440,726	32,440,726	36,569,958	5 86	45 00
Total	...	...	...	3,644,113,650	3,221,223,971	2,115,169,997	423,787,978	5,760,181,946	9,404,295,596	...	...

* Estimated.
† Bank reserve only.
a Banker's Magazine, (Lon.), Oct., '81, p. 818.
b Monetary Conference, 1881, p. 205.
c Based on statement of director of Calcutta mint for '79, (p. 43, Report of Depreciation of Silver) with coinage for ten years, 1869 to 1879 added.
d Economist, Oct. 8, 1881, p. 1254.
e Estimated from amount in last report Exports, Imports, and Consumption in the Arts, &c.
f Report of the French Commission, p. 130.
g M. Weill President Swiss Confederation, "Gold and Silver," p. 193.
h Report for 1879.
i Monetary Conference, 1881, p. 58.
j Report of the French Commission, p. 89.
k Economist, Sept. 10, 1881, p. 1138.
l Silver Commission, p. 510.
m Silver Commission, p. 475.
n Banker's Mag. (New York), July, 1881, p. 18.

Table of Government and Bank-Paper Issue and Metallic Reserves.

Countries.	Date referred to.	Paper. Government issue.	Paper. Bank issue.	Paper. Total.	Metallic reserve. Treasury. Gold.	Metallic reserve. Treasury. Silver.	Metallic reserve. Treasury. Total.	Metallic reserve. Bank. Gold.	Metallic reserve. Bank. Silver.	Metallic reserve. Bank. Total.	Aggregate.
United States	Nov. 1, 1881	*$420,161,878	$360,344,250	$780,606,128	$172,989,829	$95,985,641	$268,975,470	x$102,000,369	a$5,450,387	$107,450,756	$376,426,226
Great Britain	July —, 1881	...	207,001,444	207,001,444	...	...	...	...	...	b150,217,667	150,217,667
Canada	Dec. 31, 1880	14,234,453	27,328,358	41,562,711	,026,000	120,000	3,146,000	5,500,000	400,000	5,900,000	9,046,000
Australia	Mar. 31, 1881	...	c23,606,739	23,606,730	...	...	...	60,440,708	...	c60,440,708	60,440,708
India	Jan. —, 1881	d55,874,880	...	55,874,886	...	32,486,289	d32,486,289	50,000	3,000,000	e3,050,000	35,536,289
Germany	Dec. 31, 1880	37,076,958	239,820,700	276,897,658	...	...	...	...	...	146 355,482	146,355,482
France	Oct. 6, 1881	...	f511,328,021	511,328,021	...	...	...	117,188,921	235,853,243	f353,042,164	353,042,164
Belgium	Sep. 29, 1881	...	f63,434,827	63,434,827	...	...	...	...	...	f17,903,854	17,903,854
Switzerland	July —, 1881	...	16,594,000	16,594,000	302,045	86,850	388,895	...	...	f6,735,236	7,124,131
Greece	June —, 1879	...	12,890,000	12,890,600	...	...	...	...	...	4,500,000	4,500,000
Italy	Sep. —, 1881	g180,000,000	b143,975,402	323,975,402	...	...	...	h14,000,000	h12,799,815	b26,799,815	26,799,815
Austria	June 30, 1879 / Sep. 30, 1881	128,860,965	f166,750,622	295,611,587	...	...	...	e50,000,000	e40,400,000	f90,400,000	90,400,000
Sweden	Dec. 31, 1879	...	21,657,372	21,657,372	...	...	...	5,683,650	1,467,297	7,150,947	7,150,947
Norway	Dec. 31, 1880	...	i10,375,265	10,375,265	...	206,494	206,494	i9,037,324	...	9,037,324	9,243,818
Denmark	Dec. 31, 1879	...	19,028,000	19,028,000	...	...	...	7,000,000	...	7,000,000	7,000,000
Netherlands	Dec. 31, 1880	4,020,000	79,816,901	83,836,901	...	...	...	16,453,458	33,768,000	50,221,458	50,221,458
Russia	Oct. 3, 1881	...	j126,237,000	126,237,000	...	...	...	e110,000,000	e9,209,784	k119,209,784	119,209,784
Spain	Aug. 31, 1881	...	k53,867,288	53,867,288	...	...	...	...	e44,105,089	k44,105,089	44,105,089
Portugal	Jan. 1, 1879	...	5,023,360	5,023,360	...	...	...	...	...	9.508,169	9,508,169
Turkey	Mar. 31, 1880	21,871,289	...	21,871,289	...	...	...	...	...	...	...
Mexico	Nov. —, 1879	...	e1,500,000	1,500,000	...	...	...	...	...	...	...
Colombia	Aug. —, 1879	...	1,895,343	1,895,343	...	...	...	...	200,000	200,000	200,000
Peru	Mar. 1, 1879	13,098,820	...	13,098,820	...	...	...	62,085	1,819,933	1,882,018	1,882,018
Brazil	June 30, 1879	91,000,000	...	91,006,000	...	...	...	...	...	...	...
Venezuela	Sep. —, 1881	...	250,900	250,960	...	...	...	...	...	...	...
Central America	June 30, 1880	...	163,347	163,347	...	...	...	...	...	...	...
Argentine Rep.	Mar. —, 1880	...	373,470,000	373,470,000	...	...	...	...	...	...	...
Cuba	Mar. 26, 1881	...	l48,943,457	48,943,457	...	...	...	l24,000,000	...	24,000,000	24,000,000
Japan	June 30, 1880	130,127,596	17,161,085	147,288,681	10,399,626	4,139,701	14,539,327	955,988	399,174	1,355,162	15,894,489
Algiers	July —, 1881	...	11,195,000	11,194,000	35,773	155,475	191,248	4,053,000	2,026.500	6,079,500	6,270,748
Cape of G. Hope	Dec. 31, 1880	...	4,129,230	4,129,230	...	...	...	7,262,920	...	7,262,920	7,262,020
Total	...	1,096,326,739	0,547,786,911	3,644,113,650	186,752,273	133,180,450	319,933,723	533,688,423	390,899,222	1,259,808,053	1,579,741,776

* Includes $66,327,670 in silver certificates
a National banks only, Oct. 1, 1881.
b Banker's Mag., London, Oct. 1881, p. 883.
c Banker's Mag., London, Oct., 1881, p. 818.
d Monetary Conference, 1881, p. 205.
e Estimated from last report.
f London Economist, Oct. 8, 1881, p. 1254.
g London Economist, July 16, 1881, p. 887.
h Estimated from statement in London Economist, July 16, 1881, p. 888.
i Monetary Conference, 1881, p. 58.
j London Economist, Oct. 15, 1881, p. 1284.
k London Economist, Sept. 10, 1881, p. 1254.
l Banker's Mag., New York, July, 1881, p. 18.

Table showing the Total Paper and Specie Circulation in each of the Principal Countries of the World, the Amount of Specie in Banks and National Treasuries, and the Amount of Active Circulation.

[Compiled from the two preceding tables.]

Countries.	Population.	Total paper and metallic circulation.	Amount of specie in banks and national treasuries.	Active Circulation.	Per capita of active circulation.	Countries.	Population.	Total paper and metallic circulation.	Amount of specie in banks and national treasuries.	Active Circulation.	Per capita of active circulation.
United States	50,152,866	$1,529,548,612	$376,426,226	$1,153,122,386	22.90	Spain	16,625,669	253,867,288	44,105,089	209,762,199	12.62
Great Britain	31,628,338	901,596.088	150,217,667	751,379,321	23.76	Portugal	4,160,800	65,023,360	9,508,169	55,515,191	13.34
Canada	*4,075,000	51,608.711	9,046,000	42,562,711	10.44	Turkey	*21,000,000	37,461,117	...	37,461,117	1 78
Australia	2,749 852	84,047,447	60,440,708	23,606,739	8.59	Mexico	9,343,470	51,500 000	...	51,500,000	5.51
India	191,096.603	1,070,874 880	35,536,289	1,035,338,591	5.42	Colombia	2,951,311	6,395,343	200,000	6,195,343	2.10
Germany	45,194,172	884,690.235	146,355,482	738,334,753	16.34	Peru	2,703,070	14,980,838	1,882 018	13,098,820	4.85
France	36,905,788	1,989,390,021	353,042,164	1,636,347,857	44.34	Brazil	10,108,291	91,000,000	...	91,000,000	9.00
Belgium	5,476,668	170,434,827	17,903,854	152,530,973	27.85	Venezuela	2,080,000	11,250,900	...	11,250,900	5.41
Switzerland	2,848,102	61,294,000	7,124,131	44,169,869	15.52	Central America	*2,600,000	2,855,647	...	2,855,647	1.10
Greece	1,679,775	20,390,000	4,500,000	15,890,000	9.46	Argentine Repub.	*2,000,000	379,470,000	...	379,470,000	189.74
Italy	*27,769,475	381,875,402	26,799,815	355,075,587	12.79	Cuba	1,394,516	98,943,457	24,000,000	74,943,457	53.76
Austria	37,841,413	386,011,587	90,400,000	205,611,587	7.83	Japan	33,623,319	207,802,697	15,894,489	281,908,208	8.38
Sweden	4,568,901	33,338,988	7,150,947	26,188,941	5.73	Algiers	2,867,626	27,500,748	6,270,748	21,230,000	7.40
Norway	1,806 900	21,288,589	9,243,818	12,044,771	6.67	Hayti	*572,000	5,000,000	...	5,000,000	8.74
Denmark	1,980,675	33,207,000	7,000,000	26,207,000	13.23	Cape of Good Hope	720,984	36,569,956	7,262,920	29,307,036	40.70
Netherlands	3,866,456	169,630,174	50,221,458	119,408,716	30.73						
Russia	86,952,347	245,446,784	119.209,784	126,237,000	1.45			9,404,295,596	1,579,741,776	7,824,553,820	

* Estimated.

HISTORICAL MEMORANDA CONCERNING GOLD AND SILVER.

FOR the following we are indebted to the valuable "History of the Precious Metals," by Alexander Delmar. Nothing more forcibly illustrates the almost purely accidental character of supplies of the precious metals than the discovery of the gold placers; indeed, the whole settlement and working of California as a great mining country. The Spaniards, solely intent upon obtaining the precious metals, had discovered and partly explored this country so early as the sixteenth century. They colonized and held possession of it for three centuries, established missions, pacified and converted the Indians, whom they used as domestic servants and workmen, and cultivated many of its arable valleys. They introduced into it all of the cereal grains known in Spain, and even transplanted the grape, the fig, the pomegranate and the artichoke. Persuaded from the outset that it was a country rich in the precious metals they never ceased to look for them. Occasionally they found some particles of gold, but not enough to warrant further search. The few adventurers who were attracted thither from time to time by stories of its mineral wealth, generally found their way back, disappointed and impoverished, to Mexico, whence, for the most part, they had come. A few remained to turn rancheros, and settle down with the mission fathers and the semi-Christianized Indians into a sort of pastoral community, which eventually became a race of half-breeds, given to apathetic habits and the pursuit of pleasure

Such were the economical and social conditions of California when the adventitious "success of the Democratic party (of the United States) in the close presidential election of 1844"[1] led to the independence of Texas, the war with Mexico, the annexation of California, and to its settlement by Americans. But for these events, which have no necessary connection with mining or the search for the precious metals, Alta California might have remained as Lower California has to this day, a province of Mexico, and might still have been the remote and undeveloped country that it was under the Spanish mission fathers. The existence of Gold in Lower California was known to Cortes, who fitted out an expedition from Mexico in 1537, and returned with some small quantities of the precious metal. Its existence in Alta California was discovered in 1577–79 by Drake's expedition, and noticed in Hakluyt's account of the region.[2] The finding of gold was mentioned in 1690 in a work published in Spain by Loyola Cavello, a priest at the mission of San José, in the bay of San Francisco. Captain Shelvocke in 1721 noticed signs of gold in the soil. The historico-geographical dictionary of Antonio de Alcedo, 1786–89, positively affirms the abundance of gold, and speaks of lumps weighing from five to eight pounds. In 1837 a priest from California went to Guatemala, and induced a Mr. Young Anderson, a Scotch gentleman, to endeavor to obtain English capital for the purpose of mining gold, which, he averred, was to be found not far from San Francisco. The favorable geological appearance of the country for gold was noticed by Prof. J. D. Dana, and recorded in his report on California. In April, 1847, a Mr. Sloat made a very decided statement of this kind in Hunt's "New York Merchants' Magazine." At this time the Mormons connected with the army, together with some Mexicans and Indians, were engaged in searching for gold upon the banks of the streams. In January, 1848, some of these men gathered a quantity of gold on Mormon Island, near Sacramento, and within a few miles of the rich placers afterwards discovered.

And yet none of these observations or operations led to the great discovery, which was made by a child, the daughter of one Marshall, the overseer of Captain Sutter's mill. While a race was being dug for this mill on the American fork of the Sacramento, the child found a lump of gold which she showed to her father as a pretty stone. That lump was the

[1] "Report of the U. S. Monetary Commission," p. 43.

[2] The report of the U. S. Mining Commissioner, Nov. 24, 1866, p. 268, contains other references to early discoveries of gold in California.

beginning of over two hundred and twenty million pounds sterling, ($1,100,000,000) which the California placers have yielded to the world.

During the first few years after the discovery of the placers the entire precious metal product of the coast was derived from this source, and consequently consisted entirely of gold. Hydraulic mining was commenced in a small way so early as 1854, but it did not assume material proportions until after the close of the American Civil War. Vein mining was begun in California at about the year 1860. It has not even yet become important. It has, however, assumed enormous dimensions in the adjoining State of Nevada, where it was commenced at about the same time, and where the chief part of the product, in quantity though not in value, is silver. The principal, but by no means the only locality of this industry has been the Comstock lode, upon which Virginia city is built, many of the mines being directly beneath the town. The principal ones are thirty in number, and at the present time are being worked at an average depth of 2,000 feet, though some few of them are down nearly half a mile. From the following table it will be seen that the placers reached their maximum productiveness almost immediately after their discovery, the greatest yield having been in the year 1853, when sluicing and hydraulic mining had already been commenced. Since the year 1853 the production has steadily fallen off, until at the present time it certainly does not equal £4,000,000, and may not exceed £3,000,000 a year.

Production of Gold in the State of California Proper.

Sums in Millions of Pounds Sterling and Decimals.

Year.	Production.	Year.	Production	Year.	Production.
1848	£2·0	1859	£10·0	1870	£5·0
1849	8·0	1860	9·0	1871	4·0
1850	10·0	1861	8·16	1872	3·8
1851	11·0	1862	7·0	1873	3·6
1852	12.0	1863	6·4	1874	4·06
1853	13·0	1864	7·0	1875	3·52
1854	12·0	1865	7·0	1876	3·72
1855	11·0	1866	5·0	1877	3·0
1856	11·0	1867	5·0	1878	3·4
1857	11·0	1868	4·4		
1858	10·0	1869	4·5		

Turning from the statistics of the State of California proper to those of the Pacific coast generally—and this means substantially all of the United States, for the production of the precious metals on the Atlantic coast is too insignificant to merit consideration in this connection—we have the following results:—

Production of the Precious Metals in all the United States.

The production of gold from 1776 up to and including 1847 is estimated at £4.000,000. From 1848 to 1860 inclusive the productions of California shown in the preceding table will answer as well for that of all the United States.

The production of silver from 1776 up to and including 1858 is estimated at £200,000. For 1859 it is estimated at £20,000, and for 1860 at £30,000.[1] The annual production of gold and silver, respectively, from 1861 to 1878 inclusive is shown in the following table:

Annual Production in the United States of Gold and Silver, respectively, from 1861 to 1878 inclusive.

Year.	Gold.	Silver.	Year.	Gold.	Silver.
1861	[2]£8,600,000	[2]£400,000	1870	[3]£6,750,000	[4]£3,200,000
1862	[2]7,840,000	[2]900,000	1871	[3]6,879,600	[4]3,622,270
1863	[2]8,000,000	[2]1,700,000	1872	[3]7,621,879	[4]3,711,315
1864	[2]9,220,000	[2]2,200,000	1873	[3]7,841,311	[4]5,026,292
1865	[2]10,640,000	[2]2,250,000	1874	[3]7,693,297	[4]5,080,476
1866	[2]10,700,000	[2]2,000,000	1875	[3]7,993,639	[4]6,041,997
1867	[2]10,340,000	[2]2,710,000	1876	[3]8,577,387	[4]7,636,870
1868	[2]9,600,000	[2]2,400,000	1877	[3]8,900,000	[4]7,600,000
1869	[2]9,900,000	[2]2,600,000	1878	[3]7,500,000	[4]7,000,000

[1] R. W. Raymond, formerly Mining Commissioner, in Hewitt's "Century of Mining," pamphlet, Philadelphia, 1876, p. 31.

[2] R. W. Raymond in Hewitt's "Century of Mining."

[3] John J. Valentine's Amended Estimates, published in "Report of U. S. Monetary Commission," vol. i. app. 22.

[4] Returns from the mines to the present writer on behalf of U. S. Monetary Commission; "Report," vol. i. app. pp. 13, *et seq.*

All the above estimates, except those based upon the returns from mines, are excessive. Both Mr. Valentine's estimates and Mr. Raymond's, which are based upon them, contain many duplications, which were, perhaps, unavoidable from the method employed to obtain returns. They also contain (except those marked "[3]") the precious metals produced on the west coast of Mexico and in British Columbia, which are shipped to San Francisco for market. The estimates marked "[4]" are free from these objections. The details of the returns from the mines are given at length in the Appendix to Report of the United States Monetary Commission, vol. i., pp., 1 to 60 inclusive. The following table showing the estimated annual production of gold and silver together, by States, is derived from Mr. Valentine's original estimates, which, although excessive in its total sums by about one-fifth, or at least one-sixth, [1] is given here in order that a rough view may be had of the quantities produced in the various districts mentioned. The sums are in millions of pounds sterling and decimals.

States or Territories.	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878
Arizona	·2	·16	·16	·12	·1	·1	·02	·22	·48	·48
California	4·5	6·0	4·0	3.8	3·6	4·06	3·52	3·72	3·64	3·78
Colorado	·8	·74	·94	·94	·8	1·04	1.26	1·4	1·58	1·24
Idaho	1·4	1·2	1·0	·54	·6	·38	·32	·34	·36	·38
Montana	1·8	1·82	1·6	1·22	1·04	·76	·72	·56	·52	·76
Nevada	2·8	3·2	4·5	5·1	7·06	7·1	8·1	9·86	10·32	7·04
New Mexico	·1	·1	·1	·1	·1	·1	·08	·08	·08	·1
Oregon and Washington	.8	·6	·5	·4	·32	·16	·24	·22	·24	·24
Wyoming	—	·02	·02	·02	—	—	—	—	—	—
Utah	—	·26	·46	·48	·76	·78	1·14	1·04	1·62	1·2
Other sources	·1	·1	·06	·06	·04	·02	·02	·02	·3	·44
Totals	12·3	13.2	13·34	12·78	14·32	14·5	15·42	17·46	19·14	15 64
Valentine's amended totals [2]	—	10·22	10·74	11·62	13·34	13.64	14·32	16·44	18·14	14·94
Correct totals [3]	12 5	9·96	10.05	11·34	12·86	12·78	14·04	16·2	16·5	14·6

The annual production of gold in British Columbia, nearly all of which finds its way to San Francisco, and is included in Mr. Valentine's original estimates, and therefore also in Mr. Raymond's, is given by the Colonial Minister of Mines in his report dated Victoria, February 1, 1878, as follows. (Sums in pounds sterling):—

Year.	*Production.*	*Year.*	*Production.*	*Year.*	*Production.*
	£		£		£
1864	740.000	1869	360,000	1874	360,000
1865	700,000	1870	260,000	1875	500,000
1866	540,000	1871	360,000	1876	360,000
1867	500,000	1872	320,000	1877	320,000
1868	480,000	1873	260,000		

From these statements and figures it will be observed that the production of the precious metals in the United States reached its climax as to gold in 1853, and as to silver in 1876, and that it has since declined. At the present time the great Mines of the Comstock lode, which of late years have yielded the principal supplies of both gold and silver, have recently almost ceased to be productive, and the outlook for the future, unless it is changed by the new mining developments, points to a still further reduction in the crops of both metals.

Australia.—Gold was discovered on the Macquarie River, New South Wales, in February, 1851, and by the 1st of June following there were upwards of 1,000 men in the diggins. On the 10th of June it was discovered on a tributary of the river Loddon, Victoria;[1] on the 20th of July at Mount Alexander, Victoria; and on the 8th of August at Mount Buninyong, Victoria; and on the 8th of September at Ballarat, Victoria. In the month of October upwards of 7,000 miners were at work. By the end of the year the number of persons in all the placers of Australia was from 15,000 to 17,000, and some £900,000 worth of gold (mint value) had been taken out.[2] In 1852 the number of miners had swollen to something like 150,000 (including about 9,000 ticket-of-leave convicts[3]), when, notwithstanding the extraordinary and unequalled production of that year, it was found that on the average gold-digging was unprofitable, and many persons left the workings to engage in other pursuits. Although gold-fields were subsequently discovered in several other of the Australian colonies,[4] both the total production and the number of miners employed declined after the year 1852 with little interruption,[5] until, at the present time, the former scarcely exceeds £4,000,000 a year, and the latter 50,000 men.

The following table shows the estimated annual production of gold in all the Australian Colonies from the discovery of the first placers in 1851 to the present time, and is chiefly from the tables, presented to the British Parliamentary Commission on Silver in 1876, by Sir Hector Hay. The estimates for the years 1851, 1876, 1877, and 1878 are by the present writer.

Annual Production of Gold in all Australia, 1851 to 1878 inclusive, chiefly after Sir Hector Hay. Sums in pounds sterling.

Year.	*Production.*	*Year.*	*Production.*	*Year.*	*Production.*
	£		£		£
1851[6]	900,000	1854	9,540,000	1857	11,400,000
1852[7]	20,600,000	1855[8]	12,000,000	1858	10,680,000
1853	14,140,000	1856	14,280,000	1859	10,820,000

Year.	*Production.*	*Year.*	*Production.*	*Year.*	*Production.*
	£		£		£
1860	10,500,000	1867	5,920,000	1874	6,000,000
1861	9,760,000	1868	7,640,000	1875	5,760,000
1862	9,360,000	1869	6,320,000	1878	6,200,000
1863	8,880,000	1870	5,840,000	1877	4,800,000
1864	9,140 000	1871[9]	6,660,000	1878	4,000,000
1865	8,820,000	1872	5,800,000		
1866	8,840,000	1873	6,300,000		

The total production from the discovery to the present time has amounted to upwards of £240,000,000, a greater sum than that obtained from either of the previous notable gold-fields, of which the following table affords a rough comparison:—

[1] See Mr. Valentine's evidence given before the writer, in "Rep. U. S. Mon. Com.," vol. i. App. pp. 32–48. Mr. Valentine's tables include nearly a million pounds sterling worth of lead, contained each year in silver (base) bullion. See Ibid., Question 107, and Mr. Valentine's report for 1878, where the value of this lead is placed at £700,000 to £1,000,000 a year, since 1873.

[2] "U. S. Monetary Com. Rep.," i. App. 22; and Valentine's Report, 1878.

[3] As nearly as can be ascertained at present. Probably excessive as gold portion.

[1] New South Wales and Victoria were made separate colonies in 1856.

[2] "App. Cyc.," viii. 346, and "Progress of Victoria," by Wm. Henry Archer Melbourne, 1867, p. 50.

[3] "App. Cyc.," ii. 383.

[4] New Zealand, 1852; South Australia and Tasmania about 1852; Queensland, 1857.

[5] "Report of Mr. Consul James F. McGuire," "U. S. Commercial Relations," 1860, p. 53.

[6] This estimate for 1851 is based on the statement in the "Progress of Victoria," p. 50, that 145,137 oz. of gold were exported in that year from Melbourne alone. "App. Cyc.," viii. 351, gives a nearly equal amount for the production in that year of New South Wales.

[7] This figure seems excessive; but it has been retained only after a careful comparison of several authorities. The Melbourne gold-brokers, who had every opportunity of being well informed on the subject, state that, in the earlier years, large amounts of gold were carried away in private hands without being reported in the exports at the Custom House. See "Progress of Victoria," p. 50; also Appleton, viii. 346, where it is stated that "the product of both colonies decreased annually from 1852."

[8] Vein mining, now successfully established in Victoria, produced in this year one-eighth of the entire yield of the colony. "App. Cyc.," viii. 347.

[9] Vein mining began in New South Wales in 1871. "Progress and Resources of New South Wales," Sydney, 1871, p. 21.

Comparative Yield of the Great Gold Fields of the Modern World.

Country.	Period during which the product was not generally less than £1,000,000 a year.	Total Product of gold from beginning to end.
Japan	1580 to 1639—60 years	£40,000,000
Brazil	1710 to 1789—80 years	180,000,000
Russia[1]	1840 to 1878—39 years	160,000,000
California Proper[1]	1848 to 1878—31 years	220,000,000
Australia[1]	1851 to 1878—28 years	240,000,000
Totals	238 years	£840,000,000

It has been frequently claimed that it was owing to the observations of Sir Roderick Murchison, in 1844, concerning the similarity between the geological formation of the Australian and the Ural mountains, that gold was discovered in Australia.[2] But this was no more the fact than that it was owing to either of the following observations:—

A despatch of the Lieutenant-Governor of the Colony to the Secretary of State dated September 2, 1840, enclosed a report from Count Strzelecki stating that he had discovered auriferous pyrites in the vale of Clwydd in 1839;[3] and the Rev. Mr. Clark, a geologist, announced his discovery of the metal in the same colony in 1841. The Indians knew of it; and made their arrow-heads of gold. The white shepherds found some; but wisely refrained from searching for more.[4] The fact is, that the discoveries of 1851 were not owing to any of these observations, but to the chance prospecting of a California miner named Hargreaves. Australia was not a solitude when Hargreaves visited it. The aborigines had roamed its mountains and encamped upon its auriferous river banks from time immemorial, without troubling themselves about its gold. It had been a penal colony of Great Britain since 1788, and at the period of the discovery of gold contained a permanent population of nearly 400,000 white persons, a large portion of whom were free colonists engaged in agriculture and sheep farming, whose settlements stretched in every direction: who, before the gold discoveries, had been engaged among other industries, in mining copper; and who, therefore, had a motive for prospecting the country for metals. Yet more than sixty years had passed after the colony was established before its auriferous deposits came to light.[5]

The Western World's Production.—The following statistics of the production of gold and silver in the Western world relate to America, Europe, and those portions of Africa open to European commerce. With the exception of the £100,000,000 obtained from Japan by the Portuguese and Dutch they comprise nearly all the precious metals acquired by the European world since the discovery of America to the beginning of the present century.[6]

I. Showing, chiefly by decades, the estimated average annual Production of Gold and Silver by the mines of America from the Discovery to the beginning of the nineteenth century. From the works of Baron von Humboldt, the Abbe Raynal; Mr. Ward, and the Compiler of Executive Document, No. 117, 1st Session, 21st Congress, U. S. A.

Sums in Pounds Sterling.

Average Annual Production.

Period.	Gold.	Silver.
1493 to 1545 (53 years)	£ 340,000	£ 120,000
[7]1546 to 1555	600,000	[2]3,400,000
1556 to 1570 (15 years)	540,000	1,460,000
1571 to 1580	400,000	1,400,000
[1]1581 to 1590	600,000	[1]2,800,000
1591 to 1600	600,000	2,800,000
1601 to 1610	500,000	2,300,000
1611 to 1620	500,000	2,300,000
1621 to 1630	560,000	2,440,000
1631 to 1640	600,000	2,600,000
1641 to 1650	600,000	2,600,000
1651 to 1660	560,000	2,440,000
1661 to 1670	560,000	2,440,000
1671 to 1680	560,000	2,440,000
1681 to 1690	560,000	2,440,000
1691 to 1700	1,500,000	2,300,000
[2]1701 to 1710	[2]2,400,000	2,000,000
1711 to 1720	2,400,000	2,200,000
1721 to 1730	3,000,000	2,400,000
1731 to 1740	6,000,000	2,600,000
1741 to 1750	4,000,000	3,200,000
[3]1751 to 1760	2,000,000	[3]3,800,000
1761 to 1770	2,000,000	3,800,000
[4]1771 to 1780	2,000,000	[4]5,000,000
1781 to 1790	2,000,000	5,600,000
1791 to 1800	[5]2,000,000	[6]6,490,000
Totals, 308 years	£393,120,000	£745,260,000

[1] These gold-fields are still yielding "over £1,000,000," to wit, about £4,000,000 a year each.

[2] Report of the Commissioners of the International Congress of Australian statistics in 1861, published in Phillips on "Mining," p. 102.

[3] The Count afterwards stated that he was urged by the Governor to keep the discovery secret, for fear it would impair the discipline of the 45,000 convicts on the island. "Thirty Years in New South Wales and Victoria," quoted by Phillips.

[4] Some of the shepherds had picked up pieces of gold in Victoria, but they wisely paid no further attention to the matter. Phillips, 103.

[5] Porter's "Progress," ed. 1851, p. 770.

[6] These data were originally compiled by the author for the U. S. Monetary Commission, and published in its report, vol. i. App. p. 61, *et seq.*

[7] Discovery of Potosi.

According to Mr. William Jacob, the gold and silver produced in America, Europe, and Africa, and supplied to the commercial world from 1492 to 1809 was £1,360,600,000. Of this amount he credits Europe and Africa with £137,-000,000, leaving £1,223,600,000 for the production of America alone. Deducting £83,200,000 for the production of the nine years 1801-1809 inclusive, would leave £1,140,400,000 for the production of America during the period 1492-1800 inclusive. The £1,360,600,000 he disposes of as follows:

Exported to Asia	£399,000,000
Converted into articles of use and ornament	440,000,000
Lost by abrasion, casualties, &c.	175,000,000
Left for coin in Europe and America	346,600,000

The last-named sum, added to the estimated stock of coin on hand in Europe in 1492, viz., £33,400,000, amounts to £380,000,000, which is his estimate of the stock of coin in the Western world in the year 1809. Mr. Danson's estimate of the production of the precious metals in America during the period 1492-1803 is £1,122,000,000. Deducting £25,600,000 for the production of the three years 1801-1803, would leave £1,096,400,000 for the production of America during the period 1492-1800 inclusive. The quotient of Table I. given above is £1,138,380,000. It is, therefore, 2,-020,000 less than Mr. Jacob's estimate, and £41,980,000 in excess of Mr. Danson's. While Mr. Danson's estimate for this period is probably nearest the truth, the figures given above are preferred, because they show the production by details of gold and silver separately, and by decades of years, which is not the case with either Jacob's or Danson's tables.

II. *Showing the estimated Production of* SILVER *in the Western World (America, Europe, and Africa) annually, since the commencement of the nineteenth century.*

The figures for the year 1800 to 1829 inclusive are constructed on the following basis:—The amounts coined at all the legal mints of Mexico, brought to the royal mint of Potosi, and raised in and exported from Coquimbo, are put together, and to the quotient £2,-000,000 are added each year for the conjectured production of all other countries in Europe and America. This conjecture is warranted by Sir Hector Hay and employed in his tables of production.

The figures for the year 1830 to 1851 inclusive are from various compilations indicated in the foot-notes. When not otherwise indicated, they are from Danson's compilation, "London Statistical Journal," xiv. 23.

The figures for the years 1852 to 1874 inclusive are from Sir Hector Hay.

The figures for 1875 and 1876 are compiled by the present writer, and for 1877 estimated.

[1] Amalgamation process first employed in America by Medina in 1567. Consult Tooke, vi. 358. This process, however, was well known to the ancients.

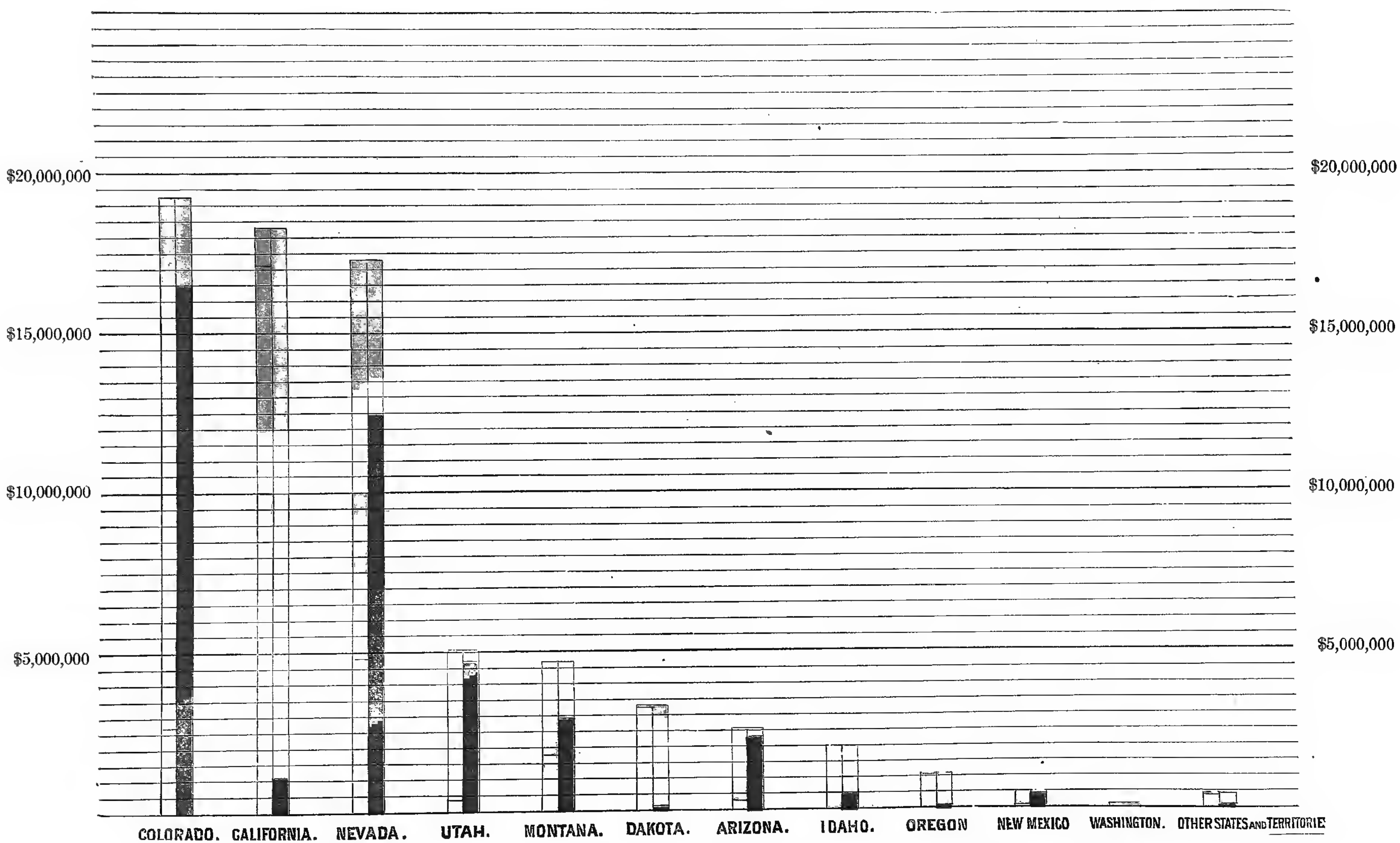
[2] Brazilian gold-washings begin to be productive.

[3] Exploration of Biscaina and Sombrerete, Mexico.

[4] Exploration of Valenciana, Mexico.

[5] Ex. Doc. 117, *note.* [6] Brogniart, "De Mineralogie."

RELATIVE BULLION PRODUCT of the STATES and TERRITORIES.



The areas in old gold indicate gold, those in light blue, silver; the relative totals being shown by the extreme height of each column.

Sums in millions of pounds sterling.

Year.	Production.	Year.	Production.	Year.	Production.
1800	[1]6.56	1810	6.28	1820	4.52
1801	[1]6.18	1811	5.28	1821	3.90
1802	[1]6.28	1812	4.26	1822	4.54
1803	7.16	1813	4.54	1823	4.20
1804	7.90	1814	4.54	1824	4.26
1805	7.84	1815	3.28	1825	4.10
1806	7.36	1816	4.26	1826	4.04
1807	6.88	1817	4.16	1827	4.32
1808	6.68	1818	4.82	1828	4.30
1809	7.50	1819	4.88	1820	4 56
				Total, 30 years.	150.82
1830	4.40	1838	4.00	1845	6.00
1831	4.40	1839	4.40	1856	[2]6.30
1832	4.20	1840	4.80	1847	6.80
1833	4.20	1841	5.00	1848	7.80
1834	4.20	1842	5.10	1849	7.60
1835	4.00	1813	5.60	1850	[3]8.78
1836	4.00	1844	6.40	1851	[4]8.10
1837	4.00				
				Total, 22 years.	120.08
1852	8.12	1861	8.54	1870	10.32
1853	8.12	1862	9.04	1871	12.20
1854	8.12	1863	9.44	1872	13.04
1855	8.12	1864	10.14	1873	14.04
1856	8.14	1865	10.40	1874	14.30
1857	8.14	1866	10.14	1875	14.00
1858	8.14	1867	10.84	1876	15.20
1859	8.16	1868	10.04	1877	14.00
1860	8.16	1869	9.46		
				Total, 26 years.	268.36

According to the preceding table the production of silver throughout the Western world during the period 1800–1829 was £159,820,000, and during the period 1830–1851, inclusive £120,080,000. Deducting £24,480,000 for the three years 1849–1851 would leave £255,420,000 for the period 1800–1848 inclusive. For the period 1803-1848 inclusive Mr. Danson estimates the American production of silver at £249,000,000, and Tooke the European and African production at £30,000,000. If to these sums there be added £20,-000,000 for the production of the three years 1801–1803, the total sum of production, 1800–1848 inclusive, according to Danson and Tooke, would be £299,000,000; but for reasons similar to those adverted to in a subsequent part of this chapter, relating to the gold production since 1800, Mr. Danson's estimates of the American production of silver are regarded as excessive, and the figures of the foregoing table are preferred.

III. Showing the estimated production of GOLD *in the Western World (America, Europe, and Africa), annually since the commencement of the nineteenth century.*

[The figures for the years 1800 to 1847, inclusive, are derived from estimates by the following authorities:—Humboldt, Raynal, Duport, Brogniart, Ward, Jacob, Danson's compilation, Price's and Tooke's "History," vol. vi. For this period the statistics are unsatisfactory, and are more reliable by groups of ten years than for any single year taken by itself. The figures for the years 1848 to 1876, inclusive, are from the authorities quoted in the foot-notes.]

Sums in millions of pounds sterling.

Year.	Production.	Year.	Production.	Year.	Production.
1800	[5]2·00	1816	1·20	1832	2·40
1801	[6]2·60	1817	1·20	1833	2 40
1802	1·80	1818	1·40	1834	2·40
1803	1·60	1819	1·80	1835	3·00
1804	2·00	1820	1·60	1836	3·00
1805	2·00	1821	2·00	1837	3·00
1806	2·20	1822	1·80	1838	3·00
1807	2·00	1823	1·80	1839	3·00
1808	2·00	1824	2·20	1840	[7]4·00
1809	2·00	1825	2·00	1841	4·00
1810	2·00	1826	2·00	1842	4·00
1811	2·00	1827	2·20 [7]	1843	4·00
1812	1·20	1828	2·00	1844	4·00
1813	1·40	1829	2·60	1845	4 00
1814	1·40	1830	2·60	1846	5·84
1815	1·20	1831	2·40	1847	8·00
				Total, 48 years	120·24

[1] Brogniart, "De Mineralogie." [2] Birkmyre.
[3] Philips. [4] "Journal des Economistes."
[5] Brogniart. [6] Birkmyre. [7] Russian gold-washing productive.

Year.	Production.	Year.	Production.	Year.	Production.
1848	[1]13 50	1858	[4]28·92	1868	[4]21·94
1849	17·40	1856	[4]28·98	1869	[4]21·24
1850	[2]18·64	1860	[4]23·86	1870	[4]21·38
1851	[1]24·00	1861	[4]22·76	1871	[4]21·40
1852	[2]38·74	1862	[4]21·58	1872	[4]19·92
1853	[3]31·00	1863	[4]21·40	1873	[4]19·44
1854	[3]25·40	1864	[4]22·60	1874	[4]18·16
1855	[3]27·00	1865	[5]26·14	1875	[4]19·50
1856	[3]29·52	1866	[4]24·44	1870	18·00
1857	[3]26·66	1867	[4]22·80		
				Total, 29 years	676·30

It should be stated in reference to the period of forty-eight years, 1800 to 1847 inclusive, which foots up £120,240,000, that this sum is considerably less than that assigned by Danson to America alone. His figure for the period of forty-five years, 1804-1848, is £142,179,411. If the production for the years 1800-1803, namely, £8,000,000, be deducted from, and the figures for the year 1848, namely, £13,500,000, be added to, the total shown in the above table, so as to make it agree with the period shown in Danson's, the total will only amount to £125,740,000, or to £16,439,411 less than Danson's estimates. An analysis of the latter, however, will hardly stand the test of criticism, and the figures are evidently excessive. For example, on the strength of five years' custom-house returns of exports of gold from Buenos Ayres during the period 1822-1826, Mr. Danson assumes the same average, namely, £71,836 per annum, for the entire period, 1809 to 1848 inclusive, and adds—quite gratuitously—266⅔ per cent. to this for smuggling to make a total from Buenos Ayres of £10,535,976. On the strength of an incidental remark by the British consul, in 1831, to the effect that the exports of specie from Montevideo in 1803 and 1804 may be taken as the ordinary shipments, he makes out a total export from that port during the period 1809-1848 of £40,000,000, of which he arbitrarily assumes 47 per cent., or £18,800,000, to have been in gold. These two results, together with £4,802,282 determined, upon a little better basis, to have been otherwise produced, in Buenos Ayres, give a grand total of £34,138,258 as the production of gold in that country during the period 1809-1848, whereas *one-tenth* of the amount would probably be much nearer the truth. In a similar manner, on the sole basis of returns of £8,825,149 of gold coined at the mints of Bogota and Popayan, in Columbia, during the period 1804-1829, which gold is believed to have consisted entirely of old coin and plate, he makes out a production of gold for that country during the period 1804-1848 of £40,851,066. Not to pursue these palpable exaggerations any further, it need only be stated that while the statistics for this period are very unsatisfactory, the figures of Humboldt, Ward, and Jacob are a sufficient warrant for keeping the average production of the period under £2,000,000 a year until the opening of the Russian gold-washings, and then at very little over £2,000,000 a year until these washings began to make a comparatively important addition to the then very limited supplies of gold to the world; and this did not occur until after the year 1840, when for the first time the Russian product amounted to so much as £1,000,000 a year.

Jacob's estimate of the average production of gold during the period 1809–1829 is £1,598,000 per annum, and this includes £720,000 per annum for Europe and Asia, leaving but £878,000 per annum for all America. A compilation published in U. S. Ex. Doc. 117, 1st Session, 21st Congress, 1830, estimates the annual production of gold in the world from 1801 to 1810 at £2,000,000 a year, and from 1811 to 1825 at £1,540,000 a year. From these evidences and the details contained in Humboldt, Jacob, Ward, Tooke, &c., it is believed that the figures of the above table are approximately correct, at least for any group of ten years, and, if at all wrong, that they are excessive. It will be observed that the lowest point of production is assigned to about the year 1816. MacCulloch differs from this in ascribing the lowest point to about the year 1829; but there is reason to believe that in this respect, and because he judged rather from the receipts of new metal in Europe than from the production at the mines, that eminent author placed the date of the min-

[1] "Westminster Review," January, 1876. [2] MacCulloch.
[3] "Journal des Economistes." [4] Sir Hector Hay. [5] Blake.

imum production a few years behind the true time. The general results of the foregoing tables are as follows:—

Sums in Millions of Pounds Sterling.

	Silver.	Gold.
Production of America during the period 1493—1800	745·26	393·12
Production of America, Europe, and Africa supplied to the Western World during the period of 1801—1876	527·70	794·54
Totals	1272·96	1187·66

or twelve hundred and seventy-two million nine hundred and sixty thousand pounds in silver, and eleven hundred and eighty-seven million six hundred and sixty thousand pounds in gold.

The following table shows the estimated production of gold and silver, respectively, throughout the world, by countries during the years 1877 and 1878.

Sums in Millions of Pounds Sterling.

Countries.	1877.		1878.	
	Gold.	Silver.	Gold.	Silver.
United States	8·3	7·6	7·5	7·0
British America (Colombia and Nova Scotia	0·6	—	0·6	—
Mexico and South America	0·8	5·0	0·6	4·0
Australia	4·8	—	4·0	—
Russia	3·8	0·1	3·6	0·1
Other countries	0·5	2·0	0·4	2·0
Total	19·3	14·7	16·7	13·1

With reference to the probable future supplies of the precious metals and their relation to the population and commerce of the world, the former must be expected to decline both relatively and absolutely. The population and commerce of the Western World are both increasing. At the same time the mines of all the principal producing countries, the United States, Mexico, South America, Australia, and Russia, are all declining in productiveness; and unless new and unforeseen discoveries—and it is difficult to conjecture in what quarter of the world such discoveries can be made—should put a different face upon the matter, the production of both gold and silver will continue to diminish. This conclusion should, however, furnish no ground for alarm. Since the beginning of the eighteenth century the precious metals have become less and less the general Measure of Value that they once were throughout the Occidental world, and more and more the measure of the Measure of Value; which latter is now the whole sum of intrinsic coin, plus the sum of token or subsidiary coin, plus the sum of bank and government and other paper employed as money. The precious metals are merely the foundation of this edifice, and for a very considerable portion of the superstructure, to wit, the irredeemable or unredeemed paper currencies of many countries, the precious metals afford no basis whatever. Whether the partially numerary systems in vogue in these countries (Brazil is the only one among them whose monetary system appears to be entirely numerary) will last, and so permanently reduce the requirement for the precious metals or not, is a problem for which it is no part of the design of this article to offer a solution.

There unfortunately exists no means of determining with any reasonable precision the amount of the consumption of the precious metals for other purposes or in other ways than for the purpose of money. Efforts of this sort have been made by Mr. Jacob and other writers, but they are not only too rude to be depended upon: those which, like Mr. Jacob's, have been made with any care, are antiquated, and would not afford any guide to the present disposition of these metals. The only satisfactory view which can be had of the subject is the limited one obtained by deducting from the total supplies since the discovery of America, the stock on hand as money at the present time. The remaining sum will necessarily be that of the meanwhile total consumption of the precious metals in the arts, shipments to Asia, loss by accident, and wear and tear by the abrasion of coin. The total sum of the supplies to Europe up to 1878 inclusive were about £2,627,800,000.[1] To this must be added £33,-400,000 for the amount of specie estimated to have been in use as coin in Europe at the period of the discovery of America. The total of these two sums is £2,661,200,000. The amount of coin estimated to have been in the Western World in 1876 was £700,000,000, and at the present time it is from £600,000,000 to £700,000,000. It follows that of the total supplies nearly £2,000 000,000, or over seventy per cent. has been lost, consumed in the arts, or exported to Asia.[2]

Similar calculations, made up to previous dates, determine the proportion of consumption to production to have been as shown in the following table:—

Sums in millions of pounds sterling.

Date.	Cumulative supplies to date.	Stock at date.	Cumulative consumption	Per cent. of consumption to supplies since last date.
1675	[3]509	250	259	50
1700	592	297	295	50
1775	1,054	275	779	74
1808	1,314	380	935	71
1828	1,441	313	1,128	78
1838	1,510	270	1,240	82
1850	1,675	400	1,275	76
1860	2,040	560	1.480	72
1870	2,365	720	1,645	70
1876	2.564	740	1,824	71

From this calculation it appears that, within the past century, the consumption in the arts, &c., and for exportation to Asia has never fallen below 70 nor risen above 82 per cent. of the total supplies, and this only at one period of unusual metallic dearth. These results appear to afford ground for the opinion that, hereafter as heretofore, this consumption will amount to about three-fourths of the supplies; but such an opinion, though possibly correct, should not be adopted without further examination. The first influence that would seem to govern the distribution of the precious metals is the requirement for coin, for upon the quantity coined appears to hang the most important consequences, to wit, the general level of prices, and therefore the relations of exchange, which means most of those of society. But this is by no means the case. Coin has been superseded to so great an extent in the transaction of exchanges, that although it continues to form the basis of them in several of the leading countries of the world,[4] its actual use has been dispensed with to a very considerable degree. Hence whether more or less of it is used as money, or it is allowed to be superseded by acceptable forms of paper, are facts that do not appear to be essential to the maintenance of prices, or the existing relations of exchange and society. Thus, some £40,000,000 of metal are said to have been accumulated in the United States within the past few years with the view to resumption this year (1879). If this be true it would seem that £40,000,000 which would otherwise have been consumed in the arts, &c., have been reserved for coin; but the fact, if it is one, does not seem to have influenced prices one way or another. These continue generally to be the same as before. The employment of bank cheques, bank and government notes, and other forms of paper is so extensive, that the monetary circulation of the commercial world has become highly elastic; and it is only when the specie basis is dangerously low, as in the years previous to 1838, or needlessly and superfluously high, as in those previous to

[1] This includes £103,400,000 from Japan.

[2] The flow of specie to Asia since the discovery of America is difficult to determine, the principal obstacle lying in the uncertainty which attended this movement during the eighteenth century. According to Jacob, supplemented by other estimates which include the flow before and since the period treated by him, the total flow to date has been upwards of £700,000,000. Allowance for the £103,000,000 obtained from Japan, would reduce the net flow to Asia to £600,000,000. It has therefore absorbed about one-third of the whole amount not reserved for coin in the European world.

[3] Including the £103,000,000 from Japan.

[4] It will be born in mind that, except Great Britain and Germany, no leading country of the world was, until quite recently, paying specie. The United States suspended in 1862; Austria in 1865; Italy in 1866; and France in 1870. Spain, Turkey, Russia and Japan have also, in fact, suspended.

1870 (*vide* the above table) that the value or purchasing power of the precious metals is affected enough to change the usual course of their distribution. For it must be considered that the enormous stock on hand, say £600,000,000 to £700,000,000 at the present time, acts as a powerful conservator of prices. Substantially not an ounce of this metal can change its purchasing power until that of the whole mass is changed, and the mass is so magnified by the use of paper substitutes that such change is slow and gradual. The miner can no more afford to wait until specie goes up, before he sells, than the silver and goldsmith can afford to wait until it goes down before he buys; consequently the one sells and the other buys, from time to time, without the least reference to the world's stock of coin, and without being at all affected (except at periods of extremity) by its fluctuations.

It would therefore seem to follow, that the distribution of the supplies of the precious metals is not primarily governed by the requirement for coin, but, owing to the elasticity of the demand for coin, rather by the requirement for the arts. Another consideration is involved in the fact that, turned into coin, metal affords no profit, while as used in the arts it does. Hence the prime tendency of the consumption of the precious metals should be, and indeed is, towards the latter. In selling his metal to the mint the miner has to compete with the spoliations and servile labor of past ages, for he can obtain no more for his product than the current value of an equal amount of gold or silver, the bulk of which was stolen from conquered races, or forced from the labor of slaves. But in devoting it to the arts, or what is the same thing, shipping it to Asia, he, or rather the silversmith, gold-beater, or merchant, who now acts for him, can dispose of it to better advantage, and this fact is enough to turn the scale in favor of its general flow towards the arts. Still another matter for thought lies in the fact that while there may be no loss in melting coin, there is a very serious one in melting plate, or reducing other works of art to crude gold and silver. Hence, while it is quite a common thing to do the former, it is a very rare one to do the latter.[1] In many forms of art, as in gilding, dentistry, photography, &c., the precious metals cannot be reduced to crude forms, and are, indeed, practically irrecoverable. This is much the case, also, with reference to the shipments of specie to Asia. This specie goes into circulation there at a much lower level of prices than that in Europe, or else it is melted down and used in the arts, for bangles and other jewelry, for gilding crockery, lacquer-ware, &c., or in the manufacture of those beautiful bronzes for which the Orient is famous, and nearly all of which contain some alloy of silver. The general result is that what metal goes into the arts in Europe, or is shipped to Asia, remains there,[2] and as it goes there in the first place without reference to the scarcity or plentifulness of coin in the European world, it remains there with equal indifference to that important consideration. Upon a general review of the subject it would appear that now, at least, not coin, but the arts, are the first and principal attraction that determines the distribution of the precious metals, and that it is only after the demand for the arts has been satisfied that the supplies of specie are permitted to accumulate as coin.

World's Stock of the Precious Metals.—The main purpose of Mr. William Jacob's history of the precious metals, and that one in the pursuit of which he was led into those many interesting digressions which contribute to greatly enhance the value of the work, was to examine "the source of those large accumulations of gold and silver which are represented to have existed in the early ages of the world, of their gradual increase in quantity, and the causes of the disappearance of a large portion of them." Unaware, or careless of the fact, that in many of the States of antiquity, notably Greece, Carthage, and Rome, numerary moneys were employed as currency in certain periods of their progress, the gifted author was led to assume that gold and silver alone, or at least principally, were used as measures of value, and in consequence he was induced to estimate the accumulated stocks of these metals in ancient times at sums which, in the light of this and other considerations, seem far too excessive. Avoiding any precise estimate of these sums until the Augustan age, he begins for that period with the assumption that the stock of the precious metals in the Roman Empire, which he regards as tantamount to all the European world, amounted to about £358,000,000. Having made this assumption he next proceeds to calculate, from the conditions of supply and consumption, particularly from the ascertained loss in the weight of coin from abrasion,[1] the vicissitude of this stock of metal, from time to time, that is to say, every thirty-six years until the year A.D. 806, and afterwards every one hundred years until the beginning of the present century; and arrives at conclusions which, ever since they were published, have commanded the respect of the learned world.[2] It is not proposed to question these calculations for any period subsequent to the discovery of America, because for these periods such abundance of evidence is advanced by Mr. Jacob and others concerning the supplies and accumulations of the precious metals as to leave no room for doubt concerning their reasonable accuracy. With regard to the previous periods the considerations above advanced, together with some others presently to be set forth, render it quite evident that Mr. Jacob's hypothetical calculations are untenable. The basis of these will now be given in the author's own words. Says Mr. Jacob: "We find in Suetonius that Vespasian, when he succeeded to the imperial dignity, asserted that a sum equivalent to £322,916,600[3] was necessary to support the commonwealth. This amount could not have reference either to the annual revenue or to the accumulation in the public treasury; for the produce of neither of those departments at any period could have yielded so large a sum. It is not, however, unreasonable to suppose that it bore reference to the whole mass of coined money at that time known, or believed, or supposed to be in circulation, within the boundaries of the republic. Assuming then that this sum was nearly the amount of the whole stock of current money, we may, without relying on its precise accuracy, venture to make use of it as the foundation of an estimate of the loss created by abrasion in the course of the period we have brought under consideration. Vespasian began his reign, and uttered the opinion we have stated, about two years after the death of Nero. In the time of Nero the aureus had declined in value, from the reign of Augustus, at the rate of somewhat more than ten per cent., and we now assume that the coined money, in this period, had decreased in nearly the same proportion. With these views we should calculate the quantity of money in the time of Augustus to have been about £358,000,000."[4] It is to be objected to this hypothesis—1st, that the sum mentioned by Suetonius refers quite plainly to the revenues which were required to support the State, and these may have included a requirement for the payment of debts during an understood term. This term may have been of one, two, five, or ten years, according to the custom of the period. Estimates of this character are often made in modern States for a period of several years together, and it is therefore not at all necessary to suppose, as Mr. Jacob has done in this case, that, if to the revenue at all, it referred to the "annual" revenue of Rome.

2d. Although long previous to the period of Vespasian, A.D. 70-79, the copper numerary system of the Roman Com-

1 "Not one-hundredth part of what passes through their (the bullion dealers') scales, consists of gold and silver that had before been manufactured." Jacob, vol. ii. p. 316.

2 The only notable exceptions to this rule were the melting of plate during the Spanish and Spanish-American revolutions, and the return of silver from India to England during the years 1832 and 1833.

1 Upon the basis of numerous experiments, made in the British Mint, the details of which are published in the appendix to Mr. Jacob's work, he determined this to be equal to about one three-hundred-and-sixtieth part annually, or a thirty-sixth part in ten years. Jacob, vol. i. p. 224.

2 Humboldt, "Fluctuations of Gold," says that Mr. Jacob's work deserves the highest consideration. Tooke (Newmarch) vi. 359, considers it "the highest authority to which we can appeal."

3 "Quadrigenties millies (scilicet H. S. Vespasianus) statim initio sui principatus opus esse professus est, ut republica stare posset."—Suetonius in Vespasiano, cap. xvi. This passage reads: "*He* (*Vespasian*, understood) *said, at the outset of his reign that, in order that the State should be able to stand, there was need of four hundred thousand*" (*hundreds of thousands of sesterces*, understood). Four hundred thousand hundreds of thousands equal forty thousand million; and this is the sum of numerary sesterces which Arbuthnot, Adam, and Jacob have converted into sterling gold.

4 Jacob, vol. 1, p. 224.

monwealth had perished and given way to a silver, and afterwards, in Cæsar's time, to a gold intrinsic currency, yet there are not wanting evidences that during the Dictator's reign coppers had again become numeraries—at least that they were highly overvalued. There is no other explanation for the fact that Caligula, A.D. 37-41, hastened to coin enormous quantities of them, and without consent of the Senate.[1] It is probable that during the period when they were wholly or nearly intrinsic (from B.C. 207 to B.C 46 or thereabouts) the copper coins of Rome were exported in large quantities to Spain and the other provinces, and that the resulting scarcity at Rome had converted them once more into numeraries, or at least rendered or left them highly overvalued As the sum mentioned by Suetonius is named in (understood) sesterces, and as the sesterce of this period was of copper,[2] and therefore highly overvalued, the rate at which it has been converted by Jacob into intrinsic pounds sterling of gold is erroneous; for this conversion (after Adam and by him Arbuthnot)[3] is made upon the basis that the sesterce was always a silver coin, or at least a sum of intrinsic silver, that is to say, silver coined at its bullion value. Dr. Adam says that the sesterce was a silver coin, the value of which was two asses and a half, "and often called absolutely nummus, because it was in most frequent use."[4] The fact that it was called "nummus," a numerary, should have guarded this learned author against the view that it was an intrinsic coin; but unfortunately it did not. Pliny, who must be regarded as better authority on the subject, informs us not only that the sesterce was of copper, but also that it was made of "aurichalcum," a peculiar sort of copper (probably to guard against counterfeiting), while the as was made of the common copper of Cyprus.[5] Mr. Noel Humphreys published fac-similes of the copper sesterces, vast numbers of which are still extant in the cabinets of numismatists.

At the period of Vespasian there were also sesterces of silver (chiefly from previous reigns[6]): just as at the present time the Americans have three-cent pieces of nickel and silver. But this fact does not help Mr. Jacob, for at this period all the silver coins of Rome were of limited and qualified legal tender, and overvalued. In other words, a given sum of sesterces, whether they were of copper or silver, would purchase more gold before than after being melted; just as at the present time a given sum in either the nickel or base-silver three-cent pieces of the United States will purchase more gold before than after being reduced to crude metal. These three-cent pieces are token coins, and so were the Roman sesterces, their value being due not to the metal they contained, but to the stamp of the government, and the law which made them limited legal tenders. On the general subject of the modern misapprehension of sums in ancient Roman money, the Marquis Garnier, who devoted a life of study to Roman antiquities, says that the translations of these sums are simply preposterous.

3d. The Roman method of notation was extremely liable to error. In the sum mentioned by Jacob, not only is "sesterces" inferred or understood, but so also is "hundreds of thousands of;" the only portion of the supposed sum actually written in the original being "four hundred thousand."

4th. The sum which Jacob assumes to have represented the stock of money in Europe at the Vespasian period of the Roman Empire, when viewed as such, is inadmissible. The population of Europe at this period, according to Merivale, did not exceed 60,000,000, and this number, when divided into the sum assumed by Jacob, gives for result an intrinsic gold or silver currency equal in amount to six pounds sterling per head of population. As even after the opening of Potosi Europe never possessed a stock of the precious metals amounting per capita to much more than one-half of this, the result arrived at by Mr. Jacob must be regarded as excessive.[1] There is no doubt that Mr. Jacob's general conclusion that the European stock of specie gradually diminished from whatever it was in the days of the Empire to about the sum he estimates it to have amounted to at the period of the discovery of America, is correct; it is only his estimate of the stock in the ancient times that is doubted. As to the stock at the period of the discovery, we have, in addition to Mr. Jacob's estimate, a statement made by Mr. Gregory King in 1696, which, although it was published at the time that Jacob wrote, is not alluded to by that writer, and probably escaped his researches. This statement affords support to and confirms the substantial accuracy of Mr. Jacob's view with regard to the stock at the period mentioned. Mr. King estimated the European stock of coin, bullion and plate, at the time of the discovery of America at £45,000,000. Mr. Jacob estimated the coin alone at £34,000,000. This is regarded as a substantial agreement.[2]

Following Mr. Jacob for the various periods between A. D. 1492 and 1828, and the most credible authorities for subsequent dates, and following other credible authorities for estimates of the population of the Western World, we have the following comparative view of the progress of gold and silver money and population at the periods named.

Table showing the estimated stock of Gold and Silver Coin, and the Population of the European world from time to time since the Discovery of America.

Period. A. D.	Authority for Population.	Population.	Authority for Stock of Coin.	Stock of Coin.	Stock per Capita.
				£	£ s. d.
1492	Estimate	40,000,000	Jacob	34,000,000	0 16 0
1636	Estimate	80,000,000	Estimate	240,000,000	3 0 0
1690	Petty-Jacob	85,000,000	Jacob	250,000,000	3 0 0
1700	Voltaire	90,000,000	Jacob	297,000,000	3 6 0
1776	Voltaire	110,000,000	Jacob	275,000,000	2 8 0
1808	Humboldt	200,000,000	Jacob	380,000 000	1 18 0
1828	Balbi	240,000,000	Jacob	313,000,000	1 6 0
1838	Humboldt.	260,000,000	Estimate	270,000,000	1 0 0
1839	MacCulloch	265,000,000	Storch	284,000,900	1 0 0
1850	Putnam	300,000,000	MacCulloch	400,000,000	1 7 0
1860	Stat. Journal	330,000,000	Estimate	560,000,000	1 14 0
1870	Behm & Wagner	370,000,000	Seyd	720,000,000	1 18 0
1877	Behm & Wagner	400,000,000	Estimate	700,000,000	1 15 0
1879	Estimate	410,000,000	Estimate	650,000,000	1 12 0

The bases for many of the foregoing figures will be found set forth in the Minute on the Population and Specie of the Western World, published in the Report of the Monetary Commission, and the authorities therein quoted.[3] They are omitted from this work from considerations of space. The basis for the last line will be found in Appendix B to this chapter. In order to make the dates in the population estimates tally with those in the estimates of coined money, proper allowances have been calculated, and the estimate as thus amended has been credited to the author who furnished its foundation. In a similar way additions have been made for the European population of America, &c., to estimate of

[1] Noel Humphreys' "Ancient Coins," p. 155.

[2] "Though the sestertius was originally a silver coin, its value was estimated in copper." Adam Smith, bk. i. ch. 5. The copper sesterce was first issued in the time of Augustus, and almost immediately became nearly the only monetary unit used in calculation." Humphreys' "Manual of Coins," i. 301.

[3] "The statements of Arbuthnot are not much to be depended upon." J. R. MacCulloch, "Com. Dic.," ed. 1856, p. 1063.

[4] "Roman Antiq.," p. 427.

[5] Pliny's "Nat. Hist.," bk. xxxiv. ch. 2; Bohn's ed. vol. vi. p. 149.

[6] The silver sesterce had almost disappeared during the reign of Augustus. Humphreys' "Manual," pp. 302-3.

[1] In A. D. 1700 the stock per capita was £3 6s., and since that period it has never been so great. It is now about £1 16s. per capita.

[2] Concerning subsequent dates these writers disagree. The following table affords a comparison of their estimates:—

Year.	Year.	King.	King.	Jacob.
King.	Jacob.	Coin, bullion and plate.	Coin and bullion only.	Coin only.
1488	1492	£45,000,000	—	£34,000,000
1588	1599	100,000,000	—	130,000,000
1688	1699	225,000,000	£146,000,000	297,000,000

Mr. Jacob having devoted much greater consideration to the subject, and having had before him the very elaborate data of Baron von Humboldt, has been preferred as an authority in these pages. Mr. King's statement was first reprinted by Mr. Chalmers in 1801, and has since been republished by Mr. Newmarch in Tooke's "History of Prices," vol. vi., p. 667.

[3] Some clerical errors which crept into the original publication ("Report," App. p. 71) are herein corrected. Some alterations are also introduced.

the population of Europe proper. The fact that the stock of coin in 1776 is put at less than that in 1700 may lead to a doubt of its correctness; but it seems to be well authenticated that until the development of the great silver lodes of Biscaina, Sombrerete, and Valenciana, in Mexico, towards the end of the last century, the supplies of the precious metals were not only inadequate to the demands of commerce, but that the stock of coin in Europe and America absolutely declined. The falling-off of the stock from 1808 to 1839 has been admitted by Humboldt, Jacob, MacCulloch, Tooke, and other writers on the subject. Referring now to the general and comparative aspects of the foregoing table, it will be observed that at the period of the discovery of America the Western World started with a stock of coin amounting to about 16*s.* per head of population, and that this proportion continued to increase until the opening of the eighteenth century, when it amounted to £3 6*s.* per capita. During this period plundering, discovery, and commercial adventure were stimulated to the extremest limits. The seas and bays of the entire world were explored, commerce was extended into the Americas, Africa, India, China, Japan, and the islands of the South Sea, and colonies were founded all over the world. The social organism was stimulated into the greatest activity. This was the period of the Revolution, Habeas Corpus Act, and Bill of Rights, in England; of the numerous risings of the peasantry, the Edict of Nantes, and the Fronde in France; of the Republic in the Netherlands; of the Protest and Thirty Years' War in Germany; and of the Reformations throughout Western Europe generally. After this period the stock of coin diminished from £3 6*s.* per capita in 1700 to £2 8*s.* per capita in 1776, £1 18*s.* per capita in 1808, £1 6*s.* per capita in 1828, and £1 per capita in 1838. It is noticeable that coincidently with this fall of the stock of coin the Western World exhibited all the marks of arrested development and social perturbation.

This was the period during which all the great national debts arose; when France, England, Russia, Germany, the Papal States, the American Colonies, the United States, Brazil, and many other countries, suspended specie payments, and when Europe and America were almost constantly shaken with insurrection and wars. It was the period of the American and French revolutions; of the separation of Mexico and the South American colonies from Spain; of the Chartist agitation and riots in England; and of popular commotion in all the countries of the Occident. Assignats, wild-cat banks, ruinous paper experiments, and the open repudiation of their debts by great corporations and States were the financial characteristics of the period. Before the eighteenth century the stock of coin and of money was the same, for there was little circulating paper in Europe beyond the confines of the Italian republics. After the beginning of the eighteenth century the stock of coin was not the same as the stock of money, but only the basis of it. At that time the Bank of England began to issue circulating notes, and this example was soon followed by other institutions. In 1716 circulating notes were issued by the Royal Bank of France; but between 1720, when this institution failed, and the issue of assignats by the French revolutionary government in 1789, no paper issues of any considerable amount were made in Europe proper; though, since the beginning of the century, they had become quite common in the American colonies. Substantially, therefore, the stock of coin and of money were much the same from the beginning of the eighteenth up to nearly the beginning of the present century. After that period they began to differ very considerably.

Of the stock of coin estimated to have been in existence in 1870 about one-third consisted of silver. The demonetizations of this metal which since that date have been effected in several of the leading countries of the world, have resulted in reducing the general stock of coin, which, at the present time, is something below its amount in 1877. The progress of the demonetization of silver threatens to reduce this stock still further, and the present tendency is therefore towards a smaller stock of specie in the European world. With regard to the stock of coin in particular countries the author has examined a great number of authorities, and from these has compiled the data on the subject to be found elsewhere in this book. From these it will be seen that at the present time the stock of coin in the Western World amounts to over £600,000,000, and that two-thirds of this amount are held in France, Great Britain, and the North German Empire. Estimates of the stock of coin existing in given countries are usually founded upon statistics of coinage and foreign commerce, and as a rule are excessive. For example, it is considered very doubtful that either France, Great Britain or Germany contains at the present time any such stocks of coin as are usually credited to them, and as quite probable that, could the truth be ascertained, these would exhibit a considerable reduction.

The Ratio of Ancient Times.—If our view is extended over the entire range of history—both ancient and modern—it will be found that the relation of value, or ratio between gold and silver has varied from 1 silver = 10 gold, to 1 gold =20 silver. An instance of the first-named ratio belongs to the Orient, and carries us back more than fifteen centuries before our era. The second belongs to the London market during the silver panic of July, 1876.[1] In a fragment of the works of Agatharchides—a Greek geographer who lived at the time of Ptolemy VI., Philometer, King of Egypt (B. C. 181—145)—we are informed that at one time the value of silver in ancient Arabia was tenfold that of gold.[2] No date accompanies this statement, but since we are assured by other evidences that so early at least as the eighth century before Christ, gold in the valley of the Tigris was thirteen times the value of silver, we may, without fear, assume that Agatharchides writes of a period long previous to this. If we may trust to the deduction of a German savant, silver was cheaper than gold during the seventeenth century before Christ. But, although this may yet prove to have been the fact, it is deemed hardly safe to infer it from the evidence advanced.[3] The superior value of silver must have disappeared when the silver mines of Greece were opened, and the Phœnician traders exchanged their exuberant metallic produce for the freights of the Orient. This occurrence must be assigned to a very high antiquity, and with the greatest probability to the era of Cadmus, some fifteen centuries before Christ. Xenophon, who lived 443—355 B. C., says of the antiquity of these mines: "No one ever pretended from tradition or the earliest accounts of time, to determine when these mines first began to be wrought, which is a proof of their antiquity."[4] And with reference to their bearing upon the value of silver he says:—

"The divine bounty has bestowed upon us inexhaustible mines of silver, an advantage which we enjoy above all our neighboring cities, by sea and land, who never yet could discover one vein of silver ore in all their dominions."[4] From these evidences there seems to be some warrant for concluding that the superior value of silver to gold, vouched for by Agatharchides, existed at some period previous to the fifteenth century before Christ. It was doubtless confined to the East. Some explanation of the high value of silver in the Orient, and particularly in Arabia, at this remote period, is found in the following named facts. 1st. In the absence of accounts of any important siver mines, or the knowledge of reducing silver ores in the Orient, coupled with the working of the gold sands of the Indian rivers, and the placer and quartz mines of ancient Arabia,[5] we are justified in inferring that previous to the discovery of the Greek silver mines there had accumulated in the Oriental

[1] The writer was informed by one of the parties to the transactions, that shortly after the discovery of gold in California, it was often sold by the miners for its weight in silver coins, or at the ratio of about 1-1. This, however, was quite an exceptional circumstance, and local to California.

[2] Jacob, vol. i. p. 97. The superior value of silver to gold in very ancient times is asserted by Boeckh, "Polit. Econ. Athen.," book i. chap. 6.

[3] Brandis, on the tribute lists of Thutmosis, sculptured upon the monuments of Thebes (Karnak). The date, however, appears to be inferred from a passage in Herodotus relating to a period "eleven centuries later. Consult Brandis as quoted by Raymond, U. S. Mining Com. Rep.," 1874, p. 473, and Herodotus, book iii. and Boeckh, p. 12.

[4] Xenophon on the Revenues of Athens; Walter Moyle's translation, D'Avenant's Works, ed. 1771, vol. i. p. 316.

[5] According to Captain Burton's recent work, "The Gold Mines of the Land of Midian," Arabia, in remote times, was devasted in the search for gold as thoroughly as the Roman provinces were in later ones.

world—and of this Arabia formed an important part[1]—a considerable mass of gold with comparatively little silver. Without any reference whatever to cost of production, the presence of a considerable quantity of one metal, and of a very limited quantity of the other, may have rendered the latter the more valuable. This we know to have been somewhat the case in Peru, where, previous to the landing of the Spaniards, gold was less valuable than copper.[2] The narrowness of the ratio in Japan, *i. e.*, 6 to 7, before the Portuguese opened it to the influence of the Western ratio, and *the relapse* of the ratio from 12 or 14, during the era of Portuguese commerce, to 6 or 7 after the ports of Japan were closed in 1639, affords other confirmation of the correctness of this view.

In the Occidental world gold seems to have been the more valuable metal from the remotest historical period. We are informed that, by the laws of Menes the value of gold was fixed in Egypt at two and a half times that of silver.[3] The era of Menes has been placed at the thirty-seventh to the thirty-ninth century before Christ; and if credit be accorded to these statements and dates, it would seem that between the eras of Menes and of Cadmus, either very little commercial intercourse existed between Egypt and Arabia, or else that for some reason, perhaps the use of numerary money, very little commerce in the precious metals took place between them; or else that the Oriental ratio, not differing materially from the Occidental in the time of Menes, had gradually accorded a higher value to silver, until this movement was reversed again through the influence of the Greek mines. It is, however, very much more easy to believe that the ratio quoted from the code of Menes belongs to a later date than Menes himself. Like other great codes of law, this one was doubtless greatly modified in time; and, though always passing by the name of Menes, contained provisions that were incorporated into it centuries subsequent to the epoch of its author. This is the case with the Roman codes, and many others. In turning from these remote eras and insecure hypotheses to the more satisfactory accounts of the classical historians, it becomes desirable to ascertain beforehand, so far as we may, what are the principal influences that govern the relation of value between the precious metals. By this means it is hoped that a more satisfactory connection may be traced between the scattered fragments of antiquity.[4]

The common view of this matter is that the ratio is governed by the relative cost of the production of these metals; but after what is elsewhere advanced by the present writer concerning the fallacy of this view, so far as it relates to the value of each metal compared with other commodities, it need scarcely be repeated that it is equally fallacious in its application to the value of one metal compared with the other. The suddenness and rapidity of many of the changes of ratio —for example, those which followed the conquests of Alexander the Great, Julius Cæsar, Cortez, and Pizarro,[5] and even the late change from the long time ratio of 15½ to the present one of 18—also prove that it cannot be due to cost of production; for these changes, and many others, took place without any corresponding changes in the conditions of production. Referring to the conclusions elsewhere reached with respect to the influences which control the value of the precious metals, it is only necessary to say in this place that quantity is the primal element that determines the value of money, whether it consists of the precious metals or any other substances, or these combined with other substances; and as to the value of one metal in the other, it depends on quantity as effected by legal regulations.

I. Quantity is related to the stock of each metal on hand in the world, monetized, or physically and legally susceptible of being monetized, plus all numeraries, tokens, bank notes, or other money, whether of paper or other substances. Quantity also involves consideration of the current and prospective supplies of metal or other moneys, either from conquest, mining, or legal monetization, and the proportion of such supplies to the combined stock of monetized metals, and other substances or tokens used as money. Taking this to be the meaning of quantity as related to money, it may be accepted as an entirely safe doctrine that it is this, and this alone, which primarily regulates its value. When this quantity is subordinate to the will of man, and that will subject without restraint to individual self-interest, then, indeed is the value of the thing thus produced due to cost of production; but not otherwise. For example, the quantity of cotton cloths which may be produced this year throughout the world is subordinate to the will of man. The exercises of this will is subject, without practical restraint, to the influence of individual self-interest. Any man who has the means may produce as many cotton cloths as he pleases; nor, as things stand, can the combined will of society stop him. There is no interdict upon the production of cotton cloths. Cotton cloth may, therefore, be produced in practically illimitable quantities, or its production may be abandoned altogether. Cost of production alone determines what quantity of it shall be produced. But this is not the case with the precious metals. Their production cannot be indefinitely increased; mines cannot always be found; nor, when found, worked; nor, when worked, made to yield metal. The vast quantity of the precious metals accumulated and on hand in the world cannot be disposed of; and this quantity is so vast compared with the utmost current production, that a long period must elapse before the latter could sensibly affect the value of the former. Nor are the precious metals alone in these respects. Improved land stands in the same category of commodities which are not amenable to the law of cost of production. Its quantity cannot be increased indefinitely; and the vast areas already in the possession of man must necessarily have a powerful conservative influence upon its price. Therefore, although the cost of taming wild lands were to fall to-day to a mere fraction of its previous cost, the fact would have no appreciable influence upon the value of land. Indeed, it may be said, broadly, that no commodity whose production is not amenable to the influence of individual interest derives its value from the cost of production.

For example, though to artificially produce water—a commodity for which there is no substitute, and with the acquisition of which society does not interfere—by the chemical union of hydrogen and oxygen, might make it worth a thousand dollars per cubic inch; yet so long as the earth is as full of it as it is to-day, that liquid will remain not without the highest worth, but without the slightest value. Were it conceivable that the springs and rivers were dried, and man were compelled to resort to the laboratory for his supplies of water, then, and not until then, would the cost of its production determine its value. And so, in a similar way, it may be said, that when there are no substitutes for gold and silver, when their production is entirely amenable to the will of man, not only socially, but individually, and every man may produce as much or little of them as he chooses, then, and not till then, will their value be determined by the cost of their production.

II. Legal regulations, first, concerning the ratio itself, and second, concerning money at all, are, next to quantity, the most potent of all the influences that determine the ratio of value between the precious metals. So potent are they that, under certain circumstances—as those of universal specie money and tolerably equal quantitative stocks and supplies, the regulation of a single important nation, or of several nations combined, might be sufficient to render the market ratio of the world whatever may be desired—for example, 1 gold = 1 silver—and to keep it there for ever, entirely irrespective of cost or of quantity. With regard to the influence of legal regulations upon the relative value of gold and silver, it is to be observed that it was exerted in three ways—firstly, through the effect of such legal regulations upon quantity; secondly, through discriminating taxes or mint charges upon the metals, after they shall have been extracted from the earth, or obtained from conquered nations (no matter what the cost of original production), and introduced into the markets at their cur-

[1] As to the commercial importance of Arabia in very ancient times, consult Baldwin's "Prehistoric Races," "The Land of Cush."

[2] Helps, "Spanish Conquest," iii. p. 478.

[3] Leon Faucher in Wilkinson's Ancient Egyptians," chapter viii.

[4] See Buckle's "Essay on Liberty," as to the higher value conferred upon facts by the discovery of their relations.

[5] See table of the ratio appended to this chapter.

rent value; thirdly, by the mere force of law, irrespective of quantity or of discriminating charges. These operations of law will be treated in their turn.

A. The effect of law upon quantity, and of quantity upon ratio.

The monetization or demonetization of either metal, or a change of standard, as it is called, will diminish the supply compared with the demand of the monetized metal. Such an act will enhance the demand, without increasing the supply, and thus render the monetized metal dearer, and contrariwise the demonetized metal cheaper. The most recent notable instance of this kind is that afforded by the German Imperial mint laws of 1871. The limitation or extension of coinage facilities will produce similar results—as witness the effects of the recent closing of the French mints to the coinage of ecus.[1] Like results will follow the suspension or resumption of specie payments by any important country, or the substitution of numeraries, tokens, or bank notes for specie, or of specie for numeraries, tokens, or bank notes. Such legal regulations will cause the supply of the precious metals to change its proportion to the demand for them, and will thus alter their value relative to other commodities. Several instances of this sort have occurred within late years, as when the United States suspended specie payments in 1862, Italy in 1866, and France in 1870.[2]

B. Effect of mint charges upon ratio.

The imposition of discriminating mint charges has an important influence upon the ratio. If the latter stood at 1 gold = 1 silver, and the same rate were levied upon one metal as the other, it would make no difference how mine charges were imposed, whether by weight or value. But when the ratio is unequal, an *ad valorem* mint charge, as though apparently similar for both, becomes in reality a discriminating charge in favor of one metal, and against the other. Thus, suppose the ratio to be, as it was in the days of Herodotus, 1 : 13, a mint charge of, say five, or any other per cent. *ad valorem* upon both metals would amount to thirteen times as much in weight upon silver as gold. The charge upon gold would be ·05 of gold, and upon silver ·65 of silver, which is thirteen times as much. If, instead of this, the mint charge were five per cent. of the weight of the metal coined, it would be equally the same for both. Thus it would amount to .05 pound of gold upon each pound of gold, and .05 pound of silver upon each pound of silver. Hence it makes an important difference whether mint charges are imposed *ad valorem*, or by weight. The tendency of *ad valorem* charges is to widen the ratio; that of weight charges, as far as the ratio is concerned, is *nil*. Whenever debts have to be paid abroad, commercial competition obliges the shipper of metal to select the one upon which the lighter mint charges are levied, in order that, upon being recoined in the country of its destination (history knows nothing of universal coinage or uniform coinage), it should yield him the greater net result in coined metal. One of the metals would thus become more desirable than the other. Since the opening of the Greek and Spanish silver mines, this metal has been gold; and the tendency of discriminating mint charges has been to continually widen the ratio. Every time the metals passed from one country to another—that is to say, every time they had to be recoined—more mint charges had to be paid upon silver than gold (for the charge, so far as we know, has always been *ad valorem*), and but for the almost entire failure, at certain times, of the supplies of both metals, and their relatively limited stock at all times, it is believed that this influence alone would have so greatly widened the ratio as to have rendered silver, ere this, almost worthless for the purposes of specie or "intrinsic" money. Previous to the era of the silver mines alluded to, the tendency of the mint charges was doubtless the other way, namely, to render gold less and less valuable. At the present time, the substitution of Government and bank notes for coins in the various mixed currencies of the world deprives silver of the protection which the limitation of new supplies has afforded to its value, against the encroachments of the mint charge; and the ratio, which now stands at 1 : 18, must be expected to widen to 1 : 20, and further. Nothing seems likely to avert this result, short of one or two measures. Either the mint charges of all the principal countries employing the precious metals for money must be levied upon weight instead of value, or else a number of powerful nations must combine together to sustain the value of silver by arbitrary decree.

C. Arbitrary decree.

Theoretically, arbitrary decree can make the ratio whatever may be desired, irrespective of either quantity or mint charges; practically, arbitrary decree is unattainable. To render such decree effective, it must be that of several important nations combined. It is easy enough for nations to resolve; but what motive beyond their own interest is there to induce them to execute? None but their own sense of right; and among nations—but few of which have as yet clearly passed beyond the feudal stage, and thrown off the influences of Church and caste—this can hardly be relied upon too implicitly. Supposing, however, that such cooperations were attainable, and, for example, the combined nations of Europe and America decree, and remained steadfast to the decree, that the ratio of gold and silver should henceforth be as 1 : 1, it is difficult to conceive how this ratio could ever be changed, either by the operation of quantity, mint charges, or any other influence. Relative demands of the precious metals for the arts could not change it, for even supposing everybody preferred gold plate to silver—a preference which under such circumstances cannot be admitted—this would not change the ratio. As no atom of gold could become money again, except at a par with silver, it is impossible to imagine that any scarcity of the one metal, or plentifulness of the other, could impair their equal value. It would not matter if, other things aside, gold were preferable to silver for use in the arts, or not. The law of nations, making them, when coined, equal as money, and all contracts dischargeable, all debts payable in the same weight of one as the other; and the conversion of both, from coin to bullion, and from bullion to coin, being unlimited, and subject to the same terms of seignorage, it necessarily follows that their value would be the the same.

Nor could the vicissitudes of production effect a change in the ratio. Though but a pound of gold a year were produced against millions of pounds of silver, still would the ratio remain unchanged. Nobody would pay more than a pound of silver for a pound of gold, when the former could discharge the same amount of indebtedness, past, present, and future. Nor would the demands of commerce change it. If debts were due from one country to another, the shipment of one metal would answer all the purposes which could be subserved by a shipment of the other, seeing that both metals, when coined, would be equally legal tender in all countries, and that coinage everywhere would be unlimited, and subject to the same charges for both metals. Nor would the condition of the stock on hand alter the ratio. Although this stock consisted nearly entirely of silver, and very little of gold, still would a pound of silver always buy a pound of gold, so long as the universal law rendered the one equally as effective as the other in the payment of debts, the market and the legal price would always be the same.[1]

Some familiar examples of the operations of law upon the value of the precious metals may seem desirable in this place. Until the passage of the recent law of the United States, remonetizing the silver dollar, that coin, always weighing the same, viz., 371¼ grains pure, was sold to the exchange brokers of San Francisco for about 90 cents in gold—*i. e.*, nine-tenths of 23.22 grains of pure gold.

[1] "Report U. S. Silver Com." [2] Ibid. pp. 21, 22.

[1] On a previous occasion the writer reached the same conclusion from even a narrower basis, *i. e.* upon the assumption of a fixed ratio, and unlimited coinage, by a single important commercial country, instead of, as herein, from the point of view afforded by the supposition of a common law on the subject between all nations. He said:—

"A legal ratio between the precious metals adopted in an important country, if coupled with full legal tender, and unrestricted coinage, at brassage, or a moderate seignorage, constitutes in effect, a standing offer to purchase all the current supplies of one metal at a fixed price in the other . . . It follows that the free mint prices, when the mints are competent to deal with the supplies, make the market ratio." "U. S. Silver Report," Appendix, 66.

Upon the enactment of the law the silver dollar rose to par. The law simply enlarged the legal tender function of the coin from $5 to an unlimited amount. At the present time, while this dollar is at par in gold, the metal it contains can be purchased in the market for 90 cents or less. Again, the trade dollar, which contains 378 grains pure, is not worth as much in the market as the silver dollar of 371¼ grains; because the law makes the latter an unlimited legal tender, and the former not. Finally, two half-dollars—weighing, if coined between 1853 and 1873, only 345·6 grains, and if coined since 1873, only 347.22 grains—are worth in the market more than a trade dollar of 378 grains, the former being legal tender for $10, and the latter not.[1] The operation of law shown by these examples is of a purely local character, and is probably not susceptible of further extension, without incurring the risk of being defeated by counterfeiting. Indeed, it is believed to be already beyond this limit.[2] It is useless to discuss the probability of the adoption by international convention of any general and radical reform, concerning the legal ratio between the metals. Such an event seems too remote; and, before it happens, it is probable that attempts will be made to solve the monetary problem, through the adoption of purely numerary systems.

Reviewing what has been adduced concerning the influences which practically determine the ratio of value between gold and silver, it may be said, briefly, that among these influences, cost of production finds no place at all; that the principal ones are the stock of the precious metals, and the laws concerning money; and that among the latter is one (the discriminating mint charge against the cheaper metal) which has always had the tendency to render the dear metal dearer and the cheap metal cheaper. Resuming our history which may now be read by the light afforded by these conclusions, it is to be observed that a considerable portion of Western Asia, which in the earliest times belonged, by political relations and commercial intercourse, to the Oriental world, had afterwards, through the influence of Phœnician commerce, become attached to the Occidental. Thus, while at the period alluded to by Agatharchides, Arabia belonged to the Eastern world; at the date next to be mentioned, it was fully within the Western, which now also embraced the empires of Assyria and Persia. The earliest instance of the western ratio is derived from the cuneiform inscription at Nineveh (Korsabad) on the Tigris, and is attributed to the year B.C. 708. This ratio is 1 gold = 13·33 silver. A more satisfactory instance is found in Herodotus, and relates to Persia, about the year B.C. 500. This ratio is derived from the payment of the Egyptian tribute to Darius, and is given at 1 gold = 13 silver.[3]

From this period to the fourth century B.C. silver fell in value, and the western ratio widened until it stood in Greece at 1 gold=15 silver; and this was probably also something near the ratio in all Levantine Europe and Asia Minor. From the fourth century B.C. to the discovery of America, gold fell in value, and the western ratio gradually narrowed until, in A.D. 1492, it stood at about 11 throughout Europe. The ratio in England was fixed by the Act of 22 Edw. IV. (1483), at 11·158;[4] North Germany by the Lubeck mint rule of 1463 at 11·60;[5] France, by the law of 1388, at 10·75;[6] Spain, by the law of 1483, at 11·575; in Italy it stood about 10½;[7] in South Germany, Russia and the Levant the ratio cannot be determined from the authorities at command. Spain and France were at that time among the most important commercial countries in Europe, and the legal ratios adopted by those countries went farthest to determine the general market rate throughout Europe. With a tendency of the western ratio, both from the continual accumulation of the stock of silver, and the influence of *ad valorem* mint charges, to always widen—in other words, with a tendency of silver always to fall in value, as compared with gold—the narrowing of the western ratio, or rise of silver, from the time of Alexander the Great to that of Columbus, must have been due to some exceptional cause, having no connection with the principles already adduced. This cause will be found in the influence of the eastern ratio. Next in antiquity to the instance related by Agatharchides is probably that one mentioned by Strabo, who states in his sixteenth book that in a country bordering on that of the Sabæans, gold has two-fold value of silver, and three-fold that of bronze.[1] No date is connected with this circumstance, but it may fairly be inferred to have related to a period long previous to the era of the great geographer.[2] In the fifth century B.C., as we are assured by another authority, gold in the East stood as 1 to 5, or 6 of silver.[3]

From the fifth century B.C. to the seventeenth century of our era, no satisfactory accounts have been met with of the ratio in the Orient, but the direction of the flow of silver furnishes an assurance that the ratio must always have been narrower than in the Occident. Said Sir Isaac Newton in 1717, "In China and Japan one pound weight of fine gold is worth but nine or ten pounds weight of fine silver, and in the East Indies it may be worth twelve." The closer intercourse with the Orient which followed the Portuguese and Dutch maritime discoveries of the sixteenth century, doubtless contributed to widen the eastern ratio from its position at the period of the discovery of America; and at this period it may be conjectured to have stood generally at about 1:6 in Japan to 1:7 in China and India, though probably the difference in localities was very great. It may be noticed here, in parenthesis, that the ratio both in Japan and China has undergone great perturbations. In Japan it probably stood at 1:6 to 1:7 at the period when intercourse was opened by the Portuguese. A century later it stood, according to Newton, at 1:9 or 1:10. In 1860, shortly after the second opening of commerce with Europe, it stood 1:6 (Griffis, "Mikado's Empire," p. 602). According to Alcock, ii. 348, and Williams' "Commercial Guide," which follows Alcock in this particular, the ratio in 1854 was 1.4; and this conclusion, which is said to have been derived from "the face value of their gold and silver coins," has been repeated in many works of reference. But no confirmation has been found of it, and it conflicts with the special report on the subject by the pursers of Perry's expedition. In China the ratio in A.D. 1285 was 1:10. In 1375 it is said to have been 1:4, but this statement lacks confirmation, and is improbable. Lecompte, a Jesuit, who wrote in 1690 (London, 1697) gave the ratio in China at 1:10, whereas, says he, "among us (in Europe), it is as 1:15." Newton (in 1717) gave it at 1:9 to 1:10. Turgot, in 1776, gave it at 1:12.[4]

In 1779 the ratio at Peking is said to have been 1:17½; but this, if true—for it lacks confirmation—was probably merely temporary and local. In 1810 it was 1:10 at Canton. In 1821 it was 1:18 in Peking; in 1844, 1:17 at Canton; and in 1845, 1:16 at Canton; these three ratios, lacking authority, and, if true, probably merely local or temporary. From 1849 to 1860 the ratios at Shanghai compared with the annual average rates at London are given herewith from Rondot's article on Chinese weights and moneys in the "Dictionary of Commerce and Navigation," published by Guillaumin at Paris, in 1861, quoted by United States Minister George F. Seward, from whose valuable communication to the Monetary Commission[5] many of the above ratios in mediæval and modern China are also obtained.

[1] Section 3,586 of the revised statutes, which for a time made the trade dollar legal tender for $5, has been repealed.

[2] The writer publicly expressed this view, upon the day after the passage of the silver bill; and in less than a week afterwards counterfeit dollars, which could not be distinguished from the genuine, were found to be in circulation.

[3] Herod., iii, 95. Boeckh, book i, chap. iv.

[4] Tooke, vi, 417.

[5] Soetbeer.

[6] Humboldt's "New Spain," iii, 400, and Balch in "Penn Monthly," Philadelphia, March, 1877, p. 198.

[7] Soetbeer.

[1] Boeckh, book i, chap. vi, note.

[2] Strabo wrote during the first century before Christ.

[3] "App. Cyc.," xiv, 658. Consult Leon Faucher.

[4] Turgot, "Wealth of Nations," ed. London, 1793, p. 49.

[5] Report, i. App. 541-570.

Year.	*Shanghai.*	*London.*[1]	*Year.*	*Shanghai.*	*London.*
1849	1 : 15·5	1 : 15·83	1855	1 : 12·8	1 : 15·36
1850	1 : 14·1	1 : 15·83	1856	1 : 13·4	1 : 15·33
1851	1 : 14·4	1 : 15·46	1857	1 : 14·2	1 : 15·27
1852	1 : 14·4	1 : 15·57	1858	1 : 14·7	1 : 15·36
1853	1 : 16·5	1 : 15·33	1859	1 : 14·9	1 : 15·21
1854	1 : 14·0	1 : 15·33	1860	1 : 15·9	1 : 15·30

Returning now to the consideration of the general subject of the ratio in ancient times, it is to be observed that while during the twenty centuries previous to the discovery of America the western ratio was narrowing from about 1:14 to 1:11, it widened in the east from about 1:5½ to 1:6 or 1:7.

Apart from any other consideration it seems probable that as commerce progressed, and intercourse between Europe and Asia grew more intimate, each ratio was modified by the other, until they both came to the same level, which they did in the early part of the present century.[2] The influence exercised by the eastern upon the western ratio was, however, not merely to attract the latter from a stationary condition towards the former, but to modify a tendency of the western ratio to widen from 1:14 to a lower value of silver and confine it to 1:11. In other words there existed a tendency of the western ratio to *continually widen.* This tendency had widened it from 1:13⅓ in 708 B. C. to 1:14 or 15 in the fourth century B. C. It was at this period that active intercourse and commerce was open between Europe and farther Asia. The Persian expeditions into Europe occurred during the fifth century B. C. The expedition of Alexander into India during the fourth century; afterwards the Greeks, Carthaginians, and Romans maintained regular commercial intercourse with the Orient. One of the results of this intercourse was that the tendency of the western ratio to widen was counteracted by the eastern ratio; and thenceforth the former, instead of continuing to widen, slowly narrowed. That the western ratio had by itself a tendency to widen, will hardly be disputed, when it is remembered that during the period under review, viz., from the fourth century B. C. to the discovery of America, the principal one of the two precious metals produced in the Western World was silver, and that the stock, though it declined after the exhaustion of the Spanish mines by the Romans, became more and more argentiferous, and less and less auriferous. During this period the Greek silver mines of Laurion, the Spanish silver mines, and the German and Hungarian silver mines, exhibited their highest productiveness; while the little gold acquired by Europe was derived from a remote commerce with the East. Aside from all other reasons—for there was another—here was an insurmountable one for silver to fall in value, compared with gold; and that it did not fall, but on the contrary rose, is solely attributable to the influence of the Oriental trade. The moment that the supplies of the precious metals to Europe from America became so ample that, instead of seeking for gold in the Orient, the former could afford to export silver to Asia, the modifying influence of the eastern ratio was destroyed; and the tendency of the western ratio to widen was left without restraint. This widening has gone on until from 1:11 at the period of the discovery, the rate has now reached 1:18. So long as silver continued to be the principal metal supplied to Europe this movement is easily accounted for. It is attributed to the continual increase of the stock of silver in Europe, and the continual relative diminution of the stock of gold. But when Brazil, and afterwards Japan, Russia, California, and Australia were opened, these conditions were reversed. It was now gold that became more plentiful, and silver relatively scarcer. Why, then, did silver still continue to fall in value? This question has already been answered. The constant tendency of silver to fall in value is found in the laws of money: in the long-time custom of levying mint charges by value. This alone has furnished a constant pressure, which has been upon silver, and promoted its decadence ever since man first learnt to extract it from its ores, and which, without radical reform in the mint laws of leading nations, must ultimately unfit that metal for money.

[1] These ratios (at London) differ slightly from those given farther on, but not enough to warrant farther attention.

[2] Except in Japan which had been almost closed to Western commerce since 1639.

Tables of the Ratio in Ancient Times.

I. *Table showing the Ratio of value between gold and silver in the Eastern and Western Worlds, respectively, from the most remote times to the 5th Century* B. C.

Eastern Ratio.			*Western Ratio.*		
Date.	*Ratio.*	*Remarks.*	*Date.*	*Ratio.*	*Remarks.*
Uncertain	1 S : 10 G	Arabia, Agatharchides.	Uncertain	1 G : 2½ S	Egypt. Laws of Menes.
Uncertain	1 G : 2 S	The East, Strabo.	—	—	—
			B. C. 708	1 G : 13⅓ S	Assyria. Cuneiform inscriptions at Nineveh.
			B. C. 500	1 G : 13 S	Persia. Herod. III 95.
			B. C. 490	1 G : 12½ S	Sicily. Time of Gelon. Boeckh, 44.
			B. C. 420	1 G , 13⅓ S	Asia Minor. Xen. Anabasis.
5th Cent. B.C.	1 G : 5 or 6 S	App. Cyc. xiv. 658.	B. C. 400	1 G : 12 S	Greece. Hipparchus. Plato.
			B. C. 400	1 G : 12 S	Various authorities quoted by Boeckh.
			B. C. 400	1 G : 13½ S	
			B. C. 400	1 G : 15 S	

II. *Table showing the Western Ratio from the 5th Century* B. C. *to the Discovery of America.*

Date.	*Ratio of Gold to Silver as 1 to —*	*Remarks.*
B. C. 404–336	12.00	Values in Greece from the Peloponnesian war to the time of Alexander; according to allusions in various Greek writers.
	13.00	
	13.33	
340	14,00	Greece. Time of Demosthenes. Boeckh, book i. chap. vi.
338–326	11.50	Special contracts in Greece.
343–323	12.50	Egypt under the Ptolemies.
300	10.00	Greece. Fall of gold, caused by influx of Alexander's spoil.
207	13·70	Rome. Boeckh, book i. chap. vi. Overvalued gold *scruples* coined at the rate of 1 gold to 17.143 silver.
189	10.00	Rome. Ratio in tax payments. Polybius, xxii. 15, & S. Livy, xxxvii. 11.
186	10.00	Rome. The long-time ratio (of 13 and over) diminished one-third in two months by extraordinary supplies of gold from Aquileia. Strabo, iv. vi. 12. Polybius, xxiv. 10. Sueton., "Cæsar," 54. [from Gaul.
58–49	8.93	Rome. Fall of gold occasioned by influx of Cæsar's spoil
54	11.91	Rome. Coinage ratio. Boeckh, book i. chap. vi.
A. D. 1–37	10.97	Rome. Reigns of Augustus and Tiberius.
37–41	12.17	Rome. Reign of Caligula. The coinage somewhat debased so that the actual ratio was generally about as 1 : 11.
54–68	11.80	Rome. Reign of Nero.
69–79	11.54	Rome. Reign of Vespasian.
81–96	11.30	Rome. Reign of Domitian.
138–161	11.98	Rome. Reign of Antoninus.
312	14.40	Byzantium. Reign of Constantine.
438	14.40	Rome and Byzantium. Theodosian Code (Boeckh, book i. chap. vi. alludes to some coinage in A. D. 422, at the ratio of 1 : 18.)
864	12.00	Probable ratio under the Carlovingian dynasty as shown by the Edictum Pistense.
1260	12.60	Average ratio in the Commercial Cities of Italy.
1344	12.09	England. Mint Indentures. Tooke, vi. 417.
1349	11.57	
1356	11.16	
1401	11.16	
1421	10.33	
1464	10.33	
1465	11.16	
1470	11.16	
1482	11.16	
1351	12.30	North Germany. Rules of Lubeck Mint.
1375	12.40	
1403	12.80	
1411	12.00	
1451	11.70	
1463	11.60	
1455 to 1494	10.50	According to the accounts of the Teutonic order of Knights.
1336	10.50	Holland. Humboldt's "New Spain," iii. 400.
1388	10.75	France. Ibid.
1492	10.50	France. Minister Gaudin, as quoted by Mr. Thos. Balch in "Penn Monthly," for March, 1877, p. 198.
1475	10.97½	Spain. "Memorias de la Real Academia de Historia," tome vi. Madrid, 1821.
1480	11.55½	
1483	11.67½	
1497	10.75½	
1492	11.00	Year of the discovery of America. Average of the Mint ratios of England, France, Germany, Lubeck, and Spain.

The Ratio in Modern Times.—Above it was shown that in very ancient times silver was more valuable than gold; that afterwards gold became more valuable than silver, first in the Western World, and afterwards in the Eastern; and that the western and eastern ratios remained distinct up to a very recent date, silver having been always more valuable in the East than the West. The time when gold became more valuable than silver was assigned to the period of the opening of the Greek and Spanish silver mines by the Phœnicians; the equalization and unity of the eastern and western ratios was stated to have taken place during the present century. It was also shown that the ratio was produced by two influences, the first of which was the quantity of money in existence (irrespective of the material of which it was formed, but provided that some portions of it were of silver and gold) and the second the prevailing legal regulations respecting money; and that the relative cost of producing the precious metals had no bearing whatever upon their value. So long as there were two ratios in the commercial world, a third influence was added to the two above mentioned. This was that of each ratio upon the other.

Although for the sake of perspicuity and convenience the relation of value between gold and silver has been classified into two great divisions, the eastern and western ratios, it should be stated that in point of law and fact there has been no such thing as either an eastern or a western ratio; the ratio in every locality being different and each country being a law to itself in this respect. Nevertheless, although thus independent, it does not escape the influence of surrounding countries; and with the intimate commercial intercourse that now exists between the various countries of the Occident, it results, as a matter of fact, that the ratio in London, the most important market in the world for the precious metals, is a pretty faithful representative of the result of all conflict on the subject, both economical and legislative, and is therefore a substantial indication of the average ratio of the Western world. At the period of the discovery of America, the (average) ratio throughout Europe stood at about 1:11. The first important act of legislation upon the subject after this date was the Edict of Medina, issued by Ferdinand and Isabella in 1497, and fixing the ratio in the coins of Spain at 1:10·755. As at one period previous to the discovery of America, viz., in 1483, the ratio in Spain had been fixed at 1:11·675, it has been imagined by some[1] that the Edict of Medina was occasioned by uncommonly large supplies of gold, which are assumed to have been obtained from America during the years which first followed the discovery. A glance at the statistics of these supplies should be sufficient to dispel this assumption. Up to 1497, and indeed for many years after, the amount of gold obtained in America did not exceed an annual average of £340,000, and everywhere throughout the correspondence between Columbus and the Court we find intimations of the disappointment of the latter at the trifling amount of metal obtained. It now remains to be shown that the Edict of Medina has been entirely misunderstood, and that instead of according a new ratio to the precious metals, it merely re-affirmed an old one. The following table shows the mint ratios of Spain for upwards of three centuries:

Mint Ratios of Spain.

Year.	*Ratio.*	*Authority.*
1475	10·975	"Memorias de la Real Academia de Historia," tome vi. Madrid, 1821.
1480	11·555	
1483	11·675	
1497	10·755	
—	—	
16—	—	
1641	14·00	Moran on Money, p. 44; and John Locke on Money, ed. 1823, vol. v. p. 206.
16—[1]	16 00	Sir Isaac Newton. Silver undervalued.
1730	16·00	Kelly's "Combist." Relation of gold in the doubloon to silver.
1772	16 00	
1786	16.38	

From this table it appears that the ratio affirmed in 1497 was one that had been previously affirmed in 1475, seventeen years before the discovery of America or the new supplies of gold; and that therefore it probably had nothing to do with either event, but, instead, had flowed from the mint ratios of the Italian commercial cities of the Middle Ages, and found its support in the average ratio which prevailed in the principal countries of Europe at the time of its adoption. This ratio, as stated in a previous chapter, was about 1:11, or, omitting Spain, about 1:10¾.

Starting from this point, viz. the period of the discovery of America with the European or western ratio at 1:11, there is no difficulty in perceiving the cause why silver has since almost continually fallen in value, so that now the ratio is little better than 1:18. The mint charges in all countries have invariably been in favor of gold and against silver, varying at first from about 1 to 2½ per cent. on the former, and from about 2½ to 5 per cent. on the latter; to, latterly, nothing, or at most ½ to 1 per cent. on the former, and 1 to 2½ per cent. on the latter. There is no room whatever to doubt that this discrimination against silver, exercised for centuries in the mints of every country of Europe and operating upon enormous sums of coin, has been fully competent to produce the result observed. Every time specie had to be shipped to complete the exchanges between European countries, gold was always preferred for the purpose on account of the lower mint charges upon it, and the inferior loss sustained by the shippers upon its reduction to the coin of the country of its destination. To this rule there has been an occasional exception. In the shipments of silver from America, to Germany, Holland, Russia, India, and such other countries as at various times adopted and sustained the single standard of silver, the metal was conveyed, directly, or indirectly, from the countries that produced it, to those that consumed it; it was coined or recoined but once, and therefore was not subject to discriminating mint charges. But the mass of international exchanges in Europe and America have been effected with gold; not because the carriage of gold costs less than that of silver—it does not, freight charges upon the precious metals being predicated upon their value and not their bulk or weight;[1] but because the seignorage exacted upon gold coins being less than that upon silver ones, the loss sustained by the shipper upon melting the former, either previous to or after shipment, was less than his loss would have been to melt the latter. As to obtaining his supplies from the uncoined bullion, there is seldom enough of this to be had: the demand for coin always tending to attract all disposable metal to the mints.

Within a comparatively recent period the influence of quantity upon the relative value of the precious metals has been exercised through two comparatively new and very powerful agencies, the extensive substitution of bank paper, and afterwards of government paper for coins; and alterations of the metallic basis, or "changes of standard." These agencies came into play at about the same period—the beginning of the eighteenth century. The first circulating bank notes in Europe (except a few by the Bank of Stockholm, established in 1668) were issued by the Bank of England, which was established in 1694. The first governmental circulating notes in Europe since those of the Mediæval Italian republics were those (if governmental they may be called) of the Royal Bank of France, under the administration of John Law. The first formal change of the metallic standard in modern times took place in Portugal in 1688, and nominally in England in 1717.[2] It has already been shown that (owing to the practice of enacting mint charges which discriminate against silver), when a nation, at least when a modern nation, parts with its metallic stock, gold is the metal preferred by exporters, and this metal is therefore always the first to be exported. This gold being recoined in the country to which it has flowed, it there enters into the circulation and assists to raise the level of prices therein. As its subsequent withdrawal would, other things aside, occasion a fall of prices to their

[1] Humboldt, "Fluctuations of Gold," p. 11.

[2] Mr. Rice Vaughan in a work published in 1675 says that "Spain, to raise a tribute on the people, hath extremely falsified the intrinsic value" of her coins; but it does not appear whether gold or silver was over-valued. Consult Harris on "Coins," ii. p. 122.

[1] This is strictly correct as to ocean freights, and generally as to land freights. Consult Cernuschi. As to express freights west of the Rocky Mountains of the United States, it seems that the *ad valorem* freight charge upon silver is about half as much again as upon gold. See examination before the present writer of Mr. John J. Valentine, questions 126 and 127. "Report of U. S. Monetary Commission," vol. i. App, p. 47.

[2] See "History of Money," by the writer.

previous level, this withdrawal is usually resisted by every influence of law or commerce which the spirit of the times or the institutions of the country permit. Some authors maintain that the ancients never forbade the exportation of the precious metals,[1] but this is incorrect.[2] At all events such restrictions were universal during the mediæval ages; formed the basis of the mercantile system of two centuries ago; were maintained in most countries down to a late period; and, in some countries, are in force to-day. When the agency of export restriction cannot be employed to prevent the outflow of gold, recourse is had to arbitrarily raising the rate of interest in government banks, and so of increasing the difficulty of obtaining gold to export. This is the method employed at present in Great Britain, France, Germany, and other countries.

The country which has parted with its gold now has but a single means of getting it back. This is to widen the ratio, to cheapen silver, to enhance the value of gold, to pay more for this last-named metal, and thus to buy it back at a value higher than that at which it was parted with. It was doubtless the perception of this great principle (aided by the product of Brazil, and the Methuen treaty which enabled England to obtain the benefit of and handle this product) that led that country, after Portugal, to adopt Sir Isaac Newton's advice, and effect such a disposition of its mint laws as practically to render gold coin its only money; an arrangement which was ratified by subsequent legislation, particularly and finally by the Act of 1816, and the resumption of specie payments in 1823. Newton's sagacity enabled him, perhaps, to foresee that so long as England continued to remain, as she had already become, the banking centre of the world, she would profit by every exchange of bullion that passed between other countries; because by their own mint laws these exchanges would naturally and inevitably always be effected in gold. Thus, other things aside, gold will continually rise in value; and England, by adopting it for money, keeping a large stock of it always on hand, and making her contracts payable in the same metal, would continually profit by the operation. But what has benefited England has injured the world at large.[3]

Take the United States, for example. Between the termination of the American Revolutionary war in 1783, and the resumption of specie payments in England in 1823, there had accumulated in the States some £3,600,000 or £4,000,000 in gold.[4] These had been purchased at the ratio of 15; for this was the ratio which had been adopted by the United States government in 1790. Between the peace of February, 1815, and the year 1820 all this gold must have been exported to England; for we are informed that from 1820 to 1834 the only coins circulating in the United States were of silver.[5] In order to introduce gold into the currency the Americans raised its price. This they did by widening the ratio in 1834 to 16, and at this price was purchased the whole of the 50 millions which are estimated to have been in the country upon the breaking out of the Civil War of 1861, to say nothing of a sum of gold, probably equally great, which was meanwhile used up in the arts. Between 1862 and 1863 they sold the bulk of this gold at the equivalent in merchandise of 16 in silver, and were recently purchasing some of it back by giving for it eighteen or nineteen times its weight in silver, until this absurd policy was temporarily arrested by the passage of the so-called Silver Bill. If this bill, however, is held not to permit the government to pay its debts in silver dollars, they will have to be paid in gold, and this gold will have to be purchased at a ratio, which, notwithstanding the supposed tendencies of the Silver bill, will be sure to continually widen in future as it has widened in the past. If it be asked why the ratio took nineteen centuries to narrow from 14 or 15 to 11, while it has only taken three centuries to widen from 11 to 18, the answer is, that after the Roman Empire had passed the meridian of its power, until the discovery of America, that is to say from the third century to the fifteenth but comparatively few coins of gold and silver were minted in Europe; and whatever were the mint rules or other laws, or conflict of laws, that, as it is assumed, occasioned the general narrowing of the ratio from the period of the Peloponnesian war to the discovery of America, their practical operation was limited to a comparatively small amount of coin. Moreover, as except between the coasts of the Mediterranean, there was little or no commerce between nations during this period, and no exchanges to effect in specie, unless with India, the consequence of changing the standard was not understood or had been forgotten after Julius Cæsar made gold the standard in Rome; for even Pliny, who wrote but a few years after him, though for other reasons he anathematizes the author of the change, does not perceive in it any bearing upon the future history of money or of the world. It should also be remembered that up to 1873 the ratio stood at 15½, a point to which it was held by the mint laws and the vast coinages of France, and still more by the rules of the Latin Monetary Union of 1867, which provided a means of obviating the necessity of melting any gold coins that might thereafter be paid between the countries which were parties to that Convention.

Long previous to this date, however, many of the legal supports that had contributed to uphold the existing ratio of Europe had been one by one knocked away, so that at this date it depended chiefly on the mint ratio and open mints of the Latin Union. Its other legal supports had perished with the suspension of specie payments in Russia, Austria, the United States, Italy, Spain, etc., and the practical closure of the mints of those countries to silver. Consequently, when the important events next to be mentioned took place, the European ratio fell in a few years as far as, otherwise, it would probably have fallen only during the course of a century. These events grew out of the Franco-German war. Germany in 1870 announced her intention to change from silver to the gold standard. This act by itself could have made no impression on the ratio; which, next to quantity, is chiefly affected by discriminating seignorages between the metals and the international movement of gold occasioned by such discriminations. But it induced France and the Latin Union to paralyze the operation of their mint laws (of 15½) upon the general ratio of the world, by suspending the free coinage of full legal tender silver. This was doubtless done to compel Germany to pay a higher price for the gold she would require, for it is creditable to French statesmen to say that, among all Europeans, they appear best to understand the technism of this intricate matter. The closure of the mints of the Latin Union removed the remaining barrier opposed to the fall of silver, deprived it of the most active means it possessed of being coined into money, and left it to the depressing tendencies of heavy seignorages in the few countries that continued to employ it for subsidiary coins. As for the influence upon the ratio which has been attributed to the extraordinary production of the Nevada mines, and the diminished flow of silver to India—occurrences alleged to have occurred during this period—these arguments were answered so fully in the course of the investigation upon the subject undertaken by the author in connection with the U. S. Monetary Commission, that it is hardly worth while to devote any space in this work to it. The substance of this answer was that the world's normal product of silver had not increased, nor had the normal flow of silver to India diminished.[1] The existing conditions of the accumulated stock, the current production and the commercial demand for the precious metals, for the present preclude quantity from exercising any noticeable influence upon their value. That value

[1] Boeckh, book i. chap. ix.

[2] "Exportari aurum non oportere, cum sæpe antea senatus, tum me consule, gravissime judicavit." Cicero, Orat. pro L. Flacco. cap. 28.

[3] As a general rule of statesmanship—to which there are, of course, exceptions—measures of fiscal policy which fit the affairs of England, are ill suited to other countries, because, being the possessor of the greatest reserves of coal (mechanical power) and wealth (capital), she has become the creditor of all the world. In order to counteract Sir Isaac Newton's system of money, the best policy for other nations would have been to adopt the single silver standard; and, so long as England retains the single gold standard, this will continue to be their best policy.

[4] Gallatin's "Reports on the Finances."

[5] Report of Mr. White, Ho. Rep. 21st Cong. 2nd Sess., No. 95. Indeed, Mr. White says there was no gold in circulation so early as 1817; that it had been shipped to England.

[1] See examination of this question in "Report U.S. Monetary Commission," i. app. 81-89.

therefore, both as it exists and evidently tends in the future, has its basis, substantially, in the conflict of the mint laws of nations, and in the operations of domestic mintage and international exchange.

TABLES OF THE RATIO IN MODERN TIMES.—The time covered by this Minute is limited to the year 1760, for the reason that no annual average quotations at one place are attainable for anterior dates, and also because of the want of any comprehensive summary of the mint codes of leading commercial countries for an earlier period. A legal ratio between the precious metals adopted in an important country, if coupled with full legal tender and unrestricted coinage at brassage or a moderate seignorage, constitutes, in effect, a standing offer to purchase all the current supplies of one metal at a fixed price in the other. Hence the free-mint prices of important countries—that is to say, of countries whose practical ability to purchase metal is equal to, and whose mints are capable of coining all that may be offered—control the market ratio, and, except so far as modified by discriminating seignorages, by demand for the arts, for token coinage, and for export to Asia, they control it almost exclusively. It is, therefore, essential to the understanding of a table of fluctuations between the metals to know what were the legal ratios in, or standing prices for, the metals offered by leading countries; and the capacity of their mints during the period covered by such fluctuations. The following is a rough summary of these details relating to France, England, and the United States, the two former countries, with Spain and her colonies, having been the principal double-standard countries during the period under review. Reliable details relating to the Spanish and German coinage systems of the last century are not within reach.

France.—The optional standard[1] at 14½ prevailed up to the year 1785, when it was changed to 15½. This ratio was ratified in 1803, and is the one now nominally existing. The conditions of coinage up to 1803 are not set forth in any of the papers submitted to the writer. In 1803 the mints were thrown open unreservedly to both metals at the charge of brassage. In 1873 they were closed to silver. The capacity of the French mints, as indicated by the greatest coinage of any single year, was as follows: Gold, year 1859, 702,697,690 fr.; silver, year 1811, 256,399,040 fr.

England.—The optional standard at 15.2 prevailed nominally from 1717 to 1816, when it was changed to gold, which is the standard now existing. The coinage throughout this period has always been called "free," but in point of fact it costs a trifle more than the French charges of brassage.[2] In 1797 the mint was closed to free silver. The capacity of the British mint, as indicated by the greatest coinage of any single year, was as follows: Gold, year 1853, £11,952,391; silver, year 1817, £2,436,298.

United States.—From and before 1760 to 1792 the silver standard prevailed in the American States, but no silver was coined by the Government until 1794. From 1792 to 1874 the optional standard prevailed—from 1792 to 1837 at 15, and from 1837 to 1874 at 16; coinage unrestricted for both metals at charge of brassage up to 1873, when the mints were closed to silver. In 1878 the Government commenced a limited coinage of unlimited tender silver dollars at the ratio of 16, and for its own account. The capacity of the American mints, as indicated by the greatest coinage of any single year up to 1876, was as follows: Gold, year 1851, £12,522,898; silver, year 1876, £3,825,300. It may be added that the American mints can easily be rendered capable of coining the entire current production of the world, and as much may be said, perhaps, of the French and British mints. The following tables exhibit the average annual market ratio between gold and silver from 1760 to 1878 inclusive, and the average monthly ratio from 1873 to the present time.

[1] Commonly called the double standard, that is when coins of either gold or silver are legal tenders to an unlimited amount.

[2] See vol. i. app. p. 230 of the "Report of the U. S. Monetary Commission."

Table *showing the average annual Ratio of Value between Gold and Silver—expressed, as is customary, in quantities of pure silver to one of gold—in the London market from 1760 to 1878 inclusive. Up to 1829, from Ex. Doc. 117, First Session, Twenty-first Congress; from 1833 to 1875, from Pixley and Abell's circulars; since 1876, from the weekly gold quotations of standard silver in the London "Economist."*

1760	14.29	1790	15.01	1820	15.71	1850	15.70
1761	13.94	1791	14.95	1821	15.98	1851	15.46
1762	14.63	1792	14·43	1822	15.91	1852	15.58
1763	14.71	1793	15.01	1823	15.91	1853	16.33
1764	14.91	1794	15.32	1824	15.64	1854	15.33
1765	14.69	1796	14.77	1825	15 69	1855	15.38
1766	14.41	1796	14.77	1826	15.69	1856	15.38
1767	14.45	1797	15.45	1827	15.77	1857	15.27
1768	14.58	1798	15.45	1828	15.77	1858	15.38
1769	14.45	1799	14.29	1829	15.95	1859	15.19
1770	14.35	1800	14.81	1830	55.37 [1]	1860	15.28
1771	14.36	1801	14.47	1831	15.73 [1]	1861	15 50
1772	14.19	1802	15.23	1832	15.73 [1]	1862	15.35
1773	14.73	1803	14,47	1833	15.93	1863	15.36
1774	15.05	1804	14.67	1834	15.73	1864	15.36
1775	14.62	1805	15.14	1835	15.79	1865	16.44
1776	14.34	1806	14.25	1836	15.71	1866	15.42
1777	14.04	1807	14.46	1837	16.83	1867	15.57
1778	14.34	1608	14.79	1838	15.85	1868	15.58
1779	14 89	1809	16.25	1839	15.61	1869	15.60
1780	14 43	1810	16.15	1840	15.61	1870	15.57
1781	13.33	1811	15.72	1841	15.70	1871	15.58
1782	13.54	1812	15.04	1842	15.86	1872	15.63
1783	13.78	1813	14.53	1843	15.93	1873	15.92
1784	14.90	1814	15.85	1844	15.85	1874	16.16
1785	15.21	1815	16.30	1845	15.91	1875	16.69
1766	14.89	1816	13.64	1846	15.89	1876	17.63
1787	14.83	1817	15.58	1847	15.79	1877	17.20
1788	14.71	1818	15.42	1848	15.85	1878	17.94
1789	14.89	1819	15.82	1849	15.78		

Table *showing the average monthly Ratio of Value between Gold and Silver—expressed, as is customary, in quantities of pure silver to one of gold—in the London market during the years 1873 to 1878 inclusive, calculated from the weekly gold quotations of standard silver in the London "Economist."*

Month.	1873.	1874.	1875.	1876.	1877.	1878.
January	15.76	16.19	16.45	17.08	16 36	17.52
February	15.76	16.05	16.41	17.66	16.50	17.38
March	15.77	15.86	16.50	17.82	17 22	17.25
April	15.78	16.01	16.47	17.57	17.39	17.44
May	15.81	16 07	16 55	17.81	17.45	17.65
June	15.87	16.05	16 88	18.21	17 53	17.76
July	15.89	16.15	16.97	19.26	17.37	17.92
August	15.98	16.26	16.92	18.11	17.40	17.92
September	15.99	16.31	16.74	18.25	17.32	18.24
October	16.05	16.34	16.74	17.95	17.12	18.69
November	16.26	16.26	16.75	17.49	17.31	18.65
December	16.17	16.40	16.69	16.71	17.49	18.88
Average	15.92	16.16	16.69	17.83	17.20	17.94

THE HISTORY OF THE RELATIVE VALUES OF GOLD AND SILVER.

THE topic is one of peculiar interest, because of the general use of these two metals as standards of value in the exchange of commodities. Neither of them is suitable to be, for the political economist, a real standard of value. That standard is rather to be sought in some more universal product of labor, such as wheat—the relation of which to the rate of wages is said, on high authority,[2] to have been substantially unaltered through centuries, one bushel of wheat representing one day's labor. But the most convenient measure of exchange has been furnished by the precious metals, and hence these have been employed as standards of value. Unfortunately the use of both of them as standards has involved a new element of complexity—the fluctuation in the relative value. It is this element, which I wish to trace here, quite independently of the general relation between money and labor and other commodities. Not the purchasing power of the precious metals measured in terms of wages or supplies, but the purchasing power of each of them measured in terms of the other, is the question to be considered; and the use of these metals as currency gives to the inquiry more

[1] "Report of the Director of the United States Mint, 1876," p. 47. No other authority has been found for the ratios given for the years 1830, 1831, and 1832.

[2] I owe the suggestion to a conversation with Mr. Abram S. Hewitt.

than a merely speculative interest. For the attempt to maintain a double standard involves the perpetual readjustment of the relation by law, and the alteration of coinage accordingly. Hence the civilized nations have gradually come, with few exceptions, to the adoption of gold as the standard, and the employment of silver as the material for subsidiary or token coinage. The illustration of this principle is scarcely required; yet a simple statement may not be out of place. If the law says that I may offer in all payments requiring dollars, either gold dollars or silver dollars, as I choose, then both coins are legal tender, and there is a double standard. At the same time the law must have fixed, for the protection of my creditors, the exact amount of fine gold in the gold dollar and of fine silver in the silver dollar; in other words it must fix, for the purpose of coinage, the relative value of these metals. Now so long as this is also the market value, or nearly so, it is a matter of indifference to me whether I give and take silver or gold. But there may be a change in the market value. For instance, a great deal of silver may be wanted by manufacturers, or for shipment in commerce to countries like India, where gold is not available for the purpose; and the parties desiring silver may be willing to pay more than a gold dollar for the silver dollar, in order that they may melt or export the latter. In that case I would prefer, of course, to sell my silver dollar, pay to my creditor the gold dollar, and keep the surplus. Everybody feeling the same impulse the silver coinage disappears, and is melted or exported. If the silver coins smaller than a dollar are also of the same fineness and relative value, this disappearance of silver causes great inconvenience, because people can no longer "make change;" and the natural result is the general use of tokens, dinner tickets, shinplasters, etc., a fractional currency, in short, which is not legal tender at all, and which, when it proceeds from individuals or private corporations, has but a local circulation. Recognizing this evil all governments provide for a regular token currency for small units of money, which shall be legal tender for small amounts only; but is redeemable by the mints in larger amounts. There is not a cent's worth of nickel or copper in the cent, or a dime's worth of paper in the ten-cent note of postal currency. The same principle is extended to the smaller silver coins of most nations, and constitutes, in fact, a recognition of the law of political economy that there should be but one standard of value in coinage. What is universally done with regard to small coins should be done for all silver coins. They should be subsidiary or token coins, legal tender only in small amounts, and redeemable in gold at the mint.

But whether the token coinage is confined to the smallest denominations or includes all silver coinage, the question remains, How shall it be maintained? How shall its value be fixed? In this country, we have seen how the copper cent disappeared, because the price of copper rose until a hundred copper cents could be sold in the market for more than a dollar. The same fate will inevitably overtake any coinage which is undervalued by law. Hence, to prevent the evils resulting from this source, it is necessary to fix upon the subsidiary coinage a value which shall be permanently in excess of its market value as metal. Yet, on the other hand, it is, for reasons which I will not fully discuss here, not advisible to debase a silver coinage or reduce its weight so far as to ignore entirely its real value. This may be done with the smallest coins; but it should not be done, for instance, with dollars and half dollars. A very important reason for this is the increased temptation and facility thus afforded to counterfeiting. The imitation of a die is not a difficult matter; and the security of the public against counterfeit coins is not so much in the design upon the coin, the workmanship of which may be, when genuiue, much defaced by wear, as in the easily ascertainable weight and fineness of the metal, and in the fact that it would not pay individuals to manufacture coins of the same weight and composition. For any coin of higher denomination than five cents, a considerable overvaluation would lead to extensive and dangerous counterfeiting by the use of the genuine metallic alloy, or one nearly approaching to it in fineness.

We have then our two limits for the legal valuation of coins; and the problem is to get as near as possible to the relative market value of gold and silver, and yet keep always on the safe side, which is, as we have seen, the side of the overvaluation of the silver or subsidiary coinage. These considerations render the history of the relative values of gold and silver an important study.

I am indebted, in the investigation of this subject, to various financial and economical authorities, including the Parliamentary Blue Books and Reports, from the days of Sir Isaac Newton, and Congressional documents, from the famous report of John Quincy Adams down to our own day. With these preliminary remarks, I present several tables, and remarks upon them, illustrating the history of the relative value of gold and silver.

ANCIENT PERIOD.

Date B. C.	*Ratio.*	*Authority.*	
1600	13.33	Inscriptions at Karnak, Tribute lists of Thutmosis (Brandis).	
708	13.33	Cuneiform inscriptions on plates found in foundation of Khorsobad.	
.	13,33	Ancient Persian coins Gold Darics at 8.3 grams =20 silver siglos, a 5.5 grams.	
440	13.	Herodotus'account of Indian tributes, 360 gold talents =4680 silver.	
400	13.33	Standard in Asia, according to Xenophon.	
400	12.	Standard in Greece according to Hipparchus," an alleged essay by Plato	
404	12.	Values in Greece, from the Peloponnesian war to the time of Alexander, according to hints in Greek writers. There were variations under special contracts. Unit, the silver drachma.	
to	13.		
336	13.33		
338–326	11.50	Special contracts in Greece.	
323–43	12.50	Standard in Egypt, under the Ptolemies.	
218	17.14	Rate at Rome, fixed for coinage of gold scruples. Violent and temporary	
100	11.91	General rate of gold pound to silver sesterces at Rome to date.	
100	8.00	About this time, sudden influx of gold from Aquileja, temporarily reducing the relative value of the metal.	
58–49	8.93	Great sums of gold brought by Cæsar from Gaul.	
29	12 00	Normal rate in the last days of the Republic.	
A. D.			
1–37	11.97	Rate under Augustus and Tiberius.	During the reigns of these emperors, however, the silver coinage was debased Hence the value of the precious metals, pure, was 1:11, and less.
37–41	12 17	Rate under Caligula.	
54–68	11.80	Rate under Nero.	
69–79	11.54	Rate under Vespasian.	
81–96	11 30	Rate under Domitian.	
138–161	11.98	Rate under Antoninus	
312–	14.40	Rate according tc coinage of Constantine and his successors. Temporary (?)	

NOTE.—In all these tables the figures in the second column show how many times as valuable as a given weight of fine silver would be an equal weight of fine gold.

REMARKS.—It appears from a study of this table that the ancient and long-established relation between silver and gold in the Orient was 1: 13.33. The stability of this relation must be referred probably to the limited nature of commerce, and its control by the sovereigns. Gold, by reason of its specific gravity, and non-liability to oxidation is found, as silver is not, in alluvial deposits; and would naturally be first brought into use among barbarous nations. But the production of silver by rude metallurgical processes (requiring much lower temperature than the metallurgy of iron) would not be a difficult discovery: and we find that at a very early period this metal also was in general use. The greater scarcity of gold and its superior qualities, especially at a time when the chief uses of both metals were for jewelry and ornament, naturally established for it a higher value; and in the absence of sudden demands or fluctuations in supply, such as active industry and free commerce would produce, the relative value of the two metals might remain, for the purposes of trade or tribute, where it was once fixed by arbitrary authority. We see, however, that in Greece, Egypt and Italy, the value referred to did not vary, as a rule, very far from the ancient ratio; and this may justify us in supposing that the relation of 1: 12 or 1: 13 approximately represented the cost of producing silver, as compared with gold. The variations from this ratio, notes, in the table, are generally due either to the sudden influx of gold from new quarters, or to the arbitrary action of governments for purposes of profit in coinage. In those days the laws of political economy were not so well understood as now; and, indeed, until a very recent period, tampering with coinage has been a favorite method of replenishing the treasury of the sovereign.

The Middle Ages.

Date.	*Ratio.*	*Authority.*
A. D.		
864	12	Probable ratio, as shown by the *Edictum Pistense*, under the Carlovingian dynasty.
1104—1494	9–12	Variable and apparently arbitary British mint-edicts.
1260	10.5	Average ratio in the commercial cities of Italy.
1351	12.3	Ratio in North Germany, as shown by very accurate rules of the Lübeck mint, corroborated in the main by the accounts of the Teutonic Order of Knights, averaged in periods of forty years.
1375	12.4	
1403	12.8	
1411	12.0	
1451	11.7	
1463	11.6	
1455—1494	10.5	Ratio according to the accounts of the Teutonic Order of Knights.
1469—1508	9.2	
1497	10.7	Ratio established by Isabella, in Spain. (Edict of Medina.)
1500	10.5	Ratio in Germany, according to Adam Riese's Arithmetic.

Remarks.—The data on which this table is cons+ructed are not all of equal authority. Particularly in England, there appears to have been a considerable undervaluation of gold for purposes of coinage. This would tend to keep the silver coinage at home, and to repay to the government the cost of obtainining silver for that purpose. But it is not necessary here to discuss the special meaning of the British figures. It is safe to say that, down to the fifteenth century, the general market ratio of silver to gold was not far from 1 : 12. The serious variation shown in the thirteenth century, when, according to Italian economists, the average ratio in Milan, Florence, Lucca, Rome, and Naples, was as low as 1 : 10.5, indicates a much greater supply of gold in that region, at that time, than was available in the more warlike and less commercial parts of Europe. Indeed, at the period referred to, these Italian cities were notably prosperous in trade and manufactures; and we may well believe that gold flowed in abundance to them, as to points where it could be safely and profitably invested. There is no doubt, however, that during the fifteenth century the relative value of gold declined from about 12 to the neighborhood of 10, probably by reason of the scanty supply of silver, and the growing demand for that metal in manufactures (especially by the silversmiths) and in Oriental commerce. The ancient source of silver in Thessaly and Spain had been to a great extent exhausted; the New World had not begun to yield its argent treasure; and the mines of Saxony and Bohemia had not reached their maximum productiveness. It will be seen in the following period, as at others in this history, that the development of new fields and new methods of industry checked the tendency created by the currents of commerce and restored the balance of value so seriously disturbed.

From the Discovery of America to the Opening of the Mines in California and Australia.

Date.	*Ratio.*	*Authority.*
A. D.		
1526	11.30	Apparent relation of market value, as deduced from the British mint regulations, some absurd and unsuccessful experiments in coinage being disregarded.
1543	11.10	
1561	11.70	French mint regulations.
1575	11.68	
1551	11.17	German Imperial mint regulations.
1559	11.44	
1604	12.10	British mint regulations—experiments disregarded.
1612	13.30	
1619	13.35	
1623	11.74	Upper German regulations.
1640	13.51	French mint regulations.
1665	15.10	
1667	14.15	Upper German regulations.
1669	15.11	
1670	14.50	British regulations.
1679	15.00	French regulations.
1680	15.40	
1687—1700	14.97	Ratios calculated from the bi-weekly quotations of the Hamburg prices current, giving the value of the gold ducats of Holland in silver thalers, down to 1771, and, after that, in fine silver bars. The nominal par of exchange during this period was 1 : 14.80; and the quotations show the variations of the market rate in percentage above or below this. At par, 6 silver marks banco were equivalent to one ducat—68$\frac{32}{47}$ ducats containing one mark (weight) of fine gold, and 23$\frac{3}{4}$ silver marks banco containing one mark (weight) of fine silver. Hence, $6 \times 68\frac{32}{47} \div 27\frac{3}{4} = 14.80$, the par ratio.
1701—1720	15.21	
1721—1740	15.08	
1741—1790	14.74	
1791—1800	15.42	
1801—1810	15.61	
1811—1820	15.51	
1821—1830	15.80	
1831—1840	15.67	
1841—1850	15.83	

Remarks.—The first part of this table, like those which precede it, is compiled from imperfect data, in the absence of such direct evidence of ruling market values as is furnished from 1687 to 1840 by the Hamburg quotations, the appearance of which is a significant indication of the extension of commerce and manufactures. All conclusions drawn from the mint regulations of countries maintaining a double standard are affected with a double uncertainty. In the first place, the frequent practice of enforcing, for reasons of state, arbitrary relations of value in coinage may mask the real market ratio; and, in the second place, the lack of free commerce and swift intercommunication among the nations may retard the evils resulting from such arbitrary action, and postpone the necessity of legislative remedy. Hence the change, as shown by the mint regulations, may apparently occur some time after the real change in the relative value of the metals. Certain wild experiments with the coinage, particularly in England, have been omitted from the table, as having no real connection with the actual relative value. But if we do not scan the dates too closely, nor lay too much significance upon the maintenance of a certain rate in one country after it had been abandoned in another, the figures above given, down to 1680, may furnish us an instructive picture of the effect of the discovery, conquest, and plunder of South America upon the commercial relations of Europe.

The earliest effect of this discovery was the shipment of gold to Spain during the first quarter of the sixteenth century. At the beginning of that century, as shown in Table II, the ratio of silver to gold was about 1 : 10.7, or 1 : 10.5. The average annual influx of gold to Spain, down to 1527, probably did not exceed $400,000. But this supply, though it seems small to us now, would doubtless have depressed still further the value of gold, but for the remarkable productiveness of the Bohemian and Saxon silver mines. The joint result of both causes was a notable increase of the amount of precious metals in circulation, and hence a rise in general prices, with which we have here nothing to do. The effect on the ratio between gold and silver was a gradual increase in the value of gold. About 1550, the annual supply of gold may be roughly estimated to have been $400,000, and that of silver $2,600,000. By 1600, the production had become about $1,200,000 gold and $10,000,000 silver; in 1650, about $2,300,000 gold and $15,000,000 silver. This increase in the supply of gold is largely due to the development of the Guinea Coast, and the productiveness of the Hungarian gold mines. The increase in the supply of silver is due to the introduction of amalgamation, and its use, principally in the form of the patio process, for the cheap production of silver in Peru and Mexico. It is scarcely necessary to point out that the relative value of the two metals is not in the simple inverse ratio of their supply. The question of cost of production and of superiority in qualities adapting them for different purposes of currency, exportation, ornament, and manufacture, must always play an important part; and, even after all these elements have been calculated, it would be difficult to fix or foretell the relative price of the metals, since the local, temporary, and fluctuating demands, and so-called "movements of specie," come in as disturbing phenomena of that incalculable element, the human will.

Thus we find that in the latter half of the sixteenth, and the first half of the seventeenth, century the production of silver was about seven times as great as that of gold. The drain of silver to the East Indies had already begun, and a large part of the product of South America found its way thither, returning in varied forms of wealth and luxury to enrich and enervate the Mediterranean nations. Yet the remainder of the silver product was great enough to cause an increasing surplus of that metal, and a consequent fall in its relative price. It was, moreover, in many countries a period of war, and the large expenditure incurred led to a general increase in the gold coinage. The sudden and violent changes shown by some of the continental mint regulations are indicative rather of financial and legislative necessities than of commercial changes. The English regulations seem to have been, on the whole, more stable, and represent probably with greater accuracy the steady enhancement of gold, the value of which, as compared with silver, advanced during the seventeenth century about 30 per cent., and during the sixteenth and seventeenth centuries together, about 45 per cent. A general tendency in the same direction is visible in the eighteenth century; but here there is much greater stability, and the rise of gold is frequently checked.

Aided by the exact data drawn from the Hamburg quotations, we can trace the causes of fluctuation more accurately than in former years. I repeat that we are not here concerned with the general rise in prices produced by the greater volume of metallic currency, and the multiplication of its efficiency through banking and credit. Our object is to study simply the agencies at work upon the relative value of the metals, and we find in this period, as in former ones, counteracting causes with a general resultant effect. The influx of silver from South America to Europe was continued and increased down to the beginning of the nineteenth century; but the export to Asia of piastres, coined from American silver, assumed colossal proportions, averaging, as Prof. Soetbeer estimates, from 1690 to 1800, about $6,000,000 annually. Moreover, there was a considerable importation of gold from Asia, in return, to Spain and England. In China and Japan, according to the celebrated report of Sir Isaac Newton, Master of the British Mint in 1717, the pound of fine gold was worth but nine to ten pounds of fine silver, while the ratio in Europe was about 1 : 15. A merchant buying his goods in India with silver, and selling them in Europe for silver or for gold, with which he purchased silver again for a new venture, would gain 50 per cent. in exchange alone, besides the fair profit of the trade; and, of course, it would be worth while for him, after completing in the East his cargo of bulkier products, to lay out the remainder of his cash capital in the purchase of gold, which could be easily stowed and transported. This explains why, in the piracy and naval warfare of those times, the East Indiamen, going or coming, were considered so desirable as prizes. In either case, they were tolerably certain to carry rich booty of silver or of gold.

But besides the exports of silver to India, and the imports of gold from India, there was, for a short period, a notable influx of gold from America, principally from New Granada and Brazil. The Brazilian supply was greatest from 1749 to 1761, and at that period occurred the unusual phenomenon of a rise of more than 4 per cent. in the relative value of silver, due to this cause. From 1701 to 1748 the average ratio was 1 : 15.19; from 1751 to 1755 it was but 1 : 14.53. This reaction, on the other hand, was checked by the demand for gold in the United Kingdom for the purpose of coinage, and for the payment of heavy war subsidies to the continental nation during the struggle with Napoleon. The Bank of England, it is true, suspended specie payments from 1797 to 1819, and during this period the circulation of gold in Great Britain was reduced, but the subsidies and hoarding kept up its price, and the resumption of specie payments caused a sharp rise, so that the average ratio for 1821 was 1 : 15.95. The contemporaneous falling off in the supply from America, Africa, and India, would doubtless have carried this movement still further, but for the unexpected development of a new source of production in Siberia and the Ural. In the absence of the political and commercial causes already enumerated as operating to enhance gold, this sudden influx of it would have mightily diminished its price. In fact, however, the ratio of value was not essentially changed, though the proportion of production was for the time being revolutionized. At the end of the eighteenth century, the whole annual product was estimated at about $15,000,000 gold and $40,000,000 silver. In 1846, on the other hand, by reason of the supply from Russia, the gold product was estimated at about $43,000,000 while the silver had not increased—had, in fact, slightly fallen off. At the beginning of the nineteenth century, in other words, the production of the precious metals was about 27.8 per cent. gold, and 72.2 per cent. silver. By 1846 it had become about 52.3 per cent. of gold to 47.7 of silver. Yet the relations of value had not greatly changed. The average of 1846 shows a ratio of 1 : 15.66. From 1851 to the present time the relative values are calculated from the London quotations, as explained fully below. To this table I invite attention, as the ratio of modern times and its economic effect is something we can more readily appreciate than in foregone centuries.

From 1851 to 1874 Inclusive.

Date	*Ratio.*	*Authority.*
1851	15.46	The London quotations. These give the price of a given weight of standard silver in shillings and pence sterling. Bearing in mind that there is in Great Britain no charge for coinage, and, hence, that the price referred to varies exactly as the market value of the metals, we can calculate ratio as follows: The standard gold is $\frac{11}{12}$ fine, and its value is fixed at 77*s.* 10½*d.*, or 934.5 pence per ounce Troy. Hence the value of an ounce of fine gold is $\frac{12}{11}$ of this sum, or 1019.45 pence. The standard silver on the other hand, is $\frac{37}{40}$ fine; hence an ounce of fine silver is worth 1.081 times as much as an ounce of standard silver. If the fixed value of an ounce of fine gold be divided by 1.081 times the quoted price of an ounce of standard silver, the quotient is the ratio desired; Thus, if x be the quoted price per ounce in pence, $\frac{1019.45}{1.081}=\frac{943}{x}$ (very nearly) is the ratio, Briefly, dividing 943 by the price in pence of an ounce of standard silver gives the ratio correctly to the second decimal place. London being the acknowledged centre of the commercial world, this ratio determines the relative value of the metals among civilized nations. The table shows annual averages only. The lowest *monthly* value of gold was 15.12 in May, 1859, and the highest, 16.35, in Oct., 1874. The annual average for 1874, here given is calculated upon the prices of eleven months, ending Nov. 30.
1852	15.57	
1853	15.33	
1854	15.33	
1855	15.36	
1856	15.33	
1857	15.27	
1858	15.36	
1859	15.21	
1860	15.30	
1861	15.47	
1862	15.36	
1863	15.38	
1864	15.40	
1865	15.33	
1866	15.44	
1867	15.57	
1868	15.60	
1869	15.60	
1870	15.60	
1871	15.59	
1872	15.63	
1873	15.90	
1874	15.15	

Remarks.—The discovery of gold in California in 1847, and in Australia in 1851, threw an unexampled quantity of this metal into circulation. While the annual product at the beginning of the century had been only about $15,000,000, and in 1846 had been swelled by the Russian placers to the then astonishing amount of $43,000,000, it had reached in 1853, according to Prof. Soetbeer, a value of more than $165,000,000, while the annual silver product was scarcely more than $40,000,000. This enormous disproportion, coupled with the continuance of vast shipments of silver to India, naturally caused many economists to anticipate a serious and permanent depreciation of gold. It appears from the table that this did not take place in such a degree as expected—and for two reasons. First, the supply of the precious metals, particularly silver, on hand in Europe was so great that even the immense production of the gold mines in California and Australia could not immediately cause an overwhelming revulsion. General prices, of course, advanced; but that is not the point now in question. Chevalier estimates that the gold production from 1500 to 1847, inclusive, had been nearly $3,000,000,000, of which (according to other authorities) something less than $2,000,000,000 had come from Spanish America, which had furnished in the same period about $5,000,000,000 in silver. Of the latter, perhaps $1,000,000,000 had been exported to India; but the stock of both metals still remaining in Europe was large; and the introduction of silver-plated wares liberated much silver which had been kept in the form of solid ware. But this would not long have sufficed to retard the fall of gold but for another cause—namely, the enormous coinage of gold in the countries employing the French system. Before discussing this important element, it is well to point out that the gold production of California and Victoria suffered a diminution, through the exhaustion of the richest superficial placers, say about 1860, which was but partially compensated by the new discoveries in New Zealand, Idaho, Montana, etc. Moreover, after 1866 the shipments of silver to India notably declined; and finally, the production of silver from Nevada and other Territories advanced to colossal proportions. It was in the period preceding these changes that the French coinage system exercised its restraining influence against the depreciation of gold. By the French law of 1803, the franc was fixed at five grammes of standard silver, 9-10 fine, and it was provided that the kilogramme of standard gold, of the same fineness, should be coined into 155 twenty-franc pieces. In other words, the relative value of the metals was established by law as 1 : 15.5. By the payment of a small coinage-charge, any one could obtain at Paris coin of either metal in exchange for fine bars of the same. Now, by reference to Table III above, it will be seen that the ratio between gold and silver in the market (which had been up to the beginning of the nineteenth century always less than 15.5) ranged steadily, during the first half of the century, above that point. Hence, there was no inducement to coin gold. The gold coins themselves commanded a premium for melting. From 1825 to 1848, inclusive; the French coinage was only 268,000,000 francs in gold, against 2,380,000,000 francs in silver. The law of 1803 had been passed at an unlucky period, and its effect for nearly fifty years was to drive gold from circulation and flood Western Europe with a redundant silver currency. But it undoubtedly operated, during that period, to check the depreciation of silver by employing an excess of it as currency, and by diminishing the similar employment of gold, and thus increasing the available supply of that metal for other uses.

The reaction caused by the influx of American and Australian gold was immediate. So soon as fine gold was enough cheaper in the market than 3444$\frac{4}{9}$ francs per kilogramme to make it profitable to holders of it to take coin for it at that rate. The amount of gold presented for coinage in France was immense. From 1851 to 1867 there were coined in that country more than 5,806,000,000 francs gold against 383,000,000 francs silver; and the silver coinage rapidly disappeared. Of $800,000,000 silver shipped to India in the period just named, probably more than half was melted down from the coinage of the franc-using countries—France, Italy, Belgium and Switzerland. Thus the new supplies of gold found a new application, and the Eastern demand for silver found a partial supply: so that the value of gold was kept at 15.09 to 15.21, in spite of the excessive influx of it, which would otherwise have caused it to sink much lower. The practical abolition of the double standard by the United States in 1853, and the increased gold coinage of Great Britain and her colonies, were subordinate causes assisting this tendency. But the French system, serving for a while as a breakwater against the natural effects of great commercial facts, was itself swept away by the tide. The disappearance of a silver coinage is more inconvenient to the masses than the lack of gold. The lack of silver for currency brought about the famous Convention of December, 1865, at which France, Italy, Belgium and Switzerland united in the attempt to regulate again the relative values of the metals in coinage. But for the obstinacy of France, the cumbrous and fluctuating system of a double standard would have been given up. What was done was to diminish the value of the silver coinage, or, rather to establish a coinage of pieces from a half-franc to two francs, which being legally as coins worth more than they were worth actually, could not be remelted or exported with profit. It was a pity that even a measure of this kind was carried out in the most unfortunate way. By changing at that time the weight of the gold instead of the silver coinage, the franc-countries might have obtained a system in which the weights of coins would have borne a direct relation to the metric system; and, if the double standard had been definitely abolished, and gold adopted as the sole standard, a foundation would have been laid for that international system which still appears an unattainable blessing—a system, namely, by which the different nations, each coining its own money, might maintain a certain uniform fineness in gold coinage, and accept as legal tender all gold coins according to their weight in metric units. The gramme of standard gold would then be the international unit of money, with which all coins would gradually be brought into simple integral relations.

But the Convention of 1865 chose a different course, and it had hardly taken the step of debasing the silver coinage, to counteract the effects of the enhancement of silver, when a revolution took place, and a depreciation of silver was inaugurated, which has continued to the present time. The causes of this change, some of which have been already alluded to, deserve closer attention. The exports of silver to India, down to 1856, were to pay for products of the East, exported to Europe and America. During our civil war, the extraordinary production of cotton in India increased this balance of trade, and thus augmented the drain of silver in that direction. Moreover, between 1856 and 1866, large sums of silver went to India as loans, to be employed in the construction of an extensive railway system. These special causes ceased after 1866, and the payment of the interest on the Indian loans is now, so far as it goes, an element on the other side of the balance of exchange. The demand of silver in India is, however, by no means extinct; and one effect of the increased development of internal trade and industry in that region will be to maintain this demand. Prof. Soetbeer, in proof of the intimate relation between the rate of Indian exchange and the ratio of silver to gold in London, calculates the following five-year averages from the London prices, and the Calcutta quotations for 6-month drafts:

Average of Period.	*Drafts on London in Calcutta.*	*Price of the ounce standard silver in London.*	*Ratio of gold to silver.*
	Pence per rupee.	Pence.	
1856–60	25¼	61½	15.33
1861–65	25	61¼	15.40
1866–70	23½	60½	15.59
1873	23	59¼	15 91

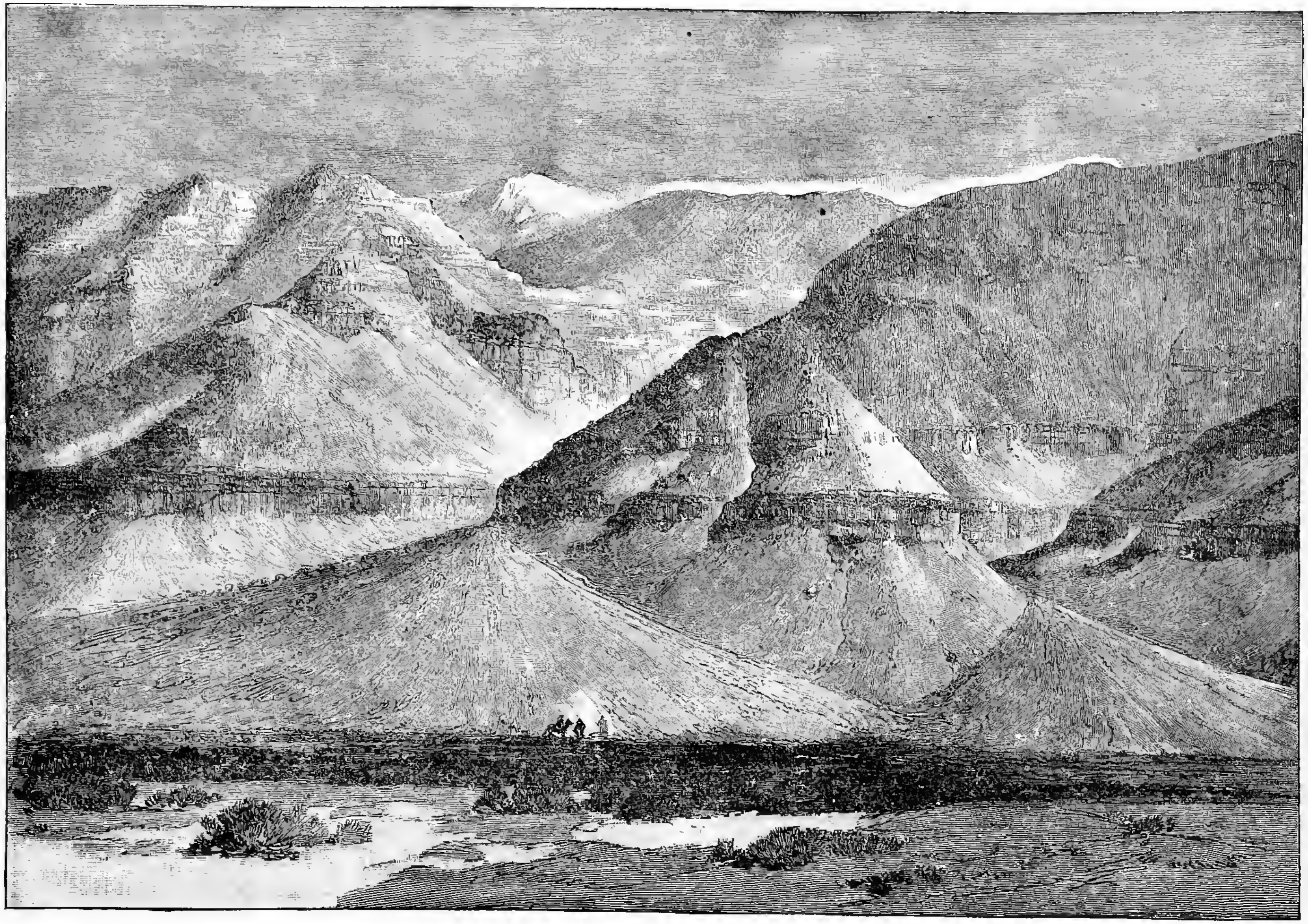
The second great cause of depreciation of silver was the colossal production from the United States. The product of this country, as I have shown, was in 1861 but $2,000,000. From 1862 to 1866, inclusive, it was $45,000,000, or an average of $9,000,000 per annum. In 1867, it was $13,500,000; in 1868, $12,000,000; in 1869, $13,000,000; in 1870, $16,000,000; in 1871, $22,000,000; in 1872, $25,750,000; in 1873, $36,500,000. The declared importations into Great Britain were:

1870, ...	£3,387,000
1871, ...	5,689,000
1872, ...	4,575,000
1873, ...	5,992,000

The great *bonanzas* discovered in the Comstock lode of Nevada have been the chief cause of the latest increase; but the extraordinary and rapid development of the silver-lead smelting industry in Nevada (Eureka) and Utah has also been an important factor. A third cause of the depreciation of silver was the abandonment by Germany, after the Franco-German war, of the silver standard, and the issue of a standard gold coinage for the Empire. Prof. Soetbeer estimates that in November, 1874, there was still in circulation in the different German States about $230,000,000 in silver coin, less than half of which would probably remain in circulation after recoinage—the remainder being thrown upon the market for exportation. The effect of the change is twofold—the liberation of silver from circulation as coin, and the increased demand for gold. The amount of Imperial gold coinage resolved upon in 1871 was 400,000,000 thalers (about $290,000,000), of which 362,000,000, had been coined up to November, 1874. It was evident, however, that at least 500,000,000 thalers would be required; and this would tend to continue the special demand for gold.

The countries of the franc-system, with double standard, have, however, again furnished a check to the prevailing tendency which has, doubtless, greatly modified the fall in silver. In these countries, the ratio being fixed at 15.50 by law, it has been, since 1866, profitable to have silver coined. In 1872, the coinage of silver in the Netherlands was 33,540,945 florins; in 1872 and 1873, all the states of the franc-system coined some 200,000,000 francs in silver. But this could not continue, and in 1874 a limit was provisionally set to the coinage of five-franc pieces. The depreciation of silver may be retarded, if the coinage of it as a legal tender currency, at a rate above its market value, is continued. But this policy, whatever its immediate conveniences, is contrary to the true principles and tendencies of political economy. The demonetization of silver, and the universal adoption of gold as a standard currency, with silver as a material of subsidiary-coinage, is that to which all nations must come. The ratio of 15.5 is too near the average market ratio for the last century, to be safely adopted. But the ratio of 15, as proposed by Mr. Elliott and other American writers on this subject, and partly adopted in our coinage, is reasonably certain to remain permanently below the market ratio, and hence to serve satisfactorily in coinage, while it possesses practical value as an integer, simply related to the decimal system.

A review of the whole history shows us that the natural tendency has been, since industry and commerce were organized, towards a depreciation of silver; that this tendency has been periodically counteracted by three great causes:



WESTERN SCENERY—ALLUVIAL CONES, BONNEVILLE BASIN—UTAH.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

the successive discovery of new gold fields (Africa, Brazil, the Ural, California, Australia, New Zealand, Idaho, Montana, etc.); the exportation of silver to the East; and its elastic employment for coinage. It is highly improbable that new Californias will be opened, though the present production from quartz and hydraulic mines, in this country at least, is likely to be maintained and even increased; the demand for India will not be augmented, but by growing reciprocity of commerce, probably decreased, though slowly; and the use of silver in coinage will probably also remain stationary or decline. On the other hand, the production of silver will probably increase—though the enormous reinforcements from this or that great *bonanza* will be temporary in their effects. Looking at the subject on a larger scale, it is not this or that single mine, but the vast era of silver-bearing territory in this country and Mexico which may be expected to develop and maintain an increased production. What may be the metallic treasures of Asia, we scarcely know as yet; but their exploration will, at all events for many years to come, produce nothing that the vast population of that region will not immediately swallow up.

All general considerations, so far, seem to point to a permanent depreciation of silver. Not that the price of November, 1874—the lowest ever reached in history by the free action of commercial and industrial causes—will be maintained or further decreased; but that the ratio ruling a dozen years ago is not likely to be regained, and the low price of silver must be accepted by miners and metallurgists as a part of the economical problems submitted to them. When I say that the gross product of a silver mine to-day is worth in gold nine per cent. less than it would have been in 1859, you will see that this is a question intimately connected with profits and dividends. Indeed, the probable suspension of mining and metallurgical operations which cannot afford this loss will, perhaps, be one reaction tending to diminish the production, and thus check the depreciation of silver. In whatever way the general current flows, it is sure to be interrupted by such eddies, the results, indirectly, of its own motion.

—*Compiled from a paper by R. W. Raymond, Ph.D.—Transactions American Institute of Mining Engineers,* 1875.

COMMONPLACE FALLACIES CONCERNING MONEY.

FEW questions have been so frequently discussed by competent writers as that of money and currency; and, at the same time, there is no other subject on which opinions so diverge. As Mr. Bonamy Price, professor at the University of Oxford, states it, "It may almost be said that every man contradicts every other man about money, about what money is and what it is not, what it can and what it cannot do. In no other subject which occupies the thoughts of men does anything approaching the same disorder exist."[1] I hope, therefore, I shall not be accused of presumption if I endeavor to point out that many of the principles put forward by the deductive school of political economy, and accepted by the English public as being evident truths and clear axioms, are in reality demonstrable errors, and in total contradiction to facts and events of daily occurrence. I will examine some of these axioms as they have been formulated by writers of well-deserved authority, and who may be taken best to express the generally accepted ideas.

The point which I think first needs to be elucidated is the following:—Is there an advantage in a community's possessing more or less money, or, rather, more or less of what may be styled monetary metal? It is known that the upholders of "the mercantile system" believed the principal riches of a nation to consist in the amount of precious metal it possessed. Everything, they urge, must be therefore done to increase that amount; and, to that end, a favorable balance must be created by stimulating exportations, and also by impeding as much as possible the importation of merchandise, so as to force foreigners to pay the difference of the commercial balance in precious metal. These notions, however, were early contested in England. In the year 1682, Petty maintained that it was an advantage to export coin, when goods of a greater value were secured from foreign countries in exchange for it ("Quantulumcunque concerning Money"). Again, North, in 1691, says that a fortune in coin is no gain, as coin in itself is unproductive: therefore, no State should feel uneasy about its provisions of gold or silver. A rich country, he observes, will never lack either ("Discourse upon Trade," 11.17). Berkeley assumes that a greater error cannot exist than that of estimating the wealth of a State by the quantity of gold or silver in its possession ("Querist," 1735). If we turn to the father of the Physiocratic School, Quesney, he labors to prove that it is impossible exportation can ever permanently and absolutely exceed importation; for, he says, "*Every purchase is a sale, and every sale is a purchase*" ("Dialogues sur le Commerce"). Finally, Adam Smith, in his treatise, completely overthrew the mercantile doctrine, and molded into definite shape the ideas which have remained current from his day until the present time. But the case might even be put more strongly. J. B. Say considers the exportation of coin as still more advantageous than that of any other merchandise, for he alleges it is the value of coin which constitutes its utility, and the value of what coin remains in the country increases in proportion to the amount exported. I borrow from Mr. Bonamy Price a statement of the opinion prevailing at the present time on this subject. It is couched in the most definite terms, and may be summarized as briefly. Professor Price first lays down that coinage is indispensable amongst civilized nations. It serves as a means of exchange, and is the common measurement of values; but it is quite useless to accumulate more of it than is necessary for this end. Gold is merchandise, and is only to be obtained by the exchange of other merchandise of equal value in its stead. In this exchange, the person who receives the precious metal is no better off than the one who receives the commodities. It is therefore absurd to believe that a nation gains when what is called the "commercial balance" is in her favor; that is to say, when she has an excess of exportation, and foreign countries are obliged to pay her by a consignment of precious metals. Gold brings no advantage to the person possessing it, except at the moment when he parts with it, to purchase an object he can consume, or in some way enjoy.

Coin is a tool, a machine, a vehicle of interchange, like a ship or a wagon. It is a means, not an end; it transfers possessions and the right of property, just as a van transports bales. Who would think of accumulating wagons in his sheds solely for the satisfaction of feeling that he possessed them? Why, then, was so much joy exhibited on the arrival of bullion from California? It did not increase the wealth of England to the amount of one single pound sterling, for she paid for it all with her produce, value for value. Would agriculturists raise shouts of joy if it were announced to them that a whole cargo of plows had been imported? At a given moment a country requires a certain quantity of cash to accomplish exchanges, but all in excess of that quantity is useless, and is even burdensome; for gold, when remaining inactive, eats its own interest. It is a noticeable fact that the further a country has advanced economically, the less requirement it has for precious metals. No country has, in comparison to the importance of her business transactions, so little of it as England. Less civilized nations have, on the contrary, a large amount of gold and silver—firstly, because they treasure it up; and secondly, because a sale is never effected save for ready money. But can a country suffer through a lack of cash, diminishing its economic activity? By no means; it is not with cash as with other necessary instruments of production. If there were fewer plows some agricultural land would remain unplowed; harvests would diminish there, and the well-being of the country would be affected. Were there less cash there would be no diminution whatever in the production of commodities. Exchanges would be accomplished as before, either because credit would become more general, or because the gold remaining in the country would be enhanced in value, and would, therefore, serve to transfer the ownership of a greater quantity of goods. A fall in the value of any special merchandise—tea, for instance—increases the well-being of a community, for a larger amount of it is consumed. A fall in the value of cash, as a result of its superabundance, would be productive only of difficulties. The cheapness of precious

[1] "Practical Political Economy," p. 360.

metals would entail, as a necessary consequence, the being obliged to tender a heavier weight of them. Money would thus become very inconvenient to carry about, and bank notes and checks would be largely substituted in its place. When, after a bad harvest, gold is seen to emigrate abroad, people get alarmed; doing so quite unreasonably. This gold brings in exchange what supports our workmen and laborers. Far from seeing a calamity in this, we should rejoice at it as a benefit for the nation. It is supposed that a drain of gold would thus cause a scarceness and "depreciation" of the monetary metal, and that a fall in prices would ensue as a natural result. These are unjustified fears. The power and the value of gold are about equal in all civilized countries, and the fall in prices would soon bring back the gold, and in that way re-establish the former level in prices.

The language of our merchants, of our bankers, of our financial papers, is still tainted with mercantile error; they always speak, of "favorable and unfavorable balances," "favorable and unfavorable exchanges." One would almost say that Adam Smith had published in vain his book, "The Wealth of Nations." The exportation and importation of gold are watched by attentive and, frequently, by anxious eyes, as if it were the one riches, *par excellence.* If we export much iron or coal there are rejoicings. If we export much gold it is just the reverse: we find lamentations and fears expressed in every financial paper. Whence this difference of opinion? Is not gold just as much merchandise as iron or coal? Those who propagate these ridiculous ideas really deserve to be buried, as Midas was, beneath the gold for which they clamor so madly. There is no necessity for uneasiness concerning the circulation of gold; it will distribute itself in different countries, according to the needs and requirements of each. It is even true that the more a country imports gold, the poorer she becomes. For, says Mr. Price, "what becomes of it when brought in by an excess of exports? So long as they remain, let us say, in England, they are locked in the Bank of England's vaults; they are wealth annihilated for the time. Meanwhile, how has it fared with England in respect of the exports for which there is so much rejoicing. They consumed a vast amount of wealth in making; food and clothing for laborers were used up, and all is gone. What has England in return? Some metal locked up in cellars. As long as it remains in England she is the poorer for these exports. The wealth returns only when the buried gold goes abroad to buy, and when the imports will exceed the exports, and the country is made the richer. Imports alone enrich a country, not exports. To buy gold which cannot be used is as pure an impoverishment for the time as if the purchasing goods had been given away for nothing."[1] The above is a short statement of what Mr. Bonamy Price teaches us on the subject of currency, summarizing, as clearly as possible, the doctrine of the deductive school. Can a more complete contradiction be conceived than that existing between these doctrines of speculative political economy and the language of the writers of the money market articles in the daily and financial papers? In spite of the remonstrance of Mr. Bonamy Price, and of other economists, they follow with the greatest attention every movement of the precious metals. When they flow in excess toward foreign countries, cries of alarm are raised; when, on the other hand, they return, or come in first, they at once announce prosperous times It is sufficient to have read the columns of the *Economist*, the *Statist*, the *Bullionist*, or the financial report in the *Times*, or any other daily paper, during the last two months, to be struck by this strange contradiction.[2] Who is right, and who wrong? Economists are not wrong *in abstracto;* but one should also say that financial editors must be right, for they grasp economic life in its daily reality. Is it possible that merchants, bankers, and writers of the newspaper money-market articles should all be led astray by the sophism of "mercantilism," so as to understand nothing of the transactions occurring under their eyes? On the other hand, is it possible that the most eminent economists should be completely deceived on this subject? We can allow of neither hypothesis. The apparent contradiction arises from the fact that the problem has been regarded from different standpoints. It has been viewed in the "static" condition by economists, and in the "dynamic" aspects by capitalists and men of business, phenomena being looked upon at a given moment by the first as being at rest, in their development and as in movement by the second. Let us explain this: England, for instance, could easily effect all her exchanges with £80,000,000, or with £40,000,000 in gold, instead of the £120,000,000 she now employs; for, as J. B. Say remarks, the value of gold, as compared to that of merchandise, would increase as the quantity of the former diminished; or, in other words, the prices, calculated in money, would diminish as money became scarcer. If I have one shilling instead of two, it makes little difference to me if I can now purchase as much with my shilling as I could formerly with two. Double, triple, if you will, the amount of precious metal in a country, that country will be none the richer. The number of useful objects which constitute its real wealth will have remained the same, only two or three times as high a price in money will be put on each one. All these are evident facts, and hitherto the reasoning of the economists is perfectly sound; but as soon as we attempt to carry these abstract ideas into practice, they are completely contradicted by facts which are daily reported by the financial papers accused of "mercantilism." This is what we will next endeavor to show.

In the world of actual affairs all contracts, whether for a long or short date, the terms of loans made by banks, the rate of discount, in fact all business, are based on certain prices and on the availability of a certain amount of cash. If this amount of cash, or the prices which it determines either increases or diminishes, the basis of all business transactions becomes necessarily modified. This is the important fact that economists have neglected to examine in its consequences. What are these consequences? That is the question we must weigh with the greatest attention. Let us suppose, first, that gold increases in quantity; what happens? Here we are by no means reduced to speculative reasoning on a hypothesis. This phenomenon occurred and assumed colossal proportions under our own eyes subsequently to the year 1850. Compared with the year 1840, the production of gold increased tenfold after the discovery of the *placers* of California and Australia, and the production of gold and silver combined is fifteen times what it then was. The consequences of this unheard-of change, have been perfectly analyzed in the well-known work of Tooke and Newmarch, "History of Prices." When this extraordinary influx of precious metal reached Europe, Michel Chevalier raised a cry of alarm, which Cobden repeated, and which greatly impressed the different Governments. Prices, it was commonly said, would double, and this would lead to profound economic disturbance; gold should, therefore, be at once rejected, a silver standard being adopted. But Newmarch explained that this danger was not at all to be dreaded because the gold, in arriving, would stimulate fresh economic activity, and in thus making for itself greater employment, would prevent its own depreciation. What followed proved that Newmarch was right and Chevalier wrong. After some few years, prices rose a little, to the extent of about 15 per cent., according to Mr. Jevons. The rise, however, was of short duration, and a fall ensued, although the total produc-

[1] "Buying and Selling:" *Journal of the Society of Arts*, May 6, 1881.

[2] Here is an example of what can be read every day in all the financial papers of the world:—"In their last summary of the state of the New York money market, Messrs. Melville, Evans, & Co., mention 25 to 30 million dollars of gold as the probable import requirement of the State between August 1 last and January 1 next. This was the current estimate in New York a fortnight ago, and we think it not unlikely to prove an under estimate should the speculation fever break out to the degree anticipated. But five or six million sterling is a large enough sum to alarm us on this side in the present state of European bullion stores and gold requirements, for one million more withdrawn from the Bank of England would agitate our market, and cause rates to advance to at least 5 per cent.—no very serious rate for sound business, but a destructive one to much of the speculation now sustained here and on the Continent." —*Pall Mall Gazette*, Sep. 22, 1881.

Mr. Bonamy Price and all the orthodox economists tell us that the export of gold is not merely a matter of indifference, but is rather a benefit; and, on the other hand, the City says that the loss of only one million— a mere trifle, indeed— would agitate, and perhaps upset, the money market in all Europe. Can there be a more complete contradiction? Why should not political economy lose its credit, as a science, when its statements are in such open opposition to the most undeniable facts?

tion of gold and silver has maintained itself at about £38,-000,000. Thus the predictions of Michel Chevalier and of Cobden were not borne out by facts. The banker had made sounder deductions than the economists. From the beginning, the prodigious development of the gold-producing countries, California and Australia, brought fresh stimulus to the industry and commerce of the whole world. These new countries did not send us the produce of their labor for nothing. For every million of gold received in Europe an equal quantity of goods was returned to them. These goods had to be made and transported, and thus fresh outlets for labor were created, This new opening for trade in the gold countries and the increased production in Europe which was needful to supply the wants arising—these occasioned more exchanges and therefore led to a more extensive employment of the precious ores, which are the metallic means of exchange and the basis of all fiduciary circulation. Gold arriving in Europe is deposited in banks where it finds its prices fixed by the mints, and so those sending it get immediate remuneration. This accumulation of cash of course leads to a fall in the rate of interest. After 1850, discount fell 1½, and even to 1 per cent. A fall in the rate of interest stimulates the spirit of enterprise and the creation of new companies of all kinds, both at home and abroad. The surplus money must find employment for itself somewhere. Besides, when capital can be obtained at the moderate rate of 2 or 3 per cent., a great many undertakings may prosper which would never do so where the rate of interest is 4 or 5 per cent. I will here borrow a very just comparison made by Mr. Bonamy Price, when he says that cash is a conveyance, but I draw it from a totally opposite conclusion.

When vehicles are plentiful they can be hired cheap, and, as a natural consequence, everybody uses them, and there is an extraordinay circulation. You see this at Naples, where the hire of a decent carriage is fivepence, and even tne beggar rolls in a *corricolo*, at a penny. So, too, when the monetary mediums of conveyance are abundant, they also are lent cheap. Circulation is active, and business is "brisk," as people say. Certainly the capital lent and borrowed is not in reality "money." Capital truly consists of all the materials requisite and necessary to production. Still, cash is the means of obtaining these materials. It is with gold that they are paid for, and it may be said to be gold which is necessary for every exchange. It follows therefore that, when gold is plentiful, the real capital is easily brought into action, and then production is developed.

The first effect of an influx of gold certainly is a fall in the rate of discount. But the phenomenon does not stop there. This fall promotes a movement of economic expansion until the demands for capital exceed the disposable quantity, and then the rate of discount rises. This was observable during the period of prosperity, from 1853 to 1870. The average rate of interest was high, in spite of the abundance of gold, because the prodigious development of production for which this period is noticeable caused an endless demand for capital. It was during this period that railways were largely made in all parts of the habitable globe; canals were opened, isthmuses cut, mountains pierced, and works, factories, and banks innumerable started. Mr. Newmarch only gives expression to general opinion when he says that the gold of the *placers* was the chief cause of this wondrous development. The second result of an exceptional influx of the precious metals is to produce an average rise in prices. Gold, which gives facility to the creation of fresh business enterprises, occasions a greater demand for everything. In works and factories, in railways, in all sorts of concerns undertaken on all hands, workmen, and iron, and wood, and every kind of raw material are wanted in greater numbers and in larger quantities than previously. The increase of demand produces necessarily a rise in value. This rise takes place gradually, and the result of it is to produce that state of the market which we call "brisk." All who are engaged in producing profit by this. Workmen, being more sought after, are better paid; they consume more in the way of fuel, food, &c., and thus raise the price of the articles of common necessity, which naturally brings benefit to those who produce or manufacture them. Manufacturers, making more profit, buy more, and the prices of the articles they want rise in their turn; and in this way profit flows in upon a second category of manufacturers and tradesmen. The buyers of raw materials for the purpose of their conversion into manufactured goods almost invariably gain by a general rise in prices; for this raw material, flax, cotton, wool, iron, is worth more when resold than when it was purchased. The economic and commercial world thus forms one immense chain of causes and effects in which the value of each link is heightened by the activity imparted to labor, the true source of all riches. It may even happen that an "industrial" fall occurs in the price of many articles, great enough to counterbalance in the increase "monetary value;" because, thanks to the multiplication of fresh enterprises and the introduction of fresh machinery, these commodities are produced at a much cheaper rate. These are the many favorable results which follow on an influx of the precious metals.

But, it will be said, these advantages are also attributed by inflationists to an abundant issue of paper money made legal tender. Doubtless this may be so; but the factitious excitement caused by the inflation is dearly bought, as it rests on no firm basis, and is brought about by an abuse of legislative power. It occasions a depreciation of the currency, the degradation of exchanges, and the permanent disturbance of foreign trade; and, sooner or later, large sacrifices have to be made in order to revert to the metallic circulation. It is quite otherwise when the impulse given to business springs from a natural source—viz., an increase in the amount of precious metal, the real basis of exchanges, and, at the same time, the true equivalent of every value. In this case, there is neither depreciation of currency nor disastrous reaction. All that could in any way occur would be a general rise in prices resulting from the large amount of cash suddenly thrown into circulation; but, as we explained, even this will probably not take place, for owing to the number of business transactions rapidly and permanently increased by the economic development which the abundance of cash will have stimulated, gold wild find further employment. The demand for it will increase in about the same proportion as the supply. The precious metals will lose nothing of their powers of purchase, and prices will not rise. This is exactly what has occurred since the year 1850. The average annual production of the precious metals during the decade 1840–1850 was 362,000,000 francs. From 1850 to the present time, the average production has tripled, having risen to from 900,000,000 to 1,000,000,000 francs annually; and, in spite of this, if prices have risen for a time a trifle, they have fallen again to about what they were formerly. Thus the extraordinary influx of precious metal which commenced 30 years ago, has been most beneficial in increasing economic activity all over the world, and this great advantage has been unaccompanied by drawbacks or difficulties. So long as I thus limit myself to stating only undeniable facts, I hope I shall not be thought guilty of either "mercantilism" or of "inflationism." I merely give a summary of Newmarch's chapters, [1] and he, I imagine, is not likely to be accused of any such heresies.

Let me now examine the opposite phenomena — the scarcity of cash—and try to ascertain its effects. The exportation of gold is a purely indifferent matter, says Mr. Bonamy Price, for exchanges are just as well effected with little as with much money.[2] Let us rather say, writes J. B. Say, that the exportation of gold is an advantage, for in exchange for gold, which is dead capital, useful goods are obtained, and the gold remaining in the country is rendered more serviceable; since, to pay for the same number of articles a less weight is given and received, according as the quantity has diminished, its value being increased. If these

[1] It is useful to read with attention the chapters devoted by Mr. Newmarch, in Tooke's "History of Prices," to the study of the effect produced by the gold of California and Australia during the period 1848–1856.

[2] At the close of his book, "Practical Political Economy," Mr. B. Price publishes, as an appendix his correspondence with Mr. Henry Gibbs, ex-Governor of the Bank of England, on the question as to whether the Bank, in fixing the rate of discouut, should, as a general rule, be guided by the amount of its reserve in gold. Of course, Mr. B. Price is strongly against this line of conduct, which is contrary to his theory. Mr. H. Gibbs replies that if the learned Oxford Professor were a "practical man" and a banker, he would understand the question better. How should not political economy lose its authority when it thus places itself in opposition to the most evident daily business necessities?

propositions (which, not long since, all the economists of the deductive school were fully prepared to vouch for), be exact, we must conclude that the entire business of the world, the Bank of England, merchants, bill brokers, speculators, and all the writers of financial articles in the newspapers, must be suffering under the strangest hallucinations. All these authorities affirm that the crisis which has so long depressed the money market, and which becomes just now more acute, was in great part brought about by a monetary contraction, and recently by the exportation of gold to America, and argue that it became more or less serious as gold left us in larger or smaller quantities for the opposite shores of the Atlantic. It is, of course, economists who are mistaken, they having made a superficial analysis, basing it solely on abstract ideas. The study of the phenomenon must be recommenced by paying special attention to facts as they really exist. Here, again, we have only to recollect what has recently taken place beneath our very eyes. When gold is to be exported it is taken from the banks of issue, because in their hands a large stock is always to be found ready at the command of all holders of bank notes or of all well guaranteed commercial drafts. Banks, being compelled to have sufficient cash in hand to guarantee the fiduciary circulation, raise the rate of discount. That is exactly what is now going on (September, 1881). In a general way a rise of 1 or 2 per cent. is sufficient to bring back the precious metal by diminishing the price of all commodities, shares, debentures, and stocks in State funds, and by raising the hire of money; but sometimes (and it has been noticed that this happens about every nine or ten years) the outflow of gold induces a sharp crisis. Mr. Jevons connects these periodical crises with the spots on the sun. I have endeavored, in a work especially on this subject, "Le Marché Monétaire depuis cinquante ans," to prove that they are brought about by the agency of three circumstances. 1st, the very general use of "instruments of credit," which in turn causes the immense mass of fiduciary circulation, notes, checks, promissory bills, and unpaid accounts, to rest on a very small metallic basis; 2d, the existence in the market of a great many term engagements, the result of the multiplication of fresh enterprises, of increased purchases of goods, and of the general speculation fever which invariably accompanies a period of expansion and prosperity; 3d, and finally, the still more decisive cause is to be found in the exportation of cash, necessitated either by the bad harvest, as in 1847, by foreign investments, as in 1825 and again in 1856, or by exceptional purchases of certain goods, as happened after the cotton famine in 1864. Indeed, whatever may be the minor causes which work toward a crisis, it is always determined by the exportation of cash, which induces either the shrinkage or else the complete collapse of credit, which follows on a sudden and too high a rise in discount. These exportations of cash are generally occasioned by some disturbance in the balance of trade. Mr. Bonamy Price and other economists make gentle fun of the balance of trade, and speak of it as an "exploded fallacy." Nevertheless the *Economist* and other special newspapers continue to write about it and to follow its course with the greatest care and attention. Here, again, business men are right. It is evident that the balance of trade can no longer be estimated, as it was formerly, by a mere calculation of exported and imported merchandise. The amount of money invested abroad, and the interest gained upon it, has now assumed immense proportions, and this, of course, modifies the balance, without the tables of the Custom House showing any record of it. The richest countries, England and France, for instance, are creditors of other countries for many millions sterling. The interest of these hundreds of millions, represented in goods, occasions imports to be made without any return exports. It follows, therefore, that rich countries import regularly much more than they export, and this without occasioning any disturbance in the balance of trade. Here are the figures for England:

	1877	1878	1879	1880
		In millions sterling.		
Imports	349·41	368·77	362·99	411·22
Exports	252·34	245·48	248·78	268·41
Imports exceeding exports by	97·07	123·29	114·21	142.81

This excess of imports naturally includes, besides the interest of money lodged in investments abroad, the immense sums for freights of merchandise, and for wares of all kinds which English vessels transport to all parts of the world, and also the profits of trade on the national and foreign produce that English merchants sell everywhere. The following is a calculation made on this subject by Mr. G. Medley. (See his work, "The Reciprocity Craze.")

Profits on Ocean Carrying Trade	£45,000000
Insurance	3,500,000
Interest on Capital in Foreign Trade	5,000,000
Merchants' Profits	17,500,000
Income from Foreign Investments	55,000,000
Total	£126,000,000

But if the state of things thus established, with an excess of imports for the creditor country, be troubled by the necessity of completing fresh foreign investments, or by an exceptional purchase of corn being needed after a bad harvest, the result will be an unusual exportation of cash, followed by a crisis more or less severe. These sharp crises have sometimes most disastrous consequences. All shares fall in the market; bankruptcies may be counted by thousands; workshops are closed; workmen find themselves without employment, and want and suffering become very great. It cannot be maintained, therefore, that even in such a case as this, the exportation of the precious metals is a matter of indifference. All that can be meant is that its advantageous effects are but transient, commerce and industry quickly again presenting their habitual aspect. Prices rise, and two or three years' practice of economy suffices to repair what losses may have been sustained. A fresh period of prosperity, of expansion and speculation soon commences, which generally terminates in another crisis. The effects of a slow and steady reduction of the stock of money are of a different character. They come into operation almost insensibly, being unaccompanied by any violent disturbance. Indeed, the cause of the evil is usually ignored, or else disputed. Instead of a burning fever it is a decline with which the social body is afflicted. A crisis of this description first occurred in the period 1816–40, and it has been repeated from 1873 to last year. Each was brought about by identically similar circumstances. They may be thus specified—1st, insufficiency of the production of the precious metals; 2d, exceptional demand for gold. Let us examine the facts. 1st, from 1816 to 1822, England, abandoning paper money, established the gold standard, and took from the general circulation of the world £20,000,000 sterling. This was an immense sum for that period, for it corresponded to ten times the then annual production;[1] 2d, the average annual production which was from 1801 to 1810, 259,000,000 francs, fell from 1811 to 1820 to 159,000,000 fr., sank still further to 151,000,000 fr. from 1821 to 1830, and amounted only to 202,000,000 fr. in the period from 1831 to 1840. After 1873 the United States, Germany, and the Scandinavian States, by adopting the gold standard, absorbed from 300,000,000 fr. to 400,000,000 fr. of gold. The production of both the precious metals taken together has not decreased; but silver, being no longer received in any mints, save for the currency in India, the monetary stock has had to be fed by gold alone, the production of which has diminished by one-third. The annual influx into circulation of the precious metal has thus fallen one-half—viz., from £40,000,000 to £20,000,000. Added to this, during these last three and a half years, America has taken from us £50.000,000 of gold. These three circumstances combined have produced subsequently to 1873, as they did also after 1816, a monetary contraction. It is that phenomenon, exactly the reverse of the expansion after 1858, which has been neglected by economists, and it is this which we must now study. This has not yet been systematically done, though striking references to it are to be found in different works, notably in Alison's "England in 1815 and in 1845; or a Sufficient and a Contracted Money;" D. Lubé, "Argument against one Gold Standard;"[2] "Report of the Monetary Commission of the

[1] Albert Gallatin, whose authority is frequently cited on these questions, wrote in 1829: "Not only has England by that experiment, in the face of the universal experience of mankind, gratuitously subjected herself to actual inconvenience, for the sake of adhering to an abstract principle, but, in so doing, she has departed more widely from known principles, and from those which regulate a sound metallic currency."

[2] The following are a few passages from these writings.—"Is

Senate of the United States, 1876;" Dana Horton, "Silver and Gold;" R. Giffin, "The Recent Fall in Prices," *Journal of Statist. Soc.*, March, 1879.

In the case of a slow monetary contraction crisis, the precious metals are not suddenly taken away from the banks in large quantities, as is the case in sharp crises; credit is not shaken, and monetary stock diminishes almost insensibly by the industrial consumption of the precious metals, since the stock, not being fed as usual, does not keep up to the level of the growth of the economic development. Then commences an almost imperceptible fall in prices, spreading from one article to another. The unfortunate consequences of this circumstance, left unnoticed by Mr. Bonamy Price and by other economists, are as follows: During the fall in prices merchants and tradesmen frequently lose, for they are often obliged to sell cheaper than they bought. Enterprises no longer bring in profit; on the contrary, they have often to be abandoned at a loss. Merchants, their hearts failing, relinquish part of their business, new undertakings of any kind become rare. Workmen, less and less sought after, see their wages lessened. They, in turn, consume less, and thus the manufacturers who provide for their wants have to reduce their productions. Merchants and tradesmen, making small or no profits, do not live so well, and here again the manufacturers who work for the middle classes also suffer. There is a general decrease in economic activity. Capital, sunk into inactivity, lies in the banks, and the rate of interest falls, the demand for advances being few and small. Cash does not appear to be lacking, and, indeed, is not wanting, for, as J. B. Say said, the quantity, if it is diminished absolutely or comparatively, is "appreciated." Each unit is worth more and effects more exchanges. Reduce as much as you will the monetary stock, it will always remain sufficient, for, as prices fall, in proportion its value rises, and it will always buy and pay for the same amount of goods. When the fall in prices is at an end, the period of suffering resulting from it finishes, and the economic world gradually regains its normal condition. Only the transition is often tedious and accompanied by many cruel trials, as we have had occasion to see during the last few years.

The question now is whether when exchanges are effected with less cash, and consequently on a lower scale of prices, will the situation be what it formerly was, as the economists who reason on abstract principles pretend? I venture to say, not at all. The pressure of previously contracted debts will have increased exactly in the same ratio as prices will have fallen. In fact, to obtain the same amount of money, more goods or more labor will have to be given, as these will be worth less. The nation in general, that is to say, taxpayers, mortgagees, public companies who have issued debentures, landed proprietors bound to pay fixed yearly incomes, pensions of one sort or another, all will be burdened and the bond holders alone will benefit. Some people will say, What does it matter? Some gain what others lose.

This was a mischievous mistake. It matters greatly, for production is sacrificed in favor of the fund holding class, or, as John Stuart Mill puts it, active capital is sacrificed for idle capital.[1] As already most European communities are taxed to the extreme limit, the consequence of any indirect increase of the burden which these loans lay upon them would inevitably be the misery of the populations, if they continued to pay, or general bankruptcy in the event of their refusing to do so. It opens up a vision of the world of Stock Exchange towering over the crushed ruins of the working world. Finally it may also happen that the two sorts of crisis, that which may be called the "anæmic" crisis, that is to say, the one which is due to a slow decrease of monetary stock, and the sharp crisis, due to the sudden and considerable outflow of gold, graft themselves so to speak one on the other, as they are doing at the present time. The exportation of metal to New York is impoverishing further our store of precious metal, and so is doubly disastrous. It retards the impetus of business which seemed to be springing again into life, and at the same time it keeps down prices which are already merely remunerative. We thus see to what extent the abstract ideas of the deductive school are contradicted by a simple statement of facts. But these economists ask, Is it then not true that produce is exchanged for produce? If that be so, gold is as much a produce as anything else. The merchant exporting it has obtained in exchange goods of a higher value, or he would not have consented to the transaction. Therefore, if the merchant has gained, it is not possible that his country loses. All these axioms, which seem so clear and evident on paper, are nevertheless daily contradicted by experience. In reality, Ist, a great deal depends on the nature of the objects exchanged; and, 2ndly, it is not true that the metal of which money is composed is a merchandise like any other. Some very simple example will serve to prove these two observations. Hunters are out in a forest in the far west of America, and live on the game they shoot. The Indians they meet propose to give them in exchange for their guns furs of at least double their value; they accept the offer, for economists have persuaded them that produce must be always exchanged for produce, and that it is always a gain to obtain articles of a higher for those of a lower value. Their want of forethought, however, is speedily punished. They are very soon nearly dying of hunger. To get back their guns, they would now be willing to transfer not only their furs, but everything else they possess into the bargain. Again, a manufacturing town has sufficient cars and wagons

there one man of sense and reflection whose mind is not sometimes occupied, and whose imagination is not startled by the actual and prospective state of the country? The monetary standard of England was what it is now and has always been throughout the rest of Europe—silver. Monstrous and incredible delusion! We are now told that the question is settled forever. But with a gold standard, circulation cannot increase; so it opposes an effectual barrier to all improvement. By the gold standard the currency has been reduced below the point that would afford remunerative prices with the present taxes."—*Argument Against One Gold Standard*, D. Lube, M. A., Trinity College, Dublin. In 1832, Lube strongly advocated the silver standard. This is what Sir Archibald Alison says on the subject of monetary contraction:—"The distress among the mercantile classes for years after the dreadful crisis of 1825, of the agricultural interest during the lowering of prices from 1832 to 1835, and of the whole community from 1835 to 1842 was extreme. The investment of capital in agriculture was, during this distress, everywhere grievously abridged, and in many places totally annihilated. Ireland, during the whole period, has been in a state of smothered insurrection. The heart sickens at the evidence, numerous and incontrovertible, which the Parliamentary reports for the last ten years have accumulated of wide spread and often long-enduring suffering amongst the laboring poor of England." After having described the progress of this state of things Alison adds: "Some external cause must therefore have paralyzed and blighted the wealth of the country in the midst of such an increasing growth of the national resources. Since the Peace, the all-important question arises, what was it which had this effect? The answer is, it was the contraction of the currency which was mistakenly made to accompany the resumption of cash payments by the Bill of 1819 that has been the chief cause of all these effects." Alison gives a perfectly complete description of the unfortunate results of the monetary contraction, the real cause of which generally passes unobserved. "It is as difficult to get the great bulk of men to understand that it is the currency itself that is shifting in value when great changes of price are going on around it, as it is to make them comprehend that the earth is moving rapidly through the heavens."—*England in 1816 and 1845; or, A Sufficient and a Contracted Money*, 1846, page 51.

[1] All the leading economists agree in thinking that abundance of money is more favorable to the progress of mankind than scarcity. Here are some quotations on the subject: "In fine," says Michael Chevalier, "a fall in the value of money will profit those who live by present labor, it will injure those who live on the fruits of past labors be it their own or that of their fathers. In this respect it will act in the same direction with the greater part of those evolutions which are accomplished by virtue of the great law of civilization, to which ordinarily we assign the noble name of progress." *La Monnaie*, 2d edition, 1866, p. 760. J. R. MacCulloch, in his discussion on the effect of the great increase in the world's stock of gold after 1850, says in conclusion: "Though like a fall of rain after a long course of dry weather, it may be prejudicial to certain classes, it is beneficial to an incomparably greater number, including all who are actively engaged in industrial pursuits, and is, speaking generally, of great public or national advantage."—*Encyclopædia Britannica*, Art, "Precious Metals. W. Roscher, the learned professor of Leipzig, points out that the gold discoveries, by preventing a dearth of money, which without them would have probably occurred, saved the nation from a grievous malady. On the other hand, he explains, in the same sense as MacCulloch aud Chevalier, how a fall in the value of money may stimulate to a notable increase of national production—*Grundlagen der Nationatoekonomie*, § 141. All the more known German economists—Nasse, O. Arendt, Adolph Wagner, Lexis, Schaffle, and even Soetbeer—express the same opinion. *Vide* for example, Erwin Nasse, *Der Bimetallismus und die Wahrungsfrage*. Holtzendorff. Brentano, Jahrbucher II. 1.

to effect all necessary transports; foreigners buy from them a part of these at a very high price. The sellers profit by many thousands of pounds, and it seems a splendid business exchange of produce for produce, with clear gains on their side. But the vehicles having disappeared from the wharves and streets, there is no means of conveying goods from place to place. The manufacturers, no longer able to obtain raw materials, are obliged to stop working their machinery and to discharge the workpeople. A general crisis arises, there being a dead-lock as regards production, and misery continues to spread among the laboring classes until fresh wagons are made or got. The loss in this way incomparably exceeds the gains which were obtained from the sale of the vehicles. Exactly the same thing occurs when gold goes off in too great quantities. He who exports it in payment of goods purchased in exchange does a good stroke of business, but the community suffers for it. Pieces of money are, for practical purposes, conveyances by means of which products are exchanged. If there be an insufficient quantity of these, the circulation becomes impeded; commerce and industry have to face difficulties in buying and selling; a crisis ensues. It is, therefore, not correct that the precious metals are as much a merchandise as anything else, and that it is a matter of indifference whether they are exported or imported.

But, Mr. Bonamy Price will say, you will not deny the truth of the following proposition, which, with several others, Mr. Mill has very clearly explained: A country has always as much money as it needs; in fact, it is impossible that one country should export, and that another, with which it trades, should, at the same time, import cash for any lengthened period. Prices will fall in the country where gold is leaving, and will rise where it is accumulating. It would soon be to the advantage of the former country to buy where things are cheaper, and thus the excess of imports would quickly bring back the gold, and the balance would be again established. I beg, first, to remark that this reasoning is neither more nor less than an application of the theory of the "Balance of trade," so described by recent economists. On the other hand we find here again the same use of abstract ideas, leading to conclusions in which falsity is mixed with truth. Contemplating this purely superficial analysis, one is led to suppose that gold can pass from one country to another, in a similar manner to water passing from basin to basin seeking its level, and that neither advantage nor disadvantage is likely to accrue to either nation from the transfer. It is not so by any means. And, first of all, there is one very great exception to be taken as to the general axiom given us by Mr. Bonamy Price and Mill—an exception which plays a very important part in the general movement of the precious metals on our globe. I speak of India. From antiquity to the present time, an uninterrupted current has always carried silver to the far East. A rise in prices there, such as would have induced the Indians to buy more goods in Europe, and discouraged Europeans from buying from the Indians, has never taken place. And why? Because the silver on arriving in Asia is made into jewels and idols, and is, further, lost and hidden away by a population in India of 300,000,000, and of 400,000,000 in China, and so does not remain in circulation; thus, having no influence whatever on prices. The fact of the balance being always favorable to Asia is explained by the circumstance that Europe needs much commodities from thence, while the East takes very little of our produce. Between European nations the balance is generally pretty equal; any momentary inequality is quickly set to rights by the variations in the rate of exchanges, and very little precious metal actually passes from country to country. In this case current economical theories find their application; but let us consider the example of a balance where the tendency is persistently unfavorable, and where a constant exportation of precious metal becomes necessary. For the study of this phenomenon we have only to examine facts in connection with the trade between Europe and America. Here, as in the case of India, an unfavorable balance seems likely to become persistent. Since the United States re-established a metallic circulation, Europe is obliged to send them each year a growing quantity of gold. In 1879–1880 it amounted to 75,000,000 dollars, and in 1880–1881 to 91,000,000 dollars. The reasons tending to the production of this unfavourable balance for Europe are the same as in the case of India. We are absolutely forced to take certain produce from America; for instance, corn, meat, petroleum, and cotton. On the other hand, as industry becomes developed in the United States, thanks to the more general employment of machinery, and to the higher intelligence of their workmen, they are less in need of our products and manufactures. The difference, in this way, of the commercial balance that we owe to the United States, we are obliged to pay (silver being refused there) entirely in gold. Hence, these exports of cash, which occur generally in the largest quantities in the autumn, and greatly disturb the European money-market. It is certain that these exceptional exports will cease some day, sooner or later. With a yearly drain of £15,000,000 to £18,000,000 sterling, there would soon be no gold left in Europe. for it produces none; and already her stock is very much reduced. On the other hand, as the Americans do not hoard their gold, or make anklets or bangles of it, as the Indians do with silver, the gold they receive, and that which they produce, by swelling the circulation, will raise the prices there, while they will fall in Europe, as a natural result of the diminution of the monetary stock. But to what famine prices will European produce have to fall before being able to pass the protectionist barrier—the American Custom-House—in quantities sufficient to turn the scale in our favor? For this to occur, the European market must be depressed severely—an event deeply to be deplored, whatever economists may say about it. One circumstance, which may singularly retard the reflow of gold to Europe is, that as soon as it reaches the opposite shores of the Atlantic, it finds immediate employment in creating new railways, new farms, fresh works of all kinds, fresh centers of production in the Far-West; for in these far-off regions the pioneers who people them love "hard money." As the financial chroniclers say, the New York market is insatiable; gold coming from Europe evaporates there like water on heated sands. It scarcely is landed before it starts off westward. The United States are now enjoying the monetary advantages of that period of economic expansion which Europe experienced after 1850. European Banks are to them now what the California "placers" there were to us then.

Gold can, however, return to the country where it has accumulated to the one whence it flowed, in another manner. In the impoverished country the fall in prices does not affect goods only; it extends, in some degree, to investments. It is therefore advantageous to lend money there; and the country where gold is plentiful, and where, consequently, everything is very dear, will not fail to do this. These exceptional purchases produce a reverse balance: gold obeying the fall in the rate of exchange, flows back again, and the equilibrium tends to re-establish itself. The economist theorem, stated by Mill and Mr. Bonamy Price, is thus verified; but an important change has taken place, which economists completely ignore. The country which, thanks to its gold, will have been able to invest money in the country momentarily impoverished, will hereafter be entitled to receive from the latter, as a kind of tribute, interest for the capital invested. It is thus that England has enriched herself, and that she can annually import a surplus of about £100,000,000 sterling in commodities, a large proportion of which represents the dividends of stocks, shares, bonds, &c., due to her by foreign nations. In 1847, France, in order to cover the deficit of a bad harvest, was forced to send large quantities of gold to Russia, and a crisis ensued. The Emperor Nicholas sent 50,000,000 francs to France. The gold returned, but Russia continued the Creditor of France to this amount. Only, here again it must be noted that the flowing back of gold from America to Europe will not be easy, because many years must elapse before capital can be more advantageously placed in Europe than in the United States.

Let us sum up these remarks on the movements of the precious metals. The real balance of trade, when all the facts are taken into account, is a very important point. It is that which determines the fluctuations in the rate of exchange, which again leads, when it passes the *gold point*, to the export of this metal. Under the influence of the variations in the exchanges, the balance generally regains its equilibrium, and thus the exports of precious metals are very nearly balanced. But when, after bad harvests, by large imports without compensating exports, or on account of freights or interest due, a country loses some of its monetary stock, it does not regain it without suffering some damage. The country in receipt of this excess of gold parts with it only to pay for goods at a cheap rate, or to purchase stock, the price of which has fallen through the scarceness of the metal, or as a result of the monetary crisis. I will finally examine one remaining question:—To what extent is it true, as orthodox economists allege, that it is a matter of indifference whether a nation be abundantly or scantily provided with the precious metals? I will restate their propositions. Precious metals, they say, are not essential to any absolute requirement. It is the abundance of useful or agreeable objects that constitutes the wealth of a nation. The more plentiful cash is, the higher each article will be priced; but this will add nothing whatever to individual well being. The only result will be that money payments will be heavier, because, in order to obtain the same number of objects, a greater weight of gold and silver will have to be given in exchange. These propositions are perfectly true, if we consider one country only, or are speaking of the entire world; but it ceases to be so when we examine the relations of one nation with others. This is what we must now make clear. It is necessary, preliminarily, to explain the meaing attached to the words "abundance of cash." It refers to abundance in comparison with what is requisite for exchanges, and not to absolute abundance. Thus, it is certain that the more highly a country becomes economically developed, the less precious metal it makes use of in accomplishing the same amount of exchanges; firstly, because the monetary media, better employed, circulates more rapidly; and secondly, because cash payments are replaced by an extensive credit system. England, for instance, does more business than France, with half the quantity of cash. But yet, allowing for the necessity England is under always to maintain a certain quantity of the metallic means of exchange, it can be truthfully said that she is always abundantly furnished in that particular. The greater portion of the precious metals produced in the entire world passes through the London market, which reserves for itself only what it requires. All the nations of Western Europe are rich countries, cash is not wanting, means of circulation are plentiful and prices are consequently high. The nations of Eastern Europe are, on the contrary, countries where gold and silver are scarce, the circulation slow, and consequently prices there are very low.

This difference in the prices of commodities is of very little consequence for the inhabitants of one or other of these groups of communities in their relations between themselves; everything there is dear or cheap. But it makes itself felt in any question of trade or intercourse between the highprice group and the low. The first can buy of the second at will; but the second, in their turn, cannot buy of the first. If I sell a chicken in London for 3*s.*, I could procure three in Bucharest for the same money. A thousand pounds sterling in England would give me a triple power of purchase in Roumania or Bulgaria. An Englishman could, therefore, if it suited his convenience, buy up everything there is to be had in a poor country, he being ready to pay a price that no one there would give. It is for this reason that everything of the finest and most costly description is sent to London and to Paris from the producing countries. It is on this account also that so many Englishmen settle abroad. Their income gives them there a much higher power of purchase, and they can live in a much higher style than in their own land. On the other hand, an inhabitant of Kief or of Sophia, wishing to come to London or Paris, to enjoy the value in his country of, say, forty or fifty quarters of corn, would have to sell double that quantity there to enable him to pay for the same enjoyment in the cities of Western Europe. The workman who in New York earns a dollar for one day's work, could for that sum get five men to work for him where the wages are a mark a day, as in Silesia, and ten where the remuneration is 5*d.*, as in India. An Anglo-Indian civil service functionary there keeps an establishment with ten or fifteen servants, wages being very low. Poor countries—poor in cash, or where the scale of charges is at a medium—are therefore, in truth, under the economic domination of rich countries where prices are high.

From all that has been said, therefore, I think it may safely be concluded that all the theories concerning the currency put forward in classic works need to be reconsidered and revised. They are superficial. They contain as much mistake as truth; and this portion of error has done much harm in preventing certain nations—England, for instance, and, quite recently, Germany and the Scandinavian States—from adopting a more rational monetary system. The "mercantile" school was right in maintaining that an influx of precious metal stimulates commerce and industry, while its withdrawal throws both into difficulty and induces crisis. It was also not in the wrong when it affirmed that gold and silver are not a merchandise like any other. These metals serve as conveyances to all other products; consequently, when they are in insufficient quantities, circulation, which is the life of the economic world, stops or languishes. But from these true observations, confirmed by daily experience, and relied upon by all business men and money-market chroniclers, the "mercantilist" reasoners have deduced erroneous conclusions: for instance, that gold and silver are the only riches, and that, consequently, in order to accumulate the largest possible amount of them, high protective duties must be imposed, so as to put an obstacle in the way of foreign import, and bonuses be offered for the purpose of stimulating exports. Economists were right in stating the true riches of a nation to consist in an abundance of useful objects, not of precious metals; but they made a mistake, and a very grievous one, in drawing the inference that it was a matter of indifference —in fact, it was rather advantageous than otherwise, to export cash. It suffices to reflect for one moment on the disturbance occasioned from time to time in the economic and financial world by the draining of gold and the ensuing crises, in order to see how grave is their error. Nevertheless, the deductive school continues imperturbably to repeat its abstract axioms, although experience too frequently gives them flat contradiction. What is to be desired in respect of currency, is that the monetary stock should be maintained at the level of the wants of circulation, and consequently that it should increase in proportion to the development of the exchanges effected in the world, so as to offer to all contracts, whether for a short or a long term, as stable a basis as possible. In spite of history, to reduce civilized nations to make use of gold only, when Nature has placed two monetary metals at their disposal, and when it is evident that the yellow metal is produced in too small and too variable quantity, is to provoke a series of disastrous crises, shackling commerce, and completely strangling free trade.

The question I will now proceed to examine is this: What determines the value of money? As Mr. Dana Horton, United States delegate at the Paris Monetary Conferences of 1878 and 1881, has clearly shown, two extreme opinions exist on this subject—that of *free trade*, which is not applicable here; and that of the *fiat money* theory, which maintains that it is the will of the legislator which creates and regulates the value of money. These two theories are evidently erroneous. Let the law once establish—as it has done from all time—a coin as legal tender, and there can be no longer *free trade* in this matter. There exists an enormous difference between gold as a simple commodity, and gold as a legal measure of value, and, at the same time, legal means of payment for any debt or purchase. Mr. Thomas Baring has mentioned the fact that, in the crisis of 1847, one sovereign was not to be procured in London for £60,000 in silver: and that in Calcutta, during the crisis of 1864, a merchant possessing £20,000 in gold became bankrupt, because he could not exchange it for silver rupees, the only legal tender. Mr. Dana Horton has clearly set forth the absurdity of attempting to introduce free trade where it is really not a question of it:—

"Free trade in legal tender may have existed in the primitive days of unsophisticated barter, and certainly must flourish in Utopia; but when we ask how it can be materialized to-day, we find ourselves in confusion. Can payees demand, or can payors give in payment, whatever merchandise they prefer? In what merchandise do men express their taxes and appropriations, salaries and fees, fines, official appraises and sales? Is it a matter of indifference, or a matter of choice, with payor or payee, whether all these obligations are fulfilled with saw-logs, whale's blubber, raw hides, or loads of gravel? Do men take up a bill of exchange, with freestone, or pay for postage stamps with dynamite? Now, all these questions occur naturally, and must be answered affirmatively, if we admit that free trade in legal tender is present in the flesh. Evidently the thinker who materializes ideal free trade in money in the nineteenth century, in the interests of science, must likewise be prepared to be done by as he does, and when he asks for bread to receive a serpent, and when he asks for fish to receive a stone."—*Gold and Silver*, p. 172.

I think we may conclude, from what we have just quoted, that those who speak of *free trade* in money do not know what they are talking about. The word "legal" tender in itself ought, however, to warn them of their error. The theory of *fiat money*—which is, at the bottom, the theory of the inflationist and of the partisans of paper money—is not less absurd when pushed to the extreme. Mr. Dana Horton gives us a curious example borrowed from Iwan Possoschkof, a Russian reformer of the time of Peter the Great:—"The foreigners estimate their money according to the quantity of metal it contains, and not according to the power of the monarch who issues it. But we honor our monarch as God, and most zealously obey his will. We do not look at the weight of the money, but upon the inscription. It is not the copper that is valuable to us, it is the name of our Czar." In truth, in former times, when sovereigns and statesmen were for ever changing the current value of money, or the proportion of precious metal in each coin, their ideas must have been very similar to Possoschkof's. To cite only one example, the following are the terms in which Phillip Valois, king of France, proclaims his absolute power with regard to the coinage of his realm, in an ordinance dated January 16, 1347:—"Aucun ne peut faire doute qu'a nous appartienne seulement et pour le tout en notre Royaume, le fait, la provision et toute l'ordonnance de la monnaie et de faire monnayer telles monnaies et donner tel cours comme il nous plait." Lord Liverpool, whose ideas as to the nature of money were so clear and just, does not overlook the predominating influence of law in the matter. He says, in his famous treatise on the "Coins of the Realm":—"Coins ought always to pass in tale, according to the rate or value which the Sovereign puts upon them in his Mint Indentures." (Bank of England edit., p. 177).

It is as little correct to pretend that the law can do everything with regard to money, as to say that it can do nothing. The following are the arguments of those who maintain the latter opinion: Doubtless the law can decree that a pound sterling shall be equal to forty shillings, as it can also diminish by one half the amount of pure gold contained in a sovereign, but in such a case the value of the new sovereign would be only half that of the old—that is to say, it would pay for only half the quantity of goods, prices having doubled themselves. Thus the step taken by the legislator would prove of no avail; it must, indeed, always come to naught, when we consider existing economic conditions which enforce themselves. The value of everything depends on the law of demand and supply, and not on the will of either Sovereigns or Parliaments. This argument is irrefutable, but does not at all prove that the law can have no influence whatever on the value of monetary metals, and consequently on that of money. In reality the influence of the State is not contrary to economic laws, but in accordance with them; for it is the State which, by opening the mints, occasions the chief demand for the precious metals. The value of gold and silver arises from their being used, firstly, for making either useful objects or objects of luxury, jewelry, etc.; and, secondly, for making coin. The monetary exceeds in influence the industrial demand—in the first instance, because it is of greater importance; in the second, because it fixes the price of the precious metals. If mints were completely closed, the value of the proscribed metal would fall to at least one-half. Gold would be worth no more than platinum—that is to say £24 to £30 a kilo, and its price would be as variable as the price of this rare metal. Silver has lost one-fifth of its former value; and this fact is entirely due to the legislators of civilized countries having forbidden its being freely coined in the mints. If the United States were to suspend the Allison Bill, which imposes a monthly coinage of at least two million dollars, and if India were also to close her mint, to what price would silver then fall? To one-half—or, perhaps, even one-third—of what it was recently worth. If, on the other hand, free coinage were to be re-established in those countries where it formerly existed, silver would certainly regain its former value. Thus we see that the power of law with regard to money consists in fixing its value by creating, suspending, or annulling the demand for the precious metals of which money is composed.[1] The law in itself does not entirely create this value, though very nearly so. Were the demand from the mints to cease completely, industry alone would, it is true, suffice to retain for the precious metals a portion of their present value, but the influence of law is certainly very great, for were the monetary employment of either metal entirely to discontinue, that metal would be offered to industry in double and triple quantities, and the price of it would consequently be enormously depreciated. In the correspondence between Mr. Gibbs and Mr. T. H. Farrer,[2] the latter sums up current opinion in the following passage:—

"What is a pound? Not merely a thing to which law has attached any particular value, but a bit of gold stamped to show its weight and fineness. The value of gold depends in no way on the stamp. It depends, on the one hand, on the supply—*i. e.*, cost, or rather difficulty, of production; on the other hand, on the demand, *i. e.*, on the extent to which men desire to use it. Over the supply law has no power whatever; over the demand law has some power, just as it has over the demand for other commodities."

All these affirmations, which have a seeming foundation, are, in reality, contrary to facts. Law has an influence over the demand for gold quite different from that which it exercises over the demand for any other commodity, for the State buys gold in unlimited quantities and at a fixed price. This it certainly does for no other merchandise. Will the State accept iron, corn, or tea, upon these conditions? It exercises also an indirect but decided influence on the supply, that is to say, on the production, for it determines the price which can be paid at the mines. If the State cease to fix the price, or if it lower it, the production will, of necessity, diminish. "A gold sovereign," says Mr. T. H. Farrer, "is, within a trifling fraction, worth as much in exchange, when melted down, as when it has the Queen's head on it." This is true, but why? Because the law allows you to change your melted sovereign back again into a sovereign "legal" standard, and this at the expense of the Mint. "It is, therefore, the law which maintains the bullion value of the melted sovereign. Let the law only close the Mint, and your gold as bullion would lose a large proportion of its value. Here is a proof of this. In France, at the present time, five francs in silver have the same power in buying and paying as five francs in gold. Melt a silver five-franc piece, and it will then be worth only four. Why? Because silver, as bullion, may not be changed back into coin. If the French mint were once more opened to silver coinage, five francs in bullion may be worth as much as five francs in money, just as with a sovereign.

Mr. Bonamy Price, and those who, like him, affirm that money is as much merchandise as any other article, or a piece of machinery, a tool, a wagon, or a cart, do not observe that the free coinage at the Mint in itself establishes a radical difference between the monetary metals and any other commodity. If you make too much cast-iron, or too much cloth, you cannot sell it all, your stock accumulates too largely, and you are a loser, for it eats up the interest

[1] In favor of the opinion that the value of money comes not from the law, but from the intrinsic value of its metal, Michel Chevalier, Bonamy Price, and other economists, quote these words of Aristotle: "It was agreed to give and receive in exchange a substance which, useful in itself, was easy of handling for the uses of men, such as iron, for example, or silver, or some other substance, of which the size and weight was first determined; and, finally, in order to avoid the trouble of continual measuring, it was marked with a stamp in sign of its value." They omit the conclusion of the passage, which runs thus: "But of itself money is an empty thing; it has value only by law, and not by nature, for a change of agreement among those using it can depreciate it entirely, and render it entirely unfit to satisfy our needs." The consequence of what Germany had done in 1873, in accepting no more silver as legal tender, is an example of the truth of Aristotle's remark. Mr. Dana Horton, in his remarkable book, "Gold and Silver," p. 118, quotes another passage of Aristotle even more explicit:—"Money (νόσμα) is, as it were, a substitute for demand (χρεία) or the thing needed; and hence it has the same 'nomisma,' because it is not so by nature, but by law (νόμω), and because it is in our power to change it and render it useless."—*Nichomachean Ethics*, book 5, chap. 5.

[2] "The Double Standard," by H. Gibbs, Appendix, p. 18.

of the value it represents. This is not at all the case with monetary metal; you can never have too much of that; thanks to free coinage, it can always be converted into money, and then you immediately draw a revenue from it. Monetary metal is never a dead capital; with money you can purchase, and pay for, any and everything. You are lord of the market. With goods you must wait to sell before purchasing or paying. This is the difference between money and tools or plows. If you possess the latter in excess it is dead capital, while this can never be the case with monetary tools, for you can always send them into circulation, and employ them in procuring your productive capital, consols for instance.

Mr. Bonamy Price thinks that surplus monetary conveyances will lie idle in the banks, like surplus plows in a shed. This is a mistake. Every piece of money will be sent into circulation, let them be ever so numerous; for, if they accumulate in banks, the rate of interest will fall. The lowered rate of interest will urge men to fresh enterprises, from which will spring an increased demand for goods of all kinds, and, as a natural result, a rise of prices will ensue. Higher prices will necessitate the use of more money, and thus the surplus coinage will find employment. Coin is, therefore, to its owner a living capital, current everywhere, and capable of being employed immediately, or of being put out to profit according as its possessor desires. This is an exclusive privilege of money, and when business men, whom economists scoff at, give it pre-eminence over all other merchandise, they are wholly in the right. According to Mr. Bonamy Price, and all the economists of the deductive school, the value of gold and silver depends on what it has cost to produce these metals. "The gold," they say, "buys by means of its cost of production." This maxim is daily contradicted by facts, as we will endeavor to prove, but this discussion needs great attention, because it is not easy to explain the changes in the value of money, which would appear unchangable as long as the coins contained a fixed quantity of precious metal. For instance, an ounce of gold, standard fineness, which can always be exchanged at the Bank of England for £3 17*s.* 10½*d.*, would appear to retain always the same value. This is, however, not the case. Without taking into consideration the abstract theory of value, we can say, with economists, that the value of an object is represented by the quantity of other objects to be obtained in exchange for it. Thus it is admitted that the value of the precious metals has fallen to a quarter of what it was in the thirteenth century, because the same weight of gold or silver will now only purchase a quarter or a fifth of corn or other commodities. If bank notes and silver were simultaneously and universally suppressed in favor of gold, it is certain that the value of gold would enormously increase, although the amount of labor necessary to the production of an ounce of gold would in no ways have changed or diminished. Silver, after 1873, and notably in 1875 and 1876, lost suddenly a large proportion of its value. The price of this metal fell from 60 to 61 pence per ounce, to 50, and even for a time as low as 46, and now the average price is about 52 pence. Has the cost of producing silver suddenly fallen a fifth or fourth? No one will attempt to maintain such a statement. Mr. Otto Arendt has proved with most accurate figures ("Die vertragsmässige Doppelwährung") that the fall in the price of silver was occasioned by Germany, selling it, combined with the prohibitions against its free coinage in all civilized countries.

The price of articles depends principally—and this will not be denied—on the demand; and as the demand for silver from the Mints ceased all at once, how could this metal not fall considerably in the market? If the free coinage of this metal were re-established in France, the United States, and Germany, on the basis of a fixed ratio of 1 to 15½ between gold and silver, is it not evident that silver would immediately regain its former value? When Belgium and, later on, Germany adopted nickel in place of copper coin, the value of that metal tripled. Had the cost of its production increased? Not at all; but the demand increased, and as nickel cannot be produced at will, the tripled price maintains itself. Suppose that men again attempted to make money out of platinum, as was once done in Russia, that metal, instead of being worth from £12 to £14 a pound, would rise to four or five times that value. If, on the other hand, the coinage of gold were everywhere to be suppressed, it would certainly fall to half its present value. The value of gold depends so little on the cost of production, that we learn from those of competent authority, who have given the question their time and attention, that the *average* cost of each ounce obtained is the price of two. It will be asked: Why, then, is such a losing business carried on? It cannot be possible! The explanation is very simple. Certain mines make very large profits, and those who work at a loss hope, some day, to strike a rich vein, a "bonanza," and they work on, cheered by that hope, until they have expended all their resources. Sometimes they succeed, and their good fortune stimulates others to similar labors. At Monaco, an analogous state of things may be observed. It is quite certain that for the totality of players the gaming there is a losing operation, for the yearly profits made by the bank amount to a considerable sum. Therefore, each franc gained by the mass of players cost them more than a franc. But the gambling goes on, each individual believing he will one day be the favorite of fortune—and there are, indeed some who prove to be so. It is most essential with the precious metals to distinguish very carefully between *price* and *value.* The price of the precious metals is determined by the Mints. The "market price of gold" is an expression in constant use, especially in England. The market price of gold is no other than the Mint price. This price enforces itself, and for a self-evident reason, which is this. Mints are not only the principal consumers, but are, at the same time, insatiable, for they buy up all monetary metal at a price fixed by themselves. Why, in any part of the world should gold be sold under £3 17*s.* 10½*d.*, due deduction being made for transport expenses, as this price can always be obtained at the Bank of England? Gold will never be sold cheaper while the Mint in London maintains its price. It cannot either fetch a higher price as long as a sovereign remains in circulation, for industry has but to melt sovereigns for £3 17*s.* 10½*d.*, and it will secure an ounce standard, and will therefore pay no higher price in the market. Certain writers imagine that if silver were universally received as standard money, with a ratio as to gold of 1 to 15½, the dearer metal, that is to say, gold, would be gradually withdrawn, and would no longer remain in circulation. But then, what would become of this metal? Could it be treasured up indefinitely? Impossible; for it would consume its own interest. Could it be sold to industry at a higher price than that fixed by the legal ratio? More impossible still; for, goldsmiths and jewelers being able to draw, at will from the monetary stock, at the price fixed by the Mint, would refuse to pay higher. The producers and holders of gold would therefore be forced to resign themselves to accept the price imposed by the Mint, for they would be unable to dispose more advantageously of their metal elsewhere. Gold could only disappear if the production were to be reduced one-half or two-thirds. But then, of course, gold could be no longer the monetary metal of the world. Let us suppose that the cost of the production of gold diminishes suddenly very much, as it probably did when the *placers* of California and Australia were first worked after the year 1850. The price of gold would not fall on that account, for the bank would still continue to pay £3. 17*s.* 10½*d.*

The value of the monetary metals, that is to say their power of purchase of other objects, is a more complicated subject. It depends on the connection existing between the exchanges to be effected, on the one hand, and the total quantity of metallic money, or other mediums of exchanges substituted for this metal, on the other. For instance, bank notes, fulfilling precisely the same mission as gold or silver coin, compete with these metals and, at all events, render them less essential, and, consequently, diminish their utility and their value. This diminution of value, or of power of purchase, occasions a rise in prices. Suppress bank notes everywhere, and the value of metallic money will considerably increase, for each monetary unit will be more sought after, and its power of purchase will augment in proportion as prices fall, although the cost for the production of the precious metals will have remained identically the same. On the other hand, if more bank notes be issued, gold and silver will be depreciated in value. For instance, when the United States and Italy adopted paper money, and allowed their monetary stock to pass into other hands, a marked depreciation in the value of coinage was observable all over the world. On the contrary, since these countries, wishing to re-establish a metallic currency, are drawing to themselves a portion of the world's monetary stock, they have occasioned a considerble increase in the value of money, by a fall in prices. These changes in the value of gold and silver are entirely independent of the cost of production. The cost of production of the precious metals can only influence their value in the long run, and that insomuch as it has the power to limit or increase the amount produced. Let us suppose that the excavation of an ounce of gold from a mine costs double what it now does; the majority of mines, commencing, of course, with the poorest, would be abandoned. The monetary stock would diminish and prices would fall. The value of goods would increase. But this fall in the price of everything, including also labor, would probably diminish the cost of excavation and allow of the abandoned mines being reopened. If, on the other hand, precious metals could be obtained at a less cost, it would probably happen that a larger quantity would be extracted from the mines and a diminution in their value *might* ensue, which would manifest itself by a rise in prices. At all events, this influence, never other than feeble, which the increase or diminution of the cost of production can exercise over the value of gold and silver has been often counteracted and annulled by circumstances other than those we have previously mentioned. Firstly, money, gold and silver, cannot be regarded as corn, coal, or such commodities. One cannot, at will, secure any amount of gold. Mines must be found to be worked, and these mines are very rapidly exhausted. During the first fifty years of this century the value of gold rose considerably without occasioning any corresponding growth in the amount produced. The discovery of the *placers* of California and Australia increased extraordinarily the annual produce of the yellow metal. This abundance of gold, and the great diminution of the cost of production at the gold-fields, occasioned but a transitory fall in its value; indeed, the price of gold very quickly regained its previous level, as I have already endeavored to prove; and this was due to the fact of there being fresh demands for it,—a necessary consequence of the extraordinary activity of commerce and industry all over the world.

Another consideration which must not be overlooked is, that while ordinary commodities are more or less rapidly consumed, the precious metals are preserved and accumulate. Therefore a difference in the annual production, unless it were to continue during a prolonged period, would have a scarcely perceptible influence on their value, for this influence would become deadened on losing itself in the immense monetary stock, the result of the labor of centuries. History proves that the value of gold is not at all regulated by the abundance of production, as economists, following Lord Liverpool, generally affirm. The latter writes in his famous book, "The Coins of the Realm," chap. iii.:—"This variation (in the value of gold and silver) is occasioned by the greater or less quantity that may happen to be at different times in the market or in circulation." We will now show that this affirmation is contradicted by facts, and, if this be the case, as a reduction in the cost of production can only affect value by increasing the production, we think the error of the thesis of Mr. Bonamy Price, "*The gold buys by means of its cost of production,*" will then be clearly proved. The value of gold in past centuries can be estimated by comparing it with that of silver; for, until the year 1816, silver was everywhere the principal standard, and the common measure of value. It will be seen, by the figures given below and borrowed from Mr. Soetbeer, that the value of the precious metals is in no way determined by the cost of production, but solely by the prices fixed at the Mints of the preponderating countries.

Average annual production in millions of German marks (a mark is worth about a shilling).

	1561–80.	1581–1600.	1601–20.	1621–40.	1641–60.	1661–80.	1681–1700.
Gold	19	20	23	23	24	25	30
Silver	53	75	76	70	65	60	61
Relative value of gold to silver.	11·50	11·80	11.25	14·00	14·50	15·00	14·96

We see that from 1561 to 1600, the annual production of silver rose from 53 to 75 millions of marks; while that of gold remains almost stationary. The value of silver ought to have fallen. It did not, however, do so, for the relative value of gold only rose from 11.50 to 11.80. From 1600 to 1700 the production of silver diminished: it fell from 76 to 61 million marks: while that of gold rose from 20 to 30 million marks. The value of silver should therefore have increased, and that of gold comparatively have diminished. We see, however, instead of this, that the value of gold rises from 11.80 to 14.96. The cost for the production of gold must have fallen, as the produce was more abundant. Why, then, has its value so increased? Because the Mint indentures of different States fixed a higher and higher value on it. Are economic laws at fault here? Not at all; but they have been badly expounded by economists. It is the demand of those insatiable consumers, Mints, which has brought about the rise in the value of gold. During the 18th century, the production of silver enormously increased, thanks to the facility with which the rich mines of Mexico were able to be worked. According to the theory of the cost of production of Mr. Bonamy Price, the value of silver ought to have lessened. The contrary took place. Here, again, I borrow the figures of Mr. Soetbeer, which are generally admitted to be the most accurate we have—

Average annual production in millions of German marks.

	1701–20.	1720–40.	1741–60.	1761–81.	1781–1800.
Gold	35	53	68	57	49
Silver	46	77	95	117	158
Ratio between gold and silver.	15·27 and 15·15	15.09 and 15·07	14·93 and 14·50	14·81 and 14·64	14·76 and 15·42

Thus, from 1700 to 1800, the production of gold increased very little—from 35 to 49 millions of marks; while that of silver grew enormously—from 64 to 158 millions; and, at the same time, until the year 1780, the relative value of gold fell, and that of silver rose. A kilo of gold (about two lbs.), which was worth, in 1700, 15.27 kilos of silver, would only fetch $14.76 in 1780. If gold in 1880 attained the ratio of 1 to 15.42, it was on account of the French Minister, De Calonne, having established a ratio of 1 to 15½, which was higher than the value known as the commercial value, and determined, before this date, by the price at the English Mint.

Facts which occurred subsequently to the year 1850, give a still more formal contradiction to the theory which asserts that the value of the precious metals depends on the cost and amount of production. The average annual production of gold which was, from 1840 to 1850, about £2,800,000, rises suddenly after 1850 to £32,000,000, or to an average of about £28,000,000 for the period 1850–60. In the twenty-five years following 1850, more gold is produced than in the 358 years between 1493 and 1850. What a prodigious change in all the elements of production of this metal! If the theory of Mr. Bonamy Price be correct, its value ought to decrease enormously. But no. The ratio of gold to silver scarcely changes. From 1851 to 1875 it is quoted at 15.53. Thus we see that the diminution in the cost of production and the more than extraordinary growth of production produced no effect on the relative value of gold. These facts give a decisive negative to the theories of economists; but they are in strict accordance with true economic laws. Let us suppose an unlimited demand for any commodity at a fixed price. This price will of necessity be forced upon the market. The free coinage of a monetary metal, at a fixed price by the Mint, constitutes an unlimited demand for that metal; the price of the Mint will become consequently the established price, if the State be sufficiently powerful to absorb all that is produced. In the event of the production increasing very considerably all that could ensue would be a depreciation of the monetary units, and consequently a rise in prices. Stuart Mill stated and proved the following principle: "Alterations in the cost of production of the precious metals do not act upon the value of money except just in proportion as they increase or diminish its quantity, which cannot be said of any other commodity." [1]

It is now time to examine if a rise or fall in prices is always in proportion to the growth or diminution in the

[1] Principles of Political Economy, People's Edition, p. 306.

quantity of money. This is what German economists call the "*Quantitats Theorie.*" I borrow also from Stuart Mill the statement of this theory: "The value of money, the other things being the same, varies inversely as its quantity, every increase of quantity lowering the value, and every diminution raising it in a ratio exactly equivalent." The great Roman jurist, Paulus, already understood this law, when he said, speaking of money,[1] "*Usum dominiumque, non tam ex substantia præbet, quam ex quantitate.*" Mr. Cernuschi has given expression to the same idea, with his usual precision, in the Proposals which he submitted to the Monetary Congress of 1881:—"Money is a legal and mathematical value; legal, for the material from which it is made is fixed upon by legislators, and its enforced currency is also imposed by them; mathematical, for the value of money varies inversely as its mass; that is to say as the quantity existing." This theory is correct if we add to it, as Stuart Mill did, *cæteris paribus*, or "the other things remaining the same." If, referring to Hume's hypothesis, we imagine that, one morning, every one wakes up finding in his pocket twice as much cash as the day before, it is certain that every commodity would be worth twice as much, for each one could offer twice as much cash in order to obtain what he wanted. But the "quantity" monetary theory is contradicted by facts, *if other things do not remain the same.* Now, many circumstances may alter. For instance: Firstly, the circulation of money may become more rapid, and, consequently, each coin, operating more exchanges, the quantity of money may be reduced, without any proportionate fall in prices occurring. Secondly, a similar effect is produced if money is replaced by means of credit. Here, again, the quantity of money may diminish, or the number of exchanges increase, without being followed by a fall in prices. So it is well known that in England and America, nine-tenths of all the great transactions are settled by credit and banking. Thirdly and finally, an increase, even very great, in the quantity of money does not produce a rise in prices, if its effect be, as is generally the case, to stimulate the creation of fresh enterprises, and thus to increase the amount of merchandise to be exchanged and transactions to be settled. We see now in what way facts contradict the maxim generally accepted in England, and thus stated by Mr. Bonamy Price: "The market value of the sovereign is what it cost to produce." As Mill has proved, the cost of production of the precious metals does not act upon the value of money except in proportion as it increases or diminishes its quantity. In its turn, the quantity of money does not influence the value, save in a manner by no means mathematical, rather irregular, and frequently in total opposition to anything the "quantity theory" would have led one to contemplate. I now approach the question which is occasioning such lively discussion at the present time. Should money, legal tender, be made of only one metal, or can it be made of either gold or silver, a ratio of value between these two metals being fixed by law? Until quite recently the question had been very little studied in England, and opinions there were almost unanimously in favor of a single metal—*i. e.*, gold monometallism. Lord Liverpool's book, "The Coins of the Realm," was considered decisive authority, and, in all respects, it well deserved to be so. Both theoretical arguments and historical facts are there clearly and perfectly stated. I will endeavor to prove from the premises of Lord Liverpool, and of other authors whom he quotes in his work, that a bimetallic coinage is better calculated to fulfill the conditions necessary to a good legal tender than a monometallic. When Lord Liverpool, contrary to universal custom, reduced England to the exclusive adoption of gold as money, he was guided by two chief considerations. The first, borrowed from Petty, Locke, and Harris, was this: It is impossible to establish a fixed ratio between two sorts of merchandise, gold and silver; therefore, in accepting these two metals at a time as a legal tender, we run a double risk of variations in its value. The second, which Lord Liverpool gathered chiefly from the monetary history of England, is as follows: It is impossible to maintain two metals in circulation. The most sought after is exported abroad or melted by industry. This law is what is called the Gresham law,[1] which might also be named "the law of alternation." The following are Lord Liverpool's authorities:—Sir William Petty ("Political Anatomy of Ireland," chap. xi,) observes, "that money is understood to be the uniform measure of the value of all commodities," and then adds, "that the proportion of value between pure gold and fine silver alters, as the earth and industry of men produce more of one than the other, so there can be but one of the two metals of gold and silver to be a fit matter for money." Locke says "that two metals, that is, gold and silver, cannot be the measure both together in any country, because the measure of commerce must be perpetually the same, invariable, and keeping the same proportion of value in all its parts."

Mr. Harris says, "that one only of these metals, gold or silver, can be the money, or standard measure of commerce, in any country; for the standard measure must be invariable, and keep the same proportion of value in all its parts,"—("The Coins of the Realm," Bank of England edit. p. 129.) Lord Liverpool allows that gold, as well as silver, varies in value, and that "coins, on that account, are an imperfect measure, though they are made of one metal only." "But," says he, "if coins are made of two of these metals, a second imperfection is then introduced; for any two of these metals, in successive periods, vary in value with respect to each other." Thus, what causes Lord Liverpool, and the authorities he quotes—Petty, Locke, and Harris—to prefer a monometallic coinage, is the opinion that a legal tender of only one metal is more stable in value. Stability in the value of money is its most essential quality. Both Aristotle and Locke recognized this: "*The measure of commerce must be perpetually the same, and invariable.*"

This ideal of permanent value being unattainable, as Lord Liverpool himself admits, the next point to examine is which legal tender approaches nearest to it, bimetallic or monometallic? We may say, at the present time, that it is a scientific truth, demonstrated by both arguments and facts, that a legal tender formed of two precious metals, gold and silver, is more stable in value than one formed exclusively of either gold or silver. This truth was clearly set forth in 1809, by Adam Müller in his book, "Elemente der Staats

[1] The passage from Paulus, whence these words are quoted, so admirably sums up the whole monetary theory, that we think we cannot do better than reproduce it in its entirety:—"Origo emendi vendendique a permutationibus cœpit. Olim enim non erat nummus; neque aliud Merx, alid Pretium vocabatur; sed unusquisque, secundum necessitatem temporum ac rerum, utilibus inutilia permutabat; quando plerumque evenit ut quod alteri superest, alteri desit. Sed quia non semper nec facile concurrebat, ut, quum tu haberes quod ego desiderarem, invidem haberem quod tu accipere velles, electa materia est, cujus publica ac perpetua estimatio difficultatibus permutationum, æqualitate quantitatis subveniret: eaque materia forma publica percussa, usum dominiumque, non tam ex substantia præbet, quam ex quantitate. Nec ultra Merx utrumque; sed alterum, Pretium vocatur."—Dig. xviii.

[1] "Gresham law" had already been observed in Greece. Aristophanes speaks of it very wittily in his comedy, "The Frogs." During the extreme distress caused by the Peloponnesian war, Athens had, for the first time, issued a debased gold coinage; the consequence was that the good money immediately disappeared from circulation. Aristophanes ("Frogs," 665) says: "The State has very often appeared to us to be placed in the same position toward the good and noble citizens as it is in regard to the old currency and the new gold. For we make no use at all, either at home or abroad, of those which are not adulterated but the most beautiful of all money as it would seem, which are alone well coined and ring properly, but of this base copper, struck only yesterday, and recently, of a most villainous stamp. And such of the citizens as we know to be well born and prudent, and honorable gentlemen and educated in the palæstra and chorus and liberal knowledge, we insult; but the impudent and foreigners, and the base born, and the rascals, and the sons of rascals, and those most recently come, we employ." Sir Thomas Gresham was a rich merchant of the City of London, a mercer who negotiated Flemish loans for Henry VIII, and for Elizabeth. He interested himself greatly in monetary matters, and gave very sound advice to the Queen on this subject. He remarked that good and bad coin cannot circulate together, and that the good coin is always withdrawn from the circulation, where speculators in the precious metals leave only the bad. *Vide* "The Life and Times of Sir Thomas Gresham," by John William Burgon; and "Dictionary of Political Economy," p. 46, by Macleod. *Vide* "Aristophanes." Montesquieu states the facts observed by Gresham, but without knowing their cause: "L'or disparait quand l'argent est commun parceque chacun en a pour le cacher; il reparait quad l'argent est rare parcequ on est oblige de le retirer de ses retraites. C'est donc une regle: l'or est commun quand l'argent est rare, et l'or est rare quand l'argent est commun."—*Espirit des Lois*, liv, xxii, chap. 70.

Kunst." It was still more plainly demonstrated by Sismondi, in 1827, in his "Nouveau Principes x d'Economie Politique," t. ii, p. 60. These two authors make use of a comparison often reproduced since, that of the "compensated pendulum." "The way," says Sismondi, "to diminish the chances of fluctuation in the value of money is to employ gold and silver simultaneously, as common measure, and to establish a legal proportion between them. In the same way, in order to have a pendulum unvarying in length, the rods are made of different metals, so that the expansion of one, produced by heat, may be counteracted by that of another, and thus the equilibrium is maintained." The essential truth which governs the whole monetary question has been demonstrated by Mr. Jevons, aided by diagrams and comparisons, with a clearness which defies all dispute:—

"In the first place," remarks Mr. Jevons, "I have no doubt whatever that M. Wolowski is theoretically quite correct in what he says about the compensatory action of the double standard system. English writers seem completely to have misunderstood the question, asserting that the system exposes us to the extreme fluctuations of both metals." [Here Mr. Jevons inserts his diagram, showing that the fluctuations in value of both metals, taken together, do not proceed to so great an extent as those of either gold or silver. And then he goes on saying] "Nor is this the whole error of English writers; a little reflection must show that MM. Wolowski and Courcelle Seneuil are quite correct in urging that a *compensatory* or, I should prefer to call it, *equilibratory action*, goes on under the French currency law, and tends to maintain both gold and silver more steady in value, than they would otherwise be. Imagine two reservoirs of water, each subject to independent variations of supply and demand. In the absence of any connecting pipe, the level of the water in each reservoir will be subject to its own fluctuations only. But if we open a connection, the water in both will assume a certain mean level, and the effect of any excessive supply or demand will be distributed over the whole area of both reservoirs. The mass of the metals, gold and silver, circulating in Western Europe, in late years, is exactly represented by the Water in these reservoirs, and the connecting pipe is the French law of the 7th Germinal; An. XI., which enables one metal to take the place of the other as an unlimited legal tender."—*Money*, pp. 137-140.

Another example may serve to demonstrate the general principle that the price of two sorts of merchandise, which can replace each other, will be steadier than that of a merchandise without a substitute. For instance, in a country where the nourishment is both rye and wheat, the price of food, and even the price of each of these cereals, will be less subject to variation than in a country where the consumption is entirely of one or the other. The figures concerning the production of gold and silver prove that the comparison made by Mr. Jevons is perfectly exact. The table of figures reproduced here[1] shows that the production of either gold or silver, taken separately, is subject to very great and frequent fluctuations, while that of the two metals, taken together, gives a remarkably stable total. If there exist in the world, as is generally supposed, a stock of precious metal amounting to 2,000 millions sterling, half gold, half silver, it is evident that the variations in the annual productions would have less influence on the value of money, and consequently on prices, if the monetary stock were formed of 2,000 millions, gold and silver together, instead of 1,000 millions either gold or silver. For instance, in comparing the year 1849 with 1853, we find that the production of gold increased sixfold, while that of the two metals combined only tripled. All economists agree in admitting that if, in 1850, the gold standard had been in force in all civilized countries, the increase in the production of gold, from £5,420,000 in 1849, to £31,090,000 in 1853, it would have occasioned considerable disturbance everywhere, while, thanks to French bimetallism, the effect of this sudden increase was very much neutralized. As M. Michal Chevalier proved, by a very just comparison, the unlimited coinage of gold and silver in France acted as a "parachute."

In conclusion, Lord Liverpool was right in seeking, above all else, stability in the legal tender; only at the present time it has been scientifically proved that this is more easily attainable with a double than with a single standard. The second motive which induced Lord Liverpool to advise the adoption of a single standard had better foundation. It was, as we have previously stated, the Gresham law, or "law of alternation, which means that when gold and silver are simultaneously in use as money, the depreciated metal only remains in circulation. At the period from which Lord Liverpool deduces his historic examples, the different countries were constantly modifying and changing the ratio of value between gold and silver,[1] and the result of this was that a country where the two metals were allowed to be freely coined was liable to lose all she possessed of either which had, for the time being, the higher value at foreign Mints. Lord Liverpool proves, by referring to the monetary history of England, that the Gresham law has in fact been a reality. At the beginning of the reign of James I. gold was valued too low, and was consequently exported. This monarch then, by successive proclamations, raised the value of gold in his coins, so that the silver coins were, in their turn, exported. In 1663, under Charles II., when a new estimate was made of the relative value of gold and silver at the English mint, that of gold was underrated; but gold was received at a higher rate, so it remained in circulation. After the great recoinage in the reign of William III., gold was estimated at a higher value than on the Continent, so the new silver coins were immediately exported. In conformity with the advice of Newton, the value of the guinea was lowered sixpence. But it was not enough to recall silver.

[1] *Annual production of Gold and Silver from* 1849 *to* 1879, *according to English and American statistics.*

	Gold.	*Silver.*	*Total.*
	£	£	£
1849	5,420,000	7,800,000	13,220,000
1850	8,890,000	7,800,000	16,690,000
1851	13,520,000	8,000,000	21,520,000
1852	26,550,000	8,120,000	34,670,000
1853	31,090,000	8,120,000	39,210,000
1854	25,490,000	8,120,000	33,610,000
1855	27,015,000	8,120,000	35,135,000
1858	29,520,000	8,130,000	37,650,000
1857	26,655,000	8,130,000	34,785,000
1858	24,930,000	8,130,000	33,060,000
1859	24,970,000	8,150,000	33,120,000
1860	23,850,000	8,160,000	32,010,030
1861	22,760,000	8,540,000	31,300,000
1862	21,550,000	9,040,000	30,590,000
1863	21,390,000	9,840,000	31,230,000
1864	22,600,000	10,340,000	32,940,000
1865	24,040,000	10,390,000	34,430,000
1866	24,220,000	10,145,000	34,365,000
1867	22,805,000	10,845,000	33,650,000
1868	21,945,000	10,045,000	31,990,000
1869	21,245,000	9,500,000	30,745,000
1870	21,370,000	10,315,000	31,685,000
1871	21,400,000	12,210,000	33,610,000
1872	19,920,000	13,050,000	32,970,000
1873	19,240,000	17,850,000	37,090,000
1874	18,150,000	14,300,000	32,450,000
1875	19,500,000	16,100,000	35,600,000
1878	19,000,000	14,800,000	33,800,000
1877	19,400,000	16,200,000	35,600,000
1878	19,000,000	17,000,000	36,000,000
1879	18,000,000	16,000,000	34,000,000

[1] Here are some examples of variations in the ratio of value between gold and silver produced, not by trade, as is generally imagined, but by the indentures of the Mint. Spain, who in the sixteenth century, adopted a ratio of 1 to $13\frac{1}{2}$ raised it in 1730 to 16. The result was that silver, being estimated at a lower value than elsewhere, was exported, and was always at a premium of even six per cent. To remedy this, the ratio was lowered to $14\frac{41}{116}$, and then raised again to 16 in 1779. In the Netherlands, the ratio was $11\frac{1}{4}$ in 1589, $12\frac{1}{2}$ toward the year 1640, $14\frac{43}{100}$ in 1663, and $14\frac{83}{81}$ toward the close of the eighteenth century. In France the ratio, which was 1 to 11·88 in 1602, was raised in 1631 to 13·62, in 1679 to 14·91, and finally in 1785 Calonne fixed it at 15·50. Calonne himself explains that the ratio existing in France was more unfavorable to gold than that of $15\frac{1}{2}$, which was the market value, and so gold being exported, in order to call it back he proposes fixing it at $15\frac{1}{2}$. What he calls the commercial price is the price fixed by the English Mint. Formerly the Gresham law could act but slowly, because, save in England, coinage was not free. Depreciated metal could not therefore be brought into any country to be made into money, the more valuable metal being taken out in exchange. In 1679 Colbert decreed the free coinage of the two metals in France, the Mint giving, weight for weight, cash for gold or silver ingots. But this measure, which according to Leblanc, attracted unexampled quantities of gold and silver to the country, was retracted in 1869. Mr. Cernuschi has clearly demonstrated that two bimetallic systems, with a different ratio between gold and silver, cannot coexist. Silver would accumulate in the country where it is estimated the highest, and gold in the other. For instance the United States, having adopted a different ratio from that in force in France, first, 1786, that of 1 to 15, then, in 1834, 1 to 16, had, in the first place, nothing but silver, and afterward nothing but gold. *Vide* "Bimetallism in England and Abroad: Letter to Henry Hucks Gibbs," by H. Cernuschi, 1879, p. 8.

Gold remained in England as the cheaper metal, and silver was smuggled to the Continent by the Dutch as the dearer metal, as was shown in a speech in the House of Lords, on the 23d of January, 1718, by Lord Stanhope, who proposed to lower again the value of gold. After 1785, when Calonne raised in France the ratio between gold and silver to 15½, gold was exported to Paris and silver returned to London. To stop this, under the influence of Lord Liverpool, the free coinage of silver was prohibited in England, in 1798, till the Privy Council should have time to consider all the questions relating to the monetary circulation in the United Kingdom. This summary of English monetary events clearly shows the power of the Gresham law, and it also proves that, at this period, when it was impossible to think of determining, by international treaty, a fixed ratio of value between the two metals, the only means of avoiding the alternative withdrawals of gold and silver was, as Lord Liverpool maintained, to permit the free coinage of only one metal. This advantage being in all probability of greater practical importance than the maintaining a steady value in coinage, by making use of two metals, it follows that, at the time he wrote, Lord Liverpool was not wrong in recommending monometallism.

Nevertheless, he might have known that Newton had already indicated the means of maintaining the "equilibratory" action of the double standard, remedying at the same time the difficulty of alternation entailed by the Gresham law. These means are, that the Mints of all the preponderating nations fix the same ratio of value between gold and silver.

"If," says Newton, "gold in England, or silver in East India, could be brought down so low as to bear the same proportion to one another in both places, there would be here no greater demand for silver than for gold to be exported to India; and if gold were lowered only so as to have the same proportion to the silver money in England which it has to silver in the rest of Europe, there should be no temptation to export silver rather than gold to any part of Europe."—(*Reports made by Sir Isaac Newton, Master of the Mint, concerning the state of the gold and silver coins*, 1717: *Vide* "Monetary Documents, published by order of the Congress of the United States," by Dana Horton, p. 317.

As long as gold was worth 15:25 in England and only 15 on the Continent, as during the eighteenth century, the flow of gold must evidently be to England and that of silver to the Continent. This result was as inevitable as that of the electric battery, which attracts one metal toward the positive, and the other toward the negative pole. When, in 1785, France adopted the ratio of 1 to 15:50, England began losing her gold and winning back silver. But if England and France had both adopted the ratio of 15:50, these two countries would have formed but one, from a monetary point of view, and all reason for exporting or importing the one metal in preference to the other would have disappeared. The laws of universal bimetallism, as expounded by Newton, are no less mathematically evident than the law of gravitation and of universal attraction. If all the principal states were to adopt the same ratio, the Newton law would completely put an end to the Gresham law. These are truths which have so clearly demonstrated in the luminous writings, amongst others, of Mr. Cernuschi, that they may be considered as acquired by economic science, and he alone will attempt to deny their veracity who has never taken the pains really to study them.

From what precedes, I think, we may draw the following conclusions:—Considering that the quality Lord Liverpool especially wished to secure to money was steadiness in value; that this steadiness is much more easily attainable by the simultaneous employment of gold and silver; and that, at the present day, the inconveniences arising from the alternations of the Gresham law could be easily remedied by an international treaty, it follows that Lord Liverpool and his authorities, Petty, Locke, and Harris, would now declare themselves in favor of a bimetallic coinage, for precisely the same reason that they rejected it in their time. To elucidate this question as completely as possible, we will now examine the objections which have been raised against the solution we consider the best. The question of a bimetallic coinage must have been very little discussed in England, or such eminent economists as Mr. Bonamy Price and Mr. Robert Giffen would not put forth objections on this subject so strange that they quite amaze one. According to Mr. B. Price, if England were to join a monetary union with the principal civilized nations, for the purpose of establishing a legal and simultaneous circulation of both gold and silver with a ratio of 1 to 15½, the following deplorable results would ensue:—First, in any conceivable case, many silver-producing nations would be left out, and they would ruin the projected scheme. They would make silver coins for the Monetary Union States, forged, but all of full silver weight, introduce them easily into these countries, and deluge them with these coins, with immense profit to themselves."[1] We give here Mr. Bonamy Price's own words, otherwise it would be hard to believe that such an objection could have been brought forward. Bimetallism being established, what reason could there be in silver-producing countries, making money of full weight, and fraudulently introducing it into the circulation of the Monetary Union? Everywhere in the United States and in Europe, the Mints would accept silver in unlimited quantities and at its full value of 60⅞ pence. A false coinage would entail great expense, and its issue would not be unattended with danger, while all the States of the Monetary Union would be ready to receive silver at a price as high as fraud could obtain for it, and would even give the money in return almost gratuitously. It would be a very strange undertaking. It is now, when Mints are closed to silver, and when, at the same time, silver pieces are standard money, as is the case in France, that the danger Mr. Price warns us of really exists, for by forging these pieces 15 or 16 per cent, could be made; as silver can be bought at 52 pence, and sold as coin at 60⅞ pence. In England, the benefit made by forging shillings and half-crowns might be still greater. If the Americans do not make shillings, half-crowns, and crowns, now that silver costs 52 pence, what inducement would there be for them to commence, if its price were 60 or 61 pence, and when their own Mint would be ready to pay for it at that rate? The truth is then quite the reverse of what Mr. Bonamy Price states. The danger of false coinage which exists at the present time, on account of the depreciation of silver through its proscription, would entirely disappear if a free coinage were introduced.

According to Mr. Bonamy Price, the second unfortunate consequence of the free and simultaneous coinage of the two metals would be that "all goods would have two prices, one in gold, the other in silver, and this last would vary with all the fluctuations of the worth of the metal." The learned Oxford Professor has certainly traveled in France or Belgium, in Switzerland, Spain, or Holland. In all these countries bimetallism is in force. All debtors and buyers can pay in either gold or silver. Are there, then, two prices? Not at all. Let Mr. Price go to Paris and buy ten thousand francs' worth of goods, or invest a million in the public funds, or pay his bill at the hotel, no one will say to him, "It is so much; but if you pay in silver, the price is different; it is 15 per cent. more." Mr. Price would pay in bank notes, if for a large sum, and his small bills in gold or silver, as he prefers. No one has observed fluctuations in the white metal in France. India and England alone lose by the exchange of silver. In France, as in England, large payments are made in bank notes; these notes are guaranteed, for the greater part, by the stock of silver at the Banque de France. No one objects to receive it, in spite of silver being very much depreciated, which would not have happened if men were not so mad as to proscribe it, although it is endowed in the highest degree with monetary qualities.

The third grievance which Mr. Bonamy Price has discovered is quite as extraordinary as the two preceding ones. If England, says he, were to adopt bimetallism, debts would be paid in silver shillings instead of sovereigns, twenty shillings to a pound sterling; and the shillings would be worth much less, for one would be able to procure nearly twenty-four shillings for a gold sovereign. The eminent professor here supposes a state of things which, were it really to occur, would be a direct contradiction to all economic laws—viz., that silver, being worth 52 pence, at the present time, should remain at the same price, when the Mints of all the great countries would be ready and willing to purchase it at 60⅞ pence, the equivalent of the ratio of 1

[1] "Buying and Selling," *Journals of the Society of Arts*, May 6, 1881, p. 531.

to 15½ which is supposed to be adopted. Is it not inconsistent to pretend that silver would not rise in value if, instead of being proscribed everywhere, it were to be received at all the Mints? Mr. Henry Gibbs, whom Mr. Bonamy Price esteems so highly, and justly so, states, in his remarkable work, "The Double Standard," that the very day France readmits the free coinage of silver on its ancient footing of 200 francs the kilogramme, that metal will again rise to its former price in the London market—*i. e.*, to 60⅞ pence, the equivalent of the French price. Why should silver be sold at 52 pence, when in Paris nearly 61 could be obtained for it? As free coinage in France has sufficed during seventy years to maintain silver at a price of 60 or 61 pence, the little variations being occasioned solely by the fluctuations in the exchange, as demonstrated by Mr. Ernest Seyd, is it not absolutely certain that this price would be maintained far more easily if all the greater nations were to agree to it and adopt the ratio of 1 to 15½? But, says Mr. Bonamy Price, by adopting the ratio of 1 to 15½, instead of 1 to 18, which is the one now in existence, you give "an excessive, unnatural, unreal, and purely artificial value to silver." On the contrary, it is the present value of silver which is "unnatural and artificial," for it is the result of the legislative measures taken recently by Germany and France and all civilized nations. To re-establish a free coinage for silver, as before 1873, would be but to restore to this metal its normal value, which it had preserved from the end of the last century.

"The bimetallists," says Mr. Price, "do not deny that by the adoption of the 15½ ratio the creditor would be wronged, but they think they have found the remedy in limiting the coinage of silver, so as to make it pass for what they please." Two errors in a single sentence are a great deal. Bimetallists have never admitted that creditors would be wronged. Far from that, they believe that silver would regain its former value, and that creditors would be indifferent whether the debts owed them were paid in gold or silver, or, rather, they would receive payment in bank notes, representing indifferently the one metal or the other, as now in France. Still less do bimetallists, desire, in any way, to limit the coinage of silver, for, as Mr. Price himself writes, some lines before the passage just quoted, "bimetallism consists in authorizing any quantity of silver to be coined into shillings." Mr. Price imagines that, contrary to all economic laws, bimetallists, wishing to raise the value of silver, would limit the coinage, or, in other words, restrict the demand; while, far from that, they desire to raise the demand to the level of the supply, by decreeing a free coinage—that is to say, creating an unlimited demand. It is certain that if the learned Oxford professor had deigned seriously to study the pith of the question, and the consequence of the doctrine he combats, he would have refrained from raising objections which are groundless, or even contradictory. He speaks of bimetallism as a thing unheard of, unknown, unimaginable, which would bring incalculable evils upon England. Is he not aware that it has existed in France since the beginning of the century, and that that country has been in possession of an abundant and easy circulation, much less disturbed by crises than that of England? None of the difficulties predicted by Mr. Price have arisen there. Mr. Robert Giffen published in the *Fortnightly Review* (August 1st, 1879) the best article which has yet appeared in opposition to bimetallism. But, in our opinion, the concessions he makes there are very important, while his objections are contrary either to his own premises or to facts.

To mention one or two examples. Mr. Giffen admits that, in periods of transition, bimetallism increases the steadiness of value of gold and silver, by means of the equilibratory action, so well described by Mr. Jevons. But, he says, this influence soon ceases. Thus, "after 1850, French bimetallism was powerless to stop the fall in the value of gold, because there was no silver in exchange for it. In the same way, from 1820 to 1850, it could not stop the fall in silver, because France was then practically a silver-using country." Mr. Giffen's observation is, in the first place, contradicted by facts, for there are many gold pieces still in circulation bearing a date between the years 1803 and 1850, and after 1850 France was very far from losing all her stock of silver; for, of the 824,987 five-franc pieces found in the offices of account (19,511 in number), on the 14th of August, 1878, 572,916 had been coined before 1851."[1] So if the same percentage of 62 per cent. hold good for the entire French stock of five-franc pieces, it would appear that France holds to-day something like 300,000,000 of these pieces coined before the drain of silver commenced. But, as Mr. H. Gibbs proves, even supposing France to be completely deprived of gold, the compensatory action of her bimetallism would not be annulled:—

"If, for example, France were to restore to-morrow the full operation of her bimetallic law, there can be no doubt that, on the same day, the exchange being about par, the price of silver here would be at its old value. It would be wholly a question of exchange. So, let us suppose France, under the operation of a bimetallic law operative in France alone, to be absolutely denuded of gold; still for 15½ ounces of pure silver remitted to my correspondent at Paris, and delivered by him to the Mint, I should be able to draw on him for the equivalent, *i. e.*, for 107.1342 francs coined for and delivered to him by the Mint. My draft would sell on Change for £4 4s. 11⅜d in gold, if the exchange between the two countries were at par; and the exchange, I need not say, depends on the balance of trade between the two countries—on there being, or not, a demand for bills for remittance, or England being, or not, for the moment, a debtor to France."[2]

The truth of what Mr. H. Gibbs states is clearly borne out by facts. France prevented a fall in gold, not by giving up her silver, but by importing gold in exchange for merchandise she sold to other countries. France coined, between the years 1851 and 1875, 6,745,565,000 francs worth of gold. She, therefore, absorbed more than half the total amount produced by California and Australia, and she only lost, through excess of importations, 1,800,000,000 francs of silver. The compensatory action of bimetallism displays itself by throwing open a free field of employment to the metal, the production of which is increasing; and this effect would be the greater as more States adopted bimetallic law. "But," Mr. Giffen says, "this is not the truth. If all bimetallic countries had the same ratio, and the cheaper metal tended to become still cheaper, they would simply be as one country." Yes, but as a country of 300 or 400 millions of inhabitants, instead of one of 36 millions, like France. If the superabundant metal, whether gold or silver, were to increase tenfold, would its value not be better sustained by bimetallism being adopted in the leading States. Bimetallism, in force in France only, was able, during seventy years, to maintain a ratio of 1 to 15½: is it not certain, therefore, that a Monetary Union, comprising the principal States, would render this ratio infinitely steadier still? Mr. Giffen does not deny that the suspension of bimetallic law profoundly disturbs the rate of exchanges with silver countries; which latter, we must recollect, represent three-quarters of the British trade. But, he says, on this subject: "Even serious evils may have to be endured, because, relatively, they are unimportant, compared with the great objects proposed in a sound currency." But, then, what is "a sound currency?" Is it not the one which gives the most steadiness to the value of money and to the rate of exchange, and is it not a bimetallic standard which answers best those two desiderata? Mr. Giffen supposes that, in 1696, England freely chose gold in place of silver, against the law. Nothing could be less exact. England was deprived of the silver she wished to preserve by the Gresham law, and gold took its place as the overvalued money, against the wishes of the country in general. To assure oneself of this fact it suffices to read the Royal Proclamation, dated December 22, 1771.[3]

[1] "Exhib. A. 7th Session of the Monetary Conference of 1878."

[2] "The Double Standard," p. 32.

[3] "G. R.—Whereas . . . . the overvaluation of gold in the current coins of this realm hath been a great cause of carrying out and lessening the species of the silver coins thereof, which is highly prejudicial to the trade of the kingdom."

"The 22d of January, 1718, the Lords, in a grand committee, took into consideration the state of the nation, in relation to the gold and silver coins. The Lord Bingley, having represented the great prejudice that trade received from the scarcity of silver, said it was a matter of wonder a remedy had not seasonably been applied to so great an evil. Lord Stanhope answered that the scarcity of the silver species was owing to several causes: 1st. The increasing luxury in relation to silver plate. 2d. To the vast exports of bullion to the East Indies, 3dly. To the clandestine trade that had lately been carried on of exporting silver and importing gold to and from Holland, Germany, and other parts."—*Monetary Documents of the Conference of Paris*, 1878, by Dana Horton, pp. 316-321.

Mr. Giffen appears to imagine that if one State of the Monetary Union were to adopt paper-money, the whole bimetallic edifice would fall to the ground, as was the case, he says, with the Latin Union when Italy was obliged to reintroduce paper after 1866. All this is inexact. The other countries of the Union were not in the least inconvenienced by this Italian forced currency, and they only put a stop to the coinage of silver when Germany demonetized that metal. Let us suppose that one of the States of the great Bimetallic Union has recourse to an inconvertible paper currency, the result would be that its metallic coin would return to the other countries. This is, in fact, exactly what took place when the United States issued their greenbacks. Was England, at that time, embarrassed by American gold? "The only chance for bimetallists," says, again, Mr. Giffen, "is universal bimetallism. But what a wild dream! Who is to draw the treaty? What power of persuasion will bring all Governments to accept this Gospel?" I answer, the power of reason and the pressure of necessity, or, rather, I will let the most competent authority on this matter speak for me. "If our Government," writes Mr. Henry Gibbs, "could say, 'England is willing,' no one would doubt that France, with the Latin Union, Austria, Holland, Spain, and the United States would at once agree, and it is asserted that Germany would also. If so, the impossibility is at once overcome, that installment of universality being quite sufficient for the purpose."

—Emile de Lavelaye in the "Contemporary Review."

THE FUTURE OF GOLD.

AFTER the year 1850, when California and Australia were sending out into the world annually about thirty-five millions sterling in gold, Michael Chevalier and Cobden raised the cry of alarm: the world would be completely submerged by a deluge of gold. After 1867, the production of gold rapidly diminishing, an entirely opposite fear gradually gained ground amongst far-seeing business men. In 1869, in the review of the preceding year, the *Economist* wrote: "It may safely be affirmed that the present annual supply of £30,000,000 of gold is no more than sufficient to meet the requirements of the expanding commerce of the world. The real danger is that the present supply should fall off, and amongst the greatest and most salutary events that could now occur would be the discovery of rich gold deposits." In 1871, after the decision of Germany to proscribe silver, the uneasiness of the *Economist* increases, and it writes thus: "As the annual supply of gold is reckoned a little more than £20,000,000, and the annual demand for miscellaneous purposes is very large, it follows that if the German Government perseveres in its policy, the strain upon the existing stocks and currency will be most severe. Unless the annual production of gold should suddenly increase, the money markets of the world are likely to be perturbed by this bullion scarcity."

What the *Economist* foresaw has taken place. The scarcity of gold has induced so great a fall in prices that they are now lower than in 1850. Mr. Robert Giffen clearly showed this in an excellent study which has never been disputed, but which has, on the contrary, been confirmed by such men as Thorold Rogers, Patterson, Samuel Smith and Williamson, of Liverpool, John Hector, T. Smith, and many others. Who can doubt that the present crisis from which the entire world is suffering is due to the scarcity of gold? Up to the present time, exchanges have been effected in civilized countries by means of two metals, gold and silver; to-day, the coinage of silver having been suspended, except in India, the stock of money in the world is now only fed by gold, and at the same time the production of gold is yearly diminishing, and, what is worse, for the last three years America has taken for herself more than sixteen millions annually—that is to say, the whole total production, less four millions, which do not suffice to cover even industrial wants. Bagehot estimated that England absorbed yearly for industry and coinage from four to five millions sterling. On the contrary, in 1879 England exported a surplus of gold, amounting to £2,389,826 and in 1880 £4,249,449. The coinage in Europe has now sunk to almost nothing. In France the coinage of gold, which amounted in 1877 to 271,645,425 francs, and in 1878 to 189,139,520 francs, sank in 1879 to 24,610,540 francs. In England last year (1881) the amount of gold coined was quite insignificant, £35,000 only. Silver can no longer, as recently, help the circulation and effect exchanges, for it is no longer admitted at mints. The production of gold, which was thirty-five millions annually some years ago, does not now exceed nineteen or twenty millions. It is clearly evident that these circumstances united—viz. the proscription of silver, the decrease in the production of gold, and the draining of gold to America—have led to an appreciation of gold, a fall in prices, and to the present crisis, as the inevitable consequence of monetary contraction. This being the case it is of the highest importance that we should carefully examine if the production of gold is destined to increase or diminish, for the economic conditions of the whole civilized world are dependent on this. If more gold be not found, silver still being proscribed, prices will continue to fall. Prices falling, the burden on all those owing gold will increase, for they will be forced to sell more articles to obtain the same quantity of gold; farmers will have more and more difficulty in paying, for the produce of their farms will lose in value; manufacturers will be exposed to heavy losses, for while converting the raw material into manufactured goods, the general fall in prices will make itself felt, and the manufacturer will in all probability find himself working at a loss.

It would be rash to predict, with too great certainty anything definite with regard to the future of gold; nevertheless, taking as a basis ascertained historical facts, and geological researches with respect to the earth's crust, it is not impossible to arrive at certain conjectures which may be at least looked upon as probabilities. This is what an eminent professor at the University of Vienna, Dr. Suess, has attempted to do in a work entitled *Die Zukunft des Goldes* (*The Future of Gold.*) This book attained a very high reputation throughout Germany, and has been successful in convincing some of the most able economists that it is essential to restore to silver its attribute of money, of which it never should have been deprived. The conclusions Dr. Suess reaches are as follows: The production of gold will in the future diminish and the mines become exhausted the more rapidly as the present means of working them are more perfected and powerful. The discovery of new mines in hitherto unexplored regions may, for the time being, stop this exhaustion, but the expanse of new country where we may hope to meet with these mines is rapidly diminishing, and in the parts previously colonized, mines once very productive are being one after another abandoned. We will examine how Dr. Suess treats these different points.

Gold and silver are essentially the "precious metals" from the mere fact of their being rare. The scarcity of gold is certainly the chief cause of its value. But can it be explained why gold is so rare? According to Dr. Suess, it is because gold is one of the heaviest metals. Three metals are noted for their extreme density—iridium, platinum, and gold. Their weight compared to water taken as a unit is represented by the following figures: iridium 22·23, platinum 21·50, gold 19·253. With the exception of that strange and also rare metal, mercury, the density of which is 14·49, gold and platinum weigh more than any other metals; for, as an instance, lead reaches 11·35, silver 10·47, bismuth 9·82, copper 8·80, nickel 8.27, and iron only 7·84. Is there a connection of cause and effect between these two facts, that gold is a rare metal, and, at the same time, one of the heaviest that exist? One would be inclined to think that there is, if one admit that the earth was first in a gaseous and afterward in a liquid state. In this case the heaviest matters must have occupied the centre of the globe in a smelting condition. If it be true that our whole planetary system has been formed from matter which constituted in the beginning an immense nebula, it follows that the planets the nearest the centre must be the heaviest. These ideas were brought forward by the great German philosopher Kant about the middle of the last century, and have been from time to time referred to since. "The great weight of platinum and gold," says a German naturalist, Petzholdt, "is the reason for these metals being so scarce on the surface of the globe, for the greater quantity of them is contained in the still liquid kernel of the earth there shielded from men's greediness." Some observations that have been made help to support these ideas. The spectrum analysis reveals no gold in the sun; we may therefore conclude that it is quite in the center, hidden from view by other lighter bodies in a gaseous state forming the photosphere. The planets may be divided according to their weight into two groups. The planets in the interior of the circle of asteroids are comparatively heavy, those exterior are comparatively light. Mercury, the nearest to the sun, weighs almost seven times as much as water; Venus, the Earth, and Mars, five times as much; while Jupiter weighs barely as much as water; Saturn 0·73, and Uranus 0·84, therefore less than water. The density of Neptune, which has not quite been accurately determined, is at all events very trifling. So we see that in our planetary system the heaviest bodies are the nearest to the center, and this leads us to assume that the same distribution of matter will be found in each planet. As the rocks forming the surface of our globe weigh on an average 2½ times as much as water—limestone 2·6 to 2·8, granite and gneiss 2·54 to 2·7, and lava or basalt 2·7 to 3—and as, on the other hand, the specific gravity of the globe is five, we are necessarily led to conclude that the interior must be composed of heavy matter, far exceeding in weight the earth's average of 5. The existence of gold in the central strata of our globe appears, therefore, very probable. But if this be the case, how can we account for gold and platinum being found on the surface of the earth? It can be explained by the action of hot springs and volcanoes. These two heavy metals are always found amongst rocks of an igneous origin—here where volcanic rocks have pierced through and scattered earlier formations, and there where granite has broken up schists. Platinum, which has only been found in abundance in the washings of Nijni-Tagil in the Ural, comes from the serpentine, a rock coming from the depths. Gold is chiefly found in quartz veins. These veins appeared to have been formed in the following manner. As a natural consequence of the contraction of the earth's solid crust, and of the upheaval and disturbance of the previous formations, crevasses have formed themselves. They have become filled with quartz, sometimes auriferous, either by the action of hot springs or by sublimation. In these veins, usually poor, exceptionally rich zones are here and there to be found. German miners call them "edle Saulen" (noble columns), and American "bonanzas." It is the working of these bonanzas that renders veins profitable, which generally contain, apart, from them, so little gold that the miner literally works at a loss. If the work be continued it is in the hope of coming upon one of those rich zones, which sometimes far more than compensate for any former deficit. The extreme scarceness of gold that can be dug up is therefore a fact, and a fact easily accounted for when we consider its distribution and the geological origin of this metal. Let us now recall some historical facts which lead Dr. Suess to conclude that the production of gold will diminish in the future. The soil from which we obtain gold may be placed under three heads: auriferous rocks, auriferous veins, and auriferous alluvium.

I. The first group comprises rocks rich in magnesium and with gold scattered through them. A good example of this is the mines of Nijni-Tagil in the Ural, where platinum is also found. As a transition between this division and the next may be cited the auriferous minerals contained in some rocks of an igneous origin, as, for instance, the gold that is to be found in the granite of the west coast of South America and in certain parts of Brazil. Granite containing tin in the Erzgebirgen, in Bohemia, is a similar formation. This division of auriferous grounds, very interesting from a geological, is less from an economic point of view, for it contributes but very slightly to the product of gold.

II. The next group, the auriferous veins, comprises all the veins that have filled up, by means of hot springs or geysers, the fissures in ground upheaved and broken. These veins may be subdivided into three categories according to the different natures of the soil in which we find them. (A.) Veins of recent volcanic rocks, principally the propylite. Gold is here found mixed with silver, and it is only in this division that those exceptionally rich seams—the bonanzas—are met with. To this category belong the Comstock Lode, in Nevada, which is the most noteworthy example; the auriferous beds of Queensland, some in New Zealand and those of Schemnitz in the Carpathian range of Hungary. The gold is found sometimes in spangles and as "electrum," or silver and gold combined, or, again, mixed with copper or sulphur. (B.) Veins in more ancient volcanic rocks, especially diorite. The gold here is not, as in the preceding division, mixed with silver, but, on the other hand, there are no bonanzas. The best example of this category are the veins of Victoria. (C.) Veins in the schists, where they meet with granite, or even in granite itself, even distant from volcanic regions. It is supposed that in this case granite has been the eruptive force which has brought the gold with it. These veins are sometimes very extensive: as, for instance, the famous Mother Lode in California, which spreads itself over a vast region; but experience proves that they are seldom sufficiently productive to repay a miner's toil. Silver is never found here, and gold only in the same circumstances as in the preceding divisions. Examples of this class are to be found in California, in New Caledonia, in Tasmania, and in the Pennine Alps.

III. Auriferous alluvium. This alluvium is formed by the decomposition of different rocks containing gold, but it has been remarked that recent volcanic regions give much less than other classes of grounds. The veins richest in precious metals are, therefore, not those which produce deposits containing the most. Gold is in this instance generally found as spangles or quite tiny grains, and sometimes as nuggets, of the size of a hen's or even turkey's egg. An extraordinary point is that the gold found in this alluvium is purer than the metal found in the veins from which it comes, though, of course, this must have proceeded from them originally. Neither this phenomenon nor the formation of nuggets has yet been satisfactorily accounted for or explained. The "placers" of California, Australia, and Siberia are the most remarkable examples of auriferous alluvium. This latter can also be divided into two categories: (A.) that found on the surface of the earth, on river banks, where gold can be almost picked up, sifted from the soil and washed in the most primitive fashion; and (B.) that of an earlier date, covered over by more recently deposed soil, and which can only be reached by labors which frequently entail large expense. In California these ancient deposits named "deep leads," are sometimes covered with basalt or lava. They are then generally worked by hydraulic pressure. Water, inclosed in dykes at a higher level, is made to flow in the direction of the works by means of pipes; then branch pipes are put which carry it with great force on to the auriferous deposit, and reduce the whole bed to a state of liquid mud. This runs away in wooden troughs, so arranged that the particles of gold are stopped in their passage. The "deep leads" worked at Ballarat, in Australia, are most curious. They are covered by 400 feet of relatively recent soil, amongst which are four layers of lava proceeding from a neighboring volcano, now extinct. These "deep leads" are the banks and alluvium beds of ancient watercourses now hidden under successive layers of sediments. The wealth of these deposits is very unequal, and the amount they produce most uncertain. The capital point in these views concerning the production of gold is that by far the greater amount proceeds from these alluvium beds. In 1854, Whitney estimated that nine-tenths of the gold in the possession of men had this origin. Dr. Suess has made a calculation for the period from 1848 to 1875 with the following result:—

Value of gold in millions of francs derived from

		Million francs.
I. Veins:		
Modern volcanic	769	
Ancient volcanic	822	
Schist and granite . . .	240	
		1,831
II. Alluvium beds		14,973
Total		16,804

We learn from these figures that of the whole sum of gold produced between the years 1848 and 1875, the working of rocks has produced an average of 12.02, and that of alluvium beds 87.98. During the last few years, as the quantity of gold procured from the placers has rapidly diminished, the gold that the miners' work extracts from veins has taken a more important place. But, in spite of this, according to Dr. Suess, the future production of gold depends almost entirely on the riches of alluvium beds. The finding and extracting of gold from the earth goes on always in the same way. Some explorers arrive in an unknown region and find on the banks of a river some gold-dust or may be some nuggets. The good tidings are spread abroad at once, and adventurers from all sides arrive in crowds. The surface sand is very quickly washed and produces a large quantity of gold, but the more active the workers, the sooner is all the superficial gold taken. Individual labor is no longer of avail. Large capitals must be employed to establish necessary apparatus for the working of the "deep leads," or for sinking shafts in volcanic or granite rocks. The "deep leads" are in their turn worked out, and the working of the veins brings but scant profit, in a general way, if one have not the good fortune to fall on a bonanza, which is rare.

These mines are thus all abandoned, one by one, and fresh regions must be resorted to, to take their place. While the working of silver continues sometimes for centuries in the same region, that of gold cannot be counted upon; it is always of far shorter duration. It follows, therefore, that gold mines are constantly to be found, and, in fact, generally are situated at the extreme limits of civilization. This curious fact had already been remarked by Herodotus (III. 106). After having spoken of the quantity of gold-dust sent to Darius by the inhabitants of India as tribute, he adds that, for one reason or another, it generally happens that the rarest and most precious metals come from the remotest corner of the inhabited globe, and Humboldt has taken this passage of Herodotus as an epigraph to his studies on the variations in the production of gold. The discovery of fresh countries is often the cause of an influx of the precious metal, and this is in itself frequently an incentive to the colonization of countries hitherto uninhabited, as we have seen in California, Australia, and Siberia. The old countries have completely ceased producing gold, and it is only in regions as yet unexplored that we can hope to discover fresh veins. A rapid epitome of the history of gold-workings will serve to confirm this law of the continuous exhaustion of auriferous beds.

In ancient times gold was, comparatively speaking, abundant. It proceeded principally from the washings of the rivers of Asia. The sands of Pactolus, the golden fleece conquered by the Argonauts, the gold of Ophir, the fable of King Midas, all contribute to show the Eastern origin of the yellow metal. According to Pliny, Cyrus brought back 34,000 Roman pounds in gold, a sum corresponding to nearly two millions sterling. The treasures Alexander the Great took from Persia amounted to 351,000 talents, or eighty millions sterling. Gold came also from Arabia and, by the Nile, probably from the center of Africa. One may read too of the rivers of Spain and of the mountains of Dacia. In Abrudbania, in the center of Transylvania, galleries are to be found that date from the time of the Romans, in rocks that are still being worked at the present time, but producing only insignificant quantities of metal. Roman writers speak of the quantity of gold found in the Tagus and the Douro. Pliny mentions Asturias as the country producing the largest amount of gold. At Indanha Velha, in Portugal, a tablet has been found bearing the following inscription: "Claudius Rufus returns thanks to Jupiter for his having caused him to find 130 pounds of gold." *Ti. Claudius Rufus Jovi optimo maximo ob raperta auri pond. CXXX votum lubens solvit.*

During the middle ages these sources of riches dried up, and the attempts made by several English companies to resume the workings were ineffectual. Bohemia, Silesia, Moravia, the Tyrol have all produced gold, and fortunes have formerly been made there. Gneiss, above Gastein, the retreat of the glaciers has brought to light old workings and at the present day a little metal is still to be found there. On the Italian side of Monte Rosa, in Val Sesia, and in the Val Ansasca, at Pestanera, auriferous veins are worked, but the production is insignificant. The only workings in Europe at all worth mentioning are those of Schemnitz in Hungary. In fact, our continent may be fairly regarded as exhausted. After the discovery of America, the Antilles, principally Hispaniola and the western coast of the Gulf of Mexico yielded a great deal of gold. It is from Hispaniola that the gold offered to Alexander VI., and which he employed for the gilding of Santa Maria Maggiore, came, as the following inscription proves: "*Quod primo Catholici reges ex India receperant.*" Very soon these mines ceased to produce. Some curious facts relating to the production of gold during the sixteenth century are to be found in a Dutch book published in "Amsterdam," 1590: "Gold comes," it says "from different countries—from the mountains of Bohemia, from the rivers of Pannonia and Sweden. More than 20,000 pounds weight of gold came from Spain every year, but now these mines are exhausted. Gold arrived afterward from the east Spanish Indias, from San Domingo, at first, and then from other parts; but all that is now a matter of the past. Actually gold comes to us from Peru, some time ago for three millions yearly, and now for five, six, and eight millions. But as time goes on these mines will be exhausted and abandoned, as the others have been." This prediction of the old book, *Tresoir van de Maten ende Gewitchen*, which resumes all in Suess's theory, has come to pass, and now no more gold is yielded by these parts of the world.

Humboldt had great hopes for New Granada and Columbia, where precious metal was to be found on all sides, but, in spite of English capital which brought over the most perfected means of working the mines, the gold yielded annually does not amount to more than £500,000. Before the arrival of the *Conquistadores*, the Indians had gathered from the river sands large quantities of gold in Peru, Chili, and along the whole western coast of South America. Later these countries produced a considerable amount of silver, but very little gold; to-day the production is ten or twelve times less than when Humboldt visited them. From 1500 to 1875, the total production of gold in South America, with the sole exception of Brazil, has been £260,000,000 sterling. Nowhere can the typical history of the working of gold mines be so well followed as in Brazil. At the close of the sixteenth century, the inhabitants of the province of S. Paulo, apprised of the presence of gold by the nuggets with which the savages adorned themselves, commenced washings. In 1697 Bartholomeo Bueno found rich deposits of gold in the province of Minas Geraes. Adventurers quickly reached the spot and war broke out between the Paulists and the Portuguese of the coast. Finally, the governor succeeded in re-establishing peace and order, and the collecting of the precious metal was set on foot on a firm basis and developed with extraordinary rapidity. Towns were built, and amongst others Villa Rica. After the year 1720, the province of Matto Grasso begins to yield up her treasures. In the eighteenth century the placers of Brazil played a similar part to that of California in the nineteenth. Minas Geraes alone gave, in the middle of this century, about £1,200,000 a year and Brazil more than £2,000,000 sterling, but the alluvium beds were soon exhausted. The working of the veins was then commenced, but with no profit. Toward the year 1820 the total production of Brazil had fallen to £100,000. Since that date, English capital has paid for the working of many mines, and notably those of Jacotinga and of St. John d'Elrey, but in each case the money has been all or in great part lost. Only the last-named mine yielded recently (in the year 1876) a sum worthy of mention, £200,000, but almost without profit. The yieldings of the mine Don Pedro North Del Rey are regularly diminishing; here are the figures—1875, £34,992; 1877, £28,172; 1879, £4,956. It follows, then, that Brazil, which a hundred years back exceeded in riches all other auriferous countries became impoverished in fifty years, and may now be considered as exhausted. The total production of gold in Brazil from the end of the sixteenth century till now is estimated to be £140,000,000.

In ancient times, and in the middle ages, Africa was noted as the country of gold. Herodotus speaks of the gold gathered by the Carthaginians from beyond the columns of Hercules. The Arabian geographer El Edrisi (A. D. 1154) speaks of the gold produced by the Wangara country, from where the river Niger rises; and the Moor baptized by Leo X., Leo Africanus, who had scoured the interior of Africa, also speaks of the gold of Wangara and of Timbuctoo. It is thence that the Moors of Spain and of North Africa procured the precious metal. Recently the French from Senegal have occupied this gold country, and have in reality found "deep leads" and veins in diorite, as in Victoria, but the produce is too small to be remunerative. All the famous Gold Coast does not yield £80,000 a year. The golden sand, washed by the negroes, is sufficient to reward them for the labor they bestow during their leisure hours, but not to pay a proper interest to any European undertaking.

The Egyptians obtained large quantities of gold from the Upper Nile and from Ethiopia. An inscription under Thutmes III., 18th dynasty (B.C. 1600), speaks of gold coming from the land of Mayu. Another inscription, of the time of Ramses II., 19th dynasty, tells us that the king, seated on a golden throne, issued orders for the opening of gold mines in the land of Atika. A papyrus now at Turin contains a detailed account and map of these workings. Mummies are often found with necklets and jewels in massive gold. Gilding was in noways spared. Herodotus tells us of a king of the Ethiopians attacked, but not defeated, by Cambyses, who loaded his prisoners with golden chains, this metal being commoner than bronze. At Sofala also gold was very plentiful in the middle ages. The geographer Edrisi tells us that copper was worn as an ornament in preference to gold. At Daghouta still more gold was found than at Sofala. When, in the year 1867, the German traveler Mauch discovered near Sofala ancient alluvium workings, and even remains of the masonry of shafts and traces of ancient Israelitish worship, it was believed that we had discovered the biblical Ophir, and the more so as in ancient maps Sofala is written Sophir. However that may be, neither on this coast, nor in the Transvaal, nor in the Orange Free State, have any of the attempts at workings which have been made proved a great success. The riches in gold of the African continent is a thing of the past. The marvellous necklace of the Queen Aah-Topeh which is exhibited in the museum of Bulak, and which dates 3600 years back; the golden chains of the Abyssinian captives in the time of Cambyses; the treasures brought by the Queen of Sheba to the temple of Solomon 2860 years ago; the masses of gold hanging on to the throne of the King of Ghâna, of which Edrisi speaks, 700 years ago, and which weighed 300,000 mithkal (value £175,000)—all these memories or legends prove beyond a doubt that in ancient times the "dark continent" produced a great deal of gold. What it yields to-day is of very little importance, at most £240,000 a year. The total production since 1495 is estimated—we must say, upon very uncertain authorities—at £100,000,000 sterling. The whole of North Africa to the Sahara and the falls of the Nile is formed of a sedimentary soil which has never yielded precious metals, but in the center of the continent ancient rocks are to be met—granite, gneiss, syenite, hornblende—with quartz veins containing gold, and thus auriferous alluvium has been formed. Only it appears that antiquity and the middle ages have exhausted it all. According to remarks made by M. Jevons, the aborigines have always been the first to discover and take advantage of auriferous sands. It is certainly possible that in the center of Africa rich golden veins and even bonanzas may be found, failing rich "placers" which must not be counted on, for, did they exist, their produce would already have reached the coast. At all events, when we consider that the workings of rocks have not yielded one-fifth of the total produce in gold, we cannot expect that, in this instance, the continent of Africa will give the lie to the general law. What China and Japan produce is far from sufficing for their own consumption.

The three important centers of production at the present time are Siberia, the United States, and Australia; but the two latter are already beginning to fall off. Let us first examine Siberia. Here the auriferous alluvium spreads itself over an enormous space, from the Ural to the region of the Amour River. In Siberia the work is less active than in the Australian or Californian placers. It is carried on either by laborers who pay the privileged contractors, or by convicts. The severity of the climate and the frosts make any washings out of the question during the greater part of the year. Accordingly, progress is not so rapid, and exhaustion will not come so soon. The washings are found in the volcanic districts of the Asiatic Ural Mountains and in the syenite, the gneiss and the hornblende, at Jenisei, at Tychovo-Sadomsk on the Nigra, in the valley of Chomolcko, and on the banks of the Muza, in the government of Nertschink; finally, in Upper Amour, and quite recently in a very remote region on the banks of the Nyman and Olga rivers. Here, as in California, gold is nearly always found where granite comes in contact with the schists. In Siberia the washings are slowly falling off, as elsewhere. Those of Jenisei fell from 1000 puds in 1850 to 300 during the last few years. Only, as the alluvium is to be found more or less everywhere spread about over an immense territory, fresh workings take the place of those that are no longer productive, and the total yield tends rather to increase. In 1869 it amounted to £4,500,000 sterling. In 1876 it had risen to £4,650,000; in 1877 to £5,700,000; in 1878 to £5,850,000; and in 1879 to £5,550,000 sterling. The total contribution of Russia to the gold stock of the world is estimated at £120,000,000 sterling.

It is North America which has produced in the latest years the greatest amount of gold. The rapidity with which the production of this metal has developed itself there is really prodigious. This was due to two causes: first, the natural riches of the country; and secondly, the extraordinary energy displayed by the Americans in making the best of these riches. The precious metal is to be found in that long double chain of mountains which extends between the coasts of the Atlantic and the plains of the center. In this great range, which is called the Rocky Mountains, the upheaval of the earth's crust by eruptive rocks have brought near the surface both gold and silver. In British Columbia even, the washings of Cassiar, of Omenica, and of Cariboo, have produced annually about half a million sterling in gold. The States of Idaho, Montana, Oregon, and Washington yielded in the year 1870 about a million sterling. In Montana the annnal production has very soon considerably decreased. In 1866 it amounted to $18,000,000; to-day it is not more than $2,500,000. From 1864 to 1871 Idaho produced annually from five to seven million dollars; in 1880 the production had fallen to $510,546. In 1868 Oregon and Washington yielded $4,000,000; in 1879 they did not reach more than $1,275,000. Dakota slightly increased from $2,000,000 in 1877 to $2,420,000 in 1879. Colorado sustains an average annual production of about $3,000,000. California has passed through the three habitual periods of the gold production. After the year 1848 the washings of the river sands produced immense quantities of gold; now, only the Chinese find this sufficient to procure them sustenance. The superficial washings were soon exhausted, and excavation of the "deep leads" and veins were then proceeded with.

The whole highest ridge of the Sierra Nevada, running parallel with the Atlantic, is granite, but half-way down the slope of the chain, toward the west, strata of schist and limestone are found amongst the granite. At the point of contact there extends from north to south of the State a zone, about eight to nine miles in width, which contains all the auriferous veins of this country. This stratum, brought to light by erosion, forms in many places an almost perpendicular wall, overhanging the forests spread out at its feet. The "Mother Lode" commences in Mariposa, and passes the limit of the State at the north, where it is covered by the lava of the powerful and as yet unextinct volcanoes Pilot Peak and Lassen Peak. This lava has also covered ancient alluvium soil with basaltic streams, from 50 to 200 feet thick, which form the present "Table Mountains." This formation is also found more south in the Sierra Nevada, not far from the "Big Trees." The alluvium beds, covered by basalt, and resting on the strata of granite and of schist in the chain, contain gold, and it is from there that the lower, superficial, and now exhausted auriferous sands were washed away by the force of the mountain streams and torrents. These "deep leads," and the veins of the Mother Lode combined, have taken the place of the river "placers," and so the Californian production is still from fifteen to seventeen million dollars.

It was in Nevada that the famous Comstock Lode was discovered, which, quite recently, was supposed to be going to inundate the world with a complete overflow of gold. Parallel to the west of the Sierra Nevada runs a chain, the Virginia Range, which is composed of comparatively recent volcanic rocks. These rocks have submerged the lower part of the mountains, and principally Mount Davidson, which rises to a height of 7827 feet, and which is composed of older syenite. At the point where the more modern volcanic rock, known as propylite, terminates, at an altitude of from 5800 to 6000 feet, appear the veins of the Comstock Lode. A crack was formed between the more ancient mountain and the rock covering it. This rent extends for a distance of 22,000 feet. Its width varies a great deal: sometimes it reaches 200 feet, and sometimes it is very much narrowed by the two walls of propylite on the one side and syenite on the other. Broken pieces falling from these walls fill it up in places; the rest is occupied by the auriferous quartz, where the "rich chimneys," the bonanzas, are found.

The most powerful of these is the bonanza of Gold Hill, which descends to a depth of 700 feet. Several companies are engaged in the excavation of this marvelous vein. The most favored has been the *Virginia Consolidated*, which, out of twenty-five million dollars produced by the Comstock in 1875, yielded seventeen million. The richness of the vein was ascertained at a depth of 1600 feet. Shafts have been sunk to 2500 feet, and one has been commenced which it is hoped will descend to 4000 feet. A tunnel, the total length of which is to be 20,000 feet, has been bored in the side of the mountain to enable the vein to be worked from underneath, and the water to be carried off without using pumps; but this gigantic undertaking, which is being directed by the engineer, Sutro, has, to all appearances, been commenced too late. On the one hand, the vein, contrary to all expectations, is poorer as the workings attain a greater depth; and on the other hand, the heat at the bottom of the shaft is simply intolerable, viz. 46° Centigrade, and the hot springs that are found there have a still higher temperature, according to the close proximity to the center fire. The workmen, who work quite naked, are instantaneously in a bath of perspiration; they can scarcely breathe, and are obliged to rest every ten minutes. Under these circumstances the price of labor is of course extremely high, and unless a fresh bonanza be found, the mine will finally be abandoned. The rapid diminution in the amount of production, and the alarming fall in the value of the shares, do not allow one to count on a brilliant future. This prodigious vein has exceeded in riches all that had ever been found previously in as great a degree as the placers of California surpassed any ancient washings. In ten years it has produced two hundred million dollars, ninety millions of which were gold. The adventurer who in 1869 discovered the famous hoard of riches, Henry Comstock, after having sold his claim committed suicide. The "furia Americana" which has been displayed in the working of this mine has contributed to accelerate its exhaustion. The Comstock Lode, which in 1877 yielded $37,911,000 of which $17,771,000 were gold, fell off, in 1878, to $10,404,000 silver and $9,825,000 gold, total $20,230,000; in 1879, to $5,-190,000 silver and $3,639,000 gold, total $8,830,000; and, in 1880, to $2,634,000 silver and $2,678,000 gold, total $5,312,000. The production of the first quarter of 1881 shows a still greater decrease; the total is only $426,400, against $,7,549,-000 in 1877, and $1,615,800 in 1880. The aggregate value of the twenty-eight principal mines on the Comstock Lode, which was, in 1875, $271,059,200, was on the 1st of May, 1881, only $14,030,058. This rapid diminution has affected the total production of gold in the United States, which, according to official estimation, amounted to $47,266,107 in 1878, $38,900,000 in 1879, and $36,000,000 in 1880.[1]

The traveler who visits the American gold country sees everywhere works abandoned, buildings in ruins, and localities, which were but recently flourishing, with scarcely an inhabitant. Many of the mines established on the Mother Lode are no longer worked. Fortunately new ones are discovered, but they will be exhausted in their turn. The director of the Mint of the United States, Mr. Burchard, thinks that the number of mines worked exceeds a thousand, but many of them leave the workers at a loss. It is in the north of the Rocky Mountains that one still hopes to make happy discoveries. It is estimated that North America has contributed £14,000,000 sterling of the stock of gold of the world. The production of gold in Australia has followed pretty much the same course as in California. There, also, they have passed from the river sands to the deep alluvium, to arrive at last at the direct working of the veins; but from that moment the produce has gradually diminished. The chain of mountains which extends in Australia from north to south, parallel to the east coast, is formed of sedimentary strata, interspersed in many places with volcanic and eruptive rocks. Numerous veins, "quartz reefs," are visible, and contain gold. It is of their fragments that the auriferous alluviums are formed, which one meets with on all sides. These alluviums are easily worked, and yielded to the province of Victoria, as soon as they were discovered, a quantity of precious metal. After Campbell in 1850, and Hargreaves in 1851, had found the first nuggets, there was a rush to the gold fields. In 1852 the production had already risen to 1,974,975 ounces. In 1855 it attained to 2,497,723 ounces; in 1856 it reached its maximum with 2, 985,991 ounces, of a value of about £12,000,000 sterling. Since then, although gold has been found in New South Wales, Queensland, Tasmania and New Zealand, the supply has continually decreased. For Victoria the yield was, in 1876, 1,095,787 ounces, of which 605,859 came from the veins, and 357,901 from the alluviums, and, in 1879, only 758,947 ounces, of which 465,-637 from the veins, and 293,310 from the alluvium. The number of miners has already considerably diminished. In 1850 there were 147,358, of whom 33,673 were Chinese. In 1873 there were not more than 37,453, of whom 14,784 worked at the veins, and 22,769 at the alluviums.

In the province of New South Wales the mountains contain veins and the rivers auriferous sands. They were worked in all directions in a zone of at least 180 miles breadth; but the veins were not remunerative, and the alluviums were soon exhausted, so that the product regularly lessened. In 1871 it rose, according to Daintree, to 535,492 ounces.[1] For the later years I borrow the figures from the excellent report of the German Consul at Sidney, reproduced by M. Soetbeer.[2]

It says: "The gold received at Sidney, at the Mint of the Colony, from New South Wales, in 1876 rose to 126,780 ounces, of the value of £479,133. These figures diminish each year. In 1872, the year which yielded the most, the produce was £1,513,186. In 1878, as I have remarked in my report of last year, the production of gold continued to decrease. In 1877 the Mint only received 97,582 ounces, of the value of £366,329. In 1879 the gold receipts (as proceeding from the workings of New South Wales) have fallen to 75,492 ounces, of the value of £279,166. The yield of gold from all sources amounts to 109,347 of the value of £382,741. Three fourths of the ore are obtained from washings." The chain of Australian mountains on entering Queensland, widens, and with its lateral ridges attains a breadth of twenty-five miles. Here, also, volcanic rocks, diorite and even granite, have brought gold to the surface. In many of the rivers, auriferous sands and large nuggets have been discovered, and already the veins are heavily worked. The richest mine, the "Comstock" Lode, of that Colony, is that of Gympie, to the north of Brisbane, on the Mary river. At the end of 1868 this mine yielded nearly 84,000 ounces, and 70,852 ounces in 1869. Since then the produce has been maintained tolerably regularly. The works have already reached a depth of 600 feet. Queensland also has had its period of promising discoveries. Thus in 1874, the Palmers' gold fields, where 6000 men were collected, produced 175,000 ounces. The German Consul of Brisbane gave the following figures for this province: £1,429,929 in 1876, and £1,611,105 in 1879. He added, "As fresh discoveries continue to be daily made, and as this district contains hundreds of square miles where no white man has yet planted his foot, still further discoveries of rich gold fields may be hoped for." This hope, although not without foundation, is not yet realized, as from the most recent reports the exportation of ore from Queensland had fallen to about one million sterling in 1878. South Australia and Tasmania

[1] 1881, $34,700,000.

[1] Queensland 1873.

[2] *Jahrbucher fur national Okonomie*, 1881, 4 Heft, p. 370.

have also produced a little gold, the total value being about £40,000 in 1878.

New Zealand yielded about forty millions sterling of precious metal between 1857 and 1879. The northern island has not contributed more than five millions, found principally in the veins of the peninsula of Coromandel, which have not formed auriferous alluviums. In the southern island, on the contrary, which has produced seven times more (or thirty-five millions), the gold was found almost exclusively in auriferous sand and deep leads, which, strange to say, were discovered on the declivity of the mountains; here they also employed, as in California, hydraulic power for the working, and the process of exhaustion resembles that of the other gold countries. The growth is rapid, and the decline equally speedy; thus a gold field near Otago gives, in 1861, 187,695 ounces; in 1863, 580,233 ounces, and falls in 1869 to 149,364 ounces. The production of the two isles diminished, though slowly, of late years. The value of the gold exported was in 1874, £1,500,000; in 1875, £1,400,000; in 1876, £1,268,599; in 1877, £1,476,312; and in 1878, £1,244,192.

The following table, prepared from the very careful calculations of M. Soetbeer, shows the progressive decline of the total production of gold in Australia, which has fallen to the half of what it was twenty years ago:

Yearly average.

	Kilogrammes.	Value: German marks.
1856–60	86,700	241,893,000
1861–65	77,700	216,783,000
1866–70	70,400	196,416,000
1871–75	59,900	167,121,000
1876	59,100	164,889,000
1877	52,300	145,917,000
1878	45,300	126,387,000
1879	39,000	108,810,000

The exportations of metal to England have diminished still more rapidly and more abruptly. This seems to prove that Australia absorbs the metal, partly for her home circulation, and partly for her direct commerce with the Indies, China, and Japan. From 1871 to 1875 England received from Australia an average each year of £7,097,800 of gold; in 1878, £5,680,000; in 1879, only £3,180,600; and in 1880, £3,614,200. These are the actual facts, and they are not reassuring for the future. Certain mineralogists, as, for example, G. Ulrich of Dunedin in New Zealand, Director of the Mining Department of Sydney, do not share the gloomy forebodings of Dr. Suess. After all, they say, if the production of gold diminishes in Australia, it is not for lack of metal, but because the workmen prefer to buy the land for agricultural purposes, or for the rearing of cattle. So it is, but that is precisely what Dr. Suess affirms. When the gold-fields are exhausted, it is necessary to excavate the veins, and then the work generally ceases to be remunerative, though some continue to work for a time, encouraged by the exceptional success of some miners. Hope and the gambling fever stimulate them to work at a loss, but at length they become discouraged and stop. According to M. del Mar, on an average, each dollar drawn from the earth costs two. Australia still supports herself by the gold-fields and the deep leads; but when the miner shall be reduced to the "quartz reefs," the produce will certainly be reduced to one half. M. Ulrich himself, notwithstanding his sanguine views, admits that Victoria will fall to 600,000 ounces—that is, to half of what she has recently produced. It is estimated that Australia has supplied £260,000,000 sterling in gold to the world. The reader will, no doubt, have been fatigued with the uniformity of these details, but it is in *that* that the instruction consists. It is this identical repetition of the same facts which enables Dr. Suess to predict that the production of gold is fatally destined to decrease. He admits that one may perhaps still discover, in the less explored regions of the Rocky Mountains, of Central Africa, or in Australia, gold-fields as rich as those of California, or veins as marvelous as the Comstock Lode; but the more powerful our present process of working, the more rapid the exhaustion of the new mines. It has been so in the past, and it will not be otherwise in the future.

From all these facts Dr. Suess concludes that the desire to make everywhere gold the *only* coinage, to the exclusion of silver, is pure madness. Geology opposes it. There does not exist in the world gold enough for that purpose. The true money metal is silver. Locke was right in saying "Silver is the instrument and measure of commerce in all the civilized and trading parts of the world"; and Bagehot expressed the same opinion before the Silver Commission of 1876 (Question 1389): "Silver is the normal currency of the world." In proportion as the people become wealthy and industrious, they require more and more gold, so that the diminishing production of gold will be barely sufficient for the use of the arts and manufactures, and the yellow metal will disappear, little by little, from circulation. At all times gold has been a subsidiary money—a money of luxury. It was a consequence of natural laws. Economical necessities will oblige men to submit to them. That which has passed since the date of the publication of Dr. Suess' book (1877) has plainly confirmed his predictions. Already the scarcityof gold has created an appearance of disquietude. One cannot be surprised at it, when one thinks of the small quantity of gold which is at man's disposal. The total quantity of this metal produced since the discovery of America is calculated to be £1,400,000,000. A learned professor of the University of Rome, Messedaglia (*Storia e Statistica dei Metalli preziosi*), has calculated that this sum, equivalent to 535 cubic mètres, would be sufficient only to cover the pavement under the cupola of the Pantheon or of St. Paul's with a bed of gold of 37 centimètres, or one foot in depth, and the annual production would add to it barely one centimètre. Of this quantity what remains under the form of money and ornaments? Perhaps one milliard sterling. M. Soetbeer shows that there exists as money in civilized countries (less India and the extreme East) 13,400,000,000 German marks (£670,000.000) of gold, and 8,400,000,000 marks (£420,000,000) of silver. That which singularly aggravates the economical situation is that the world's currency, which was maintained yearly, till 1873 by gold and by silver united—that is to say, by a total value of £35,000,000 sterling—is now to be kept up by gold alone, of which the production does not attain more than £20,000,000 each year.

Trade consumes certainly from twelve to fourteen millions sterling; for official reports show that manufactures and arts require, in the United States, 10,000,000 dollars or two millions sterling, the same amount in France (54,000,000 francs in 1878), and even more in England; that is, six or seven millions for these three countries alone. India takes away every year between two and three millions, so what remains for the requirement of the coinage in all the civilized nations? We must not forget that, according to M. Soetbeer's calculations, there has been coined in the last twenty-five years, from 1851 to 1875, £800,000,000 sterling gold, and £440,000,000 silver. Deduct what you will for recoinage, there remains certainly, taken yearly by the mint, a sum immensely superior to the four or five millions gold that the arts leave for the monetary requirements. Even supposing that the absorption of gold by America will suddenly stop—and it amounted in 1879-1880 to $75,891,391, in 1880-1881 to $91,168,650, or for these two years nearly 34 millions sterling, that is the third of all the gold coin of England—it is beyond all doubt that if silver remains proscribed, there will not be gold enough for the monetary and industrial uses of Europe. Already at the very moment these lines are written, the gold scarcity begins to be seriously felt on the money market. The Stock Exchange is looking with anxiety to every withdrawal of metal from the Bank. What the late Mr. Bagehot used to call "Apprehension Point" is very near. Soon the sentiment of living under the perpetual fear of lacking the breathing air of commerce—*i. e.* of the means of exchange—will become intolerable, long before the exhaustion of the gold washings predicted by Dr. Suess will be realized. It becomes every day more evident that the dream of using gold alone as universal money is a mere impossibility. The two precious metals, gold and silver, are not even sufficient for the rapidly growing wants of trade and luxury throughout the world

Emile de Laveleye in The Nineteenth Century.

WHY GOLD AND SILVER ARE USED FOR MONEY.

GOLD and silver were adopted as standards of value long before the beginning of the historical era; and their fitness for money was evident, even to barbarians. They are hard and not subject to oxidation, and therefore they can be kept and handled with comparatively little loss. They have a brilliant lustre, suitable for articles of ornament; and the peculiarity of the lustre, color, and high specific gravity, renders them easily distinguishable from other substances, and makes imitations difficult. They are fusible and malleable, so that they can be made into any form, or stamped with any impression, and the hardness will protect the form or impression from wearing out. Both metals are found pure, so that savages would become accustomed to their use before learning to smelt the ores of iron, copper, and lead. Both metals are rare, and thus a small quantity has served to represent a large value of other articles; and wealth in the form of gold and silver could readily be concealed, or transported from one country to another. There are other hard, rare, and lustrous metals, but they cannot be refined, or their lustre is not peculiar, or the supply is not regular, or they have no recognized value in the arts; and thus gold and silver are to-day, as they were five thousand years ago, the best of all metals for the purposes of money.

The Quantity of the Precious Metals in Greece and Rome.—The quantity of precious metals was small when Athens began to throw the brilliancy of her intelligence and genius over the ancient world. About the year 600, B. C., nine bushels of wheat could be bought for an ounce of silver in Greece; or, in other words, a bushel of wheat cost fifteen cents of our money. The advance of civilization was accompanied by an increased production of gold and silver. There were mines of both metals in Egypt, Thrace, Armenia, Spain, and the dominions of Attica. Spain had the richest mines, and the placers in the Asturias produced $4,000,000 annually for a time, and a silver mine at Guadalcañal yielded three hundred pounds of metal daily. The spoils of Persia added greatly to the stock of the precious metals in Greece, and after the death of Alexander an ounce of silver would buy only three bushels of wheat, or only one-third as much as three centuries earlier. In Italy, previous to the first Punic war, gold and silver were still very scarce and high in price, but when "the senate and people of Rome" became masters of the world, wealth poured in upon them from all the borders of the Mediterranean, and the bushel of wheat which cost the twentieth of an ounce of silver 350 B. C., cost an ounce and a third in the middle of the first century. The annual revenue of the empire in the time of Augustus, was $200,000,000, and that emperor received $150,000,000 in legacies from his friends. Cicero received $800,000 in fees, a sum which has probably never been paid to any modern lawyer. C. C. Isidorus, besides large estates and four thousand slaves, had $15,000,000 coin at the time of his death, calculating the value of the money according to weight. Jacobs estimates the total stock of coin in the Roman empire in 40, A. D., at $1,750,000,000.

The Principal Epochs in the Modern Production of the Precious Metals.—As civilization declined the quantity of the precious metals decreased, and Alaric consented to spare Rome for $1,500,000, and forty years later the Eternal City had some difficulty in raising $1,200,000 to buy off Attila. The annual average wear of coin is estimated at about one part in 360; and when this continues for centuries with no new supply it makes a great reduction. According to the estimate of Jacobs there were in 1492 only $170,000,000 of the precious metals in Christendom. Previous to the conquest of Mexico the new world yielded only about a quarter of a million dollars annually to Spain, the government of which lost considerably by the discovery, until Cortes succeeded in overthrowing the government of the Montezumas. The Aztecs washed gold from the placers and smelted silver from the ores, and had a considerable stock of precious metals on hand when Cortes came. He, of course, took all he could get, and he and his associates soon commenced the working of the lodes known to his subjects. Among these were Tasco, Zultepec, Tlalpujahua, and Pachuca, all in the vicinity of the capital. The annual shipment to Spain from 1519 to 1545 was $3,150,000. In the latter year the mines of Potosi were discovered, and their yield was so great for that age that a wonderful impulse was given to mining industry throughout the new world. In 1548 Zacatecas began to produce its treasures; Sombrerete in 1555, and Guanajuato in 1558. In 1557 a miner named Pachuca, made a discovery that was more important to silver mining than even the opening of Potosi. He found that silver could be extracted from the common ores by mixing the pulverized mineral with water, salt, and copper pyrites, and it was a process that required very little water, no fuel, little machinery, no mechanical skill, and few buildings. It was a method of reduction peculiarly adapted to the treeless and waterless mountains, and to the ignorant mining population of Mexico and Peru. Previously all the silver had been obtained by smelting in a very expensive and wasteful manner, the furnaces being small and very numerous; so that it was impossible to prevent great loss, both by incompetency and dishonesty.

Some years elapsed before the amalgamation process was extensively adopted, but within ten years it had been introduced into all the mining districts of Spanish America; and the workmen became expert, and as the mine-owners found the separation of the metal on a large scale could be supervised by one or two men, and that thus waste and thieving could be prevented to a much greater extent than before, they made renewed exertions to extend their works. The production of Potosi was six times as great in 1585 as it had been twelve years before, owing partly to the general use of amalgamation, which was first introduced there in 1570, and was not generally accepted until some years later. The copper-pan or cazo amalgamation was discovered in 1590, at Potosi, by Alonzo Barba, but its use was confined to a few districts. It was during the last decennium of the 16th century that Potosi was in its most prosperous condition, producing $7,500,000 per annum. In 1630 the mines of Cerro Pasco were discovered. In the years 1726 and 1727 the Vizcaina and Jacal mines of Zacatecas yielded $4,500,000. The great bonanza of Real del Monte was opened in 1762, yielding $15,000,000 in twenty-two years. The great wealth of the Veta Madre was demonstrated in 1768, and Guanajuato rose almost to the leading position among the argentiferous districts. The production of silver in Mexico increased very rapidly from 1770 until the beginning of the revolution; and the increase was owing to various causes, including the reduction of the royal tax from 20 to 10 per cent. on the gross yield, the reduction in the price of quicksilver, the opening of commerce to Spain, merchant vessels from numerous ports instead of confining the trade to vessels from only two ports, the reduction of the price of blasting powder from 75 to 50 cents per pound, the abolition of the alcabala, an article needed at the mines, (an odious and oppressive tax on internal trade), and the purchase of bars by the provincial treasury. The fact that the country could produce $10,000,000 annually from 1760 to 1770, as it did, in spite of all these restrictions, furnishes conclusive proof of the wonderful wealth of the mines, and also of the industry of the people. A tax of 20 per cent. on the gross yield would paralyze every branch of British and American mining, and would entirely stop the production of the precious metals in many districts of California and Australia. Quicksilver, of which more than a pound was lost for every pound of silver extracted, cost 80 cents per pound in 1750, and was reduced in 1767 to 62 cents, and in 1777 to 41 cents. The purchase of bars by the provincial treasuries was of great benefit to the miners, who previously had to sell their bullion at a loss of 20, 30, or in remote districts even 40 per cent. There were few merchants, and those few expected to make great profits from their transactions. The mines of Hualgayo in Peru were found in 1771, and three years later the placers of the Ural, which were known in the time of Herodotus, were rediscovered. It was estimated in 1777 that two-fifths of the silver of Mexico was obtained by smelting, but this was probably an exaggeration, and when Humboldt was in the country only one-seventh was taken out by the means of fire. The mines of Catorce were opened in 1778, and proved to be very rich, the mine of Padre Flores yielding $1,600,000 the first year. The mines of Guarisamey, near Durango, became productive in 1788. For two centuries the pulp in the yard amalgamation process, made with pulverized ore, quicksilver, salt, pyrites, and water, was mixed by the treading of men, who, notwithstanding the cold, moisture, and mercury, were generally healthy. Singular as it may seem, it was not tilll 1783 that mules and horses were introduced to this work; and, although the change saved 75 per cent. of the expense on that branch of the working, still it would probably not have been adopted when it was, but for the greatly increased production of silver in Mexico, and the difficulty of getting Indian *repasadores* in some districts. The great bonanza of Ramos, that yielded $18,000,000 in nine years, was opened in 1798. The mines of Mexico continued to increase in productiveness until the revolution, which was a war of races, the Mexicans against the Spaniards, the latter being in a small minority, but possessing most of the wealth, mining and commercial knowledge and enterprise in the country. They were driven out, and with them went three-fourths of the men who had the money and brains to conduct large mining operations. The production fell from $22,000,000 to less than one-third that amount, but it soon began to increase again, and from 1850 to 1860 it was as large as from 1795 to 1805. When the independence of Mexico was recognized and peace was restored, it was expected that the production would soon rise far beyond its former figure. The most brilliant hopes were excited in England, and they were based on many plausible considerations, but they were destined to bitter disappointment. Many of the best mines were offered for sale for about the amount which they produced annually. They had been well opened; their value had been proved; they had been abandoned while in full production, with large bodies of rich ore in sight; some of them had not suffered much by standing idle; their production had been increased at the average rate of three per cent. annually for 40 years before the revolution, and the workmen familiar with all the processes of mining and reduction were still numerous. And if such production and increase occurred under the oppressive policy of the Spanish government, and under the ignorant management of the Spanish mine owners, what might not be expected under a liberal republic and English engineering? The mines would no longer be burdened with the payment of one-tenth of the gross yield, over and above all the costs of refining and coining. The ore would no longer be carried up to the surface from depths of 1,500 or 2,000 feet on the backs of Indians, nor would it be packed 6, 10, or 20 miles on mules to the reduction works, nor would the water be hoisted up in raw-hide buckets by horse whims, nor would mules and horses drive the arrastras and stamps. Steam would pump the water, hoist the ore, and drive the pulverizing machinery. Wagons would do the transportation. Skilful engineers would direct the cutting of adits, shafts, and working levels, and educated metallurgists would have charge of the amalgamation. The production should rise to $50,000,000 or $100,000,000 a year, and those companies which could get possession of the best mines should make princely fortunes for all their shareholders. Great care should be exercised in the purchase of the property; only those mines should be bought which had been visited by Humboldt in 1803, and were mentioned in his book, and were known to have continued productive up to the revolution. On these principles, it was supposed that failure would be impossible. But failure was possible, and it came. England during the silver fever spent $50,000,000, for which she got little return save dear experience. Independence did not prove a great blessing to Mexico. Peace never came, and without peace there could be no success, for silver mining above all other pursuits demands peace. Forced loans were levied by the government on the productive mines, and the silver bars while on the way to the coast were taken by highway robbers. The steam machinery could not be taken to the mines till roads had been made and wagons imported; the roads cost immense sums; when the engines were in place native engineers could not be found, and foreign engineers were murdered; English superintendents and Mexican miners could not get along together; the mines were found in a much worse condition than that in which they were at the time of sale represented to be; and in a few years the mines of Mexico were, with a few exceptions, unequivocally abandoned to the Mexicans. The most notable mining districts opened in the 19th century have been the placer district of San Francisco in Sonora, in 1803; the Melkowka placers in Siberia, in 1816; the silver district of Fresuillo, in 1824; the silver district of Chañarcillo, Chili, in 1832; the silver district of Guadalupe y Caloo, in 1834; the silver district of Guadalcañal, in Spain, about 1830; the placers of the Altai mountains, in Siberia, in 1830; the placers of the Sacramento basin, in 1849; the placers of Australia, in 1851; the placers of New Zealand, in 1857; the placers of British Columbia, in 1858; the placers of Colorado, in 1859; the silver district of Washoe, in 1859; the Nevada iron pan amalgamation, in 1860; the silver and gold of Idaho in 1861; the placers of Montana in 1862.

Stock of Precious Metals.—The stock of coin in Christendom in 1492, and at various epochs since, may be thus estimated:

Stock of gold and silver coin in Europe in 1492			$170,000,000
Production of 108 years, less loss by wear		$690,000,000	
Used in arts	$140,000,000		
Sent to Asia	70,000,000		
Deductions		210,000,000	
Net gain from 1492 to 1600			480,000,000
Stock at end of 1600			650,000,000
Production of the XVIIth century		1,687,000,000	
Sent to Asia	165,000,000		
Used in the arts	300,000,000		
Abrasion and loss	385,000.000		
Deductions for the XVIIth century		850,000,000	
Net gain of the XVIIth century			837,000,000
Stock at end of 1700			1,487,000,000
Production of the XVIIIth century		4,000,000,000	
Sent to Asia	400,000,000		
Used in the arts	800,000,000		
Wear and loss	600,000,000		
Total deductions for XVIIIth century		1 800 000,000	
Net gain of XVIIIth century			2,200,000,000
Stock at end of 1800			3.687,009,000
Production of 1st quarter XIXth century		750,000,000	
Wear and loss	175,000,000		
Used in the arts	200,000,000		
Sent to Asia	125,000,000		
Deductions for 1st quarter XIXth century		500,000,000	
Net gain of 1st quarter XIX century			250,000,000
Stock at end of 1825			3,937,000,000
Production 2d quarter XIX century		1,200,000,000	
Wear and loss	200,000,000		
Used in the arts	350,000,000		
Sent to Asia	175,000,000		
Deductions 2d quarter XIXth century		725,000,000	
Net gain 2d quarter XIXth century			475,000,000
Stock at end of 1850			4,412,000,000
Production from 1851 to 1866, inclusive		2,500,000,000	
Wear and loss	250,000,000		
Used in the arts	600,000,000		
Sent to Asia	800,000,000		
Total deductions for 16 years		1,750,000,000	
Net gain from 1851 to 1866			750,000,000
Stock at end of 1866			5,162,000,000

The following is Jacobs' estimate, as given in Vol. II, pp. 70, 131, 214 and 322:

Stock on hand in 1492			£34,000,000
Production 1493–1599 over loss and wear		£138,000,000	
Used in the arts	£28,000,000		
Sent to Asia	14,000,000		
Total deductions 1493–1599		42,000,000	
Net gain 1493–1599			96,000,000
Stock on hand at the end of 1599			130,000,000
Productions of XVIIth century		337,500,000	
Sent to Asia	32,250,000		
Used in the arts	60,250,000		
Wear and loss	77,000,000		
Total deduction for XVIIth century		170,500,000	
Net gain of XVIIth century			167,000,000
Stock on hand at the end of 1699			297,000,000
Production of 1700 to 1809		880,000,000	
Sent to Asia	352,000,000		
Used in the arts	352,000,000		
Wear and loss	93,000,000		
Total deductions 1700 to 1809		797,000,000	
Net gain from 1700 to 1809			83,000,000
Stock on hand at end of 1809			380,000,000
Production from 1810 to 1829		103,736,000	
Sent to Asia	40,000,000		
Used in the arts	112,252,220		
Wear and loss	18,095,220		
Total deductions from 1810 to 1829		170,343,440	
Decrease from 1810 to 1829			66,611,440
Stock on hand at end of 1829			313,388,560

It has been customary to make estimates of the amount of precious metals in Christendom at various times by deducting the quantity shipped to China and Hindostan, and the quantity used for plate; but there is a constant change from coin to plate and from plate to coin, and the wide line which once separated China and Hindostan from European trade has now disappeared, and those Asiatic countries are within the pale of civilized commerce, and are almost as near to London and New York as California and Victoria. Whitney, in his Metallic Wealth of the United States, says that in 1853 the Russian empire produced 64,000 pounds Troy of gold; Austria, 5,700; the remainder of Europe, 100; Southern Asia, 25,000; Africa, 4,000; South America, 34,000; and the United States, (exclusive of California,) 2,200. The gold production of Chili in 1845 (the statistics for later years not being obtainable at the time) was 2,850 pounds Troy; of Bolivia, 1,200; of Peru, 1,900; of New Grenada, 13,300; of Brazil, 5,100; and of Mexico, 9,900. The yield of silver in 1850 is thus stated: Russian Empire, 60,000 pounds Troy; Scandinavia, 20,400; Great Britain, 48,500; Harz Silver District, 31,500; Prussia, 21,200; Saxony, 63,600; other German states, 2,500; Austria, 87,000; Spain, 126; France, 5,000; Australia, 10,000; Chili, 238,500; Bolivia, 130,000; Peru, 303,150; New Grenada, 13,000; Brazil, 675; Mexico, 1,650,000; California, 17,400; total 2,817,425 pounds Troy.

The effects of Prosperous Mining.—The first effect of the production of the precious metals in rich mines is that it enriches the individual engaged in mining, or at least gives him an opportunity to enrich himself. A large proportion of mankind are so stupid, so imprudent, so wasteful, or so indifferent to the value of money, that they cannot make money when they have the best chances, or keep it after they get it. The wages of miners are higher than those of other laborers, and when the mines are very rich the proprietors become possessed of immense sums. In the mining districts nearly every man when he goes out walking over the hills keeps a lookout for "indications," in hope of finding some vein that may make him a millionaire. The second effect of the production of the precious metals is to enrich the nation which possesses the mines, or to give it an opportunity to enrich itself. Nearly all mining districts are poor, although they consume luxuries which can elsewhere be afforded only by the wealthiest. The finest silks and the most costly wines went to Virginia City during the great bonanza in 1862, and similar extravagance had been witnessed before at Potosi, Cerro Pasco, Guanajuato, and Zacatecas. The owner of a rich mine cannot dig out the pure, precious metal with a shovel unassisted; he must employ a great number of laborers, and his money runs all through the community and stimulates every branch of industry. The whole nation feels rich, and it purchases for one day's work the productions on which other nations have spent two day's. The gold and silver are sent abroad to purchase those things which can be made cheaper abroad where labor has not felt the stimulus. The third effect of the production of the precious metals in large quantities is that the prices of other articles generally are affected. We want gold and silver for coin and for use in the arts, and the smaller the supply relatively to the demand the higher the value. The experience of ancient as well as of modern times has proved this principle. After Alexander conquered Persia, and enriched Greece with the spoils of Asia, three times as much silver was required to pay for a day's work as before; and now it requires in average years six ounces of silver to purchase as much wheat in Europe as could be bought in 1490 for one ounce. The cause of the change is the great relative increase in the supply of silver while there is no relative increase in the supply of wheat. The result of the great yield of the silver mines of Peru and Mexico in the 16th century was that between 1550 and 1600 wheat trebled in price. The production of the 16th century was about $690,-000,000, whereas, the production of $4,000,000,000 in the 18th century added only 50 per cent. to the price which wheat bore in 1600, but more than 200 *per cent. of the price which it bore in* 1500. When we compare ancient with modern times we see that the rise in prices was very much greater relatively in Rome after she became mistress of the world than it has been in modern Europe since the mines of America, Australia and Russia have yielded their treasures. The difference is owing partly to the fact that a large portion of the laborers in the Roman Empire were slaves, and the number of those who used money and could possess plate was comparatively small, and civilization was confined within narrow limits. The decrease of prices was less in proportion to the production of the precious metals in the 17th than in the 16th, and less in the 18th than in the 17th century, because business has increased with much greater rapidity in late times than before. Commerce, manufactures, and intelligent agriculture have grown wonderfully. Many branches of trade conducted mainly by barter several centuries ago are now managed exclusively with money. The laborers are all free, and each needs a stock of coin with which to make purchases in case of necessity. The use of silver table ware and of gold ornaments is very extensive, and large quantities of both gold and silver are used in various kinds of manufacture. The introduction of steam in mills, boats and cars has doubled the productive capacity of mankind, and far more than doubled the demand for money. The speed and cheap communication between all countries has added vastly to the general wealth, and has increased the demand for the representatives of wealth. The remotest parts of the world are now brought to our doors, and China and Hindostan open their laps to receive our gold and silver and prevent it from falling in value by becoming too abundant in our hands. One of the best indications of the increase of trade and the spread of civilization is the relative value of the precious metals, and we see that a net increase of $500,000,000, or an addition of 250 per cent. to the stock in the 16th century, trebled prices in half a century, while a net increase of $5,300,000,000, or 900 per cent., since the year 1600, has not trebled prices in 250 years.

—Compiled from R. W. Raymond's Reports.

BIMETALLISM: SINGLE AND DOUBLE STANDARDS.

THE purpose of this work and the references to coinage in the preceding paper of this part compel an examination into the great question of bi-metallism, and the maintenance of single or double standards.

The following clear exposition of mono-metallism though printed for private circulation, is too good to be lost in such a way, and is condensed here.

That there is a wide-spread misapprehension on the part of the public as to what constitutes the true value of the precious metals, as well as to the nature and functions of metallic money, and even among economists and financiers who have given the subject special attention; no one can, for a moment doubt, who has had occasion to examine the various theories upon the subject. The high estimation in which the precious metals have been held, in all ages and in all countries, and the avidity with which they have been sought by all manner of men, is, perhaps, more universal in its extent and influence, and uniform in its history, than that of any other object which relates to the aspirations or industries of mankind. And the pursuit of them has, apparently, always possessed a fascination which no other object could inspire, and which no danger or privation could repress. We trace back this thirst for gold not only to the remotest antiquity, and to the very confines of authentic history; but passing beyond these limits, we find it interwoven with all the traditions and legendary myths of prehistoric times, and coeval with the very creation of Gods and men.* Whether we trace back civilization through Aryan or Se-

*Sir John Lubbock supposes, in his "pre-historic Times," that gold was the first metal discovered and utilized by man. This is highly probable, as other metals are usually found as ores, combined with other substances; whereas, stream and placer gold is always found in metallic form, and from its native lustre, must have at once attracted attention.

The Hesiodic and Homeric Theogonies are full of references and allusions to the precious metals. And according to the "Works and Days," the successive races of men are named after the metals.

mitic channels, or attempt to penetrate the antiquity of the several families of the human race, as they successively come within the sphere of its progress and expansion; we everywhere find accumulated evidence of the fact that it was among the first objects to attract the attention of man and stimulate his industry. The human mind is sometimes almost appalled in contemplating the magnificence and opulence of the royal and commercial cities of those remote periods, as depicted by sacred and profane history, and the fabulous amounts of the precious metals accumulated in them, or expended in their construction and embellishment. We read the story in the hieroglyphics of the pyramids—in the ruined temples of the magnificent cities of the Thebaid—in the cuneiform inscriptions upon the walls and tablets found among the splendid ruins of Assyria—in the more classic ground of the Troad and the Peloponnesus—among the buried sepulchres of the Homeric heroes, of Ilium and Mycenæ—and even in those mysterious abodes, the tumuli of prehistoric man. Before the birth of commercial art, before the dawn of proprietary rights among men, the splendor of these metals had attracted the admiration and incited the acquisitive passions of mankind. In all ages historians have written and poets sung of their matchless properties and transcendent beauties, and the imagination and fancy have borrowed from them their happiest similes of all that is excellent in nature or admirable in art. And to tell us that these metals, for whose acquisition man, in all ages, has devoted the highest energies of his nature, and not unfrequently bartered his soul, possess no value except that bestowed upon them in subsequent ages, *as money*, is a travesty on the facts of history, which defies all dispassionate criticism.

It is well known that from the remotest antiquity down to the building of the Temple, and for several hundred years subsequent thereto, the quantity of the precious metals in existence far exceeded that, of which, modern times furnish us any account prior to recent discoveries. In all these hundreds, we may say thousands of years, before the precious metals—especially gold—were employed as *current money;* they were even more highly prized than now; if we measure their values by that of other commodities, or the wages of labor, as they existed in those days. Though they were then especially produced by slave labor, and belonged to the royal treasuries, and consequently, "their cost of production" was but a nominal element of value. In the ruder stages of society men dealt in exchange mainly by the simple barter of the products of their labor. As this became more subdivided, and its products more diversified, their exchangeable values became more incommensurable, and hence, the invention or origin of money, as a medium of exchange. At first, this usually consisted of some product of labor, possessed of general utility—then came the useful metals and their alloys—next came silver, and finally came gold; but not until some centuries subsequent to the invention of *coined money*. It is important to observe in this connection, that while the quantity of gold appears to have been greatly in excess of that of silver, it was then, as now, much the more valuable metal. And though we do not find that it was ever employed *as a currency*, until after the invention of coined money, it was doubtless employed in exchange and sold by weight—just as silver is to-day in England—long before it was made legal tender, or became current as money of account. We are told that Abraham returned from Egypt "rich in cattle, gold and silver," and somewhere about 1890 years B. C., we find him purchasing a burial ground from Ephron, for which he "*weighed* out to him four hundred shekels of silver, *current money*, with the merchant." This is the earliest mention we have of a precious metal as "*current money*." The shekel was both a coin and weight, and though the shekel of gold is frequently

The legend of the "Golden Fleece," in which the exploits of Gods, Demi-gods, and men, are so hopelessly mixed up, is supposed to be typical of the great wealth of Kolchis, and was a sort of prospecting party in quest of the golden sands of its famous rivers.

Zeus, the father of the gods, we are told, was "rocked in a golden cradle," and penetrated the "brazen prison" of the coy Danæ in a shower of golden dust—not an unsuccessful method, by the way, in more modern times, of propitiating the favors of that "fascinating mischief," which he inflicted upon mankind as a "punishment to mortals" for being outwitted in a little trade by Prometheus, their progenitor.

referred to in the Old Testament, and that metal seems to have been excessively abundant; we no where find it spoken of as *current money*. Indeed, we no where find that it was so employed prior to the invention of coined money, as already stated. And the Jews are said not to have adopted coined money until so late as the days of the Maccabees. The use of gold as money seems to have been first adopted by the Lydians, but to a very limited extent, and not until some 1200 years subsequent to the employment of silver for that purpose. And it was several hundred years subsequent to this, before it was so employed by the Greeks or Romans.

At the time of the building of the Temple, which was about 1000 years B. C., and still several centuries before we find any mention of gold as money; the metals had become excessively abundant, and, although silver was the current money of the day, and gold only a commodity, the former was but little better than a nuisance, and we are told that it was "in Jerusalem as stones * * for abundance," and that it was *nothing accounted* in the days of Solomon." It is true that some commentators undertake to explain this, by saying that it was so regarded for the purpose of art, but give us no authority for such an interpretation; whereas, Josephus tells us emphatically, that "there was nothing then to be *sold* or *bought* for silver," and elsewhere gives us a minute account of the enormous amount of that metal that was employed in the construction and decoration of the Temple. Economists tell us that the value of commodities arise from the "cost of production;" assuming labor as the true and ultimate measure of value. But practical miners and metallurgists know very well that the "cost" of producing silver is greater than that of gold; and that this great disparity of value between the metals existed for centuries before they were employed as money, or before it was attempted to "regulate" that value by "law." If there is any one thing well understood among all well informed economists—it is the nature and functions of money as expounded by Aristotle; and which has been made the basis of every definition of money by every subsequent writer who has represented it as an *intrinsic equivalent* possessing *inherent* value, as well as measure and sign of value.*

STANDARD MEASURE OF VALUE.

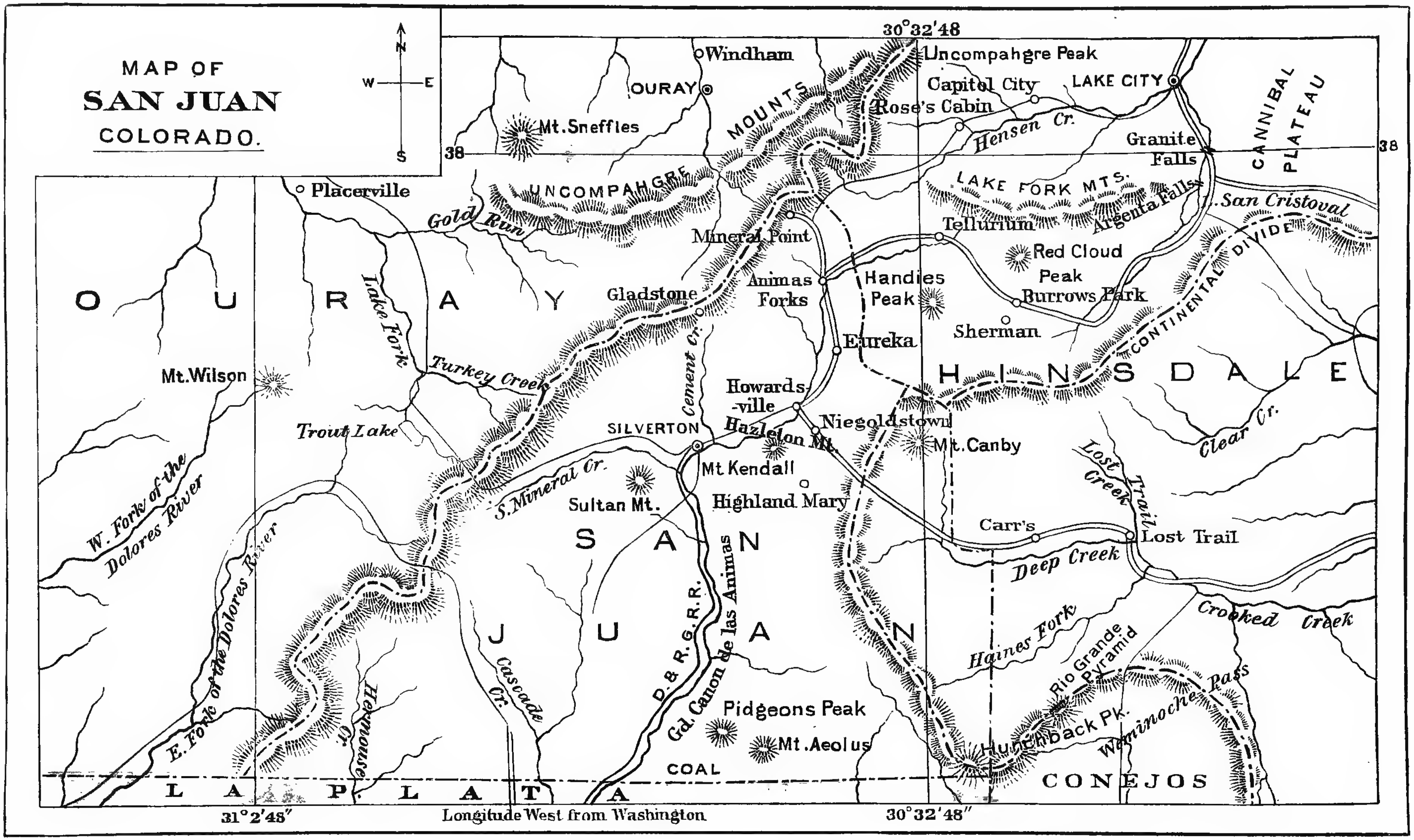
THE term "value," when applied to money *as a standard*, can only be taken in its mathematical sense, as meaning "quantity." When a standard of value has been once established, you may express the "relation" of value between other moneys, or between money and commodities, in terms of coin, made in accordance with such a standard; but you can convey no idea of the value of standard money *in terms of itself*, and can only do so by reference to some unit of physical magnitude or

* Among all modern writers, none are comparable to Locke in defining the nature and functions of money, or seem to have so clearly apprehended its true relations to human industry or stated them with such terse and philosophical precision.

"Men, in their bargains, contract not for *denominations or sounds*, but for intrinsic value, which is the *quantity* of silver by public authority, *warranted to be in pieces* of such denominations. And it is by having a greater *quantity* of silver that men thrive and grow richer, and not by having a greater *number of denominations* which, when they come to need their money, will prove but empty sounds." * * * * * * *

"Money is the measure of commerce and the rate of everything; it is the thing *bargained for*, as well as the *measure of the bargain*, being *equivalent* to the thing sold; it is not only the *measure* of value of the commodity it is applied to, but is given in exchange for it as of *equal value*." * * * * *

"The intrinsic value of silver, *considered as money*, is that estimate which common consent has placed upon it, whereby it is made *equivalent* to all other things, and consequently is the universal barter or exchange which men give and receive for other things which they would purchase or part with *for a valuable consideration*."—*Locke*. Montesquieu, Count de Verri, McCulloch, Chevalier, and others have embodied this essential idea of *intrinsic equivalent*, in their definitions of money; but in all of them we recognize the original idea of Aristotle, as something "really valuable itself."



—Drawn and Engraved for the Mines, Miners and Mining Interests of the United States.

"quantity." To say that a Sovereign shall be of the value of twenty shillings, or that an Eagle shall be of the value of ten dollars; gives us no idea of what either a Sovereign, a shilling, an Eagle, or a dollar is; but when we learn that a Sovereign contains 113.001 grains of pure gold, and an Eagle contains 232$\frac{2}{10}$ grains; we, for the first time, form a definite idea of the value or "quantity" which they express. Justinian evidently understood this, and what he meant by "perpetual value" of the "material," was its inherent or intrinsic value; and what he meant by the "power" of money, which he says depends upon its "quantity," was its *purchasing power;* and which, as before said, is entirely correct. For if it were enacted that hereafter a Sovereign should be worth forty shillings, or an Eagle should be worth twenty dollars; it would not, in the slightest degree, change the "value" or purchasing power of the Sovereign or the Eagle; *but would simply reduce the weight* or "*quantity,*" and consequently the "*value*" of the shilling and the dollar. This is shown by the fact that when we want to *over value* a coin, as in the case of subsidiary money, we simply reduce the *weight* or "*quantity*" of fine metal in it. It is surprising that the bimetallists do not detect the palpable inconsistency of their own arguments or interpretations. They endeavor to prove that money "*has value only by law,*" and not "*by Nature,*" and that the "value" of money consists in its "quantity," and that the "quantity is exactly that which *Nature produces.*" And it must follow, therefore, that "law" has nothing to do with the creation of "value," in the material of which money is made. But if the "value" or "power" of money "resides" only in the "quantity," and that "quantity is exactly that which *Nature* produces;" then it must be the "substance" only which the "law" creates; and as that substance is known to be gold, we have, at last, got a solution of the alchemist's problem, and the scare about the "insufficiency" of that metal is wholly sensational and unnecessary.

It seems almost puerile to comment seriously upon such statements as these; but it is just such material as this, furnished by "high authority," that has involved this whole question in such hopeless confusion, and by which these bimetallic enthusiasts attempt to establish the necessity of adopting the policy recommended by them. To any well informed person it will be scarcely necessary to state that not only did the precious metals have a high and well established value for centuries before they were employed as money; but when subsequently, they were so employed; their values, as such, were necessarily made to conform approximately to their previously established exchangeable values, for the very obvious economic reason, that any material *over valuation*, or *under valuation*, would either lead to an undue inflation of prices, or to expel them from circulation by over importation. And as the volume of money is but a very small percentage of the volume of commodities, whose exchange and distribution are affected by it—you would thereby either defeat the essential purpose of its creation, or produce disastrous results to the industries of the country. It would be a violent presumption, but no argument, to reason in reference to the value of any product or commodity, by assuming what the effect upon that value would be by suddenly throwing upon the markets of the world the entire stock of that commodity, which had been produced or accumulated for hundreds of years. This would simply be abrogating or suspending the operation of the laws of supply and demand; and would prove nothing. No product of industry would possess value by this process of illustration or reasoning.

It being abundantly evident then, from all the attested facts of history, as well as from the established principles of economic law, which imparts to and governs the value of the products of industry, that the precious metals possess an inherent value founded upon their utility, and have maintained this value in all ages and countries, with a greater uniformity than any other product in the pursuit of which men engage; we have next to examine to what extent that value is affected by their employment as money, or controlled by laws adopted for its regulation.

The Value of the Precious Metals but Slightly Affected by their Employment as Money.—From the quotations already made, it will be preceived that the phenomenal decline in the value of silver, which occurred in 1876, and from which it has but partially recovered, is specifically charged to the demonetization of that metal by Germany in 1873, and its *so-called* demonetization in this country by the act of February 12th, in the same year. It may be stated here, that so far as the recent disturbance in the relations of value of gold to silver is concerned; all the factors which enter into that problem have arisen since the discoveries of gold in this country and Australia. And to extend the investigation beyond this period, is only to ascertain the analogies afforded, in illustrating the principles of economic law, from which this disturbance has resulted. To show how entirely disproportioned this result has been to its alleged cause; we may state the following statistical facts as instructive upon this point, and which, at the same time, will have a bearing upon what follows further on. According to the elaborate report of the Goschen Committee of the British Parliament, it appears that for the twenty-one years ending December 31, 1871, the coinage of silver by the States now constituting the German Empire, had averaged about $20,600,000 per annum, and that the total amount remaining in circulation at that date was variously estimated to be from $225,000,000 to $295,000,000. For the purpose of argument, we will assume the maximum estimate. Of this amount $103,200,000 had been provisionally reserved for subsidiary coinage, of which $58,500,000 had been already coined to June 7th, 1876. The total amount called in to that date, was about $105,600,000, of which $29,200,000 had been sold within the three years since demonetization, leaving apparently, $17,-900,000 on hand; and $171,560,000 still in circulation and performing all the functions of legal tender money. Of the $207,300,000 on hand or in circulation, $44,640,000 still remained subject to the reservation for subsidiary curreney—leaving $162,660,000 as the extreme amount which might be called in and sold. Which, however, the committee state in their summary, might be as low as $40,000,000, with a "possibility" of exceeding $100,000,000. To determine to what extent this demonetization of silver has contributed to its decline in value; or whether, as an alleged cause of that decline it is at all adequate to the results produced, we may summarize the material facts as follows: Prior to the discovery of silver in the State of Nevada, the production of the world had been unusually uniform for a number of years, and at the time of that discovery was about $40,000,000 per annum. From 1860 to 1875, both inclusive, the aggregate production was about $905,000,000, being an average of something over $65,000,000 per annum; and which, for the sixteen years gives us a gross *exccss* of production of $240,000,000 or $15,000,000 per annum, as compared with the production prior to this discovery. We have already seen that about $30,000,000 had been sold by Germany from 1873 to 1876; or an average of $10,000,000 per annum. And that she had ceased to purchase silver for coinage to the extent of $20,600,000, which, had been her previous average consumption. The estimates of the production of the precious metals at remote periods are but little better than the wildest romance; and indeed, in our day, are extremely unsatisfactory. But for the purpose of illustration, we will here state the relative produce of the two metals at different periods as given by the most usually quoted authorities. For the periods stated, both years are inclusive.[1]

[1] We may state herc generally, that all statements we make concerning the production of the precious metals since 1850, are from tables compiled by us within the past thirty years, and which we have carefully compared with other *original* authorities, so far as they relate to foreign countries. From 1492 to 1800, we have substantially adopted Prof. Soetbeer's estimates, as he is now the most frequently quoted authority; although they appear to us very inaccurate, and we have been unable to discover upon what ground he has altered so materially, the estimates of Humboldt and others, whom we have been so long accustomed to regard as authorities best informed upon the subject. From 1800 to 1849, we have also followed compilations of our own from the best *original* sources accessible. As for this period, Prof. Soetbeer's estimates are so palpably erroneous that we were compelled to reject them. It may be observed that while there are many apparently irreconcilable discrepancies between the usually quoted authorities as to the production of the precious metals; when compared by single years, or short periods: therc appears to be a sort of compensating principle of error running through them, which, when applied to periods of fifteen or twenty years, eliminate these discrepancies, and the grand totals for such periods, as given by leading authorities, are, for all practical purposes, sufficiently accurate.

	Gold.	Silver.	Ratio.
Prior to 1492	$5,260,000,000	$3,430,000,000	69@40 per cent.
From 1493 to 1799, 307 y'rs .	2,360,000,000	5,030,000,900	32@68 "
" 1800 to 1849, 50 " .	750,000,000	1,350,000,000	36@64+ "
Total two last periods, 357 y's	$3,110,000,000	$6,380,000,000	33@67 +
From 1850 to 1875, 26 years,	$3,125,000,000	1,310,000,000	70½@29½

It will be perceived that for the twenty-six years ending with 1875—or the year before the great decline in silver occurred—more gold had been produced than in the previous three hundred and fifty-seven years ; and that the ratio of production had been more than reversed, as compared with the period prior to 1492. For the fifty years ending 1849, the average had been—

Gold — $15,000,000 per annum=36 per cent. } Average price of Silver,
Silver— 27,000,000 " 64 " } 60¼*d*.=15.53@1

For the twenty-six years ending 1875, the averages were, respectively—

Gold — $120,000,000 per annum=70½ per cent. } Average price of silver,
Silver— 50,384,000 " =29½ " } 60¾*d*.=15.53@1

It will be observed that in the latter period the *ratio of production* was more than reversed, as compared with the preceding period—and the average *excess production* of gold *per annum* was *seven hundred per cent.* Under ordinary conditions this great disturbance in the relative production, should have caused a marked decline in gold, as compared with silver. Whereas, by a remarkable coincidence, the *mean* of the *yearly averages* for the two periods *was precisely the same.* [For extreme fluctuations of each decade, see note, further on.] We shall presently attempt to explain the causes of this abnormal condition of things. In the meantime, it will be in the line of this explanation to briefly notice the circumstances existing in this country at the time of the so-called demonetization of silver by the Act of February 12th, 1873 ; to which the late Silver Commission attributed such disastrous results to our commercial and industrial interest, and such dire consequences to the entire human family. The reasons which led to the demonetization of silver in this country, we will state more in detail a few paragraphs beyond. For the present it will suffice to state that this demonetization *practically* took place in 1853, when the fractional silver coins were reduced at the rate of 28½ grains standard weight to the dollar, or nearly seven per cent.. From that date to 1872 inclusive, a period of twenty years preceding the alleged demonetization of 1873, something over $4,500,000 only of these dollars were coined—being an average of $225,000 per annum, or about half a cent per capita on the mean population for that period. But being undervalued, however, about 3½ per cent., they never went into circulation, but were exported; and never constituted any effective portion of the currency of the country. But for some twelve years prior to this alleged demonetization, it is well known that specie payments in the United States were suspended, and no kind of metallic money was in effective circulation—except on the Pacific coast—or had any monetary relations whatever to the current business of the country, during that period. But as the demand for, or consumption of silver is one of the effective factors in this question of its market price or value, as it relates to that of its demonetization—it may be stated, that, for the four years, from 1873 to 1876, both inclusive, the trade dollar and subsidiary silver coinage, amounted to over $65,000,000, or more than the entire silver coinage of the country for the previous twenty-five years; and therefore, the coinage of that metal in this country was much more effective in sustaining its market price, than it had ever been at any previous period.

Now, taking this condition of things in connection with that existing in Germany, what do we observe? We find the average price of silver in the London market for the year 1873, in which demonetization took place, to have been 59¼*d*. per standard ounce, corresponding to a ratio of 15·91 to 1 of gold, which is equivalent to a discount of 2$\frac{64}{100}$ per cent. on the ratio of 15½ to 1, and something less than ½ per cent. premium on our ratio of 15.988 to 1.* This average, by coincidence, corresponds exactly with that of the year 1845, some five years prior to the commencement of the extraordinary production of gold already referred to. No marked or sudden decline of silver occurred during the three years following this demonetization. But in the first six months of 1876 it declined from 56½*d*. in January, to 46¾*d*. in July, equivalent to 16½ per cent. Assuming the stock of silver in coin and plate among Occidental nations at that date, to have been $3,800,000,000 ; this depreciation would be equal to $627,000,000, or the entire product of the world for the previous ten years, *and nearly four times the whole amount that Germany was supposed to have for sale.* It is scarcely necessary to observe that we utterly fail to discover in this condition of things, any cause, at all adequate to such startling results. When, therefore, Mr. Seyd tells us, that because Germany had, in three years, sold 30,000,000 of silver, and some 160,000,000 more which she might sell at some future time; that this great and unprecedented decline was due to the demonetization, *"and that only;"* and when the distinguished gentlemen who constituted the late Silver Commission, repeat to us, that this demonetization, in connection with the fact that the United States had ceased to distribute among the people the enormous amount of a half a cent per capita of an old theoretical coin, which had never been in effective circulation; though coining silver to a greater extent than ever before: that not only was this depreciation due to these facts, but that it was also the cause of the wide-spreading commercial depression and industrial distress which had swept over two continents; paralyzing the energies of industry and trade in its course, and well-nigh bankrupting the Caucasian race, we are fairly appalled at the stupendous absurdity of the whole thing, and can but look upon it as—

"Resembling ocean into tempest wrought,
To waft a feather, or to drown a fly."

This great depreciation in the value of silver was undoubtedly due, to some extent, to the scare gotten up in relation to its probable excessive production in this country; which in that year reached a maximum not before attained. This is measurably confirmed by the fact, that from the low price of 46¾*d*. in July, it rose again in December of the same year, to 57*d*. or nearly 17½ per cent.—being equivalent to an appreciation of stock, of 660,000,000. The average for the year, however, was as low as 52¾*d*. Since that time, the fluctuations have not been violent, but the price has gradually gravitated downward, notwithstanding the unprecedented export to the East, in 1877, and the restoration of the double standard in this country in 1878. It reached its lowest annual average of 51¼*d*. in 1879—equivalent to a ratio of 18.40 to 1, or about 18 per cent. discount on the ratio of 15½ to 1. From this point of depression it has slightly recovered, and has now, for some time past, fluctuated between 52 and 53*d*.

Now, that Germany is no longer a seller, and the United States, for the past four years having become a much larger consumer than that country had ever been ; and therefore, more than an offset to her abandonment of the double standard : and as the present production of the two metals approximate each other more nearly than at any former period, this steadiness of price would seem clearly to indi-

* To ascertain *ratio* from any given price of silver per English standard ounce—

As one oz. of fine gold, at the Mint rate of 77½ per standard ounce, is worth 1019.4546 pence; and as one oz. of fine silver is equal to 1.081 ozs. of standard silver; the formula usually employed is—

$$\frac{1019.4546}{1081 \text{ x Price.}} = \text{Ratio.}$$

But as both the dividend and the divisor are fractional—a somewhat more accurate formula is this: The penny or $\frac{1}{240}$ part of a sovereign contains 0.47084 grains of fine gold without a fraction, and the oz. of English standard silver contains 444 grains of fine silver without a fraction; hence—

$$\frac{444}{0.47084 \text{ x Price.}} = \text{Ratio.}$$

To ascertain *price* per oz. of standard silver from any given ratio, we have the formula—

$$\frac{1019.4546}{\text{Ratio} \div 925.} = \text{Price.}$$

cate that there must be some more potent reason for the continued depression of silver than German demonetization affords. We are satisfied that it arises from a more deep-seated cause; and that *it is the effective result of economic laws* which have acquired vitality and been brought into active operation by recent radical changes in the commercial methods of the world, and by which the relative exchangeable values of the two metals *are being adjusted in accordance with their relative utility*, under existing commercial and industrial conditions. This, undoubtedly, is the true key to the solution of this perplexing problem. And this great decline in the value of silver is almost entirely due to the fact that its *utility*, upon which its exchangeable value is founded, has been impaired, if not superseded by the great abundance of gold, which has become more nearly adequate to the entire demands of commerce than at any former period, and performs all the functions of money more economically, and in that respect, as well as in others, more effectively: and is therefore, the preferred metal. This is a plain proposition, entirely susceptible of proof by indisputable statistical facts, concerning the production and movement of the precious metals, and requires no far-fetched theories of conspiracy, or imputations of insidious motive in the policy which any nation has adopted, or may think proper to pursue. Self-interest dominates the policy of nations as well as the acts of individuals, and it is a weakness in which none will indulge except visionary enthusiasts, to suppose that either will be controlled by the dictates of a more elevated principle. For the purpose of elucidating this theory, it will be necessary to state the essential facts concerning the production and movement of the metals, and the changes in business methods which they indicate. Having already stated this production down to 1850, we will only here repeat that of the last period for the purpose of illustration and comparison with those which follow. For the periods stated, both years are inclusive.

Productions of Precious Metals during the Undermentioned Periods.

	Gold.	*Silver.*	*Ratio.*
1800 to 1849, 60 years . .	$750,000,000	$1,350,000,000	36 @64
1850 to 1864, 15 years . . .	$1,925,000,000	$ 625,000,000	75½@24½
1865 to 1879, 15 years . .	1,615,000,000	1,015,000,000	61½@38½
Totals for 30 years . .	$3,540,000,000	$1,640,000,000	68½@31½
1850 to 1866, 17 years . .	$2,160,000,000	$730,000,000	
1867 to 1879, 13 years . .	1,380,000,000	910,000,000	

Annual averages of production by quintuple periods:

	Gold.	*Silver.*	*Total.*
1850 to 1854	$128,000,000	$40,000,000	$168,000,000
1855 to 1859	139,000,000	40,000,000	179,000,000
1860 to 1864	118,000,000	45,000,000	163,000,000
Totals for 15 years . . .	$128,333,333	$41,666,666	$170,000,000
1865 to 1869	$117,000,000	$55,000,000	$172,000,000
1870 to 1874	107,000,000	67,000,000	174,000,000
1875 to 1879	99,000,000	81,000,000	180,000,000
Totals for 15 years . . .	$107,666,666	$67,666,666	$175,333,333
Totals for 30 years . . .	$118,000,000	$54,666,666	$172,666,666
Averages for 50 years, ending 1849	$5,000,000	$27,000,000	$42,000,000
Excess of annual averages . . .	$ 103,000,000	$27,666,666	$130,666,666
Percentage increase of averages	700 per cent.	$102\frac{4}{10}$ per cent	311 per cent.
Estimated annual increase of population of Occidental countries	1½ per cent.	1½ per cent.	1½ per cent.

Exports of Silver to the East from Great Britain and Mediterranean ports.*

1850 to 1866, 17 years	$1,015,000,000	Average per annum	$59,800,000
Production for same period	730,000,900	" "	43,000,000
Excess of *exports* . .	$285,000,000	" "	$16,800,000

For the most active movement during this period, we have:

From 1853 to 1866, 14 years .	$963,000,000	Average per annum	$68,700,000
Production for same period	610,000,000	" "	43,500,000
Excess of *exports* . . .	$353,000,000	" "	$25,200,000
From 1867 to 1879, 13 years .	$560,000,000	" "	43,000,000
Product for same period	910,000,000	" "	70,000,000
Excess of *product* .	$350,000,000		$27,000,000

The exports of silver *into India*, approximate very nearly the *exports from Europe*, though a considerable portion of these imports comes from China and other points of the East to which they were originally consigned.

The gross and net imports into this country, for the 15 years from 1835 to 1849, both inclusive, were as follows:

		Per annum.	*Net.*	*Per annum.*
Gross	$180,141,085	$12,010,000	$122,264,595	$8,150,000
Produced . .	390,000,000	26,000,000	390,000,000	26,000,000
Excess . .	$209,888,315	$13,990,000	$167,735,405	$17,850,000

Sale of India Council Bills, prior and subsquent to the opening of the Suez Canal, in 1869:

From 1850 to 1869, 20 years .	$369,000,000	Average per annum	$18,450,000
" 1870-71@1879-80, 10 y's.	605,000,000	" "	60,500,000
Difference	$236,000,000	" "	$42,050,000

Gold Coinage.—The coinage of gold by Great Britain, France, Russia, the United States and Australia, for the 26 years ending with 1875, and just preceding the great decline in silver, was about $3,100,000,000. But the coinage of the last three named countries was so largely exported, and has undoubtedly entered so largely, by recoinage, into that of the two first named countries, that we take no account of it, nor of that which may have been coined by other Occidental nations, though, doubtless, it was very considerable. The total produce of gold for this period was about $3,143,000,000, being but slightly in excess of the coinage of the five countries mentioned. We, therefore, confine ourselves to the coinage of Great Britain and France, as probably representing the *effective supply* of gold, which took the place of silver drawn from Europe during this period:

1850 to 1866—coinage of gold	$1,575,000,000	From 1850 to 1875	$2,007,150,000
Exports of silver to the East	990,000,000	" "	1,296,000,000
Excess in supply of gold .	$585,000,000	" "	$711,150,000
Total production of gold . .	2,160,000,000	" "	3,143,000,000
" " " silver .	730,000,000	" "	1,300,000,000

Silver Stocked by Western Nations.

Average *annual exports* of silver to the East for 17 years ending 1866		$59,800,000
Average *annual produce* of silver in the world for same period—say		43,000,000
Loss of stock per annum		$16,800,000
Amount exported annually for 9 years ending 1875	$34,000,000	
Amount produced annually for same period—say .	61,000,000	
Gain in stock	$27,000,000	$27,000,000
Difference per annum in amount of silver *stocked*		$43,800,000

The foregoing figures show some phenomenal results in the production and movements of the precious metals. It will be observed that the produce of gold for the thirty years ending 1879 has been equal to that of the 400 *years preceding* 1850. It reached its annual maximum of $170,000,000, in 1852 * the greatest quintuple maximum of $755,000,000 in 1852-56, and the greatest decennial maximum of $1,405,000,000 in 1852-61. We further observe that after adding to the stock of precious metals over $4,500,000,000 in *twenty-five years*, an amount exceeding by $1,000,000,000, the product of *any previous period of* 100 *years*; the aggregate annual production of both metals during the last five years of this period of thirty years, exceeded, and is now exceeding, that which occurred during the period of *the maximum gold production*. It will also be perceived that simultaneously with this extraordinary production of gold, there also commenced the most remarkable export of silver to the East which has been witnessed in modern times. There appears to be no logical commercial connection between the two facts, and though their simultaneous occurrence is to be regarded simply as a coincidence, we shall presently see that it satisfactorily accounts for certain phenomena that would otherwise be very perplexing.

This unprecedented export of silver to the East continued

* These statements of the exports of silver are taken from the report of the Goschen Committee. The year 1850, from the table of Messrs. Pixley & Abell, page 20; and from 1851 to 1875, both inclusive, M. de Quetteville, p. 185, column 12. From 1876 to 1879, from the bullion circular of Messrs. Pixley & Abell, which, however, only state the export for these years from Great Britain. The exports of silver from the United States to the East are not included, but would not probably change materially the *proportion* existing between the exports of the two periods.

*The *"Journal des Economistes,"* and others, state this product at $182,500,000; but it includes the product of Australia for the *fractional* year 1851, which we have included in that year.

with unabated activity until 1866. The most active movement was for the 14 years from 1853 to 1866, during which the exports were over $960,000,000, which exceeded, by some $350,000,000, *the entire produce of the world for the same period.* In the meantime, the discovery of extensive silver mines in this country occurred; the produce of which, at the close of the period under consideration, reached $40,000,000 per annum, thus doubling the production of the world prior to its discovery. For the subsequent 13 years, comprised in the period from 1867 to 1879, both inclusive; these exports to the East fell to $560,000,000, while the world's produce for that period amounted to $910,000,000,—and which, without regard to the German supply, added $350,000,000, or $27,000,000 per annum, to the stock of Western nations, instead of a *deficit* of $353,000,000, as compared with the preceding period. *This increase in silver, coming upon the enormous accumulation of gold* which had been taking place while the former metal was being absorbed by the East, amounting to $585,000,000; gave an access of supply of nearly $1,000,000,000 to the current production of the two metals, then aggregating over $170,000,000 per annum; could not fail to produce abnormal relations in the value of the metals. If, now, in connection with this excessive stocking of the precious metals by Western nations, we consider the important and radical changes in the commercial methods of those nations as they related to Oriental exchanges, and which, by another coincidence, occurred at a period immediately following the cessation of the extraordinary exports of silver in 1866; we shall clearly understand why it was, that from 1850 to 1866, notwithstanding the enormous and excessive production of gold, as compared with that of silver, there was no corresponding disturbance of their relative values; and why it was, that the effective economic law, which controls their relations of value, did not assert itself, or develop its action until 1876.

Consumption of Silver as Affected by Important Changes in Methods of Oriental Exchange.—It must be borne in mind that, prior to 1866, when the exports of silver so suddenly declined, the commerce of the Western world with the great silver absorbing nations of the Orient, was carried on by sailing vessels around the Cape of Good Hope and Cape Horn. The commercial and financial centres of the Western world were thus in comparative ignorance of the condition of the Eastern markets, and the receipt of advices was usually months after date. The business with those remote quarters was carried on almost wholly by *direct exchange and remittances,* and it required from six to nine months to complete a commercial transaction and receive final returns. But within three years following this cessation of excessive exports of silver, which occurred in 1866, a complete revolution in the methods of business took place. In that year, the Atlantic cable connected Europe with the United States, and was rapidly followed by the completion of the transcontinental railway and the establishment of the China Steamship Company's line of steamers, as a branch of the Pacific Mail. Almost simultaneously with this, came the opening of the Suez Canal, in November, 1869, and the establishment of telegraphic communication with all parts of the East, via Cape de Galle. Thus, within a few years bringing the entire Western world *in daily* communication with the Orient. By these means business men in Europe and this country were kept daily advised of the exact condition of the exchange market of the East, as it related to inter-colonial as well as foreign exchange; and were thus enabled to utilize all the advantages of *cross and arbitrated exchanges,* in valuations on eastern markets, and the adjustment of balances. The advantages afforded by this new order of things is precisely the same with reference to foreign exchange—that clearance houses secure in local business. They obviate the necessity of the movement of bullion, just as the latter does the movement of coin; and it is only the final net balance that is to be covered, and not each separate intermediate balance, as must be the case where direct exchange only is employed.*

Concurrently with these radical changes in the channels of commerce, we notice some marked changes in the course of eastern exchange. For twenty years prior to the opening of the Suez Canal, the sale of India Council Bills, against the government revenues of India, had amounted to something less than $370,000,000, or an average of $18,000,000 per annum; whereas, for the ten years subsequent to that date, these sales amounted to over $600,000,000, or an annual average of $60,000,000; making a difference of some $42,000,000 per annum between the two periods. These sales obviated the movement of just so much silver, and in the latter period exceeded in amount, *the entire produce of silver in the world* for ten years prior to that event.

In pursuing this line of analysis, we further find that, for the twenty-six years ending with the year 1875, just before the great fall in the price of silver; the produce of that metal in the entire world had been $1,300,000,000, and the exports of the East for the same period amounted to $1,296,000,000 from Europe alone, thus practically absorbing the *entire amount of that produce.* For this same period of twenty-six years, the produce of gold had been over $3,140,000,000; and to say nothing of other mints, those of Great Britain and France alone, had coined and put in circulation in Europe over $2,007,000,000 of gold coin, in lieu of the $1,296,000,000 of silver coin and bullion withdrawn; an excess of over $710,000,000. In addition to this great accumulation of gold, and its current annual production, still some 530 per cent. in excess of the fifty years prior to 1849—comes an enormous addition to the stock of silver also, already noted. We here find an entirely rational solution of two problems. First, why it was that, notwithstanding the excessive production of gold from 1850 to 1866, there was but barely a perceptible appreciation of silver, as measured by gold. And secondly, why it was, that in 1876, and subsequently thereto, silver declined in value in a much greater ratio than the relative production of the two metals would require, as compared with their former relations of production and value.

The True Cause of the Depreciation of Silver.—This brings us directly to the consideration of the question of the relative "utility" of the two metals as the true underlying cause of this great disturbance of relative values. As already stated, from 1850 to 1875, both inclusive, the East drew from Europe alone, an amount of silver equivalent to the *entire produce of the world* for that period. And from 1853 to '66 it not only absorbed the entire produce of the world, but drew from Europe $350,000,000 of its old stock, but as fast as a vacuum was thus formed by this enormous withdrawal of silver, it was at once filled by the influx of gold from this country and Australia. And when it abated in 1866, its place had not only been entirely filled by gold, but the mints of England and France alone had supplied Europe with $585,000,000 of gold coin, *in excess of all the silver withdrawn.* This was largely more than was necessary to keep pace with any increase of population or expansion of commerce which had occurred, and had served to familiarize the business world with the superior advantages of gold as a medium of exchange for all large transactions. It, moreover, affords an ample explanation of the apparent suspension of the economic law, which regulates and adjusts the relative exchangeable values of commodities to their respective volumes and uses. The area of modern commerce is so extensive, and the diversities of human industry so great and complex, that the evidence of the effective operation of economic law is very slow in manifesting itself, in unmistakable industrial and commercial phenomena. It has been said that it was nearly 150 years after the discovery of America, before the full effect of the great increase

* A single example of the many important changes in the mechanism and course of exchange arising from these increased facilities, will suffice to indicate the saving in time and movement in bullion effected thereby. Instead of requiring from six or nine months as formerly, to make a remittance to China, for example, *via* Cape of Good Hope from London, and receive returns; a London banker can now telegraph his correspondent in San Francisco to remit fine silver or Mexican dollars for his account, to Hong Kong or Shanghai, as the local rates there may suggest, and to draw on London. Within twenty odd days the shipment reaches its destination. In the meantime the San Francisco banker can remit his sterling to New York or London direct, as prevailing rates may make most advantageous; and thus, from two to three times the amount of exchange will be effected *within thirty days on one movement of bullion,* that under the old methods required, as stated, from six to nine months. In the meantime, the London banker, being daily advised of local rates at all points in the Orient, can utilize all the advantages which arbitrated rates between those points afford.

in the precious metals, which followed that event, was attained. When, therefore, in 1866, and subsequent thereto, silver also began to accumulate rapidly—and coming upon markets abundantly supplied with gold for all legitimate commercial purposes, and its stock still increasing—it necessarily took some little time for the marked change in the supply of the metals which had occurred, as well as the important changes noticed in the commercial methods of distributing them; to manifest themselves by a corresponding change in their relative values. But it having now occurred, we think the facts stated clearly indicate that it is the legitimate result of effectual economic laws, whose operations for a time, acting with inverse momenta, counterbalanced each other; now reasserting themselves, and readjusting the relative values of the metals in accordance with the ratios of production and their relative utility under important changes of industrial and commercial conditions And that German demonetization has been altogether *a secondary factor* in producing this result. As already stated, utility is that inherent property possessed by commodities which enables them to fulfil some specific requirement or purpose of human economy. And while it is the source and basis of exchangeable value, it is in no wise affected thereby. Its only test is its *effectiveness* as an instrumentality, compared with other substances possessing similar functions. The utility of metallic money, therefore, must be measured by the security it affords as a "storage of value," and the effectiveness with which it performs the operations of commercial exchange and distributes the products of industry. These functions become necessarily impaired, as its volume becomes unnecessarily, or disproportionately increased, *as compared with the services to be performed by it*, or with the expansion of commerce and increase of material wealth. It not unfrequently occurs, that by new discoveries or improvements in commercial and mechanical arts, the utility of a substance is materially impaired by limiting its sphere of usefulness—and may be altogether superseded, and disappear from among the products of human industry.

If now we compare the enormous supply of gold for the last thirty years with the material progress of the Western world, we shall see that it has been greatly in excess of what that progress required, and out of all proportion to the relations previously existing between the metallic money in circulation among commercial nations, and the volume of their commercial transactions. And this excessive supply is abundantly shown by the enormous circulation of idle capital in all the financial centres of the Western world—and the unprecedented rates of interest, as shown by the marked advance in all interest-bearing securities, and the low rates obtainable for new loans—as well as by the speculative *mania* manifesting itself everywhere, and paving the way for over-production and commercial and industrial revulsion, at no distant day. While it may be true that recent political events and certain exceptional commercial exigencies have temporarily produced an abnormal movement and distribution of the gold of commerce; in view of the undisputed statistical facts produced, it is but reasonable to demand, at the hands of the advocates of bi-metallism, something a little more specific as to the insufficiency of the supply of gold, than the mere gratuitous statements of prominent financiers—however exalted their positions may be—unsupported by any statistical facts, either as they relate to the production of that metal, or to the increased volume of commercial transactions relatively thereto. With this stock of gold already largely in excess of the requirements of *legitimate* industries and commerce, and its annual supply, far in excess of any necessary increase of metallic money to keep pace with them, for years to come; to have some $350,000,000 of silver added to this stock within the last thirteen years, and its annual produce of $80,000,000, and prospective increase to be hereafter added thereto—is certainly sufficient to produce a great disturbance in the relative values of the two metals: and there cannot be a doubt that *the utility of silver for the purposes of money*, has been greatly impaired by the *great abundance of gold* and the marked advantages it possesses for all such purposes. The development and progress of human industry have long since established the fact that its *effective results* are largely in excess of the *increase of instrumentalities employed*—and it is a well recognized law of financial economy, founded upon this observation of fact, *that the increment of money which is necessary to keep pace with the increase of population and expansion of commerce, is but a very small per centage of such increase and expansion.* And the great increase in the facilities of communication and rapidity with which exchanges are effected, are daily reducing the ratio of that relative increase.

The Increase of Money Needed.—The factors which enter into this question of the quantity of money required for the *legitimate* purposes of commerce, *and the ratio of its increase*, are so numerous, that it becomes a very complex one, and it is practically impossible to establish any uniform rule upon the subject. First, we have the abnormal increase in the volume of money which expensive wars have, at some time within the past century, entailed upon all commercial nations, and which has arisen to a greater or less extent from the suspension or interruption of commercial intercourse, as well as from the necessity of increased disbursements. Then we have periods of high speculation, giving great activity to large volumes of money without adding, in any way, to the material wealth of the country, representing its progress, or distributing its products. But independently of these, we have the more legitimate variations in the quantity of money, and increase required; arising from differences in the nature and character of the commercial pursuits and industries of different nations, and their respective facilities of communication and exchange. The mere increase of population seems to be the least important factor which enters into the question; though it may furnish a convenient basis for computing the quantity, or indicating the ratio of increase.

Every man of family, and those who have had occasion to maintain large bodies of men, know that the increase in the expense of such maintenance, is not at all proportionate to the increase of numbers so maintained. It is also a well established fact that the percentum increase of material wealth and expansion of commerce, among leading commercial nations, is largely in excess of the increase of population, and is a much more important factor in the question of the increased supply of money which is necessary to keep pace with them. This again, however, is more or less modified by the nature of the industries pursued by each. Commercial nations seem to require much more money, *per capita* of population, than those engaged principally in agricultural and pastoral pursuits. And those which combine with commerce, manufacturing industries, involving minute subdivisions of labor and multiplied transactions; require still more. There are numerous other conditions which modify, to a greater or less extent, the final result. This will at once become apparent, upon a glance at the population and volume of money of Western nations, as shown by the most recent estimates:—The United States, Great Britain, Germany, France, Italy, Belgium, Netherlands, Denmark, and Spain, aggregating 224,500,000 population, average, *per capita*, $9.44 in paper money, and $15.69 in specie, making a total of $25.15. Among the highest are France and the Netherlands, being $53.10, and $39, respectively. And the lowest are Italy and Spain, being $13, and $13.77 respectively. Russia, Austria, Portugal, Sweden, Norway, Switzerland, and Greece—population 141,800,000. Paper, $7.93; specie, $3.15; total, $11.08. Canada, Mexico, Colombia, Peru, Central America, and Venezuela—population 24,600,000. Paper, $2.03; specie, $3.50; total, $5.53. Making a grand total of 391,000,000 population, with an average of $8.44 paper, and $10.88 specie, or $19.32 *per capita*. For Brazil and Chili we are unable to obtain, at the moment, any authentic data. The United States have in paper, $14, and in specie, $12, or a total of $26 *per capita*. Great Britain, $5.85 and $18.57, respectively, or $24.42 *per capita*.[1]

In 1860 the population of the United States was 31,400,000, with a circulation of $6.70 in paper, and $8.30 in specie, making $15. We now have a population of over 50,000,000; and have therefore, had, within the past twenty years, an increase of 60 per cent. in population, with only an increase

[1] With some modifications in the statement of population, based upon more recent estimates, we have taken the above figures from the report of the Director of the mint for 1880, which was obtained by extensive correspondence through the State Department, with our diplomatic and consular representatives in the several countries.

of 44 per cent. in metallic money—if so much.[1] And notwithstanding the great revival of business, and the gigantic speculative mania attending it; money is, relatively, far more abundant, and rates of interest much lower than they were in 1860. Money, undoubtedly, has an immense reserve power of measuring values, and its capacity is but partially developed by the greater or less activity of trade, and the momentum of its circulation, limited only by the facilities of exchange. The improved methods in this direction, which have taken place within the past twenty years, have greatly increased this power, and account for the fact, not unfrequently observed, of a largely increased business being effected with a diminished supply of money. In the vast extent of sparsely populated territory and limited credit system, this country is, undoubtedly, much below Great Britain and Continental Europe in those conditions which tend to reduce the volume of money required, as well as the ratio of its necessary increase. It will be, therefore, entirely safe to assume that it is above the average of the entire Western world in its monetary necessities. And if we admit the estimates of M. Chevalier, who has investigated the subject quite exhaustively, and which are undoubtedly high, we shall reach a conclusion that the alleged insufficiency of gold is wholly without foundation. He estimates that the increase of population is one-and-a-half per cent. per annum, and concedes, for safety, that money should increase *pari passu* with it. This gives us for the last thirty years an increase in population of 45 per cent. to provide for. We have already seen that for that period the average annual increase of gold has been 700 per cent. *in excess* of what it had been for the previous fifty years, and the increase of both metals had been 311 per cent. And that the increase of gold alone has been 181 per cent. in excess of that of *both metals* for the period prior to 1850. Now, if we assume that *one-half* of all the gold produced is consumed in the arts, it will still leave us 90 *per cent. increase* of that metal over that of *both gold and silver* for the previous period, which would be 100 *per cent. in excess of the amount required by the increase of population at this full estimate of M. Chevalier,* to say nothing whatever of the amount of silver produced and stocked for the same period.[2]

But we believe it has been much greater; for after repeated investigations, we have been unable to find any *authentic data* which at all justifies such an estimate as to the quantity of gold consumed in the arts, including losses and abrasion. The amount of the precious metals employed in the arts is regulated by the demands of trade, rather than by the vicissitudes affecting their production. And no impetus was given to this trade, following the discovery of gold in this State and Australia; at all commensurate with its enormous production. We find an apparent confirmation of this in the coinage of the metals. We have already seen, that, for the twenty-five years from 1850 to '74, an imperfect statement of the gold coinage of five mints, only, was nearly equal to the entire produce of the world. From 1875 to 1879, we have a more complete return, though that for the last year of this period is still incomplete. The produce of the world for this period was $495,000,000, whereas, the reported coin of nineteen States was $887,875,000; showing an excess over production, of $392,825,000, or *eighty per cent.* This, of course, is due to re-coinage. But if we only take the most prominent *producing* States, we have, for this period, a gold coinage by the United States, Russia and Australia of $412,000,000. This is over eighty-three per cent. of the entire produce. But Australia apparently only coined about one-half of her production. The re-coinage of foreign coins by the United States was about the same as her export of uncoined domestic gold. It will, therefore, be entirely safe to assume that at least $45,000,000, or *ninety per cent. of the produce of this period was converted into coin.* For the same period the produce of silver was $405,000,000, and the coinage of the same Mints $640,000,000; or an excess of sixty per cent. In view of all these facts, we cannot escape the conclusion, already stated, that, notwithstanding the statement of so many eminent authorities to the contrary; *the supply of gold alone* has been adequate to all the legitimate requirements of commerce, and its present and probable future produce, for a long time to come, abundantly sufficient to provide for any required increase. And that, therefore, the utility of silver for the purpose of money has been greatly impaired, if not superseded; and, as its exchangeable value is founded upon that utility, *its impaired usefulness is the true cause of its depreciation in the markets of the world.* There has been a marked tendency for the past two hundred years for silver to gravitate downward, as com-

[1] The above statement is based upon an estimate of about $260,000,000 of metallic money in circulation in 1860. This amount has been variously estimated from two to three hundred millions. We are rather disposed to accept the latter figures. The production of gold in this country from 1850 to 1859, inclusive, was $630,000,000. The coinage of gold for the same period was $345,000,000, and of silver, $45,000,000, making $390,000,000. In the exports of specie, which from 1850 to 1854, amounted to 119,165,000, coin is not separated from bullion. From 1855 to 1859, they consisted of $150,429,000, bullion, and $107,725,000, coin. The presumption is that much the larger portion of the 119,165,000 was bullion, as there are $285,000,000 of the $630,000,000 produced to be accounted for; and after deducting the 107,725,000 specified as coin, we have only $269,594,000 as the total export in all forms. The coinage apparently left in the country was 283,000,000, exclusive of any stock that may have been on hand in 1850. And as returning travelers and emigrants are supposed to bring more coin into the country than is taken out by that means, the specie in the country in 1860 was probably nearer $3,000,000 than the amount assumed, and which would reduce the percentage of increase, as stated.

[2] Senator Jones, in his speech of April, 1876, asserts that the increase of money should maintain a slightly increasing ratio to that of population, which is the converse of the proposition we have asserted and attempted to illustrate. In support of this theory he furnishes a number of statistical statements of population and stocks of specie at stated periods. These statements, when analyzed, *and taken in connection with the production of the world for the corresponding periods,* which he does not give, produce such discordant results, that it is impossible to deduce from them any general law or rule governing the question. For instance, he gives Jacob as authority for the statement that the stock of specie in the Western world in 1700 was $1,445,000,000. And in 1839, it was, according to Storch, $1,420,000,000. This shows an actual loss of $25,000,000 in 140 years, during which *population must have more than doubled,* and the supply of the precious metal to the Western world had been $3,510,000,000, after exporting $2,510,000,000 to the East, and *which is wholly unaccounted for.* We here give the *production* of the precious metals for the several periods stated, and his statement of the specie stocked during the same:

The Western World.

	Supply.		Specie stocked.
1493 to 1700	. . . $2,935,000,000		$1,280,000,000 = 43 per cent.
1701 to 1803	. . 2,485,000,000		355,000,000 = 14 "
1804 to 1839	. . 1,025,000,000		. . . . . . = ...
1840 to 1852	. . 1,000,000,000		700,000,000 = 70 "
1854 to 1872	. . . 2,055,000,000		1,100,000,000 = 53 "
Total supply	. . $9,490,000,000	Total stocked	$3,435,000,000 = 36 per cent.
To be accounted for	. . . .		. . 6,055,000,000 = 64 "

The Eastern World.

	Supply.		Specie stocked.
1493 to 1803	. . . $2,510,000,000		$700,000,000 = 27 per cent.
1804 to 1839	. 575,000,000		100,000,000 = 17 "
1840 to 1853	. . . 200,000,000		100,000,000 = 50 "
1854 to 1872	. . . 1,210,000,000		1,200,000,000 = 99 "
Total supply	. . $4,495,000,000	Total stocked	$2,100,000,000 = 47 per cent.
To be accounted for	. . . .		. 2,395,000,000 = 53 "

For the last period we have taken *the actual* exports of silver to the East, which exceeded the entire produce of the world—some $285,000,000. For the preceding periods we have taken these exports at one-half the produce.

The inconsistencies, however, as to the amount of money required do not end here. He tells us that "it has been calculated that specie measures *ten thousand times* its own value every year," and that it "will last, as against abrasion, loss by accident, etc., about *one thousand years.*"

Elsewhere, however, in stating the stock of specie in Asia in 1872, to be $2,100,000,000, he tells us that "merely to keep this stock reserved from the effects of abrasion and loss, Asia requires some $30,000,000 of silver every year." This would allow only the longevity of coin. In another place he makes it a little less than sixty-seven years. The measuring power of money, as stated, seems equally wide of the mark. If we take the population of the Western world at 400,000,000, and the amount of money at $20 per capita, we shall have $200,000 per annum, or nearly $600 per day, Sundays included, as the business transactions represented by every *man, woman and child in it.* And at this rate, we have no doubt, that a vast majority of people would be glad to compromise and take the equivalent of one year's operations for the balance of their natural lives. We scarcely think that such a data is sufficiently reliable to form the basis of any theory as to the monetary necessities of the commercial world, or to justify any important change of national policy concerning it.

pared with gold. Bnt prior to the discovery of the latter in this country and Australia; its supply was so limited, that, after satisfying the demand for the arts, the balance, when distributed among commercial nations, was so inadequate to the demands of commerce, that this growing preference for it could exercise no practical influence upon the relative values of the two metals, as it could never be said to have been in *effective* circulation as money. It is within the recollection of most of us, when a gold coin was regarded rather as a curiosity, and only to be worn as a *vade mecum*. But the phenomenal production of this metal which followed these discoveries, has not only familiarized the business world with it, but has demonstrated its many advantages over silver, as a medium of exchange. And notwithstanding all the absurd sentimentality in which the silver advocates indulged over the restoration of the dollar of our fathers, as some one has justly observed, it is now "always taken with a grudge, and given with a chuckle."

Depreciation of Silver but Slightly Affected by its Demonetization.—In view of the foregoing facts and considerations, it is scarcely necessary to say that Mr. Ernest Seyd's emphatic declaration, that the decline in the value of silver is due to German demonetization, and "*that only;*" is not only unsupported by fact, but is wholly illogical, as a deduction from principles of economic law. No one knows better than that gentleman, that England, from her extensive commercial relations with the silver producing, as well as silver consuming countries of the world, has, for many years, and until the discovery in this country; controlled nearly its entire produce of silver, and that all other nations have directly or indirectly drawn their supplies from her. Yet, when she demonetized silver in 1816, it at once *advanced in price*, and for five years following that event, averaged some $1\frac{3}{4}$ per cent. more than it had done for the five years preceding it. And for the 10 years subsequent to 1820, when the Bank of England had commenced accumulating gold, preparatory to the resumption of specie payments, it never declined beyond that percentage, below the average price, from 1811 to '15 inclusive. Just why, then, as he tells us, that "so long as Germany maintained silver, the equilibrium was maintained," and when she abandoned it "that equilibrum was lost;" we utterly fail to discover, when we consider the relative commercial importance of the two countries, and the diametrically opposite results which followed their respective changes of policy. It is only another illustration of the influence which hobbyism, or preconceived theories, will often exercise over the most intelligent minds, and the illogical positions in which it will betray them. Since the discovery of America, there has been no corresponding period in which the value of silver has continued so steady and uniform, as that of the fifty years following the demonetization by England in 1816.[1]

[1] The following extreme fluctuations of each decade since 1760, clearly proves this fact:

1761—67 $\frac{5}{8}$ *d* ℔ oz.=13 94 to 1· 1764—63 $\frac{3}{4}$ *d* ℔ oz.=14.91 to 1·	6 $\frac{96}{100}$ %	fall.
1774—62 $\frac{5}{8}$ *d* ℔ oz.=15.05 to 1· 1777—67 $\frac{3}{16}$ *d* ℔ oz.=14.04 to 1·	6 $\frac{71}{100}$ %	rise.
1781—70 $\frac{3}{4}$ *d* ℔ oz.=13.33 to 1· 1785—61 $\frac{3}{8}$ *d* ℔ oz.=15.21 to 1·	14 $\frac{1}{10}$ *d* %	rise.
1797—61 $\frac{1}{16}$ *d* ℔ oz.=15.45 to 1· 1799—65 *d* ℔ oz.=14.29 to 1·	7 $\frac{1}{2}$ *d* %	rise.
1806—66 *d* ℔ oz.=14.25 to 1· 1809—58 *d* ℔ oz =16.25 to 1·	14 %	fall.
1810—58 $\frac{3}{8}$ *d* ℔ oz.=16.15 to 1· 1816—69 $\frac{1}{8}$ *d* ℔ oz.=13.64 to 1·	15 $\frac{54}{100}$ %	rise.
1821—69 *d* ℔ oz.=15.98 to 1· 1824—60 $\frac{5}{16}$ *d* ℔ oz.=15.64 to 1·	2 $\frac{12}{100}$ %	rise.
1833—59 $\frac{3}{16}$ *d* ℔ oz.=15.93 to 1· 1839—60 $\frac{3}{8}$ *d* ℔ oz.=15.61 to 1·	2 $\frac{01}{100}$ %	rise.
1840—60 $\frac{3}{8}$ *d* ℔ oz.=15.61 to 1· 1843—59 $\frac{3}{16}$ *d* ℔ oz.=15.93 to 1·	2 $\frac{05}{100}$ %	fall.
1850—60 $\frac{1}{16}$ *d* ℔ oz.=15.70 to 1· 1859=62 $\frac{1}{16}$ *d* ℔ oz.=15.19 to 1·	3 $\frac{1}{4}$ %	rise.
1860—60 $\frac{11}{16}$ *d* ℔ oz.=15.28 to 1· 1869=60 $\frac{7}{16}$ *d* ℔ oz.=15.60 to 1·	2 $\frac{9}{100}$ %	fall.
1870—60 $\frac{9}{16}$ *d* ℔ oz.=15.57 to 1 . 1879—51 $\frac{1}{4}$ *d* ℔ oz.=18.40 to 1 .	18 $\frac{17}{100}$ %	fall.

We think now it should be abundantly evident that the precious metals have, and always have had, an inherent value wholly independent of that derived from the "legal fact" that they are "legal tender," notwithstanding Mr. Cernuschi's assertion to the contrary. And that also, the "quantity produced," is a very important factor among the causes which produce "variation" in the relations of value they bear each other. And that any proposition for the rehabilitation of silver, founded upon the theory that such is not the case; but that it is entirely within the control of legislative enactments, must end in disastrous failure.

As unamenable, as the advocates of such a proposition evidently are, to any statement of facts, or enunciation of economic principles tending to the demonstration of such a result; it may not be altogether uninteresting to state some of those historical analogies arising from the various experiments which other nations have made from time to time under much more favorable conditions, to accomplish the same thing in a modified form. The uniform result of all these experiments must go far to demonstrate to every dispassionate mind, the truth of what has been already stated—that there are, in this bi-metallic problem, elements of inherent antagonism arising from the operations of the economic and physical laws involved; which must forever prevent its furnishing either an *effective* medium of exchange, or *an equitable standard* of value.[1]

Why Double Standards have always failed, and must continue to do so.—Prior to the discovery of America, the production of gold had been about 60 per cent. as to 40 per cent. of silver; whereas, from 1492 to 1850, the ratio had been only 32 per cent. as to 68 of silver. We accordingly see that during the former period silver was, relatively, higher to gold than in the latter. The apparent suspension of the laws which regulates these relations of value, from 1850 until about 1875–6, has already been explained. But having again become effective, though still apparently not mathematical in the results produced; it is a question, as already suggested, whether the phenomenal relations of production and the revolution in commercial methods have not essentially altered their practical utility; and consequently their relative exchangeable values which are founded upon it? If this be true, it necessarily follows that all attempts to establish definite monetary relations between the two metals which do not exist between, or are inconsistent with their relative utilities for such purposes, must from a well-known principle of commercial exchange and the operation of physical law, result in failure. It is a maxim among cambists, that in the operations of exchange, remittances, by which bills or balances are to be covered, should always be such—the security being equal, as have the highest value, relatively to the par of exchange, at the point where the bill is to be paid; as compared with its cost at the point where the bill is drawn. Under this law the *undervalued* metal, or *better* currency, will invariably be expelled

[1] "As the values of gold and silver *perpetually vary*, not only relatively to other things, but also to each other, it is impossible arbitrarily to fix them by Mint regulations. * * The absurdity of employing two metals as legal tender, or a standard of value, was unanswerably demonstrated by Locke and Harris, and have been noticed by every subsequent writer."—*McCulloch.*

"Two metals, such as gold and silver, cannot serve at the same time, in the same country, for the medium of exchange, because this medium ought to be always the same and *retain the same proportionate value.* To adopt, as a measure of the exchangeable value of commodities, substances *which have no fixed or unvariable relation to each other*, is as if we were to choose for a measure of length an object which was subject to the process of distending and contracting itself. In each country there should be but one metal to serve for money of account, the payment of contracts, and the *measure of value.*"—*Locke.*

"What, then, shall be said of measures that are not only discordant and unprecise, but fluctuating also? What would be said of a bushel that alternately contracted and expanded, and contracted more than it expanded; of a rule of elastic rubber, or a pair of scales with a shifting fulcrum? And what shall be said of a fluctuating measure of value."—*Senator Jones.*

Echo answers what? As this is precisely to what the Senator has been devoting the highest energies of his intellect to accomplish, it would perhaps be edifying to the "fledglings of political economy. the charlatans of monetary conventions, and the numerous other dupes of Lombard street," if he would answer his own conundrums.

from circulation, and leave only the inferior one, for local or domestic purposes.[1]

This is not only theoretically and technically true, but the history of every experiment of the kind which has heretofore been made, furnishes overwhelming evidence, not only of its practical illustration, but of the endless vexation and annoyance in business transactions. But even if the vicissitudes of mining industries and the laws of commercial exchange did not defeat every attempt of this kind; the physical law of abrasion would be abundantly sufficient to produce the same result. This arises from the great disparity between the wearing surfaces of gold and silver coins *as compared with their relative units of valuation and velocities of circulation.* It is well known that coins of small denominations change hands much more frequently than larger ones—but even if this circulation was uniform, there would still be an immense difference in the relative abrasion. To show the extent of this disparity of wearing surfaces, we will here state the proportions of the relative areas in square inches, of the gold and silver coins of the United States, as compared with their units of valuation:[2]

	To $1 Gold in Double Eagle.	*To same in Eagle.*	*To same in ½ Eagle.*	*To same in ¼ Eagle.*	*To same in Gold Dollar.*
Silver Dollars . . .	24.08	19.77	15.31	11.50	6.70
2 Half Dollars . . .	30.87	25.35	19.63	14.74	8.59
4 Quarter Dollars . .	38.52	31.63	24.49	18.40	10.72
10 Dimes	52.33	42.97	33.27	25.00	14.56

So far as this question relates to the laws and usages of commercial exchange, as already stated, these disparities of wearing surfaces and the unequal abrasion arising therefrom, are practically confined to the silver dollar and the double Eagle and Eagle; and between them, it will be seen, the difference is from twenty to twenty-four times greater to the unit of silver than to that of gold; and the relative abrasion is doubtless still greater, and is amply sufficient to destroy, in a very short time, their *relative standard weights*, and, consequently, their *relative exchangeable values as bullion* for the purposes of export or use in the arts. Indeed, this physical law has heretofore been much more effective in producing the results indicated, than the economic law which relates chiefly to the question of supply and demand. Let us now, for a moment, see what has been the practical effect of these laws, as exemplified by the experience of the leading commercial nations who have heretofore attempted to maintain double standards. The first experiment of this kind affording any practical illustration of the action of these laws, was that made by England in 1663. Prior to that time silver had been, practically, the only legal tender, and, indeed, the commerce of the world at that period was almost entirely carried on by means of that metal. In that year, however, the guinea was for the first time coined, and we find the "irrepressible conflict" at once inaugurated. By the Act 2, Chas. I, in 1626, twenty shillings of gold had been made to contain 128,780 grains of pure metal, and the seignorage on silver was reduced from 2*s.* 6*d.* to 2*s.* on the pound troy of standard silver. This was equivalent to a ratio of 13,346 to 1 by Mint indentures, and to 13,431 in the market rate of silver. By the Act 18, Chas. II, in 1666, the weight of the guinea was fixed at 118,651 grains of pure gold; being a reduction of 10,129 grains, or nearly eight per cent. By the same Act the seignorage on silver was entirely removed, thus practically raising its market value some $3\frac{1}{3}$ per cent., and making the ratio to gold as 14,485 to 1; being a rise of 8.45 per cent. on the former ratio of fine metal in the coins, or $7\frac{7}{8}$ per cent. on that of the market price of silver. By this alteration of proportions of fine metal contained in the coins, gold was undoubtedly over-valued. In the meantime, the silver currency was in a most wretched condition, and prior to the great re-coinage under William III, the guinea had become current at from 28 to 30 shillings—equal to a discount in silver of from *forty to fifty per cent.* And even after the re-coinage, though only rated at 20*s.* by Mint indentures, it continued to circulate by common consent and usage, at 21*s.* 6*d.*, or some $7\frac{1}{2}$ per cent. premium on its nominal value. The consequence was, that the new silver coins disappeared as soon as put in circulation, and gold, as the over-valued metal, became practically the only legal tender. Subsequently, upon the recommendation of Sir Isaac Newton, the value of the guinea was fixed at 21*s.* by proclamation in 1717, and its weight of fine metal was reduced $\frac{1}{21}$ part, or 5,650 grains, which made its ratio to silver as 1 to 15,209, at which it remained until 1816, when the latter metal was demonetized, except as a subsidiary currency with limited legal tender capacity.

During this long period of 100 years, from 1717 to 1816, we are told that "*no silver coins of legal weight* were found in circulation," and nothing but the minor coins in a most degraded condition were current; and had been as far back as 1774 limited as legal tender *by tale* to payments of £25, and for larger sums only *by weight.* And to show how utterly non-effective was this metal, either as a currency or as a standard measure of value; we have the authority of Lord Liverpool for the statement that, for 83 years of this period, less than $35,000 per annum of silver was coined, and that for forty years prior to the suspension of specie payments by the Bank of England in 1797, less than $8,000 a year had been coined. And at that date, the half crowns in circulation were degraded, by abrasion, about *nine per cent.* below legal weight—the shillings *twenty-four per cent.*, and the sixpenny pieces *thirty-eight per cent.* Thus, we perceive, that for 150 years prior to 1816, and, indeed, we may say for the entire period over which this experiment extended; *the two metals* were never in *concurrent and effective circulation*, nor did they ever furnish anything approaching an effective or equitable standard of value, and were only productive of endless vexation and annoyance, unexampled in the financial history of that country. When now, we remember that the fruits of this experiment were just what her ablest economists had pointed out, as the inevitable results of such a violation of economic principles; and it was such eminent statesmen and practical financiers as Liverpool, Huskisson, Harris and others, who, with these disastrous results before them, recommended the adoption of a policy more consistent with the principles of economic and financial science, and which would obviate the inherent and self-asserting antagonisms of a double standard: we can well afford to be amused at the diatribes against England and her statesmen, of the financial charlatans whom this discussion has brought to the surface, and who, by some inscrutable and perverse ordination in the fitness of things; find themselves in positions sufficiently elevated to attract, if not to monopolize public attention with their driveling inanities.

Now let us look to France, whose example is so often referred to by double standard advocates. Here the condition of things was the converse of that which existed in England. But the operation and effective results of the underlying economic law were precisely the same. Prior to 1785, the louis d'or, or twenty-franc gold piece, was undervalued about one livre and ten sols, or $6\frac{1}{4}$ per cent. And the result was, according to the authority of the eminent economist, M. Jean Baptiste Say, *that all gold was expelled from circulation*, and silver only remained. To remedy this, the weight of the louis d'or was reduced $\frac{1}{16}$, which temporarily assimilated the legal and market ratios of value between the two metals. But before any effective restoration of circulation could take place, the revolution which was to convulse the world, was inaugurated, and specie was superseded by that valuable *fiat* currency, so memorable in her financial history, under the names of *assignats and mandats.* And before this nuisance could be fully abated, we find France again tinkering her metallic money by the celebrated law of 7 Germinal, year 11 (28 March, 1803). This law is memorable, as affirming that *inspired ratio* of $15\frac{1}{2}$ to one, which seems to possess such a mysterious potency, and to be founded upon principles of such eternal justice—that is but little short of sacrilege to intimate the propriety of its

[1] This is frequently called the "Gresham law," from the fact that Sir Thomas Gresham was supposed to have first called attention to it. But the principle is doubtless as old as commercial art, and has always been in effective operation. We might as well designate the law of gravitation and attraction as the "Newton law." But apples have been falling to the earth ever since "the fruit of that forbidden tree * * * brought death into the world"; and the law is coeval with the creation of matter itself.

[2] The above ratios of wearing surfaces to units of valuation of the several coins, are computed from their areas, as determined in square inches, by careful measurement of their discs and rims, kindly made for me by Prof. Geo. Davidson, of the U. S. Coast and Geodetic Survey, and whose name is an ample guarantee of their accuracy.

abrogation; although we cannot find that it ever corresponded with the relative exchangeable values of the metals in the markets of the world, except occasionally by accident. Up to this time there had evidently been nothing like an effective double standard. Soon after the restoration of peace, however, financial matters began to assume something of their former normal relations; but after such gigantic revulsion as that which had swept over Europe for twenty-five years, it was necessarily slow. No sooner, however, do we find preparations for the resumption of specie payments being made, than this irrepressible conflict of the standard reappears.

In 1816, some five years before the Bank of England resumed specie payments, silver had been demonetized, as we have seen. For five years prior to that date, the average ratio of the two metals, as determined by their market prices, had been 15.49 to 1—equivalent to $60\frac{7}{8}$*d.* per English standard ounce, and which is the nearest approximation we ever find for any similar period, to the French standard ratio of $15\frac{1}{2}$. For five years immediately following demonetization, contrary to all the theories we now hear from bi-metallists, silver advanced to $61\frac{15}{16}$*d.* per ounce, corresponding to a ratio of 15.23 to 1, and equal to a premium of $1\frac{3}{4}$ per cent. on that of $15\frac{1}{2}$ to 1. In 1819, the Bank of England commenced preparing for resumption, which became effective in 1821. Gold being now her only standard, the demand thus created for that metal, favcred, at a later period, by the political disquietude felt in France, and which culminated in the revolution of 1830; caused it to advance in price. And we find, for the decade ending 1829, a mean average of $59\frac{11}{16}$*d.* per ounce for silver, equivalent to a ratio of 15.88 to 1, or to a discount on silver of $1\frac{9}{10}$ per cent. at the ratio of $15\frac{1}{2}$, as against a premium of $1\frac{3}{4}$ per cent. for the five years ending with 1820. For the decade ending 1839, silver slightly recovered, averaging $59\frac{13}{16}$*d.* per ounce, equivalent to 15.74 to 1, and being $1\frac{3}{10}$ per cent. discount on the French ratio. As small as these divergencies were from that ratio, they were quite sufficient *to expel all the gold from France.* The official statements, show, that for the twenty-four years ending with 1839, and following demonetization by England, France exported through the customs alone, *an excess* over her imports, of $105,000,000—to say nothing of what must have been taken out of the country by private means, or was consumed in the arts. And her coinage of gold for this whole period averaged less than *two millions and a half per annum,* which is altogether too insignificant, in view of the hoarding tendencies of the working classes of that country, to afford anything like an adequate and effective currency. We do not find, therefore, that for any considerable portion of this whole period of fifty-five years following 1785, up to which silver had been the currency, that she possessed anything like an *effective* double standard. Now let us come to our own experience. By the Act of April 2d, 1792, our standard was first established, and the ratio of the metals was fixed at 1 to 15. Under London market rates, this corresponded approximately, to $62\frac{7}{8}$*d.* per English standard ounce. The average ratio in that market, however, for that year, was 14.43 to 1, equivalent to $65\frac{13}{16}$*d.* In fixing the ratio at 15 to 1, it was consequently, *undervalued* some $4\frac{3}{8}$ per cent. The next year, however, it fell to 15.01 to 1, or very nearly the exact standard ratio which had been adopted by this country. For the following fifteen or twenty years, from political and financial disturbances in Europe, it was subject to many fluctuations, more or less marked, but its general tendency was downward; and for the forty-two years, from 1792 to 1834, the average was 15.37 to 1 of $61\frac{5}{16}$*d.* per English standard ounce by this ratio, therefore silver was *overvalued* some $2\frac{1}{2}$ per cent. as compared with the average market rates, and $3\frac{1}{3}$ per cent. as compared with the French ratio of $15\frac{1}{2}$ to 1, which was $\frac{82}{100}$ per cent. below the average market value. This overvaluation of silver should, by the operation of ordinary economic laws, have retained it in circulation, and have expelled the gold; and doubtless did expel what little we had, as gold coin was still a curiosity in this country at a much later date. The real conflict was therefore, between the new silver dollar and the old abraded Spanish and Spanish-American silver, which constituted the major portion of our circulation; and which had been made legal tender at the same ratio but which, from its degraded condition, was the overvalued metal, and effectually expelled all full weighted coins as soon as put in circulation.

About 1828, however, gold began to be produced in appreciable quantities in several of the Southern States, and to assume more importance in the currency of the country. And in 1834, Congress reduced the weight of fine gold contained in the eagle, some $15\frac{1}{2}$ grains, or about $6\frac{1}{4}$ per cent.; thus establishing a new ratio of 16 to 1. By the general Mint Act of 1837, both gold and silver were required to contain $\frac{9}{10}$ of fine metal. Previously, the silver dollar had consisted of 4.16 grains, 892.4 fine, making 371.25 grains of pure silver; and the eagle contained 258 grains, 899.225 fine, making 232 grains of pure gold. The gross weight of the silver dollar was reduced to $412\frac{1}{2}$ grains, which, at 900 fine, gave $371\frac{1}{4}$ grains of pure silver, being the same as before; but the weight of the eagle, not being changed, the increase of fineness raised the amount of fine gold $\frac{2}{10}$ of a grain, which made a new ratio of 1 to 15.988. This ratio is practically equivalent to 59*d.* per English standard oz. (58.979.) But the average price in the London market for that year, was $59\frac{9}{16}$*d.*, (15.83 to 1), and for the following sixteen years, and until the parts of the dollar were reduced to subsidiary currency by the Act of 1853; the mean of the annual averages was $59\frac{15}{16}$*d.*, equal to a ratio of 15.73 to 1, which would be equivalent to an *undervaluation* of the silver coin of $1\frac{6}{10}$ per cent. As small as it was, it was quite sufficient to expel every dollar from circulation, and for several years prior to 1853, the Secretary of the Treasury had regularly called the attention of Congress to the urgent necessity of some legislation to supply the demand for small change for retail transactions. Although the silver dollar was, and had been, *wholly non-effective as a circulating medium,* it was the stipulated consideration in most existing contracts and obligations; and Congress supplied this want by demonetizing the parts of the dollar only, by reducing them some seven per cent. in weight, and limiting them to the payment of sums not exceeding $5. In the meantime, gold becoming abundant, the coinage of the *silver dollar became wholly non-effective.* Here, then, we have the practical results of the three most noted examples which the history of commercial nations furnishes, of attempts to establish and maintain a double standard; and in every case we see only disastrous failure. And its advocates may well be called upon to point to *a single example in the whole range of commercial history, of any nation, ever maintaining successfully an effective circulation of both metals.* We invariably find, in every instance, the *overvalued* metal only in effective circulation, in conjunction with the minor coins of the *undervalued* metal *in a most degraded condition;* and in no wise furnishing anything approaching a uniform and equitable standard of value, or an effective currency. Yet, in face of the fact that history furnishes no example of an effective double standard, where there was a difference of *even two per cent.* between the exchangeable market values of the two metals; and in violation or disregard of every principle of economic and commercial law: we find these distinguished gentleman in Paris seriously discussing the proposition to overvalue one metal *some eighteen per cent.,* and claiming that with a "*free and unlimited coinage,*" they can be made to circulate effectively, at such radically disproportioned values. The only conceivable result of such an experiment would be, as already intimated, *the rapid concentration of all the overvalued silver among the nations having credit balances,* and of which we have a striking illustration in the example of France, which has accumulated, since 1871, an amount of silver equivalent to nearly the *entire amount stocked by the Western world since* 1867, when exports to the East so perceptibly decreased.[1]

The advocates of bi-metallism, would perhaps, consider it as an attempt to evade what they regard as the most important example of all the experiments which have been made to maintain a double standard; if we failed to notice that of France in 1853. As already stated, silver had been the

[1] In 1870, the reserves of the Bank of France were $13,700,000 in silver, $85,740,000 in gold: a ratio of $13.8 to 82.2. In 1880, they were $245,789,000 in silver, to $116,140,000 in gold: a ratio of 68.3 to 31.7. In 1876, however, she held as much as $306,080,000 gold: a loss of $189,940,000 of gold in five years, with a gain of $236,089,000 of silver in ten years.

effective currency of that country up to that time, and was its standard measure of value, as declared by the law of March 28th, 1803. But in consequence of the enormous withdrawal of silver for Eastern account, which had then actively set in; she undertook to supply its place by the substitution of gold. This experiment has attracted much attention, and has been widely commented upon by subsequent writers on financial and economic questions. The distinguished economist, M. Wolowski, especially draws attention to it, as a practical illustration of the "compensatory" theory of a double standard which he espouses. It is claimed by him that a bi-metallic standard possesses *an inherit principle of self-adjustment.* A sort of automatic back-action, by which it maintains a perfect equipoise in the value of the two metals. That, as one metal has a tendency to fall below its legal relation of value to the other; by coining more largely the "cheaper" metal, the increased demand for it thus created, affects correspondingly, their relative market values, restores the equilibrium, and keeps the standard measure uniform. As an economic *postulatum*, this theory is not without its attractions; but when we come to analyze its *practical utility*, we not only find it subject to insuperable objections, but that M. Wolowski is very unfortunate in the illustration by which he seeks to demonstrate its utility and practical effect. The uncertainty, expense, and annoyance of constantly alternating from one metal to the other, would be a sufficient obstacle to its adoption; but the factors to be utilized are, unfortunately, not within the control of those who may desire to adopt it. A nation, may make laws for the regulation of its currency, but this question is subject to the laws of commerce and not to Mint regulations. A nation whose commercial balances are *all* favorable, might maintain a double standard when the divergencies from the legal ratio of the metals did not exceed, or only slightly so, the cost of transportation, loss of interest and commissions, or brokerage. But the net balance in favor of any commercial nation is usually the difference, only, between its favorable and unfavorable, or, adverse balances. And as, under a well-known law of commercial exchange, already referred to, balances or bills are always paid in that metal which has the *highest* value *at the point where payable*, relatively to the *cost* of the remittance at the point where drawn; the "cheaper" metal cannot be obtained, when wanted, in sufficient quantities, as suggested by M. Wolowski, without going into foreign markets and buying it; and the expense of doing so, fully offsets the supposed profit, if, it does not exceed it. And this is precisely what France had to do in this particular instance, and with precisely this result.

As already stated, this change of policy was a matter of necessity, rather than choice; growing out of the extraordinary withdrawal of silver for the East. The drain upon her reserves was so great that it became, almost, if not quite impossible to maintain them in silver. For the eight years ending 1860, she exported $296,000,000 of her coined silver, or $35,750,000 per annum, and $170,000,000 in bullion, or $21,250,000 per annum—making together $476,000,000, or an average of $57,000,000 per annum, *being* 40 *per cent. more than the entire produce of the world for the same period.* Now, the average price of silver in the London market for 1853, when this extraordinary export of silver, and coinage of gold, commenced, was 61½*d.*, corresponding with a ratio of 15·33 to 1, and equivalent to a discount of about one per cent. on gold, on the basis of 15½. The Bank of France went into the London market and made immense contracts for the purchase of gold to replace her silver. According to M. Chevalier, she paid as high as 15 per mille premium (1½ per cent.) for much of this, and for the two and a half years ending December 31st, 1857, she paid $2,707,700 premium on $262,000,000 of gold purchased. This was equivalent to an average of 1·03 per cent., to which, if we add the ⅕ per cent. as the cost of coinage, *we make the cost of the new coin* ¼ *per cent. greater than it was in the legal ratio of* 15½ *to* 1. And instead of this extraordinary coinage of $767,000,000 of gold for this period, *restoring the equilibrium*, according to the "compensatory" theory of M. Wolowski, it continued to decline, and reached its lowest price in 1859, just when this coinage reached its maximum of $135,000,000, in a single year, In the meantime, we find that in 1852, just before these extraordinary movements of the precious metals were inaugurated, the reserves of the Bank of France consisted of 86 per cent. of silver to 14 per cent. of gold, whereas in 1866, when the excessive report of silver ceased, they were 19 per cent. of silver to 81 of gold, and for this whole period the coinage of 5 franc pieces had averaged less than $1,000,000 per annum. In 1871 these reserves were only 13 per cent. of silver against 87 per cent. of gold, thus a little more than reversing the condition of things as it existed in 1852, and showing clearly, that *gold was the effective currency during this period, silver being comparatively nominal, and performing but little more than the functions of a subsidiary currency.* Thus, we see that the only theory advanced by the advocates of bimetallism, possessing the slightest plausibility, *and not absolutely absurd upon its face*, signally fails to accomplish what is claimed for it; and when tested by the practical operations of economic law and commercial usage, is proven to be wholly non-effective, except under conditions which would destroy the advantages upon which the theory of its supposed benefits is founded.

Monetary Functions of Coin only local, and affect but slightly the Exchangeable Value of the Precious Metals.—We think, now, it has been shown that no such thing as an *effective* double standard has ever existed in any country or in any age, and for the sufficient reason that it carries with it *an inherent element of self-destruction arising from antagonisms of economic and physical laws, which, from their nature, are beyond the control of legislative enactments or conventional agreements.* But while it is true that all these various attempts to make the metals circulate together as legal tender money, have signally failed; it is important to observe that they have scarcely exercised *any appreciable influence* upon their relative exchangeable values in the markets of the world, *or impaired their utility for the purpose of effecting commercial exchanges.* This is especially noticeable in the example afforded by the experience of England. We have already seen that when she demonetized silver, it made a material advance in market value, instead of declining. Of course, it would be absurd to claim that this advance was due to such a fact; it was doubtless due to other causes, and only goes to show that *the inherent value of the precious metals is founded upon a utility so universal throughout the world*, that the policy of *no one country*, however important in the family of nations, can materially affect it. It is well known that in times of great monetary stringency, especially when arising from financial or commercial revulsion; all inconvertible commodities suffer great depreciation or depression in prices, and are often wholly unavailable as a means of relief. Now, while silver has had no monetary function in England for some sixty-five years, except as a subsidiary currency, to the extent of £2; yet, she has continued to control, through her exchanges, the silver produce of the world, and to supply the wants of all other countries. An examination of the various financial panics, or periods of unusual monetary pressure, which have convulsed the London money market within the last fifty years, discloses the significant fact that *in no instance did silver bullion decline in value*, but in nearly every one *a marked advance* occurred, and reached its highest point when the alarm was most intense. Thus showing, that its utility for the purposes of exchange or the storage of value, *was in nowise impaired by the fact that it was not a legal tender.* And we cannot escape the conclusion, therefore, thus made apparent, that the importance of clothing both metals with specific monetary functions, has been immensely exaggerated by the advocates of bi-metallism, and that it is really a question of *only local or domestic financial policy.*

The *coined money* of all nations is treated *only as bullion in foreign markets*, and its *local monetary valuation* in nowise affects *its exchangeable* value in those markets, or its utility in the operations of foreign exchange. The whole trouble arises from the reluctance of commercial nations to realize and charge off the loss on their stocks of silver, which has resulted from its impaired utility and consequent depreciation of exchangeable value; in the vain hope that by some device or expedient, that exchangeable value can be maintained at a ratio to gold *wholly inconsistent with the respective volumes* of the two metals, *and their relative utility* for the purposes of commerce. We think now that we have presented facts amply sufficient to sustain the theory that, contrary to the general popular impression, the depreciation of silver has been but slightly affected by German demonetization, *and is really due to a loss of utility, arising from the excessive accumulation of gold.* We have, also, stated all the essential facts relating to the production and movement of the precious metals, and the economic effect of the laws of commerce and industry which control them; to demonstrate, clearly, that no such thing as *an effective* double standard has ever existed, and from the nature of the antagonisms involved, never can exist; and that it is wholly beyond the control of statutory regulation.

—*Compiled from Louis A. Garnett's "The Paris Monetary Conference and Bi-Metallism."*

MR. MULHALL'S ESTIMATES.

MR. MICHAEL G. MULHALL, F.S.S., who has won considerable praise for his careful calculations furnishes some tables upon this matter that throw a few side lights upon the subject. Upon gold and silver he says: These two metals, which have materially aided the cause of progress, have suffered such mutations of fortune in the nineteenth century, that it may be worth while to study their antecedents. Michael Chevalier is of opinion that at the period of the discovery of America the total amount of gold in Europe was only £12,000,000, and of silver £28,000,000. At that time an ounce of gold was worth ten of silver, but as soon as the conquest of Mexico and Peru by the Spaniards poured a flood of silver into Europe this metal lost one-third of its value. In the seventeenth and eighteenth centuries gold stood for fifteen times the value of silver. A new epoch occurred with the discovery of gold in California and Australia, but silver never recovered its position as a precious metal. The following table shows the progress of both metals since the time of Columbus:—

Date.	*Gold.*	*Silver.*	*Total.*
1492	£20,000,000	£40,000,000	60,000,000
1700	227,000,000	520,000,000	747,000,000
1800	440,000,000	1,026,000,000	1,466,000,000
1848	560,000,000	1,322,000,000	1,882,000,000
1880	1,220,000,000	1,612,000,000	2,832,000,000

During 300 years of the Spanish dominion in America the mines of Mexico, Peru, and Brazil yielded a little over £1,200,000,000, of which three-fourths were silver. Since Marshall's discovery of gold in California (1848) there has been an increase of £950,000,000 in precious metals, as follows:—

	Gold.	*Silver.*	*Total.*
United States	£282,000,000	£74,000,000	£356,000,000
Australia	252,000,000	. . .	252,000,000
Spanish America	20,000,000	160,000,000	180,000,000
Russia	93,000,000	3,000,000	96,000,000
Other countries	11,000,000	55,000,000	66,000,000
	£658,000,000	£292,000,000	£950,000,000

By a strange coincidence the annual yield of California and Australia has averaged the same amount, namely £9,000,000, and in each case the highest year reached £15,000,000, the number of diggers being also about equal, and their gains averaging from £100 to £150 per man per annum. The biggest nugget was found in Australia, namely the "Welcome" nugget, found at Ballarat, June 11th, 1858, weighing 2020 ounces, worth £8376 sterling. Siberia produces at least £3,000,000 per annum, possibly double that amount, as the Russian Government is little anxious to publish the actual yield. Spanish America, during the last thirty years, has averaged from £5,000,000 to £6,000,000 sterling of silver, but the Nevada mines, in the United States, have recently eclipsed Mexico and Peru. Since the discovery of the Nevada fields, in 1862, the production of silver has rapidly increased, while the gold-fields of the world are rapidly declining in equal ratio. The official returns since 1848 may be summed up thus:—

	Gold. *Annual Production.*	Silver. *Annual Production.*	*Total*
1848 to 1851	£14,000,000	£9,000,000	£23,000,000
1852 to 1861	27,000,000	8,000,000	35,000,000
1862 to 1871	21,000,000	10,000,000	31,000,000
1872 to 1878	16,000,000	12,000,000	28,000,000

Although the stock of gold in the world is more than double what existed in 1848, and silver shows an increase of only 25 per cent., the purchasing power of these metals has declined in different ratio. Thus gold seems to have lost but 20, and silver fully 33 per cent. It appears, meantime, from the mint returns of the various countries, that, owing to the increasing demands of trade, the amount of coin issued since 1848 has been three times as much as then existed in the world (based on the estimates of the best authorities of thirty years ago):—

	Gold Coin.	*Silver Coin.*	*Total.*
Stock in 1848	£120,000,000	£240,000,000	£360,000,000
English mint	148,000,000	12,000,000	160,000,000
Indian "	1,500,000	155,000,000	156,500,000
Australian "	38,000,000	. . .	38,000,000
United States "	186,000,000	17,000,000	203,000,000
French "	270,000,000	42,000,000	312,000,000
German "	70,005,000	45,000,000	115,000,000
Austrian "	12,000,000	27,000,000	39,000,000
Russian "	84,000,000	15,000,000	99,000,000
Belgian "	15,000 000	18,000,000	33,000,000
Italian "	10,000,000	18,000,000	28,000,000
Holland, Sweden, etc.	5,500,000	31,000,000	36,000,000
Total	£959,500,000	£620,000,000	£1,579,500,000

Thus the quantities coined since 1848 sum up £1,220,000,000, which is £270,000,000 more than the world has produced of precious metals in these thirty years. In fact we had to fall back on the uncoined bullion existing in 1848, to the extent of £180,000,000 gold and £90,000,000 silver, viz.—

	Gold.	*Silver.*	*Total.*
Coined since 1848	£840,000,000	£380,000,000	£1,220,000,000
Yield of mines	660,000,000	290,000,000	950,000,000
Deficit	£180,000,000	£90,000,000	£270,000,000

How much coin has been melted down[1] or reminted it is impossible to judge, but we know that India has absorbed since 1840 no less than £10,000,000 of gold and £238,000,000 of silver, together forming a greater value than the gold taken either from California or Australia. It is generally supposed that India is to blame for the fall of silver from 63 to 50 pence per ounce; if this be so, how comes it to pass that in 1877–78, when India absorbed £22,000,000 of silver, the price of this metal was lowest? The sale of German silver tended so much to its depreciation that Prince Bismarck, after selling £32,000,000 at a loss of 15 per cent., judged proper to stop the sale in June 1879. Meantime, the United States continue to mint £4,000,000 of silver yearly, but most of it finds its way to China. The total coinage now in use in the world is approximately as follows:—

	Gold.	*Silver.*	*Total.*
Europe	£725,000,000	£375,000,000	£1,100,000,000
America, Asia, etc.	230,000,000	200,000,000	430,000,000
	£955,000,000	£575,000,000	£1,530,000,000

About one-sixth of the bullion of the world is locked up in banks, and the actual circulation compares, as follows, with population:—

	Total Specie.	*In Bank.*	*Circulation.*	*Per Inhab.*
United Kingdom	£120,000,000	£32,000,000	£88,000,000	55 shillings
France	310,000,000	90,000,000	220,000,000	120 "
Germany	123,000,000	27,000,000	96,000,000	45 "
Austria	50,000,000	16,000,000	34,000,000	18 "
Italy	48,000,000	3,000,000	45,000,000	33 "
Belgium	37,000,000	4,000,000	33,000,050	140 "
Spain and Portugal	63,000,000	8,000,000	55,000,000	55 "
Russia	110,000,000	26,000 000	84,000,000	22 "
Holland, Greece, etc.	239,000,000	17,000,000	222,000,000	. "
Europe	£1,100,000,000	£223,000,000	£877,000,000	54 "
United States	70,000,000	41,000,000	29,000,000	14 "
Australia, Asia, etc.	360,000,000	20,000,000	340,000,000	"
	£1,530,000,000	£289,000,000	£1,241,000,000	20

The official returns of bullion imports and exports show that in the last ten years Europe has imported a surplus of £327,000,000, viz.—

From United States	£108,000,000
" Australia	81,000,000
" South America, etc.	138,000,000
	£327,000,000

[1] The annual wear-and-tear of gold, between jewellers and shipwreck, is usually estimated at £6,000,000. From 1840 to 1850 the Paris jewellers consumed per annum 5¼ tons of gold, worth £720,000, and 99 tons of silver, worth £500,000 sterling.

In the following Table are shown the countries which have absorbed the above amount, Russia being the only country in Europe which exports precious metals:—

	Imports.	*Exports.*	*Surplus. Imports.*	*Surplus Exports.*
Russia	£20,000,000	£40,000,000	. .	£20,000,000
France	272,000,000	136,000,000	£136,000,000	.
Great Britain	314,000,000	268,000,000	46,000,000	. .
Austria	33,000,000	33,000,000	. .	.
Italy	4,000,000	3,000,000	1,000,000	
Spain	26,000,000	2,000,000	24,000,000	.
Scandinavia	8,000,000	5,000,000	3,000,000	. .
Low Countries and Germany	239,000,000	102,000,000	137,000,000	. .
	£916,000,000	£589,000,000	£347,000,000	£20,000,000

While the above Table shows the shipments of bullion between the various countries, there is no way of ascertaining, even approximately, how far the passenger traffic tends to restore equilibrium, or how much the precious metals may accumulate in Europe in a given period.

Banks and Paper Money.—The Chinese invented bank-notes in the ninth century, and called them "flying money," but the currency became so inflated, that two centuries later a £20 note would only purchase a pound of rice. When Sir John Mandeville visited China, in the fourteenth century, the Emperor issued leather money ("which His Majesty spends outrageously"), and some years later the currency was transferred to a joint-stock bank of Chinese merchants, who ultimately failed, and paid only two shillings in the pound. In Europe the first bank was founded by two Jews at Venice, in the thirteenth century, but no regular bank of emission seems to have been established till that of Mr. Palmstruck, in Sweden, a few years before Patterson founded the Bank of England. At the beginning of the nineteenth century paper money was in bad repute, because people remembered in Paris when a pair of boots cost £350 in the currency of the French Republic. Confidence was again shaken in 1836, when the "wild-cat" banks of the United States caused such widespread disaster. At present paper money is of general use throughout the world, summing up a total of almost £900,000,000, which is about equal to the total stock of existing gold coin. It consists of two kinds, convertible for gold and inconvertible, the latter increasing so fast that it doubles in ten years. The actual issues are—

Convertible for gold	£385,000,000
Inconvertible	505,000,000
	£890,000,000

The following Table shows the convertible paper money, and its ratio to population:—

	Amount of issue.	*Ratio to population.*
United States	£132,000,000	60 shillings
France	90,000,000	50 "
United Kingdom	47,000,090	28 "
Germany	42,000,000	19 "
Low Countries	29,000,000	60 "
Scandinavia	9,000,000	20 "
Spain and Portugal	8,000,000	8 "
Switzerland	3,000,000	25 "
British Colonies	25,000,000	3 "
Total	£385,000,000	20 "

As regards the inconvertible currency, it varies so much that its value for gold can only be given approximately. The following Table, moreover shows how the issue has increased since 1868:—

	Amount in 1868.	*Amount in 1880.*	*Value in gold.*
Russia	£108,000,000	£211,000,000	60 per cent.
Turkey	. . .	100,000,000	50 "
Austria-Hungary	40,000,000	64,000,000	99 "
Italy	36,000,000	36,000,000	89 "
Brazil	15,000,000	28,000,000	80 "
Japan	. . .	28,000,000	87 "
Cuba	5,000,000	13,000,000	45 "
Peru	5,000,000	10,000,000	50 "
Chili	3,000,000	6,000,000	80 "
River Plata	7,000,000	9,000,000	72 "
	£219,000,000	£605,000,000	

Russian paper money dates from the time of Catherine II., and its progress has been as follows:—

	Issue.	*Value in gold.*
1788	£6,000,000	97 per cent.
1817	134,000,000	25 "
1864	101,000,000	95 "
1875	128,000,000	75 "
1880	211,000,000	60 "

In 1843 the Empire declared bankruptcy by calling in the paper money, and giving thirty new roubles for one hundred old ones. The recent war with Turkey has increased the issue by 60 per cent. yet the depreciation has only been 20 per cent. showing the elastic nature of paper money and its temptation to reckless financiering. The specie reserve of the Imperial Bank is £26,000,000 sterling.

The United States have the next largest issue after Russia, one-half emitted by Government, the other half by the banks. Paper money was first used by Gen. Washington to pay his troops, but the present issue dates from the Civil War of 1862, as follows:—

	Currency.	*Value in gold,min.*
1862	30,000,000	97 per cent.
1864-1865	166,000,000	35 "
1868	137,000,000	75 "
1880	132,000,000	100 "

Since the resumption of specie payments in December 1878, the country has entered on a new era of prosperity. Turkey comes next in amount of paper money, but everything regarding Ottoman finances is involved in obscurity. In France the monopoly of emission is held by the Bank of France, with limit, £128,000,000. Since the foundation of the bank by Buonaparte, in 1803, it has twice been compelled to suspend specie payments, but its notes only declined 5 per cent. for a brief interval. The issue has doubled in fifteen years, although the growth of trade has been only 20 per cent.

	1860-1870.	1875-1879.
Average iesne	£44,000,000	£101,000,000
Trade	306,0000,000	368,000,000
Issue to trade	15 per cent.	27 per cent.

At present the issue and specie reserves are almost equal—about £90,000,000. Austrian currency consists partly of Government notes, partly of the issue of the Imperial Bank. The first emission was in 1762, since which time the growth of paper money has been thus:—

	Issue.	*Value in gold.*
1762	£1,200,000	100 per cent.
1811	106,000,000	20 "
1814	25,000,000	40 "
1841	45,000 000	30 "
1879	64,000,000	98 "

The Empire twice declared bankruptcy, first in 1811, when new notes were exchanged for the old ones at the rate of one florin for five, again in 1814, giving two florins for five, so that the holder of £100 in 1810 was holder of £8 in 1814. The Imperial Bank re-modelled the currency in 1841, putting it on a better footing, since which time (except during the war with Prussia) it has steadily improved, and is now almost at par. Specie reserve £15,000,000. The United Kingdom shows a total issue of £47,000,000, made up as follows:—

Bank of England	£29,000,000
Other banks	18,000,000
	£47,000,000

In forty years the issue has only risen 35 per cent. while the increase of trade has been 400 per cent. Germany has an ordinary issue of £42,000,000, but the Reichsbank has power to emit £9,500,000 more than at present. The currency stands thus:—

Reichsbank	£30,500,000
Small banks	5,500,000
Government notes	6,000,000
	£42,000,000

The specie reserve of the Reichsbank is 70 per cent. or upwards of its issue. Italy dates her inconvertible currency from April 1866, when war was declared against Austria. The war lasted twenty days, and cost £10,000,000 of paper money, emitted by the National Bank. According to law this bank may emit up to £40,000,000, and other banks an aggregate of £20,000,000; but it is believed the total circulation does not exceed £36,000,000. Specie reserve £3,000,-000. Brazil has £25,000,000 of Government notes, besides £3,250,000 emitted by banks. Since 1872 specie payments are suspended. Peru, Chili, Buenos Ayres, and Montevideo have also £25,000,000 of inconvertible notes, making a total of £53,250,000 for South America. Japan owes the recent inflation of her currency to the Satsuma rebellion, the notes being now 13 per cent. below par, and the specie reserve uncertain. The Low Countries have £29,000,000 convertible notes, the Netherlands Bank having a minimum specie reserve of 40 per cent. and the National Bank of Belgium 33 per ceut. Scandinavia emits £9,000,000 in the following manner:—

Danish Riks-bank	£4,000,000
Swedish Riks-bank	1,700,000
Enskilda joint-stock banks	3,300,000
	£9,000,000

The Danish Riks-bank has the sole right of emission in Denmark, keeping a minimum specie reserve of 40 per cent. The Bank of Sweden, founded by Mr. Palmstruck in 1656, suspended payments in the last century, compounding for 70 per cent. and again in 1834 it compounded for 40 per cent. of its liabilities. Swiss currency comprises the issue of thirty-five banks, the specie reserve ranging from 45 to 50 per cent. The British colonies emit £25,000,000, as follows:—

India	£12,300,000
Canada	7,720,000
Australia	4,340,000
South Africa	510,000
	£24,870,000

Great Britain and her colonies stand for one-third of the banking-power of the world, as shown in the following Table, which expresses, moreover, the ratio for population and for the estimated capital value of each country:—

	Banking power.	*Per inhabitant.*	*Ratio to capital.*
Great Britain	£780,000,000	£33	9 per cent.
United States	620,000,000	12	8 "
France	340,000,000	9	5 "
Germany	280,000,000	7	7 "
Austria	170,000,000	6	7 "
Russia	145,000,000	2	5 "
Italy	62,000,000	2	3½ "
Low Countries	65,000,000	6	2½ "
Scandinavia	40,000,000	4	4 "
Australia	60,000,000	22	. "
India	40,000,000	.	. "
South America	50,000,000	2	. "
Canada	28,000,000	7	. "
Spain and Portugal	30,000,000	1½	2 "
	£2,600,000,000	£8	

Bank rate of interest rules cheaper in England than in other countries, which as Mr. Mundella observes, is one of the secrets of England's greatness. The following Table shows approximately the value of money in England, France and Germany, during a term of thirty-three years ending with 1878:—

	England.	*France.*	*Germany.*
1846-1853	3½ per cent.	4 per cent.	4¼ per cent.
1854-1869	4½ "	4⅛ "	4½ "
1870-1873	3¾ "	4¼ "	4½ "
Average	3$\frac{9}{16}$	4$\frac{1}{7}$	4$\frac{3}{7}$

Savings banks (although first instituted at Brunswick in 1765) may be said to belong to the nineteenth century. So rapidly have they increased in the last twenty years, that Europe now counts more than 14,000 of these banks, with nearly 14,000,000 depositors, viz.—

	Savings banks.	*Depositors.*	*Amount.*	*Ratio for population.*
United Kingdom	5,068	1,668,000	£74,640,000	44 shillings
Germany	1,687	4,033,000	76,580,000	36 "
Austria-Hungary	557	1,639,000	79,150,000	44 "
France	2,221	2,853,000	40,430,000	22 "
Italy	3,627	1,115,000	28,094,000	20 "
Scandinavia	847	1,099,000	21,305,000	50 "
Switzerland	312	542,000	11,581,000	84 "
Belgium and Holland	250	273,000	6 550,000	15 "
Russia	120	260,000	3,100,000	1 "
	14,689	13,482,000	£341,430,000	25

In Australia, if the deposits in banks be regarded as savings, we find 64,000 depositors, with £52,617,000,—a sum equal to £20 per head for the population of those colonies. The total deposits in banks of all descriptions in the United States amount to £384,000,000, or about £9 per inhabitant.

Summing up all the various banks of the world including branches and savings banks, we find as follows:—

Great Britain	8,701 banks
European Continent	15,847 "
United States	6,456 "
British Colonies	815 "
Other Countries	298 "
	32,117 "

The banking business of Great Britain has multiplied threefold since 1850.

Finances and Wealth.—Sixty years ago after peace had been restored in Europe, the expenditure of all nations summed up £239,000,000: at present it reaches £778,000, having more than trebled in the interval.

	1820. *National expenditure.*	*Shillings per inhab.*	1879. *National expenditure.*	*Shillings per inhab.*
Great Britain	£54,000,000	51	£83,000,000	49
France	27,000,000	19	111,000,000	60
Germany	8,000,000	8	85,000,000	40
Russia	23,000,000	11	73,000,000	18
Austria	15,000,000	11	68,000,000	37
Italy	8,000,000	8	69,000,000	41
Low Countries	6,000,000	16	20,000.000	42
Turkey and Egypt	4,000,000	7	29,000,000	14
Spain and Portugal	9,500,000	13	34,000,000	34
Scandinavia	2,500,000	12	8,500,000	21
Switzerland and Greece	1,000,000	7	3,500,000	16
Europe	£167,000,000	16	£572,000,000	34
United States	6,000,000	14	48,000,000	22
South America	2,000,000	3	33,000,000	25
India	20,000,000	2	60,000,000	4
China and Japan	54,500,000	3	49,000,000	3
British Colonies	500,000	10	26,000,000	66
Total	£239,000,000	6	£778,000,000	16

Europe has quadrupled her taxation, the ratio per inhabitant having doubled or trebled in all countries except Great Britain, which shows a reduction of 4 per cent. The enormous increase of taxation in Europe and America arises from the accumulation of public debt and from war expenditure. If the interest on all existing debts in Europe were duly paid, it would absorb one-third of the total revenue. Compared with 1820, we find the burthen of public debt as follows:—

	1820. *Interest per inhabitant.*	1880. *Interest per inhabitant.*
Great Britain	25 shillings	14 shillings
European Continent	3 "	11 "

Thus the relative weight of our debt is reduced nearly one-half, while that of the Continent has quadrupled. The growth of debt from 1820 to 1848 was slow, the total amount in the latter year not exceeding £1,720,000,000, equal to an increase of £9,000,000 per annum. Since 1848 the average increase has been £130,000,000 a year, the principal causes of outlay being shown in the subjoined Table:—

National debts in 1848	£1,720,000,000
Crimean War	192,000,000
Italian War	105,000,000
United States War	490,000,000
Brazil and Paraguay, etc., War	85,000,000
Austro-German War	90,000,000
Franco-German War	370,000,000
Russo-Turkish War	210,000,000
Armaments	1,607,000,000
Railways, Docks, Telegraphs	575,000,000
	£5,444,000,000

The only countries that have reduced their public debt since 1820 are Great Britain and the Low Countries, as appears from the following statement:—

	Imports.	*Exports.*	*Total.*
1815	£8,136,000	2,566,000	£10,702,000
1830	5,679,000	4,087,000	9,766,000
1863	57,200,000	60,900,000	118,100,000
1877	67,900,000	82,975,000	150,875,000

Exports are usually £10,000,000 a year over imports, and all the chief products are increasing in the following manner:—

	1868.	1878.	Increase.
Opium	£12,330,000	£12,374,000	
Rice and Grain	3,780,000	9,790,000	150 per cent.
Coffee	3,310,000	6,050,000	80 "
Tea	730,000	3,062,000	320 "
Hides	988,000	3,757,000	275 "
Jute	1,601,000	3,518,000	120 "
Sundries	20,461,000	37,365,090	66 "
	£43,200,000	£75,916,000	76 "
Cotton	20,100,000	9,384,000	decr. 53 "
Total	£63,300,000	£85,300,000	incr. 35 "

Trade has, moreover, been facilitated by the introduction of paper money in 1861, the emission rising to £5,000,000 in 1864, and at present exceeding £12,000,000. The coin mostly in use is silver, the Government having coined £40,-000,000 of this metal in the last ten years, say £4,000,000 per annum. Previous to 1870 India used to absorb £20,-000,000 of bullion, chiefly silver, every year, but since that date the influx of precious metals has fallen:—

	Amount.	Per annum.
1864–1870	£138,000,000	£19,700,000
1871–1876	53,000,000	8,770,000
1877–1878	22,200,000	11,100,000

This is by some ascribed to poverty, partly resulting from famine, partly from the taxation having been increased 18 per cent. in the last ten years.

The rise of public debt has been as follows:—

	Amount.	Per inhabitant.
1814	£18,000,000	5s.
1857	60,000,000	10s.
1862	100,000,000	15s.
1879	139,000,000	14s.

The service of the debt costs £5,500,000 per annum, or 9 per cent. of the revenue; the latter averages 6s. per inhabitant.

The number of Europeans is very small, the returns of population for 1877 showing as follows:—

Hindoos	140,000,000
Mahometans	41,000,000
Buddhists, etc.	10,000,000
British troops	66,000
civilians	64,000
	191,129,000

The British are therefore less than 1 in 1000 of the population. The annual mortality among British troops in India was 69 per 1000 (say 7 per cent.) previous to 1850; the improvements introduced by order of Parliament have reduced the rate since 1870 to 20 per 1000, which saves 3500 soldiers' lives yearly. In 1877 the rate was only 13 per 1000. The annual expenditure for the garrison of white troops is £15,-000,000, or £250 per soldier. In India there are at present 644 newspapers, of which 600 are published in the various vernacular languages—chiefly in Bengali, Urdu, Marathi, Gujarati, Tamil, and Telugu. There are 40 journals published in English. The universities of Calcutta, Madras, and Bombay educate 6000 youths, and there are also State schools in the various provinces. India has 17,900 miles of telegraph constructed at a cost of £3,000,000 sterling.

Sir Hector Hay, in his examination before the House of Commons, estimated the production of precious metals from 1852 to 1875 as follows:—

Gold	£572,195,000
Silver	241,890,000
	£814,085,000

According to Humboldt's estimates in 1803, and others carried down to 1848, the yield of Spanish America from 1521 down to the discovery of gold in California was as follows, in millions sterling:—

	Before 1803.	From 1803 to 1848.	Total.
Mexico	£406	£164	£570
Peru and Chili	482	168	650
Brazil	171	19	190
Venezuela, etc.	82	46	128
	£1141	£397	£1538

The above total was distributed thus:—

	Before 1803.	From 1803 to 1848.	Total.
Gold	£301	£142	£443
Silver	840	255	1095
Millions sterling	£1141	£397	£1538

The annual production of precious metals at different epochs in the present century is shown as follows:—

	Gold.	Silver.	Ratio of gold to silver.
1801	19 tons.	856 tons.	1 to 45
1846	42 "	727 "	1 to 17
1850	134 "	778 "	1 to 7
1852	242 "	1027 "	1 to 4
1879	90 "	1060 "	1 to 12

The actual production of precious metals is estimated thus:—

	Gold.	Silver.	Total.
United States	£5,000,000	£6,000.000	£11,000,000
Australia	3,000,000	....	3,000,000
Siberia, etc.	4,000,000	....	4.000,000
Spanish America	....	3,000,000	3,000,000
	£12,000,000	£9.000.000	£21,000,000

The first bank is now said to have been at Barcelona. The Bank of England was founded by a Scotch clergyman, Rev. William Patterson, in 1694; the founder died in extreme misery.

Sweden was the first country to establish a regular bank of emission, and is still, according to an eminent English economist, the only country in Europe that can present a complete annual balance-sheet. In 1656 Mr. John Palmstruck obtained the right of emission for his bank, now known as the Riks-bank. It was forced to suspend payments in 1745, but resumed in 1776, on paying 14s. in the £ for its notes. It again stopped payment in 1818, and again resumed in 1834, this time compounding for 7s. 6d. in the £, say 37 per cent. Since then it has always paid gold for its notes on demand. In 1852 its metallic reserve was £2,-750,000, but in October 1877 it had fallen to £640,000. Its dividends for twelve years have averaged 7 per cent. In 1830 the first of the Enskilda or joint-stock banks of issue was authorised, and in a few years their number multiplied. At present there are twenty-eight banks of issue (independent of the Riks-bank, which have 153 branches all over Sweden, the country people preferring the notes to gold. The notes range from 5 shillings to £30, and the metallic reserve varies from 35 to 50 per cent. of the emission. Each bank of issue must have at least thirty-three shareholders, all Swedes; minimum capital £55,000 all paid up, each subscriber being liable for all the bank's obligations. These banks have been so well managed that their profits every year range from 4 to 20 per cent. There are also fifteen joint-stock banks of limited liability, without right of emission, and 324 savings banks.

FIGURES AND FACTS IN CONSUMPTION AND DISTRIBUTION OF PRECIOUS METALS.

THE excellent little compilation issued annually by Messrs. Fisk & Hatch contains the following, which are valuable for their form, though taken from tables printed elsewhere.

PRESENT MONETARY STANDARDS OF THE NATIONS OF THE WORLD.

I—Gold Standard Countries.

i. e.—GOLD COIN of *full value* and *legal tender.* Silver Coin of debased value and restricted tender.

Country.	Date for which circulation is given.	CIRCULATION.§							
		Paper.	Gold Coin.	Silver Coin.		Total Specie.	Total Specie and Paper.	Per Capita.	
			Full Value.	Full Value.	Subsidiary Debased value.			Paper.	Specie.
Australia	Mar. 31, '81	$23,606,739	$60,440,708			‖60,440,798	$84,047,447	$ 8.58	$ 22.00
Brazil	June, 30, '79	91,000,000					91,000,000	9.00	
Canada	Dec. 31, '80	41,562,711	9,026,000		$ 1,020,000	$ 10,046,000	51,608,711	10.20	2.46
Cape of Good Hope	Dec. 31, '80	4,129,200	*30,000,000		*2,440,726	32,440,726	36,569,956	5.86	45.00
‡Denmark	Dec. 31, '79	19,028,000	9,316,000		4,863,000	14,179,000	33,207,000	9.61	7.16
Egypt									
†German Empire	Dec. 31, '80	276,897,658	387,143,742	$119,000,000	101,648,835	607,792,577	884,690,235	6.11	13.45
Great Britain	July —, '81	207,001,444	602,331,571		92,263,973	694,595,544	901,596,988	6.55	21.95
¶Greece	June—, '79	12,890,000	4,500,000		3,000,000	7.500,000	20,390,000	7.67	4.46
Liberia									
‡Norway	Dec. 31, '80	10,375,265	9,037,324		1,876,000	10,913,324	21,288,589	5.94	6.05
Portugal	Jan. 1, '79	5,023,360	48.000,000		12,000,000	60,000,000	65,023,360	1.21	14.42
Sandwich Islands									
†Sweden	Dec. 31, '79	21,657,372	7,158.000		4,523,616	11,681,616	33,338,988	4.74	2.56
Turkey	Mar. 31, '80	21,871,289	*15,000,000		* 589,828	16,589,828	37,461,117	1.00	.71
Total		735,043,068	1,181,953,345	119,000,000	224,226,978	1,525,179,323	2,260,222,391		

‖ Bank reserve only. ‡ These three Scandinavian kingdoms concluded a monetary convention, May 27, and October 18, 1873, based on a single gold standard and on a common system of paper money, of gold money, and of subsidiary money in debased silver and in bronze. * Estimated. † See note "a." ¶ Greece has been ranked heretofore under the double standard, but her delegate to the recent Monetary Conference, spoke of himself "as a representative of a nation which had adopted MONO METALLISM," &c. § Amounts are those given in the United States Mint Report, 1881.

II.—COUNTRIES HAVING DOUBLE STANDARD.

i. e.—GOLD COIN of *full value* and *legal tender.* SILVER COIN, *full value* and *legal tender.* Silver Coin of debased value and restricted tender.

Name.	Date for which circulation is given.	§ CIRCULATION.							
		Paper.	Gold Coin.	Silver Coin.		Total Specie.	Total Specie and Paper.	Per Capita.	
			Full Value.	Full Value.	Subsidiary Debased Value.			Paper	Specie
United States	Nov. 1, '81	$780,506,138	$663,075,743	$105,566,741	$80,400,000	$749 042,484	$1,529,548,612	$15.56	$14.93
Algiers	July —, '81	11.194,000	10,071,773	6,234,975		16,306,748	27,500,748	3.90	5.68
Argentine*	Mar. —, '80	373,470,000	4,000,000	2,000,000		6,000,000	379,470,000	186.70	3.00
Belgium	Sept. 29, '81	63,434,827	43,000,000	55,438,000	8,562,000	107,000,000	170,434,827	11.58	19.53
France	Oct. 6, '81	511,328.021	874,876,000	545,286,000	57,900,000	1,478,062,000	1,989,390,021	13.85	40.05
Italy	Sept. —, '81	323,975,402	24,000,000	20,900,000	13,000,000	57,900,000	381,875,402	11.66	2.98
Switzerland	July —, '81	16,594,000	20,900,000	10,000,000	4,700,000	34,700,000	51,294,000	5.83	12.19
Cuba	Mar. 26, '81	48,943,457	49,000,000	1,000,000		50,000,000	98,943,457	35.08	35.79
**Chili									
Netherlands	Dec. 31, '80	83,836,901	29,304,722	56,488,551		85.793,273	169,630,174	21.68	22.18
**Roumania									
**Paraguay									
†Spain	Aug. 31, '81	53,867,288	130,000,000	40,000,000	30,000,000	200,000,000	253,867,288	3.24	12.03
**Uraguay									
‖Venezuela	Sept. —, '81	250,900	‖10,000,000		‖1,000,000	11,000,000	11,250,900	.12	5.29
Total		2,267,400,934	1,767,328,238	842,914,267	195,562,000	2,795,804,505	5,063,205,429		

* These States compose the Latin Union. They receive each others coins at a valuation of 1 to 15½ of gold to silver. By agreement of January, 1874, and December, 1879, their silver coinage is now limited exclusively to subsidiary coins.

† Silver Coinage, except on Government account, ceased by Law of 1876. ‖ Estimated. ** No statistics obtainable. § Amounts are those given in the U. S. Mint Report, 1881.

III.—COUNTRIES HAVING SILVER STANDARD.

i. e.—SILVER COIN of *full value* and *legal tender.* Gold Coin of full value but not legal tender. Silver Coin of debased value and restricted tender.

Name.	Date for which circulation is given.	CIRCULATION.†							
		Paper.	Gold Coin.	Silver Coin.		Total Specie.	Total Specie and Paper.	Per Capita.	
			Full Value.	Full Value.	Subsidiary.			Paper.	Gold.
Austria	Sept. 30, '81	$295,611,587	$50,000,000	$40,000,000		‖$90,400,000	$386,011,587	$7.83	$2.39
**Bolivia									
Columbia	Aug.—, '79	1,895,243	500,000		$4,000,000	4,500,000	6,395,343	64	1.53
**China									
**Ecuador									
Hayti	Dec. 31, '80			5,000,000		5,000,000	5,000,000		8.74
India	Jan. —, '81	55,874,880		1,015,000,000		1,015,000,000	1,070,874,880	.29	5.31
Japan	June 30, '80	147,288,681	99,852,138	50,661,878		150,514,016	297,802,697	4.38	4.47
Mexico	Nov. —, '79	1,500,000	10,000,000	40,000,000		50,000,000	51,500,000	.16	5 35
Peru	Mar. —, '79	13,098,820	62,085	1,819,933		1,882,018	14,980,838	4.84	.70
Russia	Aug. 31, '81	‡126,237,000	119,209,784			‖119,209,784	245,446,784	1.45	1.37
Tripoli									
Total		641,506,311	279,624,007	1,162,881,811	4,000,000	1,436,505,818	2,078,012,129		

** No statistics obtainable. ‖ Bank reserve only. † Amounts are those given in the U. S. Mint Report, 1881. ‡ Bank circulation only. The total circulation is given in the U. S. Mint Report for 1880 at $778,514,300.

The introduction into Germany of the single gold standard instead of the silver standard, which prevailed up to 1871, in most of the German States, was decreed by the laws of the 4th of Dec. 1871, and 9th July, 1873. The gold mark is the $\frac{1}{1395}$ part of a pound of gold (of 500 grammes= 7.716.25 grains troy) nine-tenths fine, and it is coined into gold pieces of 20, 10, and 5 marks. Silver, nickel and copper coins are used as subsidiary coins.

The total amount of silver coin must not, under the present laws, exceed ten marks per head of population. Silver money is a tender only to the extent of 20 marks ($\$4^{76}$); but these coins are received in payment without limit of amount at the German Imperial and State Treasuries, and can at will, be changed for gold at a certain number of offices appointed for this purpose.

As it was impossible to withdraw from circulation all at once the former coins of the different States, and also to make the new Imperial money circulate in them suddenly, the laws in question established temporarily a régime like that of the double standard; and under it the former coins of the States were recognized as legal tender for payment, at the rate of one thaler for three gold marks, a rate which is based on the proportion of 1 to $15\frac{1}{2}$ as the value of the two metals. Up to the end of 1880, the amount of silver withdrawn from circulation on account of the Empire, was 1,080,486,138 marks.

Of this sum there have been—

1. Delivered to the mints for coinage of new Imperial silver money.

	Marks.
(a) On account of the Empire	382,501,331
(b) On payment of its value (2,034 pounds of fine silver.)	183,510
	382,684,841

2. Melted into ingots of silver 697,797,069 marks, which have produced 7,474,644 pounds of fine silver.

Of this quantity there have been—

	Pounds of Fine Silver.
(a) Sold on account of the Empire	7,102,862
(b) Used in coinage of new silver money	32,429
	7,135,291
Leaving a residue in possession of Government of	389,353

The sale of these 7,104,896 pounds of silver (*i. e.*, the above 7,102,862 plus the 2,034 pounds given to the mints on payment of their value) has realized as follows—

Year.	*Pounds of Fine Silver Sold.*	*Total in Marks.*	*Per Pound of Fine Silver in Marks.*	*Per English Ounce of Standard Silver in Pence.*
1873	105,923,372	9,296,686.77	87.77	$59\frac{5}{16}$
1874	703,685,175	61,135,676.29	86.88	$58\frac{3}{4}$
1875	214,898,594	18,208,449.08	84.69	$57\frac{1}{4}$
1876	1,211,759,204	93,936,482.37	77.52	$52\frac{3}{8}$
1877	2,868,095,533	230,424,238.51	80 34	$54\frac{5}{16}$
1878	1,622,696,403	126,203,852.08	77.77	$52\frac{9}{16}$
1879 (till May.)	377,744,712	27,934,417.89	73.95	50
Total . .	7,104,895,993	*567,139,992.99	79.82	$53\frac{15}{16}$

* Value in United States money, $\$134,978,318.^{33}$, taking the Mark at 23.8 cents. The cost of the Monetary Reform to Germany may be thus stated.

	Marks.
7,104,896 pounds of fine silver received into the Treasury,	663,621,109
Proceeds of sales of same as per previous table	567,139,993
Loss	96,481,116
To this must be added the other costs of the reform (mintage, loss on copper, &c.)	29,316,438
Total	125,797,554
On the other side must be credited the profits resulting from the monetary reform (viz: mintage, &c.) . .	81,758,134
Net cost of the reform to the Empire . . . . [*i. e.*, $10,488.522.]	44,069,420

The estimated amount of silver yet to be withdrawn, including the bullion balance in the vaults of the Imperial Bank, is from 410 to 500 millions of marks. If sales were resumed the Government would only have to get rid of that part of the 410 (or 500) millions of silver, which it could not employ to increase the subsidiary silver money. The Government therefore estimates the amount which would finally be left for sale, at from 337 to 427 millions of marks (*i. e.* 3,740,000 to 4,740,000 pounds of fine silver).

[NOTE.—The authority for the above account of the German Monetary Reform is a paper entitled a "Statement of the Monetary Situation in Germany," submitted by the German Imperial Government at the International Monetary Convention held in Paris in 1881.]

Amount of Silver Withdrawn, Sold and Reminted by Danish Government.

Withdrawn	$11,397,500
Sold	6,882,150
Reminted	4,515,350

The Demonetization of silver was accomplished October 1, 1876.

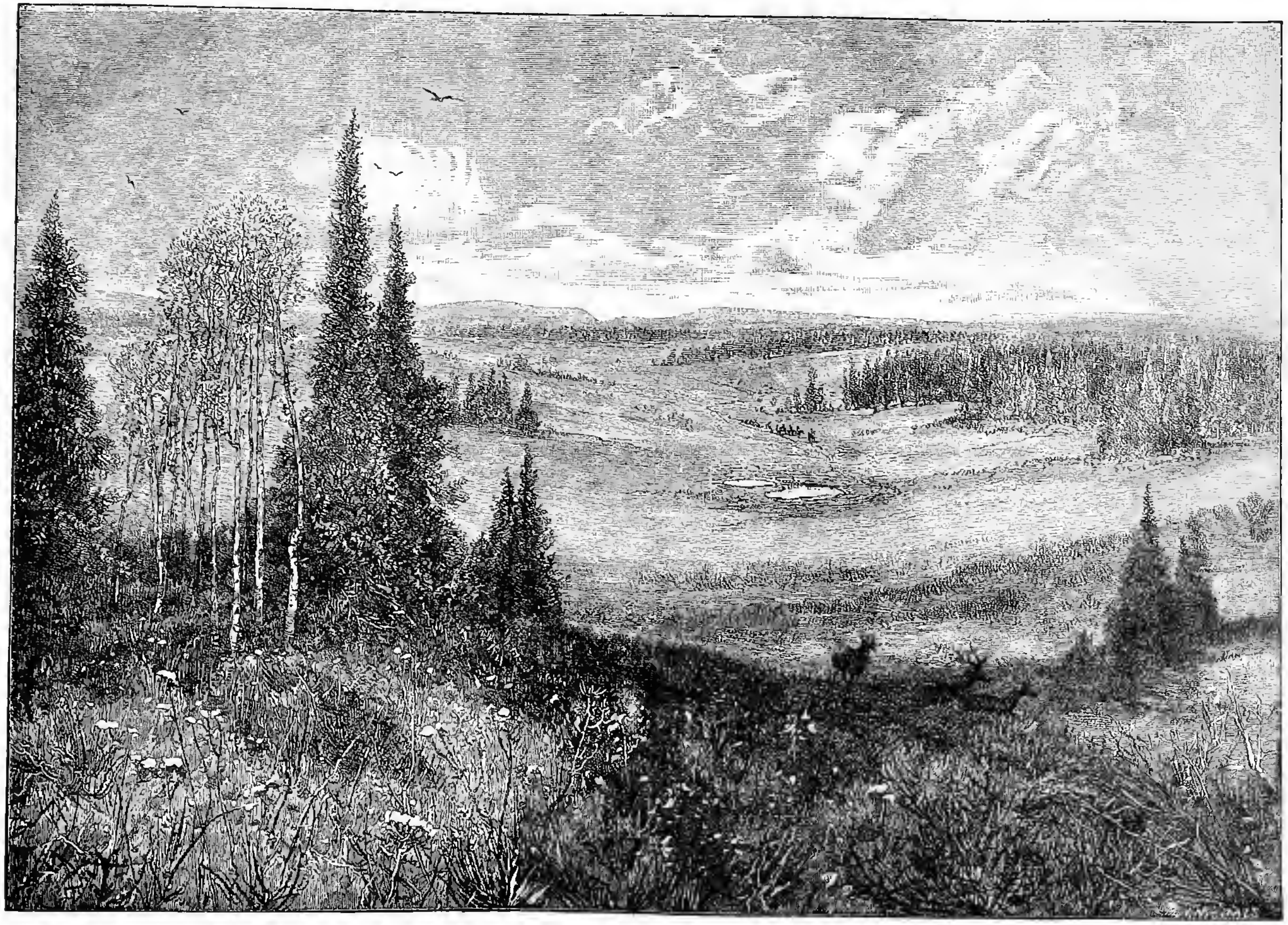
On the Production of Gold and Silver. I.—Estimated Production of the World.

Table 1.—*Production of Gold and Silver since the discovery of America up to* 1879, *according to Dr. Soetbeer, of Gottingen* (1879 *and* 1880).

Periods.	*Number of Years.*	ANNUAL AVERAGE PRODUCTION.					
		By weight in Kilograms.		*By value in Francs.*		*By value in Dollars, taking* 5 *fcs. to* $1.	
		Fine Gold.	*Fine Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*
1493–1600	108	6,990	211,400	24,070,000	46,280,000	4,814,000	9,256,000
1601–1700	100	9,123	372,340	31,430,000	82,750,000	6,286,000	16,550,000
1701–1800	100	19,001	570,350	65,440,000	126,720,000	13,088,000	25,344,000
1801–1850	50	23,698	654,480	81,620,000	145,420,000	16,324,000	29,084,000
1851–1879	29	187,973	1,312,300	647,520,000	313,840,000	129,504,000	62,768,000
1493–1879	387						

TOTAL PRODUCTION.

By Weight in Kilograms.		*By Value in Francs.*		*By Value in Dollars.*		*Average proportion of the value of Gold and of Silver in Europe.*
Fine Gold.	*Fine Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*	
754,800	22,835,600	2,600,000,000	5,074,000,000	520,000,000	1,014,800,000	11.05
912,300	37,234,000	3,143,000,000	8,275,000,000	628,600,000	1,655,000,000	14.00
1,900,100	57,035,000	6,544,000,000	12,672,000,000	1,308,800,000	2,534,400,000	15.00
1,184,900	32,724,000	4,081,000,000	7,271,000,000	816,200,000	1,464,200,000	15.07
5,451,200	40,957,000	18,778,000,000	9,101,000,000	3,765,600,000	1,820,200,000	15.85
10,203,300	190,785,000	35,145,000,000	42,393,000,000	7,029,200,000	8,478,600,000	



WESTERN SCENERY—DEMOTTE PARK—GRAND CAÑON DISTRICT.

SEE PART X.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

Production of Gold and Silver since the discovery of America up to 1878, according to Mr. Alexander *Mardle, M. E., formerly Director of the Statistical Department of the United States (London, 1880).

Periods.	Number of Years.	ANNUAL AVERAGE PRODUCTION. By Weight in Kilograms.		By Value in Francs.		By value in dollars taking 5 francs to $1.	
		Fine Gold.	Fine Silver.	Gold.	Silver.	Gold.	Silver.
1493–1600	108	3,260	139,000	11,200,000	30,200,000	2,240,000	6,040,000
1601–1700	100	4,760	275,800	16,400,000	61,300,000	3,280,000	12,260,000
1701–1800	100	20,600	419,900	70,600,000	93,300,000	14,120,000	18,660,000
1801–1850	50	21,900	602,000	84,600,000	133,800,000	16,920,000	26,760,000
1851–1878	28	173,300	1,176,400	597,000,000	261,400,400	119,400,000	54,280,000
1493–1878	386						

TOTAL PRODUCTION.

By Weight in Kilograms.		By Value in Francs.		By Value in Dollars.	
Fine Gold.	Fine Silver.	Gold.	Silver.	Gold.	Silver.
352,400	15,012,000	1,214,000,000	3,336,000,000	242,800,000	667,200,000
475,600	27,580,000	1,640,000,000	6,129,000,000	328,000,000	1,225,800,000
2,060,000	41,995,000	7,063,000,000	9,333,000,000	1,412,600,000	1.866,600,000
1,096,600	30,105,000	4,231,000,000	6,689,000,000	846,200,000	1,337,800,000
4,853,400	32,944,000	16,715,000,000	7,320,000,000	3,343,000,000	1,464,000,000
8,828,300	147,636,000	30,863,000,000	32,807,000,000	6,172,600,000	6,561,400,000

* So in B. C. Tupp's Report of the Proceedings of the Paris Conference, probably a misprint for DelMar.

Production of Gold and Silver for the years named, as given by Mr. Burchard, Director of the U. S. Mint, (1881).

Years.	By Weight in Kilograms.		By Value in Dollars.	
	Gold.	Silver.	Gold.	Silver.
1877	171,453	2,174,610	113,947,173	81,040,665
1878	179,175	2,282,573	119,092,786	94,882,177
1879	161,579	2,143,018	107,385,421	89,080,680
1880	160,984	2,105,966	106,989,846	87,643,072

Note Explanatory of the Foregoing Tables.—Last year we gave in these notes the estimates of Gold and Silver Production, published in the Report of United States Monetary Commission (1877). This year, for purpose of comparison, we present the estimates submitted to the International Monetary Conference held at Paris in 1881. They will be found to differ somewhat one from the other, as well as from the estimates made by Mr. DelMar, and this leads us to remark, that, at the best, the figures of gold and silver production must be looked upon as careful estimates, made from the best obtainable data, in the manner more fully set forth in Note D, rather than exact statements of facts.

II.—Production of Gold and Silver in the United Statee, according to the Mint Reports of 1874 and 1881.

Year.	Gold.	Silver.	Year.	Gold.	Silver.
1848	$10,000,000	$50,000	1865	$53,225,000	$11,250,000
1849	40,000,000	50,000	1866	53,500,000	10,000,000
1850	50,000,000	50,000	1867	51,725,000	13,500,000
1851	55,000,000	50,000	1868	48,000,000	12,000,000
1852	60,000,000	50,000	1869	49,500,000	13,000,000
1853	65,000,000	50,000	1870	50,000,000	16,000,000
1854	60,000,000	50,000	1871	43,500,000	22,000,000
1855	55,000,000	50,000	1872	36,000,000	25,750,000
1856	55,000,000	50,000	1873	36,000,000	35,750,000
1867	55,000,000	50,000	*1874	33,490,902	37,324,594
1858	50,000,000	60,000	1875	33,467,856	31,727,560
1859	50,000,000	100,000	1876	39,929,166	34,783,016
1860	46,000,000	150,000	1877	46,897,390	39,793,573
1861	43,000,000	2,000,000	1878	51,206,360	45,281,385
1862	39,200,000	4,500,000	1879	38,899,858	40,812,132
1863	40,000,000	8,500,000	1880	36,000,000	39,200,000
1864	46,100,000	11,000,000	1881	36,500,000	42,100,000
Total, 1848–1881			. . .	1,557,141,532	501,072,260

Total Gold and Silver, $2,058,213,792.

*1874–1881 Fiscal Years ending June 30.

NOTE.—The figures presented under this head last year, were taken from the Report of the United States Monetary Commission (1877) as compiled by Mr. Alexander DelMar.

For the purpose of comparison, we now present the figures given in the Mint Reports. We do not attempt to explain the evident discrepancy between the two statements. The present director, Mr. Burchard, in his "Special Report to Congress on the Production of the Precious Metals in the United States," (1880), says of the estimates from 1848 to 1873, inclusive, which were prepared by R. W. Raymond, U. S. Commissioner of Mining Statistics, "I am unable at present to review the data from which this table was prepared, or to vouch for its accuracy."

C.—On the Consumption of Gold and Silver.

I. By India and the East. Excess of Imports of Silver.

Year.	Net Imports.	Year.	Net Imports.
			$38,641,710
1836	$8,059,480	1859	55,737,815
1837	6,694,410	1860	26,640,045
1838	9,834,720	1861	45,432,280
1839	13,225,660	1862	62,750,775
1840	8,252,355	1863	63,983,595
1841	7,008,350	1864	50,398,990
1842	6,416,140	1865	93,343,365
1843	14,762,225	1866	34,815,370
1844	18,477,210	1867	27,969,805
1845	9,942,805	1868	43,005,110
1846	3,662,860	1869	36,601,685
1847	6,891,245	1870	4,709,685
1848	2,470,965	1871	32,564,135
1849	1,569,520	1872	3,523,220
1850	6,368,035	1873	12,256,915
1851	10,586,125	1874	23,211,010
1852	14,326,785	1875	7,776,775
1853	23,025,120	1876	35,994,360
1854	11,528,720	1877	73,381,670
1855	148,000	1878	10,853,400
1856	40,971,875	1879	
1857	55,366,235		
1858	61,094,740		

II. Amount in use as Coin in Thirty-one of the Principal Countries of the world as estimated by the Director of the Mint, in his last Annual Report, at—

Silver—Full value.	$2,115,189,997
Subsidiary	423,787,978
Total Silver	$2,538,957,975
Gold	3,221,223,971
Grand Total	$5,760,181,946

These figures do not include the circulation of China, which must be large, but of which it is impossible to make a reliable estimate.

III. Amount Annually used in the Arts as Estimated by the Director of the Mint (1881) at—

Silver	$35,000,000
Gold	$75,000,000

On the Stock of Gold and Silver now in the World.

Estimates of the production of the precious metals since the discovery of America, and of the stock in existence before that event (compiled from various sources), by R. B. Chapman (1881), and submitted to the Paris Conference.

	Gold.		*Silver.*	
	Kilograms.	*Lbs. Troy.*	*Kilograms.*	*Lbs Troy.*
In existence in 1492*	87,870	235,420	3,222,395	8,633,833
Produced elsewhere than in Extra Asia, 1493–1848*. . .	4,415,498	11,829,856	134,650,078	360,750,000
Produced in Extra-Russian Asia, 1493–1847*	1,288,768	3,452,827	3,107,309	8,325,000
1849–1850*.	102,615	274,656	2,971,539	5,550,000
Total 1493–1850	5,806,781	15,557,339	139,828,926	374,625,000
1851–1875†.	4,821,775	12,918,339	31,003,825	83,064,414
1876–1878‡	410,062	1,098,626	5293,934	14,183,333
Grand Total	11,126,488	29,809,724	179,349,080	480,506,080

Values in sterling money in 1878: Gold	£1,519,482,000
Silver at 50*d.* an oz. troy .	1,298,665,000
At 60*d.* ditto . .	1,558,398,000

*Tooke and Newmarch, Vol. VI., pp. 141, 142, 150, 231.

†Soetbeer, Production of the Precious Metals (1879).

‡Sir Hector Hay, Statistical Society's Journal, 1879, p. 436.

Note.—All the authorities who have shared in the compilation of these statistics concur in the warning that the figures, especially before 1848, must be taken with reserve. They are in fact, at the best, only guesses carefully made by competent observers, after examining all kinds of data.

Even as such they are open to the following criticisms and remarks:

I. The estimate of the metal already won in 1492, avowedly, only includes the stock in Europe, Russia in Asia, and Mediterranean Africa. It does not include the stores already won from the earth in America, Asia and the rest of Africa. Even the European stock seems probably much under-estimated; and it is likely that the Asian store was already large.

II. The estimate of the produce of Extra-Russian Asia between 1493 and 1847 is by a Russian authority, M. Otreschkoff. It does not apparently include India or Japan; yet there are indications that the production of gold in India may, in the past, have been considerable.

III. The statistics since 1847 apparently include little or nothing for Extra-Russian Asia; and the greater part of Africa is thoroughly excluded. But Jacob speaks of considerable produce in Africa, and values the produce of Asia in gold at £1,235,000 a-year, and in silver at £165,000 (Jacob, *On the Precious Metals* [1831] chapter xxvii). Otreschkoff estimated the gold production of China at £600,000 a-year, and of Sumatra, Java, Borneo and the Archipelago at £2,-400,000, and the silver production of China at £188,000 a-year (Tooke and Newmarch, vol. vi., p. 762). Chevalier estimated the yearly produce, before 1865, of Extra-Russian Asia and the Asiatic Archipelago and Africa at no less than 80,000 kilos. of gold (nearly £11,000,000), and 500,000 kilos. of silver (about £4,300,000) (*Money*, edition 1866, p. 557).

IV. On the other hand, the figures in this Table since 1492 allow for no waste and no losses, as for example, by shipwrecks, fires, forgotten hoards, and the like. Perhaps, these several omissions may be set against each other, and the weight of the precious metals now in existence estimated as follows:

	Kilograms.	*Lbs. troy.*
Gold	11,200,000	30,000,000
Silver	179,200,000	480,000,000

But these estimates probably err in the direction of being too low. Adopting these figures as correct for the end of 1878, and adding to them the amounts estimated to have been produced in 1879 and 1880, according to Mr. Burchard, in the Mint Report, 1881, and assuming that the production for 1881 approximated that of 1880, we arrive at the following figures as the amount of the precious metals in existence at the end of 1881:

	Gold.	*Silver.*
Amount in existence in 1878, ozs. troy	860,000,000	5,760,000,000
Amount produced in 1879 " . . .	5,194,764	68,898,028
1880 "	5,175,635	67,706,806
1881 "	5,175,635	67,706,806
Total in existence at the end of 1881	375,547,034	5,964,311,640
Equivalent in gold dollars: Gold		$7,763,223,772
Silver, at 51$\frac{11}{16}$d. an oz. troy (the average value for the year 1881)		6,757,843,025
Total Gold and Silver		$14,521,066,797

The weight of *gold* in existence—the above estimate being correct—is to the weight of *silver* as:—1 : 15.88.

The average ratio of the market value of gold to silver for the year 1881 was as 1 : 18.24.

On the Relative Value of Gold to Silver.—

TABLE 1.—As stated by Lord Liverpool in his letter to the King of England.

In Persia, according to Herodotus	1 : 11⅔
In Greece, at same period	1 : 13
In Greece, in the time of Plato	1 : 12
In Greece, it is stated by Xenophon at	1 : 10
After the plunder of gold from the temple of Apollo, according to Menander, it was	1 : 10
In the reign of Alexander the Great, it was	1 : 10
In Rome, according to Pliny the elder	1 : 14$\frac{12}{25}$
In Rome, after the tribute from the Italians	1 : 10
The plunder of gold from the Gauls by Julius Cæsar, reduced the proportions to	1 : 7½
In the reign of Claudius, Tacitus states it at	1 : 12½
Until the reign of Alexander Severus, it continued	1 : 12½
In the reign of Constantine the Great	1 : 10½
The disorders in the Roman Empire under Arcadius and Honorius, raised it to	1 : 14⅔
From which it appears that gold, unless when depressed by sudden and unusual occurrences or enhanced by a dread of public insecurity, may be stated to have been for upwards of nine hundred years, in the proportion of . .	1 : 10 or 12

TABLE 2.—According to Dr. O. J. Broch, International Monetary Conference, 1878.

In the middle ages the relation in the price of Gold and that of Silver was from 10½ to 12.

According to the various monetary laws, this relation should have been:

In the year 1526, in England	1 : 11.30
" " 1542, "	1 : 11.10
" " 1551, in Germany	1 : 11.17
" " 1559, "	1 : 11.45
" " 1561, in France	1 : 11.70
" " 1575, "	1 : 11.68

It was only after the discovery of the rich mines of Silver at Potosi in 1545, and still more after the invention of the method of cold amalgamation in 1557, that Silver began to fall as compared with Gold.

According to monetary laws, the relation was:—

In the year 1604, in Great Britain	1 : 12.16
" " 1612, "	1 : 13.20
" " 1619, "	1 : 13.35
" " 1640, in France	1 : 13.51
" " 1667, in Germany	1 : 14.15
" " 1669, "	1 : 15.11
" " 1670, in Great Britain	1 : 14.60
" " 1679, in France	1 : 15.00
" " 1685, "	1 : 15.10

According to the Exchanges quoted at Hamburg, with reference to Dutch Ducats, the following relation is calculated:—

1687-1700, average . . .	1 : 14.97	1741-1799, average . . .	1 : 14.74
1701-1720, " . .	1 : 15.21	1799-1800, " . . .	1 : 15.42
1721-1740, " . . .	1 : 15.08		

In the XIXth century the relation of the price of gold and that of silver, has been in the London market:—

1801-1811, average .	1 : 15.60	1831-1840, average . .	1 : 15.07
1811-1820, " . . .	1 : 15.61	1841-1850, " . .	1 : 15.83
1821-1830, " .	1 : 15.80		

After the discovery, in 1848, of rich gold beds in California, and later in Australia, the relation in the London market was:—

1850, average	1 : 15.70	1859, average	1 : 15.21
1851, "	1 : 15.46	1860, "	1 : 15.27
1852, "	1 : 15.59	1861, "	1 : 15.50
1853, " . .	1 : 15.33	1862, " . . .	1 : 15.35
1854, "	1 : 15.33	1863, " . .	1 : 15.38
1855, " .	1 : 15.30	1864, "	1 : 15.35
1856, " . . .	1 : 15.33	1865, " . .	1 : 15.46
1857, "	1 : 15.29	1866, " . . .	1 : 15.41
1858, "	1 : 15.36		

After the discovery of rich silver mines in California, in Nevada, Arizona, and Colorado, the price of silver began to fall, and the fall was accelerated by the introduction of the Gold Standard in the place of the Silver Standard in Germany in 1872, and in the Scandinavian countries in 1873.

The relation of Gold to Silver in the London Market was:—

In the year 1867, average	1 : 15.67	In the year 1873, average	1 : 15.92
" 1868, "	1 : 15.60	" 1874, "	1 : 16.17
" 1869, "	1 : 15.60	" 1875, "	1 : 16.58
" 1870, "	1 : 15.58	" 1876, "	1 : 17.48
" 1871, "	1 : 15.58	" 1877, "	1 : 17.01
" 1872, "	1 : 15.63		

The lowest price of Silver in relation to Gold was reached in July, 1876; the price of Silver, $\frac{37}{40}$ fine, had then fallen in London to 46¾d. per ounce, a price which corresponds with the relation of 20.17 between the price of Gold and that of Silver of the same fineness.

Relation of the price of Gold to that of Silver according to the Monthly Average Price of Silver in the London Market, submitted to the Paris Conference (1881) by Dr. O. J. Broch.

Years.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Average.
1845	15.85	15.92	15.95	16.05	16.22	16.98	15.95	15.88	15.88	15.82	15.80	15.92	15.93
1846	15.90	15.92	15.92	15.95	15.98	15.98	15.97	15.96	16.95	16.92	15.73	15.68	15.91
1847	15.68	16.62	15.62	15.65	15.98	15.97	15.92	15.73	15.78	15.92	15.95	15.95	15.82
1848	16.95	16.90	15.93	15.96	15.97	15.85	15 85	15.77	15.78	15.77	15.83	15.86	15.87
1849	15.97	15.78	15.72	16.75	15.76	15.82	16.82	15.77	16.80	15.88	16.85	15.85	15.81
1850	15.82	15.82	16.82	15.82	15.82	15.82	15.78	16.73	15.72	15.65	16.62	15.33	15.72
1851	16.30	15 82	15.33	15.33	15.43	16.43	16.52	15.49	15.67	15.65	16.62	16.52	15.46
1852	15.52	15.59	15.62	15.08	15.75	15.73	15.64	15.62	15.62	15.49	15.32	15.35	15.58
1853	15.36	15 38	16.36	15.36	15.41	15.46	15.35	15.30	15.21	16.40	15.14	15.27	15.33
1854	15.27	15.29	16.26	16.26	15.27	15.36	15.36	15.40	16.36	15.40	15.36	15.32	15.33
1855	15.33	15.32	15.36	15.62	15.43	15.33	15.33	15.33	15.29	15.36	15.41	15.36	15.36
1856	15.40	15.38	15.47	15.46	15.43	15.43	15.40	15.35	15.24	15.21	15.15	15.18	15.34
1857	15.19	15.24	16.27	16.27	15.33	15.26	15.29	15.24	15.32	15.26	15.29	15.26	15.27
1858	15.35	15,27	15.32	15.38	15.33	15.33	16.44	16.47	15.51	15.40	15.29	15.30	15.36
1859	16.24	15.27	15.26	15.18	15.12	15.19	15.13	15.21	15.27	15.21	16.21	16.21	16.21
1860	15.18	15.19	15.18	15.29	16.30	15.40	15.44	15.36	15.30	15.29	16.32	16.35	15.30
1861	15.38	11.41	15.24	15.44	15.43	15.67	15.67	15.64	15.57	15.52	15.47	15.48	15.48
1862	16.36	16.32	15.38	15.41	15.40	16.33	15.46	15.41	10.38	16.33	15.21	16.29	15.36
1863	15.29	15.33	15.33	14.43	15.38	15.35	15.44	15.46	15.43	15.38	15.35	16.35	15.38
1864	16.23	16 33	15.33	15.54	15.46	15.40	15.41	16.38	15.33	15.46	16.47	15.39	15.39
1865	15.33	15.35	15.41	16.64	16.54	15.57	16.55	15.54	15.51	15.44	15.10	15.32	15.43
1866	15.32	15.43	15.47	16.65	15.32	15.19	15.36	15.57	15.51	15.46	15.47	15.49	15.44
1867	15.49	15.53	15.52	15.46	16.65	15.59	16.69	15.60	15.63	15.61	15.66	15.61	15.67
1868	15.62	16.69	15.54	15.65	15.59	15.62	16.61	16.64	15.66	15.64	16.69	15.54	15.61
1869	15.53	15.49	15.57	15.67	15.66	15.68	15.64	15.64	15.60	15.61	15.59	15.59	15.60
1870	16.57	15.60	15.59	15.61	15.60	15.60	15.45	15.59	15.62	15.59	15.56	16.58	16.60
1871	15.57	15.58	15.61	15.66	15.66	15.63	15.67	15.64	15 52	15.60	15.50	15.52	15.68
1872	15.60	15.46	15.51	15.57	15.68	16.70	15.68	16.68	15.61	15.70	15.85	15.79	15.64
1873	15.75	15.75	15.75	16.78	15.82	15.88	15.90	15.96	16.00	16.05	16.26	16.25	15.93
1874	16.05	16.05	16.00	16.01	16.06	16.06	16.96	16.26	16.32	16.33	16.26	16.40	16.16
1875	16.38	16.42	16.51	16.47	18.61	16.74	16.90	16.76	16.63	16.66	16.61	18.74	16.63
1876	16.98	17.38	17.67	17.56	17.80	17.24	19.59	18.07	18.21	17.96	17.50	16.65	17.80
1877	16.35	16.64	17.16	17.40	17.42	17.59	17.44	17.42	17.32	17.13	17.30	17.20	17.19
1878	17.53	17.38	17.30	17.44	17.62	17.76	17.92	17.97	18.33	18.71	18.65	18.87	17.96
1879	18.84	18.88	19.03	18.97	18.47	18.18	18.18	18.29	18.29	18.11	17.66	17.94	18.39
1880	17.96	18.05	18.14	18.13	18.09	17.97	17.90	17.90	18.02	18.11	18.22	18.19	18.06

Table Showing the Value of the Standard Silver Dollar in U. S. Gold Coin, also the Relative Value of Gold to Silver, based on the yearly average Price of Silver in the London Market, 1860-1881.

Date.	Price of Silver per oz., U. S. Standard, (i. e., 480 grains $\frac{900}{1000}$ Fine) in U. S. Gold Coin.	Value of a Silver Dollar of 412½ Grains, $\frac{900}{1000}$ Fine, in U. S. Gold Coin.	Relative Value of Gold to Silver.
	Cents.	Cents.	
1860	121.70	104.58	1 : 15.28
1861	119.98	103.10	1 : 16.50
1862	121.21	104.16	1 : 15.35
1863	121.09	104.06	1 : 15.36
1864	121.09	104.06	1 : 15.36
1865	120.47	103 52	1 : 15.44
1866	120.59	103.63	1 : 15.42
1867	119.48	102.67	1 : 15.57
1868	119.36	102.57	1 : 15.58
1869	119.24	102.47	1 : 15.60
1870	119.48	102.67	1 : 15.57
1871	119.36	102.57	1 : 15.58
1872	118.99	102.25	1 : 15.63
*1873	116.90	100.46	1 : 16.91
†1874	116.04	98.86	1 : 16.17
‡1875	112.21	96.43	1 : 16.58
‖1876	104.07	89.22	1 : 17.87
1877	108.01	92.83	1 : 17.22
**1878	103.82	89.21	1 : 17.02
¶1879	101.07	86.86	1 : 18.40
§1880	103.06	88.57	1 : 18.02
a1881	101.07	87.63	1 : 18.24

* Germany, Denmark, Sweden and the United States demonetize silver.

† The Latin Union agree to limit their silver coinage exclusively to subsidiary coins.

‡ Holland determines to coin silver only on Government account.

‖ Spain stops silver coinage except on Government account

** The United States remonetize silver, again adopting the double standard.

¶ The Latin Union renewed for another term of years.

§ Germany contemplating the remonetization of silver. Japan adopts silver as a standard.

a Paris Monetary Conference adjourns, (without definite action), to April, 1882.

According to Dr. Soëtbeer of Göttingen, (1879 and 1880).

108 years 1:11.5.	1493–1520	28	11.3
	1521–1544	24	11.2
	1545–1560	16	11.3
	1561–1580	20	11.7
	1581–1600	28	11 9
100 years, 1:14.00	1601–1620	20	13.0
	1621–1640	20	13.4
	1641–1660	20	13.8
	1661–1680	20	14.7
	1681–1700	20	15.0
100 years, 1:15.00	1701–1720	20	15.2
	1721–1740	20	15.1
	1741–1760	20	14.8
	1761–1780	20	14.8
	1781–1800	20	15.1
50 years, 1:15.7	1801–1810	10	16.6
	1811–1820	10	15.5
	1821–1830	10	15.8
	1831–1840	10	15.7
	1841–1850	10	15.8
29 years, 1:15.85	1851–1855	5	15.4
	1856–1860	5	15.3
	1861–1865	5	15.4
	1866–1870	5	15.6
	1871–1875	5	16.0
	1876–1879	4	17.4

III.—Table Showing the Average price of Silver for the Years in which the various Loan Acts of the United States were Passed.

Date.	Act.	Price of Silver per oz. U. S. Standard (i. e., 480 Grains, $\frac{900}{1000}$ Fine) in U. S. Gold Coin.	Value of a Silver Dollar of 412½ Grains, $\frac{900}{1000}$ Fine, in U. S. Gold Coin.
March 2, 1861	Oregon War Loan.	119.98	103.10
Feb. 8, 1861 July 17, 1861 Aug. 5, 1861	Six % Bonds of 1881.	119.98	103.10
March 3, 1863	Six % Bonds of 1881.	121.09	104.06
March 3, 1865	Five Twenties.	120.47	103.52
July 1, 1862	Currency Sixes.	121.21	104-16
July 2, 1864 March 3, 1864	do do Ten Forties.	121.09	104.06
March 18, 1869	Public Credit Act.	119.24	102,47
July 14, 1870	Five % of 1881. 4½ % of 1891. Four % of 1907.	119.48	102.67
Jan. 20, 1871	do do	119.36	102.57
Jan. 14, 1875	Resumption Act.	112.21	96.43

*** Minute on the Standard of the United States.**

Act.	Coins.	Weight in Troy Grains af Pure Metal in Coined Dollar.	Extent of Legal Tender.	Legal Relation.	Approximate London Market Relation.
April 2, 1792.	Silver dollar. † Multiples of Gold dollar.	371.5 24.75	Unlimited Do	15.00000:1	14.4:1
July 31, 1834.	Silver dollar. † Multiples of Gold dollar.	371.25 23.20	Do Do	16.00215:1	15.7:1
July 18, 1837.	Silver dollar and fractions.§ † Multiples of Gold dollar.	371.25 23.22	Do Do	15.98837:1	15.8:1
Feb. 24, 1853.	Silver dollar. Gold dollar and multiples. Fractions of Silver dollar.	371.25 23.22 345.60	Do Do Five Dolls.	15.98837:1	15.3:1
Feb. 12, 1873.	Silver dollar.	371.25	Unlimited coinage interdicted	15.98837:1	15.9:1
Dec. 1, 1873.	Silver dollar. Fractions of Silver dollar. Silver trade dollar. Gold dollar. and multiples.	371.25 347.22 378.00 23.22	Five Dolls. Do Do Unlimited.		16.2:1
July 22, 1876.	Silver trade dollar.	378.00	Legal tender character taken away.		
Feb. 28, 1878.	Silver dollar. Gold dollar and multiples.	371.25 23.22	Unlimited tender.	15.98837:1	17.9:1

* From the Report of the United States Monetary Commission, 1877.

† Eagles, half-eagles and quarter- eagles.

The weights above given are for the amount of *pure metal* in the coin. All the full value coins are (since 1837) .900 fine, *i. e.*, there is .100 of alloy to .900 of pure metal. The 371.25 of pure silver given in above table is the equivalent of the 412½ grain dollar of coined silver.

§ Half dollars, quarters, dimes and half dimes.

HOW MONEY IS MADE.

ALTHOUGH the United States Mint is a never-failing attraction to visitors, it is probable that but a few obtain more than a very superficial glimpse of the manifold chemical and delicate mechanical manipulations through which the precious metals must pass before evoluting into the noble double eagle or the bright new silver dollar; and it is perhaps with a slight feeling of disappointment that the visitor, after completing the circuit of the operating rooms which are open to public inspection, is ushered into the cabinet of coins, and politely invited by the guide to make himself perfectly at home, stay as long as he likes, and "look at the coins of all nations and specimens of gold from all parts of the world." It is with a view of partially satisfying the curiosity which may have been whetted by such a visit that this descriptive article is written, and it is proposed to give the reader a little glimpse behind the scenes, and to initiate him into some of the delicate means by which the noble metals are prepared to receive the impress of the American Eagle. The early history of the precious metals forms an exceedingly interesting subject of research, but an attempt to explore this tempting by-path of knowledge would be impossible within the brief space of one article. The precious metals are never found in the pure state, and they are deposited at the mint alloyed with other metals and in a great variety of forms, such as native grains, dust, amalgam, bars or pigs, old jewelry, etc. The mixed metals are known under the generic name of "bullion." The bullion is first weighed in the "deposit weigh-room," where several balances are kept for the purpose; the largest of these will weigh as much as ten thousand ounces in one draught, and the scale will readily turn, even when loaded to its full capacity, with a weight of one-hundredth part of one ounce. The metal is then placed in a box provided with a cover and lock and taken to the "deposit melting room." Here it is put in a crucible which has been previously heated in the melting furnace, and covered with a thin coating of borax, which forms a sort of fluid glass, acting as a hermetic cover to protect the metal, when it is molten from the oxidizing influence of the air. A stalwart workman, wearing a pair of large canvas mitts (somewhat resembling boxing-gloves) stands guard, and grasping, with a pair of iron tongs, a rod or stick made of plumbago, he stirs the now fluid mass back and forth, up and down, round and round, for the purpose of rendering it thoroughly homogeneous; the metal is then cast into an iron mould called a "shoe." It is plunged into water to cool, as well as to dissolve off any particles of the borax glass which may have adhered to its surface. It is now returned to the weigh-room and reweighed. A slight loss in weight usually occurs owing to a practical refining out of the base metals, and the new weight is the amount with which the depositor is credited. Let us suppose that a depositor brings a miscellaneous assortment of old gold; watch-cases, jewelry, dentist's plates, etc., representing every grade of fineness or proportion of pure gold, desiring to obtain its equivalent in coin. We will follow in imagination the usual course pursued. After the metal has been returned from the melting-room (where it was cast into the shoe mould) and the bar reweighed, a small chip is cut off from one end of the bar and taken to the assay laboratory.

The Analysis.—The sample is laminated or rolled into a thin ribbon and stamped with the number of the deposit which it represents, it is then assayed to determine the proportion of gold, silver, and base metal, and so accurate are the processes of assay, that the exact value of a deposit, frequently aggregating many thousands of dollars in value, is determined to the fraction of a cent by calculations based on the assayer's report. The largest weight which the assayer uses in making an analysis of gold bullion is the French half-gramme (or about seven and three-quarter grains Troy). The balances used in this work are marvels of mechanical construction; they are so sensitive that a weight of one-twentieth of a milligramme (less than one-thousandth of a single grain) will cause the indicator needle to deflect a very appreciable distance from the zero point on the graduated scale marking the equilibrium. These little balances are inclosed in glass cases, provided with sliding windows to exclude any draught of air. The beam is usually made of aluminum, one of the lightest metals, and the knife edges rest on jewels. The weights are made of gold, silver and aluminum, and are graduated from the half gramme, which is arbitrarily denominated "1,000," down to the ten thousandth degree. The assayer first determines approximately the relative proportions of the metals existing in the alloy, and from this bases his more careful determinations; he weighs out on the balance exactly one-half gramme, or 1000 parts of the alloy; he wraps this in an envelope of pure lead and rolls it into the form of a "bullet." The bullet is then placed in a small "cupel" or cup, made of calcined bone-dust, which has been brought to a white heat in the muffle or oven of the assay furnace. The mass melts immediately, and the lead oxidizes rapidly by absorbing oxygen from the heated air which passes continually over its surface, and on account of the extreme fluidity of the oxide it sinks into the pores of the cupel, which absorbs it as readily as a sponge absorbs water; the lead also carries with it all the base metals which may be originally combined in the alloy, but the precious metals not being oxidizible, simply melt, and are not so fluid as to be capable of sinking into the cupel. A preparation thus takes place, and at the moment when all the base metal is removed a beautiful "flash" is observed to take place on the surface of the metal; the "button" of purified gold and silver resulting from this operation is then removed from the cupel, returned to the balance, and weighed; the loss indicates the proportion of base metal. Another weighing of the sample is then made, to which is added pure silver in the form of fine granules, in the proportion of about two parts of silver to one of gold, the alloy is enclosed in a sheet of lead and cupelled as before; the silvery button remaining is laminated, coiled into a roll called a "cornet," and boiled in nitric acid. The acid dissolves the silver, leaving a little roll of pure gold. This gold cornet is then annealed in the furnace to give it toughness, and is finally weighed; this weight represents the proportion of pure gold. The proportion of silver is ascertained by subtracting the weight of the pure gold plus the weight of the base metal from the original weight of the assay sample. Silver was formerly assayed in the same way, but it was long known that the result was not quite accurate, owing to a partial volatilization of the metal when exposed to the high temperature of the fire. Experiments were some years since instituted by the French government to overcome this difficulty, which resulted in the beautiful "humid process" devised by a celebrated chemist, Gay Lussac. This is one of the most accurate methods known to chemical science, and so complete was Gay Lussac's original description that but little room has been left for any improvements, and many thousands of dollars' worth of silver bullion are rapidly and accurately determined every day in the mint in this way. The rationale of Gay Lussac's method is very simple, viz.: a given amount of chlorine gas will precipitate a definite proportion of pure silver from its solution in nitric acid. The assayer prepares two solutions of common salt-water (chloride of sodium); one is known as the "normal solution," and the other as the "decimal solution." One begins and the other finishes the assay. The sample of silver to be assayed is weighed out, as in the case of gold, the assayer taking care to place a sufficient weight of the alloy in the scale-pan to contain at least one gramme (a little over fifteen grains) of pure silver; the weighed sample is then placed in a glass bottle, and a charge of nitric acid is added to it; the acid is caused to boil, and in a short time the silver alloy is completely dissolved. A charge of the normal salt solution is then allowed to flow into the bottle from a glass "pipette," which is made of such a capacity that it shall contain just enough salt-water to precipitate one gramme of pure silver; the chlorine in the salt-water combining instantly with the silver, precipitates it in the form of a white cloud; the bottle is agitated rapidly for a few moments, when the precipitate settles to the bottom, leaving a clear solution above; the assayer next allows a charge of the "decimal solution," which is one-tenth the strength of the normal solution, to flow into the bottle from a glass tube with graduated divisions, each division marking one hundredth the capacity of the large pipette. If any silver remains in the solution a cloud will be observed on the surface. Now, as this decimal charge is one-tenth the strength and one-hundredth the volume of the large pipette, it will, of course, precipitate just one-thousandth as much silver, or one milligramme. The bottle is again agitated to settle the precipitate, and successive charges of the "decimal solution" are added until all the silver is precipitated, and then a simple rule of three sum gives the exact proportion of pure silver contained in the original weight of the alloy. The assayer guards against all probable sources of error by an elaborate system of checks, and each set of assays is accompanied in all its mutations by one or more "proofs" or synthetic assays, made either from pure metal or from alloys of known composition. After the exact proportions of gold, silver, and base metal constituting the alloy are reported by the assayer to the superintendent the value of the deposit is calculated and the depositor is paid the full equivalent, less the charges for refining, the amount of charges depending, of course, upon the nature of the bullion.

The Refining Process.—The metal now passes into the hands of the "melter and refiner." We will suppose that the representative deposit that we have already alluded to contains a small percentage of base metals, such as tin and lead, which tend to make the alloy brittle or "short," rendering it unfit for coin. The first operation to which it is subjected is intended to eliminate these impurities, and is called "toughening." The metal is melted in a crucible and an oxidizing flux (saltpetre) is added to it while fluid, the saltpetre or niter decomposes and liberates oxygen gas; the oxygen seizes the base metals forming oxides; these rise to the surface and are dissolved in the flux; the flux, when sufficiently thick, is skimmed off, and the purified metal, consisting only of gold and silver, is cast into a bar or poured into ice water to form granulations. The next operation is designed to remove the silver; this is effected by boiling in nitric acid, when the silver dissolves, leaving the gold in a finely divided state. The "plant" used for this purpose consists of a number of large porcelain jars capable of holding about fifty gallons of nitric acid each. These are arranged in a double row and heated by steam pipes; they are inclosed in a chamber provided with sliding doors to prevent the escape of the noxious fumes, which are carried into a tall chimney from which they issue in a yellowish cloud. The dissolved silver is drawn off by means of a large siphon made of native California gold (valued at three thousand dollars) and transferred to a vat made of wood, resembling those used in breweries. The vat contains several hundred gallons of salt water, and the silver is precipitated by the chlorine, a workman facilitating the operation by agitating the liquid with a large paddle provided with a long handle.

The precipitated silver is drawn off into large filters placed on trucks and thoroughly washed by running water until the test of litmus paper shows that all trace of acid has been removed. The chloride of silver now resembles pure white cottage cheese. It is transferred to another vat lined with lead. Zinc (which has been previously granulated by pouring while melted into cold water) is added to the silver, together with a little sulphuric acid; the chlorine deserts the silver for the baser metal, forming a soluble salt of zinc. The solution is allowed to flow off, and the precipitated silver is pressed into round cakes called cheeses, dried in an oven and melted in the furnace; it is finally cast into a bar, and is found to be uncontaminated with its former base associates. The gold which remained in the porcelain jars is in the form of fine powder, and resembles sifted gravel as nearly as may be. It is also pressed into cheeses, dried, and melted under a covering of borax or charcoal, and is cast into a bar of nearly pure gold. All that now remains for the melter and refiner to do is to weigh out the requisite amount of copper to form the coin standard, which is nine parts of gold or silver (as the case may be) and one part base metal. In other words, our coin standard is nine-tenths fine. The alloy is melted in large crucibles made of plumbago and constantly stirred to render the mass homogeneous. The standard metal is cast into flat bars called ingots, twelve inches long, one-quarter of an inch thick, and from three-quarters to one and a half inches wide; the ingots are filed to remove the ragged edges, and the rough tops are cut off with large steam shears. Two samples from each melt are assayed, and if the alloy is found to be of the proper fineness and of uniform composition, they are delivered to the coiner.

The Mechanical Process.—The coiner transfers the ingots to the rolling mill, and when they have been sufficiently laminated by successive rolling and annealing, the strips are passed through a machine called the "draw bench," for the purpose of reducing them to the exact thickness required for the coin; this operation is similar in principle to the wire drawing, and consists simply in squeezing the flat strips of metal between two stationary steel cylinders set to the desired gauge. The strips are now passed to the cutting press, which consists essentially of a round punch, the size of the "planchet," or blank required for the coin, working up and down very rapidly into a hole on the steel bed plate. The strips are passed by hand through the press, and the blanks fall into a box below. The unused portion of the strips, or "clippings," is returned to the melter and refiner and remelted. The planchets are next taken to the "adjusting room," where may be seen a number of ladies seated at a long table, each one provided with a little balance and a file. Every lady is supplied with a pile of planchets, and she proceeds very deftly to weigh each one against a properly adjusted counter-weight. The planchets that are too light are thrown into a separate pile and returned to the melter and refiner, to be remelted with the clippings, while those that are too heavy are adjusted by filing on the edge. Within a very few years a novel automatic adjusting machine, designed by Mr. Ludwig Seyss, of Vienna, has been introduced for the purpose of facilitating the work and diminishing the necessity of hand labor. It is an exceedingly beautiful and ingenious piece of mechanism, but is too complicated to admit of an intelligible description without the aid of sectional drawings. A description of this instrument will be found in the Journal of the Franklin Institute. It not only weighs the blanks automatically, but separates them into three kinds; those that are too heavy falling into one box, the light ones into another, and those of the right weight into a third. The machine never makes a mistake, and will weigh and assort as many pieces in an hour as five expert ladies can do by hand, but when we consider that there are ten balances in the machine engaged in weighing at the same time, and only five used by the ladies, they must be awarded the palm for expedition. The machine also requires the constant attention of one person to supply the blanks or planchets, and when the additional cost of steam-power and wear and tear of the parts are added to the original expense of the apparatus, its merit from an economical point of view is not so great as would at first sight appear. The next operation to which the blank pieces are subjected is to impart the raised edge, technically called "milling." The machine used for this purpose is an American invention, and is admirable for its simplicity as well as for the rapidity with which it accomplishes the work. The blanks are fed by an attendant into a tube, and they are drawn horizontally, in single file, through a gradually narrowing channel formed by a groove in the periphery of a rapidly revolving disk on one side, and a stationary segment of corresponding curve on the other, keyed a little closer to the wheel at one end. The blanks are in this way compressed on the rim, acquiring the "milled edge." This machine is capable of milling as many as 1,200 pieces per minute. The blanks are now taken to the pickling vats, where they are immersed for a couple of minutes in weak sulphuric acid for the purpose of removing the black oxide of copper; they are then washed in pure water and placed in a rotating cage filled with sawdust. This rapidly dries the blanks, and when removed to the coining room they have acquired a fine, bright surface.

The Coining.—The early methods of coining were exceedingly crude and imperfect. The metal was hammered into a thin plate; pieces of irregular size were cut out and beaten into a bullet shape; this bullet was placed on a sort of anvil having the reverse die cut upon its face. The obverse die was held in the hand like a punch, and by the aid of a heavy hammer the bullet was flattened out and coined at the same time. There are many interesting specimens of this antique coinage to be seen in the mint cabinet. The oldest pieces are to be found in the case devoted to coins of the Greek Republic, dating back to seven centuries before the Christian era. It was not until the middle of the sixteenth century that the forge and hammer were succeeded by more scientific methods. In the British mint the coins are struck in the presses worked by a screw; but we have adopted the admirable invention of a Frenchman, named Thenolliér, which has been further improved upon by the skill of a former coiner, the late Mr. Franklin Peale. This machine operates on the mechanical principle of the "toggle joint" (of which the elbow-joint is a familliar example). It is controlled by a lady who feeds it with the blanks, which she places in a vertical tube. A pair of "feeders" catch the bottom piece and carry it forward, where it rests in the "collar" between the upper and lower dies; the lever is now descending with the upper die while the lower die remains fixed; the pressure increases with perfect uniformity up to the maximum, which is equivalent to about ten tons for the dime, 80 tons for the double eagle, and 120 tons for the silver dollar. The pressure gradually decreases again by reason of the relaxation of the upper joint, the lower die pushes the piece out of the collar into which it has expanded, and from which it acquires the "reeded edge." Meanwhile, the feeders have provided another blank, and as they bring it forward they push the coined piece into a channel, through which it slides into a box beneath the machine. The coins are then inspected by the foreman, and any cracked or defective pieces set aside. The larger denominations of coin are counted by hand, and the smaller pieces, as well as the "bronze" and "nickels," are numbered by means of a simple and ingenious arrangement called the counting board. After the coins have thus been counted and weighed, they are tied up in linen bags and delivered to the treasurer in drafts of $5,000 each. The accuracy of the adjustment of the weight is so nice that there is rarely a deviation from the true standard weight of as much as one hundredth of an ounce in any delivery of either gold or silver coin. As a final precaution, the assayer is required by law to select at random one coin from every lot of twenty thousand dollars; these are sealed in envelopes, numbered, and placed in a strong box provided with two locks; the key of one is kept by the treasurer and the other by the assayer. These sample pieces are called the "pyx." They remain sealed until the commissioners appointed by the President assemble at the annual "assay" in February of each year to test their purity and weight; and it has rarely, if ever, happened that any piece has been found to exceed the small limit of "tolerance" allowed by law.

The manufacture of the dies for coin requires a high order of artistic and mechanical labor, involving "the talent of the designer and the skill of the engraver and sculptor." A detailed description of the processes involved would necessarily extend this article beyond the limits assigned to it. A brief outline must, therefore, suffice. The artist first makes a free sketch on paper, he then models his design in wax upon a glass plate, and it is probably five times the size intended for the coin; from this he takes a cast in plaster, which serves, when coated with plumbago, as a matrix from which an electrotype in copper is obtained. The electrotype relievo, after being finished by hand, is used as the model from which the steel die is cut by means of a reducing pantographic cutting machine, somewhat similar to those used for reproducing designs for steel rolls used in making printed fabrics. A traveling pointer attached to the long arm of a lever is caused to move back and forth over all portions of the raised model, and a steel drill attached to the short arm is thus caused to cut an intaglio design in a block of steel corresponding in all its details to the model, but reduced to the proper diameter for the coin; the stars and lettering are now added, and the whole is finally touched up by the hand. The intaglio is not used for coining, but from it a relievo called the "hub" is made. A block of steel having been softenened by annealing, is placed in a screw press carrying the "hub," and by a succession of blows, followed by frequent annealings, the die from which the coin is to be made is produced. It is possible (owing to the great value of the raw material) to bring the processes involved in our gold and silver coinage to the perfection which would not perhaps be found profitable in any ordinary industry, and this fact, together with the national pride which is felt in the matter, should offer encouragement to the invention of all practicable methods of producing perfect work and preventing losses.

—*A. E. Outerbridge, Jr., in the Scientific American.*

PROCEEDINGS OF THE ASSAY COMMISSION OF 1882.

WEDNESDAY, *February* 8, 1882.

THE Commissioners appointed by and under the provisions of section 3547 of the Revised Statutes of the United States, met in conformity therewith for the purpose of making the annual trial of the coins reserved at the mints at Philadelphia, San Francisco, Carson, and New Orleans, during the year 1881. The director of the mint having announced that a quorum was present, Hon. William Butler, judge of the district court for the eastern district of Pennsylvania, took the chair, and the director's clerk was designated as secretary. The letter of the President appointing the following special commissioners was then read:

Hon. William B. Allison, U. S. Senate; Hon. William S. Rosecrans, House of Representatives; Prof. John Towler, Hobart College, Geneva, N. Y.; Hon. Paul A. Chadbourne, Mass.; Prof. Chas. E. Munroe, Naval Academy, Annapolis, Md.; Prof. J. E. Hilgard, U. S. Coast and Geodetic Survey; Dr. Wm. Pepper, University of Pennsylvania, Philadelphia, Pa.; Dr. Le Baron Russell, Boston, Mass.; Dr. W. P. Lawver, Assayer, Mint Bureau; Anthony J. Drexel, Esq., Philadelphia, Pa.; Thomas Donaldson, Esq., Philadelphia, Pa.; Hon. Horatio G. Fisher, chairman of the House Committee on Coinage, &c.; Hon. J. B. Belford, chairman of the House Committee on Expenditures in the Treasury Department; George W. Childs, Esq., Philadelphia. Senator Allison, Professor Towler, Doctor Russell, and Mr. Drexel declined the appointment. The *ex-officio* members of the Commission were Hon. Wm. Butler, judge of the district court of the United States for the eastern district of Pennsylvania; Hon. John Jay Knox, Comptroller of the Currency, and Herbert G. Torrey, Assayer of the U. S. Assay Office at New York. The Director of the Mint and all the members of the Commission who accepted the appointment answered to the roll-call except Hon. J. B. Belford.

On motion of Mr. Donaldson, the reading of the section of law under which the Commission is constituted, the several sections bearing upon the duties of the Commissioners, the rules for the organization and government of the Board, and the minutes of the last preceding assay was dispensed with.

On motion of Professor Hilgard, the chairman appointed and announced the following committee:

On Counting—Messrs. Donaldson, Fisher, and Pepper.

The chairman then announced the following committees:

On Weighing — Messrs. Hilgard, Fisher, Donaldson, Knox, and Childs.

On Assaying—Messrs. Rosecrans, Torrey, Chadbourne, Pepper, Munroe, and Lawver.

On motion of Professor Hilgard, it was ordered that upon the reserved coins being produced, selections should be made by the committees on weighing and assaying of a sufficient number of pieces for their purposes, and the number and dates of the deliveries from which pieces were taken should be minuted, and the selected coins be kept distinct from each other until the examination be completed. The Commission then took a recess subject to the call of the chairman.

THURSDAY, *February* 9, 1882.

The Commission convened at 3 P.M., at the call of the chairman, and came to order. Present: Messrs. Butler, Torrey, Rosecrans, Chadbourne, Munroe, Hilgard, Lawver, Donaldson, and the Director of the Mint. The committee on Counting submitted the following report, viz.:

The Committee on Counting reports that all the packages of reserved coins were opened and counted by it, or in its presence, and that the count verified the respective amounts exhibited by the abstract sheets from the books of the mints. A sufficient number of each denomination of coin of the coinage of the several mints was taken from the reserved coins by the Committees on Weighing and Assaying. The remaining coins from all the mints were at once delivered to the Superintendent of the Philadelphia Mint. The coins selected and weighed by the Committee on Weighing have also been delivered to said Superintendent, as well as the bullion made from the coins selected, assayed, or melted by the Committee on Assaying. All the packages of reserved coins from the several mints delivered to the Assay Commission of 1882, have, after use in the manner provided by law, been returned to and placed in the charge of the Superintendent of the Philadelphia Mint.

THOMAS DONALDSON.
H. G. FISHER.

On motion of Professor Hilgard, the report was adopted.

The Committee on Weighing submitted the following report, viz: The Committee on Weighing beg leave to report that they have concluded the examination intrusted to them in accordance with the order of proceedings adopted by the Commission. Single coins taken at random from the reserved coins of various deliveries throughout the year, kept separate and distinguished as to their origin and date, were accurately weighed; the gold coins to $\frac{1}{100}$ grain, the silver to $\frac{1}{10}$ grain. The aggregate weight of gold coins, similarly selected, but not kept separate, to the amount of $1,000, was also ascertained, as well as that of $100 standard silver dollars of each mint. In addition, the standard weights used for the verification of those in constant use in the Mint have been verified by comparison with the verified copy of the troy pound designated by law, (which itself should not be used oftener than once in ten years,) and have been found entirely satisfactory.

The following are the results of the selected coins:

Philadelphia gold mass weights.

134 eagles	Standard weight	72.025 oz.
	Actual weight	72.023 oz.
153 half eagles	Standard weight	41.119 oz.
	Actual weight	41.114 oz.

Philadelphia—Single pieces.

Denomination.	Date of delivery.	Heavy.	Light.
		Grains.	*Grains.*
Eagles	January 4	.04	
	January 14		.08
	January 14		Standard.
	February 5		.10
	February 26		.11
	February 28		.14
	March 2		.04
	March 7		.14
	March 28		.06
	April 7		.13
	April 8		.01
	April 27		.16
	May 3		.02
	May 11		.03
	May 25	.19	
	June 2		.03
	June 3		Standard.
	June 27	.12	
	August 22		.03
	August 26		.07
	August 27		.04
	September 13		Standard.
	September 15		.04
	September 20	.16	
	October 8	.04	
	October 29		.05
	November 4	.01	
	November 30		.12
	December 5	.23	
	December 7	.24	
	December 29		.06
Half eagles	January 14		Standard.
	January 15	.13	
	January 20		Standard.
	February 2	.11	
	February 19		.01
	February 28		.02
	March 9		.12
	March 25		.08
	March 30		.07
	April 5		.08
	April 6		.07
	April 11		.09
	April 23		.04
	April 25		Standard.
	May 5		do.
	May 17		do.
	May 26	.13	
	June 6	.03	
	June 21	.15	
	June 27	.17	
	August 31		.06
	October 12	.11	
	November 9	.12	
	November 17	.02	
	December 8		.04
	December 22		.10

Philadelphia=Silver mass weight.

		Ounces.
50 dollars	Standard weight	42.96875
	Actual weight	42.998

Philadelphia—Single pieces.

Denomination.	Date of Delivery.	Heavy.	Light.
		Grains.	*Grains.*
Dollars	January 7	.5	
	January 7	.7	
	January 27		Standard.
	January 27	.7	
	February 15	.8	
	February 15	1.0	
	February 23	1.0	
	February 23	1.0	
	March 1		.6
	March 1		.7
	March 22	.6	
	March 22		.7
	April 14		Standard.
	April 14	.8	
	April 22		Standard.
	April 22	1.2	
	May 12	.4	
	May 12	.2	
	May 18		Standard.
	May 18		.5
	June 7		.5
	June 7	.8	
	June 21	.8	
	June 21	.9	
	July 17		.6
	July 17		.2
	July 26	.7	
	July 26	.5	
	August 6		.2
	August 6		Standard.
	August 12	.6	
	August 12	.2	
	September 16		.5
	September 16		.6
	September 23	.2	
	September 23		.8
	October 4		.7
	October 4	.7	
	October 24		.2
	October 24		Standard.
	November 11		.9
	November 11	.6	
	November 22		1.2
	November 22	.4	
	December 10	.5	
	December 10		1.0
	December 20		.5
	December 20	1.0	

San Francisco—Gold mass weights.

		Ounces.
57 double eagles	Standard weight	61.275
	Actual weight	61.272
48 eagles	Standard weight	25.80
	Actual weight	25.798
58 half eagles	Standard weight	15.5875
	Actual weight	Standard.

San Francisco—Single pieces.

Denomination.	Date of Delivery	Heavy.	Light.
Double eagles		*Grains.*	*Grains.*
	April 5		Standard.
	April 7		do.
	April 15		do.
	May 9		.07
	May 10		Standard.
	May 17	.10	
	June 1	.01	
	June 9		.04
	June 17		.10
	July 16		.30
	July 27	.01	
	July 30		.06
	August 1		Standard.
	August 12		.20
	August 13		.17
	November 10		.01
	November 16		.18
	December 13	.13	
	December 19	.06	
	December 20	.02	

San Francisco—Single pieces.—*Continued.*

Denomination.	*Date of Delivery.*	*Heavy.*	*Light.*
		Grains.	*Grains.*
Eagles	January 25		.01
	January 28	.01	
	January 29		.15
	February 16		.06
	February 17	.02	
	February 18		.06
	March 18	.03	
	March 26		.07
	March 30	.06	
	August 22		.05
	August 24	.09	
	August 27		.12
	September 2		.15
	September 28		.06
	September 30	.05	
	October 8		.12
	October 19		.11
	October 26	.02	
	November 1		.25
	November 28		.02
Half eagles	January 11		.04
	January 17		.07
	January 22		.03
	February 18		.04
	February 21		.01
	February 26		
	March 1	.04	
	April 22		Standard.
	April 27		do.
	April 30		.06
	May 3	.03	
	May 6		Standard.
	May 13		do.
	September 16	.01	
	September 12		.01
	September 24	.01	
	November 22	.04	
	November 30		.15
	December 3		.06
	December 27		.01
	December 30	.06	

San Francisco—Silver mass weights.

		Ounces.
50 dollars	Standard weight	42.96875
	Actual weight	42.963

San Francisco—Single pieces.

Denomination.	*Date of delivery.*	*Heavy.*	*Light.*
		Grains.	*Grains.*
Dollars	January 6	.2	
	January 6	1.2	
	January 18		Standard.
	January 18	.7	
	February 11		.1
	February 11		.7
	February 26		1.0
	February 26	.1	
	March 3	.2	
	March 3		.3
	March 10		.9
	March 10		.2
	April 4		.4
	April 4		.8
	April 20		.8
	April 20	.5	
	May 5	.3	
	May 6		.3
	May 16		.2
	May 16	.2	
	June 3		.2
	June 3	.5	
	June 18	1.1	
	June 18		.9
	July 13	.2	
	July 13	.4	
	July 26	.6	
	July 26	.2	
	August 5		.2
	August 5		Standard.
	August 16		.4
	August 16	.4	
	September 1	1.0	
	September 1	.5	
	September 22	.6	
	September 22		.4
	October 6		Standard.
	October 6	.6	
	October 27	.3	
	October 27		.1
	November 1		.9
	November 1		.9
	November 19	.8	
	November 19		Standard.
	December 5		.5
	December 5		.8
	December 10		.5
	December 10		1.0

Carson—Single pieces.

Denomination.	*Date of delivery.*	*Heavy.*	*Light.*
		Grains.	*Grains.*
Eagles	January 14		.18
	January 14	.01	
	March 17		.12
	March 17		.02
	November 5		.02
	November 5	.10	
	November 14		.04
	November 14		.03
	November 30		.16
	November 30		Standard.
	December 8	.20	
	December 8		.17
	December 22		.2
	December 22		.3
	December 30	.04	
	December 30	.14	
Half eagles	February 3	.01	
	February 3	.03	
	February 3	.03	
	November 11		.04
	November 11		.06
	November 11		Standard.
	December 15		.20
	December 15		.01
	December 15		.10
Silver dollars	January 8		.2
	January 8		.4
	January 29		.4
	January 29	.04	
	February 16		Standard.
	February 16		.6
	February 28		Standard.
	February 28	.7	
	March 31	.2	
	March 31	.2	
	November 28		.3
	November 28	.2	
	November 29		.7
	November 29	.7	
	December 13		Standard.
	December 13		.8
	December 30		.1
	December 30		.2

New Orleans—Single pieces.

Denomination.	*Date of Delivery.*	*Heavy.*	*Light.*
		Grains.	*Grains.*
Eagles	May 6		.20
	May 5	.20	
	May 5		.09
	May 5		Standard.
	May 6		.23
	May 5		.24
	October 7	.17	
	November 23		.03
	November 23	.16	

New Orleans—Silver mass weight.

		Ounces.
50 dollars	Standard weight	42.96875
	Actual weight	42.970

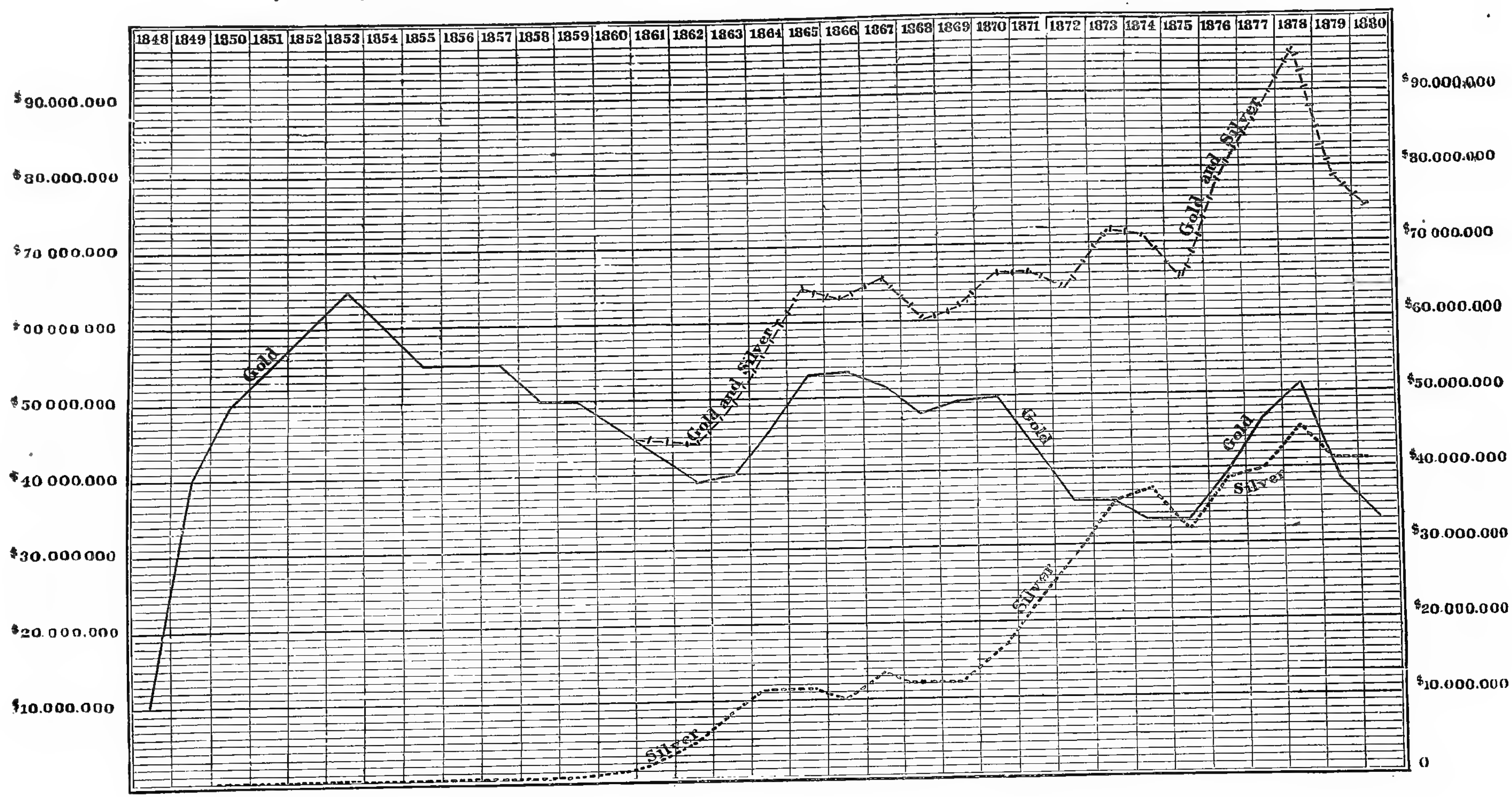
New Orleans—Single pieces.

Denomination.	*Date of Delivery.*	*Heavy.*	*Light.*
		Grains.	*Grains.*
Dollars	January 4	1.0	
	January 4		Standard.
	January 26	.3	
	January 26	.3	
	February 5		Standard.
	February 5	.3	
	February 25	.7	
	February 25		.1
	March 16		.7
	March 16	.5	
	March 28		.6
	March 28		Standard.
	April 8		.3
	April 8		.3
	April 29		.7
	April 29		.7
	May 3	.1	
	May 3		.1
	May 24	.1	
	May 24		.1
	June 10		.5
	June 10		.1
	June 16		.7

ANNUAL BULLION PRODUCT of the UNITED STATES.

For Fiscal years ending June 30, except 1880, for which the Census period is given.

If the curve for calendar years were given, points in 1875, 1876, 1877 and 1878, would appear one space to the left, respectively.



New Orleans—Single pieces.—*Continued.*

Denomination.	*Date of delivery.*	*Heavy.*	*Light.*
		Grains.	*Grains.*
	June 16		.1
	July 20		.1
	July 20		.2
	July 30	1.0	
	July 30		Standard.
	August 3		.2
	August 3		.1
	August 8		.4
	August 8		.1
	September 10	1.1	
	September 10		.7
	September 21		.7
	September 21	.2	
	October 6		.6
	October 6		.2
	October 22	.6	
	October 22	.8	
	November 4		.4
	November 4		.8
	November 23		.5
	November 23		.5
	December 1		.2
	December 1		.5
	December 23		.8
	December 23		.4

From the foregoing weighing it appears that all the coins weighed are within the limits of exactness required by law, and that, in fact, very few vary from the standard by one-half the tolerance. The results are therefore entirely satisfactory.

J. E. HILGARD.
THOMAS DONALDSON.
H. G. FISHER.
JNO. JAY KNOX.
GEO. W. CHILDS.

On motion of Professor Munroe, the report was adopted.

The Committee on assaying submitted the following report, viz: That in conformity with the law and regulations governing this Commission they have taken the gold and silver coins reserved from the several mints, to wit, Philadelphia, San Francisco, Carson City and New Orleans, the same being samples representing each delivery made during the year 1881, in the several mints named, from the coiners to the superintendents, and have assayed the same in mass, and also the individual coins, with the following results:

Gold—Philadelphia.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Eagle	January 5	900.1
2	Half eagle	January 20	899.9
3	Do.	February 2	899.9
4	Eagle	February 24	900.0
5	Do.	March 2	900.2
6	Half eagle	March 30	900.1
7	Do.	April 6	900.2
8	Eagle	April 27	900.0
9	Half eagle	May 7	900.0
10	Double eagle	May 14	899.8
11	Eagle	May 23	899.9
12	Do.	June 3	900.2
13	Half eagle	June 17	900.2
14	Do.	August 20	900.2
15	Eagle	August 27	900.2
16	Half eagle	September 6	900.0
17	Eagle	September 20	900.1
18	Do.	October 8	900.2
19	Half eagle	October 25	899.8
20	Eagle	November 4	900.2
21	Half eagle	November 17	900.0
22	Eagle	December 5	900.2
23	Half eagle	December 22	900.1
Mass.	200 half eagles 100 eagles		899.8

San Francisco.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Eagle	January 24	899.7
2	Half eagle	February 19	899.6
3	Double eagle	March 30	900.0
4	Do.	April 19	899.8
5	Do.	May 24	899.9
6	Do.	June 14	899.9
7	Do.	July 28	900.0
8	Do.	August 9	899.7
9	Eagle	September 29	899.6
10	Do.	October 1	899·7
11	Double eagle	November 18	889.7
12	Do.	December 15	899.6
Mass.	50 double eagles 100 eagles 100 half eagles		900.0

New Orleans.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Eagle	May 12	899.8
2	Do.	October 7	899.9
3	Do.	November 23	900·1

Carson.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Eagle	November 5	900.1
2	Half eagle	November 11	899.9
3	Eagle	November 14	900.1
4	Do.	November 30	[illegible].7
5	Do.	December 8	900 0
6	Half eagle	December 15	899.8
7	Eagle	December 22	900.3
8	Do.	December 30	900.2

SILVER.—Philadelphia.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Standard dollar	January 22	899.2
1	Do.	February 16	900.0
3	Do.	March 14	900.7
4	Do.	April 18	899.5
5	Do.	May 2	900.0
6	Do.	June 1	900.7
7	Do.	July 21	900.0
8	Do.	August 9	899.0
9	Do.	September 21	900.1
10	Do.	October 28	899.7
11	Do.	November 26	900.7
12	Do.	December 12	899.5
Mass.	240 dollars		900.0

San Francisco.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Standard dollars	January 10	898.9
2	Do.	February 18	899.8
3	Do.	March 23	899.1
4	Do.	April 19	899.3
5	Do.	May 7	899.3
6	Do.	June 2	899.7
7	Do.	July 28	899.3
8	Do.	August 18	899.1
9	Do.	September 24	899.1
10	Do.	October 26	900.4
11	Do.	November 8	900.9
12	Do.	December 5	899.1
Mass.	240 dollars.		899.1

New Orleans.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Standard dollars	January 31	898.6
2	Do.	February 17	898.9
3	Do.	March 11	898.9
4	Do.	March 12	900.0
5	Do.	May 6	898.9
6	Do.	June 2	898.4
7	Do.	July 29	898.9
8	Do.	July 26	899.3
9	Do.	August 23	900.2
10	Do.	September 7	899.1
11	Do.	September 6	899.8
12	Do.	October 5	900.0
13	Do.	October 29	899.5
14	Do.	November 1	899.3
15	Do.	December 7	899.5
16	Do.	December 29	900.9
17	Do.	August 12	899.1
Mass.	240 dollars.		899.5

Carson.

No.	*Denomination.*	*Date.*	*Fineness.*
1	Standard dollars	January 29	899.2
2	Do.	February 8	898.5
3	Do.	February 16	901.5
4	Do.	February 28	899.5
5	Do.	March 31	900.4
6	Do.	March 28	900.4
7	Do.	November 28	*898.5
8	Do.	December 13	899.1
9	Do.	December 30	899.8
10	Do.	November 29	*899.3
11	Do.	November 29	*898.9
Mass.	75 dollars		899.8

* Made from condemned coin of 1880.

From the foregoing, it will be seen that the greatest excess in the assay value of the gold coinage above the standard at the different mints, as stated in the following table, while the limit of tolerance is one-thousandth, is—

At Philadelphia, .2 of one-thousandth.
At San Francisco, .0 of one-thousandth.
At New Orleans, .1 of one-thousandth.
At Carson, .3 of one-thousandth.

The greatest deficiency below the standard, the limit of tolerance being one-thousandth, is—

At Philadelphia, .2 of one-thousandth.
At San Francisco, .4 of one-thousandth.
At New Orleans, .2 of one-thousandth.
At Carson, .3 of one-thousandth.

For silver, the maximum assays above the standard, the limit of allowance being 3 one-thousandth, is—

At Philadelphia, 1.1 one-thousandth.
At San Francisco, 0.9 one-thousandth.
At New Orleans, 0.9 one-thousandth.
At Carson, 1.5 one-thousandth.

The greatest deficiency below the standard, the tolerance being the same, 3 one-thousandth—

At Philadelphia, 0.8 one-thousandth.
At San Francisco, 1.7 one-thousandth.
At New Orleans, 1.6 one-thousandth.
At Carson, 1.5 one-thousandth.

Hence, the greatest deviation from the standard in the coinage examined is far within the limits allowed by law, and exhibits a remarkable degree of uniformity in mixture, while there appears a very great perfection of workmanship.

An analysis of the copper alloy present shows that it is substantially in accordance with the law and regulations.

W. S. ROSECRANS.
CHAS. E. MUNROE.
W. P. LAWVER.
H. G. TORREY.

On motion of Mr. Chadbourne, the report was adopted.

On motion of Mr. Donaldson, the following resolution was adopted:

"*Resolved*, That the Assay Commission having examined and tested the reserved coins of the several mints for the year 1881, and it appearing that these coins are within the tolerance prescribed by law, the trial is considered and reported as satisfactory."

On motion of General W. S. Rosecrans, the following resolutions were adopted:

"*Resolved*, That the thanks of the Commission be and are hereby tendered to Hon. A. Loudon Snowden, Superintendent of the Philadelphia Mint, for his kindness and attention to them during their meetings.

"*Resolved*, That the thanks of the Commission are also tendered to the officers and other employees of the mint who assisted in the annual assay of 1882."

On motion, the Board adjourned to meet at 10 A. M., Friday.

FRIDAY, *February* 10.

The Board convened at the hour appointed.

Present: Messrs. Butler, Knox, Rosecrans, Munroe, Hilgard, Lawver, Donaldson, Fisher, Torrey, Childs, and the Director of the Mint, Hon. Horatio C. Burchard. On motion of Dr. Lawver, seconded by Professor Munroe, the following resolution was adopted:

"*Resolved*, That the Assay Commission of 1882, in recognition of the long services of William E. DuBois, assayer of the United States Mint at Philadelphia, who entered the Mint in September, 1833, died July 14, 1881, after a service of forty-seven years, and of Charles B. Hare, foreman of the Assay Office of the said Mint, who entered that institution in 1830, died May 29, 1881, after a continuous service of fifty-one years—enter this minute upon the records of the Assay Commission of 1882, in appreciation of the faithfulness of these efficient officers."

On motion, the Commission adjourned *sine die.*

WM. BUTLER.
JNO. JAY KNOX.
H. G. TORREY.
W. S. ROSECRANS.
PAUL A. CHADBOURNE.
CHAS. E. MUNROE.
J. E. HILGARD.
WILLIAM PEPPER.
W. P. LAWVER.
THOMAS DONALDSON.
H. G. FISHER.
GEORGE W. CHILDS.

Present:
HORATIO C. BURCHARD,
Director of the Mint.

LAWS RELATING TO THE RESERVATION OF COINS FOR THE ANNUAL ASSAY.—*Revised Statutes, June* 22, 1874. Title XXXVII.—Coinage, Weight, and Measures.

Standard Weight of Gold Coins.—Sec. 3511.—The gold coins of the United States shall be a one-dollar piece, which, at the standard weight of twenty-five and eight-tenths grains, shall be the unit of value; a quarter-eagle, or two-and-a-half-dollar piece; a three-dollar piece; a half-eagle, or five-dollar piece; an eagle or ten-dollar; and a double eagle, or twenty dollar piece. And the standard weight of the gold dollar shall be twenty-five and eight-tenths grains; of the quarter-eagle, or two-and-a-half-dollar piece, sixty-four and a half grains; of the three-dollar piece, seventy-seven and four-tenths grains; of the half-eagle, or five-dollar piece, one-hundred and twenty-nine grains; of the eagle, or ten-dollar piece, two hundred and fifty-eight grains; of the double eagle, or twenty dollar piece, five hundred and sixteen grains.

Standard Weight of Silver Coins.—Sec. 3513.—The silver coins of the United States shall be a trade dollar, a half-dollar, or fifty-cent piece, a quarter dollar, or twenty-five cent piece, a dime or ten-cent piece; and the weight of the trade-dollar shall be four-hundred and twenty grains troy; the weight of the half-dollar shall be twelve grams (grammes) and one-half of a gram, (gramme;) the quarter-dollar and the dime shall be, respectively, one-half and one-fifth of the weight of said half-dollar.

AN ACT to authorize the coinage of the standard silver dollar, and to restore its legal-tender character.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be coined at the several mints of the United States, silver dollars of the weight of four hundred and twelve and a half grains troy of standard silver, as provided in the act of January eighteenth, eighteen hundred and thirty-seven, on which shall be the devices and superscriptions provided by said act. * * *

Standard of Fineness.—Sec. 3514.—The standard for both gold and silver coins of the United States shall be such that of one thousand parts by weight nine hundred shall be of pure metal and one hundred of alloy. The alloy of the silver coins shall be of copper. The alloy of the gold coins shall be of copper, or of copper and silver; but the silver shall in no case exceed one-tenth of the whole alloy.

Allowed Deviations from Standard Fineness and Weight.—SEC. 3533.—No ingots shall be used for coinage which differ from the legal standard more than the following proportions, namely: In gold ingots, one-thousandth; in silver ingots, three-thousandths.

SEC. 3535.—In adjusting the weights of the gold coins the following deviations shall not be exceeded in any single piece: In the double-eagle and the eagle, one half of a grain; in the half-eagle, the three-dollar piece, the quarter-eagle, and the one dollar piece, one fourth of a grain. And in weighing a number of pieces together, when delivered by the coiner to the superintendent, and by the superintendent to the depositor, the deviation from the standard weight shall not exceed one-hundredth of an ounce in five thousand dollars in double-eagles, eagles, half-eagles, or quarter-eagles, in one-thousand three-dollar pieces, and in one-thousand one-dollar pieces.

Sec. 3536.—In adjusting the weight of the silver coins the following deviations shall not be exceeded in any single piece: In the dollar, the half and quarter-dollar, and in the dime, one and one-half grains; and in weighing a large number of pieces together, when delivered by the coiner to the superintendent, and by the superintendent to the depositor, the deviations from the standard weight shall not exceed two hundredths of an ounce in one thousand dollars, half-dollars or quarter-dollars, and one-hundredth of an ounce in one-thousand dimes.

Coins to be Reserved for the Annual Assay.—Sec. 3539.—At every delivery of coins made by the coiner to a superintendent, it shall be the duty of such superintendent, in the presence of the assayer, to take indiscriminately a certain number of pieces of each variety for the annual trial of coins, the number for gold coins being not less than one piece for each one thousand pieces or any fractional part of one thousand pieces delivered; and for silver coins one piece for each two thousand pieces or any fractional part of two thousand pieces delivered. The pieces so taken shall be carefully sealed up in an envelope, properly labeled, stating the date of the delivery, the number and denomination of the pieces inclosed, and the amount of the delivery from which they were taken. These sealed parcels containing the reserved pieces shall be deposited in a pyx, designated for the purpose at each mint, which shall be kept under the joint care of the superintendent and assayer, and be so secure that neither can have access to its contents without the presence of the other, and the reserved pieces in their sealed envelopes from the coinage of each mint shall be transmitted quarterly to the mint at Philadelphia. A record shall also be kept at the same time of the number and denomination of the pieces so taken for the annual trial of coins, and of the number and denomination of the pieces represented by them and so delivered, a copy of which record shall be transmitted quarterly to the Director of the Mint. Other pieces may, at any time, be taken for such tests as the Director of the Mint shall prescribe.

Constitution of Commission.—Sec. 3547.—To secure a due conformity in the gold and silver coins to their respective standards of fineness and weight, the judge of the district court for the eastern district of Pennsylvania, the Comptroller of the Currency, the

Assayer of the Assay Office at New York, and such other persons as the President shall, from time to time, designate, shall meet as Assay Commissioners at the Mint in Philadelphia, to examine and test in the presence of the Director of the Mint, the fineness and weight of the coins reserved by the several mints for this purpose, on the second Wednesday in February, annually, and may continue their meeting by adjournment, if necessary. If a majority of the Commissioners fail to attend at any time appointed for their meeting, the Director of the Mint shall call a meeting of the Commissioners, at such other time as he may deem convenient. If it appears by such examination and test that these coins do not differ from the standard fineness and weight by a greater quantity than is allowed by law, the trial shall be considered and reported as satisfactory. If, however, any greater deviation from the legal standard or weight appears, this fact shall be certified to the President; and, if, on a view of the circumstances of the case, he shall so decide, the officers implicated in the error shall be thenceforward disqualified from holding their respective offices.

Standard Weights of the Mint—Sec. 3548.—For the purpose of securing a due conformity in weight of the coins of the United States to the provisions of the title, the brass troy-pound weight procured by the minister of the United States at London, in the year eighteen hundred and twenty seven, for the use of the mint, and now in the custody of the Mint in Philadelphia, shall be the standard troy-pound of the Mint of the United States, conformably to which the coinage thereof shall be regulated.

Sec. 3548.—It shall be the duty of the Director of the Mint to procure for each Mint and Assay office, to be kept safely thereat, a series of standard weights corresponding to the standard troy-pound of the Mint of the United States, consisting of a one-pound weight and the requisite subdivisions and multiples thereof, from the hundredth part of a grain to twenty-five pounds; and the troy-weights ordinarily employed in the transactions of such mints and assay offices shall be regulated according to the above standards at least once in every year, under the inspection of the Superintendent and Assayer; and the accuracy of those used at the Mint at Philadelphia shall be tested annually, in the presence of the Assay Commissioners, at the time of the annual examination and test of coins.

Rules of the Board of Assay Commissioners.—*Adopted by the Board in* 1880.—I. At the hour appointed for meeting by the Director of the Mint, if a quorum appears to be present he shall so announce, and the judge of the district court of the United States for the eastern district of Pennsylvania, or in case of his absence, such member as the commissioners present may designate shall take the chair, and the Director's clerk, unless otherwise ordered by the board, shall act as secretary.

II. The letter of the President, or the Director of the Mint, naming the commissioners who have been specially designated by the President of the United States, will be read, and the roll of the members, *ex-officio*, and of the others accepting the appointment, will be called.

III. A quorum being present, the secretary will read section 3547 of the Revised Statutes of June 22, 1874, under which the commission is constituted; the several sections bearing upon the duties of the commissioners; the rules for the organization and government of the board; and the minutes of the last preceding assay.

IV. The "reserved coins" having been produced by the officers in charge of them, the several packages in which they are contained will be opened in the presence of the commissioners, or of a committee for that purpose appointed, who shall report to the commission for confirmation, and the coin distributed by them in parcels with reference to their places of coinage and their metallic character as follows:

1. Gold coins from the mint at Philadelphia.
2. Silver coins from the same.
3. Gold coins from the mint at San Francisco.
4. Silver coins from the same.
5. Gold coins from the mint at Carson.
6. Silver coins from the same.
7. Gold coins from the mint at New Orleans.
8. Silver coins from the same.

But when it shall be made known to the board that at either of the mints there has taken place, during the year, a change in any of the officers that are responsible for the coinage, the coins made during the terms of the respective incumbents will be distributed in separate parcels.

V. The coins contained in each parcel having been examined and counted, the number will be compared with the number reported as "reserved," and having been verified, the secretary will note the results on the minutes of the commission.

VI. The chairman will then arrange the members of the board in *two committees;* one to take charge of the *weighing*, the other of the *assaying;* with power to associate members interchangeably, and to require the manipulatory aid of the officers of the mint.

VII. Of the Weighing.—*a.* The committee on weighing shall take from each parcel of the coins, as distributed, two or more piles —each of ten or more pieces, and embracing two or more denominations, and five or more single pieces of two or more different denominations.

b. They shall arrange the piles, and the single pieces thus taken out, with the mint marks downwards, in such order that the particular place of mintage shall be known only to the members of the committee.

c. The piles, and the single pieces shall then be severally weighed under the scrutiny of the committee, and their respective weights ascertained; the piles to one-thousandth of an ounce, the single pieces to the eighth of a grain; and the results shall be noted, with a special reference as to any that may be found without the legal limits of weight.

d. The committee shall then examine the weights ordinarily employed in the mint, and shall attest their accordance with the standards prescribed by law.

VIII. Of the Assaying.—*e.* The committee on assaying shall receive the residues of the several parcels of reserved coins; and adding to them—if it shall be necessary, but not otherwise—from the piles in the possession of the committee on weighing, shall first cause a portion of each parcel to be melted into an ingot of convenient size; and from each of the ingots so made they shall take test-samples for assay.

f. They shall then select a convenient number, not less than three, of single pieces of diverse denominations from each parcel; from which they shall take test-samples for assay.

g. They shall then arrange all the test-samples in such order as shall be known only to the members of the committee; and in that order such samples shall be assayed, the silver first, and the gold afterwards.

h. Should the operations of the assay be not consummated before the adjournment of the board for the day, the parcels of reserved coins, ingots, and test-samples will remain in a chest or vault, under the joint and separate charge of the chairman and the Director of the Mint.

IX. The weighings and assayings having been completed under the scrutiny of the committees, respectively, the committees will report fully and specially, as to the coins of each mint.

X. And thereupon the commissioners will proceed to declare their judgments by an open vote; and full record thereof, and of all their doings, having been engrossed by the secretary, it will be signed by all the members, and delivered to the Director of the Mint. After which the board will be adjourned *sine die.*

The foregoing rules are subject to such modifications or alterations as a majority of the board may at any time during each annual assay, deem expedient and proper.

PART VI.

STOCK EXCHANGES—THE LAW OF STOCK BROKERAGE—REVIEWS OF THE STOCK AND METAL MARKETS—PRICES FOR EIGHTEEN MONTHS—THE FUTURE.

OF all the facts of the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES, Part VI., will be the one to which, possibly, the majority of our readers will turn. The fascinations, the misfortunes, the fortunes, the rise and fall of the Stock Market, the state of Trade, are absorbing studies to the majority of business men. These are vital interests, and in such way have we considered them. The part opens with some points of law that are necessary to a full understanding of the situation. Then follow careful, elaborate, thoroughly able reviews of the Mining Stock Market of the United States, with such data concerning the various stock exchanges as will serve as collateral information to aid in forming a correct judgment upon the points covered in this part. The matter of the reviews was furnished for all markets except Philadelphia, by Mr. L. E. Thorne, of New York. That for Philadelphia, by Mr. J. V. Sears. Other matter is added by the compiler. The reviews of the metal markets were also written by Mr. Thorne.

LAW OF MINING STOCK BROKERS AND MINING STOCK EXCHANGES.

MR. J. R. Dos Passos has recently published a volume entitled, "Law of Stock Brokers and Stock Exchanges," which has received most favorable recognition. From its pages we take the following as of interest to the rights of purchasers of mining stocks. Touching the origin of stock brokers and stock exchanges Mr. Dos Passos says: There is a great diversity of opinion respecting the origin of the word "broker," some of the authorities maintaining that it was originally applied to those who broke up goods into small pieces—retail dealers; while others contend that the term is derived from the Saxon word *broc*, misfortune, and that the name "broker" comes from one who is a broken trader by misfortune, which is often a true reason for a man's breaking, and that none but that class of persons were formerly admitted to that employment in London.[1] But the statutes passed in the reigns of Edward the First and James the First, hereafter referred to, would seem to indicate that the latter view can hardly be correct. In England, the term "broker" occurs in an Act of Parliament as early as the year 1285.[1] It recites, in substance, that whereas divers persons do resort unto the city (London) from parts beyond the sea, fugitives from their own lands, and of these some become "brokers," hostlers and innkeepers, etc., and they do wear fine clothing, and do eat costly meat and food, etc.; it therefore enacts that "there shall be no broker in the city except those who are admitted and sworn before the warden, mayor, or aldermen." It is evident from a perusal of this statute, that the occupation of brokers in those days was subverted by persons who used the name as a cover to transact a species of disreputable pawnbroker's business, and hence the severe penalties of the second section of the act, which provided that "if any other innkeeper or broker be found within the city, or any other of whom there is evil suspicion, he shall be arrested by the warden or mayor, or the sheriffs, or the alderman of the ward, and punished, viz.: innkeepers and brokers shall be incapable of their freedom and adjudged to prison, and the others shall be punished by imprisonment or otherwise."[2]

The next statute, passed in the reign of James the First, more than three hundred years after that just recited,[3] regu-

[1] Jacob's Law Dict., tit. "Brokers." "The etymology of the term Broker has been variously given. By some it has been derived from the Saxon *broc*, misfortune, as denoting a broken trader; the occupation being formerly confined, it is said, to unfortunate persons of that description (Tomlins). According to others, it was formed from the French *broieur*, a grinder or breaker into small pieces; a Broker being one who *beats* or draws a bargain into particulars (Termes de la Ley, Cowell). The law Latin from *obrocator*, however, seems to point distinctly to the Saxon *abrœcan* (to break), as the true root, which in the old word *abbrochment* (q. v.) or *abroachment*, had the sense of *breaking up goods*, or selling at retail. A Broker, therefore, would seem to have originally been a *retailer*, and hence we find the old word *auctionarius* (q. v.) used in both these senses" (Burrill's Law Dict., tit. "Broker"). Wharton gives, as the derivation of the word, the French *broceur*, and the Latin *tritor*, a person who breaks into small pieces (Whar., Law Dict., tit. "Broker"). Webster gives as its derivation, the old English *brocour*, Norman French *broggour*, French *brocanteur*. Under the word "broke," to deal in second-hand goods, to be a Broker, Webster says it is probably derived from the word *brock*. Worcester derives it from the Anglo-Saxon *brucan*, to discharge an office; *brocian*, to oppress; and the French *broyer*, to grind. See "Broke" and "Broker." The word "Broker" seems first to occur in literature in Piers Ploughman, "Among burgeises have I be Dwellyng at London. And gart Backbiting be a brocour. To blame men's ware." It clearly means here a *fault-finder*, as in Provencal *brac* is refuse. The broker was originally one who inspected goods and rejected what was below the standard (Wedge-wood).

[1] 13 Ed. I., Stat. Civ. London, 1285.

[2] See also 2 Crabb's Dig. of Stat., tit. "Broker," 261. There were a class of persons known to the Romans, who were deemed public officers, and who united the functions of bankers, exchangers, Brokers, commissioners, and notaries all in one, under the description of *proxenetæ*. (Whar., Law Dict., tit. "Brokers;" Story on Ag. § 20 Dig. Lib. 50, tit. 14, ch. 2.) Spelman, cited in Gibbons vs. Rule, 12 Moo. 539, 543. There is very high authority, however, for asserting that the term *proxenetæ* does not occur in any Latin author before the first century after Christ. See Freund's Latin Dictionary, revised by Lewis and Short where *proxenetæ* is thus given: "negotiator, factor, broker, agent, Sen. Ep. 119; Mart. 10. 3. 4; Dig. 50. 14. 2."

[3] 1 Jac. I. c. 21, 1604.

lates the calling of Brokers with greater detail than the first act, and clearly shows, by the use of the words "merchandise and wares," that down to this period the Broker in money, stock and funds had no recognized legal existence. The preamble to the statute also indicates that the regular calling was and had been a favored one: "Forasmuch as of long and ancient time by divers hundreds years there have been used within the City of London and Liberties thereof, certain Freemen of the city to be selected out of the Companies and Mysteries whereof they are free and Members, and the same persons to be presented at least by six approved and known honest persons of the same Mystery to the Lord Mayor of London for the time being, and to the Aldermen his Brethren, and to be recommended by such Presentors to be persons for their known approved Honesty, Integrity, and Faithfulness, Persons meet for to be Broker Brokers." It was not until the latter part of the seventeenth century, when the East India Company came prominently before the public,[1] that trading or speculating in stock became an established business in England; and the term "Broker," which had then a well-understood meaning, was promptly transferred to those persons who were employed to buy and sell stock or shares, and who thenceforth became known as "Stock-brokers." In 1692, William the Third having adopted, for the first time in England, the system of raising funds[2] for governmental purposes by creating a national debt, speculations in the "funds" and the shares of the East India Company at once became general;[3] and in 1697 the Brokers and Stock-jobbers, to borrow from the language of the statute passed in that year, had been guilty of such "unjust practices and designs" in selling and discounting tallies, bank stock, bank bills, shares and interest in joint stock, that it became necessary to pass a stringent act, by which no persons except regular sworn appointees were appointed to act as Brokers; and the latter were compelled to keep a register in which all contracts were to be entered within three days after they were made, and their compensation was fixed at ten shillings per centum.[4] And Best, C. J., in commenting upon this statute, says: "The statute 8 and 9 William III., ch. 20, by which the first government loan was raised, speaks of a new description of 'Brokers'—persons employed in buying and selling tallies, the government securities of those days: these have since been called *Stock-brokers.*"[5] Several other similar statutes were passed in the subsequent reigns of Anne and George.[6]

An early legal writer gives the following account of Stock-brokers, which is interesting in this connection: "Stock-brokers are persons who confine their transactions to the buying and selling of property in the public funds and other securities for money, and they are employed by the proprietors or holders of the said securities. Of late years, owing to the prodigious increase of the funded debt of the nation, commonly called the stock, they are become a very numerous and considerable body, and have built by subscription, a room near the Bank, wherein they meet to transact business with their principals, and with each other; and to prepare and settle their proceedings before they go to the transfer-offices at the Bank, the South Sea, and India houses, thereby preventing a great deal of confusion at the public offices, where the concourse of people is so great, during the hours of transferring stock, that if the business was not prepared beforehand, it would be impossible to transact it within the given time."[7] The whole business of stock-jobbing being contrary to law, except as the persons acting as Brokers were licensed, under the act of 6 Anne, ch. 16; and as many other persons, irrespective of the requirements of the statute, acted as Stock-brokers without having received a license as such, a *silver medal* was given to each licensed Broker, having the king's arms on one side, and the arms of the city of London on the reverse, with the Broker's name, which he was ordered to produce upon every occasion when he should be required to show his qualification; and, to give further publicity to the names of the regular Brokers, a list of the licensed Brokers was annually printed by the order of the Lord Mayor and the Court of Aldermen, which was hung up in the walks of the Royal Exchange and in Guildhall, and at most of the reputable coffee-houses near the Exchange. This was before the Brokers left the Royal Exchange and located their business in Change Alley.[1] By an act passed in 1870,[2] called the "London Broker's Relief Act," the restrictions and guards which were formerly placed upon Stock-brokers were removed, and the jurisdiction of the Court of Aldermen over Brokers ceased. The effect of this act is practically to enable any person to exercise the calling of Broker in London, outside of the Stock Exchange; and this result seems to be justly deplored in the Report of the Royal Stock Exchange Commission presented to Parliament in 1878.

The advantage of employing brokers as intermediaries, in the purchase and sale of property, seems to have been early recognized among the merchants; and a very old writer on the law merchant says, "It is an old proverb, and very true, that between what will you buy? and what will you sell? there is twenty in the hundred differing in the price, which is the cause that all the nations do more effect to sell their commodities with reputation by means of brokers than we do; for that which seems to be gotten thereby is more than double lost another way. Besides, that by that course many differences are prevented which arise between man and man in their bargains or verbal contracts; for the testimony of a sworn broker and his book together is sufficient to end the same."[3]

The Venetians, says Malynes, had an office called Messacaria (Messageria?), consisting only of brokers who dealt between man and man; "and in Spain they are of such estimation that they ride on horseback, upon their foot-cloths; and, having the invoices of merchants' goods, they will deal for great matters at a time, against the lading of the fleet from Nova Espagna, and the islands of the West Indies, to be paid partly ready money and partly at the return of the said fleet; and these afterwards let you understand their merchant."[4] The origin of stock-certificates—dealings in which, at the present date, constitute the main business of Stock-brokers—cannot in England be satisfactorily traced beyond the middle of the seventeenth century. Such species of property was altogether unknown to the law in ancient times, nor, indeed, was it in usage and practice until a short period antecedent to the passage of the Bubble Act in the reign of George the First.[5]

Although it is fully established that mercantile or commercial corporations existed among the Romans,[6] and

[1] This company was incorporated by Queen Elizabeth in 1600.

[2] The system of obtaining money for government purposes by loans is said to have originated in the fifteenth century in Venice. It was next adopted in Holland, and was introduced into England shortly after the Revolution of 1688 (Tit. "Funds," Cyclopædia of Com. [Waterston]).

[3] Francis's Chronicles and Characters of the Stock Exchange, 24.

[4] 8 & 9 Wm. III, c. 32, 1697, continued by 11 and 12 Wm. III. c. 13.

[5] Gibbons vs. Rule, 1827, 12 Moo. 539; 4 Bing. 301.

[6] 6 Anne, c. 16, 1707; 10 ibid. c. 19, 1711; 12 ibid. Stat. 2, c. 16; 6 Geo. I. c. 18, 1719; 3 Geo. II. c. 31, 1730; 7 Geo. II. c. 8, 1734.

[7] Beaw. Lex. Mer. 620.

[1] "Jonathan's" Coffee-house, in Change Alley, the general mart for Stock-jobbers, was the precursor of the present Stock Exchange in Capel Court.—Addison in Sir R. De Coverley.

[2] 33 and 34 Vict. c. 60.

[3] Mal. Lex Mer. 143 (1622).

[4] Mal. Lex Mer. 143.

[5] Garrard vs. Hardey, 5 Man & G. 471, 483.

[6] Ang. & Ames on Corps. (10th ed.) ch. 18, § 26: "A *Collegium Mercatorum* existed at Rome 493 B.C.; but the modern bourse, from the Latin *bursa*, a purse, originated about the fifteenth century. Bourges and Amsterdam contend for the honor of having erected the first bourse. The Paris Bourse was erected in 1808" (Johnson's New Univ. Cyclop., tit. "Bourse"). "A Rome, malgre que le commerce n'y fut pas en grande consideration, nous trouvons ce meme usage publiquement pratique. Tite Live nous apprend, en effet, qu'en l'an 259 de sa foundation, sous le consulat d'Appius Claudius et de Publius Servillius, on construisit un vaste edifice, dont les vestiges portent encore le nom de *Loggia*, et qui, sous la denomination de Collegium Mercatorum, avait une destination analogue a celle de nôs bourses actuelles" (Droit Commercial, "Bourses de Commerce," par Bedarride). But, according to Livy (ii 27), the *Collegium Mercatorum* does not belong to this period. Livy says that when the consuls were disputing which of them should have the honor of dedicating a temple to Mercury, the question was referred to the people; and the Senate decreed that whichsoever of the consuls should be chosen should also form a "Collegium Mercatorum," or association of corn-dealers, to help him and the priest in religious

though much light has been thrown upon the character and mode of conducting these bodies,[1] there is an utter dearth of information respecting the form and manner by which ownership in the corporate property was attested and established. The Roman law required three persons to organize a corporation:[2] and as each body had at least that number of members, if not more, it would seem but natural that a certificate or some other substantial muniment of title, should have been issued by the corporation to its respective members, in which the proportion of interest of each in the capital or corporate property of the Association appeared. But whether a certificate was, in fact, issued, and, if so, was regarded as property capable of sale or other negotiation, and of vesting in the representatives of the owner, on his decease, or whether the corporations were all of the nature of guilds conferring upon the members mere *personal* rights —all of these questions seem now to be incapable of solution; and the Roman law, which sheds such floods of light upon commercial subjects, apparently leaves the above matters in total darkness.

In England, stock-certificates were not introduced into the courts of law for many years after they had become established in the mercantile community; for Lord Mansfield, in 1770,[3] in a case wherein it was contended that such certificates were *money*, in deciding against that view, said: "This is a *new* species of property *arisen within the compass of a few years*. It is not money.[4] The Bubble Act[5] having been repealed,[6] it was held[7] that the formation of a company, the stock in which should be transferable, was not an offense at common-law. And this doctrine was subsequently affirmed.[8] A Stock Exchange or Bourse, in the sense in which it is considered in this article, is also a creation of modern times. An Exchange was erected in Cornhill, London, in 1571, but it was used exclusively by dealers and Brokers in merchandise. This structure was destroyed in the great fire of 1666;[9] but it was not until several years after, when it was rebuilt, that the Brokers in funds and stock were assigned a portion of the building for the transaction of business.

In 1698, the Stock-jobbers, annoyed by the objections made to their remaining in the Royal Exchange, and finding their numbers seriously increased removed to Change Alley, a large and unoccupied space, where extensive operations might be carried on.[10] In the United States there seems to be no trace of a Stock Exchange until about the beginning of the present century, at which time there existed in Philadelphia a Board of Stock-brokers, possessing a formal organization and regular constitution, which the Brokers in New York, in 1817, used as a model in framing the rules of their own Exchange.[11] Although there is in the archives of New York Stock Exchange a document bearing date May 17, 1792, signed by a number of Brokers, in which it is, *inter alia*, stated that "We, the subscribers, Brokers for the purchase and sale of public stock, agree to do business at not less than one-fourth of one per cent.," no organization appears to have been formed in the City of New York until the year 1817, when a constitution was adopted, which is no longer in existence, it having been destroyed in the great fire of 1853.[1] It appears that in the beginning, the dealings of the Stock-brokers in this country were confined to speculations in Continental money; but when, in 1812, the United States government issued Treasury notes and negotiated loans to the amount of many millions of dollars, the dealings embraced all these securities, besides operations in the stocks of banks, which were being rapidly formed in all parts of the country. From the year 1820, when the real history of the New York Stock Exchange may be said to have commenced, it has gone on steadily increasing in its members, power and influence, until to-day it can be safely affirmed to be the most powerful organization of the kind in the world; and by forming a mart where all kinds of securities can be promptly converted into cash, it has largely contributed to the development and wealth of the country by encouraging and sustaining our great railroad systems, which have brought all parts of the Republic into a closer relation to each other, and firmly strengthened the union and prosperity of the States.

Legal Relation of Stock-broker to his Client.—In the United States, the business of buying and selling stocks and other securities is generally transacted by Brokers for a commission agreed upon or regulated by the usages of the place; and although any person may enter into such an occupation, no license to perform it being necessary,[2] such

and mercantile matters related to the temple. But the plan fell through, and it does not appear that the "Collegium" was ever formed; nor that it would have had, if formed, anything but a religious significance. Accordingly, the above citations seem to be unfounded.

[1] Brown's Lect. Civ. Law (2d ed.), 141.

[2] *Tres faciunt* collegium, Ang. & Ames on Corps. ch. 18, § 26 (10th ed.); Ortolan's Hist. Roman Law, 606. Though in Rome, it seems, corporations did not require charters from the State, the latter, by virtue of its police power, suppressed those which appeared to be dangerous, mostly those of a political character. In order to determine whether such a corporation existed, the words *tres faciunt collegium* were used. But that a corporation could exist with only one member left is well settled (1.7,2,D.3,4). Gaudsmit Pandects, I. 71, 1; Windscheidt, I 60, 3; Arndts, 44, 2.

[3] Nightingale vs. Devisme, 5 Burr. 2589.

[4] To same effect, Jones vs. Brinley, 1 East. 1.

[5] 6 Geo. I. c. 18. [6] 6 Geo. IV. c. 91.

[7] Garrard vs. Hardey, 5 Man. and G. 471.

[8] Harrison vs. Heathorn, 6 Man. and G. 81; 1 Pars. Con. (6th ed.) 144. [9] Johnson's New Univ. Cyclop., tit. "Stock Exchange."

[10] Francis's Chronicles and Characters of Stock Exchange, 24; see also report of Royal Stock Exchange Commission, July, 1878, and post, p. 248.

[11] Medbery's Men and Mysteries of Wall Street, 286.

[1] "The earliest annals of the New York Stock Exchange are meagre, the fire of 1835 having destroyed the record of the constitution adopted in 1817, the date of its first regular organization. A tablet in the wall of the present room recites that the Exchange was founded in 1792, but the evidence of that exists only in a document still preserved among its archives" (Johnson's New Univ. Cyclop., tit. "Stock Exchange," by Strong Wadsworth).

The following account is from Medbery's Men and Mysteries of Wall Street, 286: . . . . when Washington was President, and Continental money was worth a trifle more as currency than as waste paper, some twenty New York dealers in public stock met together in a Broker's office, and signed their names, in the bold, strong hand of their generation, to an agreement of the nature of a protective league. The date of this curious paper is May 17, 1792. The volume of business of all these primitive New York Brokers could not have been much above that of even the poorest first-class Wall Street house in our time. The Revolutionary 'shinplasters,' as the irreverent already styled them, were spread over the land in such plenty that there were a hundred dollars to each inhabitant. Something was to be made, therefore, from the fluctuations to which they were liable. Indeed, one of the greatest Broker firms of subsequent years derived its capital from the lucky speculations of its senior member in this currency. "The war of 1812 gave the first genuine impulse to speculation. The government issued sixteen millions in Treasury notes, and put loans amounting to one hundred and nine millions on the market. There were endless fluctuations, and the easy-going capitalists of the time managed to gain or lose handsome fortunes. Bank stock was also a favorite investment. An illustration of one of the sources of money-making to Brokers at this period is found in the fact that United States 6's of 1814 were at 50 in specie and 70 in New York bank currency.

"In 1816 one could count up two hundred and eight banks with a capital of $82,000,000." . . . "One day in 1817, the New York stock-dealers met in the room of an associate, and voted to send a delegate over on the stage line to investigate the system adopted in the rival city. The visit was successful; and the draft of a constitution and by-laws, framed from that of the Philadelphia Board, received the final approbation of a sufficient number of the Brokers to enable the New York Stock Exchange to become a definite fact. Three years after, on the 21st of February, 1820, this preliminary code of a thorough revision, and the organization was strengthened by the accession of some of the heaviest capitalists in the city. Indeed, with 1820, the real history of the Exchange may properly be said to commence."

[2] By the statutes of Pa., the occupation of Stock-broker is regulated by statute (Brightly's Purd. Dig. 42), the substance of which is here given:

1. Stock-brokers to be licensed, etc.
5. License to be renewed annually, etc., to enure for the benefit of assignees or legal representatives. Proceedings in such cases: Brokers not to use more than one place of Business. The same person may be licensed as Stock, Exchange, and Bill Broker.
6. Penalty for acting without license.
9. Tax on Broker's license. Three per cent. on commissions, etc
10. To be appraised.
11. How classified.
12. To make annual returns on oath.
13. Statement of name of Broker or firm, location of business, and amount of capital engaged to be reported to the Attorney-general.
14. Penalty for neglect.
15. Power of Auditor-general in relation to penalties.
16. Tax to be additional to license.

business is now generally restricted to those Brokers who are members of the Stock Exchanges, there being one of these bodies in several of the principal cities of the Union.[1]

Considerable discussion has arisen in the cases, especially those in the State of New York, as to the precise relation which exists, where a Broker with his own money purchases or sells stocks, etc., for his Client, for the purpose of speculation. Does the Stock-broker in such a transaction, in the absence of an express agreement defining the relation, unite in himself the characters of "Broker," "pledgee" and "trustee?" The importance of this question is obvious, because, if it be answered affirmatively, it would seem to follow that all of the incidents and consequences of those characters would attach to the Broker, in his dealings with his Client; but, on the other hand, if the question be answered negatively, the simple relation of debtor and creditor, arising out of a breach of contract, would exist. The embarrassment of the question arises from the fact that, in the case of an ordinary purchase of stocks for speculation, on a margin, the Stock-broker, without literally filling the technical definitions of "Broker," "pledgee," or "trustee," comes within the purview of all those terms. He is a Broker because he has no interest in the transaction, except to the extent of his commissions; he is a pledgee, in that he holds the stock, etc., as security for the repayment of the money he advances in its purchases; so he is a trustee, for the law charges him with the utmost honesty and good faith in his transactions; and whatever benefit arises therefrom enures to the *cestui que* trust. The circumstances attendant upon an ordinary transaction between a Broker and his Client in a stock speculation are carefully described by Hunt, Ch. J., in a leading case in the State of New York:[2]

"The customer employs the Broker . . . to buy certain stocks for his account, and to pay for them, and to hold them subject to his order as to the time of sale. The customer advances ten per cent. of their market value. and agrees to keep good such proportionate advance, according to the fluctuations of the market. . . .

"The Broker undertakes and agrees:

"1. At once to buy for the customer the stocks indicated.

"2. To advance all the money required for the purchase, beyond the ten per cent. furnished by the customer.

"3. To carry or hold such stocks for the benefit of the customer, so long as the margin of ten per cent. is kept good, or until notice is given, by either party, that the transaction must be closed. An appreciation in the value of the stocks is the gain of the customer, and not of the Broker.

"4. At all times to have in his home, or under his control. ready for delivery the shares purchased, or an equal amount of other shares of the same stock.

"5. To deliver such shares to the customer, when required by him, upon the receipt of the advances and commissions accruing to the Broker; or,

"6. To sell such shares, upon the order of the customer, upon payment of the like sums to him, and account to the customer for the proceeds of such sale.

"Under this contract the customer undertakes:

"1. To pay a margin of ten per cent. on the current market value of the shares.

"2. To keep good such margin according to the fluctuations of the market.

"3. To take the shares so purchased on his order whenever required by the Broker, and to pay the differences between the percentage advanced by him and the amount paid therefor by the Broker."[3]

It may be well to set forth the history of an ordinary transaction between a Client and a Broker; even with a little more detail than that contained in the foregoing contract. The ordinary margin paid on opening an account with a Broker—that is, in ordering him to buy or sell securities—is ten per cent.[4] The margin may be less than this or frequently none is advanced, according to the confidence which the Broker has in the ability of his Client to respond to ultimate loss. But, whether the Broker advances all or only the principal

[1] Philadelphia, San Francisco, and Boston.

[2] Markham vs. Jaudon, 41 N. Y. 235.

[3] See also Brass vs. Worth, 40 Barb. 648.

[4] Markham vs. Jaudon, 41 N. Y. 235.

portion of the sum invested in the securities, the relation of the parties is unchanged. The fact exists that the Broker looks to the principal for an indemnity upon the entire transaction. The Client having given the Broker an order to buy or sell, either in writing or verbally, the next step in the transaction is, that the Broker goes into the Stock Exchange and executes the business, making a verbal contract therefor with another Broker. Frequently the Broker, upon receiving an order, deputes another, or subordinate, Broker to do the business. This is contrary to the general principle of law, that an agent cannot delegate his business to another—"*delegata potestas non potest delegari*;"[1] but it is justified by the general usage of Wall Street, of which the Client has express or implied knowledge. The exact transaction in the Stock Exchange is as follows: The selling Broker offers for sale his securities, and if there is a Broker present who wishes to purchase, the contract is completed, upon his assenting to the terms mentioned.

Where the number of shares is not named by the selling Broker, it shall be considered to be for one hundred shares of stock, of the par value of one hundred dollars, or ten thousand dollars of bonds.[2]

Some rules of the Stock Exchange are here given, which further illustrate the transaction in the Stock Exchange:

"All offers made and accepted shall be binding."

"Offers to buy or sell shall be entitled to the floor in the following order:

"1. Bids 'seller three days,' and offers to sell 'buyer three days,' shall take precedence of cash and regular.

"2. 'Cash' and 'regular' bids and offers may be made simultaneously, as being essentially different propositions.

"3. Offers to buy and sell on longer options than three days may be made at the same time with offers to buy or sell 'buyer or seller three.'

"4. In offers to buy on seller's option, or to sell on buyer's option, the longest option shall have the precedence.[3]

"In offers to buy on buyer's option, or sell on seller's option, the shortest option shall have the precedence."

"No party to a contract shall be compelled to accept a principal other than the member offering to contract, unless the name proposed to be substituted shall be satisfactory, or shall be declared at the time of making the offer."[4]

"Whenever there is a disputed claim for the purchase or sale of a security, made during the sessions of the Exchange, the presiding officer shall decide the same, or he may appeal to the board for their decision. If an appeal be made from the decision of the presiding officer, and seconded by two members, the question shall be put to a vote."[5]

"In any disagreement between members, growing out of the purchase and sale of a security or securities, as soon as the same is ascertained, if not settled by mutual agreement, the money difference shall be established forthwith by purchase or sale by an officer of the Stock Exchange, wherever the Exchange may be at the time convened."[6]

"All purchases and sales shall be settled for on the next business day, unless expressed to the contrary."[7]

Sales for "cash" are settled for immediately after the purchase, upon the delivery of the same.[8]

In all deliveries of stocks, bonds, etc., the party delivering shall have the right to require purchase-money to be paid at the time and place of delivery.[9]

By Article XXX. of the By-laws of the New York Stock Exchange, transactions may be made in government securities for the "account" for two "settling days"—viz., the 15th and last days of each month. Provision is also made for securing and carrying out such contracts, but, as a matter-of-fact, this system of dealing is rarely if ever used.

But to continue: the Brokers, in making transactions with one another, do not know for whom they are made, the names

[1] Leask's Dig., Law of Cont. 462.

[2] Art. V. § 2, of By-laws, N. Y.

[3] Art. V. § 3, id.

[4] Art. V. § 4, id.

[5] Art. VII. § 1, id.

[6] Art. VII. § 2, of By-laws, N. Y. Stock Exchange.

[7] Art. XII. § 1, id.

[8] Art. XVII. Constitution.

[9] Id.

of the principals being jealously concealed. One Broker looks to the other contracting Broker to carry out the transaction, and in practice there is no attempt made to enforce any liability against the principal should he become known. Here another question arises, whether there is any liability on the part of the unknown principal for the default of his Broker? Is there any privity between him and the other contracting Broker? We shall not attempt to answer these questions in this place, but they are suggested as they arise in the history of the transaction.[1] There is no written contract, as a general rule, between the Brokers, each one merely dotting down the transaction made, and reporting it to his office, at which place, later in the day, the business is confirmed by comparisons made by each side. The Statute of Frauds here looms up to destroy such contracts; but the rules of the board make them inviolable between the members in the tribunal known as the "Arbitration Committee."

On the following day, if the transaction is made "regular," the stocks are duly delivered at the office of the purchasing broker by the selling broker, who receives payment for them. If the sale be made on time, the transaction is completed when the time expires. The stock, when received, remains in the office of the purchasing broker to await the further orders of the client. Sometimes the stock is held by the broker with merely a general power of attorney in blank attached to or endorsed on it.

"In the delivery of stock, of which but one transfer in a day is allowed, the receiver shall have the option of receiving said stock by certificate and power irrevocable in the name of, witnessed or guaranteed by, a member of the exchange, or a firm represented at the exchange, resident or doing business in New York, or by transfer thereof."[2]

"In all transactions exceeding one hundred shares, where the delivery is by certificate and power, the purchaser shall have the right to require the delivery in certificates of not more than one hundred shares each."[3]

"Powers of attorney, or substitution, signed by trustees, guardians, infants, executors, administrators, or attorneys, shall not be a good delivery."[4]

Sometimes the stock is transferred on the books of the company in the name of the Broker, rarely in the name of the principal. This stock is considered as the client's, subject only to the lien of the Broker for advances and commissions. The Broker collects the dividends, and pays assessments upon it, if any be levied, and the same remains in his hands through the whole transaction until it is sold, the client never having possession of, and rarely ever seeing, the stock. Upon the purchase of the stock, the Broker sends a notice to his client, giving the price and the name of the Broker from whom he has purchased.[5] What effect this would have upon a contest between the unknown principal and the other or selling, Broker is still another question. Frequently a Broker is himself a speculator, and, in executing an order for his principal, unites a purchase or sale on his own account. Finally, the Broker in many instances may have two clients, who, at the same time, give him counter-orders, the one to buy and the other to sell, which the Broker frequently executes at the market price, but without any real sale or purchase, merely making cross entries in his books. In the absence of any fraud or any damage to the clients, can such transactions stand? During the time the stock or securities remain in possession of the Broker, he uses them to raise money with which to carry on his business, and no attempt is made to keep the stocks separate, or to keep the identical certificates on hand, the client usually being satisfied if the Broker is able to deliver the number of shares purchased, without any regard to particular certificates. According to the strict legal definition it is manifest that a Stock-broker, in transactions such as

[1] See this subject considered, Ch. X.
[2] Art. IX. § 1, of By-laws N. Y. Stock Exchange.
[3] Art. IX. § 2, id.
[4] Art. IX. § 3, id.
[5] And it was decided in Hoffman vs. Livingston, 46 N. Y. Superior Ct. (14 J. & S.) 552, that a failure of the Broker to give this notice was such negligence as to preclude him from recovering his commissions.

those described above, is not embraced within the term "Broker."

"Brokers" have been defined by a standard legal lexicographer to be "those who are engaged for others in the negotiation of contracts relative to property with *the custody of which they have no concern*;"[1] and "Stock-brokers" as those employed to buy and sell shares of stocks in incorporated companies and the indebtedness of governments."[2]

The distinction between a Stock-broker and an ordinary Broker are tersely summarized by Woodruff, J., in his dissenting opinion in the well-known case of Markham vs. Jaudon,[3] in this language: "In the first place, the Stock-dealer who is employed, though called a Stock-broker, does not act as Broker in this transaction. It is no part of the office or duty of a Broker to pay the price. It is no part of the office or right of a Broker to receive the property, still less to take the title in his own name.[4] "In this transaction he acts in a peculiar business, in his own name and on his own responsibility, protected against loss by the indemnity furnished, or by the agreement to be furnished to him. The idea of mere agency ordinarily suggested by the name Broker does not, therefore, arise out of the fact that the dealers in stocks for account of others, as to profit and loss, are called Stock-brokers, In the next place, the transaction, according to the intent and purpose of the employment of the Broker, does not contemplate that the customer will ever receive the stock, or own it. It may be that if the Broker desires to close his connection with the transaction, the customer, if he pays the cost, interest, and all commissions which the Broker has earned, or is entitled to earn, will receive the stock, whether he may so insist or not is a collateral question; and, if he be so entitled, it will nevertheless be true that this is not in pursuance of the arrangement, but a departure from it; for the intent is, that the stock shall be carried by the Broker until directed to be sold, the customer never having the title to the stock at all. And, finally, in my opinion, the transaction is an executory agreement for a pure speculation in the rise and fall of stock, which the Broker, on condition of perfect indemnity against loss, agrees to carry through in his own name and on his own means or credit, accounting to his customer for the profits, if any, and holding him responsible for the loss."[5]

Notwithstanding these technical differences, the decided inclination of the courts has been to visit a Stock-broker

[1] 1 Bouv. L. Dict., title "Broker." Ewall's Evans on agency, 4 et seq.
[2] Ibid. See also Clark vs. Powell, 1 Nev. & M. 494, arguments of counsel pro and con. Ab. L. Dict., title "Broker." As to liability of Broker to pay taxes, etc., see § 3407, Rev. Stat. U. S. (2d ed. 1878), which provides as follows:

"§ 3407. Every incorporated or other bank, and every person, firm, or company having a place of business where credits are opened by the deposit or collection of money or currency subject to be paid or remitted upon draft, check, or order; or where money is advanced or loaned on stocks, bonds, bullion, bills of exchange, or promissory notes; or where stocks, bonds, bullion, bills of exchange, or promissory notes are received for discount or for sale, shall be regarded as a bank or as a banker."

By the subsequent § 3408, a tax of one twenty-fourth of one per cent. is imposed each month upon the average amount of deposits; and a like amount on the capital employed.

See also, for interpretation of this law, Northrup vs. Shook, 10 Blatchf. 243; Clark vs. Bailey, 12 id. 156, s. c. affirmed 21 Wall. (U. S.) 284; Warren vs. Shook, 91 U. S. 704; United States vs. Cutting, 3 Wall. 441; United States vs. Fisk, id. 445; Clark vs. Gilbert, 5 Blatchf. 330; Bankers' Cases, 11 Op. Att'ys Gen. 482; Selden vs. Equitable Trust Co. 94 U. S. 419.
[3] 41 N. Y. 256; Northrup vs. Shook, supra.
[4] A Broker has not the custody of the goods of his principal; he is merely empowered to effect the contract of sale or purchase on his behalf. Chitty on Cont. (11th Am. ed,) 274; Paley on Ag. 13; Story on Ag. (8th ed.) § 28 et seq.
[5] In the case of Wood vs. Hayes, 81 Mass. 375, it was held that where a Stock-broker advances his own money in the purchase of stocks for another, and holds the shares in his own name, the transaction stands on the footing of contract, which is strictly conditional to deliver so many shares on payment of so much money. "A Broker is an agent simply. He transacts business not for himself, but for another. He is a middle-man, a negotiator between other persons for a compensation. A stock-broker deals in stocks of moneyed corporations and other securities for his principal. It is a calling of great responsibilities, in which punctuality, honesty, and knowledge are required." Per Van Vorst, J., White vs. Brownell, 3 Ab. (N. Y.) Pr. (n. s.)326.

with all of the responsibilities of a Broker and pledges, and, as we shall hereafter see, to confer upon him all of the advantages of those relations. It is conceded by Mr. Justice Woodruff, and all of the advocates of his view of the law, that where the Stock-broker makes purchases of stock, etc., for his principal *for investment*, with money furnished by the latter, the relation of pledgor and pledgee exists.[1] It is also conceded that when stock, etc., is purchased on a margin for the Client, it instantly becomes the property of the latter,[2] together with all of its future dividends and earnings;[3] and that the Client is entitled to the possession of such stocks, etc., upon paying the money represented in their purchase, with the commissions of the Broker.[4]

So it has been decided that a pledgee of stock is not liable for a loss occasioned by his neglect to sell the stock, it having depreciated in his hands till it became worthless, when, by the contract between the parties, the right to sell the stock had been conferred upon the pledgee or a third person; and the pledgee has never refused to transfer the stock for the purpose of a sale, and the pledgor has never requested that a sale should be made.[5] It has also been held that a Stock-broker is not liable where spurious securities are purchased by him for a Client in the regular course of business. And if he sell stocks or securities for his principal, which turn out to be spurious, and the Broker, in consequence, repays the purchase-money to the buyer, he can recover the same from the principal.[6]

So if the pledge be stolen from the Broker, he is not liable unless the theft arose from, or was connected with, a want of ordinary care on his part.[7] Again, if assessments or "calls" are made upon stocks which a Broker holds for a Client, the liability to pay them, if any, is that of the principal, and not the Broker.[8] In fine, all of the benefits, liabilities, and disadvantages of ownership are attached to the principal, while the Broker has no interest in the transaction except to the extent of his commissions. In view, therefore, of these considerations, the better doctrine would seem to be to hold the Broker to the responsibilities of that relation; in fact, it appears difficult to conceive of any other relation which could so fully harmonize with the circumstances as that of Broker and pledgee. And this now seems to be the established law.[9] The leading case of Markham vs. Jaudon was expressly overruled on the question of the measure of damages in an action for the conversion of stocks by a Broker.[10] It should also be noticed that there were two elaborate dissenting opinions by Woodruff and Grover, JJ., on the question of the relation which existed between the Broker and the Client, the two judges just mentioned holding that the Brokers were not pledgees, but that they held the stock under a contract which enabled them to sell upon the failure of the Client to furnish margins. When this question came again before the court of last resort in New York,[1] Commissioners Earl and Reynolds both wrote opinions affirming the judgment on the specific ground that the Brokers were pledgees. But in the case of Baker vs. Drake[2] (which was not adverted to in the preceding case), overruling Markham vs. Jaudon upon the question of the measure of damage, Mr. Justice Rapallo, in alluding to the latter case, said: "It seems to me, after as full an examination of the subject as circumstances have permitted, that the dissenting opinions (per Woodruff and Grover, JJ., alluded to above) embody the sounder reasons." Yet, when Baker vs. Drake came before the Court of Appeals again in September, 1876,[3] the court expressly reiterated and reaffirmed three propositions laid down in the case of Markham vs. Jaudon, the principal one being that "the relation of Broker and Client, under the ordinary contract for a speculative purchase of stock, is that of pledgee and pledgor." From this view Rapallo and Allen, JJ., dissented.

The doctrine of Markham vs. Jaudon was again distinctly reaffirmed in the last-mentioned respect in Gruman vs. Smith.[4] The theory that the relation which exists between a Stock-broker and his Client in an ordinary speculative transaction is not that of pledgor and plegee, is mainly based upon the argument *ab inconvenienti*. It is said that as stocks are a fluctuating species of property, whose value is liable to be wiped out in a moment, the burden should not be put upon a Broker to give his Client notice of a decline or rise, as the case may be, and to make a demand for further margins. But this argument is just as forcible when applied to the undisputed case of a pure pledge, where it is conceded that there must be notice to the pledgor before a sale can be made, as where the owner of stocks pledges them to secure borrowed money. In this instance, although the stocks are liable to a decline and leave the lender without security, it is clear that, in the absence of express agreement, they could not be sold without legal notice.[5] So it has been held that where, instead of money, the Client deposits stock, etc., as margin, the relation of pledgor and pledgee exists.[6]

The Broker may always, in the outset, protect himself against the fluctuations of an advance or decline in the market by exacting sufficient margins to meet the contingencies of speculation; and if he neglect to do this, he should not expect the law to aid him. But, finally, the Broker may always fully insure himself by making a special contract with his Client,[7] which will enable him to dispose of securities in any manner and at any time that may be agreed upon without notice, and such contracts the law will uphold and carry out.[8] Upon the whole, while it must be conceded that there are incongruous features in the relation, there seems to be no hardship in holding that a Stock-broker is a pledgee; for, although it is true that he may advance all or the greater part of the money embraced in the speculation, if he acts honestly, faithfully and prudently, the entire risk is upon the Client, and may be enforced against him as a personal liability, irrespective of the value of the securities, which are the subject of the transaction. To introduce a different rule would give opportunities for sharp practices and frauds, which the law should not invite; and if it be true, as Mr. Justice Woodruff[9] puts it, that "the transaction is an executory agreement for a pure speculation in the rise and fall of stock, which the Broker, on condition of perfect indemnity against loss, agrees to carry through in his own name and on his own means," accounting to the Client for the profits, it is very questionable whether all the transactions of Wall Street could not be set aside as mere

[1] Markham vs. Jaudon, 41 N. Y. 235, at 257 and 258; also Grover, J., s. c. at 247. See also Baker vs. Drake, 53 N. Y. 211. at 216.

[2] Id.

[3] Id.

[4] Howard vs. Brigham, 98 Mass. 133; O'Neill vs. Whigham, 87 Pa. St. 394.

[5] Lamert vs. Heath, 15 M. & W. 486; s. c. Lambert vs. Heath, 15 L. J. Exch. 298; Mitchell vs. Newhall, 15 M. & W. 308; Westropp vs Solomon, 8 C. B. 373.

[6] 2 Pars. on Cont. (6th ed.) 112; Abbott vs. Frederick, 56 How. Pr. (N. Y.) 68. See Arent vs. Squires, 1 Daly, 347.

[7] McCalla vs. Clark, 55 Ga. 53.

[8] See the above questions considered elsewhere.

[9] Gruman vs. Smith, 81 N. Y. 25; Markham vs. Jaudon, 41 N. Y. 235; Morgan vs Jaudon (Ct. of App.), 40 How. Pr. (N. Y.) 366; Stenton vs. Jerome, 54 N. Y. 480; Baker vs. Drake, 53 N. Y. 211; id. 66 N. Y. 518; Ritter vs. Cushman, 7 Robt. (N. Y.) 294; Read vs. Lambert, 10 Ab. Pr. (n. s.) 458; McNeil vs. Tenth National Bank, 55 Barb. (N. Y.) 59 (reversed on other points in 46 N. Y. 325); Clarke vs. Meigs, 22 How. Pr. N. Y.) 648; Andrews vs. Clerke, Bosw. 585; Taylor vs. Ketchum, 5 Robt. (N. Y.) 507; Taussig vs. Hart, 58 N. Y. 425; Thompson vs Toland, 48 Cal. 99; Kenfield vs. Latham, 2 Cal. Leg. Rec. 235; Gilpin vs Howell, 5 Pa. St. 41 Wynkoop vs. Seal, 64 Pa. St. 361; Esser vs. Linderman, 71 Pa. St. 76; Maryland Fire Ins. Co. vs. Dalrymple, 25 Md. 242; Baltimore Ins. Co. vs. Dalrymple, id. 269; Child vs. Hugg, 41 Cal. 519. The same rule would seem to exist in England: Brookman vs. Rothchild, 3 Sim. 153, aff'd by House of Lords in 5 Bli. (n. s.) 165. Contrary to this view are Hanks vs. Drake, 49 Barb. (N. Y.) 186; Schepeler vs. Eisner, 3 Daly, 11; Sterling vs. Jaudon, 48 Barb. (N. Y.) 459, which have all been expressly overruled in the State of New York. See also Wood vs. Hayes, 81 Mass. 385.

[10] Baker vs. Drake, 53 N. Y. 211.

[1] Stenton vs. Jerome, 54 N. Y. 480.

[2] 53 N. Y. 211.

[3] 66 N. Y. 518.

[4] N. Y. 25, reversing 12 J. & S.

[5] Schouler on Bailm. 206 et seq.

[6] Lawrence vs. Maxwell, 53 N. Y. 19: see also Vaupel vs. Woodward, 2 Sandf. Ch. 143.

[7] See in this connection remarks of Hunt, Ch. J., Markham vs. Jaudon, 41 N. Y. 244.

[8] Post, subdivision (V.) of this chapter, p. 169.

[9] Markham vs. Jaudon, 41 N. Y. 256; ante, p. 109.

wagers. But, as we have seen, the cases most emphatically condemn this view, except those in Pennsylvania, in one of which—viz., North vs. Phillips[1]—the Supreme Court of Pennsylvania held that the peculiar facts there developed showed that the dealings between the Client and the Brokers were in "differences" and "margins" and the purchase and sale of the stock were a mere pretense; but it is plain, from reading the opinion of the learned judge in that case, that not only was no effect given to the verdict of the jury, which found that the purchases of stocks had been made *bona fide*, but the different elements which made up the transaction between the Brokers and their Client were completely overlooked—viz., that stock was actually purchased for the Client; that it was held subject to his orders; that he would have been entitled to the dividends thereon; that he could have insisted upon the instantaneous delivery of the stock to him upon tendering the purchase-money remaining due; that, if the Brokers had failed, the stock would not have passed to their assignees; and that, in fine, the Brokers were only interested in the transaction to the extent of their commissions. With great respect, therefore, we think that this case is not entitled to rank as an authority upon the question involved, especially as it appears to be directly opposed to the previous cases of Esser vs. Linderman[1] and Wynkoop vs. Seal,[2] where similar transactions were upheld.[3]

Definitions of Terms used.—There are a number of technical or well-known terms used in Wall Street which should be defined here. When a person is said to be "long" of stocks, it is meant that he has purchased stock through his Brokers or otherwise, in the expectation of a rise or advance in the market; he is then called a "bull."

To be "short" of stocks is where one sells stocks which he does not own or possess, and borrows the number of shares which he has sold from some third person to deliver to his vendee, expecting to be able to buy the stocks at a lower figure, and then return them to the person from whom he has borrowed them; he is called a "bear."[4]

To "carry" stocks means where a Broker or other person advances the money, or a principal part thereof, with which to purchase stocks, and holds the same subject to the orders of his Client.[5]

A "corner" in stocks is where the owners or holders (i. e. bulls) refuse to loan stocks to the "bears," with which to carry out their short contracts, in which event the "bears," being unable to deliver, are compelled to go into the market or Exchange and buy the stocks at any price at which they can obtain them.[6]

"Wash sales" are not real sales, but are made by persons interested to each other, for the purpose of giving a fictitious value to the stock.[7]

A "shave" is a consideration for carrying stock for a certain time.[8]

A "call" is a contract by which the party signing or making the same agrees, in consideration of a certain sum, to deliver, at the option of a party therein named, or his order or bearer, securities therein mentioned, at a certain day for a certain price.[9]

[1] 89 Pa. St. 250.

[2] 71 Pa. St. 81.

[3] 64 Pa. 361.

[4] White vs. Smith, 54 N.Y. 522; Knowlton vs. Fitch, 52 N.Y. 289.

[5] Price vs. Gover, 40 Md. 103; Salters vs. Genin, 3 Bosw. (N. Y.) 250, 260.

[6] Cameron vs. Durkheim, 55 N. Y. 425, 438.

[7] Byran vs. Baldwin, 52 N. Y. 232, 236; aff'g 7 Lans. (N. Y.) 174.

[8] North vs. Phillips, 89 Pa. St. 250-255.

[9] The following is a copy of the call commonly used:

"NEW YORK, 1882.

"For value received, the bearer may call on me for shares of the common stock of the Railroad Company at per cent., any time in days from date. The bearer is entitled to all dividends or extra dividends declared during the time.

"Expires 1881, at 1¾ P. M.

"Signed, ."

By the usage of Brokers, it is negotiable, and it has been declared valid by certain courts.

A "put" is also an option contract, except the party holding the same has the option of delivering securities to the maker.[1]

A "straddle," or "spread-eagle," combines the advantages of a "put" and a "call," being a contract by which the holder has the right or option either to deliver or have delivered to him certain stocks at prices designated in the writing.[2]

Commission.—In respect to the commission or compensation which a Stock-broker is entitled to receive for transacting the business of the Client, the amount thereof rests either upon an express or an implied agreement. Of course, whenever there is an express agreement by which the amount of the commission is definitely fixed, all greater or other rates are excluded.[3] But frequently, in employing a Stock-broker, nothing is said as to the amount of his commissions, in which case they must be ascertained by other means. There is a uniform rate fixed by the New York Stock Exchange which is generally observed by the Brokers in dealings with their Clients.[4] And the law seems to be that where a broker is employed, and no special compensation is agreed upon, the rate of brokerage customarily charged for the same services is the proper measure of damages. The parties are then presumed to have contracted in reference to the usage.[5] The law is that where there is a general usage in any particular trade or branch of business, parties having knowledge of the usage are presumed to contract in reference to it; and, if the usage does not conflict with the terms of the contract, it will be deemed to enter into and constitute a part of it. Knowledge of the usage may be established by presumptive as well as by direct evidence. It may be presumed from surrounding facts, as the

[1] It is as follows:

"NEW YORK, 1882.

"For value received, the bearer may deliver me shares of the common stock of the Railroad Company at per cent., at any time in days from date. The undersigned is entitled to all dividends or extra dividends declared during the time.

"Expires at 1¾ P. M.

"Signed, ."

[2] Harris vs. Tumbridge, Ab. New Cas. 209; aff'd 83 N. Y. 92, where the court, in speaking of a "straddle," said "The word, if not elegant, is at least expressive. It means the double privilege of a 'put' and a 'call,' and secures to the holder the right to demand of the seller at a certain price, within a certain time, a certain number of shares of specified stock, or to require him to take at the same price, within the same time, the same shares of stock."

The following is the form of a "straddle:"

NEW YORK, 1882.

"For value received, the bearer may call on the undersigned for shares of the common stock of the Railroad Company at per cent., any time in days from date. Or the bearer may, at this option, deliver the same to the undersigned at per cent., any time within the period named. All dividends or extra dividends declared during the time are to go with the stock in either case; and this instrument is to be surrendered upon the stock being either called or delivered.

"Expires at 1¾ P. M.

"Signed, ."

[3] Wharton on Ag. § 323; Bower vs. Jones, 8 Bing. 65; Ware vs. Hayward Rubber Co., 85 Mass. 84.

[4] Art. XVIII. Const. §§ 1, 2, and 3. By these rules a commission of one eighth of one per cent. is chargeable on all transactions in securities made for all parties not members of the Exchange, other than gold, government bonds, and exchange. The minimum rate to members of the Exchange is one thirty-second of one per cent., except in certain cases, when it may be one fiftieth of one per cent. The rates are based upon the par value of the securities.

On mining stocks selling in the market at not over $5 per share the commission shall be $3.12½; on shares selling at not over $10 and above $5 per share, $6.25; on shares selling above $10 per share, $12.50 per 100 shares. The minimum commission to members of the Exchange shall be $1 per $100 on all shares selling at $10 and below. But in all other cases the rate shall be the same as directed in this article to Railroad stocks.

[5] Morgan vs. Mason, 4 E. D. Smith (N. Y.), 636; Miller vs. Ins. Co. of North America, 1 Ab. New Cas. id. 470, and note, which contains a collection of cases on the extent to which usage is admissible to establish a rate of compensation; see also Erben vs. Lorillard, 2 Keyes (N. Y.), 567; Adams vs. Capron, 21 Md. 186; Deshler vs. Beers, 32 Ill. 368.

uniformity, long continuance, and notoriety of the same. And it is held[1] that an agreement between Brokers to share commissions earned by one on information given by the other is legal.

But it seems that a Broker or Agent is not always entitled to a commission, although he may have performed the work or transacted the business for which he was employed. Mr. Parsons lays down a proposition[2] which seems to be very generally accepted by the courts, that "neither a factor nor a Broker can have any valid claim for his commissions or other compensation if he has not discharged all the duties of the employment which he has undertaken with proper care and skill and entire fidelity." This necessarily embraces all acts of bad faith on the part of the Broker; and it even applies where a Broker, without fraudulent intent, receives commission from a conflicting interest.[3] In the State of New York, however, it has been held that where a trustee wrongfully invested trust funds in securities not authorized by law, such act did not deprive him of his right to commissions; and Mr. Justice Woodruff doubted whether even misconduct or gross negligence would operate to debar trustees of their authorized compensation, where no imputation of fraud rests upon them.[4] A Broker is never entitled to commissions for unsuccessful efforts, even though, after his failure and the termination of his agency, his labor proves of use and benefit to his principal. He does not, however, lose his commissions where his efforts are rendered a failure by the fault of his principal, or where the purchaser declines to complete because of a defect which is the fault of the principal.[5] What constitutes a faithful performance of the Broker's duty depends greatly upon the nature of the business committed to his hands. It has been held, for instance, that he is obliged to keep and render a correct account of the business transacted.[6] And, although he may not absolutely forfeit his commission by a failure to do this, it may be construed as a failure of duty on his part, or as a suppression of evidence.[7] The case of Hoffman vs. Livingston[8] peculiarly illustrates the question of a right of a Stock-broker to recover his commissions. The plaintiff there sued to recover his commissions or transactions in stocks made for account of defendant. The transactions were conducted by the plaintiff under an arrangement by which the latter speculated for the defendant under a discretionary order, buying and selling whenever he deemed it advisable. Under this arrangement plaintiff made numerous transactions, resulting in a loss to the defendant of a large sum, more than one-half of which was for commissions. Notice of each transaction was not given to the defendant in accordance with the custom of Brokers. The action was contested on the ground that the circumstances showed that the operations were made with a view of merely yielding commissions for the benefit of the Broker, and it was held that the failure of the latter to give notice to his Client of each transaction was a neglect of duty which was a sufficient bar to the recovery of commissions. The rule of law is that if the Broker's services are wholly abortive, or executed in such a manner that no benefit results from them, he is not entitled to recover either his commissions or even a compensation for his trouble. That the question is one of due diligence and ordinary skill, and the want of this may be the result of an inattention or incapacity. It is not necessary in such case for defendant to show actual fraud. It has also been held that a Broker employed to purchase government bonds for a Client cannot act in the same transaction as agent for the seller, and receive commissions from both sides, although this may be done where the Client expressly assents to the same.[1]

1 McLaughlin vs. Barnard, 2 E. D. Smith (N. Y.), 372.

2 Pars. on Con. (6th ed.) *100, and authorities cited.

3 Wharton on Ag. § 336; Story on Ag. § 331; Levy vs. Loeb, N. Y. Ct. App. Oct. 1881, not yet reported.

4 King vs. Talbot; 40 N. Y. 76; Vanderheyden vs. Vanderheyden, 2 Paige Y, N. Norsworthy, 1 Sand. Ch. (id.) 406; Meacham vs. Stearns, 9 Paige (id.), 405.

5 Sibbald vs. Bethlehem Iron Co. (N. Y. Ct. App.), 11 N. Y. Week 588; Rapalje vs. Dig. 445.

6 Clark vs. Moody, 17 Mass. 145.

7 Lupton vs. White, 15 Vesey, 432, 640; Hart vs. Ten Eyck, to Johns. Ch. 42, 108.

8 14 J. & S. (N. Y.) 552.

1 Levy vs. Loeb, N. Y. Ct. of App., not yet reported, Oct. 1881.

THE NEW YORK MINING STOCK MARKET.

THE great distance of the gold and silver mines on the Pacific coast, and the difficulty of obtaining trustworthy information regarding them, prevented, for a long time, the establishment of a mining stock exchange in New York, or any of the other Eastern cities. It is true, that ever since the California gold fever of 1849, but, more especially, since the completion of the Pacific railroads and the trans-continental telegraph, more or less business has been done by eastern capitalists in mining stocks, purchases being made at first, however, in the San Francisco market. An effort was made to create a mining excitement in the east, as a forerunner to the establishment of a recognized mining exchange, but it met with only spasmodic success, and the investments that were made proved, as a rule, so unprofitable that the business fell into great disrepute, and few persons making any pretensions to financial acumen could be found bold enough to advocate dealings in mining securities, or admit that they were interested in mining properties. So great, indeed, was the distrust in securities of this class that it was a decided injury to a business man's financial standing to be known to be dealing in them, and mining stocks were generally classed with lottery tickets. The foisting of some worthless properties on a credulous public was the principal cause for this unsavory reputation. However, the wonderful product of the Comstocks, and the princely fortunes made by a few persons connected with the development of those and some other rich mines, were too great not to excite the envy of speculators in every part of the known world. Furthermore, from year to year, more trustworthy information regarding the mines in the far west was obtainable, and a more thorough knowledge as to the most profitable manner of working the mines was acquired by the managers. This has been followed recently by the discovery of some remarkably rich deposits in Colorado, and a better understanding as to the character and most economical means of developing true fissure veins, some of which have been discovered in various sections of the west, and proved to be very valuable. These discoveries and developments, coming at a time when there was an unusual amount of surplus capital in the country, which, in many cases, had been lying comparatively idle for a long time, and when the country was rallying from the sad effects of the panic of 1873, resulted, very naturally, in awakening an interest in gold and silver mining altogether unknown in the previous history of the eastern States, as is shown by the prominence which dealings in mining stocks have assumed at the exchanges in New York, and other Atlantic coast cities within the past three or four years. Prior to that time the transactions were not sufficient to be made a matter of record in the daily newspapers, or even in the usual forum of printed lists. During 1879, however, the total reported sales of mining stocks, at the New York Mining Stock Exchange, were 15,851,878 shares, being an average of over 50,000 shares a day for each business day of the year. In the month of March alone of that year the transactions amounted to more than 2,100,000 shares. In 1880, the sales at the two mining exchanges, (one of them being in operation only seven months), were 20,012,825 shares, and in 1881, they were 43,027,426 shares, while for the first six months of the current year (1882), they have aggregated 28,211,052 shares.

Mining Stock Exchanges.—Regular dealings in mining stocks through the medium of a recognized exchange were first established in New York in 1865, three years after the organization of the first mining exchange in San Francisco. At that time a number of prominent brokers, acting under an adopted constitution, began to deal in mining stocks in a part of the board room of the New York Stock

Exchange where the transactions in railroad, government and other securities took place. The sales of mining stocks were principally those of California and Nevada companies. Many members of the Stock Exchange belonged to the organization, and for a short time it gave great promise of success. It proved, however, to be short lived, owing to some of the unprofitable ventures that were made and the inability of its members longer to secure the patronage of the speculative public. Although its corporate existence was maintained, the calls of stocks were abandoned and no business was done for several years. It was, in fact, nearly ten years later before the subject of a mining board was again revived. In June, 1876, a card in the financial columns of the New York *Herald* invited gentlemen interested in mines and mining stocks to meet at the office of Mr. William Ward for the purpose of taking the necessary steps towards the formation of a mining exchange. The scheme met with unexpected favor, and on August 19, of the same year, the American Mining Board, as the new exchange was named, was formally organized, the constitution and by-laws (modeled after those of the New York Stock Exchange) were adopted and the following officers were elected: president, William Ward; first vice president, Lawrence P. Bayne; treasurer, Daniel Butterfield; secretary, H. J. Hubbard; and assistant secretary, Walworth Ward. At that time 112 applications for membership had been received and prominent among the members were William M. Burgoyne, Gabriel Netter, Francis B. Forster, John F. Scott, George P. Townsend, Joseph T. Thompson, John T. Daly, William Brandreth, N. P. Henderson, H. J. Hubbard, Calixte Harvier, Walter Browne, Jr., James Campbell, Joseph T. Rook, Samuel S. Rutzky, Henry Lohly and Francis H. Fogg. By October 1, the number of applications had reached 650, and 270 persons had been elected to membership, including some of the large and wealthy firms of New York, Philadelphia, Baltimore, Virginia City and San Francisco. Meanwhile the initiation fee had been raised from \$100 to \$250. The new board secured rooms at the corner of Nassau and Pine streets, where it began business on October 3, 1876, when forty-five stocks were called, nearly all of Nevada and California companies. Applications were received from many other companies for the placing of their stocks on the board list, but they were rejected by the Governing Committee.

Subsequently the name of the new organization was changed to "The American Mining and Stock Exchange," and a new constitution and by-laws were adopted on November 29, of the same year which provided among other things that the Exchange should deal in all mining, railway and miscellaneous securities which might be approved by the Committee on Securities. This was a direct blow at the old New York Stock Exchange which had a monopoly of the transactions in all active securities except those of mining companies, and as a number of the members of the Mining Exchange were also members of the New York Stock Exchange, it was not long before the Governing Committee of the latter board adopted a resolution prohibiting its members from belonging to any other board, except the old New York Mining Stock Exchange that was organized in 1865, and still retained its corporate existence, being regarded as a child of the New York Stock Exchange. The result was a consolidation of the two mining exchanges, which was effective on June 14, of the following year, the name adopted for the consolidated exchange being: "The New York Mining Stock Exchange." The union was recognized by the old Stock Exchange, it having been agreed that the Mining Exchange, would not deal in other than mining securities. At the time of the union there were nearly 500 members of whom 154 were also members of the New York Stock Exchange. On June 15, 1882, the membership in good standing numbered 465, and a seat commanded about \$1,000, while sales have been made within the past two years as high as \$3,000. The call room occupied by the board is on the ground floor at No. 62 Broadway, and it extends through to New street (No. 23,) the room being 35x 130 feet, a portion of which is set apart for visitors. The first president of the consolidated exchange was George B. Satterlee, who served from July 20, 1877 until June 1880, when he was succeeded by S. V. White who still retains the position. The present officers, who were elected June 12, 1882 are as follows: President, S. V. White; Vice President, C. F. Woods; Treasurer, J. M. Stanton; Secretary, R. H. Gallaher, Jr., and Chairman, A. W. Peters. The following are the Committees:

GOVERNING COMMITTEE.

To serve one Year.

P. K. Dickinson, R. M. Shaw,
George B. Satterlee, F. B. Whitfield,
J. A. Macpherson, Louis Haight,
A. L. Seton, W. W. Hawly,
P. P. Robinson.

To serve two years.

R. M. McJimsey, J. H. Tucker,
E. P. Mitchell, W. C. Budd,
John F. Scott, George F. Mann.
C. F. Woods, W. E. Cox,
E. S. Munroe.

To serve three years.

R. K. Cooke, H. Dunham,
A. L. Faris, E. L. Clarkson,
L. J. Werner, A. Lexon,
C. H. Badeau, George W. Hoagland,
T. L. Watson.

GRATUITY FUND TRUSTEES.

To serve one year.........................R. M. Shaw.
To serve two years ....C. O. Morris.
To serve three years.........................George Phipps.
To serve four years.........................E. S. Munroe.
To serve five years..........................R. M. McJimsey.
And the President and Treasurer.

FINANCE COMMITTEE.

Louis Haight, A. L. Seton,
George F. Mann,
And the President and Treasurer.

COMMITTEE ON MEMBERSHIP.

R. M. Shaw, Louis Haight,
J. A. Macpherson, H. Dunham,
R. K. Cooke, E. L. Clarkson,
C. H. Badeau.

COMMITTEE ON ARRANGEMENTS.

R. K. Cooke, T. L. Watson,
F. B. Whitfield.

COMMITTEE ON SECURITIES.

G. F. Mann, J. F. Scott,
W. W. Hawly, L. J. Werner,
P. P. Robinson, J. A. Macpherson.
A. L. Faris.

ARBITRATION COMMITTEE.

George B. Satterlee, R. M. Shaw,
E. S. Munroe, W. E. Cox,
G. W. Hoagland, C. F. Woods,
A. Lexon.

LAW COMMITTEE.

S. V. White, George B. Satterlee,
J. H. Tucker, John Stanton,
R. M. McJimsey.

COMMITTEE ON COMMISSIONS.

R. K. Dickinson, H. Dunham,
W. C. Budd.

COMMITTEE ON MISCELLANEOUS SECURITIES.

E. L. Clarkson, A. Lexon,
H. Dunham. G. W. Hoagland,
J. F. Scott

The present Constitution and By-Laws of the New York Mining Stock Exchange are as follows:

CONSTITUTION.

ARTICLE I.—*Title*—The name and title of this Association shall be "The New York Mining Stock Exchange," and its business shall be limited to furnishing facilities to its members for the purchase and sale of the stocks and other securities of Mining, Manufacturing and Insurance Companies, and also the stocks and other securities of companies not listed on the New York Stock Exchange.

ARTICLE II.—*Officers.* Section 1.—The whole government of the Association shall be vested in a Governing Committee, composed of the President and Treasurer of the Association and twenty-seven (27) members, divided into three classes of nine (9) each, who shall be elected in the manner hereinafter provided.

Section 2.—There shall also be elected annually, a Chairman, Secretary and Assistant Secretary, who shall receive such compensation as the Governing Committee may determine.

Section 3.—The Governing Committee at their first meeting after the annual election shall choose from their own members a Vice-President of the Association.

ARTICLE III.—*Elections.*—Section 1.—The President, Treasurer, Chairman, Secretary, and Assistant Secretary shall be elected by ballot on the second Monday in June in each year There shall be elected at the same time nine (9) members of the Governing Committee, to fill the vacancies occasioned by the expiration of the term of the out-going class, and also members to fill any vacancy or vacancies in the other classes for the unexpired term. The candidate or candidates receiving the largest number of votes shall be declared elected.

Section 2.—In case a vacancy shall occur in either of the offices of President, Treasurer, Chairman, Secretary, or Assistant Secretary, a new election by ballot shall be held to fill such vacancy. In case a vacancy shall occur in the Governing Committee, by resignation or otherwise, it shall be filled by said Committee until the next annual election. In case a vacancy shall occur in the office of Vice President the same shall be filled by the Governing Committee at their next meeting.

Section 3.—No person shall be eligible to any office in this association who shall not be, at the time of his election, a member in good standing.

ARTICLE IV.—*Governing Committee.*—Section 1. All powers necessary for the goverment of the Association shall be vested in the Governing Committee. They shall have power to try all offences under or against the laws of the Association, and all charges against members, and their decision shall be final. They shall have power to fix the amount of salary that shall be paid to any officer of the Association and shall have power to terminate the contract of the Association with any such salaried officer by a vote of two-thirds of their number,

Section 2.—The Governing Committee may, at any time during the pendency of a case before any of the Standing Committees, ask for such information and give such instructions as they may deem proper.

Section 3.—Any member of a Standing Committee, before which a case may be pending, shall have the right, during the consideration of such case, or within two days after a decision has been made thereon, to demand, a reference of the same to the Governing Committee, for final adjudication; and the Chairman of the Standing Committee shall notify the President of the Governing Committee of such reference at the next regular meeting. No member of the Governing Committee shall participate in the adjudication of a case in which he is personally interested.

SECTION 4.—The President may call a meeting of the Governing Committee at any time. He shall call a meeting at the request of five (5) members. In the absence of the President, any five (5) members of the Governing Committee may call a meeting by announcement from the rostrum.

A majority of all the members of the Governing Committee, or of any sub-committee shall be necessary to constitute a quorum.

Section 5.—Any member of the Governing Committee, who, except in case of illness or leave obtained from the Presiding officer, shall absent himself from the meetings of the Committee during three consecutive regular meetings, shall, *ipso facto*, cease to be a member of the Governing Committee, and the vacancy so occurring shall be filled as provided in Art. III of the Constitution.

ARTICLE V.—*Standing Committees.*—As speedily as possible after each annual election, the Governing Committee shall appoint from their own members the following Standing Committees for the year.

1st.—A Finance Committee of three (3), in addition to which the President and Treasurer shall be members, *ex officio*.

2d—A Committee on Membership, to consist of seven (7).

3d—A Committee of Arrangements to consist of three (3).

4th—A Committee on Securities to consist of seven (7).

5th.—An Arbitration Committee to consist of seven (7).

6th.—A Law Committee to consist of five (5).

7th.—A Committee on Commissions, to consist of three (3).

8th.—A Committee on Miscellaneous Securities, to consist of five (5).

Should special exigencies require, the President shall have the right to appoint Committees *ad interim*, to act until the regular appointments are made.

ARTICLE VI.—*Duties of Standing Committees. Finance Committee.*—Section 1.—It shall be the duty of the Finance Committee to supervise the finances of the Association, to audit the accounts of the Treasurer, and to direct the investment of any surplus funds in his hands, as they may deem advisable for the interests of the Association.

Committee on Membership.—Section 2.—The Committee on Membership shall have jurisdiction over all admissions to membership in the Association. All applications for membership should be addressed to the Chairman of the Committee and must be seconded by at least two members of the Association. The name of the applicant and the names of his endorsers shall be conspicuously posted in the business room of the Association, with a notice requesting the members to inform this Committee, in writing, of any objections they may have to the person named, such communication to be duly considered in Committee and to be held confidential. The Committee shall make diligent inquiry as to the qualifications of the applicant, and if at the expiration of not less than ten (10) business days, five (5) members of said Committee shall be in favor of admission, they shall so report to the Governing Committee, and unless further inquiry is demanded by said Committee, the President, or in his absence, the Chairman, shall declare the said applicant duly elected a member of this Association, provided that within ten (10) business days after being elected, he shall sign the Constitution, and pay the initiation fee, and the contribution to the Gratuity Fund provided in Art. 23, Sec. 2, otherwise his election shall be null and void. Whenever any member of said Association shall desire to discontinue his membership and to nominate a successor, he shall send a written communication to the Chairman of the Committee on Membership stating the fact, with an official nomination of a successor, who shall pay to the Chairman of the Committee the amount of consideration for said nomination. The Committee shall then cause a notice to be posted in the business room of the Association which shall state the name of the member desiring to withdraw and invite the filing of claims against said member, and if after the expiration of ten (10) days from the first posting of such notice the nominated successor shall have been elected to membership in the manner prescribed in the preceding section of this article, the money deposited with the Chairman shall be distributed by him in the following manner, i. e.:

1st.—To this Association to the extent of any money due it.

2d.—In payment, *pro rata*, of claims filed by members and adjudicated as valid.

3d.—The remainder, if any, to the retiring member, or his legal representatives. And on the first posting of the notice of withdrawal of such member, he shall discontinue active membership and the making of new contracts with members, and when the successor shall be admitted to membership the prior membership shall cease and be void, but if the nominee shall be rejected or fail to qualify, the member may name another successor, or may resume active membership, provided that there shall be no claims against him.

No minor shall be eligible to membership.

Committee of Arrangements.—Section 3.—It shall be the duty of the Committee of Arrangements to enforce all rules and regulations necessary for good order and the comfort of the members.

They shall determine the number, duty and pay of all employees other than the officers and shall have a general supervision of all the Departments of the Exchange.

Committee on Securities.—Section 4.—The Committee on Securities shall examine and report upon all stocks or other securities entered, or to be entered upon the lists of the Association, and all applications to place securities upon the lists shall be made to them.

Arbitration Committee.—Section 5.—It shall be the duty of the Arbitration Committee to take cognizance of, and exercise jurisdiction over, all claims and all matters of difference between members of the Association, and their decision shall be binding; provided, however, that an appeal from the judgment of the Arbitration Committee may be taken to the Governing Committee in any case involving one thousand dollars or over, upon the condition that notice shall be given by the appellant to the appellee within one week of the rendition of the verdict of the Arbitration Committee of his intention to appeal the case.

The Chairman of the Arbitration Committee shall have power, and it shall be his duty, to call meetings of that Committee, for the settlement of differences or disputes between members, and he shall preside thereat, and he shall be entitled to a fee of ten (10) dollars for every case tried, which shall be paid by the losing party.

Law Committee.—Section 6.—It shall be the duty of the Law Committee to consider all questions of law affecting the interests of the Association, and report to the Governing Committee.

Committee on Commissions.—Section 7.—It shall be the duty of the Committee on Commissions to see that the rules relating to commissions are complied with and report to the Governing Committee any violation thereof.

Call of Meetings.—Section 8.—In the absence of the Chairman of any committee except the Governing Committee, the Secretary of the Association may call a meeting of the committee at the written request of two of its members, and a quorum present may choose a chairman *pro tem.*

ARTICLE VII.—*Duties of Officers.—Duties of the President and Vice-President.*—Section 1.—It shall be the duty of the President to see that the several provisions of the Constitution and By-Laws are enforced, and to have a care of the general interests of the Association.

He shall be entitled to preside over the Association during debate or whenever he may elect so to do, and he shall be a member and President of the Governing Committee.

The Vice-President shall, in the absence of the President, assume all the functions and powers, and discharge all the duties of President.

In case of the temporary absence or inability to act of both the President and Vice-President, the Governing Committee may choose from their own number an acting President of the Association.

Duties of the Treasurer.—Section 2.—The Treasurer shall receive and take charge of the moneys due the Association and shall hold the same subject to the order of the Finance Committee. He shall on the second Monday in June in each year, render to the Association a detailed account of the receipts and expenditures of the Association since the date of the last account rendered by him, and also report to the Governing Committee at any other time that they may direct. He shall specify particularly from what source or sources the receipts have been derived and for what purpose or purposes the expenditures have been incurred. He shall also state the balance then in the treasury, and how the same is invested. He shall invest the surplus funds of the Association in such securities and at such times as the Finance Committee shall direct.

Duties of Chairman and Vice Chairman.— Sec. 3.—It shall be the duty of the Chairman to preside over the association whenever it shall be assembled for business; to call the Stocks and Bonds, maintain order, enforce the rules, and perform such other duties as the Governing Committee may regard as properly pertaining to the office. The Secretary of the Association shall be Vice-Chairman, and in the absence of the Chairman shall assume all his duties and functions.

Neither the Chairman nor the Vice-Chairman shall be permitted to operate in Stocks during the period he is presiding. In the absence of both, the President may appoint, or the members present may choose, a Chairman *pro tem.*, with full powers.

The Presiding Officer shall determine all questions of order.

Duties of the Secretary. Sec. 4.–It shall be the duty of the Secretary, or his Assistant, to record all purchases or sales made at the business sessions of the Association, and to prepare a report of the same for the press; also to keep a faithful record of all proceedings of the Association in a book of minutes prepared for the purpose; also carefully to keep and preserve all books and papers of the Association, and of the several committees thereof, not properly belonging to the department of the Treasurer.

He shall prepare and keep a record of all the members of the Association, the place of business of each, and the name of the firm, if any, to which each belongs; and shall also record and charge all fines, dues, and fees which may be imposed, and report to the treasurer on the first day of each month the amount charged against each member for the preceding month. He shall also, during the first week in each month, collect and pay over daily to the treasurer, all fines, and if any member shall refuse or neglect to pay the fines, dues or fees charged to him, he shall report the same to the Treasurer, who shall, after giving reasonable notice to the delinquent, report the fact to the President of the Association who shall at once suspend such member until such dues, fees, or fines are paid.

He shall also act as Secretary to the Governing Committee when required so to do, and discharge such other duties as the Governing Committee may regard as properly pertaining to the office.

Duties of the Assistant-Secretary.—Section 5.—In the absence of the Secretary, the Assistant Secretary shall perform all the duties pertaining to that office; and at times such other duties as the Governing Committee may assign to him.

ARTICLE VIII. (See Amendments.) *Applications for Membership, Eligibility, Initiation Fee, &c.*—Section 1.—All applications for membership must be made in accordance with the provisions of Article 6, Sec 2.

Section 2.—Any member of the New York Stock Exchange in good standing shall be eligible to membership in this Association, and the fact of such membership in the New York Stock Exchange shall be equivalent to the approval of the applicant by the Committee on Membership.

Section 3.—The initiation fee of the members admitted by election shall be one thousand dollars, and that for successors of members shall be two hundred and fifty dollars, but the Governing Committee may change the amount of the initiation fees from time to time.

ARTICLE IX.—*Misstatements of Applicants.*—Whenever it shall appear to a majority of the Committee on Membership that a wilful misstatement upon a material point has been made to them by an applicant for admission or re-admission, they shall report the case to the Governing Committee, who may, by a two-third vote of the members present, deprive the offending party of his membership, or declare him forever ineligible for admission, as the case may be.

ARTICLE X.—*Withdrawal of Members.*—Any member shall have the right to withdraw from the Association and to nominate a successor by complying with the provisions of Article 6, Section 2.

ARTICLE XI.—*Nomination of Successors.*—Section 1.—When a member dies his right to nominate a successor shall be disposed of by the Committee on membership within a period of twelve months; and after satisfying the claims of the members of the Association, they shall pay any balance to the legal representatives of the deceased.

Section 2.—In every case where a member is deprived of his membership, or declared ineligible for re-admission by the Governing Committee, by reason of any offense against or under the laws of the Association, his right to nominate a successor shall be disposed of by the Committee on Membership and the proceeds thereof distributed in accordance with the preceding section.

ARTICLE XII.—*Partnerships.*—Whenever a member shall form a partnership with any other member or person he shall immediately give notice thereof to the Secretary. In like manner, notice must be given of any dissolution of partnership, and it shall be the duty of the Secretary to keep a record of all partnerships and dissolutions. No member of this Association shall be allowed to take as partner any suspended member thereof, during the period of his suspension, or to form a partnership with any insolvent person.

ARTICLE XIII.—*Expulsion for Fraud.*—Should any member of this Association be guilty of obvious fraud—of which the Governing Committee shall be judge—he shall, upon conviction thereof, by a vote of eighteen (18) of the members of said Committee be expelled.

In event of charges of fraud or false pretense being preferred before the Governing Committee or in the Courts, the Committee, if the evidence "*prima facie*" seems to a majority to warrant such action, may suspend the member at their discretion, pending the adjudication of the charges.

ARTICE XIV.—*Obligations of Members in Signing the Constitution.*—The signing of the Constitution of this Association shall be construed as an obligation and pledge of each member to abide by the same, and also by all By-laws, Rules or Regulations which may be hereafter adopted; and any member refusing to comply with the Laws of the Association, shall be reported to the Governing Committee and may have a hearing, and if said Committee decide, by a vote of eighteen (18) of their number that the complaint is proven, they may declare him no longer a member of the Association.

The property, leases, contracts, etc., paid for by this Association shall be held by the President and Treasurer of the Association—for the joint usage and interests of the Association as a whole, but no member shall have any individual or separate usage in, or of, the same, apart from his privileges while an active member under the rules of the Association, nor shall he have any devisable interests in, or claim to the said assets, excepting as to the members, at the time being, in case of any dissolution and sale of the proceeds of such property.

The payment of the initiation fee shall be an absolute contribution to the Association for the privilege of membership under the rules. and shall confer no right of property except to members at the time of any dissolution, but a membership not forfeited to the Association, shall confer the right to nominate a successor, subject to the arbitrary election of such successor to membership in the Association.

ARTICLE XV.—*Suspended Members, Re-Admission, Claims of Creditors, Etc.*—Section 1.—Any member who may fail to comply with his contracts or who shall become insolvent, shall be suspended until he has settled with his creditors.

Such member shall immediately inform the President in writing, that he is unable to meet his engagements; and it shall be the duty of the presiding officer, thereupon to give notice, from the chair, of the suspension of such member. The Secretary shall record the failure of such member in a book kept for that purpose. In default of giving such information, the party, on application for re-admission, shall not be entitled to a reference of his case to the Committee on Membership, unless two-thirds of the members of the Governing Committee present shall vote in favor of such reference.

Section 2.—When a suspended member applies for re-admission, he shall be required to furnish to the Chairman of the Committee on Membership, a list of his creditors and a statement of the amounts owing, and the nature of his settlement in each case. The Committee shall give notice, for three consecutive days through the presiding officer of the Association or by posting the same on the bulletin board provided for that purpose, of the time and place of meeting to consider the application of the suspended member and the claims of creditors. Upon the applicant presenting satisfactory proof of his settlement with all his creditors the Committee shall proceed to ballot for him, in accordance with its prescribed rules and regulations. Failing of a re-election the applicant shall be entitled to be balloted for at any five subsequent regular meetings of the Committee, to be designated by himself. Provided, however, that the six ballotings to which the applicant shall be entitled shall be within one year from the time of his first application for readmission. If after six ballotings as aforesaid, the candidate is rejected he may appeal, within sixty days thereafter, to the Governing Committee, whose action in the case shall be final. If rejected by the Governing Committee, he shall cease to be a member of the Association, and his name shall forthwith be stricken from the roll, and his right to nominate a successor shall be disposed of by the Committee on Membership. The question on appeal, however, shall not be taken unless at least twenty-one members of the Governing Committee are present, and it shall require an affirmative vote of at least seventeen members to re-instate the applicant.

Section 3.—If any suspended member shall fail to settle with his creditors and apply for re-admission within one year from the time of his suspension, his membership shall cease and the nomination of a successor shall be disposed of by the Committee on Membership and the proceeds paid *pro rata* to his creditors in the Association. The Governing Committee may, by a vote of two-thirds of the members present, extend the time for settlement and for application for re-admission, of such suspended member. No claims growing out of transactions between partners shall be admitted to share in the proceeds of the membership of one of such partners until after the claims filed by other creditors who are members of the Association shall have been satisfied.

Section 4.—Any creditor failing to file with the Secretary of the Committee on Membership a written statement of his claim against a member, prior to the transfer of the right to nominate a successor of such member shall forfeit all right to a distributed share of the proceeds of the sale of such right.

Section 5.—No member of the Association shall be allowed to take as partner any suspended member thereof, during the period of his suspension, or to form a partnership with any insolvent person or with any person who may have previously been a member of the Association, and against whom any member may hold a claim arising out of transactions made during the time of such membership, and which has not been settled or released in accordance with the laws of the Association.

ARTICLE XVI.—*Elections, Quorums, Members of a Firm Voting, etc.*—Section 1.—Any member of the Association shall be entitled to vote at an election for Officers.

Section 2.—The members present at the daily sessions of the Association shall constitute a quorum for the settlement of disputes growing out of the purchase and sales made during such sessions. When the Association shall be assembled to vote on questions other than the above, a majority of all the members of the Association shall be necessary to a quorum.

Section 3.—Only one member of a firm shall be allowed to transact business in the same security, at the same time, or vote on the questions of dispute referred to in Sec. 2.

ARTICLE XVII.—*Annual Dues.*—Each member of this Association shall pay semi-annually the sum of fifteen dollars to the Treasurer of the Association on or before the first Monday in January and July. Any member neglecting or refusing to make this payment at the time named, unless for some reason that may be satisfactory to the Governing Committee, may be suspended from the privileges of this Association.

ARTICLE XVIII.—*Commissions.*—The rates of Commissions shall be such as may be fixed from time to time by the Governing Committee. Any member doing business for less than the rates so fixed shall be liable to suspension by the Governing Committee for a period of ninety days, and for the second offense may be expelled by the vote of a majority of the Governing Committee. Provided, however, that nothing in this article shall prevent members from doing business for one another without restriction as to commissions.

ARTICLE XIX.—*Fictitious Sales.*—No fictitious sales shall be made by any member of this Association, and any member contravening this Article, shall, upon conviction, be suspended for such term as the Governing Committee shall declare in his case.

ARTICLE XX.—*Deposits may be Called.*—On all contracts other than cash, either party may call at any time during the continuance of the contract for a mutual deposit of twenty per cent. on the contract price.

Whenever the market price of the stock shall change from contract price, either way, the party in whose favor the change occurs may call on the other party for "marginal" deposits from time to time, to secure the contract to the market price, as in cases of borrowed stocks; the "marginal deposits to be made with the caller, unless the payer shall elect to deposit with an agreed third party.

In cases where deposits are called for before 2 o'clock, they shall be made, at, or before half past 2 o'clock of the same day; if called after 2 o'clock they shall be made before noon of the next day.

In case either party should fail to comply with a demand for a deposit, in accordance with the provisions of this Article, it shall be at the option of the other party to elect whether to close in the manner provided in Article 22 of this Constitution, or to continue said contract, and if no deposit shall have been made previously on the contract, he may even elect to annul the contract, which election shall be announced to the Association in open session, and a minute made thereof in the records.

Whenever there is a difference between contractors as to the place of deposit, it shall be made in the Union Trust Company.

Whenever the seller of a stock shall deposit in the Union Trust Company a margin equivalent to one hundred per centum of the contract price and a further deposit is called, it shall be at his option either to deliver the stock, or to make further deposit. Or the seller may deposit the stock covered by the contract in lieu of all deposits on his behalf to guarantee its delivery by him.

In the calling of deposits on stock, also dealt in on the San Francisco Stock and Exchange Board the prices at this exchange shall be first appealed to, but if offers and bids do not approximate to furnish a market price, then the prices at said San Francisco Exchange shall be taken and a rate for this market for such purpose be officially established therefrom, as this Association may provide.

ARTICLE XXI.—*Where Contracts are not Fulfilled.*—Should any member refuse to fulfill his contract on the day it becomes due, the party contracting with him, may employ the presiding officer to buy or sell the stock, as the case may be, at the business room of the Association during the open session, and he shall in all cases, where the stocks are bought or sold under this rule, but in such manner as in his judgment will secure the stock at the lowest price; and when instructed to sell stock under the rule, to sell in such a manner as will in his judgment secure the highest price, provided that such contracting party shall first have notified the other party personally or by leaving written notice at his office, of the intended time of sale or purchase; accounting to the member in default for any surplus or charging him with any deficiency.

If such party has no office and cannot be found after suitable search, then such stock may be bought or sold without notice.

"In cases of default in delivering stocks sold for 'the account,' and which are also dealt in at the San Francisco Stock and Exchange Board," the seller may elect, instead of being "bought in" at this Exchange to settle the difference at the market price of the stock on the said San Francisco Exchange, adding such commission, expense and penalty as may be established by this Association the hour and method of fixing such price to be also so established.

"Puts" and "Calls" shall be recognized in the same manner as other contracts; but bids or offers on them during the call are prohibited.

ARTICLE XXII.—In order to provide for the families of deceased members of this Association a special fund is hereby established, to be styled "The Gratuity Fund of the New York Mining Stock Exchange," which fund shall be maintained and administered in the manner hereinafter provided.

Section 1.—The management and distribution of the said fund, and the execution of the provisions of this Article, shall be under the charge of a Board of Trustees, to be known as "The Trustees of the Gratuity Fund," and to consist of the President and Treasurer of the Association and of five other Trustees, who shall (except in the first instance) hold office for five years, and one of whom shall be elected by the Association at each annual election.

In case any vacancy should occur in the Board of Trustees, the Governing Committee shall fill the same until the next annual election, when the members of the Association shall fill the said vacancy for the unexpired term.

It shall be the duty of the Trustees of the Gratuity Fund to keep securely invested, in accordance with the Laws of the State of New York regulating Trust Funds, all moneys paid to them for the Fund, together with the annual interest and accretions arising from the same. They shall have power to choose their own chairman, and adopt such by-laws as may be needful, subject to the approval of the Governing Committee, and they shall make an annual report to the Association of the condition of the Fund.

Section 2. Every member of this Association shall be subjeet to the conditions and entitled to partake of the benefits of the Gratuity Fund hereby established, and upon the adoption of this Article the sum of Five Dollars shall be charged against each member as the first contribution to said fund, and shall be paid to the Treasurer of the Association, and paid by him to the Trustees of the Gratuity Fund. Upon the death of any member of the Association, there shall be levied and assessed against each surviving member the sum of Ten Dollars, which shall thereupon become due from him to the Association, and charged against the membership of such surviving member, to be collected as other fines and dues are, or may then be collected, and paid over to the Trustees of the Fund.

Every person who shall become a member of the Association after the adoption of this Article, shall pay into said fund the sum of Ten Dollars before he shall be admitted to the privileges of membership.

Section 3. The Trustees of the said Gratuity Fund shall, within one year after proof of death of any member, pay out of the money so collected, the sum of Four Thousand Dollars, or so much thereof as may have been collected to the persons named in this section, as herein provided, which money shall be paid as a gratuity from the surviving members of the Association, free from all debts, charges or demands whatever.

Should the member die leaving a widow and no children, then the whole sum shall be paid to such widow for her own use.

Should the member die leaving a widow and children, then one-half shall be paid to the widow for her separate use, and one-half to the children for their use, share and share alike, provided that the share of minor children shall be paid to their guardian, and that the issue of any deceased children shall be entitled to receive the share which said deceased child would have received, if living; if of age directly, or if minors, through his, her or their guardian or guardians.

Should the member die leaving children and no widow, then the whole sum shall be paid to the children as directed in the preceding section to be done with the moiety.

Should the member die leaving neither widow or children, then the whole sum shall be paid to the next of kin of the deceased.

In all cases, a certified copy of the proceedings before a Surrogate or Judge of Probate shall be accepted as proof of the rights of the claimants, be deemed ample authority to this Association to pay over the money, shall protect the Association in so doing and shall release the Association from all further claims or liability whatsoever.

Section 4. Nothing herein contained shall ever be taken or construed as a joint liability of this Association or its members, for the payment of any sum whatever; the liability of each member, in law or equity, being limited to the payment of Ten Dollars only, on the death of any other member, and Five Dollars upon the adoption of this article, the liability of the Association being limited to the payment of the sum of Four Thousand Dollars (or such part thereof as may be collected,) after it shall have been collected from the members, and not otherwise.

Section 5.—Nothing herein contained shall be construed as constituting any estate *in esse*, which can be mortgaged or pledged for the payment of any debts, but it shall be construed as a solemn agreement of every member of this Association to make a voluntary gift to the family of each deceased member, and of the Association to collect and pay over to such family the said voluntary gift; it being understood and hereby expressly declared, that the provisions of this article 23 of the Constitution, shall only be in force in, and applied to cases of death, which shall take place after its adoption.

Section 6.—Whenever the surplus funds invested by the Treasurer under the direction of the Finance Committee, amount to the sum of One Hundred Thousand Dollars, then and thereafter, one-half of the surplus income of the Association shall be paid over to the Trustees of the Gratuity Fund, either to increase individual insurance, or to reduce the assessment levied upon the death of each member as may then be determined by the Governing Committee.

Whenever the number of deaths of the members of the Association shall exceed seven in any one year, it shall be the duty of the Trustees of the Gratuity Fund to pay out of the Fund to the credit of the surviving members, in reduction of their payments to the Gratuity Fund for that year, such sums as may be requisite to limit the total payments of each member, under this article, in any one year, the sum of Seventy Dollars, provided, however, that the Fund in the hands of the Trustees shall never be thus reduced below the sum of Four Thousand Dollars; and that the liability of each member to make payments in excess of Seventy Dollars, (after the money so authorized to be paid by the Trustees is exhausted), shall not thereby be impaired, but on the contrary shall remain in full force.

Whenever the accumulations of the Gratuity Fund shall amount to One Hundred Thousand Dollars, the Trustees shall divide the annual income thereof, among the members, in reduction of their payments under this Article.

Section 7.—The provisions of this Article shall not extend to any member who shall not have severed his connection with the Association by the transfer of his membership, whether the same is made voluntarily or involuntarily, nor to any member who now is, or hereafter may be expelled by the Governing Committee; but shall extend to suspended members.

After the decease of a member, and until a successor to his membership is admitted, the Treasurer shall pay the contribution of Ten Dollars on all other deaths occurring during such interim, deducting the same from proceeds of the sale of the nomination to the successor.

Nothing herein contained shall apply to the associate members of this Association, it being hereby understood that this article shall apply to actual membership only, and not to associate members.

ARTICLE XXIII.—*By-Laws.*—For the purpose of maintaining order on the floor, and establishing rules for conducting business between members, the Governing Committee shall make such regulations and orders as they may deem proper, which shall be known as the "By-Laws" of the Association, and may be altered or amended from time to time at the discretion of the Governing Committee.

ARTICLE XXIV.—*Legal Interference with Officers or Committees.*—Any member of this Association who shall himself or whose partners shall apply for an injunction or legal process restraining any Officer or Committee of the Association from performing his or their duty under the Constitution and By-Laws, shall, by that act, cease to be a member of the Association.

ARTICLE XXV.—*Other Stock Boards.*—No member of this Association shall be a member of any other association or organization whose members deal in stocks, bonds, etc., in this city, and any member uniting, directly or by partner, with such an organization, shall cease to be a member of this Association.

This rule shall not apply to the New York Stock Exchange.

ARTICLE XXVI.—*Constitution may be Amended.*—This Constitution shall be amended only by the affirmative vote of a majority of the Governing Committee and any member of the Association, may propose an Amendment in writing at a business session of the Association which amendment shall be referred by the presiding officer to the Governing Committee without debate, and it may, at the option of said Committee, be reported back to the Association, amended or otherwise, and whenever the Governing Committee shall report an amendment of the Constitution passed as aforesaid it shall stand as the Law of the Association, unless within one week, it shall be disapproved of by a majority of the members, exclusive of those residing in the States west of the Mississippi, but no alteration of the Article now known as Article 23 shall ever be made which shall impair, in any essential particular, the obligation of each member to contribute as therein provided to the provision for the families of deceased members.

BY-LAWS.

ARTICLE I.—*Hours for Business.*—Section 1.—The Exchange or business room of the Association shall be open for dealings on every business day between the hours of 10 o'clock A.M. and 3 o'clock P. M., unless otherwise ordered by the Governing Committee.

Section 2.—No member of this Association shall be permitted—directly or indirectly—to make any transactions in the Stocks or other securities on the lists of the Association either in the Exchange or its vicinity during the hours in which the same shall be closed, under such a penalty as the Governing Committee may impose.

Section 3.—1st—First call of the regular list of stocks, at 10.30 A.M.

2d—Miscellaneous business.

3d—Calls of the regular or special list of stock, as may be from time to time established by the Association.

ARTICLE II.—*Offers and Bids.*—Section 1.—All offers to buy or sell securities shall be binding and no member may withdraw an offer, except in an audible voice to the presiding officer; but a sale shall take all offers off the floor. No offer or bid shall be recognized between partners or members of one firm.

All offers to buy or sell shall be per share; and at such percentages of difference as the Governing Committee shall fix for the dealings in the various stocks, and, when not otherwise stated, shall be considered as made for the regular way, and for lots of one hundred shares.

Section 2.—Offers to buy or sell shall be entitled to precedence in the following order:

1st.—Bids "seller three days" and offers to sell "buyer three days," shall take precedence of "cash" and "regular."

2d.—"Cash" and "regular" bids and offers may be made simultaneously, as being essentially different propositions.

3d.—Offers to buy or sell on longer options than three days, may be made at the same time with offers to buy or sell "buyer" or "seller three."

4th.—In offers to buy on seller's option or to sell on buyer's option, the largest option shall have precedence.

5th.—In offers to buy on buyer's option or sell on seller's option, the shortest option shall have precedence.

No other bids or offers shall be permitted, or have any standing upon the floor.

No contracts beyond sixty days shall be made.

Section 3.—No party to a contract shall be compelled to accept a principal other than the member offering to contract, unless the name proposed to be substituted shall be satisfactory, or shall be declared at the time of making the offer.

ARTICLE III.—*Interest.*—All contracts over three days shall bear interest at the rate of six per cent. per annum, except when bought or sold "flat."

All other contracts shall bear no interest.

The word "flat" shall be understood to mean free of interest only, and shall have no reference to dividends or assessments.

ARTICLE IV.—*Deliveries.*—Section 1.—All securities shall be delivered before quarter past two o'clock P. M.; and when deliveries are not made by that time the contract may be closed under the rule, after due notice to the defaulting party, in the manner provided in Art. 22 of the Constitution. Such notice, however, must be given not later than half past two o'clock, and the contract must be closed, without delay, unless the time for so doing be extended by mutual consent. In absence of any notice or agreement the contract shall continue without interest until the following day.

This rule shall apply to the receipt and delivery of borrowed securities, and any party failing to perform his contract in such securities, shall be liable for the damage that may accrue. All contracts over three days shall require one day's notice, at or before two o'clock.

Section 2.—All contracts maturing during the regular closing of the transfer books, shall be delivered by power and certificate, in lots of not over one hundred shares.

Section 3.—All purchases and sales shall be settled on the next business day, unless expressed to the contrary; and all contracts falling due on Sundays, or on such holidays as are observed by the Banks shall be settled on the preceding day.

Section 4.—When two holidays occur on consecutive days, as when Sunday immediately precedes or follows a legal holiday, contracts falling due on the first of such holidays, shall be settled upon the business day immediately preceding, and those maturing upon the second of such holidays shall be settled upon the business day next following the same.

Section 5.—Deliveries shall be made either by transfer, or by power and certificate of stocks, when more than one transfer a day is allowed on the same stock. On stocks when only one transfer a day is allowed, deliveries shall be made by power and certificate only, and in lots of not over one hundred shares.

Section 6.—In delivery of stock by power and certificate, the receiver shall have the right to demand that the certificates shall be in the name of, witnessed or guaranteed by a member of the Association, excepting as to stocks admitted from the California market, which have no transfer offices in this city. In such cases, the stock shall stand in the name of such persons as may be approved of and designated by the Governing Committee.

Section 7.—Powers of Attorney; or substitution, signed by Trustees, Guardians, Executors, Administrators or Attorneys, shall not be a good delivery. This rule shall not apply to mining and manufacturing shares in the name of a trustee. Detached powers of attorney, or substitution, must be attested by a notary public under seal.

Section 8.—In the delivery of any security dealt in at the Exchange, the seller may require payment in a duly certified check on a city bank, or in lawful money upon delivery.

Section 9.—Reclamations for irregularities in deliveries of stocks, when such irregularities do not affect their validity, but only currency in the market, will not be considered unless made within ten days from the day of delivery.

Section 10.—All corporations whose stock is dealt in at this Exchange shall be required to give thirty days notice in writing, prior to any increase in the capital stock of such company or the creation of any mortgage or deed of trust on its property, said notice to be read publicly by the presiding officer and posted within the Exchange Room; and no increased stock shall be a good delivery upon contracts made previous to such notice, and the stock of any company violating this provision shall be striken from the list of stocks, at the discretion of the Governing Committee.

ARTICLE V.—*Dividends.*—Section 1.—On the day of closing the transfer books of any stock for a dividend, transactions in such stock for *cash* shall be "dividend on" up to the time officially designated for the closing of the books; all transactions other than for cash shall be "dividend off" after a quarter past two P. M. or after the closing of the books, should they close before that hour.

Section 2.—When a dividend is declared on a security, during the pendency of a contract, the seller shall collect, hold, allow interest on, and pay the same to the buyer on the settlement of the contract.

Section 3.—Members may charge one per centum for collecting and paying dividends. But when a scrip or stock dividend has been declared by a company, the one per cent. shall be upon the *market* value, and not upon the par value of the scrip or stock.

Section 4.—No offer to buy or sell dividends on stocks shall be made publicly at the Exchange.

ARTICLE VI.—*Defaults.*—Section 1.—In all cases where an officer may be directed to buy or sell securities, under the provisions of Article 22 of the Constitution, the name of the member defaulting as well as that of the member giving the order shall be announced.

Section 2.—No order for the purchase or sale of securities, under the rule, shall be executed, unless made out in writing over the signature of the party giving the order, who shall state the reason therefor, and it shall be the duty of the officer who executes the order to endorse thereon the name of the purchaser or seller, the price and the hour at which the contract is closed, and hand the same to the Secretary of the Association, who shall, within twenty-four hours ascertain whether the party for whose account the order was given has paid the difference, if any, arising from the transaction. If not paid the Secretary shall report the default to the President. The duty devolving upon the officers of the Association under this rule, shall be performed without charge.

Section 3.—No party shall be permitted to supply offers to buy or sell securities closed for his account under the rule.

Section 4.—When a contract is closed under this rule, any action of the defaulter, direct or indirect, by which the prompt fulfillment of such contract is delayed, hindered or evaded, to the detriment of the other contracting party, shall subject the offending party to suspension for not less than thirty days, or expulsion from the Association, in the discretion of the Governing Committee, by a vote of two-thirds of the members present at a meeting.

Section 5.—Should any stock thus sold not be delivered until the next day, the contract shall continue, but the party defaulting shall be liable to pay such damages as may be assessed by the Arbitration Committee.

Section 6.—The same rule as to notice, time and place, that governs defaults in other contracts, shall apply to borrowed securities, which, on non-delivery or receipt, must be borrowed or loaned in open market except in case of actual default in receiving or delivering, after notice to close the loan, then the same are to be bought or sold, as the case may be, for account of the defaulter, in the manner provided in Article 22 of the constitution.

Section 7.—In case of a failure of a creditor to close the contract as above, the price shall be fixed by the price current at the time such contract ought to have been closed under the rule.

ARTICLE VII.—*Contested Claims.*—Section 1.—The Presiding Officer shall decide all contested claims for sales or purchases, when he has sufficient cognizance of the transaction to form an intelligent opinion; but an appeal from his decision shall be entertained, provided it be seconded by a disinterested member, and the question shall be for sustaining or reversing the decision of the Chair. If the presiding officer has not sufficient knowledge of the transaction to decide the case, he shall take the vote of the members present.

Section 2.—During the settlement of disputes as to claims of purchases and sales, only claimants shall be allowed to speak without consent of the presiding officer, and all others who may interrupt shall be fined.

ARTICLE VIII.—*President may inflict penalties.*—Section 1.—No member shall use indecorous language to the presiding officer or to any fellow member; nor shall any member interrupt the presiding officer while performing the duties of the Chair, or any other member while speaking.

Section 2.—As a means of preserving order, the presiding officer may inflict a fine not to exceed Five Dollars for all cases of infraction of this rule, or of disorder of any kind, from which there shall be no appeal; and no member shall be permitted to consume the time of the Association by questioning the propriety of the fines inflicted.

Section 3.—It shall be the duty of every member, by the practice of order and decorum, to do all in his power, to facilitate the transaction of business; and any member who shall habitually violate this duty, and indulge in acts of insubordination and unseemly conduct, to the injury of the interests of the Association, shall be admonished before the Association by the President, of the necessity of a reformation, and if, after that, he shall continue the obnoxious conduct, the Governing Committee may suspend him from the privileges of the Exchange for a period not exceeding one year.

ARTICLE IX.—*Rules.*—Section 1.—Every member while dealing in stocks, shall remain within the area appropriated to members; and no member, except officers on duty, shall be permitted on the Rostrum during any session of the Association.

Section 2.—Any member bidding for or offering stock while on the Rostrum, shall be fined, at the discretion of the presiding officer, not to exceed One Dollar for each offense.

Section 3.—Any member smoking in any part of the Exchange, where the Committee of Arrangements may decide to prohibit the same, shall be fined not less than One Dollar or more than Five Dollars.

Section 4.—No persons, other than regular members of the Association, shall be allowed to buy or sell stocks or other securities within the Exchange at any time.

No persons other than members shall at any time be admitted within the area, without consent of the presiding officer, or Chairman of the Committee of Arrangements.

ARTICLE X.—*Dealing with Non-Members.*—Any member of this Association, dealing with a person not a member, in the rooms of the Exchange, shall be subject to the penalty of suspension for not less than sixty days, nor more than twelve months.

ARTICLE XI.—*Commissions.*—Section 1.—Any member doing business for less than the rates fixed by the Governing Committee, shall be liable to suspension by the Governing Committee for a period of thirty days, and for a second offense, may be expelled by a vote of a majority of the Governing Committee.

Provided, however, that nothing in this Article shall prevent members from closing business for one another without restriction as to commissions.

Section 2.—The Governing Committee shall hear all cases of alleged violation of this Article and determine as to the truth of the charge from the evidence brought before them.

ARTICLE XII.—*Transacting Business through other Exchanges.*—Any member of this Association trading directly or indirectly in any other organization in N. Y. City where mining stocks are dealt in, shall be subject to the penalty of suspension for sixty days for the first offense, and expulsion for the second offense, provided that eighteen members of the Governing Committee find him guilty. This rule shall not apply to the N. Y. Stock Exchange.

ARTICLE XIII.—*Places of Business.*—Section 1.—Every member must have in the vicinity of the Exchange, a place of business other than the Exchange, where comparisons may be made upon the day of the transaction and where all notices may be served; and it shall be the duty of every member to keep filed with the Secretary a written notice, designating such place of business, and similarly to give notice of any change thereof.

Section 2.—Any member neglecting to comply with this rule, may be considered in default on his contracts and such contracts may be closed out under the rule.

Following are the names of the stocks listed at the New York Mining Stock Exchange and called regularly:

American Flag	Eureka Con.	Quicksilver, Pfd,
Amie	Findley	Rappahanock
Albion	Father de Smet	Robinson Con.
Alice	Gold Placer	Rising Sun
Alta Montana	Grand Prize	Red Elephant
Allouez Copper	Goodshaw	San Pedro
Argenta	Great Eastern	Savage
Bechtel	Green Mountain	Sierra Nevada
Belle Isle	Gold Stripe	Standard
Belch	Granville	Silver Cliff
Beauce	Hale & Norcross	Silver King
Best & Belcher	Homestake	Silver Islet
Bodie	Hukill	Sutro Tunnel
Buckeye	Horn Silver	Spring Valley
Bulwer	Harshaw	Stormont
Bassick	Hibernia	South Bodie
Bull Domingo	Hortense	South Bulwer
Bonanza Chief	Independence	South Hite
Boulder Con.	Iron Silver	South Pacific
Boston Con.	Lacrosse	State Line, 1,
Big Pittsburg	La Plata	" 2,
Bradshaw	Leadville, Con.	" 3,
Calaveras	Little Pittsburg	" 4,
Calaveras Water	Lucerne	State Line, 1 & 4
Caledonia B. H.	Little Chief	State Line 2 & 3.
California	Mariposa	St. Joseph Lead
Climax	" Preferred	Tip Top
Con. Imperial	Maybelle	Tioga
Con. Pacific	Mexican	Tuscarora
Con. Pay Rock	Moose Silver	Union Cons.
Con. Virginia	Moose	Unadilla
Copper Queen	Miner Boy	Vizina Con.
Chrysolite	Mono	Yellow Jacket
Cen. Arizona	Navajo	Willshire
Cherokee	Northern Belle	Washington
Catalpa	North Belle Isle	Jocuistita
Crescent	Noonday	
Caribou	North Standard	Minas Nuevas
Clarence	Ontario	Sierra Apache
Dahlonega	Ophir	" Bella
Durango	Oriental & Miller	" Grande
Dunderberg	Overman	" Plata
Dunkin	Plumas	
Decatur	Quicksilver	

A NEW MINING STOCK EXCHANGE.

THE decline in the business about the San Francisco stock exchanges following the failure of the Comstocks, as dividend paying mines, and legislation averse to the interests of the brokers on those exchanges; at a time, too, when the East was beginning to awaken to the influences of the "boom" in all classes of securities that had started, drove many of the San Francisco operators to New York. While a very few of them had amassed large fortunes, a large majority of the Pacific Coast speculators who found their way to the East, were little more than adventurers—persons of some Pine street experience, but very little money. In the spring of 1880 the Mutual Trust Company was organized, for the avowed purpose of fostering speculation in mining securities and a new mining exchange was established under the auspices of the Trust Company, most of the active members of which were Californians. The name adopted for the new board was: "The American Mining Stock Exchange." It was formally opened at No. 63 Broadway on June 2, 1880, at which time the membership numbered one hundred and sixty-nine, and the listed stocks thirty-one. George W. Smiley, formerly chairman of the San Francisco Stock and Exchange Board of San Francisco, was made Chairman of the American Board, and E. D. Barnes, another Californian, Secretary. Among the prominent members of the Board at the time of its organization, were C. T. Christensen, Mark L. McDonald, Augustus Ebert, William Belden. A. E. Reynolds, L. M. Lawson, S. M. Blatchford, George Chapman, Lewis Leland, John Gray, Joseph Aaron, and John J. Marvin. The Board has suffered for want of heavy capitalists interested in its operations, and of persons who were able to secure a large patronage from the public. At times, however, its reports of transactions have made a very creditable showing for a new organization. Within the past year an effort was made to infuse increasd life into the dealings by calling railroad stocks and other securities, but the plan failed, for the same reason that a larger business was not done in mining stocks—want of sufficient capital. At present there are two hundred members, and the market value of the seats is about two hundred dollars; this includes a certificate of stock in the Mutual Trust Company for $1,000. In April, 1882, Mr. Smiley was elected the first president of the Exchange. The officers now are: President, George W. Smiley; Chairman, John R. Mullany; Secretary, W. J. Osborn, and Recording Secretary, John Robb. Unlike the other Board, a record of the purchases and sales is kept, and read at the close of each call. Following is the Governing Committee. C. G. Wilson, Geo. W. Smiley, J. R. Mullany, W. J. Osborn, Samuel M. Blatchford, J. H. Gafney, O. C. Frost, R. M. Mitchill, Jr,, C. E. Orvis, W. S. Warner, R. F. Handy, J. R. LaTouviette, C. S. Sternberger, H. H. Marks, Thomas Marshall, W. E. Leavitt, H. W. Nichols, R. S. Masterton.

The By-Laws and rules and regulations governing the American Mining Stock Exchange are as follows:

BY-LAWS.

ARTICLE I.—*Title of Association.*—The title of this Association is the "American Mining Stock Exchange."

ARTICLE II.—*Membership.*—Sec. 1. All applications for membership shall be made to the Secretary of the Exchange, who shall refer the same to the Committee on Admissions.

The name of the applicant must be posted ten days before action can be taken by said committee.

Sec. 2. Every applicant for membership must be at least twenty-one years of age.

Sec. 3. When it shall appear to the majority of the Committee on Admission that a willful mis-statement upon a material point has been made to them by an applicant for admission or re-admission, they shall report the case to the "Governing Committee," who shall, by a two-thirds vote of the members present, deprive the offending party of his membership or declare him forever ineligible for admission, as the case may be.

Sec. 4. In every case where a member is deprived of his membership, or declared ineligible for readmission by the Governing Committee, by reason of any offense against or under the laws of the Exchange, his membership, in case there are any claims against the member, shall be disposed of forthwith by the Committee on Admissions, and after satisfying the claims of the members of the Stock Exchange and Mutual Trust Company, they shall pay any balance to said member or to his legal representatives.

In no case shall any transfer of membership be permitted until all dues to the Mutual Trust Company and to the Stock Exchange shall have been paid in full, said dues being hereby declared a prior lien upon the proceeds, to be satisfied in full before any distribution shall be made.

Sec. 5. When a member dies his membership may be disposed of by the Committee on Admissions by and with the consent of his legal representatives, and after satisfying the claims of the Trust Company and the members of the Stock Exchange, they shall pay any balance to the legal representatives of the deceased.

Sec. 6. Any member shall have the right to transfer his membership under the provision of Section 1, providing he has no uncanceled contracts with members of the Exchange or the Trust Company.

Sec. 7. All fees for admission and membership shall be paid to the Mutual Trust Company, and the name of an original member or a transferee shall not be placed on the Exchange Roll until such payment has been made.

ARTICLE III.—*Elections, Officers, etc.*—Sec. 1. The officers of the Exchange shall consist of a Chairman and Secretary, to be elected at their annual election.

Sec. 2. The whole internal government of the Exchange shall be vested in a Governing Committee consisting of twenty members, five of whom shall be elected annually, by ballot, on the second Monday of April in each year, to serve four years.

Sec. 3. In case any vacancy shall occur in the Governing Committee by resignation or otherwise it shall be filled by said Committee until the next annual election, when the Stock Exchange will fill the vacancy for the unexpired term.

Sec. 4. This committee shall have power to try all offenses under or against the laws of the Exchange and all charges against members, and their decision shall be final.

Sec. 5. The Governing Committee may, at any time during the pendency of a case before any of the Standing Committees, ask for such information and give such instructions as they may deem proper.

Sec. 6. Any member of a standing committee before which a case may be pending, shall have the right, during the consideration of such case, or within two days after a decision has been made thereon, to demand a reference of the same to the Governing Committee for final adjudication; and the Chairman of the standing committee shall notify the Chairman of the Governing Committee of such reference at the next regular meeting. No member of the Governing Committee shall participate in the adjudication of a case in which he is personally interested.

Sec. 7. The Chairman of the Governing Committee may call a meeting of said Committee at any time. He shall call a meeting at the request of five members of the Exchange. In the absence of the Chairman, any five members of the Governing Committee may call a meeting by written announcement from the rostrum.

Sec. 8. Any member of the Governing Committee who (except in case of illness or leave obtained from its presiding officer) shall absent himself from the regular meetings of the committee, shall pay a fine of $1, and if absent three consecutive regular meetings, shall, *ipso facto*, cease to be a member of the Governing Committee, and the vacancy so occurring shall be filled as provided in Article II. of the By-Laws.

ARTICLE IV.—*Standing Committees.*—Sec. 1. As speedily as possible after each annual election, the Governing Committee shall appoint from its own members the following standing committees for the year:

First. A Committee on Management and Arrangements, consisting of three members, to whom shall be referred the enforcement of all rules and regulations necessary to good order and the comfort of the members. They shall determine the number and duty of all employees other than the officers, and shall have a general supervision of all the departments of the Exchange.

Second. A Committee on Arbitration, consisting of five members, to whom shall be referred all claims and matters of difference between members of the Exchange, arising from transactions in stocks or other securities, or from any transactions in money. Provided, however, that the Arbitration Committee shall, on the application of either one of the parties, or at their discretion, have the power to dismiss the case and refer the parties to their legal remedy. They shall also adjudicate such claims arising from differences, as aforesaid, as may be preferred against members by non-members, when such non-member shall agree to abide by the rules of the American Mining Stock Exchange in such cases provided. (*Vide* Rules and Regulations, Art. XXV.) The decision of this Committee shall be final in all cases, unless an appeal be taken by a member of the committee, as provided in Section 2 of this article, or in cases involving a sum of $1,500 or over, when either party may appeal within ten days to the Governing Committee for a final adjudication.

The members of the Arbitration Committee present shall receive Five Dollars each for hearing a case that shall be heard and decided at one meeting. For all cases occupying the attention of the committee at more than one meeting, Ten Dollars. No compensation to be paid any member absent from the meetings of the committee. The losing party in all adjudicated cases to pay the expenses.

Third. A Committee on Admissions, consisting of five members, to whom shall be referred all new applications for membership, and also of suspended members for re-admission. But no application for admission or re-admission of a person who has ceased to be a member of the Exchange through violation of its By-laws or Rules and Regulations shall be referred to said committee unless he has first obtained the consent of two-thirds of the members of the Governing Committee present when such application is considered.

They shall determine the manner and form in which their proceedings shall be conducted. Two-thirds of the committee approving, the candidate shall be declared elected or re-elected to a membership in the Exchange.

The Chairman of the committee, after ratification by the Governing Committee, shall inform the presiding officer of the Exchange of the admission or re-admission of any applicant, and the said presiding officer shall announce the same to the Exchange.

It shall also be the duty of this committee to consider and dispose of all applications for the transfer of membership under Article XI. of the By-Laws of this Exchange.

Fourth. A Committee on Stock List and Securities, consisting of seven members, to whom shall be referred the arrangement of the calls of Stocks, Bonds, etc., and all the applications for placing Stocks, Bonds, etc., on the list dealt in at the Exchange.

They shall have referred to them for adjudication all disputed questions as to the regularity of Stock Certificates, Bonds, etc., dealt in at the Exchange.

Fifth. A Law Committee, consisting of three members.

Sec. 2. The action of all standing committees shall be final, unless some member of said committee should not concur in any decision made by any standing committee; then, and in that event, an appeal may be made in writing to the Governing Committee, excepting the Admission and Stock List Committee, whose action shall be reported to the Governing Committee for approval or disapproval.

ARTICLE V.—*Provision for the Families of Deceased Members.*—Every member of the American Mining Exchange shall be subject to the conditions, and entitled to partake of the benefits of the plan providing for the families of deceased members hereinafter set forth.

First. By and with the concurrence of the Mutual TrustCompany, an additional number of seats, not to exceed thirty, shall be sold for the sum of Two Hundred Dollars each, the proceeds of the same, after deducting the necessary expenses attending the sale of the said seats, shall be received by the Trustees of the Insurance and Gratuity Fund, and be deposited in the Mutual Trust Company to the credit of the Trustees of the Insurance and Gratuity Fund of the American Mining Exchange; the said funds, together with the annual interest and accretions arising from the same, and all fines that may be collected from members of the Exchange, all transfer fees, if any, and, in fact, any revenue that may be collected by said Trustees, to be invested from time to time by said Trustees, in accordance with the laws of the State of New York regulating trust funds.

Second. The management and distribution of the Insurance and Gratuity Fund, and the execution of the provisions of this article, shall be under the charge of a Board of Trustees, to be known as the Trustees of the Insurance and Gratuity Fund of the American Mining Exchange, and to consist of five members, the first three to serve one year, and the other two to serve two years, selected by the Governing Committte. In case of any vacancy occurring, the same shall be filled by the Governing Committee for the unexpired term.

Third. The said Trustees shall have power to adopt such by-laws as they may think proper, subject to the approval of the Governing Committee, and shall make an annual report to the Exchange of the condition of the fund, and shall, at any time when called upon by the Committee, make a report of condition of said fund to the Governing Committee.

Fourth. Upon the death of any member of the Exchange, there shall be levied and assessed against each surviving member the sum of Ten Dollars, which thereupon becomes a due from him to the Exchange, and charged against the membership of such surviving member, to be collected as other fines and dues are or may then be collected.

Fifth. The faith of the American Mining Exchange is hereby pledged to pay, within three months after proof of death of any member, out of the money so collected, the sum of Fifteen Hundred Dollars, or so much thereof as may have been collected, to the persons named in the next section, as therein provided, which money shall be paid as a gratuity from the surving members of the Exchange, free from all debts, charges or demands whatever.

Sixth. Should the member die leaving a widow and no children, then the whole sum shall be paid to such widow for her own use.

Should the member die leaving a widow and children, then one-half shall be paid to the widow for her separate use, and one-half to the children for their use, share and share alike; provided, that the share of minor children shall be paid their guardian, and that the issue of any deceased child shall be entitled to receive the share which said child would have received if living; if of age, directly, or if minors, through his, her or their guardian or guardians.

Should the member die leaving neither widow nor children, the whole sum shall be paid to the next of kin of the deceased.

In all cases a certified copy of the proceedings before a Surrogate or Judge of Probate shall be accepted as proof of the rights of the claimants, be deemed ample authority to the Exchange to pay over the money, shall protect the Exchange in so doing, and shall release the Exchange forever, from all further claim or liability whatsoever.

Seventh. Nothing herein contained shall ever be taken or construed as a joint liability of the Exchange or its members for the payment of any sum whatsoever; the liability of each member at law or in equity being limited to the payment of Ten Dollars only on the death of any other member, and the liability of the Exchange being limited to the payment of the sum of Fifteen Hundred dollars (or such part thereof as may be collected), after it shall have been collected from the members, and not otherwise.

Eighth. Nothing herein contained shall be construed as constituting any estate *in esse* which can be mortgaged or pledged for the payment of any debts; but it shall be construed as the solemn agreement of every member of the Exchange to make a voluntary gift to the family of each deceased member, and of the Exchange to collect and pay over to such family the said voluntary gift; it being understood and hereby expressly declared, that the provisions of this Article shall only be in force in, and apply to, cases of death which shall take place after its adoption.

Ninth. The provisions of this Article shall not extend to any member who shall have severed his connection with the Exchange by the transfer of his membership, whether the same is made voluntarily or involuntarily, nor to any member who now is, or hereafter may be, expelled by the Governing Committee.

Tenth. The membership of a deceased member from the date of his death until sold, shall be subject to the same assessments, under the provisions of this Article, as the memberships of the surviving members during that period.

Eleventh. Upon the death of any member, if more than Fifteen Hundred Dollars shall be called from the members by assessment of Ten Dollars on each survivor, then the surplus shall be added to the Insurance and Gratuity Fund and invested by the Trustees as before mentioned.

Twelfth. On and after November 1st, 1881, any one becoming a member of the American Mining Exchange by transfer shall pay to the Trustees of the Insurance and Gratuity Fund of the Exchange the sum of Twenty-Five Dollars before he shall be admitted to the privileges of membership, but this provision shall not apply in cases of sale or transfer of delinquent seats.

ARTICLE VI.—Sec. 1.—At 10 o'clock precisely the presiding officer shall announce from the rostrum that the Exchange is opened for the transaction of business, and it shall remain open for such purpose until 3 o'clock, P. M., when the presiding officer shall similarly announce it closed.

Sec. 2.—It shall be the duty of the Chairman to preside over the Exchange whenever it shall be assembled for business, and to remain in the chair during business hours, to call stocks, maintain order, enforce the rules, and perform such other duties as the Governing Committee may regard as properly pertaining to the office. In the absence of the Chairman, the members present may choose a Chairman *pro tem.*, with full powers.

The presiding officer shall determine all questions of order.

Duties of the Secretary.—Sec. 3.—It shall be the duty of the Secretary to keep complete minutes of the proceedings of the Exchange, and to take charge of the books and papers of the Association. He shall conduct the correspondence of the Exchange, and keep a record of the closing and opening of the transfer books for dividends, elections, etc., of the various corporations whose stocks are dealt in at the Exchange, the amount of such dividends, and when payable, and shall post the same on the bulletin board. He shall also keep a book containing the names of all the members, with date of admission, by purchase or otherwise, and all transfers of membership; also a list of suspended members.

ARTICLE VII.—*Suspended Members, Re-admission, Claims of Creditors, etc.*——Sec. 1.—Any member who fails to comply with his contracts, or who becomes insolvent, shall be suspended until he has settled with his creditors. Such member shall immediately inform the presiding officer, in writing, that he is unable to meet his engagements; and it shall be the duty of the presiding officer thereupon to give notice from the chair of the suspension of such member. The Secretary shall record the failure of such member in a book kept for that purpose.

In default of giving such information, the party, on application for re-admission, shall not be entitled to a reference of his case to the Committee on Admissions, unless two-thirds of the members of the Governing Committee present shall vote in favor of such reference.

Section 2.—When a suspended member applies for re-admission he shall be required to furnish to the Chairman of the Committee on Admissions a list of his creditors and a statement of the amounts owing, and the nature of his settlement in each case.

The committee shall give notice, for three consecutive days, through the presiding officer of the Stock Exchange, and by posting the same on the bulletin board provided for that purpose, of the time and place of meeting to consider the application of the suspended member and the claim of creditors. Upon the applicant presenting satisfactory proof of his settlement with all his creditors, the committee shall proceed to ballot for him in accordance with its prescribed rules and regulations. Failing of a re-election, the applicant shall be entitled to be balloted for at any five subsequent regular meetings of the committee, to be designed by himself. Provided, however, that the six ballotings to which the applicant shall be entitled shall be within one year from the time of his first application for readmission. If, after six ballotings, as aforesaid, the candidate is rejected, he may appeal, within sixty days thereafter, to the Governing Committee, whose action in the case shall be final.

The question on appeal, however, shall not be taken unless at least sixteen members of the Governing Committee are present, and it shall require an affirmative vote of at least thirteen members to reinstate the applicant.

If rejected by the Governing Committee, he shall cease to be a member of the American Mining Stock Exchange, and his name shall forthwith be stricken from the roll, and his membership shall be disposed of by the Committee on Admissions.

Section 3.—If any suspended member fails to settle with his creditors within one year from the time of his suspension, his membership shall be disposed of by the Committee on Admissions, and the proceeds paid, *pro rata*, to his creditors in the Trust Company and Exchange. The Governing Committee may, by a vote of two-thirds of the members present, extend the time for settlement of such suspended member.

No claims growing out of transactions between partners shall be admitted to share in the proceeds of the membership of one of such partners until after the claims filed by other creditors who are members of the Exchange shall have been satisfied.

Section 4.—Any creditor failing to file with the Secretary of the Committee on Admissions a written statement of his claim against a member, prior to the transfer of the right of membership of such member, shall forfeit all right to a distributive share of the proceeds of such membership.

Section 5.—No member of the Exchange shall be allowed to take as partner any suspended member thereof during the period of his suspension, or to form a partnership with any insolvent person, or with any person who may have previously been a member of the Exchange, and against whom any member may hold a claim arising out of transactions made during the time of such membership, and which has not been settled or released in accordance with the laws of the Exchange.

Section 6.—No claims made against members of this Exchange by others than the Trust Company and members of the Exchange shall be recognized, nor shall any cognizance of the same be taken unless the said claim is made on account of stock transactions made on the floor of the Exchange.

ARTICLE VIII.—*Elections, Quorum, Members of a Firm Voting, etc.* Section 1.—Any member of the Exchange in full standing shall be entitled to vote at an election for officers.

Section 2.—The members present at the daily sessions of the Exchange shall constitute a quorum for the settlement of disputes growing out of the purchases and sales made during such sessions.

When the Exchange shall be assembled to vote on questions other than the above a majority of all the members of the Exchange shall be necessary to a quorum.

Section 3.—But one member of a firm shall be allowed to transact business in the same security at the same time, or vote on the questions of dispute referred to in Section 2.

ARTICLE IX.—*Fictitious Sales, Bids and Offers.*—Section 1.—No fictitious sales shall be made. Any member contravening this section shall, upon conviction, be expelled.

Section 2.—Any member who shall make fictitious or trifling bids or offers shall, upon conviction, be subject to suspension or such other penalty as the Governing Committee shall impose.

ARTICLE X.—*Payments and Deliveries in Certain Cases to be Simultaneous.*—In all deliveries of stocks, bonds, etc., the party delivering shall have the right to require the purchase money to be paid at the time and place of delivery.

ARTICLE XI.—*Regulating Commissions.*—Sec. 1. The commission on Mining Stocks selling in the market shall be as follows:

Stocks selling under 50c. p. sh., com. 50c. p. 100 shs.
" at 50c p. sh. and under $1.00 com. $1 00 p. 100 shs.
" at $1.00 " " 2.00 " 2.00 "
" at 2.00 " " 5.00 " 3.00 "
" at 5.00 " " 10.00 " 5.00 "
" at 10.00 " " 20.00 " 6.25 "
" at 20.00 " and over, " 12.50 "

When one member merely buys or sells for another (giving up his principal on the day of the transaction), and does not receive or deliver the stock, his commission shall be one-half the above rates.

On all stocks selling at $1 and under, bids and offers must not be less than one cent apart.

On all stocks selling over $1 and under $5, bids and offers must not be less than five cents apart.

On all stocks selling above $5, bids and offers must not be less than one-eighth apart.

ARTICLE XII.—*Members Guilty of Obvious Fraud.*—Should any member be guilty of obvious fraud, of which the Governing Committee shall be the judge, he shall upon conviction thereof by a vote of two-thirds of the members of said committee present, be declared by the Chairman of the Exchange to be expelled and his membership shall be disposed of, and after paying all dues and claims due members and the Mutual Trust Company, the balance, if any, shall be paid to the expelled member or his representatives.

ARTICLE XIII.—*Obligation to Abide by the By-laws and Rules of the Exchange.*—Sec. 1. Any member reported to the Governing Committee for refusing to comply with the laws of the Exchange, or for any violation thereof, shall be allowed an opportunity of being heard before them; and if said committee decide that the complaint is proved, they shall inflict such penalty as may be prescribed by the By-laws or Rules and Regulations; or where no penalty is specified, such as they may deem proper, according to the gravity of the offense.

Sec. 2. No expulsion or suspension of a member shall affect the rights of creditors as hereinbefore provided.

ARTICLE XIV.—*Legal Interference with Officers or Committees.*—Any member of the American Mining Stock Exchange who shall himself, or whose partner or partners shall apply for an injunction or legal instrument restraining any officer or committee of the Trust Company or Exchange from performing his or its duties under the By-laws, shall by that act cease to be a member of the Exchange.

ARTICLE XV.—*Fee for Placing Mining Stocks on the Regular List.*—The fee for placing mining stocks on the list shall be deposited with the Mutual Trust Company when the application is made, and returned in case the same is not approved. All stocks remaining on the list over one year shall pay an annual fee of fifty dollars in advance.

The Exchange reserves the right to suspend the calling of any stock, at any time, by a two-thirds vote of the members present.

ARTICLE XVI.—*Dues and Fines.*—Section 1.—The dues of all members of the Exchange shall be $50 per annum, exclusive of fines, and shall be paid to the Mutual Trust Company quarterly, in advance, on the 1st days of May, August, November and February.

Section 2.—Any member who shall neglect to pay dues or fines for ten days after they become payable shall be suspended for twenty days; thereupon, after three days' notice by mail to his last registered address, he shall no longer be considered a member and his membership shall be forthwith disposed of by the Committee on Admissions, except in the case of non-residents, who shall have thirty days' notice.

Section 3.—All fines collected shall be placed to the credit of the Insurance and Gratuity Fund of the American Mining Exchange, subject to the control of Trustees elected by and from the Governing Committee.

ARTICLE XVIII.—These By-laws may be changed by the Governing Committee at any regular meeting, notice having been given in writing at least one meeting previously of the proposed change, subject, however, to ratification by the Mutual Trust Company of all matters affecting finances directly or indirectly, except such as relate to the Insurance and Gratuity Fund.

RULES AND REGULATIONS OF THE AMERICAN MINING STOCK EXCHANGE.—ARTICLE I.—*Hours of Business.*—Section 1.—The Exchange shall be opened for the entrance of members upon every business day, at ten minutes before ten o'clock, A. M.

At ten o'clock precisely the presiding officer shall announce from the rostrum that the Exchange is opened for the transaction of business, and it shall remain open for such purpose until three o'clock, P. M., when the presiding officer shall similarly announce it closed.

Dealings shall be limited throughout the entire year to the interval between the hours named, unless otherwise ordered by the Governing Committee, and a fine of fifty dollars for each offense shall be imposed upon any member who shall, directly or indirectly, make any transaction publicly in stocks or bonds before or after these hours in the Exchange or its vicinity.

Section 2.—The Exchange shall not be closed at any time between the hours above named, except by order of the Governing Committee. While so closed, the same penalty shall apply to dealings outside of the Exchange as during the regular time of closing.

ARTICLE II.—*Calls.*—Section 1.—The regular calls shall be at ten A. M., eleven A. M., twelve M. and 2 P. M., and the order of business at such regular calls shall be as follows, viz.:

1. Calling the regular list of stocks or bonds.
2. Calling stocks or bonds at the request of members.
3. Reverting to stocks or bonds at the request of members.

Section 2.—After the call, any security may be recalled once without a fine, and afterwards by the payment of a fine of twelve and one-half cents each time.

ARTICLE III.—*Bids and Offers.*—Section 1.—All offers made and accepted shall be binding; and in case there are two or more claimants for the purchase or sale, the presiding officer shall decide the same, or he may appeal to the Exchange for their decision.

Section 2.—In all offers to buy or sell, the offer shall be accompanied with some specific number of shares, and where no number is named, the bid or offer shall be considered to be for one hundred shares of stock.

Section 3.—Offers to buy or sell shall be entitled to the floor in the following order:

1. Bids, "seller three days," and offers to sell, "buyer three days," shall take precedence of cash and regular.
2. "Cash" and "regular" bids and offers may be made simultaneously, as being essentially different propositions.
3. Offers to buy or sell on longer options than three days may be made at the same time, with offers to buy or sell, "buyer or seller three."
4. In offers to buy on seller's option, or to sell on buyer's option, the longest option shall have precedence.

5. In offers to buy on buyer's option, or sell on seller's option, the shortest option shall have precedence.

No other bids or offers shall be permitted, or have any standing upon the floor.

Members violating the provisions of this section may be fined by the presiding officer, and on repeating or persisting in the offense, may be cited to appear before the Governing Committee, who may, in their discretion, suspend the offender for a period of not more than ten days.

Section 4.—No party to a contract shall be compelled to accept a principal other than the member offering to contract, unless the name proposed to be substituted shall be satisfactory, or shall be declared at the time of making the offer.

Section 5.—No sale of securities shall be made on which a deposit shall be offered as the limit of liability.

ARTICLE IV.—*Interest.*—Section 1.—No purchase or sale at the option of the buyer or seller, for three days, or "at three days," shall bear interest. All purchases and sales beyond that time shall be with interest, unless otherwise agreed.

Section 2.—In all time bargains, the rate of interest shall be six per cent. per annum, to be calculated by days, according to bank usage.

Section 3.—The accrued interest on all stocks and bonds shall go to the purchaser.

ARTICLE V.—*Applications to Place Stocks, etc., on the List.*—All applications for placing stocks on the list shall be made to the Committee on Stock List and Securities, who shall report on the same to the Governing Committee within ten days, with a full statement of capital, number of shares, resources, etc. No stock or bond shall be placed on the list of stocks called at the Board except by a vote of a majority of members of the Committee on Stock List and Securities present, or by order of the Governing Committee.

ARTICLE VI.—*Registry of Stocks.*—Section 1.—The Exchange will not call or deal in any active speculative stock of any company, a registry of whose stock is not kept in some responsible bank, trust company or other satisfactory agency, and which shall not give public notice, at the time of establishing such registry, of the number of shares so entrusted to be registered, and shall not give at least thirty days' notice through the newspapers, and in writing to the presiding officer of the Exchange, of any intended increase of the number of shares, either direct or through the issue of convertible bonds, and shall not at the same time give notice of the object for which such issue of stock or bonds is about to be made.

Section 2.—All certificates of California and Nevada mining stocks which are not registered and which have no transfer office in the city standing in the following names:

E. A. Richardson, *Trustee*, Bank of California, S. F.;
E. R. Grant, *Trustee*, Agency Bank of California, S. F.,
Nat. Stein, *Trustee*, Wells, Fargo & Co., S. F.;
H. B. Parsons, *Trustee*, Wells, Fargo & Co., N. Y.;
G. B. Bayley, *Trustee*, Nevada Bank, S. F.;
Jas. Coffin, Jr., Nevada Bank;
C. Minzesheimer & Co., *Trustees*, N. Y.;

which names can be verified at the respective agencies in New York, shall constitute and be considered a good delivery on this Exchange.

ARTICLE VII.—*Settlement of Contracts.*—Section 1.—All purchases and sales shall be settled for on the next business day, unless expressed to the contrary, and except in the cases referred to in the following section:

Section 2.—All contracts falling due on Sundays, or on such holidays as are observed by the banks, shall be settled on the preceding day.

But where two holidays occur on consecutive days, as where Sunday immediately precedes or follows a legal holiday, contracts falling due upon the first of such holidays shall be settled upon the business day immediately preceding; and those maturing upon the second of such holidays shall be settled upon the business day next following the same.

ARTICLE VIII.—*Hours for the Delivery of Securities.*—Section 1.—All deliveries of securities must be made before 2.15 o'clock, P. M.; and in cases where a broker fails to make his deliveries within fifteen minutes after that time, his contracts may be closed under the rule after due notice to him (the defaulting party), in the manner provided in Article XVII.

Section 2.—This rule shall apply to borrowed and loaned securities.

Section 3.—"Due notice" is hereby defined to be, a notice in writing delivered at the office of the broker, or if he has no office, then at the post-office, addressed to the address last given by him to the Secretary.

Section 4.—In case of borrowed and loaned securities, wherever notice is given to the borrower before 11.30 A. M. for the return of the stock, such stock must be delivered before 12.45 P. M. of the same day.

ARTICLE IX.—*Settlement of Disputes as to Purchase or Sale of Securities.*—Section 1.—In any disagreement between members, growing out of the purchase and sale of stocks, as soon as the same is ascertained if not settled by mutual agreement, the money difference shall be established forthwith by purchase or sale by an officer of the Exchange.

ARTICLE X.—*Contracts Maturing during closing of Transfer Books; Due Bills.*—All contracts in stocks falling due during the regular closing of the transfer books of any company, shall be settled at maturity by the delivery of a certificate and power of attorney, as defined in article XI.; and contracts, at the option of the buyer of seller, may be notified for settlement, as if the books were open; and in case the books are closed for a dividend, the party entitled thereto shall receive a due bill therefor, signed or endorsed by the seller or the stock; but the party entitled to the dividend shall have the right to require a deposit in a trust company, payable to the joint order of the purchaser and seller of the amount of each due bill.

ARTICLE XI.—*How Deliveries shall be made when Transfer Books are closed by legal Impediment.*—Whenever the transfer books of any company shall be closed by any legal impediment, so as to render their being open again uncertain, then the deliveries of stock of such company, in satisfaction of contract, shall be made by certificate, and power of attorney irrevocable, with notarial acknowledgment and seal, and containing assignment and bill of sale satisfactory to the recipients, or passed upon by the Committee on Stock List and Securities.

ARTICLE XII.—*Deliveries of Stock by Certificate and Power.*—Sec. 1. In the delivery of stock of which but one transfer in a day is allowed, the receiver shall have the option of receiving said stock by certificate and power irrevocable, in the name of, witnessed or guaranteed by a member of the Exchange, or a firm represented at the Exchange, resident or doing business in New York, or by transfer thereof.

Section 2.—In all transactions exceeding one hundred shares, where the delivery is by certificate and power, the purchaser shall have the right to require the delivery in certificates of not more than one hundred shares each.

Section 3.—Powers of attorney, or substitution, signed by Trustees, Guardians, Infants, Executors, Administrators or Attorneys, shall not be a good delivery.

Detached powers of Attorney, or substitution, must be attested by a notary public under seal.

ARTICLE XIII.—*Contracts.*—Section 1.—No contracts for the purchase or sale of securities beyond sixty days shall be made in the Exchange.

Section 2.—In all contracts on time over three days, made at the option of the buyer or seller, one day's notice shall be given before securities can be delivered or demanded, and such notice shall be given at or before two o'clock, P. M.

ARTICLE XIV.—*Dividends.*—Section 1.—On the day of closing the transfer books of any stock for a dividend, transactions in such stock for *cash* shall be "dividened on" up to the time officially designated for the closing of the books; all transactions other than for cash shall be "dividend off" after a quarter past two o'clock, P. M., or after the closing of the books, should they close before that hour.

Section 2.—When a dividend is declared on a security, during the pendency of a contract, the seller shall collect, hold, allow interest on, and pay the same to the buyer on the settlement of the contract.

Section 3.—Members may charge one per centum for collecting and paying dividends. But when a scrip or stock dividend has been declared by a company, the one per cent. shall be upon the market value, and not upon the par value, of the scrip or stock.

Section 4.—No offers to buy or sell dividends on stocks shall be made publicly at the Exchange.

ARTICLE XV.—*Payment and Transfer.*—In all sales of stocks, transferable in this city, either party shall have the right to require the purchase money to be paid at the time and place of transfer.

In the delivery of stocks not transferable in this city, the purchaser shall have the right to require the deposit of the purchase money in some local bank, to be agreed upon by the contracting parties, or named by the presiding officer of the Exchange; such money to be held in trust until official notification of the transfer shall have been received.

ARTICLE XVI.—*Mutual Deposits on Contracts.*—Section 1.—In any contract, either party may call, at any time during the continuance of the same, for a mutual deposit of twenty per cent. And whenever the market price of the securities shall change, so as to reduce the margin of said deposit either way below ten per cent., the party whose margin is so reduced shall, upon notice in writing, deposit sufficient to restore the margin to twenty per cent., and this may be repeated as often as the margin may be so reduced. Such additional marginal deposit to be made with the caller unless the payer shall elect to deposit with an agreed third party or with the Mutual Trust Company.

The seller of the stock may, if he so desire, deposit the stock sold called for by the contract, which shall be in full for all margins.

In all cases where deposits are called before two o'clock, P. M., they shall be made at or before two and a half o'clock, P. M., the same day. If called after two o'clock, P. M., they shall be made at or before eleven o'clock, A. M., of the following day.

Section 2.—In case either party shall fail to comply with a demand for a deposit, in accordance with the provisions of this article, the party calling, after having given due notice, may report the default to the presiding officer of the Exchange, who shall purchase or resell the security forthwith in the Exchange, and any difference that may accrue shall be paid over to the party entitled thereto.

Section 3.—Where there is a difference of opinion as regards the place of deposit, for the security of purchases and sales, the same shall be made in the Mutual Trust Company.

Section 4.—No assignment of any contract made between members of this Exchange will be recognized by the Exchange, except made by mutual consent endorsed on the memorandum of contract.

ARTICLE XVII.—*Default-Contract, Closing under the Rules.*—Section 1.—Should any member neglect to fulfil his contract on the day it becomes due, the party or parties contracting with him shall, after giving notice, as required by Section 2 of the preceding article, employ an officer of the Exchange to close the same forthwith in the Exchange, by purchase or sale, as the case may require, unless the price of settlement has been agreed upon by the contracting parties.

In case of a failure of a creditor to close the contract as above, the price shall be fixed by the price current at the time such contract ought to have been closed under the rule.

In all cases where an officer may be directed to buy or sell securities under this rule, the name of the member defaulting, as well as that of the member giving the order, shall be announced.

No order for the purchase or sale of securities, under this rule, shall be executed unless made out in writing over the signature of the party giving the order, who shall state the reason therefore; and it shall be the duty of the officer who executes the order to endorse thereon the name of the purchaser or seller, the price and the hour at which the contract is closed, and hand the same to the Secretary of the Exchange, who shall, within twenty-four hours, ascertain whether the party for whose account the order was given has paid the difference, if any, arising from the transaction. If not paid, the Secretary shall report the default to the presiding officer of the Exchange. The duty devolved upon the officers of the Exchange under this rule shall be performed without charge.

No party shall be permitted to supply offers to buy or sell securities closed for his account "under the rule."

When a contract is closed under this rule, any action of the defaulter, direct or indirect, by which the prompt fulfilment of such contract is delayed, hindered or evaded, to the detriment of the other contracting party, shall subject the offending party to suspension for not less than thirty days, or expulsion from the Exchange in the discretion of the Governing Committee, by a vote of two-thirds of the members present at a meeting.

When contracts are closed out under the rule, any member applying the bid or offer, and not duly receiving or delivering the stock, as the case may be, renders himself liable to prosecution under this article.

Should any stock thus sold not be delivered until the next day, the contract shall continue; but the party defaulting shall be liable to pay such damages as may be assessed by the Arbitration Committee.

Section 2.—The same rules as to notice, time and place that govern default in other contracts, shall apply to *borrowed* securities, which, on non-delivery or receipt, must be borrowed or loaned in open market, except in case of actual default in receiving or delivering after notice to close the loan; then the same are to be bought or sold, as the case may be, for account of the defaulter, in the manner provided in this article.

ARTICLE XVIII.—*Access to the Minutes.*—No person shall have access to the minutes of the Exchange except the members.

ARTICLE XIX.—*Communications Influencing the Market.*—No communications having a tendency to influence the market shall be read to the Exchange without the consent of the Chairman or presiding officer.

ARTICLE XX.—*Indecorous Language, Disorderly Conduct, etc.—Punishment.*—Section 1.—Any member who shall, during the session of the Exchange, use indecorous language to another member or who shall be guilty of conduct subversive of good order and decorum, or of any act or acts whereby the personal comfort or safety of other members is seriously interfered with, may be fined at the discretion of the presiding officer, in a sum not exceeding ten dollars.

Section 2.—Any member interrupting the presiding officer while calling stocks, by speaking, or otherwise, shall pay a fine of not less than twenty-five cents for each offense, at the discretion of the presiding officer, from which there shall be no appeal.

The levying of all fines shall rest exclusively with the presiding officer.

ARTICLE XXI.—*Special Meetings.—Ayes, Noes, etc.*—Section 1.—Except by unanimous consent, no business shall be transacted previous to the first call of stocks.

Section 2.—When any special meeting of the Exchange shall be appointed, the fine for non-attendance may, by a vote of two-thirds of the members present, be fixed at a sum not exceeding five dollars.

Section 3.—No notice will be taken of any resolution or resolutions, unless submitted in writing.

Section 4.—No member shall speak more than twice on any question under discussion by the Exchange, without permission from the presiding officer, nor shall any member interrupt another while speaking.

Section 5.—The presiding officer shall not participate in any discussion arising in the Exchange, while occupying the chair.

Section 6.—The ayes and noes shall not be called for upon any question, excepting at the request of one-fifth of the members of the Exchange present. When the ayes and noes are ordered, a ballot-box shall be placed on the Secretary's desk, and kept open for the reception of votes from 10.30 A. M. until 2 P. M. The vote shall be taken by the deposit of a ballot, endorsed by the member voting, and containing his vote, aye or no. Said ballot shall be placed on file in alphabetical order, and preserved for fifteen days. The votes shall be entered upon the roll, opposite to the names of the members who have voted, and such roll shall be placed on the Secretary's desk for the inspection of members.

ARTICLE XXII.—*Smoking Forbidden.*—Any member smoking in the business rooms of the Exchange, or any other part of the building where the Committee on Management and Arrangements may prohibit the same, shall be fined five dollars.

ARTICLE XXIII.—*Injuring Property of the Exchange Employees, etc.*—Section 1.—If a member injures or destroys the property of the Exchange, it shall be repaired or replaced under the direction of the Committee on Management and Arrangements, and the expense charged to such member, in addition to any fines which may be imposed by the presiding officer for the offense, under Article XX.

Section 2.—If any employee of the Exchange shall deface the building or injure the property of the Exchange, he shall be discharged forthwith; and if any employee of a member of the Exchange, or if any visitor or subscriber shall deface or destroy the property of the Exchange, or be guilty of rude or improper conduct, he shall be excluded from the rooms of the Exchange.

ARTICLE XXIV.—*Dealings with Non-Members.*—Any member of the Exchange dealing with a person not a member, in the rooms of the Exchange, shall be subject to suspension for not less than sixty days, nor more than twelve months.

ARTICLE XXV.—*Arbitration of Claims of Non-members.*—Any person shall have the right to bring a claim against a member of the Exchange before the Arbitration Committee, arising from transactions in bonds, stocks or other securities, on the conditions following, and not otherwise:

The person making such a claim shall execute a full release of his claim against said member, duly signed, sealed and stamped, and shall deliver the same to the Chairman of the Arbitration Committee, to be held in trust, to abide the event of the suit before the said committee.

FORM OF RELEASE.—*Know all Men by these Presents:* That I, ——————, for and in consideration of the sum of one dollar, to me in hand paid by——————, the receipt of which is hereby acknowledged, have remised, released and forever discharged, and by these presents I do hereby remise, release and forever discharge the said——————of and from any and all demands heretofore existing and due and owing to me, and the said——————is hereby fully released and discharged from the same.

Sealed with my seal, and dated at New York this————day of ————, 18—

The Chairman of the Arbitration Committee shall keep the said release in trust, to abide the result of said suit, and shall deliver the same to the defendant in either of the three following cases:

1st. In case the claimant shall not present his claim to the Arbitration Committee within twenty days after executing said release.

2d. In case judgment shall be rendered for said defendant by the Arbitration Committee.

3d. In case the defendant shall pay, or offer to pay, to such claimant the amount of judgment rendered in favor of said claimant.

In case judgment shall be rendered against any member of the Exchange which he is unable or unwilling to pay, then such release shall be cancelled and returned to such claimant.

ARTICLE XXVI.—*Regarding Suspension of Members and Legal Proceedings.*—In all cases where, and in accordance with the provisions of Article XXV., a judgment has been or shall be rendered against any member of the Exchange by the Exchange, such member shall, without further action of the Exchange, stand suspended from the time of the rendition of such judgment until the same is fully paid or satisfied, or tendered, or refused.

Whenever any creditor of a member of this Exchange, or any person asserting a claim against a member of this Exchange, has voluntarily or shall voluntarily resort to any legal tribunal, or has voluntarily instituted or shall voluntarily institute any legal proceedings against such member concerning his claim, such claim shall not be recognized or enforced by this Exchange.

ARTICLE XXVII.—*Assessments.*—In all sales of stocks, whether on time or for cash, the buyer shall pay any assessments levied and not delinquent at time of sale; provided, that the levying of such assessment by any company shall have been previously announced by the presiding officer in open Exchange; but no assessment, whether payable instanter or otherwise, shall be considered delinquent until *thirty* days from the day on which it is levied, excepting on California stocks, which shall become delinquent here fifteen days earlier than in California.

Where an assessment is levied on a stock and made payable monthly, or in different periods in installments, each payment shall be governed by this article, and become delinquent as follows: The first payment in thirty days from this levy; the second in thirty days from the day on which it is made payable; the third the same, and so on. The day on which an assessment is levied is not counted as one of the thirty days.

ARTICLE XXVIII.—*Limitations for Reclamation for Assessments of Stock.*—No reclamation for unpaid assessments upon stock sold by members of this Exchange, the transfer office of which is in this city, shall be allowed, unless the same is presented within five days from the date of delivery; and when the transfer office is out of the city, the demand must be made within twenty days from the date of delivery.

In the event of stock which has been sold for assessment being delivered in error, the broker receiving it shall be entitled, within five days from the date of delivery, to demand transferable stock in lieu thereof; and in case such demand is not made within five days, then the broker who delivered the stock may settle with him by returning the amount which he paid for the stock.

No reclamation for any stock delivered shall be made after the expiration of thirty days, if the transfer office is in the city; and not after sixty days if the transfer office is out of the city.

ARTICLE XXIX.—*Rescinded Assessments.*—On all time sales of stock, after an assessment becomes delinquent, and is thereafter rescinded, the buyer may, upon delivery, deduct the amount of said assessment from the contract price of said stock.

ARTICLE XXX.—*Black List.*—Each and every member shall report publicly to the Exchange the name of every person who shall violate his engagements with him as a broker, after employing him to execute business on commission, or who shall have refused satisfactory settlement of any contract made with or by said broker on his account; and it shall be the duty of the Secretary to keep a book for the purpose of registering the name of every person reported as a defaulter (together with his address), and the name of the broker who shall complain, there to remain until the debt that may have accrued through the medium of the member, in his capacity as a broker, be liquidated. So long as the name of said defaulter or defaulters continues registered upon the books of the Exchange, no member shall execute, or cause to be executed, any business for him or them, under pain of immediate suspension.

Suspended members who have not settled are subject to above penalties.

The stocks listed and called regularly at the American Mining Stock Exchange are as follows.

Advanced,	Eureka Cons.,	Nevada Syndicate,
Alice,	Empire, Utah,	Noonday,
Amie,	Enterprise Cons.,	Northern Belle,
Alta Montana,	Evening Star,	Ontario,
Barcelona,	Father de Smet,	Ophir,
Barbee & Walker,	Freeland,	Oriental & Miller,
Bassick,	Glass Pendery,	Quartz Creek,
Best & Belcher,	Great Eastern,	Red Elephant,
Bear Creek,	Goodshaw,	Retort M. & M. Co.,
Big Pittsburg,	Girard,	Rising Sun,
Black Jack,	Globe Copper,	Robinson Cons.,
Bodie,	Green Mountain,	State Line No. 1,
Bonanza Chief,	Gold Stripe,	State Line No. 2,
Bondholder,	Hale & Norcross,	State Line No. 3,
Boston Con.,	Harshaw,	State Line No. 4,
Bradshaw,	Hibernia,	State Line Nos. 1 & 4,
Breece,	Highland Chief,	State Line Nos. 2 & 3,
Bull Domingo,	Homestake,	Starr Grove,
Bulwer,	Horn Silver,	Standard Cons.,
Buckeye,	Hortense,	Silver Cliff,
Bye and Bye,	Hukill,	Silver Islet,
Calaveras,	Indian Q'n M. & M. Co.	Silver King,
California,	Index,	Sierra Nevada,
Carbonate Hill,	Iron Silver,	Stormont,
Central Arizona,	Leadville Cons.,	Sutro Tunnel,
Cons. Virginia,	Little Chief,	South Bulwer,
Columbia Cons.,	Little Pittsburg,	South Hite,
Con. Pacific,	Lucerne,	South Noonday,
Chapparal,	Mayflower,	South Pacific,
Climax,	Mexican,	Taylor-Plumas,
Crowell,	Miner Boy,	Tuscarora,
Cherokee,	Michoacan Syndicate,	Tombstone,
Chrysolite,	Mono,	Union Cons.,
Mo M Co,	Napa Quicksil'r M. Co.	Van De Water,
Dunderberg,	Decatur,	Virginia Cons.,
Dunkin,	Navajo,	Washington.
Durango,		

The Mining Stock Market.—Notwithstanding the prejudice that existed a few years ago among Eastern capitalists against all gold and silver mining enterprises, circumstances combined to aid the persons engaged in promoting the development of this great industry in bringing about a change in public sentiment two or three years ago, and it is not to be denied that that prejudice was very quickly and very thoroughly removed from the minds of a large number of the monied men of the country, and a more cordial and welcome support was extended to the mining business. Millions upon millions of dollars rapidly found their way not only from the bank accounts of wealthy capitalists and speculators, but, as is well known by those who are familiar with the inside history of the offices of the Eastern mining corporations, large amounts in the aggregate came from the old stockings and the little savings bank accounts of a much poorer class of people, who were induced by the wonderful stories that were told them to try their luck in this wheel of chance. But how has the confidence thus bestowed been requited? The history of the mining stock market in New York and other eastern cities for the past two or three years, is not what it might have been; is not what it should have been, and not what good judgment and shrewd business foresight on the part of a few leading operators would have made it. The practice of killing the goose in order to get possession of all the golden eggs at once has been repeated so often by persons who were intimately acquainted with the real condition of the bird and of its capabilities while living, that their course is wholly incomprehensible. Certain it is that better opportunities were never offered to business men in this country. The result of the course that was followed is shown by the present condition of the stock market at the mining stock exchanges in this city. The year 1880 opened full of promise. The possibilities of the future were not to be measured, but there were hosts of sanguine believers in a genuine "boom" that was to last for years. Persons who in the past could not have been induced to admit that they had ever seen a certificate of mining stock or gazed into the mysterious depths of a mining shaft, were found advocating earnestly the investment of hard-earned savings in mining shares; conservative bank presidents gave ear to the statements of the promoters and funds to the coffers of mining enterprises; mining stocks made rapid advances at the exchanges, and poor men became rich—on paper. Thus the gold and silver mines of the far west were suddenly transported to the Atlantic coast. Had the properties floated upon the eastern market been good dividend paying mines, and had the statements put forth in regard to them been within reasonable distance of the truth, all might have been well. Unfortunately both these conditions were wanting. The first shock to a market that was gaining day by day the confidence of the public came with the failure of Little Pittsburg. It had been a property paying very large dividends, but it had been grossly misrepresented and wilfully so, as was glaringly apparent at a later date to the suffering stockholders, who had bought at high figures the very stock of those who deceived them.

The development of the Little Pittsburg management was the first disclosure of a policy that seems to have been adopted by a few persons early in the introduction of mining properties to the eastern market, and since carried out with only the ordinary variations common to stock jobbery and with a persistency that is at once startling on account of its audacity, and marvelous when the cupidity of the public in furnishing the necessary assistance to its fulfilment is considered. The most serious result of this policy was not, however, the loss sustained in the purchase of the manipulated stocks at unreasonable prices, although this loss amounted to many millions of dollars. It was necessary to the complete success of the manipulations that the stocks should be listed on the mining stock exchanges and the numerous "deals" that have been made there during the past two years in the stocks of properties about which the most positive assurances from what appeared to be eminently trustworthy sources were given, as to their great value, none of which, however, were realized, and the disposition of all stocks, good and bad, to sympathize with the course of the market in its ups and downs, have led to the impression, which has become general, that there are no good stocks listed at the exchanges, or, at least, that it is unsafe to purchase stock so listed. The latter may be true, if the purchase is for speculation only, but it will not do to adopt such a rule, if mining stocks are to be bought for investment. The product of the mines, as shown elsewhere, many of which are listed on one or more of the stock exchanges of the country, furnishes the most positive confirmation of this statement. It is true, nevertheless, that the large transactions reported daily at the mining stock exchanges, consist principally of purchases and sales of non-dividend paying mines for speculative purposes. This is illustrated by the fact, which is cited only as an illustration, that the sales of the stock of the Standard mine of Bodie at the two New York exchanges last year were only 3,320 shares and the dividends paid amounted to $975,000; while the sales of the Amie were over 2,000,000 shares and it paid no dividend.

The total number of all stocks dealt in at the two New York exchanges last year, was 191 and the total number of shares reported sold was 43,027.426, but of this amount 28,-636,688 shares or more than 66 per cent. were divided among 24 stocks, leaving the business done in the remaining 167 stocks at only 14,390,738 shares, in no case in which were the aggregate sales for the year equal to 500,000 shares. The transactions in 12 stocks exceeded 1,040,000 shares each, and in four stocks, 2,000,000 shares each, while the sales of Robinson Consolidated amounted to over 3,178,000 shares. Of these 24 properties, only four paid dividends during the year to their stock holders, ($1,000,000) although the dividends paid during this year by companies whose stock were dealt in at the exchanges were about $9,000,000. The following table exhibits the closing price on December 31, 1880, the highest and lowest prices at which the stock sold during 1881, and the closing price on December 31, 1881, together with the number of shares of each stock sold during the year at the two New York Mining Exchanges of the 24 stocks above referred to:

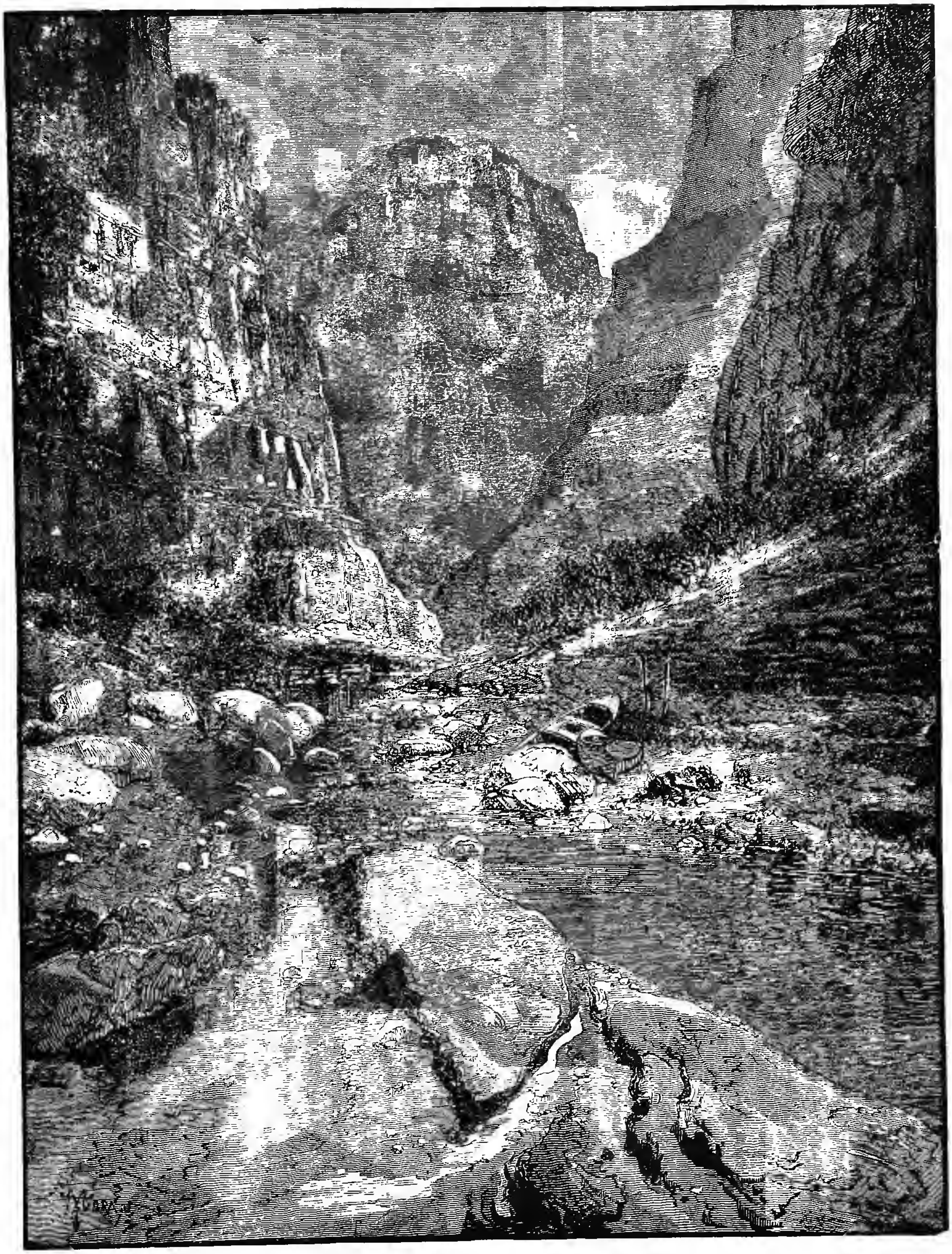
Name of Co.	*Closing.*	*Range of prices* 1881.			*No. shares sold.*
	1880.	*Highest.*	*Lowest.*	*Final.*	
Con. Virginia	2.00	3.30	.95	1.05	1,001,266
Oriental & Miller	. . .	4.50	.29	.35	2,037,605
State Line 1 & 4	. . .	3.95	.21	.27	1,294,380
State Line 2 & 3	. . .	14.00	.90	1.60	2,907,040
Vandewater	.51	.77	.23	.34	1,000,290
Amie	.50	.64	.12	.15	2,024,730
Chrysolite	5.50	8.88	3.50	4.00	609,387
Hibernia	1.50	1.80	.17	.25	1,131,211
Leadville Con.	.50	2.15	.44	.90	545,648
Little Chief	.82	2.60	.65	.88	751,034
Miner Boy	.69	2.00	.05	.11	1,561,460
Bald Mountain	.10	.12	.05	.05	645,950
Lacrosse	.28	.42	.21	.25	848,200
Moose	1.40	2.30	.25	.25	812,210
Robinson Con.	8.00	14.00	1 95	2.75	3,178,265
Boston Con.	.87	1.50	.02	.42	669,986
North Standard	.71	.60	.01	.02	631,390
Calaveras	.19	.27	.06	.06	657,173
Mineral Creek	.40	1.95	.05	.06	1,176,680
Silver Nugget, old	.12	1.30	.05	.05	898,200
Silver Nugget, new	.	1.25	.05	.11	528,331
Copper Knob	.08	.12	.05	.05	1,673,709
Crowell	.05	.35	.05	.05	1,090,150
Great Eastern	.23	.32	.07	.10	962,600
All other stocks					14,390,738
Total number shares sold in 1881					43,027,426
" " " " " 1880					20,012,825
Increase in 1881					23,014,601

During the early part of the year prices were pretty well maintained, as compared with final quotations of the preceding year, with a good demand for the better class of securities. The Leadville stocks were then the leading speculative fancies, and a wonderful future was predicted for them, especially for Hibernia. This was followed by a heavy decline in the prices of these stocks and subsequently by the listing in April of the State Lines and Oriental and Miller, which soon absorbed a large portion of the speculative transactions. It was undoubtedly due in a great measure to the remarkable manipulation of those stocks and the succeeding decline, that the mining stock market became so greatly unsettled during the latter part of the year. Stocks of all kinds, good and bad alike, steadily and persistently declined. This drooping of prices was further aided by the announcement that the Robinson Consolidated mine, of Leadville, was exhausted. The fluctuations in that and other stocks are indicated in the table given above. A large percentage of the business reported in the Robinson Consolidated stock was done during the latter part of the year after the damaging reports about the property began to be circulated. Assurances had been overwhelming that the stock was one of the safest on the list, when in November the manager of the mine telegraphed that there was neither money nor ore with which to pay the next dividend. At first it was believed by many stockholders to be a stock jobbing canard and the price actually advanced; but it soon became apparent that the telegram contained only the truth and only a part of that, and this was followed by a scramble to unload. The Comstocks were feverish and unsettled throughout the year, being affected by the repeated promises of a "boom" and although the promise was not fulfilled, the fluctuations were less violent and the declines not so marked as in many other stocks. The business at the exchanges throughout the year was well distributed, the smallest number of sales being in February and the largest number in December. The following table shows the number of shares sold at the two exchanges during each month of the year 1881:

January	3,277,800	July	2,932,384
February	2,782,209	August	3,645,194
March	4,105,241	September	2,890,220
April	4,125,022	October	3 591,245
May	4 020,501	November	3,550,705
June	3,536,365	December	4,570,540

The number of shares reported sold from month to month at the New York Board was nearly twice as large as the reported transactions at the American Board. The total transactions in all stocks dealt in at the two exchanges are shown by the following table which exhibits the closing prices on December 31, 1880, the highest and lowest prices at which the stocks sold during the past year, and the closing prices on December 31, 1881, together with the number of shares of each stock sold during the year at the two mining exchanges:

Name of Co.	*Closing Range of Prices in 1881.*						*Shares Sold.*
	1880.	*High.*	*Low.*	*Final.*	*Adv.*	*Dec.*	
Comstock Lode.							
Alta	. . .	7.50	2 00	4.75	. . .	. . .	700
Belcher	. . .	3.30	1.20	3.00	. . .	.	550
Best and Belcher	8.13	15.50	7.50	7.88	. . .	.25	25,925
California	1.55	1.70	.29	.32	. . .	1.23	417,137
Con. Virginia	2.00	3.30	.95	1.05	. .	.95	1,001,266
Crown Point	. . .	2.45	1.30	1.30	. .	. .	500
Gould and Curry	.	8.38	6.15	7.63	. .	. . .	1,400
Imperial	.17	.31	.06	.07	. . .	.10	308,712
Julia	. . .	.55	.55	.55	. . .	. .	200
Leviathan	. . .	.40	.01	.36	. . .	. . .	21,850
Mexican	6.13	14.50	4.90	9.89	3.76	. . .	28,795
Ophir	6.25	10.00	3.80	6.88	. . .	.37	33,680
Original Keystone	1.90	1.90	1.00	1.50	. . .	.40	8,925
Sierra Nevada	8.13	30.00	6.25	9.00	.87	. . .	58,031
Sutro Tunnel	1.35	2.60	.90	.96	. .	.39	392,550
Savage	. . .	4.35	1.90	1.90	. . .	. . .	6,550
Union Con.	10 38	20.00	6.50	14.75	4.37	. . .	50,532
Yellow Jacket	2.10	6.50	2.00	3.70	1.60	. . .	2,995
Tuscarora District.							
Belle Isle	.50	.80	.07	.15	. . .	35	40,275
Grand Prize	1.10	2.00	.07	.10	. . .	1.00	28,720
Independence	.25	.49	.10	.10	. .	.15	44,940
Navajo	1.15	4.00	.06	.17	. .	.98	183,140
North Belle Isle	.45	.57	.20	.30	. .	.15	33,500
Tuscarora	.29	.62	.03	.16	. . .	.13	143,050
Others in Nevada.							
Argenta	.35	.70	.10	.10	. . .	.25	8,900
Bullion	. . .	1.25	.65	1.25	. . .	. .	1,800
Barcelona	. . .	2.00	.16	.22	. . .	. . .	450,670
Eureka	21.00	35.50	10.88	12.25	. . .	8.75	34,416
Hale & Norcross	. . .	4.75	2.90	4.75	. . .	. . .	860
Kossuth	.10	.18	.10	.12	.02	. . .	3,300
Malachite	. . .	1.30	.25	.45	. . .	. . .	54,026
Martin White	. .	3.00	.40	3.00	. . .	. . .	2,425
Northern Belle	. .	21.60	8.00	8.60	. . .	. . .	24,160
Oriental & Miller	. . .	4.60	.29	.35	. . .	. . .	2,037,605
State Line 1 & 4	. . .	3.95	.21	.27	. . .	. . .	1,294,380
State Line 2 & 3	. . .	14.00	.90	1.60	. . .	. . .	2,907,040
State Line No. 1	. .	4.95	.05	.26	. .	. .	42,880
State Line No. 4	. .	3.90	.35	.35	. .	. . .	56,850
Potosi	. . .	4.05	2.25	4.05	. .	. . .	380
Vandewater	.51	.77	.23	.34	. .	.17	1,000,290
Nevada Syndicate	. . .	1.40	.96	.99	. .	. . .	28,530
Leadville District.							
Amie	.60	.64	.12	.15	. . .	.35	2,024,730
Big Pittsburg	. . .	4.70	.50	1.00	. . .	. . .	230,228
Breece	. . .	1.90	.68	.68	. . .	. . .	41,250
Chrysolite	5.50	8.88	3.50	4.00	. . .	1 50	609,387
Climax	.52	.80	.17	.21	. . .	.31	412,147
Dunkin	1.50	1.90	.38	.40	. . .	1.10	282,635
Glass Pendery	. . .	2.50	1.70	1.70	. .	. . .	159,250
Hibernia	1.50	1.80	.17	.25	. . .	1.25	1,131,211
Iron Silver	3.35	4.40	1.55	2.10	. . .	1.25	62,973
La Plata	9.25	9.38	6.00	9.38	.13	. . .	3,200
Leadville	.50	2.16	.44	.90	.40	. . .	545,648
Little Chief	.82	2.60	.65	.88	.06	. . .	751,034
Little Pittsburg	2.15	2.13	1.50	1.50	. . .	.65	8,329
Miner Boy	.60	2.00	.05	.11	. .	.58	1,561,460



WESTERN SCENERY—KANAB CAÑON—GRAND CAÑON DISTRICT.

SEE PART X.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

	Closing Range of Prices in 1881.						Shares Sold.
	1880.	High.	Low.	Final.	Adv.	Dec.	
Others in Colorado.							
American Flag	.24	.31	.04	.04		.20	128,500
Black Jack		1.55	.25	.27			126,990
Bald Mountain	.10	.12	.05	.05		.05	645,950
Baasick	12.00	13.00	.25	10.00		2.00	5,240
Boulder	.30	1.26	.03	.07		.23	418,400
Bull Domingo	3.40	4.20	.40	.43		2.97	339,825
Catalpa		2.95	1.00	1.00			34,200
Colorado Prince		1 20	.75	1.20			2,800
Crescent		1.85	1.00	1.00			26,200
Colorado Central		.71	.35	.35			8,160
Caribou		3.15	.20	2.25			4,220
Carbonate Hall		.48	.08	.22			54,400
Dunderberg		1.50	.60	.70			26,400
Freeland		2.00	1.70	1.95			900
Gold Placer	.41	.47	.37	.38		.03	53,050
Highland Chief		9.00	7.00	7.00			1,300
Hukill	1.46	1.65	.50	.63		.30	293,670
Hortense		.38	.10	.14			303,830
Head Centre		4 15	3.25	3.25			3,600
Lacrosse	.28	.42	.21	.25		.03	848,200
Lowland Chief		.33	.25	.29			3,000
Lucerne	.13	.17	.06	.06		.07	250,200
May Belle	.21	.28	.05	.05		.16	7,650
May Flower		.42	.05	.95			7,390
Moose	1.40	2.30	.25	.25		1.15	812,210
Moose Silver		2.50	.25	.70			12,420
Pay Rock		2.05	.75	1.60			78,300
N. Y. & Colorado		1.35	.30	.35			2,840
Red Elephant	.49	.50	.08	.10		.39	311,800
Robinson Con.	8.00	14.50	1.95	2.75		6.25	3,178,265
Silver Cliff	3.80	6.88	1.95	2.30		1.50	458,145
Unadilla	.11	.17	.06	.12	.01		410,300
Willshire	.96	1.60	.48	.48		.48	121,908
Bodie District.							
Bodie	5.38	10.63	2.00	2.75		2.62	64,657
Boston Con.	.87	1.50	.02	.42		.45	689,986
Bulwer	1.45	3.72	2.00	2.35	1.40		22,545
Bechtel	.90	1.90	.02	.40		.50	38,117
Con. Pacific	1.00	1.10	.05	.05		.95	232,601
Glyndale		.07	.06	.07			300
Goodshaw	.80	1.50	.20	.35		.45	155,894
Mono		2.75	1.65	1.65			1,465
North Standard	.71	.60	.01	.02		.69	631 390
South Bodie		.37	.15	.20			13,300
South Bulwer	.35	.51	.09	.16		.19	45,500
South Hite	.57	.60	.16	.35		.22	76,816
South Hite, new		1.35	.12	.12			409,725
Standard		26.25	18.00	19.25			3,320
Tioga	.54	.95	.05	.05		.49	39,870
Others in California.							
Auburn & Rock Creek	.17	.40	.11	.25	.08		1,200
Buckeye	.23	.28	.02	.03		.20	405,600
Calaveras	.19	.27	.06	.06		.13	657,173
Calaveras W. & M.		.75	.30	.30			12,620
Cherokee	1.65	2.30	.50	.32		1.33	218,940
Dardanelles		7.88	6.50	7.38			7,800
Excelsior		6.00	6.00	6.00			715
Gold Stripe	2.50	3.20	.14	.15		2.35	99,310
Green Mountain	4.95	7.38	1.90	2.10		2.85	160,625
Mariposa	.65	9.00	.60	3.35	2.70		89,330
Mariposa, pref.		9.88	1.00	4.50			25,825
Nana, Q. S.		5.00	5.00	5.00			1,100
Noonday		2. 0	.45	.45			5,890
Plumas	1.45	2.00	.10	.19		1.26	8,425
Quicksilver		12.88	12.88	12.83			100
Quicksilver, pref.		67.00	67.00	68.43			700
Rising Sun	1.95	3.10	.65	.65		1.30	124,130
Spring Valley	3.00	4.10	2.25	3.50	.50		25,630
Arizona.							
Bye and Bye		.60	.05	.05			432,500
Central Arizona		6.25	1.20	1.55			75,528
Empire		2.00	.47	.50			3,750
Globe Copper		2.65	1.10	1.45			13,600
Harshaw		15.50	9.30	15.50			300
Mineral Creek	.40	1.95	.05	.06		.34	1,176,680
Old Dominion		12.50	7.75	10.00			2,350
San Pedro		4.85	1.25	1.25			23,650
Silver King		23.13	13.75	19.25			3,110
Silver Nugget	.12	1.30	.05	.05		.07	898,200
Silver Nugget, new		1.25	.05	.11			528,331
Tip Top		6.00	2.00	4.00			14,270
Tombstone		6.00	3.35	4.45			4,875
Miscellaneous.							
Alice, Utah		8.63	2.80	3.00			55,680
Albion		4.00	1.75	3.50			9,400
Allouez, Mich.		3.85	2.75	3.15			2,330
Alta-Montana, Mont.	2.00	2.30	1.55	1.95		.05	260,945
Atlantic Copper, Mich.		17.50	17.00	17.50			200
American		.40	.40	.40			1,500
Battle Creek, Da.		2.75	.50	2.75			3,000
Bradshaw		3.00	.45	.64			295,000
Barbee & Walker, U.		4.00	1.50	2.25			7,600
Bondholder		.76	.89	.70			69,000
Bear Creek		.87	.20	.75			207,900
Bonanza Chief, Mon.		.37	.12	.08			134,600
Cosette, N. M.		2.75	1.25	2.75			22,600
Chapperal		.36	.08	.08			42,600
Cedar Tree		2.90	2.15	2.70			42,450
Clarence		2.00	.60	1.10			15,935
Caledonia, B. H., Da.		2.66	.50	.50			25,953
Cheyenne, Da.		20.00	.15	.20			122,660
Copper Knob, N. C.	.08	.12	.05	.05		.03	1,673,700
Copper Queen		6 88	6.50	6.50			1,850
Catskill		11.00	5.50	11.00			20,376
Crowell, N. C.	.05	.35	.05	.05			1,090,150
Calumet & Hecla, Mich.		248.60	216.00	216.00			415
Dahlonega, Ga.	.19	.11	.04	.04		.05	135,050
Durango, Ga.	.16	.20	.08	.08		.08	231,622
Father de Smet, Da.		14.50	7.00	7.00			3,485
Exchequer		1.46	.75	.90			16,645
Enterprise		.73	.31	.70			289,500
Exchange Silver		1.00	1.00	1.00			100
Findley, Ga.	.28	.40	.20	.30	.02		116,450
Granville N. C.	.06	1.08	.02	.02		.04	439,800
Great Eastern, Da.	.23	.32	.07	.10		.13	962,600
Homestake, Da.		28.75	14.76	16.50			1,225
Index		1.10	1.00	1.00			26,700
Horn Silver, Utah	12.50	18.00	9.00	17.00	4.50		70,579
Virginia Con.		2.90	1.50	2.85			40,750
North Horn Silver		2,50	.40	2.25			6,500
North Horn Silver, Pref.		2.50	1.50	2.25			3,000
Indian Queen		2.65	2.60	2.60			2,000
Leeds, Utah		.25	.20	.20			3,700
Legal Tender, Mon.		27.00	.67	2.20			114,700
Michoacan Syndicate		12.50	10.00	12.50			240
North State		.54	.10	.10			132,500
Ontario		39.00	33.50	32.50			445
Overman		2.10	2.00	2.10			450
Rappahannock, Va.	.2	.28	.13	.15	.03		318,650
South Pacific		14.63	3.00	4.25			318,250
Silver Islet, Can.		46.88	29.50	40.50			4,415
Sonora, Con.		.50	.75	.82			23,550
Seaton		2.30	2.30	2.30			400
St. Joe (lead,) Mo.		7.00	6.75	7.00			2,700
Stormont Utah		4.25	1.00	1.00			34,471
Starr-Grove, Utah		9.00	3.25	3.25			16 359
Taylor Plumas		.35	.06	.07			122,960
Tabor		1.00	.90	.92			19,800
Utah		9.00	7.25	7.25			100
Washington		1.20	.15	.15			51,900
Total							43,027,426

Considerable business has also been done in mining stocks at the old New York Stock Exchange, which is devoted principally, however, to dealings in railroad stocks and bonds, government, state, and other securities. An earnest effort was made to secure the listing of the leading mining stocks on that exchange, where, it was claimed, there was sufficient capital to insure a good business. Some of the old, conservative members of that exchange, nevertheless, always opposed the revival of dealings in mining stocks and the members of the New York Mining Stock Exchange, or at least those who were not members of the New York Stock Exchange, did not, of course, favor the movement, as it would necessarily interfere with the business of the Mining Exchange. Following the disastrous results of investments in Little Pittsburg, Leadville, Robinson Con., and, in fact, almost everything on the list, a mutual understanding was finally arrived at by which, while future transactions in mining stocks at the old New York Exchange were not forbidden, most of the orders now given to its members for the purchase and sale of mining stocks are executed at the New York Mining Board. When sales are made at the old exchange by persons who are not members of the mining exchange, the prices are necessarily about the same as those at the New York Mining Exchange. There are also occasional transactions in the stocks of coal companies at the New York Exchange, these stocks not being listed at the mining exchange.

The following table exhibits the closing prices in December, 1879 and 1880, the range of prices and closing quotations at which sales were made in 1881, together with the number of shares sold in 1881 of the mining stocks dealt in at the New York Stock Exchange:

	Closing Dec.		Range prices in 1881.		Closing Dec. 1881	No. Shares sold in 1881.
	1879	1880	Highest.	Lowest.		
American Coal	60⅛	50	63	60	62	1,900
Canton Coal	60	52	73¼	53	73¼	10,120
Col. Coal and Iron		36	67	35	42½	597,733
Consolidated Coal	33	36	45	31	37	18,347
Cumberland Coal	26½	23	40½	10	39¼	5,980
Cameron Coal			48⅜	25	32¾	214,411
Elk Lick Coal		45¼	39	39	39	2,000
Lehigh and Wilkesbarre		118¼				
Maryland Coal	25	24	34⅞	17¾	17¼	355,880
New Central Coal	34	29	29¾	18	21	45,365

	Closing Dec.		*Range prices in 1881.*		*Closing Dec. 1881.*	*No. shares sold in 1881.*
	1879	1880	*Highest.*	*Lowest.*		
Pennsylvania Coal	185½	215	254	240	245	767
Caribou	5½	2¼	4	2	02	16,250
Central	21½	4¾	7	1	1¾	407,467
Deadwood	...	12	14	4	4	6,586
Excelsior	25	6	7	½	½	21,121
Holmestake	39¼	29¾	29¼	14	14½	6,395
Little Pittsburg	28½	2	8¼	1½	1½	174,679
La Plata	5⅛	9	9	3½	9	400
Leadville	3⅛	1¾	30	30	30	200
Mariposa	4¾	3	9½	1	3	37,540
Mariposa, preferred	5½	3	9½	1¾	5½	8,733
Ontario	39⅞	33	38½	32½	34	6,160
Robinson Con.	...	...	13⅞	2	2⅛	125,697
Silver Cliff	...	2½	7	2⅛	2¾	56,431
Standard Con.	28	22¾	27	17¾	19¼	62,011
Stormont	...	2⅛	4	1⅜	2½	80,450
Sutro Tunnel	4	1⅝	2½	⅞	1	618,035
Quicksilver	20¾	14	21¼	12	13	98,565
Quicksilver, preferred	61¾	52	75½	58	59	97,266
Total number shares sold						3,076,489

The New York Stock Exchange—The whole government of the New York Stock Exchange is vested in a Governing Committee, composed of the president and treasurer of the Exchange and of forty members, one-fourth of whom are elected annually for four years. The members of the Governing Committee, together with the vice-president and secretary, are the officers of the Exchange. Various committees are appointed annually by the Governing Committee among which are the following: A Committee on Finance; Arrangements; Admissions; Securities (other than those of the United States Government), Government Securities; Stock List; Arbitration; Law; Printing; Commissions, and Insolvencies.

Every member must have a place of business in the vicinity of the Stock Exchange and other than the Stock Exchange where comparisons may be made at any time during the day, after the expiration of one hour from the time of the transaction, and where all notices may be served. Article XIV of the constitution provides for suspended members, re-admissions, claims of creditors, &c., as follows:

Section 1.—Any member who fails to comply with his contracts, or who becomes insolvent, shall be suspended until he has settled with his creditors. Such member shall immediately inform the President, in writing, that he is unable to meet his engagements; and it shall be the duty of the presiding officer thereupon to give notice, from the chair, of the suspension of such member. The Secretary shall record the failure of such member in a book kept for that purpose. In default of giving such information, the party, on application for re-admission, shall not be entitled to a reference of his case to the Committee on Admissions, unless two-thirds of the members of the Governing Committee present shall vote in favor of such reference.

Section 2.—When a suspended member applies for re-admission, he shall be required to furnish to the Chairman of the Committee on Admissions a list of his creditors and a statement of the amounts owing, and the nature of his settlement in each case. The Committee shall give notice, for three consecutive days, through the Presiding Officer of the Stock Exchange, and by posting the same on the bulletin-board provided for that purpose, of the time and place of meeting to consider the application of the suspended member and the claims of creditors. Upon the applicant presenting satisfactory proof of his settlement with all his creditors, the Committee shall proceed to ballot for him, in accordance with its prescribed rules and regulations. Failing of a re-election, the applicant shall be entitled to be balloted for at any five subsequent regular meetings of the Committee, to be designated by himself. Provided, however, that the six ballotings to which the applicant shall be entitled shall be within one year from the time of his first application for re-admission. If, after six ballotings, as aforesaid, the candidate is rejected, he may appeal, within sixty days thereafter, to the Governing Committee, whose action in the case shall be final.

If rejected by the Governing Committee, he shall cease to be a member of the New York Stock Exchange, and his name shall forthwith be stricken from the roll, and his membership shall be disposed of by the Committee on Admissions. The question, on appeal, however, shall not be taken unless at least thirty-five members of the Governing Committee are present, and it shall require an affirmative vote of at least twenty-nine members to reinstate the applicant. Whenever the Governing Committee shall determine upon the report of the Committee on Insolvencies, that the failure of a member has been caused by his doing business in a reckless and unbusiness-like manner, he may be declared ineligible for re-admission, by a majority vote of the entire Governing Committee.

Section 3.—If any suspended member fails to settle with his creditors within one year from the time of his suspension, his membership shall be disposed of by the Committee on Admissions, and the proceeds paid, *pro rata*, to his creditors in the Stock Exchange. The Governing Committee may, by a vote of two-thirds of the members present, extend the time for settlement of such suspended member.

No claims growing out of transactions between partners shall be admitted to share in the proceeds of the membership of one of such partners until after the claims filed by other creditors who are members of the Exchange shall have been satisfied.

Section 4.—Any creditor failing to file with the Secretary of the Committee on Admissions a written statement of his claim against a member, prior to the transfer of the right of membership of such member, shall forfeit all right to a distributive share of the proceeds of such membership.

Section 5.—No member of the Exchange shall be allowed to take as partner any suspended member thereof, during the period of his suspension, or to form a partnership with any insolvent person, or with any person who may have previously been a member of the Exchange, and against whom any member may hold a claim arising out of transactions made during the time of such membership, and which has not been settled or released in accordance with the rules of the Exchange.

The rate of commission that the members are required to charge persons or firms who are not members of the exchange, is ⅛ of one per cent. of the par value of stocks and bonds, bought or sold, and the constitution provides that "any member violating this article, directly or indirectly, shall, upon conviction, cease to be a member of the Stock Exchange, and his membership shall escheat to the Exchange."

Should any member be guilty of obvious fraud, of which the Governing Committee shall be the judge, he shall, upon conviction thereof by a vote of two-thirds of the members of said Committee present, be declared by the President to be expelled, and his membership shall escheat to the Exchange.

The Exchange is open from 10 o'clock A. M. to 3 P. M. on every business day between which hours dealings by members within the vicinity of the Exchange are limited. The by-laws provide that "all applications for placing securities on the regular or free list shall be made to the Committee on Stock List, who shall report the same to the Governing Committee, with a full statement of capital, number of shares, resources, &c."

The Stock Exchange will not call or deal in any active speculative stock of any company a registry of whose stock is not kept in some responsible bank, trust company, or other satisfactory agency, and which shall not give public notice at the time of establishing such registry of the number of shares so entrusted to be registered, and shall not give at least thirty days' notice through the newspapers, and in writing to the President of the Stock Exchange, of any intended increase of the number of shares, either direct or through the issue of convertible bonds, and shall not at the same time give notice of the object for which such issue of stock or bonds is about to be made. All delivery of securities must be made before 2·15 P. M., and where deliveries are not made by that time the contract may be closed under the rule; such notice must be given, however, by 2·30 P. M., and the contract must be closed without delay, unless the time is extended by mutual consent. The by-laws contain the following provisions respecting the deliveries of stock by certificate, the closing of transfer books, &c.:

In the delivery of stock of which but one transfer in a day is allowed, the receiver shall have the option of receiving said stock by certificate and power irrevocable, in the name of, witnessed or guaranteed by, a member of the Exchange, or a firm represented at the Exchange, or by *transfer* thereof.*

In all transactions exceeding one hundred shares, where the

* In the case of Powers of Attorney, or substitution, not executed, or witnessed by a member of the Exchange, or a firm represented at the Exchange, the endorsement of a member or such a firm is to be considered a guarantee of the correctness of the signature of the party executing the same.—*Resolution Gov. Com., May* 24, 1872.

delivery is by Certificate and Power, the purchaser shall have the right to require the delivery in Certificates of not more than one hundred shares each.

Powers of Attorney, or substitution, signed by Trustees, Guardians, Infants, Executors, Administrators or Attorneys, shall not be a good delivery. Detached Powers of Attorney, or substitution, must be attested by a Notary Public under seal.

Whenever the transfer-books of any company shall be closed by any legal impediment, so as to render their being open again uncertain, then the deliveries of Stock of such company, in satisfaction of contracts, shall be made by Certificate and Power of Attorney irrevocable, with notarial acknowledgment and seal, and containing Assignment and bill of sale, the papers to be satisfactory to the recipients or passed upon by the Committee on Securities.

Reclamations for irregularities in deliveries of Stocks or Bonds, when such irregularities do not affect their validity, but only currency in market, will not be considered unless made within ten days from the day of delivery.

All purchases and sales shall be settled for on the next business day, unless expressed to the contrary, and except in the cases referred to in the following section,

All contracts falling due on Sundays, or on such holidays as are observed by the Banks, shall be settled on the preceding day. But where two holidays occur on consecutive days, as where Sunday immediately precedes or follows a legal holiday—contracts falling due upon the first of such holidays shall be settled upon the business day immediately preceding, and those maturing upon the second of such holidays shall be settled upon the business day next following the same.

All contracts in Stocks falling due during the regular closing of the transfer-books of any Company, shall be settled at maturity by the delivery of a Certificate and Power of Attorney, as defined in Article IX, of the By-Laws; and contracts, at the option of the buyer or seller, may be notified for settlement, as if the books were open; and in case the books are closed for a dividend, the party entitled thereto shall receive a due-bill therefor, signed or endorsed by the seller of the stock; but the party entitled to the dividend shall have the right to require a deposit in a Trust Company, payable to the joint order of the purchaser and seller, of the amount of such due-bill.

No contracts for the purchase or sale of Securities beyond sixty days, shall be made in the Stock Exchange.

In all contracts on time over three days, made at the option of the buyer or seller, one day's notice shall be given before Securities can be delivered or demanded, and such notice shall be given at or before 2 o'clock, P. M.

In any contract, either party may call, at any time during the continuance of the same, for a mutual deposit of ten per cent. And whenever the market price of the Securities shall change, so as to reduce the margin of said deposit either way below five per cent., either party may call for a deposit sufficient to restore the margin to ten per cent., and this may be repeated as often as the margin may be so reduced. In all cases where deposits are called before 2 o'clock P. M., they shall be made at or before 2½ o'clock P. M., the same day. If called after 2 o'clock P. M., they shall be made at or before 11 o'clock A. M., on the following day.

In case either party shall fail to comply with a demand for a deposit, in accordance with the provisions of this article, the party calling, after having given due notice, may report the default to an Officer of the Exchange, who shall repurchase or resell the Security forthwith in the Exchange, and any difference that may accrue shall be paid over to the party entitled thereto This notice shall be either personal or shall be left in writing at the office of the party to be notified, or in case he has no office, then by public announcement whenever the Exchange may be in session. Where there is a difference of opinion as regards the place of deposit, for the security of purchases and sales, the same shall be made in the New York Life and Trust Company.

Should any member neglect to fulfill his contract on the day it becomes due, the party or parties contracting with him shall, after giving notice, as required by Section 2, of the preceding Article, employ an Officer of the Board to close the same forthwith in the Exchange by purchase or sale, as the case may require, unless the price of settlement has been agreed upon by the contracting parties. In case of a failure of a creditor to close the contract as above, the price shall be fixed by the price current at the time such contract ought to have been closed under the rule. In all cases where an Officer may be directed to buy or sell Securities under this rule, the name of the member defaulting, as well as that of the member giving the order, shall be announced.

Any member uniting, directly or by a partner, with any organization where Stocks, Bonds, &c,, are dealt in, shall cease to be a member of this Exchange. This rule shall not apply to the N. Y. Mining Stock Exchange while its transactions are limited to the class of Securities at present dealt in at that Exchange. Any member of the Exchange dealing with a person not a member, in the rooms of the Exchange, shall be subject to the penalty of suspension for not less than sixty days, nor more than twelve months.

No communications having a tendency to influence the market shall be read to the Exchange without the consent of the President or Presiding Officer.

No member shall introduce a stranger on the floor of the Exchange unless by permission of the President or Presiding Officer.

Following are the forms usually adopted by dealers in privileges:

"PUT."

NEW YORK, ... 18

FOR VALUE RECEIVED, the Bearer may DELIVER ME . . . . . . Shares of the . . . . Stock of the . . . . Company, at . . . . per cent., any time in . . . . days from date.

The undersigned is entitled to all dividends or extra dividends declared during the time.

Expires 18
. . . . M.

"CALL."

NEW YORK 18

FOR VALUE RECEIVED, the Bearer may CALL ON ME for . . . . Shares of the . . . . Stock of the . . . . Company, at . . . . per cent., at any time in . . . . days from date.

The bearer is entitled to all dividends or extra dividends declared during the time.

Expires 18
. . . . M.

"STRADDLE."

NEW YORK, ... 18

FOR VALUE RECEIVED, the Bearer may CALL on the undersigned for . . . . Shares of the . . . . at . . . . per cent., any time in . . . . days from date.

OR, THE BEARER MAY, at his option, DELIVER the same to the undersigned at . . . . per cent., any time within the time named.

ALL DIVIDENDS OR EXTRA DIVIDENDS declared during the time are to go with the stock in either case, and this instrument is to be surrendered upon the stock being either called or delivered.

Expires . . . .

The present officers of the New York Stock Exchange are—

President. F. N. Lawrence.	*Vice President.* F. K. Sturgis.
Chairman. James Mitchell.	*Vice Chairman.* Alexander Henriques.
Secretary. B. O. White.	*Treasurer.* D. C. Hays.

Bullion Production for 1882.—The following companies have reported for the first six months of this year the amount of bullion set opposite their names.

Mines.	*States.*	*Year from Jan. 1st., 1882.*
*Alice, G. S	Mont. .	$375,905
Alta-Montana, G	"	115,464
Barbee & Walker, S	Utah . .	52,906
Betty O'Neal, S	Nev .	34,893
*Black Bear, G	Cal . . .	15,650
Bodie, G. S	"	225,021
*Boston & Montana, G	Mont. .	135,039
*Caledonia, G	Dak . .	23,116
*Caribou, S	Colo . .	88,430
Central Arizona, S	Ariz . .	97,287
*Christy, S	Utah . .	133,606
*Chrysolite, S. L	Colo . .	255,372
*Cons. Bobtail, G	"	84,477
*Contention, S	Ariz . .	808,329
Crismon-Mammouth, G	Utah . .	54,729
*Custer, G. S	Idaho .	489,042
*Deadwood-Terra, G	Dak . .	328,851
*Derbec Blue Grav., G	Cal . . .	89,227

* Official.

Mines.	*States.*	*Year from Jan 1st, 1882.*
*Eureka Con., G. S. L.	Nev	558,870
Evening Star, S. L.	Colo	642,520
Father de Smet, G.	Dak	208,854
Girard, S	Ariz	90,964
Grand Central, S.	"	598,646
Head Center, S.	"	14,860
*Homestake, G.	Dak	602,656
Horn-Silver, S. L.	Utah	1,806,610
*Hope, G	Mont	113,110
Idaho, G	Cal	313,513
*Indian Queen, S.	Nev	97,966
Inyo Cons, G.	Cal	77,000
Ingersoll, S.	Ariz	90,000
Iron Silver, S	Colo	541,328
*Jocuista, S	Mex	‡301,600
*†Leeds, S	Utah	11,988
Little Pittsburg, S. L.	Colo	105,585
Manhattan, S	Nev	64,300
Morning Star, S. L.	Colo	333,126
Mount Diabolo, S.	Nev	179,445
Noonday, G	Cal	60,480
North Noonday, G.	"	61,992
Northern Belle, S	Nev	393,562
*‡Ontario, S. L.	Utah	1,380,059
Ophir, G. S	Nev	22,050
Pascoe, S	Utah	4,575
Robert E. Lee, S.	Colo	292,550
Savage, S	Nev	3,500
*Silver Bow, G. S.	Mont	124,654
Silver King, S.	Ariz	169 087
Standard, G	Cal	601,200
Star, S	Nev	33,772
Stormont, S	Utah	165,088
Syndicate, G	Cal	19,429
Tintic M. and M. Co.	Utah	26,534
*Tip Top, S	Ariz	174,383
*Tombstone, G. S.	"	‡590,286
Union Con., S.	Nev	217,623
Virginia, S	Ariz	143,200
Total amount of shipments to date		$14,603,318

* Official. † Net. ‡ Assay value. *G. Gold. S. Silver. L. Lead.*

The following companies have levied assessments and paid or declared dividends as indicated:

Name and Location of Company.	Shares. No. in 1000's	Shares. Par Value.	Assessments. Lev'd to date in 1000's.	Assessments. Date and amount per share of last.		Dividends. Total paid to date in 1000's.	Dividends. Date and amount per share of last.	
Ali e, Mon.	400	25	*	. . . .	. .	400	Dec. '81	10
Amie Con., Co.	500	10	*	. . . .	. .	305	May '80	10
Atlantic, Mich.	40	25		. . . .	. .	140	Feb. '82	2 00
Argenta, Ne.	100	100	175	Jun. '82	15	40	Feb. '80	20
Barbee and Walker, Ut.	100	10	*	. . . .	. .	60	Nov. '80	10
Bassick, Co.	100	100	*	. . . .	. .	25	Feb. '80	25
Belle Isle, Ne.	100	100	65	May '82	10	300	Dec. '79	25
Black Bear, Ca.	30	100	15	Sep. '79	50	865	Apl. '82	30
Belkner, Ne.	104	100	2510	Apl. '82	25	15307	Apl. '76	1 00
Bodie Cons., Ca.	100	100	125	Dec. '81	50	1200	Mar. '80	25
Boston and Mon, Mon.	200	10	. .	. . . .	. .	280	May '82	10
Breece, Co.	200	25	*	. . . .	. .	2	Feb. '80	1
Bulwer, Ca.	100	100	30	Dec. '77	50	90	July '82	10
California, Ne.	540	100	422	Jun. '82	10	31320	Dec. '79	60
Cal. and Hecla. Mich.	100	25	. .	. . . .	. .	21850	Aug. '82	1 00
Caribou, Con., Co.	100	10	*	. . . .	. .	60	Mar. '80	10
Carolina Q'n, N. C.	100	2	. .	. . . .	. .	4	July '82	02
Castle Creek, Id.	100	1	. .	. . . .	. .	6	July '82	3
Catalpa, Co.	300	10	*	. . . .	. .	180	May '81	20
Chrysolite, Co.	200	50	*	. . . .	. .	1600	Dec. '81	50
Climax, Co.	200	10	*	. . . .	. .	180	Aug. '80	30
Cons. G. Mg., Ga.	100	5	*	. . . .	. .	56	July '82	04
Cons. Va., Ne.	540	100	735	Jan. '82	30	42930	Aug. '80	50
Copper Queen, Ar.	250	10	*	. . . .	. .	375	July '82	40
Crown Point, Ne.	100	100	2673	Feb. '82	25	11588	Jan. '75	2 00
D'dw'd-Terra, Dk.	200	25	*	. . . .	. .	†740	July '82	15
Dunkin, Co	200	25	*	. . . .	. .	200	Jun. '81	7½
Eureka Cons., Ne.	50	100	100	May '76	1 00		July '82	25
Evening Star, Co.	60	10	*	. . . .	. .	1175	July '82	1 00
Excelsior, Ca.	100	100	300	Jan. '82	1 00	875	Oct. '80	25
Fa. de Smet, Dk.	100	100	. .	. . . .	. .	470	Aug. '82	20
Findley, Ga.	200	1	*	. . . .	. .	8	May '79	. .
Freeland, Co.	200	26	*	. . . .	. .	50	May '80	25
Glass-Pend., Co.	250	20	*	. . . .	. .	25	May '81	15
Gold Stripe, Ca.	150	10	*	. . . .	. .	76	July '81	15
Gold and Curry, Ne.	108	100	3422	May '82	50	3826	Oct. '70	. .
Grand Prize, Ne.	100	100	370	Jun. '82	20	460	Sept. '80	26
Great Eastern, Dk.	300	1	*	. . . .	. .	16	July '80	01
Gr. Mountain, Ca.	125	10	*	. . . .	. .	212	Nov. '80	7½
Hale and Nor., Ne.	112	100	3950	May '82	50	1598	Apl. '71	6 00
Hall-And's'n, N. S.	150	1	. .	. . . .	. .	7	Jan. '82	05
Hecla Con., Mon.	30	50	. .	. . . .	. .	342	Apl. '82	50
Hibernia, Co	300	26	*	. . . .	. .	180	July '81	40
Homestake, Dk.	100	100	200	Apl. '78	1 00	1512	July '82	40
Horn-Silver, Ut.	400	25	*	. . . .	. .	1400	Aug. '82	75
Hukill, Co.	200	5	*	. . . .	. .	210	Dec. '78	10
Indep., Ne.	100	100	185	Feb. '82	15	225	Sept. '79	25
In. Queen, Ne.	125	2	12	Nov. '79	10	350	July '82	05
Ioyo, Ca.	100	6	*	. . . .	. .	45	Apl. '82	05
Iron Silver, Co.	500	20	*	. . . .	. .	700	Jun. '82	20
Jocuista, Mex.	100	100	. .	. . . .	. .	350	May '82	1 50
La Plata, Co	200	10	*	. . . .	. .	550	July '82	10
Leadville C., Co.	400	10	*	. . . .	. .	210	Jun. '82	05
Leeds, Ut.	60	100	87	Jun. '82	50	78	Oct. '78	15
Little Chief, Co.	200	50	*	. . . .	. .	700	Aug. '80	50
Little Pitts., Co.	200	100	*	. . . .	. .	1350	Mar. '80	50
Martin White, Ne.	100	100	925	May '82	25	90	July '79	30
Moose, Co.	200	10	4	. . . .	. .	550	Mar. '78	25
Morning Star, Co.	100	10	. .	. . . .	. .	490	July '82	25
Navajo, Ne.	100	100	235	Mar. '82	20	25	Mar. '81	25
N. Y. and Colo., Col	50	20	. .	. . . .	. .	25	July '79	10
N'h'n Belle, Ne.	50	100	. .	. . . .	. .	2200	Apl. '82	50
N. Belle Isle, Ne.	100	100	40	July '82	15	30	Aug. '81	15
Ontario, Ut.	150	100	. .	. . . .	. .	4475	July '82	50
Ophir, Ne.	100	100	3294	Mar. '82	1 00	1595	Jan. '80	1 00
Osceola, Mich.	50	25	. .	. . . .	. .	710	July '82	1 00
Plumas, Ca.	100	10	*	. . . .	. .	151	July '79	8
Quicks. Pref., Ca.	43	100	. .	. . . .	. .	654	Jun. '82	6 00
" Com., Ca.	57	100	. .	. . . .	. .	151	Jun. '82	40
Quincy, Mich.	40	25	. .	. . . .	. .	3230	Aug. '82	5 00
Rising Sun, Ca.	150	5	*	. . . .	. .	52	May '81	7½
Robinson C., Co.	200	50	*	. . . .	. .	575	Nov. '81	50
Robt. E. Lee, Co.	500	500	. .	. . . .	. .	50	July '81	10
Savage, Ne.	112	100	5664	Jun. '82	50	4460	Jun. '69	3 00
Sierra Nev., Ne.	100	100	4950	May '82	1 00	102	Jan. '71	1 00
Silver King, Ar.	100	100	. .	. . . .	. .	1000	July '82	25
Silver King, Co.	500	2	. .	. . . .	. .	50	Aug. '81	10
Socorro, N. Mex.	2.5	100	. .	. . . .	. .	4	Mar. '82	¾
Spr'g Valley, Ca.	200	1	*	. . . .	. .	50	Jan. '81	25
Standard, Ca.	100	100	. .	. . . .	. .	3825	July '82	75
Starr-Grove, Ne.	200	10	*	. . . .	. .	160	Jun. '81	10
Stormont, Ut.	200	1	*	. . . .	. .	155	Nov. '81	05
St. Joseph, Mo.	100	10	*	. . . .	. .	350	Jun. '82	20
Tip Top, Ar.	100	100	170	Mar. '80	50	100	Nov. '81	20
Tombstone, Ar.	500	25	*	. . . .	. .	1350	Apl. '82	10
Vizina, Ar.	200	25	. .	. . . .	. .	140	Mar. '82	10
Yellow Jacket	120	100	5358	Feb. '82	1 00	2184	Aug. '71	2 50

* Non-assessable. † The Deadwood has previously paid.

Little more need be said of the mining stock market for the first six months of 1882, than that it was a continuation of the transactions of the preceding year. There were further heavy declines in nearly everything on the list, with very active trading in a few of the speculative favorites, the prices of which in some cases went practically out of sight. There were few new properties introduced, and with one or two exceptions the active business was confined to the manipulation of stocks listed prior to the first of last January. The total sales reported for the six months under review, reached the unprecedented figures of 28,211,052 shares, but of this business 20,262,838 shares were distributed among 29 stocks and over one-half the latter number among three stocks. The sales of State Line Nos. 2 and 3 alone were over 5,000,000 shares, and of South Pacific, over 4,000,000 shares, which is much the largest business in any single stock that has ever been reported for a whole year in the previous history of the mining exchanges. It must not be inferred, however, that these figures represent the purchases made for the public. Never before since the revival of dealings in mining securities on the eastern coast have the purchasers for investors and non-professional speculators, been as light as during the past six months. There were many sales of some of the active stocks made for the account of deluded investors who listened to the flattering reports that were circulated about those properties during the past year, and, by their purchases then, furnished the promoters of those gigantic swindles with an opportunity to market their stocks at high figures, but the purchases at the reduced quotations have been made principally by the professional manipulators. A large percentage of the reported transactions is also to be credited to "washed" sales, or dealings between brokers for the purpose of advancing or forcing down prices, without holding each other responsible for the differences thus established.

Perhaps the best history of the market is furnished by giving the course of prices of a few of the most active stocks, for the rest, good and bad alike, followed those leaders, nor was it possible in many cases to arrest the downward tendency of the stocks of the old and regular dividend paying properties. The State Lines which played a very active part in the market during a considerable portion of 1881, were still prominent, especially Nos. 2 and 3, at the opening of the current year. After closing last year at $1.70, Nos. 2 and 3 by the middle of February was down to 66 cents from which there was a slight rally, and it did not break again below 65 until the latter part of March when it sold at 58 cents, and on April 1st, at 50 cents and the next day at 39 cents. Again it rallied to 69 and then 71, and with sales for the month of over 1,700,000 shares it hovered between 60 and 70 cents until April 24th, when the quotations were 64 @ 39 @ 43 cents with sales of 152,000 shares for the day; before the month closed it touched 32 cents, and on April 1st, 29 cents. It then took another stand at 30@33 cents until May 19th, when it sold at 22 cents. Another drop came on May 26th, when it fell to 18 cents. On June 4th it touched its lowest price—13 cents, and it has since rallied to 34 cents and closed on June 30th at 30 cents. It was the evident policy of the manipulators of this stock, instead of letting it down gradually to force it lower suddenly, a step at a time, and then furnish the support necessary to hold it there long enough to induce, if possible, the unwary fish to bite again, in the hope of recovering some of that which had been lost. It is not probable, however, that they were ordinarily successful in their operations. State Line Nos. 1 and 4 followed closely in the wake of Nos. 2 and 3, but reached its lowest point—05 cents—in the latter part of May, and has since sold at 15 cents, closing at 10 cents.

Another wild speculative stock has been South Pacific which closed last year at $4.25, and during the early part of 1882, was marked up to $8.25. The stock was extremely feverish, undergoing wide fluctuations from day to day, and by the middle of February was selling at $2.45; it did not go below $2.35 until March 14, when the quotation was $2 35 @ $1.30, and on the day following it fell to $1.00. After selling at 98 cents, it rallied by the close of the month to $1.45, but early in April it fell back again to 99 cents, and was tolerably, or at least comparatively, steady at about $1.00 until April 19, when it sold at $1.05 @ 70 cents. At this decline it again halted until May 3, when the transactions were reported at 65 @ 20 cents, from which it fell later to 07 cents, and closed at 09 cents on June 30. The sales for the six months were over 4,000,000 shares. It is not known that the stock has any intrinsic value.

Robinson Con., which proved to be an unusual disappointment to a great many people last year, including some prominent members of the old New York Stock Exchange, took an upward turn during the latter part of February, advancing to $3.65, and on March 6 it sold at $4.50, from which it declined spasmodically, having frequent, sudden fluctuations, until on May 31, it was down to $1.05, and on June 4, to 84 cents. It has since fluctuated between the price last mentioned and $1.05. Moose has served on several occasions as the tool of stock-brokers in manipulating a "corner." In March and April it advanced from 95 cents to $1.80. On May 7 it touched $2.00, and then stood at $1.90 @ 2.00, until May 11, when it sold at $2.85, and at 50 cents, closing at 60 cents. The "corner" was broken, and, also, as it subsequently proved, the leading operator in the stock. On May 12 it sold at 80 @ 28 cents, and it has been dull since that time, and as low as 11 cts., but closed at 20 cents. Moose Silver fell from 30 cents to 01 cent on May 11, and has since recovered to 30 cents. North State has gone out of sight, declining to 01 cent in May, and passing June without sales, but the reported transactions for the last six months foot up 243,300 shares, and during that time the stock sold at 14 cents; last year it was as high as 54 cents.

Among the more recent fancies are Decatur, Quartz Creek and Navajo. The stock last mentioned was dull until about the middle of March, when it sold at 18 cents. On March 28 it was up to 57 cents, and on March 30 to $1.10. It then went back suddenly to 65 cents, and remained dull again between that price and $1.00, until the latter part of April, when it rose quickly to $2.00, and for some time was extremely feverish between $1.35 and $2.00. On May 18 it sold at 2.45, from which it persistently advanced to $4.75, at which it sold on June 29, and at $4.20 on June 30. The sales have not been as large as of some of the other prominent stocks, amounting only to 118,110 shares; Decatur took its position on the stock board in March, selling at 90 cents, from which it rose to $2.50, by June 6, but two days later it was selling again as low as 60 cents, and most of the time since that date it has fluctuated between $1.00 and 90 cents. The dealings in Quartz Creek have been confined to the American board, where it sold in February and March at 20 @ 15 cents. It then took an upward course under the influence of unadulterated manipulation, reaching 50 cents by May 18, and 85 cents on June 11; it has since sold at 50 cents and at 65 cents; during May and June the reported transactions amounted to 285,000 shares.

As an illustration of how little business has been done in the stocks of the strong dividend paying mines that are known to be A1, it is only necessary to cite the sales of Ontario, which, for the six months under review, were 60 shares at an advance of 25 cents; Standard, 5,400 shares, during which the price declined from $19,25 to $13.50, following the stoppage of the works for a short time for repairs. The regular dividend was not stopped, however, and the stock closed at $18.50, a net decline of 50 cents; Copper Queen, 400 shares at $6.50 @ 5.25, closing at $5.50, a decline of $1.00, and La Plata, 50 shares at $10.00, a gain of 62 cents. With a very few exceptions the lowest prices were reached in May or the early part of June, since which time, if there was any life left in the stock, there has been an apparently healthy improvement. For the last two or three weeks in June, brokers report more inquiry from the public, and there is something more than a faint hope that the "bottom" has been reached. During the past six months the dealings at the mining exchanges have been confined to 156 stocks against 191 stocks traded in last year. A few stocks are now in the list that were not there at the close of 1881, and a number of stocks included in last year's list have been dropped. Of the 156 stocks referred to 105 show declines, as compared with December 31, 1881, ranging from .01 cent to $41.66, and 38 stocks are higher than they were six months ago, the greatest advance being $3.63. Taking the past six months, the largest business was done in May and the smallest in January.

A comprehensive idea of the market may be obtained from the following table, showing the closing prices at which sales were made last year, the highest, lowest and final prices for the first six months of the current year, the advances or declines, and the number of shares reported sold of each stock dealt in during those six months:

	Final sale 1881.	RANGE OF PRICES. *Jan. 1, to July 1, 1882*			*Changes six months, ending July 1.*	*No. shares Sold.*
		Highest.	*Lowest.*	*Final sale.*		
Advance	. . .	.59	.45	.57	. . .	78,200
Albion	3.50	3.00	1.70	1.70	—1.80	2,740
Alice	3.00	3.35	2.25	2.50	— .50	39,785
Allouez	3.15	3.55	3.00	3.00	— .15	1,100
Alpha	. . .	1.15	1.15	1 15		100
Alta Montana	1.95	1.95	.58	.58	—1.37	84,890
Amie	.15	.40	.16	.20	+ .05	1,492,505
American Flag	.04	.12	.04	.05	+ .01	2,900
Argenta	.10	.25	.10	.12	+ .02	1,800
Bald Mountain	.05	.10	.01	.01	— .04	18,800
Barbee & Walker	2.25	2.00	.10	.20	—2.05	300
Barcelona	.22	.23	.06	.08	— .14	350,800
Bassick	10.00	7.50	5.00	7.50	—2.50	100
Bear Creek	.75	.60	.60	.60	— .15	1,300
Beauce	. . .	2.00	1.20	1.45		58,120
Bechtel	.40	.57	.20	.20	— .20	1,100
Belcher	3.00	1.50	.49	.49	—2.51	750
Belle Isle	.15	.70	.04	.70	+ .55	18,120
Belvidere	. . .	.44	.12	.12		7,500
Best & Belcher	7.88	7.75	3.25	5 00	—2.88	23,110
Big Pittsburg	1.00	1.10	.55	.55	— .45	32,750
Black Jack	.27	.30	.24	.30	+ .03	2,200
Bodie	2.75	8.00	2.25	4.88	+2.13	29,740
Bonanza Chief	.08	.36	.03	.03	— .05	28,100
Bondholder	.70	.09	.02	.05	— .65	1,000
Boston Con.	.42	.51	.01	.23	— .19	188,330
Boulder Con.	.07	.07	.01	.01	— .06	80,080
Bradshaw	.64	.68	.07	.07	— .57	183,600
Breece	.68	.33	.25	.25	— .43	7,700
Buckeye	.03	.16	.02	.03	0	143,683
Bull Domingo	.43	.46	.09	.13	— .30	32,155
Bullion	1.25	1.00	.75	.85	— .40	500
Bulwer	2.85	2.95	1.70	1.90	— .95	19,075
Bye & Bye	.05	.12	.02	.02	— .03	86,300
Calaveras	.06	.15	.14	.09	+ .03	65,460
Calaveras, W & M.	.30	.60	.24	.27	— .03	38,400
Caledonia, B. H.	.50	1.25	.40	.55	+ .05	25,540
California	.32	.43	.05	.14	— .18	267,900

	Final Sale 1880.	RANGE OF PRICES. Jan. 1, to July 1, 1882. Highest.	Lowest.	Final Sale.	Changes six months, ending July 1.	No. shares sold.
California, W. & M. Co. .	. .	.48	.45	.45		2,300
Carbonate Hill	.22	.85	.20	.76	+ .54	35,243
Catskill	11.00	6.00	6.00	6.00	—5.00	100
Central Arizona . .	1.55	1.60	.48	.80	— .75	99,475
Chapparal	.08	.07	.02	.06	— .02	424,500
Cherokee .	.32	.56	.19	.28	— .04	102,345
Cheyenne . .	.20	.05	.05	.05	— .15	500
Chrysolite .	4.00	6.38	2.90	3.60	— .40	279,916
Clarence . . .	1.10	1.60	.03	.04	—1.06	50,128
Climax	.22	.45	.19	.21	— .01	106,450
Con. Pacific . .	.05	.45	.03	.35	+ .30	10,400
Con. Pay Rock .	1.60	.50	.20	.20	—1.40	2,272
Con. Virginia . . .	1.05	1.25	.28	.45	— .60	298,822
Copper Knob . . .	.05	.03	.01	.02	— .03	325,850
Copper Queen . .	6.50	6 50	5.25	5.50	—1.00	400
Crowell	.05	.20	.05	.07	+ .02	165,350
Crown Imperial . .		.05	.05	.05		1,000
Dahlonega . . .	.04	.08	.02	.02	— .02	44,900
Decatur . .	. .	2.50	.60	.91		118,620
Dunderberg .	.70	.76	.42	.50	— .20	6,500
Dunkin . .	.40	1.15	.30	.35	— .05	117,457
Durango . . .	.08	.56	05	.12	+ .04	602,700
Empire	.50	2.00	.98	1.35	+ .85	24,800
Enterprise Con. .	.70	1.25	.60	.97	+ .27	272,000
Eureka	12.25	24.00	11.75	15.00	+2.75	3,500
Father de Smet .	7.00	7.00	5.00	6.00	—1.00	3,305
Findley . . .	.30	.26	.11	.11	— .19	9,800
Freeland	1.95	.85	.85	.85	—1.10	100
Globe Copper . . .	1.45	[illegible]	.10	.23	—1.22	213,300
Gold Placer . . .	.38	.47	.30	.30	— .08	2,100
Gold Stripe	.15	.48	.15	.40	+ .25	55,500
Goodshaw	.35	.80	.15	.15	— .20	49,550
Gould & Curry . .	7.63	3.50	2.00	2.00	—5.63	310
Grand Prize	.10	.30	.05	.25	+ .15	2,900
Granville	.02	.04	.02	.02	0	56,200
Great Eastern	.10	.10	.03	.05	— .05	171,933
Green Mountain .	2.10	2.65	1.35	2.30	+ .20	106,780
Hale & Norcross .	4,75	1.13	.95	1.13	—3.62	1,130
Harshaw	15.50	3.35	2.25	2.25	—13.25	12,700
Hibernia	.25	.27	.06	.10	— .15	352,080
Highland Chief .	7.00	1.75	1.40	1.40	—5.60	600
Homestake . .	15 50	20.00	14.75	17.88	+2.38	1,010
Horn Silver	17.00	17.75	9.25	10.00	—7.00	56,932
Hortense . . .	.14	.30	.12	.17	+ .03	24,900
Hukill	.65	.75	.34	.40	— .25	34,670
Imperial . . .	.07	.15	.01	.03	— .04	50,050
Independence .	.10	.45	.01	.35	+ .25	14,150
Index	1.10	.51	.48	.48	— .62	300
Iron Silver . . .	2.10	2.55	1.95	2.00	— .10	153,733
Lacrosse. . .	.25	.30	.09	.15	— .10	31,000
Leadville	.90	.90	.50	.70	— .20	36,731
Little Chief	.88	1.15	.50	.60	— .28	212,368
La Plata	9.38	10.00	10.00	10.00	+ .62	50
Little Pittsburg .	1.50	2.55	1.25	1.45	— .05	30,807
Lucerne .	.06	.06	.03	.03	— .03	3,700
Mariposa	3.35	3.25	.06	1.50	—1.85	13,286
Mariposa, preferred	4.50	2.50	.40	.50	—4.00	3,175
Martin White .	3.00	7.00	2.10	6.63	+3.63	865
May Belle	.05	.24	.10	.10	+ .05	800
May Flower . .	.95	.24	.10	.10	— .85	23,200
Mexican	9.88	12.00	5.00	6.50	—3.38	15,895
Michoacan Synd. .	12.50	12.50	12.38	12.38	— .12	200
Miner Boy . .	11	.10	.03	.04	— .07	521,760
Mineral Creek . . .	.06	.06	.01	.02	— .04	319,600
Mono	1.65	2.00	1.30	1.50	— .15	1,150
Moose . . .	.25	2.85	.11	.20	— .05	296,446
Moose Silver	.70	.30	.01	.15	— .55	6,600
Navajo . . .	.17	4.75	.16	4.20	+ .03	118,810
Noonday	.45	1.60	.25	1.13	+ .68	5,200
Northern Belle	8.50	12.63	6.00	10.00	+1.50	15,826
North Belle Isle .	.30	.35	.15	.30	0	4,495
North Standard .	.02	.30	.10	.20	+ .18	24,600
North State . .	.10	.14	.01	.01	— .09	243,300
Ontario	33.50	35.75	33.75	33.75	+ .25	60
Ophir	5.88	7.88	2.25	3.38	—2.50	1,150
Overman	2.10	.75	.75	.75	—1.35	10
Oriental & Miller .	.35	.40	.14	.31	— .04	540,455
Plumas	.19	.25	.05	.05	— .15	2,000
Potosi	4.05	.70	.70	.70	—3.35	200
Quartz Creek	. .	.85	.15	.65		383,200
Quick Silver	12.88	14.25	8.75	13.00	+ .12	11,300
Quick Silver, preferred .	66.63	62.00	25.00	25.00	—41.66	1,300
Rappahannock . . .	.15	.43	.16	.18	+ .03	171,090
Red Elephant	.10	.19	.09	.11	+ .01	28,525
Retort	. . .	.90	.75	.90		9,800
Rising Sun	.65	.71	.20	.71	+ .06	115,320
Robinson Con.	2.75	4.05	.84	1.05	—1 80	967,700
Savage	1.00	1.75	.78	1.25	— .65	1,090
Sierra Nevada . . .	9.00	10.00	4.05	6.75	—2 25	37,357
Silver Cliff	2.30	2.80	.32	.52	—1.78	74,620
Silver King	19.25	20.00	15.00	15 25	—4.00	1,750
Silver Nugget . . .	.11	.11	.05	.06	— .05	229,525
Sonora Con. . .	.32	1.10	.10	.11	— .21	14,500
South Bodie	.20	.15	.12	.12	— .08	200
South Bulwer . . .	.16	.27	.15	.15	— .01	7,950
South Hite	.12	.20	.05	.14	+ .02	96,240
South Pacific	4.25	8.25	.07	.09	—4.16	4,068,595
Spring Valley	3.50	4.20	2.90	2.90	— .60	6,327
Standard	19.25	19.13	13.50	18.50	— .75	5,400
Starr Grove	3,25	3.25	.30	.33	—2.92	6,200
State Line No. 1	.26	.27	.08	.12	— .14	1,925
State Line No. 4	.35	.35	.14	.22	— .13	1,500
State Line Nos. 1 & 4 . .	.27	.29	.05	.10	— .17	410,050
State Line Nos. 2 & 3 . .	1.60	1.80	.15	.30	—1.30	5,165,648
St. Joseph, Lead .	7.00	7.50	7.50	7.50	+ .50	300
Stormont . . .	1.60	1.60	.20	.78	— .82	84,445
Sutro Tunnel	.96	1.00	.28	.39	— .57	809,645
Taylor Plumas	.07	.86	.05	.15	+ .08	418,500
Tioga	.05	.40	.05	.10	+ .05	17,555
Tip Top	4.00	4.50	2.50	2.50	—1.50	1,950
Tombstone	4.45	4.50	.81	.81	—3.64	5,100
Tuscarora	.16	.25	.05	.24	+ .08	81,600
Unadilla	.12	.15	.07	.09	— .03	118,905
Union Con.	14.75	17.50	8.38	9.50	—5.25	14,135
Vandewater	.34	.40	.19	.20	— .14	252,650
Virginia	. . .	2.90	1.05	1.15		34,460
Washington	.15	.15	.05	.05	— .10	24,000
Yellow Jacket	3.70	3.15	.70	.70	—3.00	1,605
Total sales for 6 months, 1882	. . .	. . .	. . .	. . .	. .	28,211,052
" " " 12 months, 1881		. . .	. . .	. . .	. . .	43,027,426

THE PHILADELPHIA MINING STOCK EXCHANGES AND THE PHILADELPHIA MARKET

PHILADELPHIA is the metropolis of the most extensive coal and iron producing region in the world, and a history of the mining interest centering in Philadelphia would be coincident with a history of the material progress of Pennsylvania. William Penn, the founder of the commonwealth was interested in the production of iron in England, and early gave of his time and means to the promotion of mining industries; the first record of his moving in the matter being dated the year following his landing, namely in 1683. The development of the mineral resources of Pennsylvania attracted the capital and enterprise of the Penn colonists from the first, and very early in the eighteenth century the foundations were laid of the several allied industries that have since given the commonwealth so large a measure of manufacturing and commercial importance. It is a noteworthy fact that Philadelphia names identified with these interests from the beginning are still prominent in current records. The old families connected with the first attempts to mine iron ore and to set up iron furnaces in 1715 to 1770 have representatives in various departments of the vast iron industries of 1882; the Rutters, Potts, Thomas, Logans, Morris, Nutts, Bransons, Taylors and Walkers who made the initial ventures having direct descendants among the leading iron masters of to-day.

The conversion of nature's mineral treasures into available wealth being a leading factor of Philadelphia's prosperity, mines and mining have always received marked attention, and ventures in this direction have been hospitably entertained and favorably considered. The lead deposits of Galena, the copper veins of Lake Superior and the gold fields of the Carolinas give evidence of the intelligent liberality of Philadelphia capital and the persistence of Philadelphia enterprise. The finding of gold in California awakened an immediate excitement in that city, before the importance of the discovery was realized elsewhere. Among the Argonauts and Forty-niners were considerable numbers of Philadelphians, and it is not too much to say that these furnished a large proportion of the worth and respectability of the first emigration. Men of character and means went out and became leaders in bringing order and civilized society out of the chaotic condition which obtained when the "diggings" were first opened. They early occupied the field of business too—Philadelphia stocks of goods making prompt appearance whenever new camps were formed.

Returned Californians, nearly all of them successful and prosperous, have for many years constituted a noticeable element in Philadelphia society, and have aided in sustaining an animated interest in the production of the precious metals. This interest has been conspicuous in the development of that vast silver production beginning with the opening of the Comstock Lode in 1859 and extending since then through half-a-dozen of our Rocky Mountain Territories, which has made this country a larger contributor to the world's annual output of silver than all other countries together. In Nevada, Idaho, Montana, Arizona, Utah, Colorado and New Mexico, Philadelphia skill, energy and money have accomplished their full share in bringing forth the hidden riches of the earth. President Lincoln characterized the Rocky Mountains as the strongbox of the nation. In unlocking this depository and devoting the precious contents to the service of commerce and the arts, no people in the country have been more active and successful than the quiet denizens of the Quaker City.

Gold mining in the early days of gulch and placer finds was carried on by individual enterprise, the miners' labor, pick and pan constituting the only capital invested, and his buckskin belt retaining all the dividends. In the White Pine district silver also gave good returns to the individual miner for a time, but silver deposits are generally too refractory to be dealt with by private means. To mine silver successfully has required the use of large capital and the force of corporate organizations, and the business has therefore been carried on by joint stock companies from the beginning. Since the exhaustion of the placer diggings, gold mining has been conducted in the same manner, so that it may now be said that the production of the precious metals is practically in the hands of corporate companies.

On the discovery of a new mine, the claim is frequently sold as an integral property, thereafter it usually passes into the possession of a company, and transfers of ownership are made by the purchase and sale of the company's stock. Beside representing the fee of the property in stock, these companies commonly issue stock also for development purposes and for working capital. In railroad construction, which is also carried on almost invariably by corporate companies, capital is commonly obtained in these days by issuing bonds secured by mortgage; the stock frequently representing only the equities in the properties and good will of the business, so to speak, that is, the capacity of the road to earn dividends after meeting the bonded interest; but in the development and working of mines, the issue of bonds is seldom resorted to, as a mortgage on a mine could hardly be made an attractive security, and the periodic payment of interest might at any time become an onerous burden even on the biggest of bonanzas hidden underground. The fee of the property, the cost of development and working capital of all mining enterprises are therefore represented by stock.

The production of silver has increased very rapidly, as above indicated within the past twenty years. The Centennial Exhibition brought to Philadelphia not only an immense collection of ore samples of all grades and descriptions but also a large number of prospectors and property holders, each with a project or two on hand, promising rich returns on comparatively small investments; and this gave an additional impetus to mining enterprise, so that within the past six years, especially, an important interest in bullion has grown up here. Mining companies have been formed literally by the hundreds and thousands of people have invested money in them. In 1880 there were nearly 100 companies, mostly silver companies, either organized in Philadelphia, or brought there for investment, and the number started in other years has been correspondingly large, so that within the period embraced between July 1876 and July 1882 not less than 300 companies have been either formed or introduced in Philadelphia.

The dealings in the stocks of these companies were for a long time confined to private hands, but as the shares were more widely distributed throughout the community, the need of some centre of trade where those who wished to buy and those who wished to sell could meet on common ground became more and more clearly defined. The auction rooms served this purpose in a not altogether satisfactory manner for a time, and finally the dealings attained sufficient importance to attract the notice of the Philadelphia Stock Exchange. Most of the leading brokers were dealing in Mining shares to some extent as early as 1878 and 1879, and in the spring of 1880 application was made to the stock exchange to place certain mining stocks on the sales list, and in course of that year, *Girard*, *Iowa Gulch*, *Orion* and one or two others were listed.

There are about 150 stocks, beside a long list of bonds, regularly dealt in at the Board and the brokers who buy and sell these representations of value are obliged to keep themselves informed as to the condition and prospects of each property and business named on the list. These stocks and bonds are for the most part railroad issues, and to follow the fortunes of a railroad is an undertaking involving a good deal of skill, attained by long practice, and constant attention to daily details of business. Mining matters embrace a range of facts of an entirely different character, and after mining stocks had been dealt in at the Board for a time, it was evident that brokers who would give them undivided attention could handle them to better advantage than could those who were mainly occupied with railroad investments. The desirability of a separate exchange for transactions in mining stocks became plainly apparent, and during the summer of 1879 propositions were discussed among parties interested in such transactions for the establishment of a Mining Stock Board.

The Philadelphia Mining and Stock Exchange.—About the middle of August preliminary steps were taken which resulted in the organization of the PHILADELPHIA MINING AND STOCK EXCHANGE. On the 15th of that month, Frederick Schuellermann, a gentleman largely interested in Mining venture, invited several others, similarly situated, to meet in conference respecting the matter, and at that meeting Mr. Schuellerman, in co-operation with Mr. L. Emig and Mr. G. W. Powell, drew up a prospectus which served as a basis for the new undertaking. Subscribers to the number of fifty were immediately found and a compact organization was effected under the title above given. A constitution and by-laws similar to those of other Mining Exchanges were adopted, and the following officers elected:

President, William M. Capp; First Vice-President, Edward A. Green; Second Vice-President, Fred. Schuellermann; Treasurer, Samuel W. Powell; Secretary, Geo. A. Q. Miller; Clerk, Geo. W. Powell.

Governing Committee, Samuel W. Powell, William N. Viguers, Chas. Kane, Fred. Schuellermann, Lawrence Emig and Chas. Gladding.

Standing Committee, Samuel M. Capp, William Davis, Sparta Fritz, William Wilson and Samuel Gladding.

The Board was ready for business by the 1st of September, but owing to the difficulty of securing suitable premises, the opening of the exchange was seriously delayed. The most desirable location to be considered was the rotunda of the Commercial Exchange Building, and as this room was practically vacant at the time, negotiations were at once entered into for a lease. Sundry and various obstacles arose to prolong these negotiations, until, after nearly two months of uncertainty, the purpose of leasing the rotunda was finally abandoned. The building No. 310 Chestnut street was then rented, and, being on the main thoroughfare, near the Stock Exchange and the financial centre of the city, the location proved to be a very advantageous selection. The place had been used for banking purposes, and required alterations involving further delay. Possession was taken in November, and on the 4th of December, 1879, the first mining stock exchange in Philadelphia was formally opened for business.

The stocks traded in were the *Argent*, *Orion*, *Iowa Gulch*, *Rara Avis*, and others. The business done did not at first meet the expectations that had been formed, but after the first of the year 1881, a noticeable improvement set in and the members of the Exchange soon found ample reason to be satisfied with their venture. New stocks were added to the list, the membership increased nearly one half during the spring, and the trade in mining stocks assumed quite an important aspect as a factor of the city's commerce.

During the summer of 1880 some new groups of mines in Arizona and in Colorado were brought before the Philadelphia community with a good deal of *éclat* about the time that interest in mining was fully awakened here. Several of the leading business men of the city invested in these properties and took an active part in the formation of companies upon them. City politicians of prominence also became identified with new ventures in the regions above mentioned. The production of the precious metals took on quite a marked "boom," and stock operations in connection with extending developments were stimulated to animated activity. As often happens, the success of the new Exchange resulted in the springing up of a factional feeling, some of the later comers being ambitious and wanting more control than their position gave them. The disturbing element joined hands with the Arizona and Colorado interests above alluded to, and resolved to organize another exchange in which they could exercise the sway which they considered they were entitled to by virtue of the magnitude of their operations and the extent of the prospective mineral wealth they represented. Toward the close of 1880, the plans of the faction were matured, and the purpose to withdraw was publicly announced. The movement was made with a decided show of vigor, and several gentleman of high repute in the community were induced to take part in it. The name of the National Mining Exchange was adopted and nearly three-quarters of the members of the old Board went over to the new.

The National Mining and Stock Exchange.—The National Mining and Stock Exchange was finally organized January 3d, 1881, at a meeting held in the Continental Hotel. The subscribing roll numbered 54 names, and the organization was perfected by the election of the following officers: president, Samuel Disston; vice president, William B. Dalton; treasurer, Joseph W. Thompson; secretary, G. A. Q. Miller; trustees, T. Henry Ashby, W. J. Cheney and Charles Disston. Subsequently the following committees were appointed; auditing committee, J. K. Vallance, F. S. Bond, W. R. Hunt, Thomas J. Stewart and Andrew Hazlet; listing committee, Julius Hirshfield, L. S. Ganz and William Wilson; membership committee, H. Burgen, John Tracy, Charles Kane and L. Gilbough. The subscription price of seats in the National Exchange was fixed at $750, but as the membership rapidly increased the price was advanced to $1000, when the list numbered 75 members. The rotunda of the Commercial Exchange Building, at Third and Walnut streets, was leased for business, at $3000 per year. This chamber was used for many years previous to 1876 by the old established Board of Brokers, and is admittedly one of the finest exchange rooms in the country. The National organization expended a considerable sum in fitting up the place in the best manner for the uses intended, and opened it for business on Tuesday, the 1st of February, 1881, celebrating the event with appropriate ceremonies. Business started off in a very encouraging manner, and it was hoped that the National Exchange was destined to attain a position of permanent importance. The Philadelphia Exchange having recruited its membership, however, still held the largest share of the trade, and, subsequently, when the Mining Annex was opened, it was found that with three Richmonds in the field the trade was very seriously cut up. Overtures were made for a consolidation with the Philadelphia Exchange, or rather were made to each of the Exchanges, by gentlemen who had joined the new organization, while still retaining their seats in the old one. Some difficulty was experienced at first in bringing the members to agreement, personal feeling and rivalry standing in the way, but eventually the impediments were all removed, the differences adjusted and the National Board united with the Philadelphia, taking the title of the latter, and removing to the "old stand," No. 310 Chestnut street. This union was effected in July, 1881, leaving the Philadelphia Exchange and the Mining Annex to compete for the trade.

The Mining Annex.—The organization of a special mining exchange encountered a good deal of opposition from the members of the regular stock exchange, and there was, furthermore, a noticeable sentiment of hostility, always more or less active among the conservative habitués of Third street. It was held that trade in stocks, if legitimate, could be, and should be carried on at the regular Board, and if not legitimate should be altogether discountenanced. The more successful and important the Mining Exchange became, the more decided were the expressions of opinion that the regular Board ought to bring the business under its own cognizance and control. With this view, a Mining Annex was opened in connection with the stock exchange, about the middle of March, 1881. Business was opened in the basement of No. 310 Chestnut street, immediately under the Philadelphia Mining Exchange. The brokers resorted there occasionally, whenever they had mining stocks to buy or sell, but with two other exchanges in operation the annex did not flourish very abundantly, and no great impression was made, either on mining stock traders, or on the public. The annex was, however, the acknowledged authority in the business, fixing prices, and giving character to stocks; the other exchanges adopting the annex quotations, and the public looking with distrust upon those stocks not listed there. Many influential members of the independent exchanges freely admitted that it would be an advantage if the purview of the annex could be extended with sufficient liberality of administration to cover their dealings without restricting them to narrower limits than they could work in. After the Philadelphia and the National Exchanges were united, the question of consolidating with the annex was discussed with freedom, and during the spring of 1881 active measures were taken looking to practical results. Committees were appointed on each side, conferences were held, and reports made, and after several months of negotiating, the consolidation was finally consummated in October, 1881.

The staid, conservative and reputable old Philadelphia Board of Stock Brokers, the oldest exchange in America, took the entire business of handling mining stocks into its care, retaining the title of its branch, the Mining Annex, and submitting the business to regulations established by its governing committee. The members of the independent exchanges were admitted to membership in the annex on satisfactory terms, the honor of belonging to the Philadelphia Board of Brokers probably being a valued though not an expressed consideration. The business was moved again to the rotunda of the Commercial Exchange Building, which desirable location the Annex still occupies.

By-Laws for the Mining Annex.

Article I.—*Membership.*—Section 1.—Every applicant for membership must be at least twenty-one years of age, and a citizen of the United States.

Section 2.—The initiation fee of members admitted by election shall be one thousand dollars; and of those admitted by purchase, fifty dollars. In all cases where initiation fees shall not be paid within five days after the election, and proper notification by the Secretary (except in cases of sickness or absence from the city), such election shall be void.

Section 3.—Any member wishing to sell his membership, shall have the right to do so, provided he has no unsettled contracts with, or claims against him, by any member of the Stock Exchange or Mining Annex, for transactions arising in or relating to the business of banking, or a stock or exchange broker; but where the Arbitration Committee shall determine that any claims or contracts exist, the Governing Committee may, except in cases of insolvency, refuse to permit the seat to be sold, until such claims or contracts are in its opinion satisfactorily settled.

The proceeds of the seat, if sold, shall, after deducting all charges (determined, in case of controversy, by the Arbitration Committee to be) due to the Stock Exchange or Mining Annex, belong to its owner's creditors, being members of the Stock Exchange or Mining Annex, in proportion to the amount of their respective claims, determined by the Arbitration Committee. The claims of members, so ascertained, shall be paid in full; and what remains, if anything, shall be paid to the owner.

Section 4.—When a member dies, his seat shall, within one year thereafter, be sold or transferred; and the proceeds thereof, after deducting all charges (determined, in case of controversy, by the Arbitration Committee to be) due to the Stock Exchange and Mining Annex, shall belong to its owner's creditors, being members of the Stock Exchange or Mining Annex, in proportion to the amount of their respective claims. The claims of members, so ascertained, shall be paid to them in full; and what remains, if anything, shall be paid to the legal representatives of the deceased. The seat of a deceased member shall be liable for all assessments which may be made, by the Governing Committee, from the day of his death until such times as his seat is sold and transferred.

Section 5.—In case any member shall have begun legal proceedings against the Stock Exchange or Mining Annex, and shall not have prosecuted the same to a successful termination, all expenses incurred by the Exchange or Mining Annex, in and during the prosecution of the suit, including counsel fees, costs of Court, printing, etc., shall constitute a charge against the seat of said member, the collection of which shall be enforced in the same manner as that now provided for the collection of fines; and upon the sale of the member's seat, during his lifetime, or after his death, the said charge shall, in all respects, be treated as an ordinary fine.

Section 6.—No member of the Stock Exchange or Mining Annex shall be allowed to take as partner any suspended member, during the period of his suspension, or to form a partnership with an insolvent person.

ARTICLE II.—*Elections*.—Section 1.—All elections for members of the Mining Annex shall be held by the Governing Committee of the Philadelphia Stock Exchange.

Section 2.—No rejected candidate shall be eligible for membership, for six months after his rejection, without the unanimous consent of the Governing Committee.

ARTICLE III.—*Insolvency*.—Section 1.—Any member who fails to comply with his contracts, or who becomes insolvent, shall immediately inform the President of the Stock Exchange, or Chairman of the Annex, of the fact, whose duty it shall be to give notice forthwith of the failure of such member to the Stock Exchange and Mining Annex; and such notice shall forthwith work a suspension of the insolvent from the privileges of the Annex, unless a settlement is made as hereinafter provided. In case of the neglect of the insolvent to make such report to the President or Chairman, it shall be the duty of any member having knowledge of the fact, to report the same forthwith to the Governing Committee, or to the President, or Chairman, who shall thereupon appoint a committee of three members to inquire into the fact, and report thereon without delay to the Mining Annex; and if said committee report the charge to be true, and no appeal from the said report be taken within seven days; or, where an appeal having been taken, the report shall have been confirmed by the Governing Committee, said member shall from that time be held to be suspended, and notice be posted in the Stock Exchange and Mining Annex. In case of the insolvency of any member, he shall within three (3) days make good to the full amount thereof all friendly loans of cash or stocks from members, or any overdraft on any bank; but seven (7) days shall be allowed him in which to settle stock contracts.

Section 2.—Members holding securities deposited by the insolvent, as margins on his contracts, are authorized, upon the application of the creditor or creditors, for whose benefit such margin has been deposited, to sell the same; and, after satisfying the claim of such creditor or creditors, to pay over the remainder, if any, as directed by the Governing Committee. Such securities as are saleable at the Stock Exchange or Mining Annex, must be sold by the presiding officer, at a regular session of the Stock Exchange or Mining Annex; and all other securities under the direction of the Governing Committee. When a difference becomes due by a sale of collaterals which had been held to secure a loan, the difference so created shall be treated as an unsettled contract, and not as a friendly loan of cash, and seven (7) days shall be allowed to settle the same. On the failure of a member of the Annex, all claims existing against him must be reported in writing to the Secretary; and it shall be his duty to record the same in a book kept for that purpose. The terms of all settlements must be reported to the Stock Exchange and Mining Annex when made. Any settlement made with a member unable to meet his contracts, and not, at the time, reported to the Stock Exchange and Mining Annex, shall, in case of a further failure, debar such creditor from any claim on the seat of the debtor until all subsequent claims are settled in full.

Section 3.—Any member who shall be declared a bankrupt, shall, *ipso facto*, be suspended from the Mining Annex; but a suspended member, presenting a certificate of discharge under the United States Bankrupt Law, becomes eligible under the rules for re-instating suspended members.

Section 4.—If any suspended member fails to settle with all his creditors within one year from the time of his suspension, his membership shall be sold by the Secretary, and the proceeds, after deducting all charges (determined, in case of controversy, by the Arbitration Committee to be) due to the Stock Exchange or Mining Annex, shall belong, and be paid *pro rata* to his creditors in the Stock Exchange or Mining Annex. The amount due said creditors shall be determined by the Arbitration Committee.

Section 5.—Hereafter, all claims against the proceeds arising from the sale of the membership of insolvents, must be presented to the Treasurer within thirty (30) days from day of notice, which will be given on three (3) successive days, by the Chairman. After the expiration of said thirty (30) days, all claims, not presented, will be debarred.

Section 6.—On an application for re-admission, a suspended member may be restored to his membership, provided his name shall have been acted upon by the Committee on Admissions, and re-elected, as provided for in Article on Elections. The applicant must, at the request of the committee, give full explanations on any disputed or unsatisfactory transactions, and free access to his books and papers for that purpose.

Section 7.—A suspended member shall, before he is re-instated, pay all fines due at the time of suspension.

ARTICLE IV.—*Hours of Business*.—Section 1.—The Mining Annex shall be open for the entrance of members on every business day, at ten minutes before 10 o'clock A. M. At 10 o'clock, precisely, the presiding officer shall announce, from the rostrum, that the Annex is open for the transaction of business, and it shall remain open for such purpose until 3 o'clock P. M., when the presiding officer shall similarly announce it closed.

Section 2.—Dealings shall be limited, throughout the entire year, to the interval between the hours above named, unless otherwise ordered by the Governing Committee of the Stock Exchange, and a fine of $50 for each offence shall be imposed, without excuse or appeal, upon any member who shall directly or indirectly make or offer to make any transactions in stock, before or after those hours, in the Mining Annex.

Section 3.—The Mining Annex shall not be closed at any time between the hours above named, except by orders of the Governing Committee of the Stock Exchange. While so closed, the same penalty shall be imposed as in Section 2.

ARTICLE V.—Section 1.—At 11 o'clock A. M., the first regular session shall commence, when the Chairman shall call the regular list. While the call is progressing, the members may call up the various stocks on the regular list of the Mining Annex. A charge of ten cents will be made for all calls.

Section 2.—The second regular session shall commence at 12½ P. M. The third regular session shall commence at 2 P. M., and close at 2.30 P. M. At these sessions, the Chairman shall call such stocks as the members may request in writing, without charge, and such as are requested orally, at a charge of ten cents.

Section 3.—At the last sessions, the oral request shall in all cases have precedence.

ARTICLE VI.—*Commissions*.—Section 1.—On the shares of Mining Companies:

Selling under $1.00 per share—one cent per share.

Selling at $1.00 and up to $2.00 per share—two cents per share.

Selling at $2.00 and up to $5.00 per share—three cents per share.

Selling at $5.00 and up to $10.00 per share—five cents per share.

Selling at $10.00 and over—twelve and a half cents per share; and no charge of less than twenty-five cents shall be made on any one transaction.

Section 2.—Commissions in conformity with the above rates must be charged on all purchases and sales for non-members, and on all transactions for joint account, in which a non-member is a co-partner; and no arrangement having in view, directly or indirectly, a rebate upon the regular rates hereby established, shall be allowed. Any member who shall transact business for a less commission than the rates set forth as above, (except in cases provided for,) shall, for the first offence, be fined one hundred dollars, and shall be suspended at the pleasure of the Governing Committee of the Exchange; and for the second offence, he shall be fined five hundred dollars and suspended for a period not less than one year. But nothing in the foregoing section shall be construed to apply to full business partners of members of the Stock Exchange. But members may transact business for charitable objects without charge.

Section 3.—Commissions may be halved with banks and bankers, having their place of business as such outside of the limits of the city, also with members of Stock Exchanges of other cities; and with stock and exchange brokers in cities where there is no Stock Exchange, also with brokers whose names are on the half-commission list.

ARTICLE VII.—*Record of Sales*.—Section 1.—No person is permitted to enter sales in the books of record, except the Chairman, the Clerks, or a member acting as such, under the authority of the Chairman. No alteration in the record shall be made, except with the consent of the members present, while the Annex is in session; and whenever any objection to the record is made, the objection shall be held in abeyance, if either of the principals to the transaction be absent.

Section 2.—The record of sales shall be kept in a book provided for that purpose. Sales between members, made out of the Annex, may be recorded in this book, unless objected to by a majority of the members present.

Section 3.—In all time sales, it shall be the duty of the seller to furnish the contract.

Section 4.—Any member altering or tampering with the book of record of sales, shall be fined one hundred dollars, and be suspended at the pleasure of the Governing Committee.

ARTICLE VIII.—*Bids and Offers.*—Section 1.—During the session of the Mining Annex, bids and offers may be made either for cash, or for the next business day (commonly termed the regular way), or for any number of days, not exceeding sixty.

Section 2.—From the moment the Chair calls any one stock, until he passes to another, all bids and offers remain in full force, unless a member audibly announces that he is *out* of the market. In case of a doubt, whether a member is out or not, the concurrent testimony of five members, that they heard him call *out* in time, is sufficient to establish the fact. It is understood, that only the last bid or offer of a member is binding upon him, as superseding former ones; but a bid does not supersede an offer, nor *vice versa.*

Section 3.—Any member calling a stock, is entitled to the market on that particular stock, on the terms and time *first* proposed by him, if he makes a prompt bid or offer, or both, although, in the first moment, he may have been anticipated. This preference, however, is lost the moment he varies his bid or offer in any way.

Section 4.—Bids and offers on all stocks selling at twenty-five cents or under, one cent per share; from twenty-five cents to five dollars per share, two and one half cents; from five dollars to ten dollars, five cents per share; from ten dollars and upward, twelve and a half cents.

Section 5.—A member making several sales, need not report until he has finished selling on that call.

Section 6.—In all offers to buy or sell during a session, whenever the words "the most," "the lowest," "all I have," "all I want," or others of *the same import* are used, they remain binding on the member, while the stock remains before the Annex. Any variance from his terms applying to amount, or price, but not to time, subjects a member to a fine of one dollar; and any transaction made with him, in consequence of his original declaration, or which may be affected by his subsequent change from it, may be cancelled at the option of the other party. This rule applies, when a bid or offer is made for another member.

Section 7.—Any member who shall, either in or out of the Annex, buy, or sell, or offer to buy or sell, any amount of stock at a certain price, and any other amount of the same stock at another price, making one purchase or sale depend on the other, shall be fined five dollars.

Section 8.—Any member guilty of dealing with a person in the room, not a member of the Annex, shall be fined one hundred dollars, without excuse or appeal; and for a repetition of the offence, shall be suspended at the pleasure of the Governing Committee of the Stock Exchange. It shall be the duty of any member, having a knowledge of the violation of this rule, to report the same, without delay, to the Chairman, or to the Governing Committee of the Stock Exchange.

Section 9.—Any member bidding for, or offering to sell stocks any number of days over three, flat, shall be fined five dollars.

Section 10.—No fictitious purchase, sale, or contract, shall be made, under a penalty of suspension at the pleasure of the Governing Committee of the Stock Exchange.

ARTICLE IX.—*Transactions on Time.*—Section 1.—Sales and purchases "on time" are not to be made over sixty days, Sundays to be counted in the same manner as in promissory notes; contracts maturing on Sunday, or on a legal holiday, must be settled the day previous, interest to be charged to the date of payment only.

Section 2.—No purchase or sale of stock, except beyond three days, shall bear interest. Sundays and legal holidays being counted.

Section 3.—All purchases and sales of stocks beyond three days, shall be *with interest. All* days, whether working days or not, being counted.

ARTICLE X.—*Notifying for Delivery.*—Section 1.—In contracts made, *buyer's* or *seller's option*, a notification for delivery, by the party having the option, must be given on the preceding business day, before the first regular session. When the option is without notice, notification must be given before the first regular session on the day of delivery.

Section 2.—A contract made before the first session, buyer or seller three days without notice, may be notified for the same day. A contract with interest must run at least one day.

Section 3.—On a contract, where the buyer or seller's option is *after* a certain number of days, the option commences only *after* the specified number of days has elapsed; for instance, on a contract, sixty days buyer after ten, the buyer cannot claim the stock until the twelfth day: if, however, the contract is without notice, he can claim it on the eleventh day.

Section 4.—Every member must have, in the vicinity of the Annex, a place of business other than the Annex, where all notices must be served; and it shall be the duty of every member, to keep filed with the Secretary of the Stock Exchange, a written notice designating such place of business, and also to give notice to the Secretary of any change thereof. A failure to comply with these requirements, for thirty days after notice by the Secretary, shall subject the member to suspension.

ARTICLE XI.—*Contracts in Stocks not Fully Paid.*—In all contracts on time for stocks not fully paid up, the seller shall charge any instalment that may be called for, and paid between the day of sale and that of delivery, with interest from the day on which said instalment has been required to be paid.

ARTICLE XII.—*Contracts Due when Books are closed.*—In the event of contracts for the delivery of an even hundred or hundreds of shares of stock maturing during the closing of the transfer books, the delivery shall be made by certificate and power at the maturity of the contract. But contracts for the delivery of odd amounts of stocks, so maturing, may be extended, at the request of either party, until the opening of the transfer books; the terms, in all cases, remaining the same as in the original transactions.

ARTICLE XIII.—*On Dividends.*—Section 1.—All dividends declared on stocks go to the purchaser, until regularly announced at the Annex, or by due notice in public papers. When a contract for the delivery of stock becomes due on the day on which a dividend has been officially announced, or between that day and the day on which the dividend is made payable, the seller shall deduct said dividend from his bill, or deliver his due bill for the same, at his option. Members have the right to demand security on such due bills.

Section 2.—Any member reporting as the dividend of any Mining Stock Company, a rate of percentage which proves erroneous, shall be fined twenty-five dollars.

ARTICLE XIV.—*Certificate and Power.*—Section 1.—All stocks sold in hundreds, may be delivered certificate and power, in certificates of not more than one hundred shares each, and the seller must guarantee the power, when requested to do so. Either party may demand a transfer.

Section 2.—Whenever the transfer books of any company shall be closed by any legal impediment, so as to render their being open again uncertain, then the deliveries of stock of such company, in satisfaction of contracts, shall be made by Certificate and Power of Attorney irrevocable, the papers to be satisfactory to the recipients or passed upon by the Arbitration Committee.

ARTICLE XV.—*Irregularities of Deliveries.*—Reclamations for irregularities in deliveries of stocks, when such irregularities do not affect their validity, but only currency in the market, will not be considered unless made within five days from the day of delivery.

ARTICLE XVI.—*Payments and Transfers.*—Section 1.—Stocks must be delivered before 2.30 P. M., or the buyer may demand that they shall lie over until the next day without interest. When a sale has been made for cash after 2 P. M., the seller shall have until 3 P. M. to make his delivery.

Section 2.—Payments may be demanded in current bank notes, or a due bill of one of the associated banks.

ARTICLE XVII.—*Of Borrowing Stocks, etc.*—Section 1.—Stocks borrowed against money shall be considered the same as stock contracts.

Section 2.—Stocks borrowed without an equivalent, shall be considered as friendly loans.

Section 3.—Where money is borrowed upon stocks, the collateral cannot be used by the holder.

ARTICLE XVIII.—*Operating for Another Member.*—Section 1.—A member bidding for, or offering stocks for another member, must mention his name with the bid or offer, or be responsible for the contract. The party accepting the name must compare with the principal before 4 P. M. on the same day, or else all claim on said principal shall be forfeited.

Section 2.—Members have the privilege of trading for members suspended for insolvency, at any rate of commission they may choose to charge or agree upon, for *three* months from the date of their suspension. Full commission must be charged to all other suspended members.

Any member who shall execute any order for the purchase or sale of stocks for any person in the employ of another member, without first obtaining the consent of the employer, shall, for the first offence, be fined one hundred dollars, and for the second, shall be suspended at the pleasure of the Governing Committee of the Stock Exchange.

ARTICLE XIX.—*Of Deposits.*—Section 1.—At any time while a contract is pending, a mutual deposit may be called by either party to secure the same. No additional deposit can be required, except from the party against whom the contract rules. The deposit of the stock on the part of the seller shall, in all cases, be considered sufficient security. In case of dispute, as to the amount, character of security, or place of deposit, the matter shall be referred to the Arbitration Committee of the Stock Exchange, whose decision shall be final.

Section 2.—Where deposits are called before half-past 10 o'clock A. M., they shall be made before 1 o'clock P. M., the same day; if called before 2 o'clock, they shall be made before quarter of 3 o'clock P. M., the same day; if called after 2 o'clock, they shall be made on or before half-past 10 o'clock A. M., the following day.

Section 3.—Should the call not be responded to, within the prescribed time, the Chairman shall, upon proper notification from the member making the call, forthwith close the contract upon which the deposit has been called.

Section 4.—Parties depositing margins shall name the security deposited, designating the amount and market value of the same, that the party to be secured may be able to accept or to reject such security.

Section 5.—Any deposit of money as a margin is strictly a trust, and cannot be used by the party receiving it in his business, except by special agreement.

ARTICLE XX.—*Advertising Stocks, etc.*—Section 1.—No member shall have the right to advertise, by circular, or in the papers, any particular loans, stocks, or bonds (Government securities excepted) which are current at the Stock Exchange or Annex, under a penalty of one hundred dollars for the first offence, and for the second, suspension, at the pleasure of the Governing Committee of the Stock Exchange.

Section 2.—Special permission may be given to members of the Annex, by the Stock List Committee of the Exchange, to advertise any new loan or series of bonds received, or to be received, from any mining company issuing the same; the decision of that committee to be subject to an appeal to the Governing Committee of the Stock Exchange. And parties obtaining such permission, shall sell to members of the Annex at least one-quarter per cent. cheaper than they sell to the public. Penalties for violating, same as Section 1.

ARTICLE XXI.—*Application to have Stocks, Bonds, or Loans Placed upon the List.*—Section 1.—Application to have a stock, bond, or loan placed upon the list, must be made to the Stock List Committee of the Stock Exchange, in writing, and signed by at least five members of the Annex.

Section 2.—If a stock, the application must state the amount of authorized capital, par value of the shares, whether assessable, amount paid in, whether dividend paying, and if so, time and place of dividend, address of transfer office, amount of funded and floating debt, all of which must be certified to by the officers, with the seal of the company attached. In each case, a listing fee of two hundred dollars must accompany the application; to be returned if the application is refused.

Section 3.—If a bond or loan, the application must state the amount authorized, the amount outstanding, when due, percentage of interest, when and where payable, whether taxable, whether guaranteed, and by whom, and name of trustee, if any.

Section 4.—If the List Committee approve the application, they shall report to the Governing Committee of the Stock Exchange for final action.

ARTICLE XXII.—*Against uniting with other organizations.*—Section 1.—No member shall be directly or indirectly (through a partner or clerk) connected with any other organization in this city, where mining stocks, bonds, etc., are dealt in. The penalty, for the first offence, shall be a fine of one hundred dollars, and suspension by the Governing Committee, for a period of not less than sixty days. For a repetition of the offence, a fine of five hundred dollars, and suspension for at least six months.

Section 2.—Any member giving or accepting orders to be executed at any other such organization in this city, shall be subject to the same penalties as in Section 1; this rule not to apply to sales of stocks or bonds made at public auction, in the reading room of the Merchants' Exchange.

ARTICLE XXIII.—*Fines for Disorder, etc.*—Section 1.—Any member guilty of indecorous language or conduct towards the presiding officer or a member, while in the Annex, shall be fined five dollars, without excuse or appeal, and for a repetition of the offence, shall, by a vote of two-thirds of the Governing Committee of the Stock Exchange, be suspended for not less than one month, nor for a longer period than three months.

Section 2.—Any member interrupting the presiding officer while calling stocks, by speaking or otherwise, shall pay a fine of not less than twenty-five cents for each offence, at the discretion of the presiding officer, from which there shall be no excuse or appeal.

Section 3.—In all cases where a fine is inflicted by the presiding officer for loud talking, the member so fined shall not be excused by simply denying it, unless he denies *talking*, the presiding officer being the judge whether or not the session is disturbed.

Section 4.—Any member who shall be guilty of an act or acts, which shall endanger the person of a member, shall be subject to a fine of not less than ten dollars, or more than one hundred dollars.

Section 5.—Any member having his coat off in the Annex shall be fined fifty cents.

Section 6.—No member shall smoke in the Annex, until after the last regular session, under a penalty of five dollars, except in a special room, provided by the Committee on the Building.

Section 7.—Any member who shall, *at any time*, in the Annex, be guilty of conduct subversive of good order and decorum, shall be fined, at the discretion of the presiding officer, in a sum not exceeding five dollars.

Section 8.—When a member is fined for an alleged violation of the rules, and he denies it, and the offence is proven by the testimony of others, the fine shall be doubled.

Section 9.—Any member who shall inquire of the presiding officer what he was fined for, in a case involving a simple fine, shall be fined double, unless he denies the commission of the offence.

Section 10.—No fine can be ordered to be taken off by the presiding officer, except while the Annex is in Session.

Section 11.—A fine of one dollar shall be imposed on any member carrying a cane or umbrella about the room, unless said member is lame.

Section 12.—Any member who shall stand upon, or put his foot upon the furniture, recline upon a lounge, or in any way injure the furniture, shall be subject to a fine of not less than one dollar, nor more than five dollars, without excuse or appeal, and shall be charged with the cost of all necessary repairs.

Section 13.—A fine when no special mention is made of the sum, means ten cents, without appeal.

Section 14.—Any member swearing, or using profane-language in the Annex, shall be fined five dollars.

ARTICLE XXIV.—*Of Appeals.*—Section 1.—On an appeal from a fine, *no debate* is allowed. No motion to excuse a member from a fine can be entertained by the Chair, after an appeal has been made by the member, and decided in the negative. When the Chair has once declined fining a member, no appeal from that decision to the Annex shall be entertained.

Section 2.—A member may, upon a motion, be excused from his fines, by a vote of two-thirds of the members present.

ARTICLE XXV.—*Yearly Dues.*—Section 2.—In case the revenue of the Mining Annex shall be insufficient to meet the current expenses for the year, the Governing Committee shall levy an assesment of one-half on members of the Annex, other than members of the Philadelphia Stock Exchange.

ARTICLE XXVI.—*Non-Payment of Fines and Dues.*—Any member neglecting to pay his fines or assessments for the period of three months, shall be notified by the Secretary of the Stock Exchange; and continuing in his neglect for one month thereafter, shall be suspended until the payment of the same.

ARTICLE XXVII.—*Rules in Force at all Times.*—Rules for the behavior of members during the sessions of the Annex are in force in the buildings *at all times*, whether the Annex is in session or not; and it shall be the duty of the Chairman to enforce them without waiting for a formal complaint against the offender.

ARTICLE XXVIII.—*Admission of Strangers and Non-Members.*—No member shall introduce a stranger or non-member in the inclosure of the Annex, unless by permission of the Chairman, or a member of the Governing Committee. The clerks of brokers are not permitted to enter the inclosure at any time.

ARTICLE XXIX.—*Dissolution and Change of Firms, etc.*—It shall be the duty of every member of the Annex, to notify the Secretary of the Stock Exchange at once of any change in the constitution of the firm, and upon failure to comply with the provision of this article for a period of ten days, shall be fined twenty-five dollars.

The Philadelphia Mining Board of Trade.—After the consolidation of Mining Exchange with the Stock Exchange, in the Mining Annex, it was found that a good deal of business was left without a local habitation, so to speak, by the exclusive restrictions of the Annex rules. Corporate companies carrying on legitimate undertakings of various kinds, not only mining, but manufacturing and commercial, whose stocks were handled on the street, were not listed at the Exchange, and the parties interested in them were therefore constantly subjected to more or less inconvenience, the dissatisfaction arising from these circumstances suggested the idea of forming another Exchange for the trading in railroad, mining and miscellaneous stocks. The brokers who were opposed to the merger of the Mining Board with the Annex, took an active interest in this suggestion, and in the autumn of 1881, a plan was formulated for the new venture. A number of gentlemen associated and applied for a charter in November, and early in December the instrument was obtained, the grant being made to The Philadelphia Mining Board of Trade. This is believed to be the only instance on record in Pennsylvania of a charter grant to a commercial body of this description. The provisions of the charter are very liberal and permit the Board to trade in anything and everything coming within the scope of legitimate enterprise. Upon receipt of the charter, the association was regularly organized under the above title, and the following officers were elected: President, James B. Anderson; Vice-President, A. L. Garver; Secretary, A. H. Woodman; Treasurer, W. B. Keen; Chairman of Calls, Edwin Faxon; Clerk, James W. Mulford. Listing Committee, H. S. Twining, C. H. Woodruff, W. J. Radcliff. Room Committee, E. M. Harris, J. W. Mulford, S. H. Jenkins. Committee on Membership, Charles I. Fireno, W. H. Wade, K. H. Wilson. Committee on Finance, W. B. Keen, A. L. Garver, T. H. E. Gruel. Directors, James B. Anderson, C. I. Fireno, A. L. Garver, E. M. Harris, W.

B. Keen, W. H. Wade, J. W. Mulford, A. H. Woodward, F. J. Moody, W. J. Radcliff, W. S. Turner, C. H. Woodruff, H. S. Twining, K. H. Wilson.

The premises No. 239 Chestnut street were leased and fitted up as an Exchange, the place affording pleasant and suitable accommodation in an accessible location. Formal possession was taken December 27th, 1881, and the Exchange was open for business, after addresses by the President and other officers. The Exchange opened with 63 members, and the original subscription fee was $25. The membership has steadily increased, numbering 103, July 1st, 1882; and the fee has been advanced to $75. Any stocks of whatever description can be listed and dealt in at this Board, provided they represent valid enterprises with bona fide business and can pass the Listing Committee's examination as to capital, responsibility and character of management. The purpose is to rigidly exclude all wild cat corporations, and the concerns whose resources consist mainly of a desk and chair, but to extend liberal facilities to sound companies of good standing whether listed in other Exchanges or not. The business done during the first six months has been mostly in mining shares, though other stocks have also been handled. Trade has been growing in volume slowly, but on the whole satisfactorily, and the promoters of the enterprise are convinced that it is gradually attaining a position of assured permanency. On the 1st of July, 1882, the Board was found to be in excellent financial condition, and future prosperity looked fairly promising.

The Philadelphia Stock Market.—The several Mining Stock Exchanges have afforded facilities rather more than ample, for the buying and selling of mining stocks, and in this have rendered the public valuable service. Furthermore, they have enabled the promotion of mining enterprises to bring their properties and projects before the public and to solicit investments therein. A method commonly pursued in getting a mining company under way is to reserve a portion of the stock for working capital. This stock, called "treasury stock," is sold at the best price that can be obtained, and the avails supply the means for carrying on the undertaking until it can be made self-sustaining. This is the theory, and although it has not been found to work satisfactorily in practice, it is still defensible as a theory, and is generally followed in the promotion of mining companies. The Stock Exchanges have been used as agencies for the distribution of "treasury stock" among investors, and it must be plainly said that in the performance of this office, public confidence has been outrageously abused. It is true that the Exchanges have established rules and regulations looking to the exclusion of fraudulent concerns and abortive undertakings, and it is true also that no wisdom can provide against the misfortunes to which mining ventures are proverbially liable, but, after all allowance is made, the fact remains that through the Mining Exchanges of Philadelphia a vast amount of utterly worthless stock has been foisted on the public. An astonishing number of companies have sprung up whose principal and often only resources have resided in their "treasury stock," and the palming off of this stock has been the sole business contemplated. Even in cases where the companies have been honestly based on good properties in the beginning, the facility with which the public could be fleeced by operations in the stocks on 'change, has again and again tempted the managers to convert bona fide undertakings into schemes for swindling. The history of dealing in mining shares during the past three years is largely a history of the decline and extinction, so far as market price is concerned, of stocks originally issued with a flourish of trumpets at anywhere from a dollar to five dollars per share. Not less than $60,000,000 of nominal capital has been wiped out of the market during this time, and there are unquestionably still further reductions to be made. What actual loss investors have been subjected to it is of course impossible to estimate, and it is also impossible to determine what part of the loss has been due to misfortune and the actual exhaustion of mineral deposits, but it is certain that an appallingly large proportion is attributable directly to fraud. It is to be noted too that unavoidable business losses are met with fortitude in mining as in any other branch of human affairs, while the wholesale swindles here referred to have resulted in desperate depression, insanity and suicide.

The Share Market for 1881.—During the early months of 1881 business in mining stocks was carried on both at the stock exchange and at the mining exchanges. Of the companies listed at the stock exchange only *Tombstone*, *Girard*, *Orion* and *Iowa Gulch* showed much activity. Prices remained fairly steady on limited transactions at the Mining Exchange. The active stocks at the beginning of the year were *Fairview consolidated*, *Iowa Gulch*, *Rara Avis*, *Buena*, *Dauntless*, and *Argent*. The daily dealings at the Mining Exchange averaged 20,000 to 30,000 shares, gradually growing lighter towards the close of January. The variations in prices were not important except in the case of Iowa Gulch, which opened for the year at $1.00 at $1.10 and dropped to 35 during the last week of January, returning to 85 early in February.

On Tuesday, February 1st, 1881, the National Mining and Stock Exchange was opened in the rotunda of the Commercial Exchange Building, the chamber formerly occupied by the Philadelphia Stock Exchange. The occasion was marked by an entertainment tendered by the members of the New Exchange to the brokers, leading business men, distinguished citizens and the press. Speeches were made by Colonel A. Lowden Snowden, Director of the Mint, General Hartranft, Collector of the Port, Governor Safford of Arizona, and others, and, through press reports, the proceedings attracted a good deal of public attention. With this send off, business in mining shares took on increased activity and received more general notice both from speculators and from inventors. There were in February three Boards dealing in mining shares, namely, the popular old established stock exchange, the Philadelphia Mining Exchange and National Mining and Stock Exchange. The total dealings during February ran from about 120,000 to 200,000 shares daily. Of this aggregate the new National Exchange contributed from about 40,000 to 100,000 shares. Besides the stock listed elsewhere, the National traded actively in the shares of several new companies, the *Homestake* and the *Standard* being the most prominent. Toward the beginning of March the general market began to manifest noticeable weakness and prices showed a declining tendency, *Iowa Gulch*, the most sensitive stock, returning to 37½.

As the spring advanced trade improved in character, though not in volume, and the higher priced stocks were now freely handled. *Tombstone*, a regular dividend payer at this period, became a favorite, *Gunnison Improvement* was bought out and commanded respectable figures, and *Denver City consolidated* presented quite a substantial appearance as compared with the long list of trashy stocks selling at a few cents per share.

The market continued fairly active and without special feature requiring notice here, until after the middle of April, the fluctation in prices not being very important, the general tendency being slowly downward. During the third week in April *Tombstone* began to break off, slightly at first and subsequently with alarming rapidity. As the *Tombstone* company was the most solid and reputable corporation of its kind in Philadelphia, and as the stock had always stood at the head of the market, this break excited marked attention not only in mining circles but throughout the community. It was attributed to a disagreement among the managers of the company. The general market was a good deal demoralized by the weakness of *Tombstone*, and growing distrust was reflected in lighter dealings and lower quotations. The close of the spring season, however, found the market improving again. A change having been made in the management of *Tombstone*, the stock revived somewhat and though never fully recovering its former place was yet in fair investment demand at a range 20 to 30 per cent. lower than in its palmy days. The managers of this company were men of high standing in the community and a great many investors were satisfied to put money into the stock merely on the strength of the well known names at the head of it. The early summer trade was characterized by apathy and inertia, throughout. The general tendency of prices was steadily toward lower figures, and, many of the stocks of more speculative than actual value, slowly sank out of sight, their places on the share list knowing them no more. *Iowa Gulch*, heretofore cited as an illustration of the market and admittedly one of the most important stocks so far as traffic is concerned, wavered irregularly downward, and in July ranged from 35 to 45 cents per share. *Tombstone* held steady during this period at the lower range of $5.00 to $5.50. The Mining Annex of the old established stock exchange was opened at this season, but comparatively little trading was done then.

About the end of July and beginning of August there was a mid-summer access of activity, and with heavier dealings prices generally improved. The low grade stocks however continued to droop and the list of two cent stocks would have grown longer but that the poorest of them dropped below a cent a share and so out of the market. The improvement in the market was attributed in part to the consolidation of the Mining Stock Exchange with the Mining Annex of the Philadephia Stock Exchange which took place July 11th. The effect of this consolidation was to give the trade in mining stocks an appearance of greater stability and importance, and transactions in "100 shares at three cents buyer 60," no longer made such a noticeable not to say ridiculous feature of the sales reports. The stock sales at the Mining Annex, as the consolidation continued to be called, amounted to a daily average of over 150,000 shares. The receipts of bullion from Arizona especially were large and continuous, and the solid metal coming in large quantities had a stimulating effect on mining investments. There was a good demand for stocks in fair repute and Philadelphia claimed the credit for the moment of the best mining share market in the country.

Late in September and during the first weeks of October, investment traffic declined and speculation followed suit, the dealings at the Annex falling off to 75,000 or 80,000 shares daily. Prices drooped and though rallying fitfully at times did not at any moment recover the August range. During October and part of November the market exhibited signs of improvement. The commission trade, which is the basis of stock dealing, was larger and prices occasionally reached an almost buoyant character. Several of the older companies that had been in difficulties owing to incompetent management, effected salutary changes during the autumn and presented more hopeful prospects; and rumors of the decline of other companies, the *Tombstone* for example, were held to be disproved by continued dividends. The improvements did not hold through December, the market resuming its gravitating course, turning very dull and ruling heavy toward the holidays. Distrust of *Tombstone* was again manifested and although the 20th monthly dividend was paid in December, the stock dropped $2.00 per share. *Iowa Gulch* fell to 30 cents and the entire list was decidedly lower. The year came to a close with the market in a weak and yielding state. The result of the dealings for 1881 may be summed up in the statement that some 20 companies were wiped out of the market and the range of prices was let down 25 to 30 per cent.

The Share Market in 1882.—An important event in the opening of 1882 was the watering of the stock of *Iowa Gulch*. This was important, not only to the company and to the parties immediately interested, but to the entire mining community. *Iowa Gulch* occupied a prominent position in the share market, and the proposal to increase the stock attracted general attention. There had been a strong disposition manifested during the latter part of 1881 to protest against the capitalization of mining companies at absurdly inflated figures, and against the abuses incident to the issue of "Treasury stock." The capital of *Iowa Gulch* was already 500,000 shares, and this proposal was to put out 100,000 shares more. The issue was professedly proposed for the purpose of procuring more working capital; that is to say, it was another issue of "Treasury stock." It was hoped that the shareholders would refuse to sanction the project, but there was very little opposition, and the addition of 20 per cent. to the nominal capital was duly made. It is not too much to say that this instance of persistence in demoralizing practices tended seriously to injure the mining share market, as it unquestionably gave an impetus to the subsequent decline in the stock of this company. This decline during January reached 27 cents per share from a range of 35 to 45.

During the first month of the year, reports began to be heard that the deposit on which the prosperity of *Tombstone* had been based was exhausted. Furthermore, it was admitted that the company had a large floating debt to be provided for instead of a considerable surplus fund as previously claimed. An important law suit threatened to terminate adversely to the company, and altogether the model company of Philadelphia seemed to be in a bad way. The January dividend was, however, paid on time, and the stock which had been down to $3.80 rallied to $4.50 before the close of the month. Outside of the regular market, the *Gunsight* company, a Philadelphia concern, with a promising property in Pima county, Arizona, began to attract investments. The *Lake Valley* mines, Dona Ana Co., New Mexico, owned by Philadelphians, and since attaining wide celebrity as wonderfully rich properties, on which the *Sierra* companies have been located, also came conspicuously before the public, early in the year.

The general market was very quiet during the late winter and early spring, in sympathy with stock speculation of every description. Beside this reason for lighter dealings, the decline of prices for a number of stocks on the list to very low figures tended to check operations. There is very little inducement to trade in a stock after it has sunk to a range of 3 or 4 cents a share. In February and March *Tombstone* made its regular dividends, and maintained its price at about the same figures, although it was tolerably evident that large blocks of stock were being distributed on the market. The *Sierra* mines were not listed, but were selling outside at about $2.50 for *Sierra Apache*, $3.00 for *Sierra Bella*, and $6.00 for *Sierra Grande* and *Sierra Plata*. *The Philadelphia Mining and Smelting Company* and the *Little Wood River Mining and Smelting Company* are also Philadelphia organizations, whose stock, though unlisted, attracted increasing attention during the spring months. The stocks sold during the spring at $5.00 to $6.00 per share. An incident of the month of March occasioning a noticeable excitement was the arrest of the ex-secretary of the *Grand Union Gold and Silver Mining Company*, together with two mining stock brokers on charges of conspiracy to defraud by over issues and bogus transfers to the extent of 135,000 shares of the *Grand Union Company's* stock. This event occasioned the more commotion as it was a matter of common report that the stock of other companies had been tampered with in similar ways. The first attempt to bring punitive measures to bear on wild cat stock operations had the effect of putting a check on the bringing out of "paper" companies, and hastened the retirement of others already on the market. It also awakened attention to the desirability of making the registration of stock compulsory on all listed companies. There was some discussion of a proposal for compulsory registration among the brokers during the spring and early summer, but up to present writing nothing practical has come of it.

The *Tombstone* April dividend was paid as usual, but the annual statement of the company showed a discouraging state of affairs, the conditions revealed being even more hopeless than the street gossips anticipated. From a range above $4.00 per share the stock fell below $2.00 before the close of April, and predictions were freely ventured that no further dividends could be made. During this period, *Iowa Gulch* declined below 25 cents per share and was in consequence relegated to a place among the "penny shares," after having been for a considerable period at the head of the list. The general market continued very dull and the sagging tendency above noted ruled through the list, with two or three exceptions. The unlisted stocks were in better demand in April and May and it became evident that a better business was growing up in these stocks than the regular call could command. Prices for the *Sierras* and *Little Wood River* companies shares remained firm at about the same figures. In May the dealings on 'change declined still further, the average amounting to about 60,000 shares daily; sometimes dropping to half that volume, and, moreover, a large proportion of the transactions were in the "penny" stocks. Of the higher priced shares, *Tombstone*, and *Girard* a neighboring concern, furnished more than half the business. On the 26th of May a great fire occurred in the *Tombstone* settlement and *Tombstone* stock fell to 1.27½. The rest of the list seemed to be gradually wearing out the respect and even the patience of the community. With one or two exceptions, prices were at figures so low that shares had to be handled by the basketful to make any show of business, and even the most persistent operators showed evidences of weariness and disgust with the old list of worn, frayed-out, and too often worthless "penny" shares. The principal listed companies at the close of June, 1882, are *Tombstone*, selling at $1.02½ to $1.10; *Denver City*, at .30; *Silver Cord*, at 62½; *Iowa Gulch*, at .22; *Girard*, at .33; *Gunnison*, at .95; *Argent*, at .20; *Pembina*, at $1.02½; *Rara Avis*, at $1.45; *Governor's Group*, at .24; *Buena*, at .11; *Penn Breckenridge*, at .40; *Compromise*, at .27½; *Cincinnati*, at .13. Beside these there are 66 other companies listed, in various stages of decline, from 25 cents to 1 cent per share. The principal unlisted companies are the *Philadelphia Mining and Smelting*, selling at about $6.00; the *Little Wood River*, at $5.50; *Sierra Grande*, at $6.50; *Sierra Platte*, at $5.75; *Sierra Bella*, at $2.25; and *Sierra Apache*, at $1.70.

The amount of live Philadelphia capital in gold and silver mining at this date is estimated at $50,000,000, though the considerable number of private ventures making no public exhibit whatever, renders the extent of investment somewhat uncertain. The receipts of bullion from the mines owned here are larger than ever before and are gradually increasing. The prospects of valid enterprises are in most cases very favorable, and their stocks, nearly all of which are unlisted, are likely to meet with fair investment demand. But as to the trade in the list now handled at the Mining Annex, no one can deny that it seems to be "peetering out." Unless a radical improvement is made very soon, the Mining Annex will become as moribund as some of the old stocks it still clings to.

THE BOSTON MINING AND STOCK EXCHANGE.

THE deep interest taken in Boston and throughout New England in the revival of the mining interest on the Eastern coast, led in Sept. 1880, to the organization of a separate exchange in Boston for dealings in mining securities. The name adopted was the "Boston Mining and Stock Exchange," a number of the younger and active brokers of the city joined the exchange, and for a time the board was very popular and the business transacted was large. The repeated disappointments of the public brought about by misplaced confidence in the managers of mining schemes, have finally had their decided effect upon this exchange, however, and the business transacted on it from day to day is much smaller than formerly. Following are the constitution and by-laws of the exchange revised to March of the current year:

CONSTITUTION OF THE BOSTON MINING STOCK EXCHANGE.—The subscribers associate themselves together for the purpose of establishing at Boston a place where mining and other stocks may be bought and sold, after the manner usual in a stock exchange; and to this end we hereby adopt the following Constitution:

ARTICLE I.—*Name.*—The name of the association shall be "The Boston Mining and Stock Exchange."

ARTICLE II.—*Annual and Special Meetings.*—The annual meeting of the members shall be held on the third Tuesday of September, at twelve o'clock noon, in the rooms of the Exchange at Boston.

Notice of the time and place of meeting shall be mailed to each member at his place of business by the Secretary, not less than seven days prior thereto.

Special meetings may be called whenever the President or Standing Committee deem expedient, and shall also be called upon the written request of not less than ten members, addressed to the Secretary, stating the object of the meeting.

Notice of special meetings shall be given by the Secretary in manner aforesaid, not less than two days prior thereto, and shall state the object of the meeting. All meetings may be adjourned from time to time for the purpose of acting upon unfinished business, but no business shall be transacted at any adjourned meeting which would not have been in order at the meeting originally called.

ARTICLE III.—*Quorum.*—Fifteen members shall be necessary to constitute a quorum for the transaction of any business; except that in the regular daily sessions for the buying and selling of stocks, no quorum of members shall be requisite.

ARTICLE IV.—*Votes and Proxies.*—At all meetings each member shall be entitled to one vote.

Voting by proxy shall be allowed only at the annual election of officers.

ARTICLE V.—*Officers.*—At each annual meeting, there shall be chosen by ballot from among the members a President, Vice-President, Treasurer, Secretary, Chairman of the Exchange, a Standing Committee, Finance Committee, and a Committee on Securities; each of the said committees to consist of five persons. The President and Vice-President shall be members *ex-officio* of the Standing Committee; the President and Treasurer shall be members *ex-officio* of the Finance Committee; and three members shall be chosen at large as aforesaid, upon such committees, to complete their number. The Committee on Securities shall be chosen at large from the members.

Any vacancy occurring in any of the foregoing offices from death, resignation, permanent absence, disability, or otherwise, shall forthwith be filled by election by ballot, at a special meeting of the members of the Exchange to be called for that purpose.

ARTICLE VI.—*Duties of the President.*—The President shall preside at all meetings of the members except at the regular daily sessions for buying and selling stocks. He shall have the custody of the Treasurer's bonds; he shall be *ex-officio* chairman of the Standing and Finance Committees, and preside over their meetings; he shall have a casting vote in case of tie; and his decision upon points of order shall be final unless, upon an appeal being taken, he is overruled by a two-thirds vote of the members present and voting.

ARTICLE VII.—*Duties of the Vice-President.*—It shall be the duty of the Vice-President to perform the duties of the President in the absence of the latter. And in case of the absence or disability to act, of the President or Vice-President, the Chairman of the Exchange shall preside at all meetings regularly called, excepting the annual meeting, and shall be possessed in this particular of all the powers now vested in the President or Vice-President, excepting that of casting a vote in case of a tie.

ARTICLE VIII.—*Duties of the Treasurer.*—The Treasurer shall have charge of the money and funds of the Exchange, shall deposit the same apart from all other money in his name as Treasurer, or in the name of the association, as shall be determined by the Finance Committee, in some bank to be designated by said committee, and shall pay the current bills of the Exchange upon the approval of the Finance Committee. He shall keep accurate books of account, showing the receipts, expenditures, and funds of the Exchange, which shall upon all reasonable times be open for the inspection of all the other officers and members. At each annual meeting he shall render a statement in writing, showing the financial condition of the Exchange. He shall give such bonds for the faithful performance of his duty as the Finance Committee may by vote require. He shall perform such other duties as the Finance Committee shall from time to time assign him.

ARTICLE IX.—*Duties of the Secretary.*—The Secretary shall give notice of all annual and special meetings of the Exchange in the manner aforesaid, and shall keep a correct record thereof, which shall at all reasonable times be open for the inspection of any member, and shall keep a list of fines, recording all sales and purchases made at the Exchange, and such other transactions between members as may be reported to him in writing by the parties respectively interested, and shall perform such other duties as may from time to time be assigned him by the Standing Committee.

ARTICLE X.—*Duties of the Chairman.*—Section 1.—It shall be the duty of the Chairman of the Exchange to preside during the daily sessions, to call stocks at the hours which may be fixed from time to time by the Exchange, to settle all questions of order and enforce the by-laws, rules and regulations during such session; and to this end he is authorized in his discretion to impose reasonable fines, from which there shall be no appeal. The Chairman shall be a member of the Exchange, *ex-officio*.

Section 2.—No member shall speak more than twice on any question under discussion by the Exchange without permission from the presiding officer; nor shall any member interrupt another while speaking, except when raising a point of order.

ARTICLE XI.—*Duties of the Standing Committee.*—The Standing Committee shall define the powers and duties and shall fix the salaries of all the officers and servants of the Exchange. They shall have the general management of all the business of the Exchange, except as herein otherwise provided; they shall keep minutes of their proceedings, and shall, when required, submit the same for examination at any meeting of the Exchange; to them shall be referred all applications for membership, for such recommendations to the Exchange as they shall see fit to make thereon. They shall hold monthly meetings, and in addition thereto shall meet at any time upon the call of the Chairman or any member whose grievances are laid before them. Any action of the Standing Committee may be reversed by vote of a majority of the members present at any regular or special meeting.

ARTICLE XII.—*Duties of the Finance Committee.*—The Finance Committee shall have general charge of the finances of the Exchange, shall determine the bank and manner in which the Treasurer shall deposit its funds, and the method of checking out the same. They shall also invest any surplus which may accumulate from time to time not needed for the payment of expenses, at their discretion, in the name and for the benefit of the Exchange, unless otherwise ordered by a three-fourths vote at a meeting called to act upon the disposal of the surplus fund, and no appropriation exceeding the sum of one hundred dollars shall be made (except for ordinary expenses) without three days' notice being given, unless by the vote of a majority of the members of the Exchange present at any regular or special meeting.

They shall keep minutes of their doings, which when required shall be submitted to the Exchange for examination; they shall also require from any officer or servant such bonds as they shall see fit.

ARTICLE XIII.—*Duties of the Committee on Securities.*—The Committee on Securities shall examine and report upon all stocks and other securities entered or to be entered upon the regular list of the Exchange, and all applications to place securities upon the list shall be made to them; and on a favorable report by a majority of the committee, such stocks and securities shall be placed upon the regular list. Every company on making application shall pay a fee of one hundred dollars at the time of application, to be retained by the Exchange, whether the stock is accepted or rejected. The committee shall also designate what stocks or bonds shall be placed upon the *free* and *fine* lists, with power to revise the same whenever in their judgment it shall be deemed advisable, subject, however, to the approval of the Exchange.

ARTICLE XIV.—*Election of Members.*—The number of members of the Exchange is limited to one hundred and fifty; election of membership shall be by ballot; and no person shall be eligible thereto who is not a stock broker or dealer in stocks at the time of application, except as hereinafter provided. The application must be indorsed by at least two members of the Exchange, and receive the approval of the Standing Committee, after which the name of the applicant and parties indorsing him shall be conspicuously posted in the Exchange Room at least five days before election; and six black balls shall exclude. After such rejection of any person, no new application for his election shall be entertained within thirty days, nor be voted upon within ten days from the date of the new application. Whenever it shall be made to appear to a majority of the Standing Committee that a wilful misstatement upon a material point has been made to them by an applicant for admission or readmission, they shall report the case to the Exchange, and the offending party shall be deprived of his membership, or declared forever ineligible for admission, as the case may be, by a vote of two-thirds of the members present.

ARTICLE XV.—*Fees.*—Every person admitted by election to membership, before doing business at the Exchange, shall pay an initiation fee of not less than two hundred dollars; and all members admitted by transfer shall pay a fee of twenty dollars. In all cases where the initiation or transfer fee shall not be paid within five days after the admission of a member and his notification by the Secretary, such admission shall be declared void. Every member shall pay annual dues of not less than fifty dollars, payable quarterly in advance. These dues may be advanced by a majority vote of members of the Exchange, at a meeting specially called to consider the subject of such advances, or the same may be reduced, but not below the figures before stated, by a like vote, at a meeting specially called to consider the subject of such reduction: *provided, however*, that no such advance or reduction shall take place until the next following year or quarter, as the case may be. Non-payment of quarterly dues continuing over fifteen days shall subject the member to pay an additional amount of ten per cent. to be added to his bill; and at the expiration of thirty days the Secretary shall notify such delinquent member that if his dues are not paid within five days from the date of such notice, his membership will be terminated, and he shall not be reinstated unless he can furnish some reasonable excuse for non-payment of said dues.

ARTICLE XVI.—*Transfer of Membership.*—Section 1.—Whenever any member wishes to transfer his membership, the name of the party to whom he proposes to transfer shall be submitted to the Standing Committee, and his election shall be made by ballot, as provided in Article 14; but no transfer shall be made provided the member transferring has unsettled contracts with any member of the Exchange.

Section 2.—If any suspended member fails to settle with his creditors, and apply for readmission within three months of the time of his suspension, his membership shall be disposed of by the Standing Committee, and the proceeds paid *pro rata* to his creditors in the Exchange.

Section 3.—In every case where a member is deprived of his membership or declared ineligible for readmission by reason of any offence against or under the laws of the Exchange, his membership may be disposed of forthwith, and the proceeds covered into the treasury of the Exchange.

Section 4.—Any creditor falling to file with the Secretary a written statement of his claim against a member, prior to the transfer of the right of membership of such member, shall forfeit all right to a distributive share of the proceeds of such membership.

Section 5.—When a member dies, his membership may be disposed of by the Standing Committee; and, after satisfying the claims of the members of the Exchange, they shall pay any balance to the legal representatives of the deceased. The Standing Committee shall have full power to determine the price at (not less than the market price) which the seat of the deceased shall be sold.

ARTICLE XVII.—*Commissions.*—No member shall charge a less commission on sales than the rate established by the Exchange, nor make nor cause to be made any purchase or sale whatever for any person who is not a member of the Exchange, without charging full commission. A division of commissions, however, may be made with members of any other Stock Exchange offering a like privilege. Any member violating this article shall be fined twenty-five dollars for his first offence, and shall be deprived of the privilege of membership until his fine is paid; for any subsequent violation he shall be suspended from the Exchange for three months, and shall pay a fine of fifty dollars.

ARTICLE XVIII.—*Contracts.*—When the principals on time contracts are surrendered and accepted, it shall be done in writing. No party to a contract shall be compelled to accept a principal other than the member offering to contract, unless the name proposed to be substituted shall be declared at the time of making the offer.

ARTICLE XIX.—*Insolvency.*—Any member who fails to comply with his contracts or becomes insolvent shall be suspended until he shall have settled with all his creditors. On his application for readmission, a special committee of five members shall be appointed to investigate his conduct and the cause of his failure, who shall report the same to the Exchange; and if, after three days' notice, two-thirds of the members present in voting are in favor of re-instating him, he shall be again entitled to his seat: *provided, however*, that, after a second failure, a vote of three-fourths of the members present and voting shall be required for his readmission, the votes in each case to be taken by ballot; and no person after his suspension shall be allowed to take his seat at the board until all of his dues accruing during his suspension shall have been paid.

ARTICLE XX.—*Fictitious Sales.*—No fictitious sale or contract shall be made at this Exchange; and any member violating this article shall be suspended during the pleasure of the Exchange upon a majority vote of members present and voting.

ARTICLE XXI.—*Indecorous Conduct.*—Any member of the Exchange who shall be guilty of indecorous language or conduct toward another member while the Exchange is in session shall be suspended by a majority vote of members present and voting, for not less than one week nor more than one month; repetitions of the offence shall subject the party so offending to expulsion upon two-thirds vote of members present and voting by ballot, after which he shall not be re-admitted except upon a like two-thirds vote.

ARTICLE XXII.—*Powers to make By-laws.*—The Exchange shall have power to make such by-laws, rules and regulations not repugnant hereto, as its members, by two-thirds vote of those present and voting, shall from time to time deem requisite for the orderly and efficient conduct of its affairs. No such by-law, rule or regulation shall be altered, amended or repealed, except upon a like two-thirds vote; nor shall the proposition to pass, alter, amend, or repeal any by-law, rule or regulation be acted upon, except at a meeting specially called for the purpose by the Secretary of the Exchange, upon motion of five members.

ARTICLE XXIII.—*Signing the Constitution.*—This Constitution shall be signed by each member before transacting business at the Exchange; and each one thereby pledges himself to be governed by the provisions thereof, and to keep and obey such by-laws, rules, and regulations as may from time to time be adopted by the Exchange.

ARTICLE XXIV.—*Refusal to Comply with the Constitution, By-laws, etc.*—Any member charged with violating any article of this Constitution, or any by-law, rule or regulation of the Exchange, shall be entitled to a hearing by the Exchange; and if he be found guilty of the offense, the penalty for which or the vote imposing which is not herein specifically provided for, he shall be fined, suspended, or expelled, as shall be determined by two-thirds of the members present and voting by ballot.

ARTICLE XXV.—*Non-Liability of Members.*—Nothing in this Constitution shall be construed as creating between members a partnership in any stock transaction, nor as imposing on them any pecuniary liability whatever for each other's contracts in buying, selling or delivering any stock; but the entire liability of each and every member is hereby declared to be expressly limited to his proportionate share of the necessary current expenses of maintaining and conducting the Exchange.

ARTICLE XXVI.—*Changing the Constitution or By-laws*—Any article in the Constitution or By-laws may be altered, amended or repealed by a two-thirds vote of the members present and voting at a special meeting to be called for the purpose, on notice mailed by the Secretary to each member at his place of business, not less than seven days prior thereto, and stating the object of the meeting.

ARTICLE XXVII.—*Gratuity Fund.*—Upon the death of any member of the Exchange there shall be levied and assessed against each surviving member the sum of ten dollars, and the amount collected from such assessment shall be paid as a gratuity to the representatives of the deceased, on the conditions as follows:

First.—Should the member die leaving a widow and no children, the whole amount collected shall be paid to such widow for her own use.

Second.—Should the member die leaving a widow and children, then one half of the sum collected shall be paid to the widow for her separate use, and one half to the children for their use, share and share alike, provided that the share of minor children shall be paid to their guardian.

Third.—Should the member die leaving children and no widow, then the whole sum collected shall be paid to the children, as directed in the preceding section.

Fourth.—Should the member die leaving neither widow nor children, then the whole sum collected shall be paid to such person or persons as he may especially designate; and in case of his decease without any special designation as to the amount, it shall be paid to his heirs-at-law.

Fifth.—Nothing herein contained shall ever be taken or construed as a joint liability of the Exchange, or its members, for the payment of any sum whatever, beyond the amount collected, as heretofore stated, it being distinctly understood that the amount paid is a gratuity. All payments and assessments shall be charged against each member of the Exchange, and shall be collected in the same manner and have the same priority as all other fines, assessments and dues.

BY-LAWS.

ARTICLE I.—*Opening of the Exchange.*—The Exchange shall be open every business day at 10 o'clock A. M., and continue open until 3.30 o'clock P. M. The regular calls for stocks and bonds shall be at 11 o'clock A. M. and 2 o'clock P. M., which hours may be changed by the vote of a majority of the members present. One or both of the sessions may be omitted at any time by a like vote; *provided, however,* that the Exchange shall not adjourn for more than one day, without the consent of two-thirds of the members present.

ARTICLE II.—*Calls.*—The order of business at the regular calls shall be as follows:

First.—Call of the regular list of stock or bonds.
Second.—Call of the free list.
Third.—Call of the fine list.
Fourth.—Call of the stocks or bonds at the request of members.
Fifth.—Reverting to stocks at the request of the members.

ARTICLE III.—*All Offers Binding.*—All offers made and accepted shall be binding, whether reported by the Chairman or not.

No offers to buy and sell privileges, to take or deliver securities, shall be made publicly at the Exchange.

No bids or offers shall be allowed on stocks selling under one dollar per share of less than one per cent. per share, and on stocks selling at one dollar and under two dollars of less than two and a half cents per share, and on stocks selling over two dollars of not less than five cents per share.

ARTICLE IV.—*Offers to Buy or Sell must state Amount.*—Any member offering to buy or sell stocks or other securities at the Exchange shall state the number of shares or the amount: and no one shall be allowed to withdraw an offer which he has made, unless it be done in an audible voice. All previous offers shall be considered as withdrawn after a sale, or when the Chairman has passed to another stock. Any sale or purchase made when the amount was not stated shall be considered for one hundred shares. Any member offering stock who refuses to name the amount shall be fined, and the bid offered shall not be entertained by the Chairman.

ARTICLE V.—*When Offers are not Allowed.*—No offer allowed while the Chairman is reporting sales.

After a sale has been made and while the Chairman inquires the terms, no member shall propose a new bargain until the Chairman has actually stated the result for the purpose of record by the Secretary; and when any stock is under consideration after the list has been regularly called, no member shall be allowed to call any other stock until the Chairman has said, "Any other stock?"

ARTICLE VI.—*Claimants for Purchase or sale of Stocks.*—In case there are two or more claimants for the purchase or sale of stock, the Chairman shall decide the same, or he may appeal to the Exchange for their decision; if an appeal is made from the decision of the Chairman, and the appeal is seconded by five members, the question shall be put to vote.

ARTICLE VII.—*Settlements.*—All purchases and sales shall be settled on the next business day unless expressed to the contrary; and all contracts falling due on Sunday, or such holiday as is observed by the banks, shall be settled on the preceding day; or when two holidays occur on consecutive days, as when Sunday immediately precedes or follows a holiday, a contract falling due on the first of such holidays shall be settled upon the business day immediately preceding, and those maturing upon the second of such holidays shall be settled upon the business day next following, together with whatever interest may be due to the day of settlement; and whenever the Exchange shall adjourn for a day, all contracts maturing on that day shall be settled on the day following. In all sales or contracts for stock between members of the Exchange, the party who has to receive the same shall not be bound to take it after 1.30 o'clock, P. M., but may postpone payment, without being charged interest, to the following day.

ARTICLE VIII.—*Rights to take or Deliver.*—When a contract is made for the right to take or deliver stock on or before a certain day, the right shall cease at 2 o'clock on the last day; but the settlement shall be made on the next day; and the usual grace is to be allowed on such contracts, if at one month or more, as in ordinary sales on time. Contracts for "the right to take or deliver" bear no interest, but shall, if consummated be regarded in all other respects as regular contracts on time, and be governed by the same rules.

ARTICLE IX.—*Notices for the demand or delivery on Time Sales.*—In all contracts on demand or on time, at the option of the buyer or seller, one day's previous notice shall be given before the stock can be demanded or delivered; and such notice must be given at or before 2 o'clock P. M.

ARTICLE X.—*Payments and Transfer of Stocks.*—On the sales of stocks which are transferable in Boston, either party shall have the right to require the purchase money to be paid at the time and place of transfer, and of stocks transferable elsewhere, at the time of delivering the certificates, in the name of satisfactory parties, with powers of attorney or other necessary documents.

ARTICLE XI.—*Contracts maturing during the close of Transfer Books.*—Contracts for stock which may arrive at maturity while the transfer books are closed shall be extended until the opening; and where interest has been allowed, it shall continue until the opening of the transfer books. Contracts to be settled at the opening shall carry interest, unless the books are opened within three days. Margins may be called on such sales or purchases as in time contracts.

ARTICLE XII.—*How deliveries shall be made when Transfer Books are closed by Legal Impediment.*—Whenever transfer books of any company shall be closed by any legal impediment, certificates properly indorsed shall constitute a delivery.

ARTICLE XIII.—*Dividends.*—Section 1.—On the day of closing of the transfer books of any stock for the purpose of dividend, any such stock sold for cash shall be "dividend on" previous to the time officially designated for the closing of books. All transactions shall be "dividend off" after the day of closing the books.

Section 2.—When a dividend is declared during the pendency of the contract, the seller shall collect, hold, allow interest on, and pay the same to the buyer at maturity of the contract.

Section 3.—And when new stock shall be created in any existing corporation, the stock of which has been sold on time, or where shares shall be entitled to similar privilege, the purchaser of any stock entitled to such new stock or other privilege may take such new stock and pay for it, unless the seller's security would be thereby impaired; in which case the purchaser shall give additional security, or make some other satisfactory arrangement, it being understood that a sale on time gives to the purchaser all the collateral advantages, and that said purchaser assumes all responsibilities which he would have had if he had actually taken delivery of the stock, the seller being considered as holding it as security for the payment of the purchase money.

Section 4.—When any assessment shall become due on stock sold on time, the seller shall pay such assessment, which shall be refunded by the buyer on settlement of the contract.

ARTICLE XIV.—*Time Contracts.*—Sales made on three days or less carry no interest; sales of over three days carry interest; sales of less than thirty days carry no grace; sales on thirty and sixty days shall be considered as one and two calendar months; sales of thirty days and over carry grace, and also interest to the day of settlement.

ARTICLE XV.—*Tendering of Stocks.*—In all time contracts it shall be the duty of the seller to tender stocks sold at the expiration of the contract; and, in case of neglect so to do it shall be the duty of the buyer to notify the seller the following day, and if such notification is not given within three days, no further liability shall be attached to either party.

ARTICLE XVI.—*Notification on time sales of Stocks.*—Buyers of stocks on time shall be entitled to one day's notice, said notice to be given before 2 o'clock on the day previous. Borrowers and lenders of stocks shall be entitled to the same notice for the return of the stocks; and any failure to respond to such notice shall be considered a violation of contract.

ARTICLE XVII.—*Proxies.*—In all sales on time, the seller shall have the option to give proxies or not, as be may elect.

ARTICLE XVIII.—*Bids for turning Stock.*—When a party bids for regular stock "for the turn," the sale of the regular stock shall not cut off the buyer bid on the Exchange.

ARTICLE XIX.—*Clerk shall read Sales.*—At the close of any call where there have been several transactions, the clerk shall read such sales at the request of any member.

ARTICLE XX.—*No Bids or Offers received while Members are Seated.*—No bids or offers shall be received from members while seated; a fine of twenty-five cents shall be imposed upon any member making such bids or offers; but bids and offers may be made from any part of the floor by members while standing.

ARTICLE XXI.—*Sales to be Reported.*—All sales made at the Exchange shall be reported unless objected to by three members; and such objection is sustained by a majority of the members present.

No person shall have access to the records of the Exchange except members, their partners or clerks, and no member shall inform any one, except other members, their partners or clerks, or for the purpose of notifying principals, by whom any sale, or offer to buy or sell, has been made at the Exchange, under a penalty of twenty-five dollars for each offence.

ARTICLE XXII.—*Fine for Smoking.*—Any member smoking in the rooms of the Exchange during the sessions of the board shall be subject to a fine of one dollar for each offence.

ARTICLE XXIII.—*Stocks quoted "Self to Self."*—When any member quotes stock as bought or sold "self to self," it shall cut off his bids, but shall not affect any other bids or offers on the board at the time.

ARTICLE XXIV.—*Deposits on Contracts.*—On all contracts for stocks or bonds sold on time, either party may require a deposit of thirty per cent. of the contract price; and in case of variation in the market price of the securities bought or sold, a further deposit shall be made if called for by either party to keep the thirty per cent. good during the existence of the contract. In case of default by either party to make any additional deposit which may be required, or in case of non-fulfillment at expiration, the contract may be closed, by purchase or sale, as the case may be, on the following day. The seller shall always have the privilege of depositing the whole amount of the stock sold, in lieu of the cash; in which case the margins shall be paid to him by the buyer, and the amount credited on the contract, and bear the same rate of interest as specified in the contract. Margins called before half past twelve o'clock P. M. shall be deposited before two o'clock of the same day; if called after half past twelve o'clock P. M., shall be deposited before eleven o'clock the next morning. All margins shall be placed in the "American Loan Trust Company," when requested by either party.

ARTICLE XXV.—*Default.—Closing Contracts under the Rule.*—Should any member neglect to fulfil his contract on the day it becomes due, the party or parties contracting with him shall, after giving notice, employ an officer of the Exchange to close the same before half past twelve o'clock P. M. on the following day in the Exchange, by purchase or sale, as the case may require, accounting with the member in default for any surplus, or charging him with any deficiency.

In case of a failure of a creditor to close the contract as above, the price shall be fixed by the price-current at the time such contract ought to have been closed under the rule.

In all cases where an officer may be directed to buy or sell securities under the rule, the name of the member giving the order shall be announced. No order for the purchase or sale of securities under this rule shall be executed unless made out in writing, over the signature of the party giving the order, who shall state the reason therefore; and it shall be the duty of the officer who executes the order to indorse thereon the name of the purchaser or seller, the price, and the hour at which the contract is closed, and hand the same to the Secretary of the Exchange, who shall, within twenty-four hours, ascertain whether the party for whose account the order was given has paid the difference, if any, arising from the transaction. If not paid, the Secretary shall report the default to the Chairman, whose duty it shall be to announce the facts to the board at the next regular session. The duty devolving upon the officers of the Exchange, under this rule, shall be performed without charge.

When a contract is closed under this rule, any action of the defaulter, direct or indirect, by which the prompt fulfilment of such contract is delayed, hindered or evaded, to the detriment of the other contracting party, shall subject the offending party to suspension for not less than thirty days, or he may be expelled from the Exchange by a vote of two thirds of the members present at any meeting. When contracts are closed out under the rule, any member supplying the bid or offer, and not duly receiving or delivering the stock, as the case may be, renders himself liable to prosecution under this article.

Should any stock thus sold not be delivered until the next day, the contract shall continue; but the party defaulting shall be liable to pay such damages as may be assessed by the Standing Committee.

The same rules, as to notice, time and place, that govern defaults in other contracts shall apply to borrowed securities, which, on non-delivery of receipt, must be borrowed or loaned in open market, except in case of actual default in receiving or delivering after notice to close the loan; then the same are to be bought or sold, as the case may be, for account of the defaulter, in the manner provided in this article.

ARTICLE XXVI.—*Dealings with Non-members.*—Any member dealing with a person not a member in the rooms of the Exchange, without demanding of him the name of a member of the Exchange who shall act as his broker in the transaction, shall be subject to a suspension for not less than sixty days, nor more than twelve months.

ARTICLE XXVII.—*Calling Stocks.*—Any member shall be allowed to call any stock regularly listed or called at any other stock board; and the caller of any stock shall be entitled to the first bid or offer.

ARTICLE XXVIII.—*Fine List.*—Any stock placed upon the fine list by the Committee on Securities and dealt in at the Exchange, shall subject the seller to one fine of twenty-five cents for all sales he may make in such stock during the session of the board. All fines shall be due and payable monthly.

ARTICLE XXIX.—*Dispute or Disagreement among Members.*—In case of dispute or disagreement between members of the Exchange, or in which a member of the Exchange is a party in interest, the matter in question shall be referred to a committee of three persons, two of whom shall be selected by the respective parties, and the third chosen by the two thus selected; and the decision of this committee, if unanimous, shall be final and binding upon the parties, otherwise the committee shall report the case to the Exchange for their decision.

ARTICLE XXX.—*Failure.*—In case of the failure of any member of the Exchange, a committee of three members (if so requested by said member or by any creditor) shall be appointed to take into consideration any or all of his unsettled contracts, and to adjust the same in such manner as may appear to said committee to be equitable, unless the insolvent party shall, within three days of the time of failure, give satisfactory security for the fulfilment of his contract or contracts at maturity.

The insolvent member shall not, however, be precluded from an appeal from the decision of the committee, nor shall the committee be allowed to surrender the settlement of said member's affairs into his hands without authority from the Exchange; and all balances collected by said committee shall be paid over to the Treasurer of the Exchange, to be held by him as a fund, separate and distinct from all other money in his hands, until such time as the Standing Committee may deem it safe and proper to distribute the same, when it shall be returned by the Treasurer to the chairman of the first-named committee, to be paid by him, after deducting the necessary expenses, to the respective parties entitled thereto.

ARTICLE XXXI.—*Neglect to Pay Fines.*—Any member who shall neglect to pay his fines for fifteen days after they become payable, shall, after due notice, pay an additional amount of ten per cent., to be added to his bill; and if not paid at the end of thirty days, he shall no longer be considered a member, and his membership may be disposed of by the Standing Committee.

ARTICLE XXXII.—*Annual Assessments.*—The annual assessments on each member shall be fifty dollars, payable in advance installments, Jan. 1, April 1, July 1, Oct. 1.

ARTICLE XXXIII.—*Rescinded Assessments.*—On all time sales of stock, after an assessment becomes delinquent, and is thereafter rescinded, the buyer may, upon delivery, deduct the amount of of said assessment from the contract price of said stock.

ARTICLE XXXIV.—*Commissions.*—Stocks selling under fifty cents per share, the commission shall be fifty cents per hundred shares.

Stocks selling at fifty cents and under one dollar, commission shall be one dollar per hundred shares.

Stocks selling at one dollar per share and under two dollars, commission shall be two dollars per one hundred shares.

Stocks selling at two dollars and under five dollars per share, commission shall be three dollars per hundred shares.

Stocks selling at five dollars and under ten dollars, commission shall be five dollars per hundred shares.

Stocks selling at and over ten dollars per share, commission shall be ten dollars per hundred shares.

Lots of less than one hundred shares of stocks selling at and under five dollars per share, commission shall be same as for one hundred shares.

These commissions may be changed at any time by the vote of two-thirds of the members present at a meeting called for that purpose.

ARTICLE XXXV.—*Members not Bound to Sell other than Specified Lot Offered.*—When a specific lot of stocks is offered for sale or purchase, the member offering the same shall not be obliged to sell or buy any part, although the amount in the aggregate should equal the amount of his bid or offer.

ARTICLE XXXVI.—*Conditional Bids Not Allowed.*—No sale of securities shall be made on which a deposit shall be offered as the limit of liability.

ARTICLE XXXVII.—*Partnerships.*—No member of the Exchange shall be allowed to take as partner any suspended member thereof during the period of his suspension, or to form a partnership with any insolvent person, or with any person who may have previously been a member of the Exchange, and against whom any member may hold a claim arising out of transactions made during the time of such membership and which has not been settled or released in accordance with the laws of the Exchange.

ARTICLE XXXVIII.—*Claims between Partners.*—No claims growing out of transactions between partners shall be admitted to share the proceeds of the membership of one of such partners, until after the claims filed by other creditors who are members of the Exchange shall have been satisfied.

ARTICLE XXXIX.—*Length of Time Contracts Limited to Sixty Days.*—No time contracts longer than sixty days shall be allowed at the calls of the Exchange.

ARTICLE XL.—*Suspension of By-Laws.*—Any one of these By-Laws may be temporarily suspended by the unanimous consent of all the members present.

OTHER MINING STOCK EXCHANGES.

FOLLOWING the "boom" in mining securities, several leading brokers opened commodious offices in Chicago and other large cities where quotations were furnished visitors gratuitously, by recording them on a blackboard, and, in some instances, private wires connecting with the New York market were under the control of the brokers. Some of the Chicago capitalists became large holders of mines and mining securities, and finally it was decided that Chicago should have an exchange of its own. A charter was granted to the "Chicago Mining Exchange" on April 7, 1882, and by-laws, rules and regulations were adopted. At present, there is one call per day, extending from 11.00 to 12.30, which is held in the room of the Provision, Grain and Stock Board on Calhoun street. The membership is limited to 250, and there are already 215 members enrolled. The first 100 seats were sold at $50 each; the next 50 seats, $100 each, and then 50 seats at $250 each. The price of the last 50 seats (of which 15 have been sold) was fixed at $500 each. Some seats have been resold at from $100 to $250 each. The charge for examination and listing the stock of a company is $50 per annum. The stocks of the following companies have been listed:

Ætna, Col.	Amie, Col.
Abington, Col.	Anglo-American, Col.
Barcelona, Col.	Breece, Col.
Baskin, Col.	Buckeye, M. & T. Co Col. preferred.
Camp 61, Col.	Chrysolite, Col.
California, Cal.	Cerro Gordo, Utah.
Central, Arizona.	Central, Colorado.
Columbia, Col.	Dunkin, Col.
Durango, Col.	Denver City, Col.
Dyer, Col.	Fiskdale, Col.
Frisco Con. Utah.	Globe Copper, Arizona.
Golden Comet, Arizona.	Girard, Col.
Hailstorm.	Hayden.
Hooker, Col.	Horn Silver, Utah.
Hibernia, Col.	Iron Silver, Col.
Iron Mountain, Col.	Iowa Gulch, Col.
Joslyn Con., Col.	Kokomo, Col.
Little Chief, Col.	Leadville and Gunnison, Col.
Laxey (Iron) Mining Co., Mich.	New York Hematite (iron), Mich.
Minnehaha, Col.	Ocean Wave, Col.
Palmyra, Col.	Quartz Creek, Col.
Quartz Mountain, Cal.	Rice and Wheeling, Col.
Robinson Con., Col.	Rara Avis, Col.
Stormont, Utah.	Silver Cliff, Col.
Sutro Tunnel, Nevada.	Silver Cord, Col.
Silver Group, Cal.	38 Stars, Col
Treasury, Col.	Tombstone, Arizona.
Vernon, Arizona.	Vandewater, Utah.
Wisconsin and San Juan, Col.	Whalen Con. (copper), Nevada.

The officers are as follows: Geo. R. Vernon, President; Erwin E. Wood, Treasurer, and Edward M. Greene, Secretary.

St. Louis Mining and Stock Exchange.—According to the announcement made by circular letter under date of August 10, 1880, the growing importance of Mining and Stock interests of this country, and the intimate relations of St. Louis and St. Louis Capital to them, are among the reasons that have led to the formation of this Board at this center of trade. The St. Louis Mining and Stock Exchange is a stock company organized under the laws of the State of Missouri; and the stock is all owned by St. Louis men. The organization was recently completed by the election of the following Board of Directors:

G. W. Chadbourne.	J. W. Noble.	W. R. Allen.
Chas. F. Orthwein.	D. P. Roland.	D. R. Francis.
Frank T. Iglehart.	Thomas Richeson.	James Baker.
J. W. Paramore.	E. S. Chester.	Jno. E. Ennis.
	T. W. Heman.	

The officers and committees were as follows:

James Baker—*President.* T. W. Heman.—*Secretary*
Thomas Richeson—*Vice President.* Frank T. Iglehart.—*Treasurer.*

Executive Committee.

Thomas Richeson. G. W. Chadbourne.
Jno. W. Noble. Theo. W. Heman.
D. P. Rowland.

Finance Committee.

W. R. Allen. D. R. Francis.
Jno. E. Ennis.

Membership Committee.

D. P. Rowland. F. T. Iglehart.
D. R. Francis.

Stock Committee.

J. W. Paramore. E. S. Chester.
Chas. F. Orthwein. F. T. Iglehart.
T. W. Heman.

The charges to mining companies for listing their stocks on the exchange were $150 each.

Application was made by mail to the officers of the St. Louis Exchange for fuller and later information in regard to its affairs and standing, but no response whatever was received from them.

The Rico Mining Exchange.—There is a mining exchange at Rico, Colorado, known as the "Rico Mining Exchange" which was incorporated March 13, 1882. Following are the officers: Julius Thompson, President; J. W. Winkfield, Vice-President; Harry Calm, Treasurer; F. R. Lewis, Secretary; B. F. Klee, Corresponding Secretary, and Charles A. Jones, Assistant Corresponding Secretary.

Denver Stock Exchange.—A mining stock exchange has also been established at Denver, Colorado, at which regular calls of listed stocks, which number about twenty, are made daily, and a fair amount of business is transacted.

THE MINING INTERESTS OF THE WEST.

FROM statements published in the San Francisco *Mining and Scientific Press*, during the early part of the current year, the following statistics of the mining interests of the west, and comments upon the output and business of the past year, are taken:

Never before in the history of the country has there been a year so marked for advance in the mining industry as that of 1881. This is not so much noticeable in the bullion product, for 1881 only exceeds 1880 by $4,366,481; but in the increase of area of the territory under process of development. Idaho, Montana, Arizona and New Mexico are all widening their fields of labor. Some of the camps in these regions have very much increased in importance within the year, noticeably, Tombstone, Butte and Wood River. Up to within the past few years the states of California and Nevada have overshadowed all others in the mining interests. Now these two states are by no means so much ahead of others. Colorado heads the list, California coming second and Nevada third.

The Bullion Product.—The Superintendent of the U. S. Branch Mint at San Francisco furnishes the following, showing the bullion product for the *fiscal* year ending June 30, 1881:

	Gold.	*Silver.*	*Total.*
California	$17,986,323	$757,525	$18,743,848
Nevada	2,534,792	7,706,818	10,311,610
Arizona	554,517	7,796,306	8,350,823
Idaho	1,541,652	1,068,916	2,620,568
Oregon	753,613	79,671	823,284
Washington	90,000	. . . . . .	90,000
Alaska	1,900	. . . . . .	1,900
Total	$23,462,797	$17,579,236	$40,942,033

A peculiar significance of this table lies in the fact that it is made up of figures from the actual returns made by mine owners to the Superintendent of the U. S. Mint. It is, therefore, free from the "estimates," which may be more or less carefully made.

The following returns of the bullion product of 1881 are furnished by Mr. John J. Valentine, General Superintendent of Wells, Fargo & Co.:

Statement of the Amount of Precious Metals Produced in the States and Territories West of the Missouri River, including British Columbia (and Receipts in San Francisco by Express from the West Coast of Mexico), during the Year 1881.

States and Territories	*Gold Dust and Bullion by Express.*	*Gold Dust and Bullion by other conveyance.*	*Silver Bullion by Express.*	*Ores and Base Bullion by Freight.*	*Total.*
California	$16,349,216	$817,480	$548,582	$305,421	$18,020,679
Nevada	95,492	.....	7,855,574	3,896,498	11,847,564
Oregon	560,931	580,000	48,684	.....	1,189,615
Washington	67,309	33,654	.....	.....	100,963
Alaska	.....	13,000	.....	.....	13,000
Idaho	1,046,548	410,000	370,540	1,007,386	2,834,474
Montana	1,136,290	227,258	2,305,723	689,800	4,359,071
Utah	99,959	10,336	3,563,610	3,637,363	7,311,288
Colorado	1,907,160	.....	2,820,000	18,230,000	22,957,160
New Mexico	32,944	.....	77,000	705,000	814,944
Dakota	3,225,950	325,000	.....	.....	3,550,950
Arizona	396,697	132,232	6,278,895	1,390,942	8,198,766
Mexico (west coast)	343,127	.....	1,699,216	391,000	2,433,343
British Columbia	757,600	115,000	.....	.....	872,600
	$26,019,223	$2,663,940	$25,567,824	$30,253,430	$84,504,417

Compared with the report of the same authority for 1880, California shows a decrease in gold of $579,069, and an increase in silver of $323.582. Nevada shows a total falling off of $3,184,057; the yield from the Comstock being only $1,726,162, as against $5,312,592 in 1880, a decrease of $3,586,430. The product of Eureka district is $4,127,265, as against $4,639,025 in 1880, a decrease of $511,760. Utah shows an increase of $860,335. Colorado shows an increase of $1,672,171; and Arizona $3,726,395 over the report of last year.

The following table shows, with the authorities, the total yield of precious metals in California from 1848 to January 1, 1882:

Precious Metals in California.

Year.	*Amount.*	*Year.*	*Amount.*
1848 } 1849 }	$15,000,000	1865	28,500,000
		1866	25,500,000
1850	44,000,000	1867	25,000,000
1851	75,000,000	1868	22,000,000
1852	85,000,000	1869	22,500,000
1853	75,000,000	1870	25,000,000
1854	65,000,000	1871	19,679,224
1855	65,500,000	1872	19,050,098
1856	65,000,000	1873	18,025,722
1857	67,600,000	1874	20,300,531
1858	50,000,000	1875	17,753,151
1859	50,000,000	1876	18,615,807
1860	45,000,000	1877	18,174,716
1861	40,000,000	1878	18,920,461
1862	34,700,000	1879	18,190,973
1863	30,000,000	1880	18,276,166
1864	26,600,000	1881	18,020,679

	Gold.	*Silver.*
1848 to 1857, Garnett	$548,100,000	.....
1858 to 1870, Raymond	424,800,000	.....
1871 to June 30, 1881, Valentine	190,096,076	$14,914,452
	$1,162,992,076	$14,914,452
	14,914,452	
Total	$1,177,906,528	

This makes an aggregate of nearly 1178 millions.

Of Nevada County the San Francisco *Transcript* says:

"The quartz mining interests of Nevada County are in a most encouraging condition. In this district, by which we mean Nevada township, nearly 200 stamps are dropping, and the number is being increased from month to month. The numerous live enterprises, old and new, that are adjacent to Grass Valley, are mostly prospering, and several new producers will be opened there also before many months. In all other parts of the county, where auriferous quartz deposits abound, the same indications of activity in this branch prevail. Even the Meadow Lake country is gradually passing from under the cloud that has hung over it so long, and before long, we hope to chronicle that the ores there, which have heretofore proved so rebellious, are yielding up their treasure at the touch of science. The drawbacks that beset the hydraulic mining will be removed soon, we trust. The scarcity of water this winter is not satisfactory, but our people are hopeful, and find consolation in turning their faces towards the near future, which is bright with hope.

"In this county is the representative gold mine of this State—the Idaho mine. For something over thirteen years the mine has been paying regular monthly dividends, having in that time disbursed to stockholders $3,101.550, out of a gross product of $6,780,295.60; the total number of dividends being 148, in value to 1000½ per cent. upon the capital stock. The past year has been one of great prosperity with the mine, being the best since 1874, and the third best since the mine commenced paying dividends. In 1873, the product was $1,010,612.20; in 1874, $669,023.03, and in 1881, $640.-107.58. The product of 1881 was $199,761.59 greater than the yield of 1880, showing the improved condition of the mine in its deepest workings, which have extended down to the 12th level, over 1,500 feet on the incline, and over 1,300 feet in perpendicular depth. At these depths the ledge has continued to hold its average width, and has decidedly improved in quality as shown by the yield of the ore for 1881, the average per ton being $22.95¾, as against $15.82 per ton for 1880: while the average cost per ton for mining and milling has but slightly increased, being 9.29½ per ton in 1880, and 9.51 1-9 per ton in 1881. All the profitable ores of the mine for the past year have been from the No. 11 and the No. 12 levels, and the stopes connected therewith, as the levels above are nearly exhausted. The history of the mine is sufficient to demonstrate the value of the mineral resources of the district."

Bodie district, in Mono County, vies with Nevada County in bullion yield. As to the yield of bullion, the *Free Press* of the 10th inst. said: The bullion shipments from Bodie during the year just closed were the largest of any year since the revival of the district. They amounted to the sum of $3,173,000. This is an increase of more than $100,000 over those of 1880, of more than $600,000 over those of 1879, and of more than $1,000,000, over those of 1878, which was the year of greatest excitement in Bodie mines. The shipments for the five years ending December 31, 1881, have been as follows:

1877	$979,022 80
1878	2,129,732 58
1879	2,556,847 58
1880	3,063,699 13
1881	3,173,000 00
Total	$11,952,302 09

Before the middle of the present month Bodie district will have made the grand record of $12,000,000 added to the permanent wealth of the world. We are of the opinion that the yield of the present year will be fully equal to that of 1881, and there is a good reason to anticipate that it will be larger. The prospects of opening up a new bonanza are exceedingly good, particularly in the south end of the camp. Outside

Annual Products of Lead, Copper, Silver and Gold in the States and Territories West of the Missouri River, 1870–81.

Year.	*Products as per W. F. & Co.'s Statements, including amounts from British Columbia and West Coast of Mexico.*	*Products after deducting Amounts from British Columbia and West Coast of Mexico.*	*The net product of the States and Territories west of the Missouri River, exclusive of British Columbia and West Coast of Mexico, divided, is as follows:*			
			Lead.	*Copper.*	*Silver.*	*Gold.*
1870	$54,000,000	$52,150,000	$1,080,000	.....	$17,320,000	$33,750,000
1871	58,284,000	55,784,000	2,100,000	.....	19,286,000	34,398,000
1872	62,236,959	60,351,824	2,250,000	.....	19,924,429	38,177,395
1873	72,258,693	70,139,860	3,450,000	.....	27,483,302	39,206,558
1874	74,401,045	71,965,610	3,800,000	.....	29,699,122	38,466,488
1875	80,889,057	76,703,433	6,100,000	.....	31,635,239	39,968,194
1876	90,875,173	87,219,859	5,040,000	.....	39,292,924	42,886,935
1877	98,421,754	95,811,582	5,085,250	.....	45,846,109	44,880,223
1878	81,154,622	78,276,167	3,452,000	.....	37,248,137	37,576,030
1879	75,349,501	72,688,888	4,185,769	.....	37,032,857	31,470,262
1880	80,167,936	77,232,512	5,742 390	$898,000	38,033,055	32,559,067
1881	84,504,417	81,198,474	6,361,902	1,195,000	42,987,613	30,653,959

districts in the neighborhood of Bodie are attracting much attention, and more activity than usual is anticipated in Homer district during the coming seasons, where several new combinations of capital will enter into mining operations. The Sweetwater mines, about twenty miles north of Bodie in an air line, it is confidently predicted, will create a furore of excitement during the present season. The Aurora mines will have an opportunity of making a stir under the impetus of milling facilities, as the Humboldt mill will be in operation before the end of the present month. Altogether, there is every probability of an unusually brilliant year in mining in Bodie and the surrounding country.

The Georgetown *Gazette* says of El Dorado County: "The mining outlook is certainly brighter than it has been for years, particularly quartz mining. No less than 30 quartz locations have been recorded in this district alone during the past year, and locations are still being made. The California W. & M. Co. continues to carry forward its great work of permanent improvements upon its ditch property. Kelsey, Garden Valley, Greenwood and Volcano districts are all making progress in the quartz mining industry. These districts have all added new mills, and started up idle ones within the past year, and we hear of more mills and mining machinery which are to be added to all of those mining districts within the next six months. The mines of Spanish Dry Diggings continue to hold their own. Georgetown district is not behind, in fact, present indications are that this district will stand ahead of any in the county before the close of 1882." The *Mountain Democrat*, of the same county, says: "The mining industry is greatly revived. More quartz mills and hoisting works have been put up within the past year than within any other year since the county was organized, and the number of new mining enterprises started within the year is without a precedent."

In his testimony before the Superior Court of Sacramento County, in the case of the People vs. the Gold Run Ditch and Mining Co., J. B. Hobson, a miner of Iowa Hill, testified in reference to the extent of the mining operations in that district, and the yield to date of various Iowa Hill mines as follows: "There has been mined into the North Fork, above Rice's bridge 3,585,800 cubic yards of material from the Iowa Hill mines—about 31 acres. At the mine on Independence Hill, during the three seasons, we worked 278 days, and used 500 inches of water. We took out $66,529. The expenses of the mine were $35,450, and the net proceeds $30,977. The following amounts have been taken out of that vicinity: North Star and Weisler claim at Iowa Hill proper, $2,000,000; Wolverine mine at Roach Hill, $800,000; Shelby, $105,000; Columbus, $100,000; Dayton, $156,000; Phillips, $80,000; Morning Star mine at Morning Star Hill, $250,000; Bird's Flat mines, $200,000; Strawberry Flat, $100,000; Wisconsin Hill, $550,000; Grizzly Flat mines, $350,000; Sucker Flat, $250,000; total from Independence Hill mines, $100,000; Mountain Gate at Damascus, $1,500,000; total, $6,541,000. The production of the Mountain Gate mine at present varies from $3 to $5 per load—about $40,000 per acre."

Nevada. The yield of Nevada last year, $11,847,564, shows a total falling off of $3,184,057; the yield from the Comstock being only $1,726,162, as against $5,312,593 in 1880, a decrease of $3,586,430. The product of Eureka district is $4,127,265, as against $4,639,025 in 1880, a decrease of $511,760.

In 1880 the Consolidated Virginia mine alone yielded $1,756,536, which is more than all the mines in the lode turned out in 1881; in addition, California produced $880,515, the two mines yielding an aggregate of $2,647,151. This is the second year only when Nevada has not been the leader in bullion product for many years, and it is even now third, following California and being over three millions and a half ahead of Arizona, which comes next to it.

The great need of Nevada at present is a means of working low-grade ores. There are thousands of tons of such ores all over the state, and more particularly on the Comstock, but by processes at present known it is impossible to work them at a profit. They contain, however, sufficient metal for a profit if worked at a low price.

The sources of the Nevada yield are indicated in the following table, which shows the results of mining product for twelve months, ending September 30, 1881, and is that from which the tax levy is based:

Counties.	Quantity worked. Tons.	Quantity worked. Lbs.	Gross Yield or Value.	Net Yield on which Taxes are Levied.
Ores.				
Elko	3,333	1,473	$221,906.08	$64,344.35
Esmeralda	37,388	1,297	1,490,457.42	466,898.78
Eureka	77,005	191	3,168,543.91	918,655.94
Humboldt	5,448	830	74,920.05	13,546.41
Lander	7,036	460	850,419.05	403,082.96
Lincoln	3,206	586	97,904.75	19,028.41
Nyo	18,088	1,167	465,269.14	15,572.48
Storey	88,509	1,284	1,565,000,98	344,975.76
Whito Pine	8,297	359	365;952.30	76,189.11
Total Ores	248,316	1,647	$8,409,373.64	$2,322,394.20
Tailings.				
Humboldt	5,833	666	$20,170.15	$8,170.05
Lincoln	8,094	1,663	83,109.43	12,333,98
Lyon	77,096	....	346,031.02	50,607.15
Ormsby	41,005	....	179,406.02	56,370 54
Storey	37,912	1,000	176,560.64	26,027,11
Washoe	5,256	....	39,533.42	4,036,15
White Pine	12,834	....	41,740.44	4,174,05
Total tailings	188,841	1,329	$886,641.12	$162,709.04
Salt, Etc.				
Esmeralda	15,570	691	$209,956.81	$56,268.36
Grand total for year	452,728	1,667	$9,505,971.41	$2,542,370,50
1877. Grand total ores	728,810	194	$42,295,076.05	$23,738,726.79
1878. Grand total ores	134,382	1,444	6,257,225.57	3,194,032.70
1879. Ores, tailings, salt.	183,220	1,338	5,112,175.12	2,161,961.34
1880. Ores, tailings, salt.	560,579	1,643	13,655 967.86	4,496,738.91

Eureka this year takes the lead. The *Sentinel* points, with gratification, to what has been done in the two mines that have been most prominent in the history of Eureka district so far. The Eureka Con. has disbursed in dividends $4,705,000. The payment of dividends was suspended November 1, and the surplus funds on hand retained to pay for improvements that are being made—the sinking of a new shaft, and the erection of new, extensive and costly works. The Richmond Company has paid dividends up to the present, aggregating $3,564,000. This company has also a substantial reserve fund to meet all demands.

On the Comstock, the great bonanza mines, as they are called, found no extensive or rich bodies of ore either in 1880 or 1881. Vigorous prospecting has been carried on, however, not only in these two mines, but in the other more prominent ones on the lode. To show the expensive nature of the work going on, it is only necessary to quote from the report of one or two mines for the year.

The famous California mine for the year ending December 31, 1881, turned out 6,175 tons of ore, yielding bullion to the value of $122,107.26, or an average of $19.77 per ton, milling 79 per cent. of assay value. There was gold in bullion to the value of $82,146,10, and silver to the value of $39,961.16. There were raised 13,299 tons of waste rock. All the work done was of a preparatory nature. The following figures show receipts and expenditures of the mine:

Receipts.

Bullion on hand at last annual statement	$ 34,359.03
Cash on hand at last annual statement	903.42
Samples on hand at last annual statement	65.91
Gross product of mine for 1881	122,182.32
Assessment No. 1	162,000.00
Overdraft Jan. 18, 1882, at Nevada Bank	74,630.25
Total	$394,140.93

Disbursements.

Overdraft at last annual statement	$ 9,804.50
Salaries and wages	55,580.76
Supplies	30.381.47
Hoisting	16,006.63
Compressed air	6,097.50
Sutro tunnel royalty	3,058.30
Suction fan	3,706.11
Assaying account	745.58
Team account	148.75
Taxes	2,856.14
Pumping expense	755.00
Bullion freight	465.20
Virginia City expense	1,330.08
C. and C. joint shaft	126,200.00
Real estate Virginia City	1,325.00
Interest and exchange	6,027.02
Legal expense	11.923.80
Advertising	4,657.25
Discount on bullion	10,104.91

Refining charges on bullion	997.74
San Francisco office expense	3,767.96
Books and stationery	580.20
Cash on hand	1,174.52
Samples on hand	14.36
Total	$394,140.94

The Consolidated Virginia mine turned out 6,435 tons of ore in the year, yielding $144,064.10 or $21.13 per ton. There were also 8,307 tons of waste rock taken out. The receipts and expenditures were:

Receipts.

Dec. 31, 1880, cash on hand	$1,569 60
Samples on hand	154.40
Assaying	6,284.19
Supplies	11,382.33
Best and Belcher joint work	14,029.94
Drafts on secretary	320,365.05
Samples produced	104.47
Suction fans	13,903.10
Total	$367,792.98

Disbursements.

Salaries	$6,000,00
Wages	83,079.50
Timber	7,793.72
Ice	6,547.82
Candles	2,240.35
Powder, fuse and caps	6,966.04
Miscellaneous supplies	6,441.01
Office expenses	707.84
Assay office wages	6,906.51
Assay office supplies	3,588.05
Team expense	284.75
Legal expense	8,617.05
Tax on real estate	1,443.05
Tax on proceeds of bullion	3,576.48
Hoisting	15,466,20
Reduction	61,351,20
One-half expense C. & C. shaft	126,200.00
One-half royalty to Sutro Tunnel Co	3,134.00
Interest and exchange	1,373.66
Transportation and hauling	1,458.85
Best and Belcher joint winze	777.35
Suction fans	15,675,41
Samples shipped	258.87
Compressed air	2,069.60
Cash on hand, Dec. 31, 1881	1,980.87
Total	$367,792.98

As to the cost of sinking deep shafts on the Comstock, it will be well to note the cost of the C. & C. shaft during the year. This was in January, 1880, about 194 feet below the 2300 level, and had been sunk (the first of January 1882) 33 feet below the 2500 level. A large sump drift has been run out a distance of 50 feet from the bottom. Stationary double plunger pumps have been put in at the 2400 level and 2500 level, with the necessary balance bobs and tanks to complete the main pumping system to that level. To do this work cost $377,200, as will be seen by the following record of disbursements for this shaft for the year:

Office supplies and repairs	$1,418 19
Miscellaneous supplies	28,460 33
Candles	6,736 70
Powder, caps and fuse	18,977 50
Timber	19,890 24
Wood	106,671 99
Oils	4,364 68
Ice	24,724 85
Water	9,600 00
Wire cable	2,373 44
Salaries	1,800 00
Wages	112,125 34
Real estate	750 00
Team expense	77 00
Contribution account	90 00
Interest and exchange	333 86
Taxes	4,073 58
Pumping	10,037 60
Surveying	1,800 00
Legal expenses	20,410 50
Transportation and hauling	3,027 10
Balance cash on hand	457 70
Total	$377,200 05

The following, from the White Pine *News*, shows that the bullion shipment from Cherry Creek, Nevada, through Wells, Fargo & Co.'s office for the year ending December 31, 1881, the December shipment being pretty closely approximated:

January	$ 23,020	August	27,150
February	33,072	September	25,465
March	23 040	October	21,950
April	39,490	November	31,367
May	41,685	December	33,000
June	39,757		
July	32,700	Total	$375,680

Of this amount the Star shipped $363,031.91, the balance coming from the Exchange, Teacup, Silver Cañon, and Shellburn.

The shipments of Tuscarora bullion for the year 1881, as furnished by the books of Wells, Fargo & Co. at that place, are given as follows:

January	$ 25,025 04	August	69,972 96
February	39,224 76	September	14,091 00
March	97,590 06	October	9,146 01
April	81,276 13	November	37,207 14
May	20,747 43		
June	24,028 28	Total	$387,196 34
July	16,8388 6		

With the December shipments already made, and those to come, it is estimated that the amount will reach a total of $422,396.

Colorado.—Colorado ranked all the States and Territories last year as a bullion producer. The Denver *Tribune* presents a statement of the bullion product of Colorado by counties for the year 1881, showing a grand total of $22,680,-909, an increase of $859,000 over 1880. Lake county, in which the famous Leadville district is located, is credited with $13,502,000 by that paper, while Clear Lake county is credited with $2,205,000, Gilpin county $2,150,700, and Summit county $1,820,000. Fourteen other counties figure in the list, the three most noteworthy being Bowlder, Custer and Gunnison, the aggregate yield of which was $1,670,300, about equally divided. The product of Leadville is given by the Leadville *Herald* at $13,170,600, in quarterly statements, as follows:

First quarter	$3,097,800	Second quarter	$3,404,000
Third quarter	3,170,300	Fourth quarter	3,498,500
		Total	$13,170,600

Last year the *Democrat* reported the coin value of gold, silver and lead produced by the Leadville mines at $15,095,-200. The decrease of $2,000,000 for the past year is not encouraging. The yield of the Leadville camp has been remarkable. The total for the past five years has been as follows:

In 1877	$ 655,300	In 1878	$ 3,152,900
In 1879	10,189,500	In 1880	16,095,200
In 1881	13,100,800		
		Total	$42,093,700

The camp has only come into prominence during the past four years. Up to the close of 1876 the total yield has only been a little over $6,000,000. The product for the past two years has exceeded that of any other mining camp in the whole country.

The list by Colorado counties is as follows:

County.			Total.
Bowlder	$535,482.88	Chaffee	$100,000.00
Clear Creek	2,204,980.00	Custer	608,549.37
Dolores	125,000.90	Fremont	14,535.50
Gilpin	2,105,700.00	Grand	10,000.00
Gunnison	635,033.00	Hinsdale	187,375.00
Lake	13,502,029.00	La Plata and San Juan	40,000.00
Ouray	78,000.00	Park	350,000.00
Pitkin	120,000.00	Rio Grande	251,000.00
Saguache	40,000.00	Summit	1,828,000.00
		Grand Total	$22,680,685.00

These figures include gold, silver, copper and lead.

Following is a statement of the business from Colorado smelting works for 1881:

Boston and Colorado Works, Argo.

Counties.	*Gold.*	*Silver.*	*Copper.*	*Total.*
Gilpin	398,000	$ 76,000	$ 89,000	$ 563,000
Clear Creek	29,000	518,000	13,000	660,000
Bowlder	48,000	23,000	1,000	72,000
Park	3,000	128,000	3,000	134,000
Lake	....	220,000	.....	220,000
Chaffee & Gun	....	72,000	5,000	77,000
Summit	....	728,000	.....	728,000
Custer	63,000	16,000	.....	79,000
San Juan	4,000	33,000	.....	37,000
Montana	11,000	388,000	174,000	673,000
New Mexico				
Utah, etc	12,000	14,000	12,000	38,000
Total	$568,000	$2,216,000	$297,000	3,081,000

Moore Mining and Smelting Co., Golden.

Counties.	*Tons.*	*Ozs. Gold.*	*Ozs. Silver.*	*Value.*
Gilpin	3,906	5,739	59,250	$183,377
Clear Creek	2,900	168	327,215	403,713
Lake	414	.....	21,654	26,956
Other sources	902	.....	52,302	64,456
Total	1,122	5,907	460,421	$678,505

Golden Smelting Company.

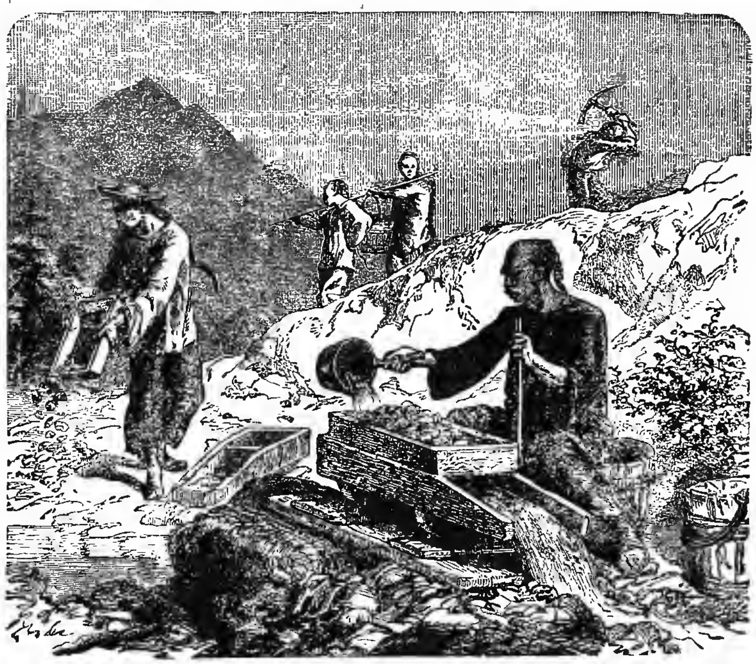
County.	*Gold.*	*Silver.*	*Lead.*	*Totals.*
Gilpin	$144,016.13	$258,524.74	$ 8,282.96	$210,823.83
Clear Creek	551.06	184,686.96	29,571,52	214,809.54
Bowlder	35,421.96	43,487.37	.....	78,909.33
Lake	.....	38,326.59	15,981.36	54,307.95
Summit	.....	34,423.70	7,929.44	42,353.14
Custer	.....	26,868.80	33,513.02	60,381.82
Other sources	449.36	2,088.98	782.40	3,320.74
				$664,906.35

Total No. of tons, 8,081.
Tons bought in 1880—5,012; value, $586,044.26.
Tons bought in 1879—3,006; value, $310,062.69.

The following table represents the amount of ore purchased by the Miners' Smelting and Reduction Co. since commencing business in May, 1881. In a few weeks their furnace capacity at Golden will be doubled:

County.	*Gold.*	*Silver.*	*Copper.*	*Total.*
Gilpin	$ 58,833.61	$ 11,734.00	$7,663.00	$ 78,230.61
Clear Creek	35,305.00	184,006.85	11,600.00	230,911.85
Other sources	6,159.00	7,100 00	12,436.00	25,695.00
Totals	$100,297.61	$202,840.85	$31,699.00	$334,837.46

According to the figures given above of bullion production by counties the total is $500,000 short of last year. Lake falls short $1,500,000; Clear Creek, $800,000; Gilpin, $500,000; Bowlder, $250,000; Custer, $200,000, and Park $50,000. Summit has gained $1,400,000; Gunnison and Pitkin, $900,000; Chaffee, $50,000, and San Juan country, $700,000. The total output of the mines falls short of expectations, yet the results are very satisfactory. A number of the once heavy producing mines of Lake, Gilpin and some other counties have taken out very little ore for various reasons.



THE ROCKER.

Oregon.—The state of Oregon is credited with a yield for 1881 of $1,189,615, all of which was gold, except $48,684. Oregon in 1880, produced $1,059,644.

Eastern Oregon is just in a transition stage from a placer mining section to a quartz producing region. It comprises, says the *Oregonian*, the five counties of Union, Grant, Baker, and Wasco, all containing quartz ledges of various importance, and Umatilla, which has no mining except the Chinese rocker claims along the Columbia. Baker county has produced the largest value of bullion; Grant next, while Union and Wasco are known to have ledges of argentiferous galena, which have not yet been sufficiently developed to determine their value. Those of Union lie in the Eagle Creek range, which divides Wallowa valley from that of the Grande Ronde, while those of Wasco are on the head waters of the Ochoco. Baker county has placer gold diggings on Burnt and Powder rivers and their tributaries, chief among which is Auburn creek, which at one time gave employment to over 2,000 miners. Strange to say, no quartz ledges of any width or specific value have been discovered on the headwaters of that stream. On Burnt river, about 30 miles from Baker City, is a new ledge, owned by Capt. J. C. Ainsworth, of Oakland, Cal., and Theodore Wygant and Capt. Joseph Myrick, of Portland, the latter gentleman being Superintendent. The Conner Creek mine is located on that stream, about 50 miles from Baker City, and is owned by S. G. Reed and John Faull, the latter being Superintendent.

The celebrated Virtue mine, formerly called the Rockfellow, is also located in Baker county, but has produced no bullion for several years, and its shafts are full of water. It has always been an expensive mine to run for that reason. The Rye Valley mine, at one time owned by Fiske & Thielsen, of this city, but now the property of a Boston company, is under the supervision of J. D. Locke, but we have no date of its output. Grant county contains a greater diversity of valuable minerals than any other county in the State, though the production of bullion is below that of Baker. The chief placer mines are on Canyon and Prairie creeks, both of which have paid enormously in the past 20 years. These diggings were struck by a party of prospectors from Yreka, Cal., who were bound to Boise Basin. Two or three of the wealthiest firms in San Francisco got their start in Canyon City, the diggings of which extend a distance of two miles down to John Day town. Every foot of this ground has paid enormously, and some of it has been worked half a dozen times over. Near Prairie City, on the opposite side of John Day valley, irregular bodies of auriferous quartz have been found, easy to work and free from rebellious sulphurets. Over on Granite creek are several small ledges of antimonial silver, the best of which is the "Beagle," situated about three miles from the "Monumental," famed for its dividends of the Fenian persuasion. All this rock is cased in granite, which does not speak well for its durability, but the grade of ore is very high. Down in the John Day river, below the South Fork, are deposits of red manganese, which is used in the manufacture of gold and silver ware as a polishing agent. Carbonates of lead, carrying a small portion of silver, are also found in the extreme north end of the county, but no thoroughly developed ledge as yet exists. Small deposits of cinnabar have been found in the southern end of the county.

Southern Oregon Mines.—In southern Oregon mining is the great special industry. All the mines operated in Jackson county are placers, and in the winter they present the unsightly appearance of scars upon the country, very much resembling abandoned brickyards. There are several fine quartz ledges in the county, but to operate them mills must be employed, and none have yet been put in. The dust is used as a circulating medium among the miners; part of it is sold at the Jacksonville bank, part is traded at the stores, part is shipped by registered packages, part is shipped by express, and part is carried out by the miners themselves. Fully one-half of the men engaged in mining are Chinese and one of the principal mining bosses and proprietors is a Chinaman. The mining season commences in November or December, with the winter rains, and lasts till May, the miners generally making enough during these months to keep them the rest of the year. Every process of water mining, from the old-fashioned rocker to the most approved hydraulic methods, are employed in these mines.

Mining is the great and almost the only industry of Josephine county. They are similar to the mines of Jackson. The annual gold production of the various districts in Josephine is estimated at $192,500. The number of men engaged in these diggings is about five hundred, more than 250 being Chinamen. The various hydraulic methods are in use. The mines of Douglas county are mostly quartz, and are undeveloped.

For more than thirty years black sand mining has been carried on along the beach south of Coos Bay. The Lane mine was first worked sixteen years ago, and is now under the management of Mr. Baily, to whom it is leased. The works represent an investment of $25,000, and employ sixteen men. The Eagle company spent $50,000 in building works, etc., and after conducting a failing business for some time sold out for $40,000 to a California company, which spent $25,000 more and then abandoned the claim. First and last a good deal of gold was taken out of the Eagle, but the business never was profitable. Miners working by hand along the beach have always made good wages, and some few have picked up fortunes. "Big Mac" took $100,000 out of the sand in a few weeks, spent it in a few months, and is now keeping a hotel in Crescent City.

Arizona.—The Yuma *Sentinel*, of Arizona, speaking of bullion product, says: From her small output of less than $400,000 of gold and silver in 1875, Arizona's yearly output has been steadily augmenting until it has reached, in 1881, over $9,000,000. The output for 1880, up to June 30th, was $2,400,000, of which $2,000,000 was silver. The gain from this last date to June 30, 1881, was $5,950,823, of which $5,796,306 was silver. These amounts are authorized estimates, which of course, do not include segregated small amounts not statistically reported. From one stamp mill in 1868, the increase has been to 55, of from 1 to 100 stamps each, aggregating 785 stamps, besides some 10 others that are now being put up.

The Arizona *Star*, in summing up the bullion product, says: The output of the precious metals in 1880 from Arizona did not exceed $4,000,000. For the year 1881, so far as heard from, the output has been $9,101,179.66. This does not include the output north of the Tiptop mine, nor that of the 80 stamp mill of the Vulture; nor Silver King concentrations, and the large quantity of high-grade ores shipped out of the Territory, all of which will, at a conservative estimate, add at least $1,000,000 to the total amount.

Tabulated, the statement is as follows:

Tombstone	$5,149,120.53
Silver King	1,800,000.00
Harshaw Co	779,500.00
Ore from Harshaw District	46,000.00
Yuma and Mohave gold	64,000.00
" " silver	103,000.00
Tiptop	293,512.32
Dos Cobezas	27,862.81
Globe District via Casa Grande	726,000.00
Total product of Pima county gold dust	40,159.00
Silver bullion, Pima	51,516.00
Galeyville	15,500.00
Making a total of	$9,101,179.66
To which add a value of copper	1,563,011.40
And from all other sources	1.000,000.00
And we have a total of	$11,664,191.00
The total product of Harshaw Co	$1,155,154.00
Total of Tiptop	1,212,022.60

TOMBSTONE MINES.

T. M. & M. Co	$2,704,936.00	Corbin Mill	40,000.00
Contention	2,703,144.39	Ingersoll	15,000.00
Grand Central	1,050,875.30	Sunset	15,000.00
Head Center	191,520.00	Boston Mill	112,007.83
Vizina	526,716.00		
Total for Tombstone, since discovery of district,			$7,359,200.83

DIVIDENDS.

		Grand Central	600,000.00
		Vizina	80,000.00
T. M. & M. Co	$1,100,000.00		
Contention	1,375,000.00	Total dividends	$3,155,000.00

The most prominent camp in Arizona is Tombstone, and this has produced the largest supply of bullion. The record of the district from the dropping of the first stamp in June, 1879, to Jan. 1, 1882, is given by the *Epitaph* as follows:

TOMBSTONE M. AND M. CO.

Total to Nov. 1, 1881	$2,462,843.60
For November	112,092.73
For December	130,000.00
Total	$2,704,926.33
Dividends	1,100,000.00

WESTERN (NOW CONTENTION.)

Total to Nov. 1	$2,437,144.39
For November	130,000.00
For December	136,000.00
Total	$2,703,144.39
Dividends	1,375,000.00

VIZINA.

To Nov. 1	$424,693.00
For November	57,023.98
For December	45,000.00
Total	$526,716.98
Dividends	60,000.00

BOSTON.

To Dec. 1st	$112,007.31

GRAND CENTRAL

To Nov. 1	$848,176.46
For November	97,698.84
For December	105,000.00
Total	$1,050,875.30
Dividends	$300,000.00
Repayment original outlay	300,000.00
Total	$600,500.00

HEAD CENTER.

To Nov. 1	$156,520.52
For November	20,000.00
For December	15,000.00
Total	$191,520.52

SUNDRIES.

Corbin Mill	$40,000.00
Ingersoll	15,000.00
Sunset	15,000.00
Total	$70,000.00

The Boston mill has reduced all the ore of the Vizina Co., therefore the actual production of the mill has been $638,724.29.

RECAPITULATION.

Tombstone M. & M. Co	$2,704,936.33
Western (Contention)	2,703,144.39
Grand Central	1,050,875.30
Vizina	526,716.96
Head Center	101,520.52
Boston Mills	112,724.29
Corbin Mills	40,000.00
Ingersoll	15,000.00
Sunset	15,000.00
Total	$7,359,917.81

DIVIDENDS.

Tombstone M. & M. Co	$1,100,000.00
Western (Contention)	1,375,000.00
Grand Contral—repayment	300,000.00
Grand Central—dividends	300,000.00
Vizina	60,000.00
Total	$3,135,000.00

To show the yield per ton, etc., and yield of ore from two or three prominent mines, the following is given:

The Contention Con. property from March 8, 1880, to Dec. 31, 1881, produced bullion to the value of $2,678,327, and paid dividends to the amount of $1,475,000, and all resulting from a total ore product of 38,720 tons, which is a trifle over the rate of $59 per ton.

The Grand Central ore output for the eight months and thirteen days of 1881, foots up a total 22,115 tons, and from its reduction resulted $1,061,875, being at the rate of $48 per ton. Its declared dividends foot up $300,000, besides the $300,000 refunded to those who advanced them for the construction of the mill and hoisting works and the opening of the mine, making thus $600,000 in all paid by this very profitable mining venture.

The Head Center mine, from April 15, 1881, to Dec. 31, 1881, yielded 7,450 tons of ore, from the reduction of which resulted $206,853, being at the rate of $27.66 per ton.

The Virginia Con. Co., up to Jan. 1, 1882, produced 5,887 tons of ore and shipped $547,886, in bullion as the result, giving at the rate of $93 per ton.

Pioneer district, where the famous Silver King is, demands more than passing notice. Pinal *Drill* says: Pioneer district stands pre-eminent to-day in our young Territory. We have risen, within the last couple of years, from a perfect *terra incognita* to a shining mark amongst our sister districts. Pioneer district is the first bullion-producing district in the Territory. With us mining is a sober, steady business, and no farming community in the country is more free from crimes and misdeeds. Solid, substantial development, regular and permanent production and profit, mark the onward progress of Pinal. The Silver Queen, the Mount View, the Wide Awake, the Pinal Con., the Eastland, the North King, the Oxford and Dover, the Lewis, the Goodenough, the Specie Paying, the Arizona and Massachusetts, the Hudson and the Hastings Con., are all incorporated companies in addition to the Silver King. Besides these incorporations, individual owners of mines have, during 1881, expended large sums of money, and done much work. The contiguous camps on Mineral Hill, Belle Air, Silver King, Queen Creek, Happy Camp, Peachville, Rogers, Cole and Randolph districts, all centering at Pinal, are of immense value.

New Mexico.—New Mexico is credited by Wells, Fargo & Co., with a production of $814,944 for the year 1881. The year before it produced $711,300

Very little has been done in the way of developing the mineralogical resources, as may be seen from the following table, which affords a close estimate of the yield since New Mexico became a portion of the territory of the United States:

1848 to 1868	$2,500,000
1868	250,000
1869	500,000
1870	500,000
1871	500,000
1872	500,000
1873	500,000
1874	300,000
1875	325,000
1875 to 1880	2,200,000
1880	711,300
1881	814,944
Total	9,601,244

It has been very difficult to get correct statistics of production of New Mexico. Even as late as 1880, there was a great difference in the estimate of production made by Wells, Fargo & Co., and the director of the mint. The latter puts the product for calendar year 1880 at $555,000, of which $425,000 is silver. Wells, Fargo & Co., fix the figures at $711,300.

New Mexico expects before long to exceed all other regions as a copper producing country. The New Mexico *Mining World* says: An investigation of the copper resources of New Mexico leads to the belief that the depreciation in the value of copper, which will follow in the development of the New Mexican mines, will practically exclude the other mines in the United States, if not, indeed, the most of those in the world, from competing with the Territory. One of the richest deposits is at Clifton, 93 miles almost due west from Silver City, and between 60 and 65 miles from Coronada. The ore seems almost unlimited in quantity—in fact there is a solid mountain of copper. To prove this, the first development was by tunnel at the base, and from which drifts were carried in all directions, shafts in the meantime being sunk from above, the ores from the top showing fully as rich as those at the bottom. In Silver City, Grant county, there are four stamp mills and two smelters now in operation. At the Lake valley mines a $100,000 plant for reducing the vast quantities of ores of the Philadelphia companies is to be erected. At Socorro the Torrence stamp mill is now in operation. The mine has nearly 700 ft. of levels and 430 ft. of shafts, with considerable bodies of free mining ore in sight. The La Joya and New Orleans smelter at this point is completed and has made several successful runs of ore from the adjacent districts already.

The Los Cerillos Reduct on and Mining Co., are buying ores with great diligence in all parts of the Territory, especially in the Magdalens, where their agent is daily making contracts. In the Cerillos, the Duryea furnace and other reduction works are almost ready to turn out bullion. White Oaks has a 10-stamp mill, and the Homestake company has a large plant on the ground, to be erected and working in a few weeks.

The San Pedro and Canyon del Aqua companies, in the placers, are doing a great deal of work, and will doubtless ship a large amount of bullion in the coming year.

The Black range is a section which has attracted great attention. It is situated in Socorro county, in the southwestern part of the Territory, and constitutes a portion of the main Rocky mountain chain, dividing the drainage of the Cuchilla, Negra and Gila rivers. The more elevated portion is densely timbered with pine and juniper, and presents in the distance that somber appearance, which first suggests the name. The most important mines are on the eastern slope of the mountains, or Wild Horse, Turkey, Dry, Mineral and Chloride gulches. The district is 65 miles from San Marcial, on the Atchinson, Topeka and Santa Fe railroad.

Utah.—Utah Territory, made last year a good showing in its bullion product, having turned out $7,311,288 as against $6,450,953, in 1880. The following table is taken from the Salt Lake *Tribune*.

Wells, Fargo, & Co.'s Statement of the Mineral Product of Utah for 1881.

Base Bullion.	*Lbs. Lead Ref'd.*	*Lbs. Lead Unrefined.*	*Ounces Silver.*	*Ounces Gold.*
Frisco M. & S. Co.	.....	3,023,213	221,846	425
Germania S. & R. Works	2,645,373	3,687,284	234,260	191
Hanauer	.....	3,015,228	176,320	438
Horn Silver Mining Co.,	.....	16,343,995	1,259,903	...
Mingo Furnace Co.	.....	11,997,649	437,176	832
Other Smelters	.....	1,634,597	56,680	215
	2,645,373	39,681,966	2,386,185	2,101
Deduct Base Bullion purchased for Germania Refining Works	.....	385,365	18,427	39
Net Product Base Bullion	.....	39,296,601	2,367,758	2,062
Lead, Silver and Gold in Ores Shipped	.....	2,895,026	276,141	560
Total Ref'd Lead Ores and Base Bullion.	2,645,373	42,191,627	2,643,899	2,622

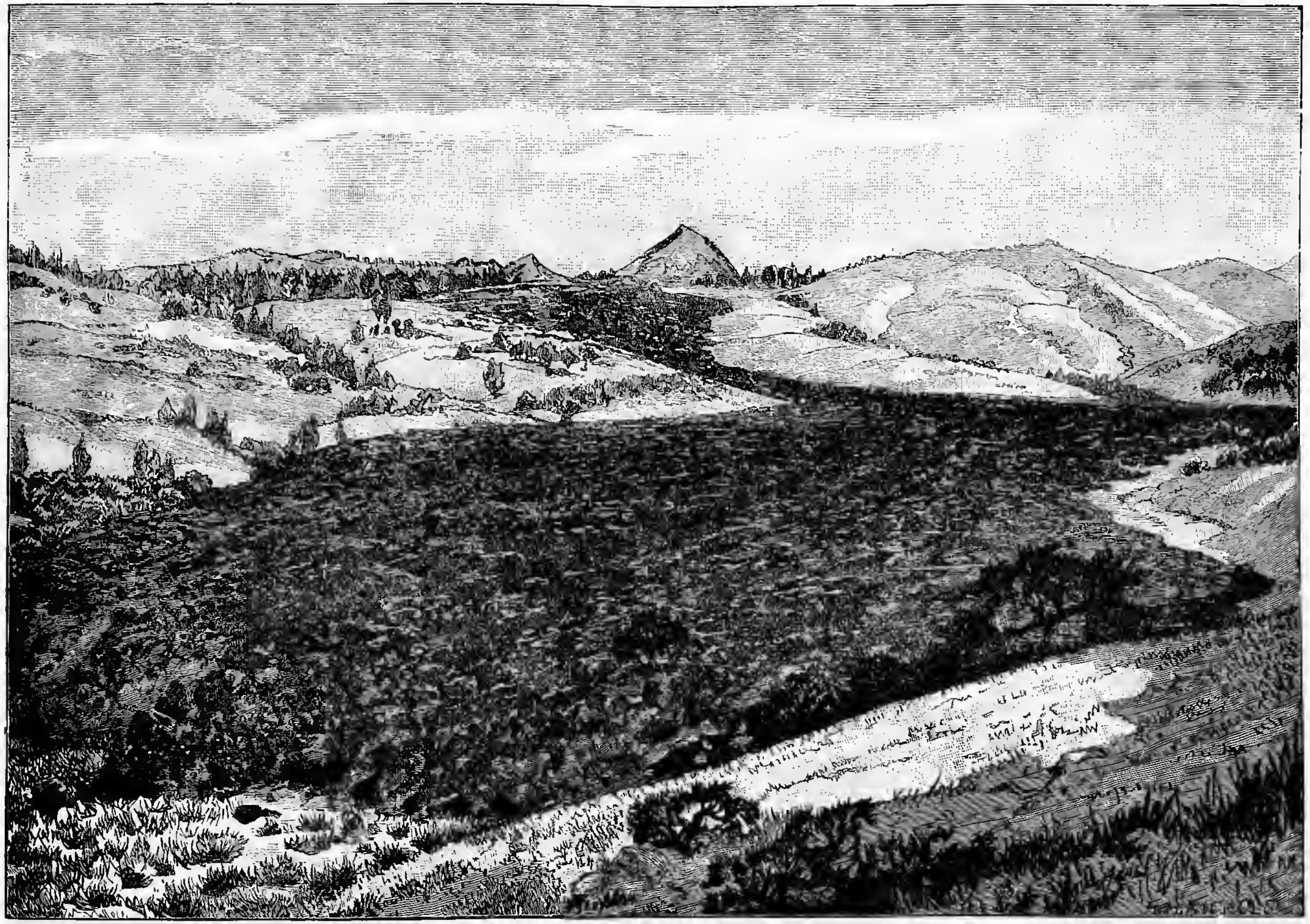
Dore Bars.	*Ounces Silver.*	*Ounces Gold.*
Germania Refining Works	115,219	317
Ontario Silver Mining Co.	1,909,870	..
Silver Reef Mills	614,368	...
Tintic M. & M. Co.	73,031	406
Other Mills and Placers	43,804	4,613
Total Dore Bars.	2,756,292	5,336

RECAPITULATION.

2,645,373 lbs. Refined Lead, at 5½c per lb	$ 145,495 51
42,191,626 lbs, Unrefined Lead, at $50 per ton	1,054,790 67
5,400,191 ozs. Silver, at $1.11	5,994,212 01
7,958 ozs. Gold, at $20	159,160 00
Total Export Value	$7,353,658 19

The above includes the ores received from Idaho, Montana and Nevada, aggregating 3,969,440 lbs. lead, 441,846 ounces of silver, and 976 ounces of gold. Computing the gold and silver at the Mint valuation, and lead at its value at the seaboard, it would increase the value of the product to $9,401,475.56. The Ontario mine produced the past year 1,909,870 ounces silver; in 1880 it produced 1,439,542, an increase of 470,228 ounces, or $521,953.08. A gross production for this mine of $2,119,955.70 during the year 1881 is considerably in excess of the yield of any other single concern. Its yield, moreover, is pure silver.

The great Horn Silver comes next in volume of production. In 1881 it produced 16 343,995 lbs. of lead, and 1,259,903 ounces of silver, or a total export value of $408,600 for lead, and $1,398,492,33 for silver, an aggregate produc-



WESTERN SCENERY-RECENT LAVA STREAM ON THE UINKARET—GRAND CAÑON DISTRICT.

SEE PART X. —FROM U. S. GEOLOGICAL SURVEY REPORT.

tion of $1,807,092.33. This is an increase in valuation of $942,290.93 over 1880, or more than 100 per cent. In all these reckonings the value of lead is computed at $50 per ton for each year, but the value of silver was computed at $1.10 in 1880, and $1.11 in 1881. The Germania smelter has made a remarkable increase. Its production of unrefined lead rose from 1,722,865 lbs. in 1880, to 3,687,284 lbs. in 1881; of silver, from 162,909 ozs. to 234,260 ozs., and of Dore bars from 36,422 oz. to 115,219 ozs. Its production of fine lead fell from 2,892,498 lbs. in 1880, to 2,645,373 lbs. in 1881. Its production for 1881 represents a value of $145,495.51 of refined lead, $92,200 of unrefined lead, $260,028.60 of silver, and $127,893.09 of Dore bars—an aggregate production the past year to the volume of $725,617.20 against $364,394.80 in 1880, being very close to an increase of 100 per cent. The Mingo smelter also made a surprising gain. It produced 11,977,649 lbs. of lead and 437,176 ozs. of silver in 1881, as against 6,464,382 lbs. of lead and 272,832 ozs. of silver in 1880. The export value of the product of 1881 is $784,705.36 against a value of $461,715.20 in 1880. The Mingo smelter is the only one which shows an increased gold product in 1881 over 1880. For 1881 it produced 832 ozs. of gold as against 675 the year before.

The Frisco smelter produced 3,023,213 lbs. of lead in 1881, and 221,846 ozs of silver, against 2,017,991 lbs. of lead and 125,722 ozs. of silver in 1880. Value of product in 1881, $321,799.06; value in 1880, $190,570.20. The Hanauer smelter (last year Morgan smelter) produced in 1881, 3,015,229 lbs. of lead and 176,320 ounces of silver, as against 2,733,782 lbs. of lead in 1880, and 157,374 ounces of silver. Value of the product of 1881, $271,095.20; in 1880, $236,451.40. The most remarkable increase in any one item is in that of "lead, silver and gold in ores shipped," which jumped from 831,600 lbs. lead, 24,024 ounces silver and 23 ounces gold to 2,895,026 lbs. lead, 276,141 ounces silver and 560 ounces gold. The Silver Reef mines fell off in production on account of the strike, which caused a long torpor in the Stormont, and perhaps from other causes, from 846,062 ounces silver, in 1880 to 614,368 ounces in 1881. The Tintic M. & M. Co. made a handsome increase from 41,923 ounces silver in 1880 to 73,031 ounces in 1881.

Montana.—Montana stands credited for the past year with a total yield of $4,359,071, against $3,822,379 in 1880. This increase is mainly from the large and growing camp of Butte, the bullion output of which, as shown by the books of the Pacific Express Co., for the year 1881, was as follows:

	Weight.	*Value.*
January	8,441	$71,535.82
February	11,252	112,400.35
March	13,036	131,483·01
April	12,835	129,292.24
May	11,738	106.599.47
June	10,409	99,988.93
July	9,873	98,613.41
August	13,556	129,966.17
September	9,015	78,520.11
October	11,035	94,239.28
November	9,951	82,491.13
December	10,641	94,050 14
	131,787	$1,229,180.06

To this amount, says the *Miner*, must be added $500,000, which was shipped through other sources. The output of the smelters is not given in the above table. It is reasonable to suppose that it will bring the grand total up to $3,000,000, as the product of the mines of Butte for the year 1881. The following is a list of the mills, smelters and arastras in Butte and vicinity:

Alice—new mill	60 stamps
Alice—old mill	20 "
Moulton	40 "
Silver Bow	30 "
Dexter	15 "
Lexington	10 "
Centennial	10 "
Gagnon	10 "
Burlington	10 "
Clipper	10 "
Grove Gulch	5 "
McMinn's	1 "
Total	221 stamps

SMELTERS.

	Capacity.
Montana Copper Co.	50 tons
Colorado and Montana	40 "
Parrot	80 "
Bell	50 "
Total daily capacity	220 tons

ARASTRAS.

Suprenant's.	Smith & Keasler's.

Three million, five hundred thousand pounds of ore and matte, and 2,000,000 pounds of bullion were shipped out of Montana during the year 1881 by the Utah & Northern railway.

The following table shows the value of gold and silver bullion deposited at the U. S. Assay Office, Helena, Montana, during the year ending Dec. 31st, 1881.

	Gold.	*Silver.*
January	$ 28,093 05	$ 4,364 86
February	23,354 63	3 878 04
March	19,733 12	10,395 11
April	22,844 93	14,348 24
May	41,614 17	4,715 29
June	61,361 02	3,427 60
July	104,792 02	10,685 02
August	63,654 59	6,443 87
September	64,732 59	4,190 47
October	63,828 28	9,310 32
November	59,528 23	13,955 22
December	17,000 00	13,000 00
Total	$570,536 63	$98,714 04

SUMMARY.

Year ending Dec. 31st.	*Gold.*	*Silver.*
1877	$379,481 18	$241,197 12
1878	298,681 77	404,667 98
1879	512,809 15	175,732 93
1880	495,155 19	97,924 60
1881	570,536 63	98,714 04
Total	$2,256,663 92	$1,018,136 67

There is shown a very great discrepancy in the figures of production from this district. The *Inter-Mountain* gives the following:

The total amount of silver, copper and gold product in the Butte district in 1880 reached $1,428,088.26. An intelligent idea of the rapid rate at which the mining industry of the Butte district has increased since that time can be obtained from the following table of production during the year 1881:

Alice Company	$1,120,937 50
Montana Copper Company	1,042,640 00
Colorado Company	864 000 00
Silver Bow Company	600,000 00
Lexington Mill	147,000 00
Dexter Mill	76,293 00
Centennial & Clipper (estimated)	25,000 00
Copper ore shipped	197 000 00
Gold shipped through banks	102,280 20
Total	$4,075,150 70

To this amount should be added the value of 5,000 tons of copper-silver ore extracted during the year and now at the Colorado smelter awaiting reduction. Estimating the value of this ore at an exceedingly low figure—say $55 per ton—we have $275,000 as its cash valuation. At the Alice mine is an extracted reserve of 4,000 tons which, at $40 per ton is worth $160,000. On many other mines of the district many hundreds of tons of high and low grade ore have accumulated, and the most conservative statistician would not estimate the value of the unworked ore extracted during the past year at less than $600,000, which added to the above tabulated statement of silver-copper matte and gold production gives as the value of the total output of the Butte district for the year $4,675,150.70. There are at least, 300 good mines being worked at Butte. The silver creek mines, where placer mining is still carried on, have now 146 stamps at work on quartz The Drum, Lummon, Belmont, Cotter and Hickey, Whippowill and Gloster are the principal ones. Ten-Mile district is stituated on the west side of Red mountain, on the upper portion of Ten-Mile creek, and in the southwest corner of Lewis and Clarke county. The district embraces an area of about 16 miles, and is about 20 miles distant from Helena. The main cluster of mines of this camp forms a network along the western slope of Red mountain.

Idaho.—Idaho bullion returns foot up according to Wells, Fargo & Co. $2,834,474, against $1,894,747 in 1880. During 1881 the Wood river country made rapid advances. The region attracted more attention than other and older regions of the Territory. Up to last year ores were shipped to Salt Lake City, and even in 1881 there have been shipped to Salt Lake City from Eastern Idaho, 5,728,741 lbs. of ore during the season of 1881. This contained 3,851,807 lbs. lead, 361,811 ozs. silver, and 645 ozs. gold. The base bullion product of Eastern Idaho, from local smelters, was 796,319 lbs., containing 80,856 ozs. silver and 112 ozs. gold.

A large portion of the ores in Saw Tooth and Smiley districts are milling and of high grade. In the districts on Wood river below Galena City, galena and carbonate ores predominate, the general average of which is about 100 ounces per ton of silver and 60 per cent. lead. The experience of smelting on Wood river proves the fact that there is no difficulty in reducing raw ores of the section with water-jacket furnaces. Lime and iron are the principal fluxes needed, of which there are plenty to be had, of the best quality.

Dakota.—Dakota sends for 1881, $3,550,000, as against $4,123,081 in 1880, a marked decrease in view of the total sum. This is almost entirely from the Black Hills region.

Dividend and Assessments.—Before giving any figures it is well to state that though they serve as a basis for comparison between one year and another, they are by no means to be considered as reliable indications of the state of the mining industry. There are hundreds of mines in every direction which neither advertise their assessments nor their dividends, and the figures from these mines are therefore never made public. In California particularly there are hundreds of mines which are paying their owners good profits, but which are never heard of by outsiders, and which make no figure at all in the dividend returns as published. Mines which are owned by incorporated companies, or which have stock which is quoted on the boards are those which appear in the list of dividends and assessments. The following tables will, however, give a good idea of this branch of the subject. The total assessments levied for the year amount to $7,497,510, of which at least two-thirds have been levied by companies operating on the Comstock lode. On the other hand, the dividends for the year foot up $15,047,068.

Following is a list of assessments for the year:

Nevada.

Storey County.

The Comstock, 54 mines			$5,355,800

Elko County.

Argenta	$40,000	Howe	$10,000
Belle Isle	25,000	Independent	35,000
Blue Belle Con	20,000	Navajo	45,000
Grand Prize	115,000	Tuscarora	30,000
Total			$320,000

Esmeralda County.

Equator	$25,000	Mt. Potosi Con	$10,000
Holmes	26,000	Real del Monte	75,000
Juniata Con	2,000	Tilden	10,000
Lodi	15,000	Vanderbilt	10,000
Metallic	12,500		
Total			$179,500

Eureka County.

Albion Con	$202,500	Phenix	$5,000
Total			$207,500

Humboldt County.

Paradise Valley			$7,000

Lander County.

Betty O'Neal			$75,000

Lincoln County.

Day	$30,000	Meadow Valley	48,000
Hillside	100,000		
Total			$178,000

Lyon County.

Silver City			$6,310

Nye County.

Alexander	$150,000	Gila	$25,000
Belmont	25,000	Liguria	25,000
Total			$225,000

White Pine County.

Martin White	$45,000	Ward Beecher	$20,00
Star	40,000		
Total			$105,000

California.

Mono County.

Addenda	$10,000	Maybelle	$36,000
Bechtel	25,000	McClinton	3,000
Belvidere	30,000	Mono	175,000
Blackhawk	15,000	Noonday	75,000
Boston Con.	50,000	North Noonday	75,000
Con. Pacific	55,000	Oro	73,400
Champion	25,000	Red Cloud	200,000
Defiance	5,000	South Bulwer	25,000
Double Standard	25,000	Spaulding	10,000
Goodsaw	80,000	Syndicate	25,000
Jupiter	16,000		
Total			$808,400

Arizona.

Head Center	$30,000	San Pedro	$10,000
Northern King	25,000		
Total			$65,000
Grand Total			$7,497,510

THE DIVIDENDS.

Following is the dividend record for the year, embracing the copper mines of Lake Superior and the mines of Colorado:—

Arizona.

Copper Queen	$150,000	Tombstone	$600,000
Grand Central	250,000	Vizina	40,000
Silver King	300,000	Western	775,000
Tiptop	120,000		
Total			$2,265,000

California.

Black Bear	$45,000	Plumas Eureka	$135,469
Bulwer Con.	10,000	Plumas W. & M. Co.	7,501
Gold Stripe	65,500	Quicksilver Mining Co.	525,395
Great Western, Q. S.	25,000	Rising Sun	25,870
Green Mountain	100,000	Sierra Buttes	76,250
Idaho	263,500	South Yuba	82,500
Inyo Con	35,000	Spring Valley	50,000
Magalia	15,000	Standard	975,000
Napa Con., Q. S.	90,000	Yuba	8,000
New York Hill	100,000		
Total			$2,636,985

Colorado.

Bonanza Develop. Co.	$135,000	Leadville Con.	$20,000
Catalpa	180,000	La Plata	180,000
Chrysoline	600,000	Morning Star	50,000
Dunkin	110,000	Moore M. S. Co.	36,000
Evening Star	425,000	Polonia	12,000
Gem	3,750	Robert E. Lee	50,000
Glass-Pendery	25,000	Robinson	450,000
Hibernia	150,000	Silver King	50,000
Iron Silver	400,000		
Total			$2,776,750

Dakota.

Deadwood Terra	$900,000	Homestake	$360,000
Father de Smet	130,000		
Total			$1,390,000

Georgia.

Con. Gold			$28,000
Total			$28,000

Mexico.

Jocuista			$200,000
Total			$200,000

Michigan.

Calumet & Hecla	$2,000,000	Osceola	$225,000
Central Copper	120,000	Quincy	320,000
Lake Superior	100,000		
Total			$2,765,000

Missouri.

St. Joseph's Lead			$60,000
Total			$60,000

Montana.

Alice	$400,000	Gagnon	$5,000
Boston & Montana	160,000	Hecla Con.	75,000
Total			$640,000

Nevada.

Brown & Urton	$8,333	Northern Belle	$400,000
Eureka Con.	255,000	North Belle Isle	15,000
Exchange S. M. Co.	25,000	Richmond	810,000
Indian Queen	63,750	Star-Grove	120,000
Navajo	25,000		
Total			$1,682,083

Utah.

Christy	$30,000	Ontario	$850,000
Horn Silver	300,000	Stormont	20,000
Total			$1,194,000
Grand Total			$15,662,068

THE SAN FRANCISCO MINING STOCK MARKET AND EXCHANGE.

ACTIVE trading in mining securities in San Francisco began almost immediately after it became known that a bonanza had been discovered in the Comstock Lode. At that time purchases and sales were made by feet and inches, the value of a mine being measured by the depth of the shaft sunk. Although there was a Board of Brokers prior to 1862, the principal business transacted at it was in gas and water stocks, bonds and other similar securities. There were no headquarters for transactions in mining stocks, but some of the large mine-owners were in the habit of meeting early in the day, at which prices for the day were agreed upon. Necessarily such a crude system was open to great deception and fraud and this was further aided by the practice of issuing additional stock from time to time as the depth of a mine increased. The first effort, however, to organize an exchange for dealings in mining securities was not successful, some of the large mine-owners regarding this movement as prejudicial to their interests, as it would open the speculative field to a much larger number of operators and would also more readily expose their unwarrantable transactions in marketing worthless properties. The first meeting was attended by only five persons, but the promoters of the movement were in earnest and finally the signatures of twelve subscribers to preliminary articles of agreement were obtained, the plan of organization proposed being similar to that of the New York Stock Exchange. Among the most active promoters of the enterprise were J. B. E. Cavallier, R. C. Page, Joseph Grant, Samuel Bruce, Franklin Lawton, Theodore C. Sanborn, E. J. Santa Marina, Henry Schmeidell, John Perry Jr., and T. W. Teacle. Following is a copy of the first agreement, and the names of the signers obtained previous to the organization:

SAN FRANCISCO, Sept. 1, 1862.

For the purpose of facilitating the purchase and sale of stock, and mutual security, we, the undersigned, propose to organize a San Francisco Stock Exchange, on the plan of the New York Stock Exchange Board. In futherance of which object we do each agree to pay into the hands of the Treasurer, when chosen, the sum of $100: J. Perry Jr., T. C. Sanborn, S. Heydenfeldt, Geo. R. Barclay, H. C. Logan, Robert C. Page, C. H. Wakelee, Joseph Grant, J. B. E. Cavallier, S. C. Bruce, P. C. Hyman, Henry Critcher, P. B. Cornwell, N. A. Watson, Wm. L. Higgins, E. J. de Santa Marina, Simon Mayer, Franklin Lawton, D. C. Williams, Henry Schmeidell, H. P. Wakelee, E. W. Teacle, O. Abbott, R. E. Brewster, A. Marnis Chapelle, E. Dupre, A. J. Shipley, R. H. Sinton, T. A. Talbert, Wm. Wilson Lawton, Frank M. Pixley, David Henriques, Wm. H. Parker, Wm. R. Garrison, J. Downe Wilson, A. Van Lokeren, Chas. K. Smith.

The first meeting called for the purpose of organizing the new board was held Sept. 8th, 1862, at 428 Montgomery street, at which time temporary officers were elected, as follows: Henry Schmeidell, Chairman; and Frank Lawton, Secretary. The following committee was also chosen to draft a constitution and by-laws: John Perry, Jr., Theodore C. Sanborn, Henry Critcher, Robert C. Page, David Henriques and Frank Lawton. At the next meeting, which was held three days later (Sept. 11th, 1862,) the committee reported a constitution which was adopted by the meeting. The name adopted for the new board was the *San Francisco Stock and Exchange Board*, and permanent officers were elected as follows:

President, J. B. E. Cavallier; Vice President, E. W. Teacle.

Secretary, Frank Lawton; Treasurer, Henry Schmeidell.

On the following day the by-laws were adopted. At the time of the organization the admission fee was $100, only $50 of which was then collected. A small room was rented in Montgomery Block for the use of the board which was furnished with a plain table, in horse-shoe form and desks for the president, secretary, &c. The members were at first inexperienced in dealing in stocks on an exchange, and for a time business was very dull. The following statement taken from the records of the board at that time, and showing the transactions for the first five days, illustrates how few were the transactions at the beginning:

			Friday, September 26, 1862.	
Perry	Logan	$500	Starr	377½
Marina	Sanborn	10 feet	Chollar	185
Perry	Pixley	50 shares	Mt. Davidson	8
			Saturday, September 26, 1862.	
Perry	Logan	5 shares	Cal. Navigation	39½
			Monday, September 29, 1862	
Perry	Logan	3000	S. F. Bonds	70½
Wilson	Perry	6 feet	Esmeralda	50
			Tuesday, September 30, 1862.	
Logan	Cavallier	50 feet	Desert	12½
Sanborn	Cavallier	10 feet	Potosi	187
			Wednesday, October 1, 1862.	
Marina	Cavallier	15 feet	Chollar	175
E. H. Wakelee	Mayer	10 feet	Sierra Nevada	140
Perry	Shipley	20 shares	Mt. Davidson	6½
Logan	Perry	10 feet	Meredith	20
Logan	Hyman	36½ feet	Meredith	20
Perry	Sanborn	7 shares	Bensley Water Co.	35

It was not long, however, before there was a large increase in the purchases and sales from day to day, and the fresh applications for membership were also numerous. It was decided to increase the number of members, which was originally forty, and at the same time the membership fee was raised to $250; later it was further increased to $500, and finally to $1,000. The number of members was limited to eighty until about six years ago when it was increased to one hundred. It was not long until the room originally occupied in Montgomery Block was found to be entirely too small to accommodate the members and the board moved to the opposite side of the street to the building belonging to Michael Reese. Again a few months later it removed to a room over the Metropolitan Theatre. About the same time the Bank of California moved to the new building on California street, and other monied institutions followed, thus making that locality the financial centre of the city. When the Merchants Exchange building on California street between Montgomery and Sansome street was constructed, it was therefore arranged that the mining stock board should occupy a portion of it, and the board contributed to the erection of the building to the extent of $20,000. After occupying the rooms set apart for the board, the location and accommodations were found to be unsatisfactory, and once more it sought new quarters, this time in Duncan's Building at No. 411½ California street. The final move of the board was made on Oct. 1st, 1877, when it left the place last above named for the San Francisco Stock and Exchange Building on Pine street.

For some time after the board was organized no charge was made for listing and calling mining stock, but as the business increased and the number of mining stocks seeking the benefits to be derived from the exchange was greatly enlarged, it became necessary to exact a fee for the listing of stocks. The amount charged at present is $1,000.

Mr. J. B. E. Cavallier who was elected president of the board at the time of its organization Sept. 11th, 1862, was re-elected from year to year and continued to serve in that capacity without interruption, until Jan., 1872, when E. P. Peckham was elected for one year. The succeeding presidents have been as follows: William Burling, two years—1873 and 1874; J. R. Keene, from Jan. to August, 1875 when he resigned and was succeeded by Coll Deane; John W. Coleman, one year, 1876; E. P. Peckham, three years, 1877, 1878 and 1879, and since the last date mentioned, G. T. Mayre, Jr.

The present officers and standing committees of the board are as follows:

President, Geo. T. Marye, Jr. *Vice-President*, S. B. Wakefield. *Chairman*, B. H. Cott. *Secretary*, Chas. S. Neal. *Treasurer*, J. M. Shotwell.

STANDING COMMITTEES.—*Executive Committee.*—Homer S. King, H. L. Van Wyck, M. Herman, Geo. C. Hickox, A. F. Coffin.

Finance Committee.—Geo. I. Ives, E. E. Dewey, J. H. Mahony, Jr.

Stock List Committee.—M. J. McDonald, Joseph Marks, W. E. Hale, L. T. Lazure, D. Z. Yost.

Committee on Commissions.—R. C. Hooker, H. H. Noble, C. A. Kenney.

Committee on Membership.—Samuel Dixon, M. P. Hall, Jno. Scott Wilson, C. H. Stoutenborough, C. W. Fox, O. V. Walker, S. B. Boswell.

CONSTITUTION.

ARTICLE I.—*Title of the Association.*—The title of this Association shall be "The San Francisco Stock and Exchange Board."

ARTICLE II.—*Number of Members.*—The number of members of this Board is limited to one hundred.

ARTICLE III.—*Title to property of the Association, and effect of suspension of a member on his interest in the same.*—The legal title and ownership of all property, effects, and assets of the Association, shall vest in the officers named in Article IV, in trust for the benefit and enjoyment of its members.

Whenever a member shall be suspended from or deprived of the privileges of membership, such suspension or deprivation of the privileges of membership, until removed by the action of the Board, shall operate as a full release of all his right, title and interest in and to the property and assets of the Association.

No member, under any circumstances, shall be deemed to have, or claim, or possess any individual right, title or interest in the property or assets of the Association, except when the same shall be finally dissolved and its affairs wound up by its then remaining members.

ARTICLE IV.—*Officers, Elections, etc.*—The officers of this Association shall consist of a President, Vice-President, Chairman, Secretary, and Treasurer, who shall be elected by ballot, annually, on the second Monday in January; and in case of any vacancy, a new election shall be held forthwith for the unexpired term.

Any officer may be removed by a vote of two-thirds of the members of this Association.

ARTICLE V.—*Duties of the President and of the Standing Committees and Officers appointed by him.*—It shall be the duty of the President to see that the several provisions of the Constitution and By-Laws are enforced, and have a care of the general interests of the Board. He shall appoint all committees, and preside at all meetings except the calling of stocks; and he shall be, *ex-officio*, a member of all committees.

He shall, at each annual election, appoint the following committees,* viz: An Executive Committee of five members, to whom shall be referred all applications for donations, and all matters affecting the interests of the Board not otherwise specially provided for in the Constitution and By-Laws.

A Finance Committee of three members, to have the general supervision, management and control of all financial affairs of the Board; to whom shall be presented all bills and demands against the Board, and by whom the same shall be audited and approved before payment; to whom shall be reported by the Secretary, all moneys collected, and the sources from which they are collected; to whom shall be reported by the Treasurer, the amount of money received, and from what sources; to whom shall be reported by the Roll-Keeper, all fines; and a record of whose proceedings and of said bills, demands, collections, dues and fines shall be kept by the Secretary of the Board, acting as Secretary of the Committee. Said Committee shall meet on the first Monday of every month, and at other times when business may require. The Secretary, Treasurer, and Roll-Keeper shall report, as herein required, on the first Monday of every month, and at other times when required by the Committee. The Committee shall make at least quarterly statements to the Board.

A Stock List Committee of five members, to whom shall be referred all applications of companies to be placed on the regular list.

He shall appoint such Assistant Secretaries as may be required, at such salaries as may be fixed upon by the Board.

A Roll-Keeper, at a salary not to exceed two hundred dollars per month, whose duty it shall be to record all fines, and report monthly to the Secretary the amount levied upon each member.

A Sergeant-at-Arms, and such other assistants as may be required.

All appointments made by the President shall be subject to the approval of the Board.

ARTICLE VI.—*Duties of the Vice-President.*—In the absence of the President the Vice-President shall perform all the duties pertaining to the office of President.

ARTICLE VII.—*Duties of the Chairman.*—The Chairman shall call stocks at such hours as the Board may from time to time direct, maintain order and enforce the rules. He shall receive such salary as may be fixed upon by the Board: it being stipulated that, before entering upon the duties of the office, he shall bind himself by a solemn pledge to the Board, through its President, not to act as a broker, or be interested, directly or indirectly, in the purchase or sale of stocks. In the absence of the Chairman the members present may choose a Chairman *pro tem.*

ARTICLE VIII.—*Duties of the Secretary, Record of Transactions, List of Delinquent Members, etc.*—It shall be the duty of the Secretary to keep a full and faithful record of the purchases and sales—which record shall be considered binding on the members; to keep complete minutes of the proceedings of the Board, and to take care of the books and papers of the Association; to collect all moneys due, and pay the same weekly into the hands of the Treasurer, and to perform such other duties as the Board may direct. He shall also furnish, on the first of each month, to the members of the Board, a list of all parties delinquent to them.*

ARTICLE IX.—*Duties of the Treasurer.*—It shall be the duty of the Treasurer to take charge of all the moneys belonging to the Association, subject to such regulations as the Board may from time to time determine.

ARTICLE X.—*Proposals for Membership.*—Any member proposing the name of an applicant for membership in this Board, shall, at the time of his nomination, state in open Board the name of the person to whose seat said applicant desires to succeed.

ARTICLE XI.—*Election of Members—Committee on Membership—no Member to belong to any similar Organization.*—At each annual election a committee of seven members shall be elected, five of whom shall constitute a quorum, who shall be known as the Committee on Membership, to whom shall be submitted all proposals for membership, and who shall scrutinize all objections to applicants. The Committee shall decide by ballot the question of admissibility; and if the whole or a majority of the Committee report in favor of the applicant, he shall be balloted for, and not otherwise, at the next executive session of the Board; *provided*, that five days shall have elapsed between the day of nomination and the submission of their report to the Board. Should the Committee report in favor of the candidate, twenty negative votes shall exclude.

The name of the applicant shall be conspicuously posted in view of the members, at the desk of the Secretary, from the day of nomination to the day of election. No election shall be valid unless fifty votes are cast.

If any member of the Committee on Membership shall be for any reason incapacitated from serving for the period of one month continuously, his office shall become vacant, and the President shall immediately appoint his successor, subject to confirmation by the Board.

At the election, the ballot-box shall be placed in charge of three tellers, who shall be appointed by the President, one of whom shall be the member proposing the candidate, or his seconder. The Secretary shall then call the roll, and each member as his name is called shall deposit his ballot in the box. The poll shall remain open until the conclusion of the executive session. The tellers shall then count the ballots, and the President shall declare the result. Any member who was not present at roll-call, may vote before the close of business by announcing his intention to the Secretary.

Should any discrepancy be discovered between the tallies and the number of ballots in the box, a special meeting of the Board will be held after the next business session, when a new ballot shall be taken.

No member of this Board shall belong to any similar organization in this State, under penalty of immediate expulsion; and any member of this Board who joins or belongs to any similar organization elsewhere than in this State, shall forfeit all the rights and benefits given him by Article XXII of this Constitution and the right to share in any dividends paid by the Board during the period of his connection with such other organization; he shall remain at all times subject to all assessments, dues, or claims, including those contemplated by Article XXII of the Constitution which may accrue against him by reason of his membership in this Board.

ARTICLE XII.—*Suspended Members—Re-election, etc.*—Any member failing to meet his engagements in the Board shall be suspended until he has settled with his creditors.

If he applies for re-admission within six months of his failure in the Board, a committee of three members shall be appointed by the President to inquire into the causes of his failure, who shall report before his seat is forfeited by limitation, and on their presenting a favorable report, announcing that he has settled with his creditors, he may resume his seat in the Board, upon the assent, by ballot, of two-thirds of the members then present.

ARTICLE XIII.—*Sale of Seat upon Retirement, Death or Delinquency of a Member—Members of the Board preferred Creditors.*—In case of retirement of a member in good standing, he shall have the right to dispose of his privileges in the Board, and to nominate a successor to fill the vacancy occasioned by his retirement; *provided*, that no nominee of a retiring member shall acquire any right or privilege until elected in the manner and form prescribed by this Constitution, it being distinctly understood and agreed between the Board and each member thereof that the Board reserves the right to reject any nominee.

In the event of the death of a solvent member, the Board will dispose of the vacant seat to the best advantage for the benefit of his widow and children, or those persons who shall be designated by him in his last will and testament. But no person shall be designated as, or permitted to become successor to the privileges of membership in the Board by virtue of any instrument in the nature of a will.

Any member who has been suspended for six months, and who has not made a satisfactory settlement of his contracts in the Board during that time, shall be deprived of all privileges of membership, and his seat shall revert to the Board, and be appropriated to satisfy his creditors in the Board as follows.

Whenever any member shall have been deprived of all privileges of membership, pursuant to this article, or shall voluntarily surrender his membership for the benefit of his creditors in the Board,

* See also Article XXXIV of By-Laws.

* See also Article XLIII of By-Laws.

the President of the Board shall call a meeting of the creditors in the Board, of such person, who shall thereupon present to him their several claims against the delinquent, and the President in all such cases shall be *ex-officio* a trustee for such person and for his creditors in the Board, and the said trustee shall be vested with all the rights and privileges formerly held by such person in the Board, and shall dispose of the same in the same manner that a person retiring in good standing may dispose of his seat and privileges. The proceeds of any such disposition so made shall be devoted by the trustee to discharging the obligations due by such person to members of the Board, and any surplus remaining shall, after having satisfied all other claims against him, be delivered to the delinquent or to any person authorized to receive the same. If the amount received by said trustee shall be insufficient to discharge all the obligations in the Board of such person in full, then the trustee shall apportion it ratably among the creditors in the Board, paying to each creditor in the Board such proportion of moneys realized by him as the claim of each creditor bears to the total amount of claims proved by the creditors in the Board against such person.

The Board may, however, by a vote of two-thirds of the members present, extend the time for settlement of any suspended or delinquent member for a period not exceeding thirty days.

ARTICLE XIV.—*Delinquents may Voluntarily Surrender Seats.*—Any delinquent member may waive his right of redeeming his privileges in the Board. He may do so by notifying the President in writing that he is unable to meet his engagements with members of the Board, upon contracts for the sale or purchase of stocks, and requesting him to call a meeting of his creditors in the Board, stating them; the President shall thereupon take such action as is required by Article XIII., to be taken by him in respect to one deprived of all privileges of membership pursuant to said Article, and the like proceedings for the sale of his seat and distribution of proceeds shall be had as in a case arising under said Article XIII.

ARTICLE XV.—*Sales of Seats for Account of Delinquent Members—Members of the Board Preferred Creditors.*—In sales of seats for account of delinquent members, pursuant to Article XIII. of this Constitution, the proceeds shall be applied to the benefit of the members of the Board exclusive of outside creditors, unless there shall be a balance after the claims of members are paid in full. And the seat and privileges of every member shall be deemed and taken to be, from the time of his admission and as long as he remains a member, a continuing security to all members of the Board with whom he may deal, according to its rules, for the performance of his contracts and the fulfillment of his engagements.

ARTICLE XVI.—*Quorum.*—In all cases a majority of the Board shall be necessary to do business, except the calling of stocks.

ARTICLE XVII.—*Maximum Rates of Commission*—The rates of commission charged by members of the Board shall not be higher than the following:

Legal Tender Notes on par	½	per cent.
Funded Debt on par	1	" "
Bank Stocks	1	" "
Insurance Stocks on par	1	" "
Wharf Stocks on par	1	" "
Railroad Stocks on par	1	" "
Gas Stocks on par	1	" "
Steamboat Company Stocks on par	1	" "
Telegraph Company Stocks on par	1	" "
Water Company Stocks on par	1	" "
Bills of Exchange on net amount	1	" "
Mint Certificate on net amount	1	" "
Specie on net amount	1	" "
Mining Shares over $500	1	" "

ARTICLE XVIII.—*Fictitious Sales.*—No fictitious sales or contracts shall be made at this Board. Any member or members concontravening this Article may, upon conviction thereof, be suspended.

ARTICLE XIX.—*Payment for and Delivery of Stock.*—In all sales of stocks transferable in this city, either party shall have the right to require the purchase-money to be paid at the time and place of transfer. In the delivery of stocks not transferable in this city, the purchaser shall have the right to require the deposit of the purchase-money in some local bank, to be agreed upon by the contracting parties, or named by the President of the Board; such money to be held in trust until official notification of the transfer shall have been received.

ARTICLE XX.—*Penalty for Non-compliance with Constitution or By-laws.*—Any member refusing to comply with any Article of this Constitution or of the By-laws, may have a hearing before the Board, and if he shall persist in refusing, two-thirds of the members present may declare him no longer a member, and he shall thereupon lose all the rights and privileges given by this Constitution.

ARTICLE XXI.—*Altering Constitution or By-laws.*—No motion for altering the Constitution or By-laws shall be acted upon until at least five days after the motion has been submitted in writing, unless by the unaminous consent of the Board, and none shall be made except by the consent of two-thirds of the members present. In all cases the Article proposed to be altered or amended shall be stated.

ARTICLE XXII.—*Donation in case of Death of Member.*—Upon the death of a member of the Board, the Finance Committee may pay, from the funds of the Board, to such person or persons as may have been designated in writing by such deceased member, the sum of ten thousand dollars, in United States gold coin. In case there be no such written disposition made, then to the widow of such deceased member the sum of ten thousand dollars in United States gold coin. In case there shall be no widow, and a child or children of such member, then to such child or children equally, share and share alike. If there shall be neither widow, child or children surviving such deceased member, entitled to receive said money, nor any disposition made of the same, as herein above provided, then there shall be no payment or provision made under this article.

The payments herein provided for shall be deemed absolute donations to the persons, or for the object to which the same are made or applied, free from all claim or control from any other source or persons.

In case the Finance Committee shall not have sufficient funds or moneys to meet the donations herein provided for, as the same shall be needed, the deficit shall be made good at once, by assessments, *pro rata*, upon the members of the Board, and collected in like manner and under the same penalties as other dues or fines.

ARTICLE XXIII.—*Manner of Acquiring Right to Participate in Benefits of Article XXII.*—No member of this Board admitted after this date (June 8, 1875) shall have any claim or interest in the privileges and benefits provided by Article XXII. of this Constitution, until he shall have filed with the Secretary a certificate from the Medical Examiner attesting his fitness to be accepted by this Board as a participant in such benefits, and no member admitted since June 8, 1875, and who had not filed his Medical Certificate before August 2, 1876, as hereinbefore provided, shall be deemed to have acquired any claim or interest under the provisions of Article XXII. of the Constitution, excepting under the following conditions:

A duly qualified physician shall be appointed by the President as Medical Examiner of the Board, who shall be considered as an appointee thereof, and whose fees shall be paid out of the general fund in like manner as other ordinary expenses. The candidate for admission to the benefits of Article XXII. of the constitution must submit to such examination as may be required by said Medical Examiner, who shall transmit to the President a sealed report containing a detailed statement of the physical state of health of said candidate, as well as his opinion concerning the fitness of said applicant to become a participant in the advantages of said Article XXII. of the Constitution.

The President shall, upon receipt of said report, immediately call a meeting of the Executive Committee, and shall refer the same to them for their consideration. The said Committee shall thereupon decide by ballot whether the Board is justified in admitting the said member to such benefits, and the decision of said Committee shall be reported to the Board at its next ensuing executive session. *Provided*, that the application of such member to participate in such benefits shall not be considered to have been admitted or rejected until the affirmative or negative action of the Executive Committee upon the same shall have been approved and ratified by this Board.

BY-LAWS.

ARTICLE I.—*Order of Business.*—The Board shall meet daily, Sundays and legal holidays excepted, and excepting also a summer vacation, not to exceed five days, at and including the Fourth of July adjournment; the duration of said vacation, within the five days limit above stated, and the time of its commencement, to be determined by a vote of two-thirds of the members, after five days' written notice of intention to move such adjournment.

The hours of business shall be: Morning session at 11 o'clock; afternoon session at 3 o'clock—except on Saturday, when there shall be held but one session, commencing at 11 o'clock A. M. The order of business shall be as follows:

1. Reading the minutes of the preceding day, other than purchases and sales, if called for by two members.
2. Notices of Election.
3. Calling the regular list of stocks.
4. Calling stocks at the request of members.

The hour for business at the 3 o'clock afternoon session may be postponed fifteen to thirty minutes, according to the judgment of the Chairman, and when publicly announced by him to the Board at its preceding session.

ARTICLE II.—*Stocks to be Called—Application to Place Stock on List.*—No stock or bond shall be placed on the list of stocks, etc., regularly called at the Board, except by a vote of a majority of the members present; and application for the placing of stocks on the regular list shall be made directly to the Board by parties interested, subject to all rules and regulations of the Board, with full statement of the capital, number of shares, resources, etc., certified to and signed by said parties; but the stock of no company or corporation shall be placed on said list unless first referred to the Stock List Committee.

ARTICLE III.—*Fees for Placing and Keeping Mining Stocks on the List.*—The fee for placing mining stocks on the regular list shall be five hundred dollars each. This Board reserves the right to suspend the calling of any stock, at any time, by a two-thirds vote of the members present. All mining stocks remaining on the list over one year shall pay one hundred dollars per annum in advance. And the said annual fee shall become due on the first day of January, and any stock upon which said fee shall remain unpaid on the third Tuesday in February, shall be stricken from the list by a majority vote; and no stock so stricken from the list shall be replaced, except by a two-thirds vote.

ARTICLE IV.—*Stocks may be called up when on the list.*—After the regular list has been once called over by the Presiding Officer, any stock upon the list may be called up, the party calling having the privilege of making the first offer.

No bid or offer for the purchase or sale of shares of stock shall be entertained for fractions of a dollar of less than one-quarter where the value of the same is $25 and over; of less than one-eighth where the value is $5 and less than $25; and of less than one-twentieth where the value is under $5. The above rules shall govern the informal as well as the regular sessions of the Board.

ARTICLE V.—*All offers binding—The presiding officer's decision final—Recording sale not made on call.*—All offers for stock, etc., made and accepted, shall be binding whether called by the Presiding Officer or not; and in case there are two or more claimants for the purchase or sale, the Presiding Officer shall decide the same, or he may appeal to the Board for their decision. No sale shall be recorded unless made on the call, except by unanimous consent.

ARTICLE VI.—*Specific Number of Shares to be Offered.*—In all propositions to buy or sell, the offer shall be accompanied with some specific number of shares, the par value of which, other than mining stocks offered, shall not be less than five hundred dollars.

ARTICLE VII.—*Reading the Minutes.*—After the call of each stock, if any transactions have been made, the record of purchases and sales may be read, which reading shall confirm the same.

ARTICLE VIII.—*Fine for interrupting the Presiding Officer.*—Any member interrupting the Presiding Officer while calling stocks, by speaking or otherwise, shall pay a fine of not less than twenty-five cents, and not more than five dollars for each offense, at the discretion of the Presiding Officer, from which there shall be no appeal. The levying of all fines shall rest exclusively with the Presiding Officer.

ARTICLE IX.—*Informal Sessions.*—Section 1.—No assembly of members of this Board outside of the Board-rooms, for the transaction of stock business, shall at any time be allowed, and the said rooms shall remain open for the holding of Informal Sessions between 10 and 10.30 A. M., and between 2 and 2.30 P. M., excepting on Saturday, when only the morning informal session shall be held. All transactions made during such informal sessions shall be recorded in a book kept for the purpose, and shall be binding in the same manner as those of the Regular Sessions. Any adjournment of the Board shall affect its Informal, as well as its Regular Sessions, and the Board-rooms shall remain closed during the whole time of such adjournment.

Section 2.—The Chairman of the Board shall preside at its Informal as well as its Regular Sessions, for the preservation of order and decorum—by the imposition of fines, for the settlement of disputes, and for the supervision of the records to be kept of the transactions made.

Section 3.—The Assistant-Secretary shall be in attendance during the Informal Sessions of this Board, to record all transactions at the request of members, under direction of the Presiding Officer.

ARTICLE X.—*Contracts Falling due on Holidays.*—All sales made at this Board shall be settled the following day, unless expressed to the contrary, and all contracts falling due on such holidays as are observed by the banks, shall be settled on the preceding day. All stocks falling due on Sunday will be carried over until Monday.

ARTICLE XI.—*Hour before which Stocks can be Called for or Delivered.*—In all sales of, or contracts for stocks between members of the Board, the party to receive the same shall not be bound to take them after 2.30 P. M., but may postpone the same, without the charge of interest, to the following day; and any member having a right to call on another for stock, shall demand the same before the hour above specified, or be subject to a continuance of the contract until the following day.

ARTICLE XII.—*Notice on Time Contracts.*—In all contracts on time, made at the option of buyer or seller, one day's notice shall be given before stocks can be delivered or demanded before maturity, and such notice shall be given at or before 3 o'clock P. M.

ARTICLE XIII.—*No Contracts to be made over Ninety Days.*—No contracts, for the receipt or delivery of stock, etc., beyond ninety days, shall be made at this Board.

ARTICLE XIV.—*A Deposit on Contracts may be Required.*—On all time transactions made at the Board, either of the contracting parties may require a deposit of twenty per cent. on the amount of purchase money, as security for the fulfilment of the contract. Should the stock contracted for vary in price to within five per cent. of the margin of said deposit, either party may call for an additional deposit of ten per cent., and may continue to do so as often as the latest deposit may be exhausted by change of price; it being fully understood that either party may draw down any excess of twenty per cent. that may be in his favor.

When the seller deposits his stock, the deposit paid by the buyer shall go to the seller.

When a member of this Board neglects or refuses to put up the usual deposit on time contracts, after due notice of requirement, it shall be at the option of the opposite contracting party to close the same by purchase or sale through the Presiding Officer, with some other member, on his account; the defaulting party to be held responsible for any differences. When any member neglects or fails to meet his contracts upon which deposits are made and in bank, the said deposits of money or stock shall be due and payable to the other party, upon the signature of the President or Vice President of the Board.

ARTICLE XV.—*Right of Broker to demand further Deposits—Sales of Delinquent Stock of Non-Members.*—Where stocks are bought or sold on time, or where money is advanced on stocks by a broker, he may call on his principal for an additional deposit, *sufficient to maintain the original margin*, but in the event of the margin at any time being reduced to within twenty per cent. of the market price of the stock, then the broker shall have the right to sell out or buy in such stocks, through the Presiding Officer, with or without notice to his principal.

The Secretary shall make a record in a book kept for the purpose of all such sales or purchases, with the name of the broker and principal for whose account they were made.

All sales of delinquent stock made on account of any person not a member of this Board, and without the order of such person, shall be made by the Presiding Officer in the Board-room, at public auction, immediately after the adjournment of any session, and all persons (irrespective of membership) shall be at liberty to bid for the same.

Upon all purchases so made, a deposit of twenty per cent. shall be made at the time, and failing such deposit, the stock shall be re-sold forthwith.

ARTICLE XVI.—*Place of Deposit on time Sales.*—When deposits are made on time sales, the seller shall have the privilege of designating the banking-house in which the deposits shall be made. The seller shall be responsible for the money deposited, and for the delivery of the stock. Should the purchaser object to the place of deposit, the President of the Board shall designate some other place of deposit, in which case the responsibility shall be mutual, as between buyer and seller.

ARTICLE XVII.—*Limitation of Contracts.*—This Board will take no cognizance of contracts that remain unsettled five days after they become due, unless continued by mutual consent.

ARTICLE XVIII.—*Outside Contracts.*—This Board will not recognize or enforce any time contracts made by members outside of the Board, unless the same shall be reduced to writing within three days: and any member of this Board having stock transactions with a party not a member, must, for his own protection, ask for a broker, otherwise the transaction must stand on its own basis, and the Board will not take any action in the matter.

ARTICLE XIX.—*Assignment of Contracts.*—No assignment of any contract made between members of this Board will be recognized by the Board, except made by mutual consent, indorsed on the memorandum of contract.

ARTICLE XX.—*Payments.*—All payments shall be gold coin of the United States, unless otherwise agreed to by the Board.

ARTICLE XXI.—*No Stock to be Called when Transfers are not allowed in the usual hours.*—No stocks shall be called at the Board, the transfer of which is not allowed to be made within the usual hours of business as frequently as may be desired by the stock-holders.

ARTICLE XXII.—*How Stocks are to be Delivered when the Transfer Books are Closed.*—Whenever the transfer books of a company shall be closed by any legal impediment, so as to render the time of their being open again uncertain, then the deliveries of stock of such company, in satisfaction of contracts, shall be made by notarial power-of-attorney, irrevocable, containing assignments, and bill of sale, and certificate; the papers to be satisfactory to recipient, or passed upon by the Board.

ARTICLE XXIII.—*Stock Privileges.*—When any member agrees to pay a sum of money for the privilege of receiving or delivering stock at his option, the premium bid for the privilege shall be paid on the next business day. No member of the Board shall be allowed to bid for or offer privileges on any stock during the session of the Board.

ARTICLE XXIV.—*In case of failure, contracts closed at the Market price of the Day.*—In case of the failure of any member of the Board, the President shall adjust all outstanding contracts with him at the average prices of the day he failed, if the failure is announced before 2 o'clock P. M.; and if not, then at the average prices of the ensuing business day.

ARTICLE XXV.—*Default must be reported within forty-eight hours and Claims filed within Thirty Days Thereafter.*—In cases where a member of the Board shall fail to comply with his stock contracts, it shall be the duty of his creditors to report said default to the President of the Board within forty-eight hours after said defalcation becomes known to them. No claim or contract, unless so reported, shall ever after be recognized or enforced by this Board. During the suspension of a member, no such report shall be required.

All claims of members and non-members against said delinquent member, must be filed with the Secretary of the Board within thirty days after he has been reported, and must be accompanied with a detailed statement of the account.*

No claims, unless so filed, shall ever after be recognized or enforced by this Board.

ARTICLE XXVI.—*Preferred Indebtedness.*—When a member of this Board fails, and is re-admitted to his seat, all subsequent accruing indebtedness shall be considered preferred.

ARTICLE XXVII.—*Sale of Dividends not Allowed.*—No purchases or sales of dividends will be permitted at the Board.

* See also Article 45 of the By-laws.

ARTICLE XXVIII.—*Dividends declared and interest accrued after Sale. Script Dividends.*—In all sales, dividends declared after the sale and before the payment and delivery shall go to the purchaser.

When the seller draws the dividend on stocks sold on time contracts, the amount of said dividend shall be deducted from the price of said stock, and the deposits made accordingly.

Should a stock upon which a dividend has been declared be delivered whilst the transfer books of the Company are closed, the purchaser shall have the right to deduct the dividend.

When mining companies make stock or scrip dividends, the stock or scrip so divided shall go with the original stock for ninety days from date of distribution.

The accrued interest on all stocks and bonds, not especially excepted in the By-Laws, shall go to the purchaser.

ARTICLE XXIX.—*Assessments, when delinquent, and by whom paid.*—In all sales of stocks, whether on time or for cash, the buyer shall pay any assessments levied and not delinquent at time of sale; *provided*, that the levying of such assessment by any company shall have been previously announced by the Presiding Officer in open Board; but no assessment, whether payable instanter or otherwise, shall be considered delinquent until thirty days from the day on which it is levied.

Where an assessment is levied on a stock and made payable monthly, or at different periods, in installments, each payment shall be governed by this article, and become delinquent as follows: the first payment in thirty days from the date of levy; the second, in thirty days from the day on which it is made payable; the third, the same, and so on. The day on which an assessment is levied is not counted as one of the thirty days.

ARTICLE XXX.—*Rescinded Assessments.*—On all time sales of stock after an assessment becomes delinquent, and is thereafter rescinded, the buyer may, upon delivery, deduct the amount of said assessment from the contract price of said stock.

ARTICLE XXXI.—*Charges on Stock advertised for Assessments.*—The seller of stock shall pay all the charges for advertising delinquent assessments, etc., pending the settlement of time contracts.

ARTICLE XXXII.—*Limitations of Claims for unpaid Assessments, and of other Demands.*—No reclamation for unpaid assessments upon stock sold by members of this Board, the transfer office of which is in this city, shall be allowed, unless the same is presented within five days from the date of delivery; and when the transfer office is out of the city, the demand must be made within twenty days of the date of delivery.

In the event of stock which has been sold for assessment being delivered in error, the broker receiving it shall be entitled, within five days from the date of delivery, to demand transferable stock in lieu thereof; and in case such demand is not made within five days, then the broker who delivered the stock may settle with him by returning the amount which he paid for the stock.

No reclamation for any stock delivered shall be made after the expiration of thirty days, if the transfer office is in the city; and not after sixty days, if the transfer office is out of the city.

ARTICLE XXXIII.—*No Appropriations except by Ballot.*—No appropriation of any moneys for any person or object whatever, other than ordinary expenses of the Board, as provided by the Constitution and By-Laws, shall be made, unless two-thirds of the members present shall, by vote, concur therein. Notice of any such appropriation shall be made in writing, and shall lie over one day, and vote thereon shall be by ballot.

ARTICLE XXXIV.—*Establishing a uniform rate of Commission.*—No member of this Board shall transact any business as a stock broker upon commission at a less rate than one-half (½) of one per cent; *provided*, that upon each and every transaction* in any one stock not exceeding in amount $200, the commission shall not be less than one dollar, except for another member, when the commission shall not be less than ⅛ of one per cent. Nor shall any member be permitted to avoid the effect of this By-law in either of the aforesaid cases by means of any rebate, deduction, or allowance; not charging commission on joint-stock transactions, or on all purchases or sales in every account, whether on behalf of members or non-members, or in any other manner whatever, susceptible of proof to the satisfaction of the Board, of an intention, either directly or indirectly, to evade its provisions; *provided*, that no member shall be compelled to charge commission where the occasion of, or the service rendered is of an exceptional or casual nature.

Whoever shall violate this by-law shall be subject to the following penalties, and there shall be no power in the Board or its officers to modify or remit any part thereof, except by a vote of two-thirds of the members present: For the first offense, a fine of five thousand dollars in United States gold coin shall be imposed, the amount thereof to be equally divided between the complainant and the general fund. The party convicted shall be suspended from all the privileges of the Board until the fine be paid. If the fine shall be not paid within one week from the date of its being imposed, the suspended member shall be considered as delinquent to the Board in the amount thereof, and subject to all the provisions of Article XIII of the Constitution, and Article XXV of the By-Laws, respecting suspended members and the filing of claims against the same, and the amount of said fine shall be deemed as preferred indebtedness over any and all claims which may be presented against the seat of said delinquent.

Upon all second or more convictions under this by-law, in addition to the penalty already prescribed as aforesaid, and which shall be similarly applied, the offending member, if the said fine be paid at any time before his seat shall have reverted to the Board, shall be suspended for one month after such payment, from all his rights of membership. No member, however, shall be deemed to have lost the right of participating in the benefits of Article XXII of the Constitution, by reason of any conviction or penalty imposed under this by-law, until the forfeiture of his seat shall have been accomplished through the operation of Article XIII of the Constitution.

The President shall appoint a committee of three members to whom complaints for infringement of this by-law shall be made. Said committee shall investigate the same under oath, and decide by ballot as to the guilt or innocence of the accused, and report the result of said investigation to the Board.

ARTICLE XXXV.—*No Business before Calling Stocks.*—Except by unanimous consent, no business shall be transacted previous to calling stocks.

ARTICLE XXXVI.—*Communications having a Tendency to Influence the Market.*—No letters or communications having a tendency to influence stocks shall be read publicly at the Board, without first being presented to the President.

All communications addressed to the Board, affecting the state of the mines or mining stocks, shall be read instanter.

ARTICLE XXXVII.—*Receipts and Deliveries must be Made between Members.*—All receipts and deliveries required by the purchase and sale of shares of stock must be made directly between the members of this Board; and any member who shall, in completion of such stock transactions, either receive the certificates from or deliver them to any person other than a member of this Board, shall be fined five hundred dollars for the first offense, and for the second shall be expelled.

ARTICLE XXXVIII.—*Penalty for Employment of non-Members.*—No member of this Board shall employ, directly or indirectly, a non-member to buy and sell mining stocks dealt in at the Board, under a penalty of one thousand dollars for each offense.

ARTICLE XXXIX.—*Indecorous Language or Conduct—Smoking—Punishment.*—Any member who shall be guilty of indecorous language or conduct during the session of the Board, shall be fined not less than five nor exceeding one hundred dollars, or shall, by a vote of two-thirds of the members present, be suspended from his seat for not less than one week nor more than one month; and a repetition of the offense shall subject the party so offending to expulsion, and he shall not again be admitted unless by consent of two-thirds of the members present.

A fine of five dollars shall be imposed upon any member who shall stand upon the desks or chairs in the Board-room, either during the session of the Board or after.

Smoking shall not be allowed in the Board-room. Any member violating this rule shall be fined twenty-five dollars.

ARTICLE XL.—*Fine for non-attendance at a Special Meeting.*—When a special meeting of the Board shall be called, the fine for non-attendance may, by a vote of two-thirds of the members present, be increased to a sum not exceeding five dollars.

ARTICLE XLI.—*Neglect to Pay Fines for Three Months—Penalty.*—Any member who shall absent himself from the Board, and omit to pay his fines for the period of three months, may be declared no longer a member. A list of members delinquent for fines shall be furnished the Sergeant-at-Arms, and he is ordered to refuse admittance to the Board-room to all members who fail to pay their bills before the 21st of each month. The Secretary shall notify delinquent members to this effect.

ARTICLE XLII.—*Access to the Minutes.*—No person shall have access to the minutes of the Board except the members and their clerks.

Clerks admitted to the business sessions of the Board are prohibited making abstract and duplicate lists of sales for other than their employer.

ARTICLE XLIII.—*Black List.*—Each and every member shall report publicly to the Board the name of every person who shall violate his engagements with him as a broker, after employing him to execute business on commission, or who shall have refused satisfactory settlement of any contract made with or by said broker on his account; and it shall be the duty of the Secretary to keep a book for the purpose of registering the name of every person reported as a defaulter (together with his address), and the name of the broker who shall complain, there to remain until the debt that may have accrued through the medium of the member, in his capacity as a broker, be liquidated. So long as the name of said defaulter or defaulters continue registered upon the books of the Board, no member shall execute, or cause to be executed, any business, for him or them, either as principal or agent for any other person, under pain of immediate suspension.

Suspended members, who have not settled, are subject to above penalties.

ARTICLE XLIV.—*Arbitration of Claims of Non-members.*—Any person not a member of the Board shall have the right to bring a claim against a member of said Board arising from any transaction

*This provision of Article XXXIV of the By-laws has received the official construction of the Board in executive session, and it was then held that the commission should be *not less than one dollar* on every order in each stock. See minutes of Executive Session of May 12th, 1880.

in stocks, or money loaned during his membership, on the conditions following, and not otherwise:

The person making such claim shall execute a full release of his claim against said member, duly signed, and shall deliver the same to the President, to be held in trust to abide the event of the suit before said Board.

The President shall keep the said release in trust, to abide the result of said suit, and shall deliver the same to the defendant on the happening of either of the three following events:

1st. In case the claimant shall not present his claim to the Board within twenty days after executing said release.

2d. In case judgment shall be rendered for said defendant by the Board.

3d. In case the defendant shall pay, or offer to pay, to such claimant the amount of judgment rendered in favor of said claimant.

In case judgment shall be rendered against any member of the Board, which he is unable or unwilling to pay, then such release shall be canceled and returned to such claimant.

FORM OF RELEASE.—*Know all Men by these Presents:*—That I, ————————for and in consideration of the sum of one dollar, to me in hand paid by————————, the receipt of which is hereby acknowledged, have remised, released and forever discharged, and by these presents I do hereby remise, release and forever discharge the said————————of and from any and all demands heretofore existing and due and owing to me, and the said————————is hereby fully released and discharged from the same.

Sealed with my seal, and dated at San Francisco, this———— day of————, 18—.

ARTICLE XLV.—*Regarding Suspension of Members and Legal Proceedings.*—In all cases where and in accordance with the provisions of Article XLIV. of the By-laws, a judgment has been or shall be rendered against any member of the Board by the Board, such member shall, without further action of the Board, stand suspended from the time of the rendition of such judgment until the same is fully paid or satisfied, or tendered and refused.

Whenever any creditor of a member of this Board, or any person asserting a claim against a member of this Board, has voluntarily or shall voluntarily, resort to any legal tribunal, or has voluntarily instituted, or shall voluntarily institute any legal proceedings against such member concerning his claim, such claim shall not be recognized or enforced by this Board.

ARTICLE XLVI.—*Prohibiting Connections and Transactions with Similar Organizations.*—All members of this Board shall cease all partnership connections in any way with members of any similar organization. And also cease executing orders, either directly or indirectly, through clerks or otherwise, in any similar organization, under penalty of suspension.

ARTICLE XLVII.—*Providing a Safeguard between Brokers and their Clerks.*—First. All clerks and employees of the members of this Board shall be registered in a book provided for that purpose by this Board; said book to be open to the inspection of members only.

Second. Any member of this Board trading with a clerk or employee of any other member of this Board, after said clerk or employee has been registered, in accordance with section one of this by-law, and not reporting his transactions with said clerk or employee to his employer before the next session of the Board, shall, for the first offense, by a majority vote of the members of this Board, be suspended from and deprived of all his rights and privileges as a member of this Board for the period of thirty days, and fined in the sum of five thousand dollars ($5,000), and said suspension to continue until the fine is paid. And for the second offense, under this rule, he shall be expelled.

Third. Like penalties shall be imposed on any member of this Board doing business for any other member of this Board suspended under this resolution.

Fourth. All fines collected under this resolution shall be placed to the credit of the general fund of this Board.

Fifth. It shall be the duty of all members of this Board to report immediately all changes in the clerical department of their business.

Sixth. The Secretary of the Board shall furnish each member with a printed copy of said book in which the names are registered, and shall report to the members all changes in the clerical force as reported to him.

Seventh. Brokers' clerks shall not be allowed to trade on the floor of this Board.

ARTICLE XLVIII.—*Amounts due the Board for Moneys paid on Death of Members.* The amounts due to the Board by the forfeited and suspended seats of members for assessments levied in the manner prescribed by Article XXII. of the Constitution, shall be paid out of the general funds, and charged to each seat respectively.

ARTICLE XLIX.—*Investigation of Claims by Arbitrating Committees.*—All differences, investigation of claims, or settlement of accounts between members, or between members and non-members, shall be referred to the President, unless otherwise ordered, to Committees of Arbitration, consisting of at least three members. Said committees shall report in writing within fifteen days from date of appointment, unless further time be granted; and their report, if adopted, shall stand as the award of the Board.

ARTICLE L.—*Bids and Offers Confined to Members.*—The bids or offers for the purchase or sales of shares of stock shall, during all sessions of the Board, be exclusively confined to members thereof, and anything contained in these By-laws conflicting herewith is hereby rescinded.

ARTICLE LI.—*Tickets of Admission.*—Section 1.—Tickets of admission of visitors of this Board shall have the following printed on the backs of said tickets:

"This ticket is issued on condition that the holder thereof will abide by all rules and regulations of the San Francisco Stock and Exchange Board, and for any violation thereof the Board reserves the right to cancel the same, and deny the holder admission to the rooms of the Board."

Section 2. None but ticket-holders shall be admitted to the Board-room, and no person whatever, excepting members or employees of the Board, shall be permitted to enter within the railings on the floor of the same during any of its sessions.

Free admission for ladies and their escorts to the galleries of the Board-room shall only be granted by cards issued by members.

ARTICLE LII.—*Authority of Treasurer to Pay Drafts.*—The Treasurer is hereby authorized to pay all drafts signed by the President and Secretary.

RESOLUTIONS AND MICELLANEOUS RULINGS.

Resolution Adopted May 7, 1872.

Resolved, That the written record, after being correctly copied immediately after the adjournment of the Board, from the phonographic report, and certified to by the Secretary and Assistant Secretaries, be, and is hereby acknowledged as the official record.

Resolution Adopted October 3, 1877.

Resolved, That mining companies that have been stricken from the list for non-payment of annual dues, can only be reinstated by paying the usual fee of five hundred dollars.

Resolution Adopted February 13, 1878.

Resolved That the secretaries of all mining companies be requested to inform this Board of all dividends declared on their capital stock, at the time of their declaration.

Ruling of President Regarding Liability of Partners Adopted as a Rule of the Board, August 25, 1880.

"Under the Constitution and Rules of the Board, the seat of every partner member of the Board is responsible for every check signed and given by his partner or partners in business, in payment or satisfaction of any contract or transaction made by him in the Board."

Ruling of the Chair, September 14, 1881; *Adopted as a Rule of the Board.*

That where a transaction is claimed to have been made during any regular or informal session of the Board, and on the call of the stock alleged to have been dealt in, and the transaction should have been recorded, but has not been, through the error or omission of the parties, or through the omission of the recording officer of the Board, and the omission of the Recording officer has not been corrected or sought to be corrected at the time of the reading of the record, the parties to the transaction, or the one who afterwards demands its performance, must compare, or seek to compare it before leaving the Board-room after the expiration of the session, or the Board will not enforce the transaction.

This ruling does not apply to cases where the record has been correctly read, but the recording officer has afterwards made a mistake in filling it out.

Other California Exchanges.—It was not to be expected that a close corporation like the San Francisco Stock and Exchange Board whose membership was limited to eighty and with a remarkably prosperous business, could exist for a great length of time without more or less dissatisfaction among those who could not secure admission, and without an effort to create a rival exchange. This was not accomplished, however, until in January, 1872, nearly ten years after the organization of the first mining board. Just after the development of the bonanza in the Crown Point and Belcher mines had been made, it was decided by a number of "outsiders" to organize a new board, the forty charter members of which were as follows: John Middleton, T. J. L. Smiley, Jackson McKenty, S. Barrell, S. Hyneman, W. W. Lawton, M. D. Townsend, W. H. Wright, H. S. Fitch, Charles L. Weller, E. L. Smith, A. C. Chick, Joseph Klopenstine, Joseph de Sta. Marina, H. C. Logan, M. Rudesdale, J. P. Cantin, W. H. Brown, Wm. Jay Smith, T. J. Poulterer, T. C. Sanborn, J. F. Crossett, A. Diffot, R. F. Kent, F. Wolf, E. S. Tibbey, R. Broderick, E. J. Baldwin, C. C. Harvey, W. J. Williams (since deceased), J. B. Bourne, J. R. Maxwell, Louis Lacour and J. Tilden. The name selected was the "California Stock Exchange Board," and at the organization T. J. Poulterer was elected President; T. J. L. Smiley, Vice-President; W. W. Lawton, Secretary; E. J. Baldwin, Treasurer; James Tilden, Caller; and John Gray, W. J. Williams, and Joseph Tilden, members of the Executive Committee.

The first session of the new board was held on February 1, 1872. The number of members authorized by the Constitution was seventy, and the remaining thirty seats were quickly taken; subsequently, however, the limit was reduced to sixty-two, at which it remained for a long time. The market value of a seat in this exchange in the early part of 1875 was fully $2000, but the organization of a third board about that time, caused twenty-six of its most active members to withdraw, and others followed. However, the vacancies were filled by new members and the board continued to do business. When the Bank of California suspended, it was the only board to continue its daily sessions during the trying times which followed, and this fact gave it considerable prestige. It was compelled to succumb, however, in 1880.

In the spring of 1875 a movement was made to organize a mining exchange which should include among its members all the leading and at that time very rich operators on the Pacific coast. The plan also embraced a scheme for the loaning of money on mining securities as collateral. An agreement was signed by forty persons, among whom were such prominent stock operators and brokers as E. J. Baldwin, Wm. M. Lent, H. J. Booth, Capt. James M. McDonald, Geo. S. Dodge, Andrew J. Moulder, George C. Hickox, Henry P. Wood, M. D. Townsend, Gen. Thomas H. Williams, George Hearst, George W. Grayson, Paul Moroney, Philip S. Fay, John F. Boyd, Gustave Sutro. The name selected was the Pacific Stock Exchange. In May, 1875, the forty charter members completed their organization by selecting forty other members, a number of whom were prominent brokers in the California Board, as above mentioned. The eighty members forming the organization paid in $5,000 each, thus creating a cash capital of $400,000. The movement was very popular, as much as $10,000 being offered for a seat, before the last forty members were chosen, and the applications for membership were twice as many as the vacancies to be filled. The permanent organization of the exchange was effected on May 6, 1875, by the election of the following officers: President, E. J. Baldwin; Vice-President, Geo. S. Dodge; Secretary, Andrew J. Moulder; Chairman, Joseph Tilden; Treasurer, Geo. C. Hickox. On May 24, William M. Lent, H. J. Booth and James M. McDonald were elected a Trust Fund Committee, which was one of the features of the new exchange, the committee being entrusted with all its funds which were to be loaned to members on stock collaterals. The first meeting for the purchase and sale of stocks was held on June 7, 1875, in the large hall in the Halleck building, on the corner of Sansome and Halleck streets. In recognition of their services in promoting the great mining interests of the Pacific coast, the following gentlemen were elected honorary members at that meeting: Wm. Sharon, J. C. Flood, Jno. W. Mackay, Wm. S. O'Brien, James G. Fair, Robt. F. Morrow, J. D. Fry, Jno. P. Jones.

It was necessary that a company should be incorporated under the laws of the State for the purpose of holding and managing the property of the Pacific Stock Exchange, and for this purpose the "Pacific Exchange" was incorporated on Oct. 5, 1875, the first directors being: E. J. Baldwin, George S. Dodge, George C. Hickox, William M. Lent, George W. Grayson, T. J. L. Smiley, and J. L. Hunt. After the organization was completed, T. J. L. Smiley, C. L. Weller and J. L. Hunt were appointed a Building and Finance Committee. Meanwhile, the Pacific Stock Exchange had purchased (on May 24, 1875) the property now occupied by it on Montgomery street for $325,000 gold, on which, under the direction of the Building and Finance Committee, the present building was erected. The new hall has a frontage of fifty-two feet on Leidesdorff street, running back 100 feet, and communicating with an exquisitely ornamented rotunda, and that with a spacious vestibule, elaborately decorated, opening upon Montgomery street.

The Constitution and By-Laws of the Pacific Stock Exchange are substantially the same as of the San Francisco Stock and Exchange Board. The charges for placing a mine on the list of the Pacific Stock Exchange are $500, and an annual fee for renewal of $100.

Dealings in the Comstock Shares.—As has been stated, the excitement in mining shares on the San Francisco market, and for that matter, throughout the financial world, rose to fever heat about the time of the discovery of the Comstock bonanza. Respecting the Comstock properties the San Francisco *Bulletin* has the following:

"Mining property is about the most uncertain kind of a possession. Its value depends on circumstances entirely beyond the control of the owners. This is especially true where the mines have become stock-jobbing enterprises. The value is fixed without much regard to laws or analogies. It is often the case that the shares are rated below what the assets would bring, independent of the mine; and it is just as often that they are rated at fabulous figures. There is a wonderful amount of sympathy between contiguous mines. What sends the value of shares in one to a high or low figure has a corresponding influence on adjacent claims without the least regard to merit. Because one good body of ore is found in a certain locality, it is taken for granted that equally good discoveries are certain in all contiguous mines for miles around. This is contrary to all precedent, and yet the influence still exists. Good mines do not go in schools like fish, nor graze in groups like sheep. The Comstock has never had more than one or two good mines in operation at the same time. The same is true of other sections in that State and other States and Territories. The one mine of Utah is the Ontario, and the one mine of Dakotah is the Homestake.

"It is now nearly five years since it was whispered that the Consolidated Virginia would pass its dividend. Such an event had been anticipated by those on the inside for some months previously, but to the great majority of operators in stocks the news was a surprise and a disappointment. It naturally had a depressing effect on values. The mine had been paying continuously for thirty-two months, and for the last twenty-two months at the rate of $1,080,000 per month. Besides, for the last eight months, its companion, the California, had been paying at the rate of $1,080,000. Many believed that those disbursements could be kept up for a long period. But when January, 1877, passed, and no dividend from the Consolidated Virginia, faith in the perpetuation of a bullion product from the Comstock Lode was very much shaken. The fact that California kept up its dividends softened the disappointment, but it did not entirely heal the breach. Consolidated Virginia resumed dividends in May, 1877, and kept them up until June, 1878. It also paid dividends of 50c. per share in 1879, and two of the same kind in 1880.

"California commenced paying in May, 1876, and kept up its dividends monthly until August, 1878, though the last two were at the rate of $1 per share. It subsequently paid two of the same amount in December, 1878, and January, 1879, and four others at 50c per share at irregular intervals in 1879. The last dividend by the California was in December, 1879, and the last by the Consolidated Virginia was in August, 1880. These two mines have been the mainstay of the Comstock for the past nine years, during which they have produced over $100,000,000 in gold and silver and paid $74,250,000 in dividends. The note of warning sounded in the ears of the public by the passage of the dividend of the Consolidated Virginia in January, 1877, and the subsequent irregularity of its disbursements and those of the California have had an important influence on Comstock values in the past four years.

"The leading Comstock mines have been steadily depreciating in value for the past three years or more; and at times they have appeared to be unusually depressed. Some think that even now they are at bed rock prices. But take them right through they are not so low as they have been this year and in previous years. Considering the limited amount of bullion produced by them during the past year and their present condition, it is, perhaps, remarkable that values should have been kept up as well as they have. In November, 1870, according to the rating of shares in this market, $4,696,700 would have purchased all the leading mines on the Comstock from Utah on the north to Alta on the south, a section of nearly two miles of mining claims. A little more than four years later on, say in January, 1875, a check for $271,000,000 for the same mines would doubtless have been refused. In May, 1877, these mines fell to $27,658,900. A year later they were worth $36,261,000, and in September, 1878, they were rated at $114,260,000. This was during the excitement in Sierra Nevada and Union.

"The highest and lowest prices of twenty-nine of the principal claims for this interval are given in the annexed tables:

Highest Prices of Comstock Shares in Four years.

Mines.	1878.	1879.	1880.	1881.
Utah, per share	$56 00	$32 00	$18 75	$14 25
Sierra Nevada	270 00	88 50	28 00	29 00
Union Con	195 00	99 00	53 00	19 75
Mexican	99 00	47 75	23 50	14 75
Ophir	98 00	45 00	22 60	10 00
California	15 75	11 60	4 50	2 15
Con. Virginia	17 00	9 78	5 00	4 90
Best & Belcher	40 00	26 00	15 00	16 75
Gould & Curry	31 50	16 50	7 37	9 37
Savage	30 00	18 00	8 50	4 60
Hale & Norcross	39 00	21 25	9 50	7 62
Chollar	35 00	9 37	9 50	4 25
Potosi	35 00	7 00	5 75	4 95
Julia Con.	9 87	6 25	3 25	70
Bullion	30 00	11 75	6 75	2 50
Exchequer	11 50	12 00	4 25	2 10
Alpha Con	24 00	32 60	12 25	5 75
Con. Imperial	1 90	1 95	1 05	30
Confidence	14 00	23 00	9 00	6 50
Yellow Jacket	42 00	27 00	13 37	7 50
Kentuck	10 25	8 00	4 25	3 25
Crown Point	13 00	7 00	7 00	3 45
Belcher	16 00	9 62	13 75	3 90
Overman	29 00	14 00	3 33	3 00
Caledonia	6 00	3 50	2 75	80
Justice	12 00	6 00	3 80	1 40
Silver Hill	4 00	3 00	2 00	50
Alta	26 00	15 00	20 50	5 50
Benton Con.	13 00	8 87	3 75	1 25

Lowest Prices of Comstock Shares in Four Years.

Mines.	1878.	1879.	1880.	1881.
Utah, per share	$6 75	$6 00	$5 00	$5 00
Sierra Nevada	2 60	14 75	6 50	4 85
Union Con	3 00	25 00	8 25	6 37
Mexican	7 00	13 25	5 50	4 15
Ophir	24 50	14 75	5 00	3 10
California	7 75	2 70	1 50	40
Con. Virginia	7 00	3 00	2 05	1 05
Best & Belcher	10 12	6 87	6 00	6 00
Gould & Curry	4 00	3 75	2 50	2 25
Savage	7 75	3 37	1 00	75
Hale & Norcross	4 80	4 75	2 50	1 65
Chollar	11 00	4 50	1 50	1 15
Potosi	10 25	2 50	1 40	1 00
Julia Con.	1 25	55	25	10
Bullion	3 00	2 50	85	25
Exchequer	1 90	1 80	80	75
Alpha Con.	6 75	6 00	2 20	2 39
Con. Imperial	30	25	10	5
Confidence	3 00	6 75	2 75	2 00
Yellow Jacket	6 00	6 37	2 90	1 50
Kentuck	2 00	1 50	1 00	45
Crown Point	3 00	85	1 00	60
Belcher	2 10	1 00	95	80
Overman	7 25	2 00	50	50
Caledonia	1 25	50	10	6
Justice	3 50	60	25	35
Silver Hill	30	55	10	5
Alta	3 00	1 90	1 00	75
Benton Con.	60	85	65	35

"The highest prices in 1878 occurred during the month of September. The cause for that advance was the reported discovery of a body of ore in Union Consolidated and Sierra Nevada that was as much larger and richer than that found in Consolidated Virginia in 1874 as that was larger and richer than that found in Belcher in 1871. That reported discovery was one of the gravest mistakes ever made in the history of mining in that section, or it was one of the most stupendous frauds. Either horn of this dilemma is far from being flattering to those who fabricated the one or perpetrated the other. The history of that affair now reads like a fairy tale, which no one is expected to believe. Experts tested the assays and with diamond drills pierced the immense ore body, the dimensions of which could only be conjectured. In the height of the excitement a private sale of 5,000 shares Union Consolidated was closed at $200 per share, and the buyer actually paid $1,000,000 to the purchaser, presumably for the above stock.

"Over three years have since elapsed, and no bonanza has been developed in either Sierra Nevada or Union Consolidated, and there is no show that any such body of ore exists there, and there is less reason to believe that one will be found. Still, in mining, all things are supposed to be possible. The completion of the Sutro Tunnel upwards of a year ago, and the facilities it affords for working at great depths, ars having a fair trial in these north end mines. Heat and water are great obstacles in the way of success, and expenses increase with depth. But a large body of ore averaging as high as that in the Consolidated Virginia would offset all these difficulties. The question simply lies in the finding of such an ore body. Experience rather favors the theory that there is considerable pay ore in the Comstock Lode that has not yet been penetrated. It is because of this faith and the mystery surrounding the location of the deposit that interest in the work of development is kept up and money advanced.

"It will be noticed that all attempts to restore values to the high plane of September, 1878, have failed. The best general average for 1879 was considerably below the best ratings in 1878. In 1880 the scale was still lower, and in 1881 a still lower level was reached. The cost of a single share in each of the foregoing mines, if purchased at the highest rating of each this year, would have been only $184.75. It would have taken twice that amount of money to have made a similar purchase on the same basis in 1880. In 1879, double the sum for 1880 would have been needed to accomplish the same end, while for 1878 the difference was still greater. The same law applies to the minimum rates for each year, though not to the same extent. The minimum rates for 1881 are on a lower level than for any time in several years, though the difference between this year and last year, in this respect, is not so very great.

"The number of shares of stock in the twenty-nine companies above mentioned, and the highest and lowest value of each as measured by the market price in San Francisco of those shares during the year 1881, was as follows:

	Shares.	*Highest.*	*Lowest.*
Utah	20,000	$ 285,000	$100,000
Sierra Nevada	100,000	2,900,000	485,000
Union Con	100,000	1,975,000	637,500
Mexican	100,800	1,486,800	683,200
Ophir	100,800	1,008,000	312,480
California	540,000	1,161,000	189,000
Con. Virginia	540,000	2,546,000	540,000
Best & Belcher	100,800	1,083,600	604,800
Gould & Curry	108,000	1,012,500	243,000
Savage	112,000	515,200	84,000
Hale & Norcross	112,000	854,000	184,800
Chollar	112,000	476,000	123,200
Potosi	112,000	564,100	112,000
Julia Con	110,000	77,000	11,000
Bullion	100,000	250,000	25,000
Exchequer	100,000	210,000	75,000
Alpha Con	30,000	172,500	69,000
Con. Imperial	500,000	150,000	60,000
Confidence	25,000	162,500	50,000
Yellow Jacket	120,000	900,000	180,000
Kentuck	30,000	97,500	13,500
Crown Point	100,000	345,000	60,000
Belcher	104,000	405,600	83,200
Overman	115,200	345,600	67,600
Caledonian	100,000	80,000	6,000
Silver Hill	108,000	54,000	6,400
Justice	105,000	147,000	36,750
Alta	108,000	394,000	81,000
Benton	108,000	135,000	37,800
Totals	4,021,600	$18,983,200	$5,028,900

"If each of the above mines had been sold at its highest market value this year, the sum of $20,000,000 would have been sufficient to have taken them all in, while if purchased at their lowest valuation, a check for $5,000,000 would have been nearly sufficient. A variation of over $14,000,000 has been the incentive to business."

THE SAN FRANCISCO SHARE MARKET IN 1882.

FROM Jan. 1st, to July 1st, 1882, there was little change in the condition of the market. In nearly every instance prices experienced a further decline and the business done was extremely light. To this rule, however, Bodie and Eureka Con. were exceptions, the former advancing $2.00 and the latter $2.25. But the closing prices on June 30th, were not generally the lowest for the six months. For some weeks prior to that date there was a better tone to the mining stock market in all parts of the country, including California, and, while the improvement was not sufficiently marked to cause any great changes in quotations, there seems to be reason for the hope, that bottom prices for good properties have been reached, and that the tendency for a time, at least, will be in the direction of higher figures.

The following is of interest as showing the highest prices at which some of the prominent mining stocks have sold in their history and their closing prices on June 30th, 1882, at the San Francisco stock exchanges:

Name of Company.	*Highest price at which stock was sold.*	*Closing price June 30, 1882.*
Alla	$26.00, August, 1878	.75c
Alpha	77.00, March, 1876	.60
Argenta	8.75, September, 1878	.20
Andes	16.00, January, 1875	.30
Bulwer	22.00, April, 1879	1.80
Belmont	16.00, January, 1875	.80
Benton	10.50, July, 1879	.30
Bodie Con	53.00, July, 1878	4.75
Best & Belcher	89.00, January, 1875	5.12½
Bullion	67,50, February, 1876	.35
California	780.00, January, 1875	.10
Crown Point	47.50, January, 1875	.40
Con. Virginia	700.00, January, 1875	.45
Chollar	165.00, March, 1876	.60
Confidence	59.00, January, 1875	.65
Eureka Con	74.00, May, 1875	14.75
Exchequer	425.00, January, 1875	.10
Grand Prize	21.00, November, 1877	.20
Gould and Curry	72.00, January, 1875	2.40
Hale and Norcross	79.00, January, 1875	1.05
Julia	41.00, August, 1875	.05
Justice	18.00, January, 1875	.30
Martin White	10.00, September, 1878	4.12½
Manhattan	14.25, January, 1877	1.00
Mexican	85.00, January, 1875	6.50
Mono	14.50, June, 1879	.90
Mt. Diablo	15.00, November, 1879	4.25
Northern Belle	50.00, April, 1876	9.25
Ophir	315.00, January, 1875	3.30
Occidental	8.00, January, 1875	1.00
Overman	119.00, January, 1877	.30
Potosi	7.00, June, 1879	.40
Sierra Nevada	270.00, July, 1878	8.62½
Syndicate	10.75, July, 1879	.15
Savage	190.00, January, 1875	.75
Seg. Belcher	165.00, January, 1875	2.00
Scorpion	23.00, August, 1879	.75
Silver King	20.00, August, 1878	14.25
Tioga	7.75, July, 1879	.05
Utah	34.00, March, 1876	9.75
Union Con	193.00, August, 1878	9.87½

THE FUTURE FOR MINING SHARES.

NOTWITHSTANDING the very unsatisfactory condition of the mining stock market, as reflected by the dealings at the stock exchanges during the past eighteen months, the fact is not to be ignored that the public is deeply interested in the development of mining properties, and that investors are still to be found who are ready to put their money into mining schemes that give unmistakable promises of fair returns. Capital is continually finding its way into this channel. At present, the plan which is meeting with a good deal of favor is the formation of small syndicates, in which the contributors are, or are supposed to be, all favorably known to each other. The property is investigated by one or more of them, in whom the others have full confidence, and the work is done in the same way. Manipulation of stock is thus avoided, the motives for misrepresentation are much reduced, dishonest management is quickly detected, and, if the enterprise prove unsuccessful the probabilities are that the reasons for this failure are limited to those contingencies which each member of the syndicate understood to exist before investing his money, and there can be little or no fault finding. If, on the other hand, the investment proves successful, the profits are to be divided among a very few persons, and the chances are that the individual gains will thus be very large. Many properties are being quietly worked in this way, the results of which the public knows little or nothing about. It is also to be remembered that large sums of money were invested in prospective mines from two to three years ago, the distinct understanding then being that the development of the property would require considerable time. Dividends were not looked for immediately, and no one has been disappointed, but the work thus done has, to the present time, yielded no returns. A large amount of work of this kind was begun about the time that the "mining fever" first made itself manifest in 1879 and 1880. The bullion output, there is every reason to believe, will be largely increased, at no distant day, on account of this development work. In a number of instances it is known that the managers of such properties have continued the shafts and cross-cuts through rich ore without any stoping or the bringing of more ore to the surface than was necessary. Meanwhile stamps and other machinery have been erected, and the active production of bullion in large quantities must soon begin. The success which has attended this plan of developing the western mines has been so satisfactory that other similar associations are being continually formed among eastern capitalists, making manifest a determined disposition not to abandon again a field in which statistics demonstrate so much has been gained, and when the chances of large profits following careful, judicious management are so great as is afforded in the mining of gold and silver.

But persons who invest in the manner above described, seldom put their money into mining stocks dealt in at the stock exchanges. When investments are made at the latter places, the money generally comes from persons of limited means who are financially unable to form private associations or syndicates, but who are also the least able to suffer loss. It is safe to presume that this condition of affairs will continue just so long as the leading operators on the mining exchanges confine their transactions to manipulation of worthless stocks. As long as one-half the total reported sales at the mining boards from day to day are limited to one or two stocks, about which the public knows little or nothing, except from the stories furnished from the offices of the companies, a continuation of the present unsatisfactory condition of the stock exchange markets may be expected. There are some signs, however, of an improvement in the mode of managing the business at the exchanges. In a few instances, stocks known to be worthless have been stricken from the lists, and promises of further reform in this direction from persons prominent in the councils of the exchanges are not wanting. The pruning-knife will work wonders if dexterously applied. There is not any doubt whatever, that, for the perfect development of the mining interests of the country, mining stock exchanges are valuable adjuncts; are, in fact, necessary. It is only by such means that the masses are enabled to take a hand in the work—a work which under proper management promises returns as sure as that furnished by the soil to the agriculturist. But there must be a change in the management of those exchanges. The slight evidences of a movement in this direction are not the only assurances that a change may be brought about at an early day. To live, the mining broker must have customers—the public must buy and sell. Under the present condition of affairs the commissions fall within such narrow limits that necessity, the mother of inventive genius, will compel a resort to such a course as will re-establish public confidence, or an abandonment of the business. The fact that many of the brokers have given the subject sufficient attention to discover the cause of the present trouble, furnishes assurance that the remedy will be applied. The present condition of the crops, the relations existing between the managers of the principal railroads of the country, and other known conditions affecting the question, furnish a reasonably trustworthy indication of the course of the railroad stock market for some time to come. This is true, at least, within comparatively narrow limits. But who would dare forecast the course of any of the speculative mining stocks dealt in on the New York stock exchanges during the next six months, unless he possessed sufficient means to make the price by manipulation whatever he desired it to be? In the inscrutable wisdom (?) of the managers of the dealings in the stock of the Chrysolite company, it was made to sell at $40 a share, and honest investors paid that price for it, while to-day it is a foot-ball on the exchanges at less than one-fifteenth part of that quotation. And yet Chrysolite has a measureable, intrinsic value apart from all speculation. This serves as an illustration of the condition of many stocks on the exchange lists. The change, if it is to come, cannot be made too quickly, and it will be heartily welcomed by a host of honest and honorable brokers in mining stocks, as well as by the public.

THE NEW YORK IRON AND METAL EXCHANGES.

AN Iron and Metal Exchange was organized in New York, in June of the current year (1882), the object of which is set forth in the by-laws given in full below. It is proposed to hold daily sessions of the Exchange at which the standard manufactures of iron and other metals will be called. Already the promoters of the enterprise have received applications for membership, from considerably more than 200 persons. The officers and board of managers are as follows:

President.—Edward P. White, 55 Fulton street.

Vice-President.—Maurice B. Flynn, 624 E. Fourteenth street.

Treasurer.—T. Delafield, 95 Liberty street.

Board of Managers.—William W. Snow, Ramapo, N. Y.; Carl Mayer, 112 Pearl street; B. B. Leman, 64 Wall street; Henry A. Rogers, 19 John street; J. P. Robinson, Jr., 14 Coenties Slip; Allston Gerry, 68 Wall street; John D. Fraser, 109 Beekman street; Edward Hill, 101 Wall street; H. B. Moore, 70 Wall street; Geo. V. Tompkins, 22 Burling Slip; A. G. A. Harnickell, 83 Maiden Lane; J. H. Whitney, 32 Chambers street.

Secretary.—Edward J. Shriver.

STANDING COMMITTEES.

Executive.—T. Delafield, chairman; Geo. V. Tompkins, Maurice B. Flynn.

Finance.—Carl Mayer, chairman; Allston Gerry, B. B. Leman.

Floor.—Henry A. Rogers, chairman; A. G. A. Harnickell, Geo. V. Tompkins.

Law.—Maurice B. Flynn, chairman; John D. Fraser, J. H. Whitney.

Warehouse.—J. P. Robinson, Jr., chairman; H. B. Moore, A. G. A. Harnickell, Allston Gerry, T. Delafield.

Information and Statistics.—Carl Meyer, chairman; Edward Hill, Edward J. Shriver, J. A. Flynn, S. Mendel.

Trade.—B. B. Leman, chairman; Carl Mayer, John E. White, J. G. Sibbald, H. C. Marval.

The following by-laws have been adopted:—

Title.—Section 1.—The title of this association shall be the New York Iron and Metal Exchange.

Objects.—Sec. 2.—The objects of this association are to provide and regulate suitable rooms or premises for an Iron and Metal Exchange in the City of New York; to inculcate just and equitable principles in trade; to establish and maintain uniformity in commercial usages; to acquire, preserve and disseminate valuable business information, and to adjust controversies and misunderstandings between its members.

Members.—Sec. 3.—Any respectable person, on the proposal of one member, seconded by another, and on presentation of a written application stating the nature of his business and such other facts as the Board of Managers may require, after ten days' notice of such application has been conspicuously posted upon the Exchange, shall be admitted to membership if elected by the Board of Managers on the payment of the initiation fee, hereinafter mentioned, or on presentation of a certificate of membership duly assigned to him, and on the signing of an agreement to abide by the by-laws and rules of the Exchange, and all amendments that may be made thereto. The initiation fee for the first two hundred members shall be $100 each, and thereafter the initiation fee shall be $500.

Sec. 4.—Each member shall be entitled to receive a certificate of membership, bearing the signatures of the President and Secretary, which shall be transferable upon the books of the Exchange to any person eligible to membership, upon the payment of a transfer fee of $2, and any unpaid assessments due thereon. The certificate of a deceased member may be transferred by his legal representatives. In case of the absence of a member through sickness, or for any other urgent or proper reason, the Board of Managers may cause to be issued to his *bona fide* partner or clerk, a temporary ticket of admission to the Exchange, for the purpose of transacting said member's business only, the same to be canceled on the return of the member to the Exchange, or at the pleasure of the Board of Managers. The member shall be responsible for the violation by such representative of any by-law, or rule, in the same manner as for such violation by himself, and shall also be answerable for all acts and contracts of the representative.

Annual Election.—Sec. 5.—There shall be an annual election by ballot, held at the Exchange on the first Wednesday in May, for the Officers and Managers of the Association. The polls shall be opened at 11 o'clock and closed at 2 o'clock, and every person duly admitted a member, and holding in his own name a certificate of membership, shall be entitled to a vote thereat.

Sec. 6.—A majority of votes cast shall constitute a choice. No proxies shall be allowed.

Inspectors of Election.—Section 7.—The members of the Exchange, at their annual election, shall choose by ballot a Board of Inspectors of Election, to consist of three inspectors, whose duty it shall be to receive the votes at each election held during their term, to canvass them immediately after each election, and make a return thereof immediately to the President and Secretary, and such return shall be posted at once in the Exchange. The Inspectors shall send a certificate of election to each of the members elected to office.

Sec. 8.—Any vacancy that may occur among the Inspectors of Election, from any cause, or the temporary absence of any Inspector when such Inspectors are required to act as a Board, may be filled or supplied by the President, or, in his absence, by the remaining Inspectors present.

Board of Managers.—Sec. 9.—The property, affairs, business and concerns of the Exchange shall be vested in a Board of Managers, consisting of a President, Vice-President, Treasurer, and twelve Managers, who shall be elected in the manner provided in the by-laws, and be subject only to the provisions thereof. Any vacancies that may occur, from any cause, in the Board may be filled by the remaining members. The Board of Managers shall receive no pay for their services.

Sec. 10.—The Board of Managers shall provide and regulate suitable rooms for the Exchange, and cause them to be provided with such proper and useful things as, in, their judgment, will tend to promote the best interests of the Exchange. They shall appoint such clerks, counsel and other agents as they may deem necessary, and shall fix the compensation of same. They may also, at their discretion, require from any such appointee a good and sufficient bond for the faithful performance of his duties, such bond to be made payable to the President and his successors in office.

Meetings of the Board.—Sec. 11.—Regular meetings of the Board of Managers shall be held on the first Thursday of each month, except when the same shall fall on a legal holiday, in which case it shall be held on the following Tuesday, but the President may, when he deems necessary, or at the request of three members of the Board, call special meetings of the Board. Six members present at such meetings shall constitute a quorum for the transaction of business.

Sec. 12.—The following order of business shall be observed at all meetings of the Board of Managers, and no business shall be taken out of the regular order, except by unanimous consent, viz:

1. Calling of roll.
2. Reading minutes of preceding meeting.
3. Report of Treasurer.
4. Reports of standing committees.
5. Reports of special committees.
6. Unfinished business.
7. Resolutions, motions and notices.
8. Miscellaneous business.

Sec. 13.—If any member of the Board of Managers shall absent himself from two consecutive regular meetings of the Board without sending a communication to the President stating a good and sufficient reason for so doing, his seat in the Board may be declared vacant by the Board.

Sec. 14.—No officer or member of the Board of Managers shall contract any debt on behalf of the Exchange, or in any manner or to any extent render the association liable for the payment of any sum, unless the same shall first have been directed by the Board of Managers; and no debts shall be contracted, or money expended, either by the Board of Managers or by the Exchange, except for the legitimate business of the Exchange, as set forth in Sec. 2 of the by-laws, and no appropriation of money for any purpose shall be voted except by the Exchange.

Sec. 15.—Special committees, and all committees required by the rules and regulations made by the Board of Managers for the government of the trades carried on by the members of the Exchange, shall be appointed by the President, subject to the approval of the Board, unless directed to be chosen by ballot; and shall consist of such number as may be ordered at the time of their appointment, or provided by the rules and regulations before mentioned; which committees shall hold office at the pleasure of the Board.

Section 16.—Reports of committees shall be made in writing to the Board of Managers, and signed by a majority of the members thereof.

Minority reports may be submitted. A majority of any standing or special committee shall constitute a quorum for transaction of business, and a majority decision of such quorum shall be valid. Vacancies that occur in any of the committees shall be filled in the same manner that such committee was originally appointed or chosen.

President.—Sec. 17.—The President shall preside at the meetings of the Exchange and of the Board of Managers, and shall be a member *ex-officio* of all standing committees (except the arbitration committee). He shall also, at the annual meeting of the members of the Exchange, and at such other times as he shall deem proper, communicate to the Exchange or to the Board of Managers such matters as may, in his opinion, tend to promote the prosperity and welfare and increase the usefulness of the Exchange, and shall perform such other duties as are necessarily incident to the office of President of the Exchange.

Vice-President.—Sec. 18.—In case of the death or absence of the President, or of his inability from any cause to act, the Vice-President shall perform the duties of the President, and in case of the absence of both President and Vice-President, then the Board of Managers shall appoint one of their number to perform the duties of president for the time being.

Treasurer.—Sec. 19.—The treasurer shall receive all sums due to the Exchange, and, under the direction of the Board of Managers, shall invest, deposit and disburse the same. He shall not pay out any of the funds of the Exchange unless authorized by the Board, and then under the direction of the Finance Committee. All disbursements, amounting to $10 or more, shall be made by checks signed by the Treasurer and countersigned by the President, or some member of the Finance Committee. He shall keep regular books of accounts, and carefully preserve all vouchers for the payment of money, and all bonds and securities of every kind belonging to this association. He shall render a monthly account at each regular meeting of the Board of Managers, and an annual report to the Exchange at the annual meeting thereof, all of which reports shall be audited and approved by the Finance Committee before presentation. The funds, books, vouchers and securities in his hands, shall at all times be under the supervision of the Board of Managers, and subject to its inspection and control. He may be required by the Board to execute a bond, with two sufficient sureties, approved by the Board, in a penal sum to be fixed by the Board of Managers, for the faithful performance of his duties, and at the expiration of his term of office shall transfer all funds, books, papers and other property of the Exchange in his possession to his successor.

Secretary.—Sec. 20.—At the first meeting of the Board of Managers after their election they shall appoint a Secretary of the Exchange, who shall not be a member of the Board, and who shall hold office during its pleasure. He shall keep a record of the proceedings of the Board of Managers and of all meetings of the Exchange; shall immediately post conspicuously upon the bulletins of the Exchange all reports from the Inspectors of Election; shall conduct the correspondence of the association, and of the Board of Managers, under the direction of the President; and shall have custody of the seal of the association. He shall, under the supervision of the Executive Committee, have charge of the buildings or rooms occupied by the Exchange, and shall cause them to be supplied with the necessary stationery, and to be properly heated, cleaned, ventilated and kept in order and repair. He shall also have charge of the books and documents of the Exchange (except those pertaining to the Treasurer), and shall cause all information, statistics, and notices pertaining to the business of the Exchange to be posted upon the bulletins in a neat, correct and orderly manner. He shall, with the advice and consent of the Executive Committee, appoint such clerks, messengers, &c., as are requisite to the proper transaction of the business of the association; and shall perform such other duties incident to his office as may, from time to time, be required of him by the Board.

Committees.—Sec. 20.—At the first meeting of the Board of Managers after their election the President shall, subject to their approval by the Board, appoint the following committees, viz:

1. A Finance Committee, to consist of three members of the Board of Managers.

2. An Executive Committee, to consist of three members of the Board of Managers.

3. A Law Committee, to consist of three members of the Board of Managers.

4. A Floor Committee, to consist of three members of the Board of Managers.

5. A Complaint Committee, to consist of three members of the Board of Managers. One member of this committee shall retire at each regular meeting of the Board, and the President shall thereupon appoint another member of the Board in his place.

6. A Warehouse Committee, to consist of five members of the Board of Managers.

7. A Committee on Trade, to consist of five members, two of whom, including the chairman, shall be members of the Board of Managers. The other three to be selected from among the members of the Exchange who are not members of the Board.

8. A Committee on Information and Statistics, to consist of five members, to be composed and appointed in the same manner as the Committee on Trade.

These several committees shall hold office at the pleasure of the Board, and perform such duties as may be necessarily incident to the purposes of their appointments, as hereinafter prescribed, and such as may be required of them, from time to time, by the Board of Managers.

Finance Committee.—Sec. 21.—The Finance Committee shall audit all bills or claims against the Exchange; shall direct all payments, deposits and investments authorized by the Board of Managers, and shall audit the accounts of the Treasurer monthly, and also his annual account, before presentation to the Exchange.

Floor Committee.—Sec. 22.—The Floor Committee shall have general supervision over the rooms used by the Exchange during 'change hours; see that proper order is kept, and that no unauthorized persons are admitted on the floors of the Exchange. All applications for membership to the Exchange shall be referred to them, and they shall report on the same to the Board of Managers for their action.

Committee on Information and Statistics.—Sec. 23. The Committee on Information and Statistics shall, unless otherwise directed, have charge of all matters pertaining to supply of newspapers, market reports, and telegraphic and statistical information for the use of the Exchange; and it shall be the duty of said committee to organize plans for obtaining regularly, and at the earliest moment, such reliable information as may affect the value of articles dealt in by the members of the Exchange. They shall organize and maintain a system for recording, in books to be provided for that purpose, such statistics of the movement and prices of iron and other metals at the city of New York and other prominent points as may be of general interest to the members of the Exchange, or may have any bearing on the question of transportation as identified with the interests of the city and state of New York.

Law Committee.—Section 24.—The Law Committee shall have charge of all legislation that may be required by the Exchange, including the presentation of memorials to the city, to the State Legislature, or to the general government. They shall nominate to the Board for their approval suitable counsel to represent and protect the interests of the Exchange in any suits at law that may arise, or for the examinations of titles to real estate of which the Iron and Metal Exchange may become possessed, and to render general legal services. An amendment proposed to the By-laws shall be submitted to them for their consideration, and they shall report on the same to the Board.

Executive Committee.—Section 25.—The Executive Committee shall have, subject to the Board, general supervision of the property, business and affairs of the Exchange, and shall make such reports and recommendations as, in their judgment, will best promote its interests; shall have the direction and supervision of all appointed officers and employes in the discharge of their respective duties, and see that all rooms provided are suitably furnished and kept in good order for the accommodation of the Exchange, the Board of Managers and committees.

Warehouse Committee.—Section 26.—The Warehouse Committee shall examine into, and pass upon, all applications for licenses as warehousemen, weighers, inspectors, truck-owners and owners of lighters, and refer the same to the Board of Managers with their recommendation for their action; shall adopt such rules and regulations for the guidance of licensed parties as they may deem necessary, and shall report the same to the Board of Managers. Upon complaint of misconduct on the part of any person licensed by the Exchange (which complaint must be reduced to writing, and verified by the party making it), they shall summon the accused and accusers before them, and shall sit as a Court of Inquiry in such case or cases, take testimony, and submit the same, together with their recommendation, to the Board of Managers for its action. The committee may, in its discretion, suspend the license of any person or persons pending the final action of the Board.

Committee on Trade.—Section 27.—The Committee on Trade shall consider, and from time to time report to the Board of Managers for its action, such rules and regulations as to the purchase, sale, transportation and custody of iron and other metals as they may consider beneficial to the interests of the members of the Exchange. They shall, so far as practicable, establish relations with similar associations at leading commercial points in our own and other countries, to the end that uniformity of practice and usage may be attained in all matters of common interest.

Complaint Committee.—Section 28.—Any member of the Exchange who shall be accused of a wilful violation of the By-laws, or fraudulent breach of contract or of any proceeding inconsistent with just and equitable principles of trade, or of any other misconduct, shall, on complaint, be summoned before the Complaint Committee, when, if he desires, he shall be heard in his defense. Should the committee be unable to conciliate the disputants, or induce them to arbitrate, and the circumstances seem to warrant, the complaint should be referred to the Board of Managers, when both parties shall have an opportunity to be heard again in person, prior to final action in the case; and if, in the opinion of the board, the charge or charges against said defendant are sufficient and be substantiated, it may, by a vote of not less than two-thirds of all the members present, censure, suspend or expel such member from the Exchange.

Section 29.—All complaints which may be made against members of the Exchange shall be made in writing, and addressed to the chairman of the Complaint Committee, who shall cause a copy thereof to be transmitted to the member against whom the complaint shall have been entered, previous to his being summoned to appear before said committee, as provided for in section 28.

Section 30.—To reinstate an expelled member, it shall require the affirmative vote of three-fourths of the members of the Board of Managers present and voting at the meeting at which the application for such reinstatement shall be acted upon; but a suspended member may be reinstated by a majority vote at any meeting of the Board of Managers.

Settlement by and with Members who fail to meet their Contracts.—Section 31.—It shall be the duty of any member failing to meet his contracts with or to any other member of this Exchange, to immediately notify the president in writing of such failure, and the president shall thereupon cause the following notice to be posted on the official bulletin:

NOTICE:

" Members of this Exchange are hereby notified of the inability of to meet his (or their) mercantile obligations. All contracts with him (or them) must therefore be closed as provided in section 33 of the By-laws."

Section 32.—In case any member so failing shall notify the President, as thus provided, it shall be the duty of the Complaint Committee, upon satisfactory proof to them of such failure being made, to notify the President in writing, and the President shall thereupon immediately call a meeting of the Board of Managers, who shall proceed to investigate the case in the same manner as provided in cases of complaints in section 28 of these By-laws. In case of satisfactory proof of failure, the President shall be instructed by the Board of Managers to post the same notice as provided in section 31, and such member may be suspended or expelled at the same or any subsequent meeting of the Board of Managers by a vote of two-thirds of the members present.

Section 33.—All outstanding contracts between members so failing and other members of the Exchange, in cases where official notice of failure has been given, may be closed by settlement at the market price of any of the five business days next succeeding the day of such official notice of failure, upon at least one business day's notice in writing to said member so failing. In case no such notice is given to said member so failing, the settlement shall be made at the market price of the fifth business day succeeding the day of official notice of failure, provided, however, that no contract shall thereby be extended beyond its maturity. Disputes as to the market price of any of said days shall be finally determined by the Committee of Information and Statistics.

Annual Assessment.—Section 34.—For the purpose of defraying the expenses of the Exchange, the Board of Managers shall annually assess upon each certificate of membership such sum as it shall deem necessary, but not to exceed $25.

The amount of such assessment shall be payable at the office of the Exchange at such time as the board may designate; and any person who shall fail to pay the same after five days' written notice by the Treasurer so to do, shall be suspended from the privileges of the Exchange until the same shall have been paid.

If the amount of such assessment shall remain unpaid for the period of six months after a notice to pay the same, signed by the Treasurer, shall have been sent by mail to the last-known residence or place of business of the member in whose name such certificate shall stand on the books of the Exchange, he shall cease to be a member of the Exchange.

The Board of Managers shall thereupon direct such certificate, and all interests therein, to be sold at public auction at the Exchange, after notice of such sale, and of the time and place thereof, shall be published in two of the daily papers of New York City once in each week for four successive weeks, and posted on the bulletin of the Exchange four successive weeks, and a copy of such notice sent by mail at least twenty days before such sale to the last-known residence or place of business of the person in whose name such certificate stands.

In case the Exchange shall be notified of the death of the member or person in whose name such certificate shall stand, then such notices as before prescribed shall be sent by mail to his legal representatives, or either of them, with the same effect as if sent to such member or person if living. Any person may attend such sale, and if not a member, facility for attending shall be furnished him by the Board of Managers, but the purchase of such certificate shall not entitle the purchaser to membership in the Exchange, nor shall it be transferred upon the books of the Exchange, except to a person duly approved and entitled to membership, as provided in these by-laws.

The purchaser of such certificate shall, however, be entitled to a memorandum of such sale and purchase, signed by the Treasurer, and upon the presentation of such memorandum, duly indorsed by a person approved and otherwise qualified for membership, a new certificate shall be issued to him upon the payment of the transfer fee prescribed in these by-laws, and the certificate so sold shall, after such sale, be considered cancelled and shall be void.

From the proceeds of such sale the Treasurer shall pay the expenses of publishing said notices and of said sale, together with the assessments due on said certificate, and the balance shall be paid to the person in whose name the certificate so sold stood in the said books, or to whomsoever shall be entitled to receive the same.

Meetings of the Exchange.—Sec. 35.—The annual meeting of the members of the Exchange shall be held at their rooms on the first Wednesday in May, at half-past one o'clock, P. M., (of which at least one week's previous notice shall be given by the Secretary), for the purpose of receiving the reports of the Board of Managers and the Treasurer, and for the transaction of such other business connected with the affairs of the association as may be presented for consideration.

Sec. 36.—The President may, and upon the written request of a majority of the Board of Managers or 25 members of the Exchange shall, call special meetings of the members of the Exchange for the transaction of business directly connected with the affairs of the Association, of which at least twenty-four hours' notice shall be given by the Secretary. Such notice shall state explicitly the object of such meeting, and at such meeting such business only shall be transacted as shall have been mentioned in the call. Meetings for other important purposes may be called by the President upon the written request of a majority of the Board of Managers, similar notice being given and observed. The Board of Managers may, in their discretion, upon like notice, submit to the members for their approval by ballot any question directly connected with affairs of the Association not otherwise provided for in these by-laws, and a majority of the votes cast shall determine such question.

Sec. 37.—The President may, and at the request of the Committee of any trade, or upon a petition satisfactory to the President, shall call meetings of any of the several branches of the trade represented on the Exchange, to consider matters directly connected with the affairs of that trade. Such meetings shall be called at not less than twenty-four hours notice, setting forth the specific object of the meeting, and in case it is proposed to adopt a new rule, or modify any existing rule, not less than forty-eight hours notice shall be given of such meeting, stating the purport of the proposed new rule or amendment. These meetings shall be called to order in the same manner as provided for other meetings of the Exchange, but the meeting may be organized by the appointment of one its members as chairman, who shall certify to the record of its proceedings.

Sec. 38.—At all meetings of the members of the Exchange called under Sections 35 and 36, twenty-five members present shall constitute a quorum for the transaction of business, and at all meetings called under Section 37 the quorum shall consist of such number of members as shall be prescribed by the rules governing the respective branches of trade; but in either case a less number than the prescribed quorum shall have power to adjourn to a future time, which time shall be stated.

Exchange Open.—Sec. 39.—The Exchange shall be open for business daily, except Sundays and legal holidays, during such hours and under such rules as the Board of Managers may establish; but the Exchange may be closed for one day at any time, when the Boards of Managers shall direct a vote of the members to be taken thereon by ballot, of which, at least, twenty-four hours' notice shall be given by the President, provided two-thirds of all the votes cast shall be in favor of such closing.

Notices.—Sec. 40.—Notices of meetings of the Exchange, and of all other matters intended for the information of members, shall be given by posting the same conspicuously on the bulletin boards of the Exchange, and no notices shall be posted upon the Exchange except such as relate to the affairs of the Association, unless by consent of the Floor Committee.

Visitors.—Sec. 41.—No persons, except members and their temporary representatives, as provided for in Section 4 of the by-laws, shall be admitted on the floor of the Exchange for purposes of business. Members, however, may introduce their friends as visitors, by entering their respective names in a book kept for that purpose, and may obtain for such visitors a card of admission for seven consecutive days in each current year. This privilege shall not be extended, except with consent of the Floor Committee; and should any person so introduced violate the rules of the Exchange by the transaction of business, the member introducing such person shall become liable to pay a fine of not less than $25, nor more than $50, for each offense, at the discretion of the Board of Managers, and be subject to the same penalty for non-payment as provided for in Section 34 of the by-laws.

Rules.—Sec. 42—All rules adopted by the Board of Managers shall, after having been posted on the bulletin of the Exchange ten days, be in force and binding on the members; and the rules in force shall govern all cases to which they may be applicable, provided they do not conflict with any specific provisions of a contract.

Amendment of By-Laws.—Sec. 43.—These by-laws shall not be altered nor Amended, unless the proposed alteration or amendment has been approved by a vote of two-thirds of the Board of Managers and ratified by a majority vote of members voting by ballot, at a meeting held for the purpose, of which ten days' notice shall have been given, stating specifically the alteration or amendment proposed.

Code of Rules.

The following code of rules governing transactions in iron and steel on the floor of the New York Iron and Metal Exchange and between members, has been adopted:

Rules Governing Transactions in Pig Iron between Members of the New York Iron and Metal Exchange.

Committee on Pig Iron.—Rule 1.—At the first meeting of the Board of Managers after the election, the President shall (subject to the approval of the Board) appoint as a Committee on Pig Iron the members of the Exchange, who are known as manufacturers, dealers or brokers in pig iron. It shall be the duty of this committee to grade and classify pig iron, and to them shall be reported all cases of complaint against inspectors, and also any question or dispute in regard to the inspection, quality, grade or weight of pig iron. A majority of the committee shall constitute a quorum, and a decision of a majority present at any hearing shall be final and binding. They shall keep a record of their proceedings, and a fee of $9.00 shall be paid the committee for each reference case heard by them, to be paid by the party adjudged to be in fault, unless otherwise ordered by the committee.

Classification of Pig Iron.—Rule 2.—The kinds of pig iron to be dealt in shall be American, Scotch, English and spiegel iron; and as soon as practicable after their appointment the Committee on Pig Iron shall determine the classification, respectively, of No. 1, No. 2, Gray Forge, Mottled and White American Anthracite pig iron, and Nos. 1 and 3 Scotch and English pig iron, and shall, if deemed practicable, cause samples of each grade to be placed in the Exchange, which samples shall be the standard of comparison, as hereinafter provided for.

Deliveries.—Rule 3.—Foreign pig iron, "ex-store," shall be good delivery only (unless otherwise stipulated at time of sale) free to vessel or lighter from such warehouses as are designated by the Warehouse Committee of the New York Iron and Metal Exchange; when sold "on dock" it may also be delivered ex-ship, and free to vessel or lighter.

Rule 4.—American pig iron shall be good delivery, free to vessel or lighter, from warehouses designated by the Warehouse Committee of the New York Iron and Metal Exchange, or at the shipping ports of Perth Amboy, Elizabethport, Hoboken or Jersey City. When pig iron is sold g. m. b. (good merchantable brand), only such irons shall be good delivery as may, from time to time, be designated as such by the Committee on Pig Iron.

Rule 5.—Spiegel iron, to be a good delivery, shall, unless by special agreement average 20 per cent. of manganese, and shall be delivered, free to vessel or lighter, in the port of New York, ex-ship, or a warehouse designated by the Warehouse Committee of the New York Iron and Metal Exchange.

Rule 6.—When buyers are notified by sellers of proposed delivery of pig iron, it shall be the duty of buyers to immediately inspect such iron, and in case buyer claims that the iron is not of grade and quality called for in contract, he can demand an inspection, expense of such inspection to be borne by the party adjudged to be in fault; but buyer must give notice of his desire for inspection in time to allow seller to have said inspection made, so as not to postpone settlement contemplated under Rule 8 (general rules of iron and steel). The inspector to be licensed by the New York Iron and Metal Exchange. Inspector's fees shall be as follows: on 100 tons or less, $5; for every additional 100 tons or fraction thereof, 50 cents.

Rules Governing Transactions in Old Iron and Steel between Members of the New York Iron and Metal Exchange.

Committee on Old Iron and Steel.—Rule 1.—At the first meeting of the Board of Managers after their election, the President shall (subject to the approval of the Board) appoint as a Committee on Old Iron and Steel three members of the Exchange, who are known as manufacturers, dealers or brokers in old iron and steel, and to them shall be reported all cases of complaint against inspectors, and also any question or dispute in regard to the inspection, quality, grade or weight of old iron or steel. A majority of the committee shall constitute a quorum, and a decision of a majority present at any hearing shall be final and binding. They shall keep a record of their proceedings, and a fee of $9 shall be paid to the committee for each reference case heard by them, to be paid by the party adjudged to be in fault, unless otherwise ordered by the Committee.

CLASSIFICATION.—Rule 2.—As soon as practicable after their appointment, the Committee on Old Iron and Steel shall make a classification of scrap iron as "No. 1, No. 2 and No 3, New York Iron and Metal Exchange classification," and also a classification of old rails, old car wheels and old steel, and on all contracts under these rules only such iron and steel shall constitute a good delivery for the grade called for by the contract as shall fully comply with the official specification (unless by special agreement at time of sale), which specification shall be posted conspicuously on the Exchange, and copies thereof furnished to any member who may apply for them.

DELIVERIES.—Rule 3.—Deliveries of old iron and steel shall, unless by special contract, be ex-ship, or from a warehouse designated by the Warehouse Committee of the New York Iron and Metal Exchange, free to vessel or lighter. On contracts for delivery at Philadelphia or Baltimore, deliveries shall be made ex vessel or warehouse, and free to vessel or lighter.

INSPECTION.—Rule 4.—On all deliveries of old rails, scrap iron, old car wheels and old steel, inspection to be governed as in pig iron.

Rules Governing Transactions in Manufactured Iron and Steel Between Members of the New York Iron and Metal Exchange.

BAR IRON.—Rule 1.—Merchant Bar Iron, to be good delivery, must be in accordance with the Eastern Classification of Regular Sizes and Extras; must be of strictly neutral quality, neither cold or red-short. Bars must be of uniform lengths, from 15 to 17 feet long for sizes, 1 to 6 inches wide by ⅜ to 2 inches thick for flats, ⅜ to 4 inches rounds and squares (unless otherwise specified.) All flat and square bars to have good square edges. Round bars to be uniformly round. All bars to be free from defects, such as flaws, seams, cracks, &c., and practically straight, and rolled true to size. Other sizes than above specified to be manufactured and packed as buyers may desire. Any disputes as to quality or specification of bar iron shall be settled by a special committee of three, to be appointed by the president of the New York Iron and Metal Exchange.

STEEL BLOOMS.—Rule 2.—Steel blooms, to be a good delivery, shall, unless by special contract, be of good homogeneous steel, free from flaws, 7 inches square, and not more than 610 pounds, or less than 590 pounds in weight, and shall be delivered free to vessel or lighter in the port of New York, ex-ship, or a warehouse designated by the Warehouse Committee of the New York Iron and Metal Exchange, and delivery order must be accompanied by a certificate of analysis by an approved chemist at point of manufacture. Any disputes as to quality to be settled by a special committee of three, to be appointed by the president of the New York Iron and Metal Exchange.

General Rules Governing Transactions in Iron and Steel Between Members of the New York Iron and Metal Exchange.

CALLS.—Rule 1.—There shall be two public calls each day, at 11 A. M and 1.30 P. M., (except Saturdays, on which there shall only be the morning call,) on Scotch, English and American anthracite pig iron, Bessemer pig iron, spiegel iron, old rails, steel rail cross ends, scrap iron, old car wheels and steel blooms, to be conducted by the Secretary of the Exchange, or in his absence by a person to be selected by a majority of the members present. On pig iron, only such brands shall be called separately as may be designated from time to time by the Committee on Pig Iron. Spot shall be called first, and then the months in their order for each article. No offer to buy or sell shall be entertained at a less difference than 25 cents per ton on pig iron, old rails and scrap iron, or for a smaller quantity than 100 tons. The first offer to buy or sell at a price shall be accepted before subsequent offers at the same price may be placed. Subsequent offers to buy at a higher or sell at a lower price shall vacate prior offers to buy at lower or sell at higher prices. A transaction shall vacate all previous bids and offers. All disputes as to offers, acceptances or withdrawals shall be decided on the spot by the person presiding at the time, subject to an appeal to the members present. The appeal must be promptly taken, and a majority of the members present and voting shall settle the disputed point finally. The secretary shall immediately, after each call, cause to be posted on the bulletin of the Exchange the results of the call, setting forth the bidding and selling prices of the several articles dealt in. At the close of each call, settling prices of iron and steel shall be announced by the person conducting the calls, subject to the trade there assembled; and the prices so fixed shall govern all calls for margins. These prices shall also be used for settlements of contracts and of differences on deliveries under contracts in accordance with Section 34 of the By-Laws, and of Rule 5 of the general trade rules on iron and steel.

MARGINS.—Rule 2.—Either party to a contract, prior to or upon signing the same, shall have the right to call an original margin of $2.50 per ton on iron, and either party may call for margins to meet variations in the market. All margins on contracts shall be deposited in one of such trust companies, banks incorporated by the State or National Banks, as may have been designated for this purpose by the Finance Committee of the New York Iron and Metal Exchange. When margins are called before 12 o'clock M., they must be deposited before 3 o'clock P. M. the same day; if after 12 o'clock M., they must be deposited before 11 o'clock A. M. the next day.

Rule 3.—In case of failure to deposit as above, then the party calling the margins shall notify in writing the party on whom the margins were called of his or their failure to make the required deposit, and if the party in default fails to give the notice required in Section 32 of the By-laws the party collecting the margins shall have the right to cover his or their contract at discretion for account of party failing to respond to the call for margin, and if covered, give notice in writing to that effect to the party in default. In case of failure of any bank or trust company in which such margins have been deposited, it shall be the loss of the party or parties to whom it may be found to be due, taking the average price of like deliveries on the day such bank or trust company failed as a basis of settlement. When margins are called, original or for variations in the market, certified checks must be drawn to the order of the bank or trust company in which they are to be deposited. Checks must be sent to the Secretary of the New York Iron and Metal Exchange, who shall deposit them and get a certificate of deposit made payable on the order of Secretary of the New York Iron and Metal Exchange, and to the order of the buyer and seller. As soon as the Secretary has received the certificate, he shall send it to the party making the deposit, and an abstract of the same to the party calling the margin. In settlement, the Secretary shall ascertain the amount due each of the parties at interest, and shall indorse the amount due each one on the certificate over his own signature, as instructed by both parties. In case the two parties do not agree as to the amount due on a margin receipt, either of them may refer the matter to the Committee on Pig Iron or Old Iron and Steel, as the case may be, for decision, which shall be final. On the decision of said committtee, the Secretary of the New York Iron and Metal Exchange, on being informed thereof, shall promptly indorse to each party the amount each shall be entitled to by such decision. In case of the absence of the Secretary, the President of the New York Iron and Metal Exchange, or the Chairman of the Finance Committee, shall act in his stead under this rule.

Form of Contracts.—Rule 4.—The following shall be the form of contracts for pig iron and old iron and steel sold for future delivery:

Pig Iron Contract:—

New York,————188

In consideration of $1, in hand paid, the receipt of which is hereby acknowledged,————have this day sold to (or bought from)————————about————tons ————of————pig iron,——brand, at———— dollars per ton, deliverable at seller's option.

This contract is made in view of, and in all respects subject to the by-laws and rules established by the New York Iron and Metal Exchange, in force at this date,————.

Sale through————, Broker.

Old Material Contract:—

New York,————188

In consideration of $1, in hand paid, the receipt of which is hereby acknowledged,————have this day sold to (or bought from)————about————tons————of old ————at ——dollars per ton, deliverable at seller's option.

This contract is made in view of, and in all respects subject to the by-laws and rules established by the New York Iron and Metal Exchange in force at this date,————.

Sale through————, Broker.

The ton of iron or steel shall be 2240 pounds, avoirdupois weight. On all future contracts, 25 per cent., more or less, may be delivered, but any deficiency or excess greater than 10 per cent. must be settled for at the market price on day of delivery.

Settlement of Contracts.—Rule 5.—Contracts shall not be transferable, and any difference found to be due on settlement shall apply on account between the parties to the contract. Any party holding a contract against another, corresponding in all respects (except as to price) with one held by the other party against him, may close or cancel both by giving notice in writing to said party; and where it appears that several parties have contracts corresponding (except as to price), and that a "ring settlement" can be made, the party finding said "ring" shall notify all parties thereto, giving names, time of delivery, quantity, and settlement price (which price must be within twenty-five cents of the market), and get their acknowledgments, from which time the said "ring" shall be in force, and cannot be broken by the failure of any of the parties therein; and all parties thereto shall be compelled to settle their differences on said contract with each other on the basis of the settlement price. Where settlements of contracts for a specified month are made before maturity of said contracts, the legal rate of interest shall be allowed on the differences paid up to the first day of the maturing month. All offers to buy iron or steel openly, for future delivery, on the floor of the Exchange, must be open to the member first accepting such offer. Verbal contracts, when satisfactorily proven, shall have the same standing as written contracts; but the claim under such contracts must be made on the day of the alleged transaction, or on the next business day thereafter. Parties holding an option may, by giving the necessary notice or order, require the other party to receive or deliver on the first business day of the option, subject to the same conditions as on any other day covered by the contract.

Removal and Rejection of Goods sold on Contract.—Rule 6.—Iron and steel sold on contract must be removed by the buyer before 5 P. M. of day of delivery; if not so removed, all risk and expense must be assumed by buyer.

Rule 7.—When iron or steel is rejected under final appeal, if tendered on a seller's option, all expenses shall be paid by the seller, and it shall be held that no tender has been made. If under a buyer's option, the seller shall, within twenty-four hours, tender another lot to the buyer, and pay all damages that the buyer has, in the opinion of the proper special committee, sustained.

Rule 8.—The foregoing rules shall apply to all iron or steel sold by contract or to arrive. When specific lots are sold to arrive, however, rejections are not required to be replaced. When, under sales for future shipment of iron and steel, specific lots and vessels containing them are then named, sellers are released on such lots as may be rejected on arrival for cause.

Notice of Delivery.—Rule 9.—On spot sales of iron and steel, the buyer shall be allowed forty-eight hours, exclusive of Sundays and legal holidays, in which to make the proper inspection and remove the property. On contracts forty-eight hours' written notice for inspection and delivery shall be given, exclusive of Sundays and legal holidays. When sales are made to arrive, the seller shall give the name of the vessel or vessels as soon as known to him, and, on arrival, notice to be given buyer in writing. All such notices shall be given between the hours of 11 A. M. and 2 P. M. Payments shall be made on transfer of documents conveying title before 2 P. M. of the day on which delivery is to be made.

Private Arbitration.—Rule 10.—In case of disputes arising under any contract which are not otherwise provided for under the rules, unless the same shall be submitted to the Arbitration Committee of the Exchange, or any other provision made for their settlement, it shall be the duty of the parties thereto promptly to agree to the appointment of two arbitrators, and these shall appoint a third. The question in dispute shall be submitted to them, and their decision shall be final and binding. Said arbitrators shall be appointed from the branch of trade out of which the dispute may have arisen, and shall declare, before considering the question, that they know nothing of its merits from conversation with the principals, or otherwise; and they shall be paid $2 each for each hearing by the party adjudged by them to be in fault.

Inspectors.—Rule 11.—All inspectors and weighers of iron and steel for delivery on sale or contract, under the Rules of the Exchange, must be licensed by the Board of Managers, and must obligate themselves not to be interested in any parcel they are licensed to inspect or weigh. They shall be licensed only upon written application, stating the location of their place of business, which must be within the harbor of New York, or the cities connected therewith. Provided, however. that the certificate of inspection of those furnace companies, whose grading may be approved by the Board of Managers of the New York Iron and Metal Exchange, shall be valid for American pig iron, delivered at shipping port, and not stored. All licenses shall expire annually at such time as the Board of Managers may designate, and they may revoke said licenses at any time for cause. Fees of inspectors and weighers must be paid by the party employing them, or as under Rule 6 of Pig Iron Rules.

Rule 12.—The buyer of any article shall have the right to designate an inspector, but the seller shall have the right to appeal to the Committee on Pig Iron or Old Iron and Steel, as the case may be, whose decision shall be final and binding. All appeals from inspectors must be made before the property leaves the city or place of delivery. Weights and quality of iron and steel must be settled at place of delivery, unless otherwise agreed upon.

Payments.—Rule 13.—On sales of iron and steel, made for cash, seller shall have the right to demand payment at the time of passing title.

Maturity of Contracts.—Rule 14.—When a contract shall mature on Sunday, or a legal holiday, delivery on such contract shall be made on the preceding business day. On contracts maturing on any other day upon which the Iron and Metal Exchange does not hold a business session, deliveries shall be made on the following business day.

Brokerage.—Rule 15.—The brokerage on merchant bars and nails shall be 2½ per cent., and on all other articles of iron and steel 1 per cent., and shall be due and payable at the time of passing contracts.

Weighing.—Rule 16.—On all foreign iron and steel the United States Custom House weights shall be taken to decide quantity, whenever the entire lot shall be delivered as originally entered. On all other lots of iron and steel any sworn weigher's certificate at point of delivery (whose fees shall be paid by seller) shall be a good tender in proof of weight; but, in any case, either buyer or seller shall have the right to demand a reweight by a weigher licensed by the New York Iron and Metal Exchange, whose fee shall be paid by the party demanding such reweight.

Defaults.—Rule 17, Section 1.—In case iron or steel be not delivered at maturity of contract, the purchaser shall notify in writing the special committee on that kind of iron or steel of the failure to deliver, and the committee shall, at the next call, publicly read such notice, and buy in the property for account of the party directing the purchase; but no unreasonable price shall be paid, arising from manipulated or fictitious markets, or unusual detention in transportation. Any legitimate loss resulting to the buyer shall be paid by the party in default, and the property so bought in shall be a good delivery on defaulted contracts maturing that day.

Section 2.—In case iron or steel contracted for delivery be not received and paid for when properly tendered, it shall be the duty of the seller, in order to establish a claim on the purchaser, to sell it on the market at any time during the next 24 hours, at his discretion, after such default shall have been made, notifying the purchaser within one hour after such sale; and any loss resulting to the seller shall be paid by the party in default.

Rule 18.—When a member buys from or sells to another member, and the names of principals are not given up by the one to the other within 24 hours, those members shall be to each other as merchants or principals in such transactions, with claims on each other only, and liabilities to each other only, and notwithstanding that it shall afterward be shown that such members (either or both) were acting as brokers.

Rule 19.—Fictitious sales or false reports of sales are positively forbidden, and will render the parties concerned liable to suspension or expulsion from the New York Iron and Metal Exchange.

Rule 20.—All rules as to iron and steel must be justly and liberally construed, and no property shall be rejected or condemned for merely technical reasons.

Amendments.—Rule 21.—No change shall be made in these rules by any special committee before submitting the same to a meeting of the trade interested, properly called, at which 10 members shall constitute a quorum.

Following is the form of certificate that has been adopted:

New York Iron and Metal Exchange.—This certifies that is a member of the New York Iron and Metal Exchange at the time of the date hereof, and this certificate of membership may be transferred upon the books of the Exchange to any person eligible to membership, provided all assessments hereon shall be paid at the time of such transfer and the provisions of the by-laws relating hereto fully complied with.

NEW YORK, 1882

President.

Secretary.

On the back of this appears the following endorsement:

At the City of New York, on this day of 188 , for value received, I hereby assign, transfer and set over to all my right, title and interest in and to the within certificate, and all rights of membership vested in me by virtue of the said certificate.

Witness

The Iron and Metal Exchange Company, Limited.—This is an outgrowth of the same want that gave birth to the "Iron and Metal Exchange." The by-laws were adopted April 4th, this year (1882), and the following officers were elected in the following month:

Officers of The Iron and Metal Exchange Company.—President, James B. Brinsmade; Treasurer and Secretary, Edwin F. Bedell; Assistant Secretary, Wm. Allen Smith. Directors, May, 1882. Jas. B. Brinsmade, of E. Bech and Co.; Benjamin G. Clarke, of The Thomas Iron Co.; Frederick L. Lehmann, of Naylor and Co.; Edwin F. Bedell, of Cooper, Hewitt and Co.; William H. Wallace, of Wm. H. Wallace and Co.; Edwin S. Wheeler, of E. S. Wheeler and Co.; John B. Cornell, of J. B. and J. M. Cornell; Chester Griswold, of The Albany and Rensselaer Iron and Steel Co.; Thomas J. Pope, of Thomas J. Pope and Bro. The by-laws are as follows:

I. The business of this Corporation shall be managed by a Board, consisting of nine Directors.

II. The term of office of such Directors shall be one year.

III. Vacancies among Directors and Officers may be filled at any meeting of the Board, by a majority vote by ballot, two-thirds of the whole Board being present.

IV. The Annual Meeting shall be held on the first Tuesday in April, at three o'clock in the afternoon, at the office of the Company in the city of New York.

V. Special Meetings of stockholders shall be called by the President or Secretary whenever a majority of the stockholders shall request him to call such meeting. The President, or in his absence the Treasurer, or in his absence the Secretary, shall preside at such meeting.

VI. In order to constitute a quorum for the transaction of any business at any meeting of stockholders, a majority, in shares, of the stockholders must attend in person or by proxy. But, in case there shall not be present a majority within fifteen minutes after the time named for the meeting, the same may be called to order, and, by vote, adjourned to another time.

VII. The officers of the Corporation shall be a President, a Treasurer, and a S cretary, all of whom shall be elected by the Board from their own number, by ballot, to serve one year, or until the meeting of the Board next succeeding an election of Directors, and they shall not be entitled to any compensation for their services. It shall be the duty of the President to preside at the meetings of the Board and of the stockholders; to sign certificates of stock; to have a general supervision of the affairs of the Company; to audit all bills against the Company which he shall find to be correct, and to perform the acts which are usually incident to the office.

It shall be the duty of the Treasurer to have the care and custody of all the funds of the Company, to deposit the same in such bank as the Board may direct; to sign and indorse checks, drafts, and orders necessary for the collection, custody, and disbursement of the funds of the Company, subject to the direction of the President; to present to each annual meeting of the stockholders, and at any other meeting if he shall be required to do so, a report showing the receipts and disbursements, and the financial condition of the Company; and to exhibit his books and accounts to any stockholder, whenever requested so to do; and to countersign certificates of stock. He shall give a bond in the penal sum of three thousand dollars, with two sureties, to be approved by the President, conditioned for the faithful discharge of his duties.

It shall be the duty of the Secretary to keep the minutes of the meetings of stockholders and of the Board; to have the custody of the seal of the Company, and to affix the same to certificates of stock, and, on the order of the Board, to any other paper or document; to keep the stock certificate book, transfer book, ledger, and such other books as the Board may require, and to exhibit the same at the request of any stockholder; to collect statistics and other information which may be useful in the Company's business, and keep the same in good order for permanent preservation and reference; to take charge of and safely preserve the papers of the Company; to take general supervision of the rooms of the Company, and see that the same are well kept; that the comfort of those who have a right to the use of the rooms is provided for; that the rules of the rooms are duly observed and obeyed, and to report all violations of such rules to the Board; and to give and serve such notices of meetings as may be required.

There shall also be an Assistant Secretary, to be appointed by vote of the Board by ballot, whose duty it shall be to be in constant attendance at the rooms of the Company during the open hours of the same, to perform such of the duties of the Secretary as that officer shall delegate to him, and to render for the Company such services as shall be required of him by the Board or the President. He shall hold office only during the pleasure of the Board, and shall be entitled to such compensation as the Board shall determine.

VIII. Three Inspectors of Election shall be appointed by the Board, and it shall have power to determine how the vacancy shall be filled, in case any inspector so appointed shall fail to attend a meeting at which an election is to be held.

IX. The Board shall, as soon as practicable, secure the use of a room or rooms, to be called the IRON AND METAL EXCHANGE ROOMS, and it shall prescribe rules and regulations designating what persons, and on what terms, shall be entitled to admission to the same, and to the enjoyment of its privileges, and also rules and regulations to be observed by such persons as a condition of their having and retaining a right to admission to said rooms. But no person shall be entitled to such admission except by vote of the Board, and three ballots against his admission shall exclude him.

In the government of said room it shall be the duty of the Board to make every effort possible to make the same a convenient and desirable place of resort during suitable hours, on every business day, for producers and consumers, and sellers and buyers of iron and other metals, for selling and buying for actual consumption, and by all means in the power of said Board to discourage and prevent buying and selling on speculation; to exclude from the privileges of the room any person who shall be dishonest or dishonorable in any business dealing, or who shall fail to fill any contract or pay any debt.

The Board shall also discourage litigation, and shall organize an Arbitration Committee, to be composed of persons who are not Directors, and shall prescribe such rules and regulations for said Committee as may make it efficient to settle disputes, correct misunderstandings, and preserve harmony among those who choose to submit any question in difference to such committee.

X. The stockholders shall be entitled to dividends of six per cent. per annum, if the profits of the Company shall warrant it. The Board may appropriate any part of the surplus profits, not necessary for the due maintenance of the rooms, in such way as they may think proper, to promote social acquaintance and good fellowship among those having a right to the use of the rooms; or, it may accumulate such surplus towards providing a fund for the purchase or erection of a suitable building for the purposes of the Company; or, may make such other disposition of said surplus as it may deem best to subserve the interests of the Company.

XI. These By-Laws may be amended by a majority of the stockholders at any meeting of the same, two-thirds of the stock being represented either in person or by proxy.

A REVIEW OF THE IRON MARKET FOR THE EIGHTEEN MONTHS ENDING JUNE 30, 1882.

IN his review of the iron trade in this country for 1881, Mr. James M. Swank, secretary of the American Iron and Steel Association, says: "The prosperity which was restored to the American iron trade in the spring of 1879, and which was continued in 1880, attained its highest development in 1881. This was the most prosperous year American iron and steel manufacturers have ever known. The demand for their products was very active all through the year, production was greatly stimulated, and prices were in the main satisfactory. It was notably a year of *uniform* prosperity; not characterized by spurts and reactions, but by a steady demand at good prices in all branches except in some pig iron districts in the summer months, when the demand for pig iron weakened slightly in consequence of the large quantities of foreign pig iron that were pressed upon the market. From this local depression there was, however, a complete recovery in the autumn. With this temporary variation in the general situation the demand for all forms of iron and steel was active and even urgent all through the year. The production was far in advance of that of any previous year, and it all passed into consumption. The stocks on hand at the beginning of the year were also consumed. Never has there been a healthier business done by our iron and steel manufacturers than they did in 1881. The year ended with more orders on their books than were entered when it began, and at prices that were generally higher than were then obtained." The average monthly quotations for the year for the articles mentioned, he also gives, as follows:

Months.	*Iron rails.—Per ton.*	*Steel rails.—Per ton.*	*Pig iron.—Per ton.*	*Bar iron.—Per lb.*
January	$46.50	$60.00	$25.00	2.5c
February	47.50	62.00	23.50	2.5c
March	47.00	62·50	26.00	2.5c
April	47.00	63.00	25.00	2.4c
May	46.50	63.09	25.00	2.4c
June	46.50	65.00	24.00	2.4c
July	46.75	61.00	24.50	2.45c
August	47.00	60.00	24.50	2.55c
September	47.75	60.00	25.25	2.7c
October	47.50	60.00	25.50	2.8c
November	47.75	61.50	25.75	2.9c
December	48.00	60.50	26.00	2.9c

At the beginning of 1881 there were 456,658 tons of pig iron in stock with producers, and of foreign iron the amount was stated at over 800,000 tons, all of which, as Mr. Swank says, was consumed during the year. The production in the United States was 4,641,564 net tons. The following table shows the highest and lowest prices by months for the year in New York, of the articles named:

The following is a comprehensive statement of the Bessemer steel works in this country:

Names of Companies.	*Converters.*
Albany and Rensselaer Iron and Steel Co., Troy	two 6¼-ton.
Bethlehem Iron Co., Bethlehem	four 7-ton.
Pennsylvania Steel Co., Steelton	two 6½-ton. three 8-ton.
Lackawanna Iron and Coal Co., Scranton	two 7½-ton.
Cambria Iron Co., Johnstown	two 6-ton.
Carnegie Bros. & Co., Limited, Bessemer	three 10-ton.
Pittsburgh Bessemer Steel Co., Limited, Homestead	two 4-ton.
Pittsburgh Steel Casting Co., Pittsburgh	one 7-ton.
Cleveland Rolling Mill Co., Cleveland	two 6¼-ton.
North Chicago Rolling Mill Co., Chicago	two 10-ton. two 6¾-ton.
Union Iron and Steel Co., Chicago	two 5⅓-ton.
Joliet Steel Co., Joliet	two 5⅓-ton.
Vulcan Steel Co., St. Louis	two 6¼-ton.
Scranton Steel Co., Scranton	two 4-ton.
Colorado Coal and Iron Co., South Pueblo	two 5-ton.
Total	.37

There were indications before the close of the year that the remarkable prosperity which had attended the iron business for the preceding twelve months, could not be expected to continue throughout 1882. Indeed, there were unmistakable signs of a decreased demand and of lower prices in December. The over-speculation in railroad stocks, short crops in the west reducing the east bound tonnage, and the reduced rates prevailing, all pointed to a more conservative management of the railroads already built and hesitancy and delay in carrying out or undertaking new schemes. Just at a time when the country had demonstrated its ability to furnish a large increase in the supply of steel rails, there was a falling off in the demand. The prospects of last winter respecting the condition of the trade this year have been fully verified. Steel rails on December 15, 1881, were quoted at $60, and by Jan. 1, at $58. On May 15, of this year orders could be easily placed at $50. Iron rails were $48 on Jan. 1, and only $44 in May. On July 1, steel rails are quoted at $47.50 to $50.00, but there is nothing doing, and there is not even a reliable quotation for iron rails. At the close of the six months the quotations for pig iron are as follows: No. 1 foundry, $25.00; No. 2, $23.00; gray forge, $22.00 Scotch pig; Eglinton, $22.75 to $23.00; Glengarnock, $24.75; Gartsherrie, $25.50 to $26.00, and Coltness, $26.50 to $27.00. These prices are in the face of a strike in the mills at Pittsburg, Wheeling, the Mahoning and Shenango valleys, Chicago and St. Louis that has existed for nearly three months. With none but the mills in the Cincinnati district running, those in operation are complaining of the condition of trade. In commenting on the present market for furnishing iron the *Iron Age* of New York, in its issue of June 29, says: "It will be remembered that the chief point of difference at the conference between the iron manufacturers and the workingmen was as to the ability of the former to pay any advance in wages at the present time, owing to the state of trade. The manufacturers stated that there was no trade, that prices were declining, stocks were accumulating, and that they would soon have to reduce pro-

Months.	*American Pig-Iron.*			*Scotch Pig-Iron.*				*Rails.*				*Wrought.*
	No. 1.	*No. 2.*	*Forge.*	*Coltness.*	*Eglinton.*	*Glengarnock.*	*Gartsherrie.*	*Iron.*	*Steel.*	*Old Ts.*	*Old D. Hs.*	*Scrap.*
	$ $	$ $	$ $	$ $	$ $	$ $	$ $	$ $	$ $	$ $	$ $	$ $
January	25 @26	21 @23	20 @21	23½@25	21½@23	22½@23½	23½@24	46 @52	57½@62	26½@28¾	28 @30	25 @31
February	25 @26	22 @23	20 @21	24½@ 25	22 @22½	23½@ . .	23½@24	47 @52	59 @66	28 @28½	29½@30	30 @32
March	22 @26	22 @23	20 @22	24½@ 25	21½@22	23 @23½	23 @23½	48 @50	62 @65	27½@28	28½@30	30 @31
April	24 @26	22 @23	20 @22	23½@24½	21 @22	22½@23	22½@23½	46½@50	59 @67	26 @27½	27 @29	30 @32
May	24 @25	21½@22	19 @20	23 @23½	20½@21	21½@22½	23 @ . .	46 @50	60 @61	26 @27	27½@28	27 @30
June	24 @ . .	22 @ . .	19 @20½	23 @24	20½@21½	21½@22½	22½@23½	44 @48	56 @62½	25 @26½	26½@27½	26 @30
July	24 @25	21½@22	20 @21	23 @24	20 @21½	22½@23¾	23 @ . .	45 @50	55 @60	25 @26½	25 @28	26½@30
August	24 @25	22 @23	20 @21½	23½@24	21 @21½	22 @22½	23 @ . .	47 @50	55 @58	26¾@27½	28½@30	27 @30
September	24½@25½	22½@23	20 @21½	23¾@26	21 @23	22½@24	23 @23½	47½@50	57 @62	27 @28	29¾@30	27½@30
October	25 @26	22½@23	21 @22	26 @26½	23 @24	24 @25	25 @25½	47 @50	60 @62	27¼@29	29¾@32	28 @31
November	25 @27	22½@23	20 @21	25½@26½	23 @24	24½@25	25 @25½	48 @50	61 @62½	28½@29	31 @32	31 @32½
December	25 @27	23 @25½	22 @23½	20 @27	23 @24	24 @25	25 @26	47½@50	56 @62	29 @ . .	31¼@32	30 @32½

The average prices in Philadelphia for a number of years of No. 1 anthracite pig iron, and also of bar, iron rails and Bessemer steel rails, are given in Mr. Swank's report, printed in another part of this volume.

duction. The workingmen denied this, claiming that it was a cry that was always heard about this time of the year, and that it was uttered for effect. They asserted that the reports in certain newspapers showed that prices were not declining, that consumption was up to production, and that manufacturers could afford to pay the advance asked. Of course there was no doubt among manufacturers and those posted in what might be called the secrets of the iron trade, as to the correctness of the statement of the manufacturers, and this has now become apparent to all on-lookers; and even the hot-heads among the workingmen, who insisted that the manufacturers' statement was not true, are becoming convinced that it *was* true. It is a strange fact that with all of the Pittsburg, Mahoning and Shenango valleys, Wheeling, Chicago and St. Louis mills virtually idle, and with only the mills in the Cincinnati district running, the Cincinnati mills are complaining of bad trade, and it is a fact, also, that this statement is not made for effect. The Cincinnati mills are finding it difficult to secure orders to run their mills. So, also, immediately after the strike many Pittsburg manufacturers who wished certain sizes of bar to sort up with, wrote East to endeavor to secure the iron. They were answered, almost without exception, that it would be impossible for Eastern mills to fill orders before the middle of August or the first of September. Soon, however, the Eastern mills took a very different turn. One Pittsburg iron manufacturer, for example, who two weeks before could not get quotations on the little iron that he wanted, received in one day offers from four different parties in the East of 100 tons of iron delivered in Pittsburg at less than card rate at Pittsburg. Another manufacturer who wished some pipe iron with which to sort up some sizes, failed at first to get quotations. In the second week of the strike he received a telegram offering him 100 tons of the size he wished at mill, delivered at less price than he had been selling the iron for before the strike. The same is true regarding English iron. As we have stated above, considerable of No. 20 sheet iron, which is largely used at Pittsburg in connection with the manufacture of oil tanks, has been placed with English parties. The card rate at Pittsburg on this iron is 4.1. The English iron, which is equal to the Pittsburg iron, has been laid down in Pittsburg at 3.5. All these facts go to show not only that the manufacturers' statement was correct, but also that they were fully justified, in view of the condition of the market, in refusing to pay the advance demanded. Further, it shows that the present stoppage will be of very great importance and profit to the manufacturers. With this condition of things existing, it certainly is evident that if the manufacturers had continued running, iron must have gone down materially in price, and it probably is true that if the mills were to start to-morrow iron would be selling at two cents before many weeks had passed. No doubt a belief in this is what made the manufacturers so united in their determination to resist the demands of the workingmen, and no doubt also led consumers to refuse to place orders except for immediate delivery. Further, the Spring of 1882, while in some respects, was a good time for the workingman to strike—fuel, clothing and food not being needed to the extent that they are in the winter, and the opportunities for outside labor being much greater—it is also true that it was a good time for the manufacturers. The railroads were doing nothing. The other large consumers of iron, that is the manufacturers of agricultural implements, were doing very little. They were finishing up machines that were being manufactured, and had not yet begun to manufacture for next year, and, in view of the state of the iron trade, they certainly will not place their orders at this time."

Writing in the middle of May, Mr. Swank says:—"The fact may as well be accepted philosophically, if reluctantly, that we have again entered upon a cycle of low prices for iron and steel. We do not think this result is greatly to be regretted, if we consider that some remedy is needed to check our enormous importations of these articles. Were these importations to be continued for a few years longer upon the scale which has existed during the past three years, our iron and steel industries would suffer the most serious consequences, which would be felt for a generation. * * * Importations of iron and steel had, therefore, to be checked, in some way, if we would not prevent the future prosperity of the domestic producers of these articles. Low prices may be a distasteful remedy for our manufacturers and their workmen, and for iron ore producers, but no other remedy is available. It is a pity that good use was not made of it a few months ago."

In some respects the western iron market is peculiar, although with the exception of certain brands, such as car-wheel iron, it sympathizes with the general market of the country. But in the Lake Superior and Missouri ore regions, which control the ore trade of the West, it is customary to contract with the blast furnaces early in the year for the entire season's wants at a fixed price. This usually renders the market devoid of features of interest, except such as may relate to the output, or such as come from the advance in price of the ores not contracted for, as was the case in 1880, when the Republic Iron Co. sold some of its ore as high as $15 on the docks at Cleveland. The chief feature of the trade in 1881, was the enormous production of ore during the year, far exceeding that of any previous year. The total production of Lake Superior iron ore in 1881 was the largest in the history of the district, being 2,336,335 gross tons against 1,987,598 tons in 1880, and 1,414,182 tons in 1879. For the first six months of 1882, the total lake shipments were 1,161,148 tons against 727,185 tons for the same time last year. There has also been a large increase in the output of the Missouri mines as well as those in the vicinity of Pittsburg and other sections of the country. The region known in iron circles as the "West" has within the past few years become not only the largest producer, but the largest consumer of pig iron of any of the sections of the country. It produces and consumes considerably more than one half of the pig iron product of the United States, the consumption being larger than the production. But little pig iron comes from the West to the East, and that is only charcoal iron, while the West draws largely from the East and South. This condition of the market has been especially manifested for more than a year past. The quotations of pig iron in the West are generally on forge irons at four months' time. The market opened in January with a medium quality of forge iron, selling at $23 @ $24 and $26 @ $27 *for all ore red short irons.* These grades advanced to $25 @ $25.50 and $27 @ $28, respectively, by the middle of February. From this point prices dropped to $24 @ $25 and $26.50 @ $27.50 in April, and to $22.50 @ $23 and $25 @ $26 in August. In September the market became much firmer, and the medium quality sold up to $23.50. From this point the advance was gradual until the close of the year, when it bounded to $24 @ $25.50 for medium, and all ore-red shorts, $26 @ $28. Since the beginning of the current year, prices have followed the general course of the market, notwithstanding the mills have generally been idle for several months. The following table, compiled from actual sales, shows the range of prices at Pittsburg of gray forge coke or bituminous irons made in whole or in part from Lake Superior ores. The prices are on four months' time:

Month.	1881.	1880.	1879.	1878.	1877.	1876.	1875.	1874.	1873.
January. .	$22.00 @ 24.00	$37.00 @ 45.00	$16.50 @ 19.50	$17.50 @ 21.00	$20.50 @ 22.60	$21.50 @ 23 00	$23.00 @ 24.00	$25.00 @ 32.00	$38.50 @ 43.00
February .	25.00 @ 27.50	45.00 @ 45.00	16.50 @ 19.50	17.50 @ 20.00	20.00 @ 22.50	22.00 @ 22.50	23.00 @ 24.00	28.00 @ 32.00	38.50 @ 43.00
March. . .	25.00 @ 27.50	38.00 @ 43.00	16.50 @ 19.50	17.00 @ 19.50	19.50 @ 22.50	21.00 @ 23.00	23.00 @ 26.00	27.00 @ 30.00	38.50 @ 43.00
April . . .	24.50 @ 27.00	29.00 @ 40.00	17.00 @ 19.50	17.00 @ 19.50	18.50 @ 22.00	21.00 @ 22.00	22.00 @ 25.00	26.00 @ 29.00	38.50 @ 43.00
May. . . .	23.50 @ 26.00	23.00 @ 29.00	17.60 @ 20.00	17.00 @ 19.00	18.00 @ 22.00	21.00 @ 22.50	23.00 @ 25.00	25.00 @ 28.25	37.50 @ 43.00
June . . .	23.50 @ 25.00	19.00 @ 23.50	17.50 @ 20.00	17.00 @ 19,00	18.00 @ 21.50	21.50 @ 22.50	24.00 @ 25.00	25.00 @ 28.00	35.00 @ 38.00
July. . . .	22.50 @ 24.50	19.00 @ 22.00	17.50 @ 21.00	17.00 @ 19.00	18.00 @ 21.50	21.00 @ 22.50	24.00 @ 25.00	25.00 @ 28.00	33.00 @ 36.00
August . .	22.50 @ 24.60	22.50 average	18.00 @ 22.00	16.50 @ 19.00	18.00 @ 21.50	21.00 @ 22.00	24.00 @ 25.00	24.00 @ 27.00	32.50 @ 35.00
September	22.50 @ 26.50	22.50 average	22.00 @ 30.00	16·50 @ 19.00	17.50 @ 21.00	21.00 @ 22.50	22.00 @ 24.00	25.00 @ 28.00	32.00 @ 35.00
October. .	23.00 @ 27.00	22.50 average	28.00 @ 32.00	16.50 @ 19.50	17.50 @ 21.00	21.00 @ 22.00	23.00 @ 24.00	25.00 @ 28.00	28.00 @ 34.00
November.	23.50 @ 27.00	22.50 average	29.00 @ 33.00	16.50 @ 19.50	17.60 @ 21.00	21.00 @ 22.00	23.00 @ . .	24.00 @ 27.00	25.00 @ 30.00
December.	23.60 @ 28.00	20.00 @ 21.00	31.00 @ 36,00	16.50 @ 19.50	17.50 @ 21.00	20.50 @ 22.00	21.00 @ 24.00	23.00 @ 24.50	24.00 @ 30.00

The *Iron Age* publishes returns from the blast furnaces quarterly. In its summary of the reports for the quarter, ending July 1, 1882, it gives the following:

Furnaces.	*July* 1, 1882.		*January* 1, 1882.	
	In blast.	*Out of blast.*	*In blast.*	*Out of blast.*
Charcoal	151	126	155	117
Anthracite	164	72	159	67
Bituminous	119	109	142	78
Total	434	307	455	262

For the last six years the relative condition of the furnaces on July 1 was reported as follows:

Furnaces in Blast July 1.

	1877.	1878.	1879.	1880.	1881.	1882.
Charcoal	87	64	81	131	147	151
Anthracite	87	95	101	167	146	164
Bituminous	85	89	95	115	144	119
Total	259	248	277	413	437	434

Furnaces out of Blast July 1.

	1877.	1878.	1879.	1880.	1881.	1882.
Charcoal	181	202	176	136	125	126
Anthracite	139	130	125	68	90	72
Bituminous	123	128	107	109	77	109
Total	443	460	408	313	292	307

In the above tables the columns "in blast" and "out of blast" show only the stocks from which the journal quoted received reports, and their footings for different periods when added, will not always agree. The following table prepared by Mr. Joseph Nimmo, Chief of the Bureau of Statistics at Washington, shows the quantity and value of iron ore imported into the United States during the year ended December 31, 1881, by countries:

Countries.	*Tons.*	*Value.*
Brazil	800	$2,002
France	44,465	103,449
French Possessions in Africa and adjacent islands	147,165	444,955
Germany	1,034	17,933
England	67,540	285,463
Scotland	2,247	10,535
Ireland	14,959	34,263
Gibraltar	1,500	5,539
Nova Scotia, New Brunswick and Prince Edward Island	5	37
Quebec, Ontario, Manitoba, Rupert's Land and Northwest Territory	44,222	143,445
British Columbia	1,100	1,522
British Possessions in Africa and adjacent islands	715	2,857
Italy	89,225	250,930
Portugal	23,946	63,379
Russia, on the Baltic and White Seas	*987	30,812
Spain	327,848	753,373
Turkey in Asia	*2,687	66,029
Turkey in Africa	2,850	5,317
Uruguay	505	1,700
Total	782,887	2,222,552

*Correct per certified invoices. This ore, or the most part of it, is imported by chrome works for chromic acid.

A REVIEW OF THE COAL MARKET FOR THE EIGHTEEN MONTHS ENDING JUNE 30, 1882.

THE demand for anthracite coal during 1881, exceeded anything heretofore known in the history of the coal trade. This was due partly to the prosperous condition of all kinds of business, and especially the manufacture of iron in which large quantities of coal were consumed, and partly to the fact that the low prices for coal which prevailed for some time prior to the last combination of the leading anthracite coal companies, led to the introduction of anthracite coal into new fields and especially the West as far as the Mississippi river. There are reasons for believing that anthracite coal will gradually become more and more a house fuel throughout the country, while the softer coals will in time take the place of anthracite in the manufactures. In commenting on some figures showing the amount of anthracite coal still available for use in the Schuylkill, Lehigh and Wyoming districts, Mr. Frank Wilkinson says: "In less than forty years, if coal be produced at the rate of 30,000,000 tons per annum, anthracite will be an article of luxury, and the price it will bring will exclude the poor people from its use." Any danger of this kind, however, had no appreciable effect upon prices, except such as may have arisen from the gradual introduction of bituminous coal into manufacturing districts, where the harder coal geographically controlled the field.

It is a remarkable fact that there was no change in the circular prices of the leading companies during the whole of 1881, except one of 10 to 25 cents in March of that year, and for the first six months of the current year, the only changes were a reduction of 10 to 15 cents in January caused by the light consumption on account of the unusually mild winter, and a restoration of the old prices in June. This steady condition of the market has been brought about by an agreement between the coal companies that they will regulate the output so as not largely to exceed the consumptive demand from month to month, by a stoppage of work whenever required. The producing capacity of the mines still exceeds the demand for consumption, and consequently frequent suspensions of work occurred during the past eighteen months. The average circular prices of anthracite coal were only two cents higher in 1881 than in 1880, but as prices were not as well maintained in 1880 as 1881, it is probable that the average prices actually received were as much as 25 cents higher last year than during the year preceding. It is practically impossible to maintain full circular rates throughout the year, but the fluctuations, except as stated above, consisted in the shading of the published schedule rates, which was not so great as to cause a rupture of the mutual understanding between the companies as to output.

The shipments in round figures were 5,000,000 tons greater in 1881 than in 1880, and during the last six months of 1881, they were about 16,000,000 tons, which was nearly equal to the carrying capacity of the railroads and vessels by which the coal is moved. A potent influence which is operating upon the anthracite coal trade in its extension to the Western States, is the condition of the through traffic of the trunk line railroads. Freightage to the sea-board from the West has been largely in excess of the shipments on the return trips of the cars, and consequently many cars had to be hauled back empty. The expense of drawing a loaded car from New York to Chicago is little more than if the same car were taken unloaded. Consequently the railroads can afford to carry freight, not liable to damage, by transportation, such as coal, from the east to the west at a very low figure. This they are now doing, and the extension of the anthracite coal consuming territory may thus be much greater than could possibly be brought about if the coal had to pay its full cost of transportation. This demand from remote sections of the country must, of course, be limited to household purposes.

The year 1881 opened with a stock of only 500,273 tons in the hands of the companies, and a very unusually large demand caused by the severe winter weather. The water routes were frozen up, and dealers and others who supposed they had laid in a full supply for the winter months, already found their stocks running low. Large shipments had to be made by rail, and prices consequently stiffened. An agreement which had been made in the previous month to work only three days in each week during the remainder of that month and January had to be abandoned for the third week in January to meet the requirements of consumers. During the month the stocks held by the companies were reduced 82,387 tons. In February there was trouble with the transportation companies on account of heavy snow storms, and the coal companies were consequently unable to move as much coal as there was a demand for. The retailers advanced their prices in New York 50 cents a ton and the companies made no effort to curtail production. The stocks were further reduced leaving the coal in the hands of the companies at the end of the month at only 395,286 tons or a little more than one-half a week's production. There was milder weather in March and prices were a shade lower at the opening of the month. On March 17, at a meeting of the presidents of the leading companies, it was resolved to work only three days a week during the following two weeks. As lower prices were expected, buyers held off or made only light purchases. The companies had been unexpectedly slow in coming to a mutual agreement to regulate trade, which had the effect of destroying confidence in the stability of the market. Soon after the meeting at which it was decided to reduce the output, the Pennsylvania Coal Company issued a circular making a reduction in its prices, and the other companies followed with a reduction ranging from 10 to 25 cents a ton. The shipments from the mines for the first three months of the year exceeded the shipments for the corresponding period of 1880 by 1,208,903 tons, and the stocks at the end of March were 563,063 tons. In April it was found that all the coal that the trade demanded could be produced by working only three days in each week, and a failure to observe this rule for the fourth week, had the effect of weakening the market. On April 15 the Western Association established prices 55 and 60 cents a ton lower than those which prevailed immediately preceding that time, but the schedule prices at the east remained unchanged. During three weeks of May, the companies worked only half time, and by June some of the companies were so well supplied with orders that they would not consent to more than six days. curtailment. The business for June was remarkably good for that season of the year, and the month closed with a scarcity of vessels and indications of higher prices for coal. For the first six months of the year the shipments were 12,467,496 tons against 10,312,120 tons for the corresponding six months of 1880, an increase of 2,155,376 tons while the stocks in the companies' hands at the end of the half year were 598,565 tons, a gain of 180,680 over the amount on hand at the beginning of the year.

The last stoppage for the year to control production was made in July (3 days), and at the end of the month the stocks amounted to 674,716 tons, but the demand in the following month far exceeded expectations, that from the West being greater than the companies could get transportation to meet. The total shipments amounted to 2,733,548 tons. In September there was some trouble on account of a scarcity of water and of labor at the mines. Transportation was also limited, there being a want of cars for the West and of vessels at the seaboard. The Delaware and Hudson Canal Company sold some coal which it called "off-color" at a concession and prices were somewhat irregular. The Western Association, however, advanced the price of egg, stove and chestnut sizes 25 cents a ton. Throughout October the demand was ahead of the supply and prices were well maintained. The want of cars to supply the western trade caused shipments to be made by the Erie Canal to Buffalo, and in some instances more than schedule rates were paid for certain sizes. November opened with current prices 15@25 cents a ton higher than circular rates (which were not changed) for stove and chestnut sizes, but the extra demand was supplied during the month, while during December the larger sizes accumulated with some of the companies, and prices were consequently weak. During this month vessels were in fair supply and freights reasonable. The mild weather which prevailed up to the close of the year, led to apprehensions that a stoppage of work at the mines in order to curtail. production would soon have to be resorted to again.

The year was in some respects the most remarkable in the history of the anthracite coal trade of the country. The total production for the year was 28,500,017 tons, an increase over 1880 of 5,062,775 tons, while the stock on hand at the close of the year was 497,024 tons, a slight reduction for the twelve months. The desperate determination among the managers of the companies to maintain prices at what they regarded as living rates, was never more conspicuous, and they were successful in burying all differences which would prevent the consummation of this end. At the same time the absence of any fluctations in prices or of uncertainty as to what would be the probable cost of fuel in the near future, gave general satisfaction to the public. Where formerly all was confusion and doubt and complaints were consequently abundant, no matter how low the prices might be, under the present system the coal trade has ceased to be a subject of daily interest to the public and the officers of companies and consumers alike appear happy.

The trade during the past six months—the first half of 1882—has been less satisfactory to the coal companies and coal dealers. The remarkably mild weather which prevailed throughout the winter, and the absence since then of an active demand until recently, have kept prices weak and the market dull. A reduction of 10 to 15 cents early in January did not immediately improve matters, but this accompanied by a stoppage at the mines for three days in the latter part of the month, had a tendency to stiffen quotations, but notwithstanding the companies kept the mines idle nine working days in February, prices fell below the schedule rates. The managers of the companies began to lose confidence in each other, and by the end of the month there was a manifest disposition among them to take what business they could get at the best figures obtainable. It is also to be remembered that February is always a poor month in the coal trade. It was evident that the stocks were not heavy in March, but the demand continued light with no improvement in prices until toward the end of the month when a slight improvement was noticeable. The total production for the first three months of the year amounted to 4,897,703 tons, against 5,565,210 tons for the corresponding period of the preceding year, a decrease of 667,507 tons.

During the latter part of March it was agreed that the companies would suspend work three days in the early part and three days near the last of April, but the market was extremely dull, closing heavy at a considerable reduction from the published rates, in prices actually obtained. The western demand sympathized with the eastern market in being dull and prices weak. There was a stoppage again of nine days in May, and by the end of the month a slight improvement in quotations was observable. The only suspension of work in June was for three days in the first week. The low stocks and apprehension that the trouble which had broken out in some other trades, might extend to the coal mines, led many persons to regard the time as a good one in which to increase their supplies and the demand very much improved. Prices were advanced 10 to 15 cents early in the month and the condition of the trade during the month gave evidence that another advance might be expected soon. Following is a comparative statement of the production of anthracite coal for the first six months of 1881 and 1882:

Tons of 2240 lbs.	1882. Year.	1881. Year.
Wyoming Region.		
D. & H. Canal Co	1,539,120	1,651,298
D. L. & W. R.R. Co.	2,014,921	1,960,377
Penna. coal Co.	581,205	585,883
L. V. R. C. Co.	512,000	542,830
P. & N. Y. R. R. Co.	95,184	39,449
C. R.R. of N. J.	1,093,045	1,107,664
Penna. Canal Co.	173,287	163,724
	6,008,762	6,052,225
Lehigh Region.		
L. V. R.R. Co.	2,171,322	2,041,830
C. R.R. of N. J.	996,574	942,405
S. H. & W. B. R.R.	20,000	1,224
	3,187,896	2,985,459
Schuylkill Region.		
P. & R. RR. Co.	2,922,568	3,054,759
Shamokin & Lykens Val	546,017	454,224
	3,468,585	3,508,983
Sullivan Region.		
St. Line & Sul. R.R. Co.	27,070	31,017
T tal	12,692,313	12,577,684
Increase	114,629	....

The above table does not include the amount of coal consumed and sold at the mines, which is about six per cent. of the whole production. The total production compares with the first six months of previous years as follows:

Years.	Tons.	Years.	Tons.
1877	9,915,120	1879	12,033,998
1878	7,212,665	1880	10,321,876

The annual report of the Department of Internal Affairs of the State of Pennsylvania gives the following information respecting the mining of anthracite coal in the State in 1881:

Total number of collieries	319
Average number of days worked during year	275.01
Total number employees	75,169
Total amount paid in wages during the year	$27,454,781.36
Total production of anthracite for 1881, tons	27,929,128.18
Average amount per ton paid in wages	$11,655
Average amount of coal produced per employee	373.14

A similar table for the bituminous fields shows the following:

Total number of collieries	382
Average number of days worked during the year	217.07
Total number of persons employed	35,530
Total amount paid in wages during the year	$14,540,057.50
Total production of bituminous coal for the year ended December 31, 1881, tons	15,692,923.12
Total number of coke ovens	6,640
Total production of coke for the year, tons	2,176,403.08
Average amount per ton paid in wages	$0.92.05
Average amount of coal produced to each employee	442.47

The Connellsville coke region furnishes a remarkable illustration of the development of an industry that was practically unknown only a few years ago. The manufacture of coke was begun just before the war and amounted at first to a car-load a week, and it gave but little promise of becoming an item of importance, until 1870. To-day there are at least four firms in the coke regions whose output is over 100 cars a day and one that equals 200 cars. The development since 1878 has been marvelous; at the beginning of that year there were about 3578 ovens, with a daily product of 4500 tons; the close of 1881 found a total of nearly 8000 ovens in the region, with a product of 11,000 tons a day, and it is reported that contracts are out or in progress that will raise the total to nearly 10,000 ovens. There seems to be a demand for all of this immense production. In the West not only has the output of blast furnaces, classified as coke furnaces, largely increased, both by an increased output at old furnaces and by the output of newly-built furnaces, but many of the furnaces that formerly used raw coal have either changed to coke entirely or are using a large percentage of coke by reason of the largely increased output it gives. The same is and has been increasingly true of anthracite furnaces; there is hardly an anthracite furnace that can procure it that does not use some coke. It is becoming true of charcoal furnaces and bloomaries. It is a fact, not generally known, that charcoal pig and charcoal blooms are made with, in many cases, a large percentage of coke as fuel. Coke is also entering more largely into consumption for domestic purposes.

The production of the Connellsville region the past year was considerably below its capacity, and it seriously inconvenienced furnaces. This arose, not from a lack of demand, but from the impossibility of securing cars for transporting the coke. Usually no coke is stored in the region; the ovens are discharged upon the "wharf" or platform at the mouth of the ovens, and the coke is loaded immediately upon cars. During the past year, in some cases, large piles of coke were stored waiting for transportation, but in this case but little coke can be stocked, owing to its bulk and the yards, not being prepared for storing, being too small. Regarding the production of coke in Western Pennsylvania no reliable statistics have yet been published, and but few figures of any kind. The railroads that convey most of the coke are chary about giving any statistics of the amount transported, which would include nearly all made. Estimates can be made with some degree of accuracy based on the number of ovens and the output. These estimates make the amount produced in 1880 about 2,500,000 tons and in 1881, 3,000,000. The prices were remarkably steady last year, being in this respect like 1879 rather than 1880. In 1879, the prices to furnaces did not vary more than 15 cents @ 25 cents a ton the whole year. In 1880 the price fluctuated between $1.50 and $5 a ton. Opening with $1.50, it advanced to $4 @ $5 in March and April and fell to $1.50 @ $1.75 at the close of the year. In 1881, the price to furnaces on yearly contracts was $1.50 @ $1.65 on cars at ovens. For foundry purposes and occasional orders the price was $1.75 @ $2. The price to furnaces for 1882 was fixed at $1.65 @ $1.85.

In the bituminous regions the number of days worked in the year is much less than in the anthracite regions. One reason of this is, probably, that the demand supplied from the bituminous regions is more local than that from the anthracite districts. The number of days' work in a large section of the West Pennsylvania bituminous field depends upon the state of water in the Ohio River, which was not favorable to shipments, and consequently to mining, last year. The greater ease of mining bituminous coal has made the output per man much greater than in the anthracite region.

Mr. John H. Jones, accountant, of Philadelphia, has compiled some interesting statements, principally from official sources, showing the distribution of anthracite coal in 1881, as follows:

Competitive—Including tonnage passing out of Capes of Delaware, to New York Harbor; to points on Hudson River, Long Island Sound, and Atlantic Coast, North of Port Judith	12,169,030
Western—Including tonnage to United States points west of Buffalo and the Detroit River, Erie, Pittsburg, and Baltimore	2,079,134
Canadian—Including all tonnage by lake and rail to points in Dominion of Canada	694,428
Southern—Estimated tonnage to all points in Delaware, Maryland and the territory bounded by the Ohio and Mississippi River on the north and west and the Gulf of Mexico on the South	800,000
Pacific Coast—	15,000
Local—Embracing all coal consumed in Pennsylvania, New York, and New Jersey	12,742,424
Total production in 1881	28,500,016

The shipments to Western United States points were as follows:

By lake from Buffalo	839,465	
rail " " and the Bridges	616,044	
lake " Erie	85,030	
rail " "	166,258	
" " Pittsburg, Baltimore, Salamanca, Dunkirk, etc	309,191	
From Lake Ontario ports through the Welland Canal	63,146	—2,079,134

A review of the Copper Market for the eighteen months ending June 30, 1882.—The *Encyclopedia Britannica* for 1879 gives the maximum production of metallic copper throughout the world at 130,000 tons, and Professor Davies, for the same year, makes the following distribution of the output:

	Tons.
Japan metallic copper	3,000
Russia "	6,500
Spain "	6,000
France "	2,000
Austria "	3,000
German Empire "	2,000
Norway & Sweden "	2,000
Cuba and West Indies, about	2,500
Chili, about	39,000
Australia, about	5,000
United States, about	25,000
Leaving for England and all other countries	34,000
Total	130,000

The following table shows the product (refined copper) of the Lake Superior copper mines for each year since 1854, together with the average value:

Year.	Tons.	Lbs.	Value.
1854 and previous	6,992	1,727	$4,146,400
1855	2,904	1,334	1,586,160
1856	4,108	1,392	2,218,320
1857	4,765	830	2,382,500
1858	4,579	1,916	2,129,235
1859	4,463	1,995	2,239,591
1860	6,034	375	2,654,960
1861	7,519	837	3,487,995
1862	6,793	328	3,634,255
1863	6,492	1,344	4,415,600
1864	6,245	1,965	5,870,300
1865	7,197	583	5,635,515
1866	6,875	63	4,629,375
1867	8,763	1,607	4 442,841
1868	10,467	124	4,940,424
1869	13,312	1,300	9,230,016
1870	12,311	849	5,096,752
1871	12,873	349	5,728,485
1872	12.276	1,523	7,979,400
1873	15,045	1,505	8,726,100
1874	17,168	1,389	8,009,356
1875	18,019	1,497	8,180.626
1876	19,135	997	7,998,430
1877	19,513	671	7,327,888
1878	20,845	1,266	6,920,540
1879	21,425	1,529	7,327,350
1880	24,869	367	9,947,673
1881	20,274	1,708	9,955,321
Total	328,328	1,370	$152,571,458

The yield of the Lake Superior copper mines in 1881 was distributed as follows:

Name of mine.	Net tons.	Lbs.	Name of mine.	Net tons.	Lbs.
Adventure	3	1,600	Huron	127	615
Allouez	736	1,007	Isle Royal	23	1,308
Arcadian	1	267	Madison	....	1,534
Ash Bed	6	1,984	Mass	233	1,684
Atlantic	6,264	9	Minnesota	12	227
Aztec	4	784	Minong	7	1,397
Calumet & Hecla	15,580	781	Nonesuch	69	1,397
Central	709	465	Ogima	8	775
Cliff	39	1,382	Osceola	22,089	1,976
Concord	14	849	Pewabic	938	244
Conglomerate	193	91	Phœnix	200	1,357
Copper Falls	334	1,121	Quincy	2,753	848
Evergreen Bluff	....	968	Ridge	117	1,606
Flint Steel River	2	1,400	Sheldon Columbian	6	31
Franklin	1,338	1,932	Star	....	758
Grand Portage	13	264	St. Clair	62	1,493
Hancock	285	1,897			
			Total	37,274	1,708

The special features of the copper market during the past 18 months have been the absence of speculative influences upon prices, the development of mines in Arizona, New Mexico, Colorado, and other portions of the far west to an extent sufficient to affect materially the total output, and the increased consumption, which promises to assume large proportions in the near future, for electrical purposes. The continued troubles between Chili and Peru prevented Europe from obtaining a full supply from that source last year, and in this country the excess of exports over imports amounted to about £7,000,000 against an excess of imports in 1880. The Chilian product was only 38,000 tons against an average of 45,239 tons for the preceding twenty years, and 54,867 tons for the exceptional year 1869. The domestic product during the past two years has been as follows, approximate figures being given for 1881:

	1880.	1881.
	Pounds.	Pounds.
Michigan	45,830,262	53,000,000
Maine	83,080	100,000
Maryland	164 640	100,000
Missouri	230,717	100,000
North Carolina	1,640,000	1,000,000
Pennsylvania	476,508	500,000
Vermont	2,647,894	2,500,000
Wisconsin	18,087	50,000
Colorado, Arizona, Idaho and California and other western territories,	5,764,460	12,750,000
Total	56,855,640	71,200,000

Of the quantity given above, Arizona produced alone last year 8,000,000, and Colorado 1,750,000 pounds.

The year 1881 opened with a quiet market, which, however, was firm at $19\frac{1}{8}$ cts. for Lake Superior. In London Chili Bars were £62 and Best Selected £67. During January the price rose to $19\frac{1}{2}$ cts. and the market continued dull at steady quotations until March when the quotation fell to $19\frac{1}{8}$. The sales at New York in January were only about 750,000 pounds; in February 500,000, and in March 1,000,000 pounds. In April the market became still duller, the sales not exceeding 500,000 pounds at $18\frac{3}{4}$ to $18\frac{7}{8}$. The principal Lake Superior companies came to the relief of the situation by large export sales amounting to about 3,000 tons, the London market meanwhile having declined to £59 for Chili Bars and £66 for Best Selected. The approach of the season when a fresh supply from the Lake region would be thrown upon the market, accompanied by reports of the wonderful production of the copper mines in the west and south-west prevented purchases for anything more than the amount required to supply immediate wants, and the May sales were again limited to 1,000,000 pounds. Confidence in the richness of the western mines, both in quantity and in high grade ores, and the fact that some large contracts had been made for supplying the metal from that region, led to a quick and decided decline in June. During the latter part of May the quotation in New York for Lake Superior copper was 19 to $18\frac{3}{4}$ cts.; on June 3 it sold at $18\frac{1}{4}$, on June 10 at 18 cts., on June 17 at 17 cents, and a week later at $16\frac{1}{2}$ cts. The sales for this month were about 1,200,000 pounds; but early in July a number of manufacturers, including the leading consumers of copper, purchased fully 20,000,000 pounds, deliverable throughout the rest of the year at 16 cts., an extremely low figure. Later in the month some small sales were made amounting in the aggregate to 200,000 at $16\frac{1}{4}$ to $16\frac{1}{2}$ cts. Meanwhile Chili Bars having fallen in the latter part of June in London to £58, it was shown that the charters on the west coast (of South America) for the year ending June 30 had only 35,250 tons against 48,350 tons during the preceding twelve months, and this was followed by a recovery of prices in London to £59 10s. An active market was not to be expected after the heavy transactions above referred to, but prices stiffened somewhat, closing at the end of August at $16\frac{3}{4}$ with sales for the month not exceeding 500,000 pounds.

From this time forward there was a radical change in the condition of the market, prices steadily but persistently advancing upon what under the circumstances was an unprecedented demand from consumers, and on account of rising quotations in London. The transactions in September reached 1,500,000 pounds, and the price $18\frac{5}{8}$ cts. The supply in first hands had been well taken up, and there was therefore no urgency on the part of producers to sell; as a result the market remained steady until the latter part of November, with only slight fluctuations from the quotations last given. The October sales were 1,000,000 pounds. But the total sales during the first nine months of the year included 6,685,788 pounds for export against only 312,371 pounds during the corresponding period of the preceding year, and in November a speculative movement in London carried Chili Bars to £66 10s., the quotation being £63 10s. in October. In the New York market the price advanced to $19\frac{1}{2}$ with sales for the month of 1,200,000, and during December further decided advances were made on sales of about 1,000,000 pounds on the spot and 4,500,000 to be delivered in January and February. The closing quotation was 21 cts., at which considerable business was done, and which is the highest price at which the metal has sold in the past eighteen months. Meanwhile the London market advanced to £70 10s. for Chili Bars and £76 for Best Selected. The predicted production of the territory west of the Mississippi river for 1882 of twenty to twenty-five millions pounds was offset by the wonderful increase in consumption which promised to continue.

Notwithstanding the very bad management of some of the leading gold and silver mining properties introduced within the past three years to eastern capitalists, and the unwise investments in other cases, eastern men have not been discouraged easily, the best evidence of which is to be found in the avidity with which they still seize upon any mining enterprise that can show a fair prospect of making returns for the investment asked. The promoters of some of the copper mining companies have met with flattering success in placing their properties on the New York and other eastern markets during the past year or two. Probably never before in the history of the country has the copper market attracted as much attention as during the past six months. The new elements that have begun to affect the market are also of such an uncertain quantity that experienced dealers are much at sea as to the future. While the domestic consumption last year was about 64,000,000 pounds, it was estimated until recently that the American product for 1882 would not fall much, if any, short of 90,000,000 pounds, and it would require a heavy increase in the amount of the home consumption as well as a heavy falling off of Chilian shipments to England and other parts of Europe, to take care of this excess of products; otherwise a break in prices was inevitable. During the month of June the price declined, it is true, from 21 cts., at which it closed last year, to 20 cts., and this on light sales. At the same time Chili Bars had fallen in London to £66 10s. and Best Selected to £73 10s. With a dull market and lighter sales this decline continued slowly until April when the quotation for spot copper was 17⅞ to 18 cts., and about the middle of the month fully 6,000,000 pounds were sold to brass manufactnrers, to be delivered during the next four months at 18 cts. The London quotation for Chili Bars was then £65, and for Best Selected £70 10s. In May spot copper was a shade firmer, prices ranging between 18 and 18¾ cts.; during the latter part of the month over 1,200 tons were sold for export, principally on French account, at 16 cts. It became apparent about this time, however, that both the United States and Chilian supplies would fall considerably short of the early estimates. The panic in some of the mining districts of Arizona, from which region a much larger supply than for 1881 was expected, owing to the Indian depredations, has caused some of the miners to desert the camps. The English production from domestic ores declined from 14,823 tons in 1862 to 3,500 tons in 1881.

The falling off in Chili and England within the last few years has been compensated for in part by the Rio Tinto mines in Spain, which Bremen and London capitalists purchased some six years ago when the Spanish Government was in financial distress. Since then, French capitalists have likewise become interested there, and Rio Tinto has become a great producer by turning out something like 10,000 tons of metallic copper per annum. Besides the Rio Tinto mines, there is the Tharsis Copper Co., of Spain. Australia and the Cape, as well as Japan and minor producers, contribute about the same amount as for years past. These have not been sufficient, however, to compensate for the decline in the Chilian and English products and the increased consumption abroad, so that the foreign demand for our copper may be expected to continue and the increased consumption in America is enormous. According to the English Board of Trade returns the total imports and exports into and from that country for the first five months of the following years were:

Imports.

	1889.	1881.	1882.
	Tons.	*Tons.*	*Tons.*
Copper in ores	5,156	3,953	4,204
Copper regulus and precipitate	11,222	11,556	11,017
Bars, cake and ingots	16,609	10,992	14,034
In pyrites, estimated	7,682	5,803	6,938
Total	40,689	32,334	36,193

Exports.

English copper—wrought and unwrought	11,895	13,287	10,788
Foreign copper—unwrought	6,606	4,575	4,813
Yellow metal	8,158	6,170	7,644
Total	24,659	24,032	23,246

According to advices from Valparaiso, the comparative exports of fine Copper from Chili and Bolivia to all parts of the world during the first three months of the following years were:

1882.	1881.	1880.	1879.	1878.	1877.
10,764	8,200	11,898	12,422	11,909	12,699

The increase this year will be noticed. The old Cobre Mining Co., of Santiago de Cuba, previous to the Cuban rebellion a most productive English Copper mining enterprise on the East Coast of Cuba, has been taken in hand again by its owners.

The market was dull throughout the month of June, but prices at New York were firm at 18¼ @ 18 @ 18⅛. In London at the close of the month, Chili Bars were quoted at £67 5s. and Best Selected nominally at £74 10s.

The following table shows the value of ingot copper at New York in currency (cents per pound) for the years indicated:

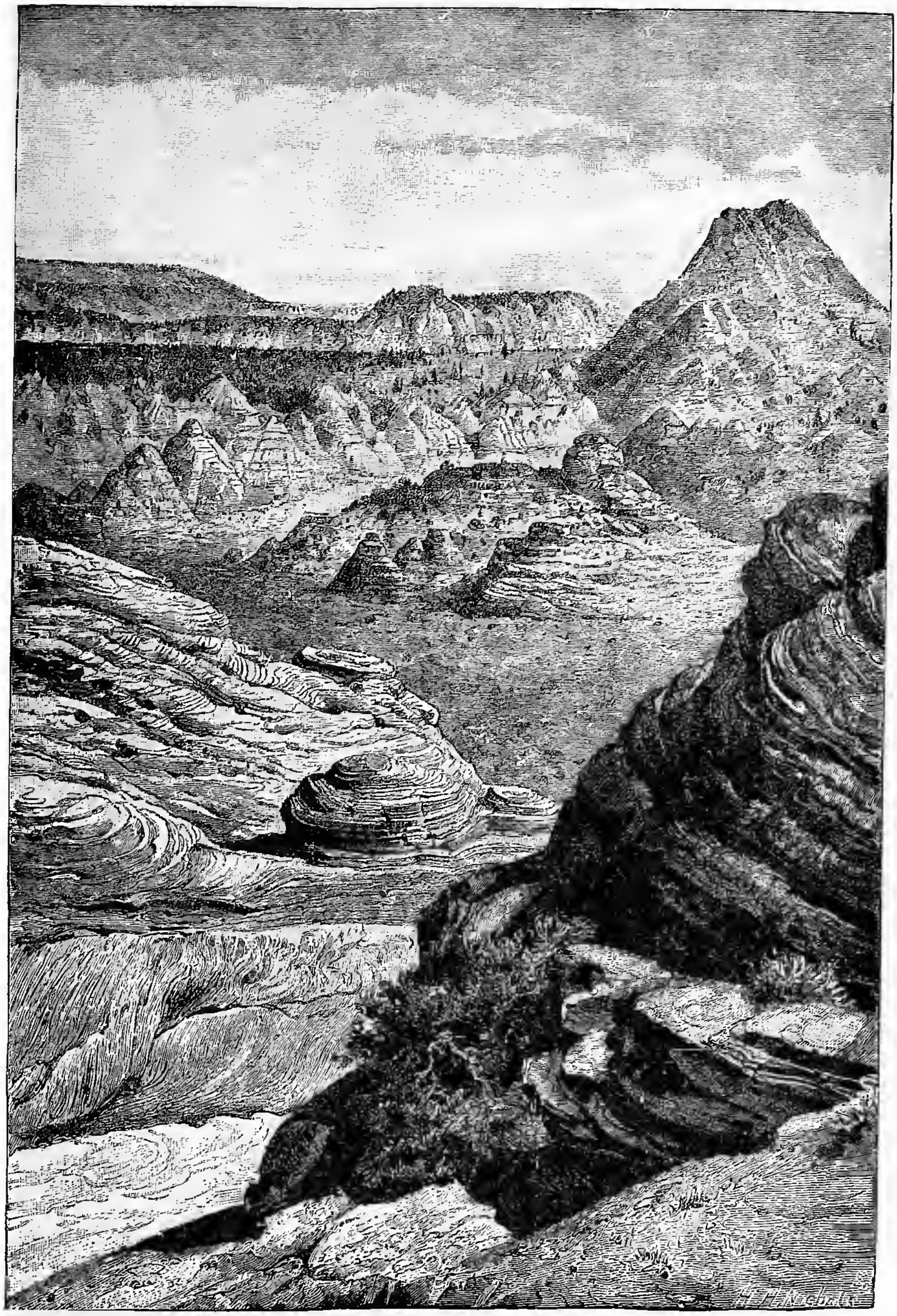
	1874.	1875.	1876.	1877.	1878.	1879.
January	26	23¼	23	19⅝	17½	15¾
February	25	22	22¾	19	17¼	15½
March	24½	21½	22½	19⅜	17⅛	15¾
April	25	22½	22¾	18⅜	17	16
May	25	23	20	19¼	16¾	16⅛
June	24¾	23	20¾	19¼	16⅜	16¼
July	24	23½	20¼	19⅛	16¼	16⅛
August	21	23½	19½	18	16⅛	16¼
September	21¼	23¼	20⅜	18	16⅛	17¼
October	22¼	23½	21	17¾	16	21
November	23¼	23½	20¾	17¾	15¾	21½
December	23¼	25¼	20	17⅝	15⅞	21½

And the following table gives the lowest and highest prices for Lake Superior copper at New York, in cents per pound for the period mentioned:

	1880.	1881.	1882.
January	21 @ 25	19 @ 19½	19¾ @ 20½
February	24 @ 24½	19⅜ @ 19½	19 @ 20
March	22¼ @ 23⅞	19 @ 19⅜	19 @ 19½
April	21 @ 22¼	18½ @ 19	17⅞ @ 19
May	17¾ @ 20½	18½ @ 19	18 @ 18½
June	18 @ 18¾	16⅜ @ 18¼	18 @ 18¼
July	18½ @ 18¾	16 @ 16½	
August	19 @ 19½	16½ @ 17	
September	18⅝ @ 18¾	17 @ 18⅝	
October	18¾ @ 18⅙	18 @ 18¼	
November	18¾ @ 18⅞	18¼ @ 19½	
December	18⅞ @ 19	19¼ @ 21	

REVIEW OF THE TIN MARKET FOR THE EIGHTEEN MONTHS ENDING JUNE 1882.

DURING the past year there has been a very active speculation in the London tin market, a fact which has attracted all the more attention because it did not belong to a class of merchandise which one would expect to be selected for speculative purposes. For this very reason, however (that it had become a speculative commodity abroad) it has attracted less than the usual amount of attention in this country. The year 1881 opened at New York with a visible supply of 5,000 tons at 19 cents for Straits. In London the price stood at £93. The product of the world has increased 75 per cent. during the past eight years, this enormous increase being due principally to the steadily increasing output in Australia proper and Tasmania. In 1872 the Australian product began with 150 tons, but it rose at once in 1873 to 2,990 tons; in 1874 it was 5,800 tons; in 1878, 9,500 tons; in 1879, 8,458 tons; in 1880, 9,149 tons and in 1881, 10,084 tons. The increase in the Australian output has come principally from the island of Tasmania or Van Dieman's Land, which lies to the south of Australia and forms one of its colonies, and which has developed its tin mines with great energy and corresponding success; it is, in fact, becoming almost as important as the main land. A very large increase in consumption in this country saved the market from a heavy decline, on account of the steady increase in the world's product, until it was taken in hand by the speculators. The imports of tin into the United States in 1880 amounted to 13,346 tons, worth $6,120,316 against 10,186 tons in 1879, worth $3,605,614. From the Straits alone the shipments to the United States



WESTERN SCENERY—A MIDSUMMERDAY'S DREAM—JURASSIC—ON THE COLOB. GRAND CAÑON DISTRICT.

SEE PART X.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

were 8,650 tons in 1880; 7,300 tons in 1879: 4,140 tons in 1878, and 4,204 tons in 1877. During the early part of the year the shipments from the Straits were light to the United States and correspondingly heavy to England and Holland; consequently the price rose here to 20 @ 20¼ cents, and declined in London to £88. By the close of April the visible supply here was reduced to 1,400 tons, while the price was steady throughout March and April at 20 and 20½ cents. In London on May 1, 1881, Straits tin was worth £87 10s. against £82 for the corresponding period of the preceding year, £68 10s. on May 1, 1879, and £61 in 1878. An unexpected dullness and corresponding weakness was developed in May, and in some instances resales were made here by discouraged holders, thus forcing prices still lower. The quotation went as low as 19⅝ cents and in London, £86 10s. The result was a speculative movement begun in June, which has not yet culminated, although the highest prices were reached some time ago. The visible supply was increased by July 1, in New York to 3,480 tons, and the price had advanced to 20⅝, and in London to £89 10s. In July little was done, but in August, owing to the light shipments to the United States for the first six months of the year, the price rose to 21¼ cents; in London it also advanced to £92. The speculative movement showed more strength in London during September, and the price was pushed up to £96; there was also a gain here of ½ cent to 21¾ cents. By November 1, the visible supply here again reached 5,000 tons, and it became necessary in the interest of speculators to send a portion of this supply to Europe. At the same time the price was advanced in London and Holland by the purchase of some large lots, bought to be held from the market for a time. The speculation was a complete success, so far as obtaining control of the market and running up prices were concerned, notwithstanding it was carried on at a time of the year that the heaviest shipments are made from Australia. In November Straits tin advanced in New York to 22 cents, and in London, after some fluctuations, to £107 10s. There was a virtual cessation of shipments from the Straits this way in November and December, by which through a concerted movement between London and New York, an artificial famine was created, thus giving to the speculation its strongest support. Prices advanced here during Dec. to 24½ cents and in London to £108 10s. @ £110 10s. for spot and futures.

The following table shows the product of the world for several years past:

	1881.	1880.	1879.	1878.
	Tons.	*Tons.*	*Tons.*	*Tons.*
England	8,620	8,907	9,500	10,106
Banca	4,385	3,638	4,253	3,960
Billiton	4,000	4,000	3,259	3,417
Straits	11,324	11,000	11,369	8,350
Australia	10,084	9,149	8,458	9,514
Bolivia	300	200	300	250
	38,123	36,994	37.539	35,597

Consumption last year is estimated to have been 32,000 tons in Europe and 9,000 tons in this country. The total visible supply in Europe and America on January 1, 1882, was 18,736 tons, against 20,938 tons at the beginning of the preceding year and 23,500 tons on January 1, 1880. In Europe one of the greatest items of consumption is the manufacture of tin plates, and the strongest argument in favor of higher prices is the increase of Welsh tin plate exports from 118,800 tons in 1872 to 242,400 tons in 1881. The world's consumption of tin plate is dependent, however, to a considerable extent upon the cheapness of the article, and the unnatural advance in tin that has taken place during the past year must have a very decided effect upon the demand.

There was no halt in prices in January of the current year when sales were made as high as 25½ cents here for spot, with no transactions in futures at the highest figures, while in London the price rose to £114 5s. for spot and £115 15s. for future delivery, an extensive business being done in the latter place; the market was, however, feverish and wide fluctuations were frequent. Quotations remained steady here at 25 @ 25½ cents until the latter part of February, when, in sympathy with the London market where most of the speculative trading was done, the price declined about ½ cent, and continued dull at this decline throughout the greater part of March. As compared with former years the price of Straits tin at the beginning of March was as follows in this market: 1882, 25 @ 25½ cents; 1881, 19¾ cents; 1880, 22¼; 1879, 15⅛, and 1878, 14¾. After a dull market these figures were succeeded by a heavy decline about the middle of April. In a single day, April 14, London prices fell from £106 to £96, and by April 19 the quotations were down to £91 and back to £94. Several failures occurred and the market became very unsettled. There was very little business done here, and quotations could be considered only nominal at about 22½ @ 23 cents. By the middle of May, with a dull market, prices were down to 22 @ 22¼ cents, and on June 1, to 21½ @ 21¾ cents. A little better feeling has prevailed here during the latter part of June and, partly owing to the threatened closing of the Suez Canal, a decided improvement in prices has taken place, sales being made as high as 22½ cents, but the general dullness in all kinds of metals has prevented a realization of the full effect of the Eastern troubles. The imports of tin into the United States for the ten months ending April 30, were 7,879 tons against 7,304 tons for the corresponding period last year.

The following table indicates the prices in New York for the period indicated:

Straits Tin.

Sept. '78	13⅛c @ 13½c	May, '80	16 c @ 18 c
Oct. '78	13⅛c @ 15½c	June, '80	15¼c @ 18¾c
Nov. '78	15¼c @ 17 c	July, '80	18⅜c @ 20¾c
Dec. '78	15 c @ 16 c	Aug. '80	20⅝c @ 21⅛c
Jan. '79	14 c @ 14½c	Sept. '80	19⅞c @ 20¾c
Feb. '79	14¾c @ 15 c	Oct. '80	19¾c @ 20 c
Mar. '79	14¾c @ 15½c	Nov. '80	20⅜c @ 21¼c
April, '79	14½c @ 15 c	Dec. '80	19¼c @ 20½c
May, '79	14⅛c @ 14½c	Jan. '81	19½c @ 20½c
June, 79	14½c @ 15⅜c	Feb. '81	19½c @ 20¼c
July, '79	14½c @ 14⅞c	Mar. '81	19¾c @ 20 c
Aug. '79	14⅝c @ 16 c	April, '81	20 c @ 20½c
Sept. '79	15¾c @ 17½c	May, '81	19⅔c @ 20⅛c
Oct. '79	18¼c @ 25 c	June, '81	19½c @ 20¾c
Nov. '79	22 c @ 24 c	July, '81	20⅜c @ 20⅔c
Dec. '79	20 c @ 22 c	Aug. '81	20¾c @ 21¾c
Jan. '80	21 c @ 25 c	Sept. '81	21 c @ 21¾c
Feb. '80	23¼c @ 24¾c	Oct. '81	21⅜c @ 22 c
Mar. '80	21¼c @ 22⅜c	Nov. '81	20¾c @ 22 c
April, '80	18¼c @ 21¼c	Dec. '81	22¼c @ 24½c

For the past six months the prices have been as follows:

Jan. '82	24½ @ 25½	April, '82	21½ @ 24¾
Feb. '82	24¾ @ 25½	May, '82	21½ @ 22¼
March, '82	24¾ @ 25¼	June, '82	21½ @ 21¾

Prices of Banca tin in Holland since 1873, in guilders, per 50 kegs, have been as follows:

	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
January 1	70	57¼	50	45	40¾	38½	54¾	55¼
February 1	70	56¼	50½	43½	40	36¾	58¼	54
March 1	62	54	50¼	43¼	40½	40	55½	53
April 1	53	51½	50	42¾	40	43	52¼	53¼
May 1	57	50¾	49	42½	39½	40¼	50¼	52¼
June 1	58½	50	45½	42½	39½	39½	43½	52
July 1	60	50¾	46¼	42½	39¼	39	49	54½
August 1	56½	48¼	44	41⅝	39½	38½	56	55
September 1	57	51	43	40½	37¾	41¼	54½	55¼
October 1	56½	52¾	42½	40¾	35¾	45	52	58½
November 1	58	52¼	44½	43	37¾	57	54½	59¼
December 1	58½	51	44¾	41⅔	39	56	56½	64

The following tables will be found interesting as illustrating the enormous increase in the consumption of tin plate in this country for several years past. The Board of Trade returns of the United Kingdom show the following general export of the article:

Years.	*Tons.*	*Years.*	*Tons.*	*Years.*	*Tons.*
1867	79,000	1872	118,900	1877	153,100
1868	88,400	1873	120,600	1878	156,100
1869	96,700	1874	123,000	1879	197,800
1870	99,900	1875	138,000	1880	217,700
1871	119,600	1876	132,400	1881	242,400
	483,600		632,500		966,100

There was, as is here shown, an increase of 31 per cent. from 1871 to 1876 in the exports from the producing country, and of 52 per cent. from 1876 to 1881. The imports into this country have increased even more rapidly, as indicated by the following figures:

Net Import of Tin in the United States.

Calendar Year.	Tons.	Value.
1876	89,617	$9,376,956
1877	111,907	10,624,575
1878	107,055	9,001,454
1879	154,054	13,208,980
1880	157,554	16,428,558
1881	182,517	14,838,246
1882	65,997	6,138,551

The importations have thus doubled within the past five years. But notwithstanding this great increase in the American consumption, the price of coke tin has fallen to about one-half of what it was before the panic as shown by the following table giving the price of coke tin in Liverpool on January 1, 1873—1882 inclusive:

	£ s d		£ s d
1873	1 14 0	1878	0 18 0
1874	1 9 0	1879	0 16 0
1875	1 9 0	1880	1 7 0
1876	1 2 6	1881	0 16 0
1877	1 0 0	1882	0 17 3

This decline was due on the one hand to cheaper raw material, and on the other to the fact that the output was all along in excess of the demand, notwithstanding the rapid increase of consumption.

REVIEW OF THE LEAD MARKET FOR THE EIGHTEEN MONTHS ENDING, JUNE 30, 1882.

THE production of lead during 1881 was remarkably heavy, the total output amounting fully to 440,000 tons, of which the United States contributed 111,000 tons and of which fully two-thirds were desilverized metal. Some of the western cities have very rapidly become prominent as lead markets, at the head of which stand St. Louis and Chicago. A number of desilverizing works were erected during the year at various points, and there is a growing tendency to arrest the flow of bullion from the Rocky Mountains to the east, not only to supply the local demand, but also to compete with eastern refiners. The market opened in New York quiet and weak, early in January, Common Domestic selling at $4. 30. This very low price, however, attracted the attention of manufacturers, and some good sales were made before the month closed at $4. 75 @ $5.00. There were also 700 tons refined disposed of at $5. 25. From San Francisco there had been shipped by sea in 1880 altogether 9276 tons, of which 9190 came to New York; the previous year the total shipments had been 6413 tons, of which 6162 were for New York. The import of lead into England had been 96,000 tons in 1880, against 102,100 in 1879, and 100,233 in 1878, while there had been exported 33,000 tons, against 37,007 and 34,385. England's production from native mines was 60,000 in 1880, against 51,635 in 1879; 58,020 in 1878; 61,403 in 1877, and 58,667 in 1876. In 1871 it had been 69,037 tons. The import of Pig Lead into the United States in 1880 was 2884 tons, against 1633 in 1879. The export of Pig Lead from Spain in 1880 was 92,400 tons, against 100,336 tons the previous year.

In February prices were barely steady, but by March the long winter began to tell upon the spring trade and before the month closed quotations had drooped to $4.62½. The succeeding month gave no better assurances of an increased demand from consumers, although the reported sales amounted to about 4,000 tons for spot and futures, while the price declined further to $4. 50. The decline was assisted by some leading operators, who sought to break the market in order to buy up stock at low figures. At St. Louis the price fell to $4. 12½. There was an earnest effort made by large holders in May to rally prices, which were pushed up to $4. 62½, only to react again, however, in the absence of a consumptive demand, and the market closed flat at $4. 25. Owing to some heavy purchases by Russia (20,000 tons) a better feeling was created in London, and common English pig advanced to £14 10s. @ £14 15s. Nevertheless reports of a large yield in the west held the American market down, St. Louis declining as low as $4. 05. The New York market was quiet. June was, however, more active and sales of 4,000 tons were made at $4. 25 @ $4. 37½. In July the quotation touched $5.00 in New York and $4. 30 in St. Louis, the building demand for lead during that month and August being very active, and there was also a brisk movement in shot. Estimates were published during the summer showing that the probable consumption in the United States for the year would not fall much short of 120,000 tons. The visible supply was rather light, the price rose to $5. 37½, and a few imports were made from Europe. But notwithstanding the available supply of lead continued light, the price fell in October to $5.00, large consumers depending on the supply on hand and the arrival of some shipments from California. The mild weather of November and December favored consumption which proved equal to the earlier prognostications, and the supply consequently remained light, but the purchases were not heavy. In November the range of prices was $4. 87½ @ $5. 25, while during the last month common became so scarce that it was dearer than refined, selling at $5.00 @ $5. 25, with a few transactions as high as $5. 37½.

The winter of 1881–2 continued remarkably mild, and there was therefore little check to consumption, which gave unusual strength to prices at that season of the year. From January 1 to March 4 quotations did not fall below $5.05, and they ranged between those figures and $5.25. The market was extremely dull during March, and sales were made as low as $4.90, and at $4.85 just at the close of the month. This weather continued, and common lead has since sold as low as $4.60, but most of the transactions have been at $4.85 to $5.00, except during the latter part of May and early in June, when it touched the low price here quoted. The further decline that was then threatened was checked by the burning of the Grant Smelting Works at Leadville, which was not as disastrous to the trade as was at first imagined, but was sufficient to arrest the decline. The market in the meantime has been dull, sales being confined principally to jobbbers.

The average price of common domestic lead at New York, in cents per pound for the periods indicated, has been as follows:

	1877.	1878.	1879.	1880.	1881.
January	6¼	4⅛	4¼	6	5⅞
February	6⅜	3⅝	4⅝	6	4⅞
March	6⅝	3¾	4	5½	4⅞
April	6½	3¾	3	5⅜	4
May	5¾	3½	3	4¾	4⅝
June	5⅜	3⅛	3⅝	4⅝	4⅜
July	5⅜	3½	4	4½	5
August	5	3⅝	4⅛	4¾	5
September	4¾	3⅝	4	4⅞	5¼
October	4⅜	3½	5¼	4⅝	5⅛
November	4¾	3⅞	5⅛	5¼	5⅛
December	4½	4	5¾	5⅜	5¼

The quotations for the first six months of the current year are as follows:

1882.		1882.	
January	$5.05 @ $5.25	April	$4.85 @ $5.12½
February	5.12½ @ 5.20	May	4.60 @ 4.90
March	4.85 @ 5 15	June	4.60 @ 4.85

REVIEW OF THE SPELTER MARKET FOR THE EIGHTEEN MONTHS ENDING JUNE 30, 1882.

THE year opened with a fair demand for spelter in this country and an effort in Europe to force prices higher; the result was that Common Domestic advanced in New York during January from 5 cts. to 5½ cents., while Silesian was steady at 5¾ cts. The expected demand from India did not come, however, to the relief of the London market, and prices began to droop in February both here and abroad, accompanied by light orders. No relief whatever came until in April, when news was received from the West that production had diminished there somewhat, and a little better feeling prevailed for a short time. But this was succeeded by extreme dullness both here and in Europe, and by the end of May the price had declined to 4¾ to 5 cts. Production in Germany was shown to have been 100,000 tons in 1880 against 97,000 tons in 1879. The imports of Calamine from Spain into England had been 32,491 tons in 1880 against 27,631 tons in 1879. The condition of the English market is easily shown by the statement that the London quotation on May 1, 1881, was £15 7s. 6d. against £19 15s. at the corresponding period of the preceding year; £14 15s. on May 1, 1879; £18 on May 1, 1878; £20 5s. May 1, 1877, and £24 on May 1, 1876. It finally became apparent by July that the use of galvanized goods was greater than had been generally estimated, and a somewhat better feeling followed on both sides of the Atlantic, while the subject of forming a syndicate to control the market was again revived. The price rose here to 5 to 5⅛ cts., but with this advance dullness again ensued. Thereafter the market continued barely steady at 5⅛ to 5¼ cts. for Domestic and 5⅜ to 5½ cts. for Silesian, until October, when a decided improvement set in caused by the increased demand for galvanized goods and by greater activity in the rolled metal. A good demand came from consumers who laid in their supplies without the aid of the proposed syndicate. The European stock was low, and with the approach of winter only a light supply was to be expected from the Silesian mountains; the result was a better feeling in the European market as well as in American. Meanwhile the price advanced in New York to 5¾ cents. During November there was a further advance to 5⅞ cents., and the volume of business was restricted only by the supply. London also gained £1 to £17 12s. 6d. Sheet zinc had gradually risen during the year from 7 cts. to 8 cts. In December the market was steady at 5⅞ to 6 cts. for Common Domestic and Silesian, while Sheet zinc sold at one time as high as 8½ cts., but declined again to 8 to 8¼ cts., on receipt of a supply from Europe. The London quotation for Spelter advanced to £18 10s.

England's production of Zinc Ore in 1881 was 27,548 tons, from which 7,162 tons of metallic Zinc were made. Besides this, 43,177 tons of ore were imported, Italy sending 11,028 tons; Greece, 11,485, and Algeria, 17,578 tons, the remainder probably coming from the North of Spain. The import of crude Spelter was 33,301 tons, 13,480 coming from Germany, 7,993 tons from Holland in transit, and 9,402 tons from Belgium. There were also 16,677 tons of manufactures received, Germany contributing 3,797 tons; Holland, in transit, 6,675, and Belgium, 5,907 tons. The export of Spelter and manufactures was 12,237 tons, of which British India took 7,640 tons. Estimating the yield of slab metal from foreign imported ore at the same figure as the domestic British, there was a production of 11,225 tons of metallic Zinc, and adding the import of Spelter and its manufactures, the total quantity obtained from abroad was 92,203 tons, of which 12,237 tons were re-exported. The exports of Calamine from Spain have been as follows:

1880.		1879.		1878.	
Tons.	*Value in francs.*	*Tons.*	*Value in francs.*	*Tons.*	*Value in francs.*
32,491	1786,995	27,613	1,507,781	33,532	2,011,954

The Silesian output of metallic zinc has increased of late years at the rate of about ten per cent. per annum, or 10,000 tons a year. But the large exports of Sheet zinc from Silesia to Russia have greatly fallen off of late, caused by an increase in the tariff imposed by the latter country for the purpose of protecting the Polish production. Poland now produces between 4,000 and 6,000 tons of Spelter, but under protection this amount may be doubled. The total imports by the United States in 1881 were only 3,643 tons, as follows:

	1881.	1880.
	Lbs.	*Lbs.*
In blocks	2,511,203	6,160,653
In sheets	2,676,790	4,288,028
Total	8,187,993	10,448,681
Less re-export—		
Sheets	27,611	74,598
Net import	8,160,382	10,374,083
Equal to tons	3,643	4,631

During the past six months much more attention has been given to the Spelter market than in 1881. At the enhanced price Domestic Spelter has shown great steadiness. It would not unlikely have advanced beyond six cents but for the heavy importation of Silesian, of which some 3,500 tons arrived during the first quarter of the year. The price of Domestic Spelter remained tolerably steady under these heavy arrivals, whereas some brands of Silesian are said to have sold in February as low as 5¼ cts. on the dock. The firmness of the domestic product in the face of these unexpectedly large imports was due, on the one hand, to the reduced output at the West, in consequence of the failure and stoppage of works, and on the other, to increased consumption in this country since September last year. The increase noticed was not only in brass manufacture and for rolling purposes, but especially for galvanizing, notably fence wire. It is estimated that the present annual output in the United States does not exceed 18,000 tons, while the consumption this year may not fall much if any short of 30,000 tons. This would require an importation of 12,000 tons assuming that the stock to be carried into next year is to be as great as that carried over from 1881—2,000 tons.

The market continued strong throughout the first quarter of the year at 5⅞ to 6 cts. against 5 cts. @ 5⅜ @ 5⅛ cts. for the corresponding period in 1881; but for the past three months dullness accompanied by lower prices has been the prominent feature of the market, and there is still no improvement. The quotations for both Domestic and Silesian are 5⅜ to 5½ cts, and in London, £16 15s. to £17. This is the condition of affairs at the end of the first six months of the year, notwithstanding a syndicate was formed in Europe on April 19, representing two-thirds of the European output, for the purpose of controlling the market.

The following table exhibits the lowest and highest prices in cents per pound of Common Spelter at New York for the periods indicated:

	1878.	1879.	1880.	1881.	1882.
January	5⅝ @ 6	4⅜ @ 4½	6⅛ @ 6¾	5¼ @ 5½	5⅞ @ 6
February	5⅜ @ 5⅞	4⅝ @ 5	6¾ @ 6⅞	5¼ @ 5½	5¾ @ 6
March	5⅜ @ 5¾	4½ @ 4¾	6⅞ @ 7	5 @ 5½	5¾ @ 6
April	5⅛ @ 5⅝	4⅜ @ 4¾	6 @ 6¾	4⅞ @ 5¼	5½ @ 5⅞
May	4¾ @ 5⅝	4½ @ 4¾	6 @ 6¼	4⅞ @ 5⅛	5½ @ 5¾
June	4½ @ 5	4⅜ @ 4⅝	5⅜ @ 5½	4⅞ @ 5⅛	5⅜ @ 5⅝
July	4.55 @ 5	4½ @ 4⅛	5 @ 5¼	4⅞ @ 5⅛	
August	4¾ @ 5½	5 @ 5¾	5⅛ @ 5½	5 @ 5⅛	
September	4⅞ @ 5	5¾ @ 6⅛	5⅛ @ 5½	5 @ 5¼	
October	4¾ @ 5⅛	6 @ 6½	5 @ 5⅛	5⅜ @ 5¾	
November	4⅝ @ 5	6⅛ @ 6½	4⅞ @ 5	5¾ @ 5⅞	
December	4⅛ @ 4¾	6 @ 6¼	4¾ @ 4⅞	5⅞ @ 6	

The daily output of the different furnaces in Kansas and Missouri when in active operation, is given as follows:

Pittsburgh, Kan., 10 furnaces	22,500	
Wier City, Kan., 8 furnaces	18,000	
Joplin, Mo., 4 furnaces	9,000	
Rich Hill, Mo., 1 Siemens gas	8,500	
Rich Hill, Mo., 1 Siemens gas	8,500	
		66,500
At Carondelet:		
Missouri Zinc Co., 14 furnaces	24,000	
Glendale Zinc Co., 8 furnaces	18,000	
Carondelet Zinc Co., 4 furnaces	6,500	
		48,500
Total daily in Kansas and Missouri		115,500
Collinsville, Ill., 3 furnaces		5,500
Total		120,500

This makes a total output of 60 tons per day or 22,000 tons per annum. There are also works at Lasalle and Peru, in Illinois, which are capable, it is stated, of producing 50 tons per day, but the zinc at the two places last mentioned, is generally rolled into sheets.

REVIEW OF THE QUICKSILVER MARKET FOR THE EIGHTEEN MONTHS ENDING JUNE 30, 1882.

THE total production of quicksilver in California in 1881 was 60,851 flasks against 59,453 flasks during the preceding year. The exports by sea in 1881 were 35,269 flasks, valued at $1,027,508, of which about 17,000 went to China and 15,141 flasks to Mexico. In its review of the quicksilver market the San Francisco *World* says: "The production during 1881 has not materially varied, compared with former years, neither in California nor in Europe, say about 60,000 flasks here and 50,000 in Europe. Stocks here are moderate, it being the policy of our producers generally to meet the demand under reasonable restrictions. Probably our whole available stock is about 5000 flasks, while in London it was 84,000 on the 23d of last November, according to the statement of the agents of the Almaden Mine (Spain), the Rothschilds, they holding 13,000 bottles and speculators 71,000 bottles. It is safe to say that this large quantity has all accumulated during the past six or seven years, and 10,000 to 20,000 flasks are now being added yearly, which will give in London by the close of the present year 100,000 flasks or over. Prices during the year were tolerably steady at 37 cts. to 38 cts., except on or about the 26th of September, when advices came from London of a sharp advance there from £6 5s. to £6 10s. per bottle, and a few days later to £6 17s. 6d. to £7. The price here was advanced and carried as high as 42 cts. per pound, at which sales were reported. It is, however, to be noted that considerable quantities were taken by speculators, they paying from 37 cts. to 39 cts. per pound. Subsequently the price declined in London, and when the semi-official statement was made of stocks there on the 23d of November, the market fairly collapsed and £6 5s. to £6 2s. 6d. per flask was the asking price, less 3 per cent. Hence the price dropped to the old figures. With an average production, both here and in Europe, it is difficult to see how prices can be permanently advanced, unless new uses can be found for the article or valuable bodies of silver-bearing ore be discovered involving large consumption. As with silver product, doubtless China would take all offered at the same price, but as purchasers for that country, both in silver and mercury, are largely made as a means of investing surplus wealth—another term for speculation—no permanent relief would follow in the matter of stocks of this article, and any advance in prices would be, at the best, only spasmodic. The producer here can hardly be expected, after selling at moderate figures, to hold his stock out of the market and aid the London speculators to work off their large stock at high figures. All indications point to steadiness in price and moderate figures."

The following table shows the production of the different mines of California in 1881, and also the highest and lowest prices for the year. The compilation was made by Mr. J. B. Randol, manager of the New Almaden Mines, which, it will be observed, lead all the rest:

The product of the first six months of the current year has been much below the corresponding period of last year, as is shown by the following table, also from the same source:

	1881. Flasks.	1882. Flasks.	Difference. Flasks.	
New Almaden	12,545	12,508	Decrease.	37
Napa Consolidated	2,914	3,076	Increase.	162
Great Western	3,179	2,711	Decrease.	468
Sulphur Bank	5,962	2,583	"	3,379
New Idria	1,266	977	"	289
Guadaloupe	3,447	732	"	1,715
Reddington	1,224	909	"	315
Great Eastern	506	521	Increase.	15
Various	163	111	Decrease.	51
	31,206	24,128	Decrease.	7,078

Notwithstanding this heavy reduction in the California production, there has been an increased demand from China.

Almaden Mine, in Spain, turned out last year 50,353 flasks, weighing, net, 1,737,572 kg., or 34½ kg. per flask, 76.07 pounds, English. The New Almaden (California) flask nets 76.50 pounds. Between January 1 and April 27, 1882, the export by sea from San Francisco was only 11,639 flasks, against 14,029 during the corresponding time in 1881, but the price, nevertheless, gradually improved there from 36½ cts. on January 1 to 38½ cts. April 27, 1882.

Since 1850 California up to the first of the current year, produced altogether some 1,250,000 flasks, and exported of that amount 890,000 flasks. Toward this amount of production the New Almaden mine alone contributed no less than 710,729 flasks, while the Almaden mine of Spain has turned out, altogether, 902,364 flasks. The highest price was reached in California in 1874-5, when quicksilver commanded as much as $1.55, and the lowest in 1879, when it fell to 33 cts. In London it advanced to £26 per flask in 1874, and receded to $5 17s. 6d. in 1879, since which time the highest figure attained was £7 15s., again receding to £6 5s., from which price it has fluctuated but little.

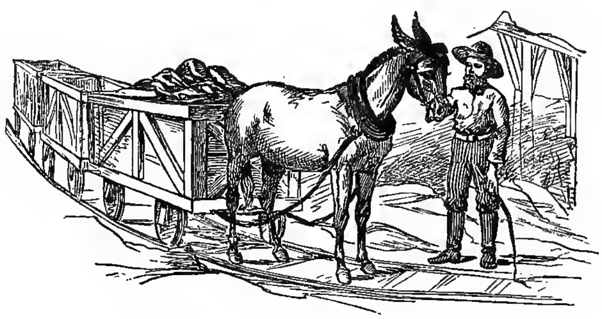
The Spanish Government at the time of the renewal of the lease of the Almaden mine to the Rothschilds, a couple of years ago, came to an understanding with the lessees that the price should be regulated by the one ruling in London, but £6 was fixed as a minimum. Between £6 and £8 the difference is shared jointly, and if the price rises above £8, Spain receives two-thirds of the difference between £6 and the price obtained, while the Rothschilds only get one-third. The interest of the latter firm in a high ruling at London is therefore considerable, and the only obstacle in the way is excessive production in California. The consumption of quicksilver for gold and silver mining purposes has decreased since 1878, and with the very large output that is constantly taking place, production runs ahead of consumption. Spanish quicksilver has also of late entered into a more active competition for the Hong Kong and other Chinese markets, as well as that of New York. For mere technical purposes, exclusive of

1881.	New Almaden.	Sulphur Bank.	Great Western.	Napa Con.	Guadaloupe.	New Idria.	Reddington.	Great Eastern.	Cloverdale.	Various.	Total production.	Price in San Francisco. Highest.	Price in San Francisco. Lowest.	Exports.	Production of the Almaden, Spain.	Prices in London. Highest.	Prices in London. Lowest.
																£ s. d.	£ s. d.
January	2,259	895	451	430	1,300	330	140	13	...	43	5,861	37	36½	By sea and rail from San Francisco.	7,288	6 15 0	6 7 8
February	2,187	635	399	233	600	171	32	....	...	4	4,261	39	37		6,400	7 00 0	6 15 0
March	2,466	1,100	400	505	350	208	354	179	...	...	5,560	38	36½		7,933	6 15 0	8 7 6
April	2,507	708	447	466	357	158	284	123	...	23	5,071	39	37½		7,270	6 10 0	8 2 6
May	1,346	1,163	681	659	500	200	218	97	...	25	4,889	37¾	37½		5,678	8 10 0	6 5 0
June	1,780	1,463	801	621	340	201	196	94	45	23	5,584	37½	37¼		....	6 5 0	6 5 0
July	2,208	1,057	714	481	255	110	160	47	48	108	5,188	38	37¼		....	6 10 0	6 5 0
August	2,260	1,139	685	490	300	209	190	67	32	88	5,350	38	37		....	6 10 0	5 6 0
September	2,090	1,076	457	692	201	212	187	113	32	5	4,965	37½	36¾		....	6 10 0	8 6 0
October	2,233	969	414	485	400	140	165	106	50	12	4,965	41½	38.		2,798	7 00 0	6 10 0
November	2,572	588	434	310	375	677	180	166	...	30	5,232	41½	39		6,401	6 12 6	6 6 0
December	2,162	361	458	280	250	261	83	70	...	15	3,945	37¾	36		5.595	8 5 0	5 5 0
Total	26,060	11,152	6,241	5,552	5,228	2,775	2,194	1,065	208	370	60,851	41½	36½	45,799	50,353	£7 00 0	£8 26 0

Production in California during 1881, 60,831 flasks, each of 76.50 pounds avoirdupois. Production in Spain during 1881, 1,737,571,600 kg. (50,353 flasks, each of 76.07 pounds, avoirdupois.)

mining, quicksilver is not very important outside of China, where it is used extensively in the preparation of paints, etc. Since quicksilver entered this country duty free, Rothschild has thrown on the New York market, in 1879, 5441 flasks; in 1880, 200 flasks, and in 1881, 3005 flasks, competing advantageously with California dealers here on account of the high freights from the Pacific coast to the New York market.

The world's production of quicksilver was last year 115,-600 flasks, which include Idria, in Austria, and some other minor localities, while the actual consumption for 1881 has been estimated at 110,000 flasks. On January 1, 1882, the stock in London had gradually accumulated to no less than 92,000 flasks, of which only 12,000 flasks were in first hands, the remainder being held by speculators, having been bought long since at high prices.



PART VII.

MINING LAWS AND REGULATIONS—THE LAND OFFICE AND ITS PREROGATIVES—U. S. MINING LEGISLATION—STATE LAWS—THE DEBRIS QUESTION.

LAW and legal difficulties are to many engaged in mining business little short of a terror. There has been so much misery and anxiety caused by the uncertainties of titles, by the ups and downs of legal decisions and the irrepressible conflict of laws that we doubt not Part VII of the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES, will be very welcome to mining men, furnishing, as it does, a clear statement of all laws touching mineral lands passed up to July 1, 1882. An account of the powers and duties of the Land Office is added, and the Part is appropriately begun with a paper on the relations of government to mining, which, though it appeared in 1870, in Mr. Rossiter W. Raymond's report, is still timely from an historical point of view. The Debris question, a much vexed issue upon the Pacific coast, having recently begun what promises to be a long squabble in the courts, is therefore properly placed in the part devoted to law. The various forms that are necessary to the successful legal prosecution of a mining company's business are also included here.

MINING AND MINING LAW AMONG THE ANCIENTS.

THE main subject of the present discussion being the history of mining jurisprudence, and the consideration of that subject being limited as far as possible to its bearings on the immediate problems of legislation in the United States, I shall not attempt to collect, in this chapter, all that is known of the practice of ancient nations in regard to the arts of mining and metallurgy. The theme is an exceedingly attractive one. Our knowledge of the legislation of earlier times has to be, however, in great part inferred from circumstantial evidence, or from the records which remain of ancient practice. A frequent reference to the history of mining, as distinguished from that of mining law, is unavoidable; yet this account must not be considered as even a complete outline, much less a comprehensive summary of all that is known to antiquarians on this interesting subject. In comparison with the literature concerning the dress, language, mythology, and poetry of the ancients, we have very few books about the much more important questions connected with their proficiency in the mechanical arts, and especially the arts of mining and metallurgy.

Authorities.—Two books published during the last century are the only ones which have come to my knowledge in which the indications and fragmentary facts contained in ancient literature or existing ruins, observed by travellers, have been collected and systematically arranged. One is the work of Caryophilus, *De Auri et Argenti Fodinis Veterum,* of which I have not yet been able to find a copy in this country, though it is accessible in several libraries abroad; the other is a dissertation in the German language, by Dr. J. F. Reitemeier, published in Göttingen, 1785, and entitled *Geschichte des Bergbaues und Hüttenwesens bei den alten Völkern.* This admirable essay received the prize of the Royal Society of Sciences at Göttingen. There is a copy in the city library of Boston, to the superintendent of which I am indebted for the courtesy with which he placed the book at my disposal. Ancient authorities are more numerous, but not so satisfactory, since they give us mostly mere allusions or accidental revelations. Among them we may mention the Bible, Herodotus, Strabo, Pliny, Diodorus, Agatharcides, Clement of Alexandria, Aristotle, (*de mirabilibus, de cura rei familiaris, etc.,*) Dioscorides, Livy, and Polybius, not to mention a multitude of classic writers from whose works intimations of importance can be gleaned, such as Xenophon, Cæsar, Plutarch, and even the legendary poems of Homer and Hesiod. To these sources of information must be added the works of various mediæval and modern travellers, and the researches of antiquarian scholars in special fields of inquiry, too numerous to be catalogued here.

The origin of mining.—The art of mining is linked with so many others, which are the fruit of civilization only, and must be practiced under so many natural difficulties, which only advanced science has been able to overcome, that we may naturally believe it to have had neither a very early nor a very rapid development. No doubt the first races were led to the discovery of one metal after another by accident rather than systematic study of nature. Probably the first metals used by men were those occurring in a native state—such as gold, silver, and copper. The discovery of bronze, or the secret of hardening copper by rude metallurgical processes and mixture with other metals, was a step in the progress of the human race so important that it marks an epoch of pre-historic time, known as the age of bronze. The peculiar properties of gold and silver—their beauty, malleability, and above all their resistance to oxidation, which rendered their preservation possible through long periods, were undoubtedly the ground of that high esteem in which they have always been held, and which is at the present day enhanced by their relative scarcity, and the difficulty of obtaining them. The knowledge of these metals seems to have been indigenous in all countries where they occur, whether among the tribes of Asia, of Siberia, or of North America. Gold and silver are the A and B of the alphabet of metallurgy; and, although the mastery of the whole alphabet and its combinations in the literature of civilization has been the laborious work of ages, and is not yet complete, these first letters of it were beneficently made easy for man to discover. The rudiments of mining are first found in those countries where the human race itself probably had its origin. The Bible informs us that even before the *Noachian* deluge, some of the peoples of Asia understood the use of iron—but this knowledge does not appear to have been propagated among other nations. The Siberians and the Peruvians most certainly did not possess it, and other nations have made the discovery at a comparatively late period; but this only corroborates what we have already said, that the knowledge of metals was not, in the beginning, transmitted from one nation to another, but was the child of circumstances and accidental discovery in different parts of the world. At any given epoch of the first historic eras, before commerce and literature had produced an interchange of commodities and ideas, it is to be supposed that some nations would be more advanced than others in these respects. If the use of iron was confined to the race destroyed by the flood, then it perished with them.

At a much later period we learn that the Chaldeans and Assyrians possessed gold, silver, and "brass." The Phœnicians had also an abundance of metals; and it is more certain, in their case, that they obtained their supply from some sort of systematic mining. Their country itself was not rich in mineral wealth. Possibly they worked the copper mines at Sarepta, but these were their only mines at home. But their extended commerce brought them into connection with other countries abounding in the treasure they sought; and they went to islands of the Mediterranean for gold and other metals, including iron, of which they understood the use, ascribing its discovery to two of their mythical heroes. They are known also to have mined in Spain, (probably for "Tyrian lead" and silver,) and they even touched the distant shores of Britain in their bold explorations, and gathered the tin ore of Cornwall and Devon. But at least an equal antiquity, and a much greater elaboration and system, must be recognized in the mining of the Egyptians. Under the reign of Osiris, the Egyptian mines of copper, silver, and gold were in productive operation. Both on the Ethiopian and the Arabian border, and near Saba, (which may or may not be Sheba of the Bible,) they worked the ores of their country. The Sinaitic desert, through which the Israelites travelled, contains to this day the ruins of mining works, the origin of which is shrouded in mystery, but may well be ascribed to that wonderful people the Egyptians, the extent of whose achievements in many directions the world is just beginning to estimate aright. They did not learn the use of iron so early as that of some other metals. Abraham found gold and silver used for instruments, ornaments, and currency among them, but no mention is made of iron. In the time of Moses, however, as is evident from two passages in Deuteronomy, the Egyptians smelted iron.

Mines of the Persians and Egyptians.—In the early times, as in all subsequent periods, conquest was one of the foes of mining. The Egyptians were twice conquered by the Ethiopians, and had several Assyrian wars, which must not only have produced such a disturbed condition of affairs as prevented the prosecution of mining, but also have drawn into the military service the classes of laborers employed in that business. The final establishment of the Persian dominion removed the disturbances from without, but the tyranny of the provincial governors produced numerous revolts, which doubtless had a disastrous effect upon mining. The Persians, however, amassed much treasure from their conquests, and obtained from the Egyptian mines, in particular, the finest silver. The strength which wealth imparted to this dynasty was painfully felt by the Greeks, in the vast armies which invaded their territory and the bribes with which their leaders were corrupted. The first period in the history of mining closes with the overthrow of the Persian empire by Alexander, and the transfer of the treasure and resources of the Orient into European hands. Meagre as are our data for this period, we are nevertheless led to a reasonably certain conclusion with regard to the tenure and authority under which mining was carried on. We hear of kings, like Crœsus, enriching themselves from the product of the mines; but there is no indication that these sources of wealth were open to private citizens. The immense quantities of gold and silver employed by governments, and their use in constant wars, also confirm our conjecture that the mines of Asia and Africa were the property of the rulers, and that they were worked by slaves. This was certainly the case in Egypt, in the following period. It is probable, therefore, that the doctrine of ownership by the crown of the metals in the earth was originally established by tyranny, and that before its establishment mining, like agriculture, was carried on by the citizens. The story of Joseph, in the Bible, shows by what means the despot of Egypt was able to destroy the individual industry of agriculture, and to turn the whole kingdom into his own farm. Doubtless the process of "consolidation" in mining followed a similar course.

In the second period there was apparently still greater activity and extent of mining operations; at least our information on the subject is more satisfactory. Gold, silver, copper, and iron were obtained in Ethiopia, and iron at least in Libya. Possibly the recent discoveries of gold in Africa, which are now attracting considerable attention from the English, are but rediscoveries of the fields worked centuries before Christ. India and Caramania produced gold, and the latter country also silver, copper, and cinnabar. The people, however, are said by Strabo to have been very ignorant of the art of working metals. The Derbæ did not know how to melt their gold dust into lumps, and the Indians sold crude specimens of rich ore to foreigners. The Chalybeans, on the other hand, became famous as workers in iron, and derived their principal revenue from this source. In Asia Minor the gold mines formerly owned by Crœsus were worked down to the times of Xenophon, but Strabo says that in his day they were exhausted, and only traces of them remained. There were iron mines and skilled workmen in Palestine. Arabia Felix is celebrated by many ancient writers as possessing very rich gold and silver mines, but no traces of them now remain, nor have modern travellers observed auriferous sands in any of the streams of that country. Historical testimony on the subject is, however, quite positive and unanimous, and the matter may be considered as still in doubt. It is not impossible that the ancient writers, who were not always exact in such statements, mistook the treasure obtained by the Arabians through their Indian commerce for a product of their own soil. We may well believe that this wide-spread development of mining, accompanied as it was with a diffusion of government, brought about some change in the mining law. The loosely-strung empire of Alexander fell to pieces after his death, and no doubt the mines became the property of governors, generals, nobles, and wealthy citizens. We have, however, in Egypt a type of the general systems which obtained, on a greater or smaller scale, throughout the petty despotisms which divided the world. Diodorus gives us a picture of Egyptian mining, partly taken from the earlier work of Agatharchides. According to this account the mines of Egypt were the property of its kings, who obtained immense sums from them.

Those were in one sense the palmy days of mining; for the king got his mining ground gratis, worked only the richest deposits, captured or reduced to slavery the necessary laborers, and levied contributions on his kingdom for the necessary food and other mining supplies. Rich mines, worked at no expense, naturally paid handsome dividends. Machines were not employed to any extent, since human power was cheaper. The Egyptian monuments which remain to us represent the most stupendous works of engineering, as accomplished by the labor of countless multitudes of men. The labor of the mines was performed by prisoners of war, convicts, and purchased slaves. As the Egyptians were not a warlike people, and seldom returned from battle victorious, it is not likely that their prisoners were numerous. Neither could the convicts have supplied their extensive mines. It is probable that the greater portion of their miners were purchased slaves. We are, in fact, informed that the workmen in the Egyptian mines spoke different languages. To prevent conspiracies and escapes the different gangs were placed under overseers who were not their countrymen, and all hope of flight was finally extinguished by fetters, by constant confinement in contracted caverns, and by the nature of the region itself, which offered no opportunity for successful escape. The lot of these unhappy creatures in the mines and furnaces was indeed a hard one. They were forced to labor day and night, without rest or hope, and under the most dreadful hardships and cruelties. They were entirely naked, and neither age nor sex, sickness nor wounds, excused them from the severity of discipline. The stronger ones hewed the rock in the mines, the half-grown youths carried the ore to the surface, persons over thirty years (so soon was their vigor destroyed) were set at the easier task of crushing it in mortars, and the women and old men ground it fine in hand-mills. The historian adds, with laconic pathos, that they continued to labor until they dropped dead beneath their burdens.

Ancient Mining in Siberia and Europe.—The far northern country of the Massagetes is said by ancient writers to have produced gold and copper, but no silver nor iron. This is the nearest approach to a mention of mining operations in Siberia which history presents. But the observations of travellers, especially those recorded by Pallas, Lepechin, Gmelin, and Rytchkow,* afford convincing evidence of the existence of extensive workings for gold and copper in Siberia. The tradition of the Russians, that these early miners were Scythians, is groundless. Tartars they were not, since they were unacquainted with iron, which the former knew how to use. A nomadic race they are believed to have been, since no traces of buildings or masonry remain in those regions. All that we can conclude with probability is that, before the irruption of the Tartars into Siberia, very extensive but rude mining operations were carried on in that country by tribes not far removed in culture from the aborigines of North America. The tools which they employed were either of stone or copper—never, so far as has yet been discovered, of iron. The smelting of copper appears to have been successfully carried on, even with somewhat refractory ores. Traces of mining accidents, of the voluntary abandonment of very hard rocks, of great economy of labor in "dead work," &c., taken together with the indications above mentioned of the social condition of this unknown people, prove to us that they carried on their mining operations by individual enterprise, as freemen, and probably without reference to particular ownership of the soil. Although this system (if system it may be called) stands in favorable contrast, on grounds of humanity, with the cruel and tyrannical practices connected with mining in the southern Orient, and especially in Egypt, yet it is evident that its result was superficial exhaustion, abandonment, and finally burial in oblivion of the mines. From the very dawn of history, therefore, these two representative voices of Egypt and Siberia warn us that neither mining by the crown, nor nomadic, superficial mining by the individual, is the true method of utilizing with economy the mineral resources of any country. The first is inconsistent with liberty, and the second with stable industry.

Concerning the earliest beginnings of mining in Europe little can be said. The civilization of the East, as is well known, communicated itself first to the Mediterranean nations. As mining is an essential condition to the progress of civilization, so we may reasonably conjecture the progress of mining at any given period from the culture of the people. We are justified, therefore, in assuming that mining in Europe takes its rise with the emergence from barbarism of the Mediterranean tribes. Strabo, Pliny, and Herodotus declare that Cadmus, a Phœnician, opened the first gold and copper mines in Thrace—a statement which is philosophically, if not historically, true. The Phœnicians certainly carried on mining in the islands of the Mediterranean, and even along the coast of distant Spain. But it is not probable that their operations contributed much to the spread of the art among the barbarians; since they not only, with characteristic selfishness, carried away all the products of their industry to enrich their own land, but kept to themselves whatever knowledge they acquired. They cannot be regarded as the teachers of European nations in this art—a credit which belongs rather to fugitives and exiles from other parts of Asia, who opened mines, or communicated the knowledge of mining, in the regions where they took refuge. The nature of the laws or customs regulating mining differed, therefore, according to the source of the art. The labors of the Phœnicians seem to have derived extent and comparative permanence from the conservative influence of commerce rather than tyranny.

Mining in Greece.—The mining works of ancient Greece are remarkable for extent, antiquity, and improved arrangement. The Greeks mined in the mother country and in their eastern and western colonies, and maintained through many centuries this industry, improving it by their own experience, and even studying it by scientific methods. The works of Theophrastus and Philo on metals are unfortunately lost, as is that of Strabo on machines and methods of parting metals. The remains of Greek mines are too nearly obliterated to afford us any evidence. We must learn what we can from incidental passages in Greek literature, and these refer almost entirely to the mines of Attica. The history of Greek mining may be divided into three periods. The first includes the activity of the mines upon the islands, the oldest of which belonged to the Phœnicians; the second period comprises the operations of the Greeks themselves, on the main land; and the third is characterized by the working of new and productive mines in the provinces of the Macedonian Philip, which finally, with the rest of the Greek mines, fell into the hands of the Romans. The operations of the first period must be mainly inferred from passages in the Iliad and Odyssey; and these are of course to be interpreted with due allowance for their poetic form. When it is said that Helios, or the sun, invented gold, and the mythical, not to say allegorical, Erycthonius discovered silver, while copper was brought to light by the investigations of workmen directed by the gods, we may infer that the order in which these metals became known to the Greeks was similar to that which, as we have already seen, obtains in the history of other peoples. Iron is said by an old Greek inscription to have been discovered at a period corresponding to 1431 B. C. of our calendar. These gleams of early history help us to understand how gold and silver, more than any other metals, have come to be considered the property of sovereigns. They were the earliest known, and that at a time when sovereigns took all they could get and could get almost anything they wanted. Homer's descriptions of the magnificence of Greek princes, if we may interpret them as historical, indicate no small surplus of gold and silver in Greece. It is to be remembered, however, that in the absence of that diffusive action which commerce maintains, and of that great demand for the precious metals to which their use as currency gives rise, the accumulation in a few hands of a comparatively small amount of gold and silver might well justify the glowing descriptions of Homer; and also that if the rich men of the present day were to spend their wealth, not on the means of comfort and enjoyment, not on books and works of art, not on public improvements, but only on plate, armor, jewelry, and chariots, they could far outshine the splendor of Homeric heroes. The islands in which the Greeks carried on mining operations included Crete, (iron,) Thasos, (gold,) Eubœa, (iron and copper,) Cyprus, (gold, and silver, copper, and iron,) Delos, (copper,) Rhodes, (copper, iron, and lead,) Milo, (alum and sulphur,) Seriphos, (iron,) and Siphnos, now (Siphanto, very rich gold and silver mines.) From the mines of the latter island one-tenth of the product was sent every year to the shrine of Delphi. In later times, this payment having been discontinued, the mines were drowned by the rising of the neighboring sea; and this disaster was ascribed to the wrath of Apollo at being deprived of his divine royalty! In addition to these mines upon the eastern islands, there were others, probably of later origin, upon the islands near Italy. Pithecusa, opposite Cuma, was rich in gold; Sicily and the Liparian Islands were also famous for various ores. The petty rulers of the islands were the only or principal owners of the mines, and the labor was doubtless performed by slaves, according to rude and simple methods.

The second period of Greek mining, comprising the operations on the mainland, in Greece proper, is better known and more important. The Spartans, under the influence of their political system, established no important industry of this, or, indeed, of any kind; but the Athenians became distinguished in the administration of the rich silver mines of Attica, and the productive colonial gold mines in Thrace and Thasos. Thessaly had also rich gold ores, Bœotia produced iron, and Epirus possessed mines of silver. These resources seem to have been developed about the time of the Persian war. The public revenue from the Attic mines at the beginning of that war was equivalent to about $30,000, and afterwards increased to much larger sums, which, to-

* The treatise of Pallas is found in *Actis Soc. Imp.* 1780, published at St. Petersburg, 1784; and that of Rytchkow in Busching's Magazine, part 8.

gether with the product of the colonial mines, had a great deal to do with the splendor and power of Athens. The unhappy Peloponnesian war put an end to Athenian mining. In vain Xenophon exhorted his countrymen to reopen the sources of their former prosperity, and prophesied the continuance in depth of the rich ores they had once so successfully worked. The poverty of the citizens, and the exhaustion (in spite of Xenophon) of the mines, were obstacles which could not be overcome. Neither, as we shall see, was the system of the Athenians favorable to the persistent working of mines under discouragement. We may take leave to doubt, at the present day, whether the mineral deposits of Attica are really exhausted; but at that time a temporary barrenness was equivalent to a complete failure. For nothing can carry forward such an industry over its periodical seasons of depression except despotic power on the one hand, or on the other hand that faith in the future which is the result of accumulated experience, called science; and the Athenians had neither of these. Their failure in mining was due to the same cause as their failure in political science; there was no education of the people to take the place of centralized power.

The administration of the Athenian and that of the Egyptian mines differed as widely as did the political systems of the two countries. The State indeed appears to have held a certain title to the minerals, but its rights did not extend to absolute possession, or at least were not strictly insisted upon. Before the Persian war the income of the mines was annually distributed among the citizens, from which we may conclude that the republic either mined for itself or leased its mineral lands. After that war, however, this distribution of profits was discontinued on the advice of Themistocles, although the State still received payments from the mines. It is not improbable that certain mines, especially ancient ones, were rented on special terms, as the property of the republic; but the general practice was adopted of encouraging the development of mineral resources by a liberal and universal code. Taxes on gross production were remitted; citizens and friendly aliens alike were encouraged to mine under the light royalty of one twenty-fourth part of the net profits. The number of private adventurers thus encouraged to mining enterprise must have been very great. Even Demosthenes, in whose day Athenian mining was already on the wane, speaks of them as a class, like farmers and merchants.* The labor was performed by slaves, hired from their owners. The overseers were also slaves skilled in mining. It is probable that in many cases the lessees themselves were slaves, as it was not uncommon in Athens for masters to lease to their slaves factories, workshops, and farms. In such leases the slave-superintendent usually paid a daily net sum *per capita* for the number of laborers employed. The owner of slaves employed in mining received daily one obolus for each. The lessee was rosponsible for the food and clothing, and, in case of flight, for the value of the slaves—possibly also for their lives. No doubt this was a much milder slavery than that of the Egyptians, yet, as the slaves were strictly watched and always kept in fetters, it was oppressive enough, Slave-labor must always be lacking in individual skill and zeal, and make up for this deficiency by increased numbers. Accordingly we find that the slave-miners of Athens amounted to many thousands, or, as Athenœus says, to myriads. History speaks of a miners' revolt, in which the insurgent slaves took possession of Mount Sunium, and from that point made many destructive raids upon the Attic realm. The extent to which the republic attempted to prevent such perils by laws, regulating the number of laborers in each mine, or to control in general the operations of lessees, is unknown. That a certain governmental supervision was exercised appears from the fact that a director of mines was appointed, who indicated to adventurers, upon application, where they might prospect for ore, and that there were laws to determine the methods of mining, and the location, direction, and extent of veins, as well as the proper distance between different claims upon this same field.

Ancient Mining in Western Europe.—Before the time of the Roman dominion, mining was carried on in many parts of western Europe; and although there are little or no traces left of the laws which regulated the industry of the barbarians, I shall briefly mention the localities referred to, partly to complete this historical outline, and partly because the mining jurisprudence of the Romans, like their mining science, was affected by their conquest of those countries where the natives already practiced this art. The Etruscans and the Sabines, in Italy, were acquainted with the use of copper, and the former made early discovery of iron on the neighboring island of Elba, the specular ores of which are famous to this day. The Salassians, in Lombardy, turned the Po into canals, and established extensive washings for gold. The region of the Taurisci and Norici was rich in gold, and at one time the natives invited laborers from the south to assist them in its production; but the result was an over-stocked market, and a fall of one-third in the value of gold, which caused them to send home their laborers and reduce production to maintain the price. The tribes of Gaul obtained gold, silver, copper, and iron. But Spain exceeded in its treasures of gold, silver, copper, tin, lead, and iron all the countries of the ancient world. The barbarian natives obtained these metals from superficial deposits or outcrops, and the Phœnicians and Carthagenians, and afterwards the Romans, extracted them by deep mining. In fact, the art itself was planted in Spain by these foreign nations. The mere use of surface deposits can no more be called mining than the gathering of bunch-grass and pine nuts by our Nevada Indians can be called agriculture. Probably the Phœnicians themselves, in their distant operations in Spain and Britain, engaged rather in commerce than mining, buying the metals of the barbarians. But Carthagenians, we know, established in Spain and Sardinia most extensive and productive mines, the revenue of which enabled them to support a numerous army of mercenaries and to wage long and costly wars with Rome. No doubt these mines were in some form the property of the state. The British islands were the scene of a considerable native industry, comprising gold, silver, iron, copper, lead, and tin. Strange to say, the Britons seem to have lacked or despised the art of manufacturing copper, though they practiced the more difficult metallurgy of iron. The Phœnicians traded with them secretly for tin, and the Romans, by following the Phœnician ships, finally discovered the mystery of the Cassiterides. But the Britons continued, until their conquest by Cæsar, to work their own mines of lead and tin. The tin of Cornwall was shipped first to the Isle of Wight, and thence to the coast of Gaul, where it was loaded upon horses and transported to Marseilles—a journey of 30 days.

Mining of the Romans.—Almost all the nations celebrated for their mines in ancient times became at last the prey of the Romans; and Roman mining was therefore a very widespread industry. Our knowledge concerning it is, however, mainly confined to Europe; since neither the hints of classical writers nor the observations of modern travelers have thrown much light on the Roman mines in Asia and Africa. The poverty of the early Romans indicates that they did not work the mines of their native land. They struck the first silver coins shortly before the first Punic war, when, by rapid conquests in middle and lower Italy, they acquired mines which furnished them the means to greater undertakings. The wars against Carthage made Rome mighty among nations, and eminent in the history of mining. The first two Punic wars delivered into her power the important mines of Sardinia, Sicily, and Spain. Oriental conquests added mines in Asia Minor, Greece, and Macedonia, and at a subsequent period the remaining mines of the east, in Asia and in Egypt, were acquired by the victorious arms of Pompey and Augustus, and those of northern Spain and Gaul yielded to the legions of the Cæsars. The tin mines of Britain were their latest conquest of this sort; and after these had been gained Rome was mistress of all the important mines of the ancient world, and gathered into her coffers the wealth which had before been the strength and glory of many different nations.

As the mines had been acquired by conquest, they became the property, not of private citizens, but of the republic, and afterwards of the empire. In the period after the first Punic war the revenues of the republic were collected, indirectly, through contractors; and the censor, to whom belonged the duty of farming out the finances, awarded

* Demosth. adv. Aristocratem.

at certain times the leases of the mines. Ordinarily, as for instance in upper Italy and Spain, the lessees worked their ground with purchased slaves. In a few districts, however, the native inhabitants were held to a certain amount of labor in mines and furnaces, as a sort of vassalage, like that of the crown-serfs of Russia a few years ago, and this crown-right over their services was granted to the lessees of the mines. The treatment of the slaves was not less inhuman than that practiced by the Egyptians. Diodorus describes both in nearly the same language. The increased money value of a slave among the Romans might indeed have caused some amelioration of his condition for the sake of prolonging his life; but probably this was lost sight of in view of the immediate profit derived from the rapid and reckless robbery of the mines. It was the swift exhaustion and waste of their mineral resources, and not any considerations of humanity towards barbarians, which led the Romans to change their policy of leasing the mines. From an economical point of view no system of mining could have been more injurious to the state. The lessees cared nothing for the future; they took no pains to utilize all the treasure in the earth; they were absorbed in the endeavor to realize as much profit as possible during their limited term of possession, and to this end they employed vast armies of slaves and ruthlessly laid waste the mining lands. Polybius says that the lessees of a single district in Spain employed in their mines no less than 40,000 purchased slaves; and this evil grew to such a size in the gold mines of upper Italy that the censor, in order to delay the exhaustion of the mines and prevent the sudden depreciation of the precious metals, made it a condition of lease that the number of laborers in those mines should not exceed a certain limit. Of course under these circumstances the art of mining made no progress. The Romans took it as they found it among the conquered nations, and rather fell behind their teachers than surpassed them. The system of Egypt, bad as it was, was better than this. The selfishness of despotism was at least more provident than the indifference of democracy. The period from the first Punic war to the empire was characterized by an immense production of metals, and ended with the exhaustion of many of the mines. The despotic emperors took the matter in hand, and, though the past could not be repaired, they reformed the causes of evil. They began to work the mines through regularly appoined officials, instead of leasing them to unscrupulous speculators; and as it was not feasible for the government to obtain so many slaves as had previously been employed by private parties, the system of feudal service from the inhabitants was gradually extended, and the oppression of the former irresponsible administrations was lightened. The crown-serfs, so to speak, were allowed to own and sell land, but the purchaser acquired, together with the property, the obligations of service resting upon the former owner. Slaves were also employed, but these were rather condemned convicts than purchased barbarians or captives of war. The emperors seem to have preferred to apply this system to the maintenance of mines already open, and to have willingly allowed private adventurers to discover and explore new ones. Thus Trajan allowed the Dacian gold mines to be worked by a sort of stock company, (*collegium aurariorum,*) and Valentinian I. gave free permission to prospect for metals on payment of a portion of the subsequent products. Instances are mentioned of private persons owning large and profitable mines, probably by special grant. A new impulse was thus given to mining, and gold mines were opened during the first hundred years of the empire in Dalmatia, Illyria, and Dacia. The supervision of this vast industry required numerous officials, of whom the names only are left to us, such as *Comes metallorum*, the *Comes sacrarum largitionum*, the *Comes Orietis*, the *Vicarii*, and *Rationales.* Probably their duties were chiefly of a financial or magisterial nature, although the *Comes metallorum* may have been a sort of mining engineer.

But agencies came into play which overpowered the good influence of the new system. The errors of the past were, to a great extent, irremediable; the impoverished mines could not compete with others more favorably situated; and finally the irruptions of the barbarians on the borders disturbed or destroyed the industry of many districts. The serf-laborers were quite as likely to join the invaders as to defend the mines against them. From the silence of the later historians we may infer that mining in the Roman empire declined rapidly after the third century; and after the fifth century, when the barbarian hordes overwhelmed with successive invasions the tottering empire of the west, it ceased entirely. The Byzantines maintained it a little longer, but after the seventh century they gradually surrendered their mines to the conquering Arabs. The mines of Asia Minor, Thrace, and Greece were the last which the empire retained. The victorious barbarians no doubt gleaned what they could from the abandoned works of their predecessors. This was done, we know, by the Arabs in Spain, the Franks in Gaul, and the Goths under Theodoric in Italy. But we have no record of their manner of operation, nor can we say in what way the mining of mediæval times grew out of this ruin of ancient mining. There is a chasm of centuries not bridged by historic records.

Mining Law in the Middle Ages.—Mining is the only industry which extends its activity into the earth's interior. The accidental boundaries which topography or commerce may give to landed estates can scarcely be the limits for the extent of underground work, which is rather controlled by the dimensions of subterranean mineral deposits. Mining was therefore even in prehistoric times already separated, as an independent industry, from other exploitations of the soil. It is carried on neither within the same boundaries nor by the same persons as agriculture. Under the influence of this distinction peculiar legal relations were established in Germany at a very early day, probably at the commencement of systematic mining, which have for their subject the subterranean deposits, and are not dependent upon the ordinary laws of property. In the form of a local custom, obtaining with remarkable uniformity in all the original centres of German mining, the principle of mining freedom (*Bergbaufreiheit*) established itself, permitting all persons to search for useful minerals, and granting to the discoverer of such a deposit the rights of property within certain limits. This principle of free mining emigrated with the German miners to all places whither their enterprise extended itself, and the original local custom became the general law. In this existence of an estate in minerals, entirely independent of the estate in soil, lies the distinctive character of German mining law. It is eminently a special law, not subordinate to the civil law, but co-ordinate with it. Its rules and maxims are self-created, and based upon its own peculiar experience. Where the mining freedom of which we have spoken does not exist, where the owner of the soil possesses, as in England, the exclusive right to the minerals contained in it, there can be no such thing as a distinct mining law.

The Roman law gave, as a rule, the mineral right to the land owner; but the opposite principle seems to have sprung up spontaneously in Germany. The earliest record of the German custom is the mining treaty between Bishop Albrecht, of Trent, and the miners immigrating from Germany to that locality, bearing date March 24, 1185. In 1208 the mining customs were officially announced in Trent. The formation of the Iglau code in Moravia took place about 1250, and this system was rapidly extended through Bohemia also. The Schemnitz law in Hungary was formed somewhat latter, but coincides exactly with that of Iglau. The code of Freiberg, in Saxony, was probably brought from the Harz, since Freiberg was first settled by Goslar miners. Its publication took place in the 14th century. The mining regulations of Massa, in Tuscana, date from the middle of the 13th century. The uniformity of these laws is striking, and extends not only to the common principle of free mining, but to special provisions thereunder, and even to certain formulated maxims, which lead us irresistibly to the conclusion that they have in the transmitted habits and traditions of wandering miners their common origin. This was much earlier than the records above cited. Mining is known to have been carried on by the Germans at Andreasberg, in the Harz, since anno Domini 972 by the pawing of a steed, named Rammel, tied to a tree in the forest. Before the return of the master the horse had "developed" a promising vein of ore, and the mountain was baptized in his honor. The Freiberg district was discovered about 1165, by a teamster of Goslar, who picked up a rich specimen of ore while passing through the then unpopulated region. A stampede of miners from Goslar, and the opening of many valuable mines, was the result. Since 1547 the mines of Freiberg have been steadily producing. The mines of St. Annaberg were discovered by one Daniel, said to have been guided by a celestial flame. The mines of Schneeberg were found about 1470 by a specie pedlar from Zwickau, who, travelling by this mountain, noticed a discoloration of the soil, and set some laborers at work. In 1477 the great mass of native silver was found at Schneeberg, and honored by the elector Ernest, who used it on a memorial occasion as a dining table. It was a slab nearly a foot thick, and about 12 feet long by 6 broad. When it was melted, it yielded some 20 tons of silver. The mines of Marienberg date from 1521, and those of Mansfeld, which are still prosperous, from 1199. But older than any of these is Hungarian mining, which can be traced as far back as A. D. 750. Reitemaier* says the German mines were undeniably opened by miners from Gaul; but I think it fair to conjecture from the great antiquity of Hungarian mining, that there was also a direct current of progress from the east, perhaps not unconnected with those operations of the Danube to which allusion was made in a previous chapter. Whatever mining the Gauls did was done under Roman law, and certainly there is no trace of that law in the history of German mining. In this case, as in many others, the tide of Latin ideas broke in vain upon the rocky Saxon character, and retreating left no marks but such as time speedily erased.

The earliest records of mining law in the middle ages do not create, they only recognize and establish, the customs which were even then already old. If the source of these customs is lost in obscurity, so also is their gradual development; for, as I have said, the earliest publication of them was made in Trent—in other words, in a foreign land, where they came into collision with existing systems. Of their peaceful growth at home we have no trace. They suddenly appear in history, adult and strong. But they soon met with opposition and modification at home, where the emperor and the territorial sovereigns laid claim, at the end of the 12th century, to the mining royalty. The German mining law is a product of this antagonism—a compound of mining freedom with mining royalty—(*Bergfreiheit und Bergregal.*) The contest between the two principles occupied part of the 13th and 14th centuries. It was the south against the north, Egypt against Siberia. The proud dynasty of Hohenstaufen began the war. Frederick I claimed the mines of Trent as imperial royalties, (*regalia,*) and forced the bishop to accept a lease of them. The mines themselves were not interfered with. All that the emperor desired was a recognition of his prerogative, as a support to future claims; and, in general, the struggle of the German emperors for the royalty of mines was prompted, not by their desire to appropriate and work them, but by their claim of the right to levy on mining imperial taxes, independently of the different legislatures and sovereigns of the empire. Meanwhile, the territorial rulers saw their advantage in promptly adopting and employing for their own interest the theory of royalty, and finally the owners of the soil made themselves heard, and obtained a certain recognition of their claims to some non-precious metals.

During this conflict of ideas contradictory principles were proclaimed by different parties; and the thirteenth century presents a scene of confusion and uncertainty as to the relations of emperor, prince, landlord, and miner. The famous "Golden Bull" of Emperor Charles IV, dated January 9, 1356, simplified the contest by excluding from it two of the conflicting parties. That emperor was more inclined to augment his hereditary power as a Bohemian prince than to increase the prerogatives of his imperial authority, which would pass to some other German sovereign after his death. He therefore, in the imperial law referred to, surrendered the claims of the emperor in favor of the electors; and in fact the result of this partial surrender was the actual exercise of mining royalty by all the other sovereigns, as well as the electors. But the Golden Bull excluded also the land owner, putting all metals, precious and base, together with salines, under one rule, namely, the right of the territorial sovereign. Two forces were now left face to face, the royalty of the princes, recogized by the emperor, and the principle of free mining, already repeatedly recognized to a greater or less extent by the princes themselves. The relations of these two forces were not determined by the Golden Bull, which left the princes free to enforce their claims as far as they had already done so, or might be able to do so in future. The issue of the conflict, thus left to time, was different in different states; but the essential victory remained with the miners. The princes recognized the right of free prospecting and the right of the discoverer to the mineral deposit discovered, reserving to themselves only the usual tribute (finally the tithe) and the rights of police and magisterial jurisdiction. But although mining freedom thus obtained practical recognition, the rights of the sovereigns were exercised in exceptional cases in opposition to this principle. Mines and whole mining districts were granted without reference to the discovery; and the occasional feature of special grants was accepted as a part of the jurisprudence of mines. The procedure necessary to obtain property in minerals also suffered a change. Mere occupation by the discoverer was no longer sufficient; he must "denounce" his claim, and obtain his lease from the prince or his delegate—generally a regularly constituted office or court of mines, (*Bergamt, Bergbehörde.*) The maxim was still preserved, "The first finder is the first claimant;" but the greater weight was laid upon the "denunciation," (*Muthung,*) and the right of the discoverer was forfeited if he failed within a brief period to make his discovery known in the appointed manner. The princes of different states made use of their power to extend and modify existing regulations, so that mining codes proper took the place of the mass of traditional usages which had accumulated through four centuries, and which have been called by partial analogy the common law of mines.

German Mining Codes of the Sixteenth and Seventeenth Centuries.—One of the first steps taken by sovereigns to confirm by exercise their rights of royalty, was the endowment of certain cities and districts with peculiar privileges, on account of their mines. Turin and Vallensasco, in Italy; Mont Saut, in Languedoc; Truro and Pensance, in Cornwall; the Isle of Wight; Grünberg, Engleberg, and Melchthal, in the canton of Underwalden; several iron mines in the canton of Berne; the Black Erzberg, in the valley of Filisur; Mount Guntzen, in the Alps; Goldberg, Reichstein, Zuckmantel, Kupferberg, and Gieren, in Silesia; Cremnitz, Schemnitz, Altsol, Neusol, Königsberg, Puggany, Tyller, and Eperies, in Hungary; Smaland in Sweden; and Casan in Tartary, are examples of this practice outside of Germany. The mining cities of Germany were very numerous. The Harz alone contained seven, which exist to this day, St. Andreasberg, Altenau, Clausthal, Zellerfeld, Grund, Lautenthal, and Goslar. In Saxony, and particularly in the realm of the Counts of Meissen, was the "ancient and honorable free mining city" of Freiberg, originally called Freistein, the origin of which is interesting as an illustration of the history of the period. The Freiberg district, as I have said, was discovered about 1165 by a teamster of Goslar, (the locality of the famous Rammelsberg mines in the Brunswickian Harz) and first settled by miners from that place. A few years after, Duke Otto of Brunswick quarrelled with his director of mines, (*Bergvogt,*) and the latter, to revenge himself, marched to Saxony with all his workmen. They were joyfully welcomed by the Margrave, who not only granted them extraordinary privileges, but also, for the protection of the Freiberg mines in those uncertain times, surrounded them in 1176 with walls, and built the castle of Freistein in the midst of them. Saxony has many other mining cities, among which may be named St. Annaberg, Schneeberg, St. Georgenstadt, Schwarzenberg, Marienberg, localities of silver mining, and Altenberg, Eibenstock, Scheibenberg, Wolkenstein, and Ehrenfriedersdorf, localities of iron and tin mining. Arensberg at Cologne, and the copper mines of Riegelsdorf in Hesse, are also mentioned among the privileged mining districts. Watering-places were generally favored also, as appears from the following passage in an old essay on mining royalty:

> Regarding mineral springs, hot and metallic baths, it is not considered that a great prince should make a royalty of them, or demand of the guests at such places any payment for their use. For

* *Geschichte des Bergbaues, etc. bei den Alten Volkern,* p. 150.

Almighty God did not cause these springs to flow for the sake of princes and rich people only, but also, and perhaps chiefly, for the healing of the poor. And it is to be feared that they may dry up, if this gift is abused, as indeed was the case with the Griesbach, not far from Strasburg, the water of which disappeared when a certain duty was imposed upon the spring, but reappeared again as soon as the duty was removed. For this reason the Emperor, Charles IV, granted a privilege to the Wildbad of the Canton Berne. If a prince, however, should tax lightly the guests at any spa and use the money for their benefit, as, for instance, in the erection of a church in that place, he may not be reproved.

The principal German mining codes (*Bergordnungen*) of this period are those of Electoral Saxony, Cremnitz and Schemnitz in Hungary, Treves, Joachimsthal, Brunswick-Lüneberg, Zohnstein, &c. There is also a Danish mining code, and a good statement of general principles in the celebrated work of Agricola, *De Re Metallica*. It would be scarcely profitable at this time to review these different systems in detail, or to burden the general description which I propose to give with constant reference to particular sources of information. It will be quite sufficient for my purpose to present a picture of those features in which the codes of this period substantially agree, in order to show the general nature of the system which obtained throughout middle Europe during the period of "paternal government"—a period when political economy was imperfectly understood, and the doctrine that sovereigns might interfere for their own private ends with individual industry was replaced by the notion that governments ought to regulate for the general good all the affairs of the people.

It was principally the flow of precious metals, and afterwards of other products, from America to Europe which brought the industrial problem of the sixteenth and seventeenth century, and placed commerce in antagonism with the hitherto accepted maxims of government. At the end of the fifteenth century the value of the precious metals in Europe reached its maximum. The price of grain in 1494 was only half as much as in 1399; but it rose in the sixteenth century, (or, in other words, gold fell) to three times, and in the seventeenth century to five times, the price of 1494. The effect of this change on mining was disastrous; and the arbitrary measures taken, in accordance with the spirit of the age, to abate the evil, of course failed of their intended effect. It must be remembered that at this time the laws regulating the guilds prescribed precisely how many masters, journeymen and apprentices there should be in every trade, and what wares they might or might not produce; workmen were not allowed to labor outside of their proper city; heavy penalties attended the importation of any article which, in the opinion of the guilds, could as well be manufactured at home. It is not surprising that mining also was administered by the state under a bureaucratic system, and on false notions of political economy. It is amusing to read that in one instance the increase of the number of coal mines was forbidden, *lest the expense of so many deep workings should raise the price of coal*, while, at the same time, the owners of mines nearest the market were prevented from working, because it would not be fair to those whose mines lay further away! In spite of such follies as these, however, there grew up an elaborate, and, in many respects, very wise system of administration, much of which has remained to the present day, and is well worthy to be studied.

A scheme of the organization of this industry would be something like the following:

1. The sovereign.
2. The director of mines, (*Berghauptmann.*) This officer represents the government, and is the highest authority. There may be more than one in the same state if it is a large one. Prussia recently had five, besides one chief director of mines, who was at the same time a sort of minister without a vote (*Vortragender Rath*) in the royal cabinet.
3. Mining councillor (*Bergrath.*) These are inspecting and consulting officers, who make periodical tours through the districts under their charge, and report to their superior. The director of mines and the councillors include within their duties also the administration of smelting works; but all ranks below them are restricted to one or the other department.
4. Master of mines, master of furnaces, (*Bergmeister, Hüttenmeister.*) This officer has charge of a single district, and inspects weekly.
5. Sworn inspectors of mines or of furnaces, (*Berggeschworene, Pochgeschworene.*) These officers inspect daily.
6. Surveyor, (*Markscheider.*)

These six grades must be filled by men of thorough education as well as experience.

7. Captains and foremen, (*Bergsteiger, Pochsteiger, Untersteiger.*) These officers may or may not be graduates of schools. They are chosen for their faithfulness and practical ability, and are constantly under the supervision of the various inspecting engineers.
8. At the smelting works there are assayers, counter-assayers, &c., and there is a paymaster (*Schichtmeister*) elected by the miners and confirmed by the mining court, who takes charge of the accounts of several mines at once.

This is an outline of the system which still prevails substantially in Germany. I am far from recommending, as the sequel will show, the adoption of such a plan by the American government; but mining companies in different districts would be greatly benefited if by free and voluntary association they could effect a similar cheap and effective administration. Under such a system the whole mining enterprise of the Comstock lode could have been superintended by the ablest men in the country at one-quarter the expense which has been incurred under the multiplied administrations of different companies.

As I have said, great weight is laid, in the ancient codes, upon the denunciation of claims. Prospecting seems to have been in most cases unhindered. Says a German writer:

Here occurs the question whether a private person has any right to dig for and mine metals on the ground of another. A doubtful question *a priori*, since "no one may go a-hunting on another's land." It is also forbidden for any one to seek treasure on the land of another, and we might naturally suppose gold and silver mines to be meant; nevertheless the contrary is declared, in view of the general benefit from the production of metals, and the particular advantage of the royalty to the coffers of the state.

This freedom of prospecting was, however, limited so far that the foundations of buildings must not be injured, and all damages done to the surface or to agriculture must be paid. The discovery of a vein must be immediately made known to the master of mines by a denunciation, either written, or, if oral, then followed within three hours with a written one. The master of mines must see that the first discoverer is not cheated of his rights. He also exercises a general authority over all the prospecting work, and when the vein is actually exposed, he issues upon the denunciation aforesaid a permit to work it, (*Muthzettel, Muthschein.*) No such permit can be issued unless the denunciation contains an accurate description of the locality of the vein; until such a definite statement is possible the work proceeds merely as prospecting. After the permit is issued, the miner may go on until he has developed the true dip and course of the vein and opened it to a sufficient depth to require "bucket and rope" for his operations. At this point the master of mines orders a survey and location of the field, which is then regularly leased to the holder of the preliminary permit. Denunciations of placers (*seifen*) may also be received, but the master must then visit the place in company with the royal gamekeeper and forester, and satisfy himself that the proposed operations will not be hurtful to timber, game, irrigating or draining canals, etc., when he may give a license for placer mining. This license, however, he may revoke at any time; and if wilful damage is done in these respects by the placer miners, he may not only eject them, but hold them for the repair of the said damage, and even proceed, if required, to punish them for the wrong committed. The erection of stamp-mills, etc., he may authorize, if not to the injury of others already erected. All mining leases require the work to be continuously prosecuted. Parties engaged in making preparatory shafts and tunnels are allowed no interval, unless they are miners at work part of the time elsewhere. This provision was evidently intended to encourage prospecting by the workmen in their leisure hours, and to give them a chance to become mine owners on their own account; but at the same time to prevent capitalists from commencing work and then dropping it, while continuing to claim such rights as would exclude other adventurers. After the mines are open and ore is struck, the making of the survey and application for a lease is peremptory, and when the lease is once issued, certain delays, caused by natural necessity, are to be permitted. Foul air or much water are good excuses. The longest interval of idleness, however, must not exceed one quarter for silver and two quarters for base metals. Other claimants offering at any time during such an interval, "time is called" upon the idle lessees, and they must presently resume operations or lose the lease, which may then be issued, upon new denunciation, to others. Parties receiving permits to reopen abandoned mines are not obliged to specify the vein or veins they will work, but must report them and take leases upon them as soon as they are discovered.

Leases were generally subject to the royalty, usually 1-10 or 1-20 of gross product, paid to the sovereign. Where the mines were upon private lands, the landlord received a second tithe in lieu of damages. It was common also to give the Elector, "by ancient usage," one-eighth of the stock in every leased mine. This he retained, liable to the same assessments as any other stockholder, and if he at any time declined to pay his share of assessments his stock was forfeit. Poor mines, and in many cases iron mines, were freed from the oppressive tithe. Yet the coal mines were frequently held subject to the metallic royalty. The Counts of Schaumburg are said to have derived as much revenue from coal as other princes from silver. In Holland and Lower Saxony, even peat was laid under royalty, and it was not uncommon to include the manufacture of saltpetre in the same category.

Mining leases covered a certain area of the surface and a space below the surface, either bounded by vertical planes or by surfaces parallel with a dip of the vein. The first was called a square location, (*gevierdtfeld*), and the second an inclined location, (*gestrecktfeld*). The practice of following to any distance outside of the vein leased the "dips, spurs, and angles," was unknown; and I am unable to discover any traces of it in ancient or modern times except in the mining customs of this country. The possessor of an inclined location was generally allowed to work about 30 feet in the hanging wall, and the same distance below the foot wall, (*Vierung, viertehalb Lachter ins Hangende, und viertehalb Lachter ins Liegende*). Within these limits all the ore discovered might be extracted by the lessee. In cases of veins crossing the elder location took precedence, but could only maintain the right to a zone of 30 feet on each side of its vein. In cases of doubtful controversy the matter was compromised by a union of the two mines. The simple square location was applied to beds, masses, and even to true veins, when they possessed a dip of not more than 15° below the horizontal plane. The size of this kind of location varied with the locality and the circumstances, such as the number of associates or stockholders, etc. A frequent size seems to have been about 200 feet square, with the discovery shaft in the centre. The length of a claim upon a vein was also variable. In Frieberg, I believe, 400 feet were allowed; in Hungary 200, and elsewhere, ordinarily, 300. According to the general rule, the discovery shaft stood in the middle of the claim. A mine was generally divided into 128 shares, (*Kuxe*), which might be held by one man, if he could afford it; but such was scarcely ever the case. An old authority says, "a silver mine needs thirty-two stockholders, a copper mine sixteen, and a tin mine eight." Wood for timbering was furnished, when possible, by the royal forester. Where there were no crown lands and forests, the companies must agree with the owners of timber, and it was the duty of the master to preserve harmony and fair play between the two interests. The mines were mostly worked under contracts with the laborers, and the price per foot or fathom (*Lachter*) was fixed by the master and sworn inspector, according to the varying hardness of rock and difficulty and danger of the work. The driving of adits or deep tunnels was the privilege of the prince, but it was almost universally permitted, under certain regulations, to private parties. There were peculiar rights connected with such a work. One was the tunnel-right, (*Stolleniheb*), entitling the lessee to all ores found within about eight feet (5 *Viertellachter*) above the water level of the tunnel, and for a distance of two feet on either side. The second right was the tunnel royalty (*Stollengerechtigkeit*), entitling the tunneller to one-ninth of the profits of any mine drained and ventilated by his tunnel. To gain this, however, the tunnel must really and effectively drain and ventilate; and this royalty might be taken away by the opening of a deeper tunnel, which thus acquired the right to one-ninth the mining profits. In order to gain either of these privileges a tunnel must be a certain distance "under grass," in Saxony 70 feet, and in some states as much as 120. A new tunnel, in order to be entitled to the royalty already enjoyed by an older one, must strike the mine at least 30 feet deeper. Special contracts were frequently made between tunnels and mines, by virtue of which, when the ninth was too onerous and the mine was in danger of failure, a lower royalty was accepted.

The Spanish Mining Law.—The essential features of this law were given in the first report of Hon. J. Ross Brown, and I shall only recapitulate a few important facts in regard to it, referring to that report and to the full compilation of Mr. Rockwell.[1] The royal ordinance of the King of Spain published in 1783, has been ever since substantially in force in Mexico. It asserts the right of sovereignty over all species of metal, and authorizes the concession of mineral rights only while the mine is worked. It is also very full in its directions as to the manner of mining, experience, having shown that a mere temporary ownership of mines tends to a reckless and insecure method of exploitation. This law is remarkable for an attempt to reconcile the two systems of square and inclined locations by an elaborate graduation of the size and shape of the surface claim according to the dip of the vein. Chapter VIII of the ordinance, containing this plan deserves to be quoted. It runs as follows:

Section 1.—Experience having shown that the equality of the mine measures established on the surface cannot be maintained under ground, where, in fact, the mines are chiefly valuable, it being certain that the greater or less inclination of the vein upon the plane of the horizon must render the respective properties in the mine greater or smaller, so that the true and effective impartiality which it has been desired to show towards all subjects of equal merit has not been preserved; but, on the contrary, it has often happened that when a miner, after much expense and labor, begins at last to reach an abundant and rich ore he is obliged to turn back, as having entered on the property of another, which latter may have denounced the neighboring mine, and thus stationed himself with more art than industry—this being one of the greatest and most frequent causes of litigation and dissension among the miners—and considering that the limits established in the mines of the kingdoms, and by which those of New Spain have been hitherto regulated, are very confined in proportion to the abundance, multitude, and richness of the metallic veins which it has pleased the Creator of his great bounty to bestow on these regions, I order and command that in the mines where new veins, or veins unconnected with each other shall be discovered, the following measures shall in future be observed:

Sec. 2.—On the course and direction of the vein, whether gold, silver or other metal, I grant to every miner, without any distinction in favor of the discoverer, whose reward has been specified,[2] 200 yards, taken on a level, as hitherto understood.

Sec. 3.—To make it what they call a square, that is, making a right angle with the preceding measure, supposing the descent or inclination of the vein to be sufficiently shown by the opening or shaft of ten yards, the portion shall be measured by the following rule:

Sec. 4.—Where the vein is perpendicular to the horizon, (a case which seldom occurs,) one hundred level yards shall be measured on either side of the vein, or divided on both sides, as the miner may prefer.

Sec. 5.—But when the vein is inclined, (which is the most usual case,) its greater or less degree of inclination shall be attended to in the following manner:

Sec. 6.—If to one yard perpendicular the inclination be from three fingers to two palms,[3] the same hundred yards shall be allowed for the square, as in the case of a vertical vein.

[1] A Compilation of Spanish and Mexican Law in Relation to Mines, &c., by J. A. Rockwell, New York, 1851.

[2] The reward of the discoverer (chap. iv, secs. 1 and 2) consists in three "portions" of the vein when in a mountain where no shaft nor mine has ever been opened before, and two portions when in a mountain known and worked in other parts. This grant is conditioned upon denunciation within ten days, and like all others, becomes void by four months' neglect to work the mines.

[3] This corresponds to a "dip," as now estimated by mining engineers, measured by the angle between the plane of the lode and that of the horizon, of 85° 25′ to 63° 20′. In the following section

Sec. 7.—If to the vertical yard there shall be a departure of—

Amount of departure.	*Side of square allowed.*	*Dip. in degrees.*	*Depth.*
Two palms, three fingers .	112½ yards	60° 39'	200 yards.
Two palms, six fingers . .	125 yards.	58°	do.
Two palms, nine fingers. .	137½ yards . .	55° 30'	do.
Three palms	150 yards.	53° 08'	do.
Three palms, three fingers	162½ yards . . .	50° 55'	do.
Three palms, six fingers .	175 yards.	48° 50'	do.
Three palms, nine fingers .	187½ yards.	46° 50'	do.
Four palms	200 yards	45°	do.

So that if to one vertical yard there correspond a departure of four palms, which are equal to a yard, the miner shall be allowed 200 yards on the square of the declivity of the vein, and so on with the rest.

Sec. 8.—And supposing that in the prescribed manner any miner should reach the perpendicular depth of 200 yards, by which he may commonly have much exhausted the vein, and that those veins which have greater inclination[1] than yard for yard, that is to say of 45 degrees, are either barren or of little extent, it is my sovereign will that although the declivity may be greater[2] than the above mentioned measures, no one shall exceed the square of 200 level yards, so that the same shall always be the breadth of [claim upon] the said veins by the length of 200 yards, as declared above.

Sec. 9.—However, if any mine owner, suspecting a vein to run in a contrary direction to his own, (which rarely happens,) should choose to have some part of his square [laid off] in a direction opposite to that of his principal vein, it may be granted to him provided there shall be no injury or prejudice to a third person thereby.

Sec. 10.—[Provides that banks, beds, or other accidental depositories of gold or silver shall be apportioned into claims by the miners themselves, attention being paid to the richness of the place and to the number of applicants, and preference given only to the discoverer. The government reserves the right to revise such local mining regulations so as to prevent unfair dealing.]

Sec. 11.—The portions being regulated in the manner described above, the denouncer [that is, each claimant) shall have his share measured at the time of taking possession of the mine, and he shall erect around his boundaries, stakes or landmarks, such as shall be secure and easy to be distinguished, and enter into an obligation to keep and observe them forever, without being able to change them; though he may allege that his vein varied in course or direction, (which is an unlikely circumstance: but he must content himself with the lot which Providence decreed him, and enjoy it without disturbing his neighbors. If, however, he should have no neighbors, or if he can without injury to his neighbors, make an improvement by altering the stakes and boundaries, it may be permitted him in such case, with previous intervention, cognizance, and authority of the deputy of the district, who shall cite and hear the parties, and determine whether the causes for such encroachment are legitimate.

It is frequently said that the Spanish mining law is the best that was ever devised. It certainly is one of the most elaborate, and perhaps was well fitted to the knowledge and social conditions of the era when it was formed. But a careful study of it is sufficient to show that it is now antiquated. The chapter above quoted, for instance, is evidently based on two assumptions: first, that mineral veins very seldom change their course and dip, and that an opening ten yards deep is enough to show what these characters are; and second, that no mine can be profitably worked to a greater depth than 200 yards. The first of these assumptions is not justified by experience; and the second has long since been rendered obsolete by the steam-engine, deep tunnels, and other appliances of modern engineering. The Spanish system in Mexico has certainly stimulated mining, after a fashion, in that country. The mines of Mexico have produced vast quantities of bullion, but a closer examination reveals that the art of mining itself has made little progress; the lack of permanent proprietorship has led to reckless robbery of mineral deposits; very valuable veins have been so unskillfully opened as to render deep workings impossible; the profits of mining have not been expended in permanent improvements, but either carried out of the country or wasted in civil wars; in short, Mexico has been plundered, not developed. She is just so much poorer to-day by the millions she has yielded to man; and those millions are proof only of the magnificent endowment which nature bestowed upon the land, not of any extraordinary wisdom in its administration. At the present time the policy of the Mexican government is to tax mining just as much as it will bear. A recent reduction in the exorbitant charges upon the extraction and exportation of bullion was the result merely of the determination of the mining companies to stop work if these tyrannical exactions were continued; and I do not yet see the signs of an intelligent and liberal policy towards this industry. The spirit of old Spain, which regarded the treasures of the earth as a prize to be avariciously grasped and selfishly appropriated, is still dominant in republican Mexico. An indolent people desires mining to prosper, not that agriculture, manufactures, and all other forms of industry may also prosper, but that all these industries may be unnecessary. The cure for this evil is to alienate the mines from the government, make them private property, put them on a level with other property, relieve them from unjust taxation, and make them a part of a wise general system of internal administration. Whether such a change could be effected as would extend the miner's title along the dip of the vein in depth, I do not pretend to decide. In Prussia the inclined location has been abolished; but that country has been so long the scene of mining operations that almost every group of mineral veins has been sufficiently explored to determine its peculiarities. Hence, by a proper selection of ground on the surface, a mining lessee may secure all the advantages of an inclined location. Whatever be the case in Mexico in this respect, it is, I think, quite necessary at present in our comparatively unexplored mining regions to give the miner what in early days the German law gave him, the right to follow his vein.

Modern German Codes.—The elaborate administration of the mining interest on the part of the state which characterized Germany in the middle ages is giving way to a more democratic policy. Even so late as a century ago, the mining code of Frederick the Great made it the duty of the authorities to superintend all mining operations, to inaugurate them in one district, regulate them according to scientific principles in another, or sustain and protect them where they were already properly established. This policy is no longer necessary. The spread of knowledge and the activity of commerce renders it safe to leave to the mining communities in the main the management of their own affairs. The new Prussian mining law, which took effect October 1, 1866, replacing the former systems of Prussia, Nassau, Hanover, Electoral Hesse, Frankfort, and other provinces, presents the best example of the modern idea, in which education takes the place of government; and I shall content myself with a brief review of its characteristic features, omitting any detailed description of the present codes of Austria, Saxony, and other German states, as prolonging too far this already extended historical sketch.

1. According to the general mining law of Prussia,[1] the following minerals are excluded from the proprietary rights of the land-owner; Gold, silver, quicksilver, iron, (with the exception of bog-iron ores,) lead, copper, tin, zinc, cobalt, nickel, arsenic, manganese, antimony, sulphur, ores of alum and vitriol, pit coal, brown coal, graphite rock salt and other salts occurring with it, and salt springs. These minerals are objects of mining, and the law prescribes the manner in which a title to them can be obtained. The state surrenders entirely its claim to mineral rights, and stands henceforward on the same footing as private citizens, retaining only the rights of police, justice, and finance, which it exercises over every other form of property and labor. Special grants, made under the ancient system, are not interfered with. To be properly objects of mining, the minerals enumerated must be (1) in their natural deposits, and (2) in such forms as can be utilized. Alluvial deposits, such as gold or tin

I have added to each specification the dip in degrees, and also the depth in yards at which, according to this law, the vein, *if it held a regular dip*, would pass out of the mining field into the neighboring one.

[1] The word "inclination" is the same as I have previously translated "departure," and a greater inclination than 45 degrees would be, in modern phrase, a smaller one, that is, the vein would dip less than 45 degrees below the horizon. See remarks on this section, below.

[2] Less.

[1] Perhaps the best manuals on this subject are those of Mining Councillor R. Klostermann, Berlin, and Director A. Huyssen, of Halle, both of which I have freely used, in various portions of this report.

placers, are included; the rare metals, precious stones, amber, petroleum, &c., are either left to the land-owner or made subject to special regulations. Marble and building stone generally are not held as objects of mining. In provinces once Saxon, as in the present kingdom of Saxony, coal belongs to the owner of the surface.

2. Prospecting, (*Schürfen,*) whether by open cuts, pits, shafts, tunnels, or bore-holes, is allowed to all under the following limitations: It must not be carried on upon any public square, street, or railway, nor in grave-yards, nor in places where the authorities forbid it on grounds of public interest, nor, without express consent of the owner, within 200 feet of any building on grounds belonging to the same, nor in gardens or yards. Whoever wishes to prospect on the grounds of another must seek his permission, but every land-owner must give such permission to all applicants, unless some one of the objections above enumerated can be shown to exist. Probable injury to wells, mineral springs, ponds, or neighboring mines is sufficient ground for prevention of prospecting by the mining authorities. The prospector is bound to pay the land-owner annually in advance for the use of his land, if it be necessarily withdrawn by the prospecting operations from other uses, and to return it to him at the close of such occupancy, with damages for any depreciation of its value. All disputes arising are settled by the proper court. The prospector must make formal application in every case to the authorities, and receive the necessary license, before commencing to work. The proprietor of mines in operation cannot forbid prospecting in his field for metals to which he has not acquired the right; but, like the land-owner, he may demand security in advance for possible damages to his own property; and, when the new prospecting work actually threatens the safety or the undisturbed operation of the older mines, the authorities may refuse to allow it. But the owner of a mine has the preferred right to apply for permission to work for other metals than those already granted to him if the authorities decide that the former had better be mined in common with the latter. If the prospector, therefore, discovers them, the previous miner in the same field may claim them.

3. The discovery of a vein must be followed by its regular denunciation, (*Muthung.*) This act, like the recording of a claim in American mining districts, gives the miner at once the right of property in the mineral. The denunciation, which is also an application for license to mine, is made in writing, and in duplicate. Each copy is endorsed with the day and hour of presentation to the authorities, and one is then returned to the applicant. It must contain the name and residence of the applicant, the name of the metal or metals to be mined, a description of the locality in which the vein or deposit has been discovered, and the title by which the mine is to be known. A title already applied to a mine in the same district is not allowable. As I have said, the mere presentation of this document gives the applicant a *prima facie* ownership; but this right is still conditioned upon the investigation of the mining authorities, as to the validity of the alleged discovery. The metal or metals mentioned must be found, by official examination, to exist at the point described, in natural deposit, *i. e.*, not brought there by human agency, and in such quantity as to justify mining. The latter question is a delicate one, and the facts are generally construed with great liberality towards the applicant, who, after all, assumes the greatest risk of loss, if the deposit be poor. But certainly the rights of a land-owner are not to be disturbed to favor some crack-brained adventurer who has found a seam of coal an inch thick, or a lump of galena as large as a walnut. Under this rule the mining authorities of Bonn refused to grant a license on the strength of a few particles of pyrites in the rock. It should be also borne in mind that such a refusal is no real hardship to the prospector, unless he desires to deceive some one, or the public, as to the value of his claim. He is still free to continue prospecting as before. Finally, the authorities have to be satisfied that the proposed concession of a mining field does not conflict with the rights of other parties, whether earlier discoverers or neighboring mine-owners. For this purpose due nctice must be giveu, and a certain time allowed. Meanwhile, the applicant must have the field surveyed by the official surveyor, and file duplicate maps, upon which the discovery-point and boundaries are laid down. This must be done within six weeks after the denunciation, otherwise the latter fails of validity—a very important provision calculated to secure the *bona-fide* prosecution of a claim by the discoverer. The actual discoverer of a vein has, for one week after his discovery, the prior claim, even though another make earlier denunciation; but after the lapse of that period the date of denunciation determines priority of right.

4. Mining rights are granted, as far as possible, in fields bounded on the surface by straight lines, and in depth by vertical planes. The ancient custom of granting "inclined locations" on the dip of the vein is thus entirely abolished, and modern authorities in Europe do not hesitate to condemn it as productive of great uncertainty and litigation. The size of the field on the surface may be a little over five acres in most parts of Prussia, but is restricted to a quarter of an acre in a few districts, for special reasons. Theae areas give only the maximum; of course smaller fields may be granted. The shape of the field may vary, straight lines being the boundaries, and the greatest length not exceeding for a five-acre field about 13,600 feet (2,000 Prussians *Lachter* or fathoms,) and for a quarter-acre field one-fourth that distance. The discovery-point must lie within the field, though not necessarily in the centre.

5. All preliminaries being complete, the deed (*Verleihungsurkunde*) is made out in the name of the king, and published in the official newspaper of the district. It contains the name, business, and residence of the grantee, the name of the mine, the area and boundaries of the field, with a description of its location as to parish, county, civil and mining districts, the names of the metals to be mined, the date, and the seal and signature of the authorities. Three months are allowed for the assertion of conflicting claims, after which the rights of such claimants, in ordinary cases, expire.

Under certain conditions, which I will not pause to enumerate, the consolidation of adjacent mines is permitted. The division of one field into several, or the exchange between neighboring mines of portions of their respective fields, is generally permitted by the authorities; but such divisions or exchanges are not permitted as would leave segregated mining fields too small to be worked independently.

6. The nature of the property thus conveyed to the grantee is defined as "the right to obtain and utilize the minerals excluded for reasons of political economy from the title of the land-owner, and to construct, above and under ground, all necessary buildings and apparatus for this purpose." This right may be sold, mortgaged, and levied upon, like real estate. It must be exercised, however, under certain regulations, justified by the general good, and fixed by the state, and, when these conditions are not complied with, the right itself may be impaired or forfeited. A few of the more important conditions will be enumerated. The mine-owner is bound to keep the mine in operation, if so required by the authorities. It is no longer, as formerly, forbidden to let a mine lie idle for more than a certain period. On the contrary, work may be suspended at any time, without the formal permission of the authorities; and they can only demand its resumption when clearly required by public interests. A great lack of metals produced, and an impossibility of obtaining a supply from other quarters, would be a satisfactory reason for such a demand. The owner has six months' time in which to comply with this demand, and, even before it is issued, is entitled to a hearing of his protest. He may also appeal to the minister of commerce. If he intends to resume work, he gives the authorities four weeks' notice of the fact. But if he fails to comply with their demand, they may proceed to deprive him of his grant, unless the circumstances which made the demand proper have in the mean time changed. Every mine must be worked according to a plan, which must previously be submitted to the government officials, and approved by them. If no objection is made, the mine-owner may proceed with his plan. If the plan is objected to, which can only be on grounds of safety to the mine, the miners, and the public, the mine owner must convince the authorities that their objections are unfounded, or change his plan to obviate them. Violation of this rule is punished with fine, and if necessary the authorities may suspend operations at

the mine. Every mine must have an exact map of the underground workings, and this must be periodically perfected as the work advances. The responsible managers and superintendents of mines must be reported to the authorities, and if necessary examined as to their capacity for their several positions. If a person not recognized as competent by the mining authorities is put in charge of a mine, they may demand his removal, or suspend the operations of the mine until a competent person is appointed. Superintendents are responsible for the proper working of the mines according to the plans agreed upon, and bound to afford the proper officials free opportunity for inspecting the works, and all desired information. The mine-owner is bound to furnish, at stated periods, the statistical information called for by the minister of commerce. He must also permit persons bearing the permission of the authorities to enter his works. (This provision is most beneficial to students at a German school of mines, since they enjoy by virtue of it an opportunity of studying practical operations, such as they could not otherwise obtain.)

7. The mining authorities are: 1. The district officials (*Revierbeamten*;) 2. The supreme mining bureaux (*Oberbergämter*;) and 3. The minister of commerce. The district officials are inspecting and reporting officers or surveyors. The names given in a previous chapter, on the codes of the middle ages, are mostly retained, but the superintendents and mining captains are no longer government officials. The mining bureaus are presided over by the directors, as formerly. They issue licenses and grants, and have the general administration of the law in their hands. The minister is appealed to in the last instance.

8. In addition to these authorities there are the courts, the jurisdiction of which is determined by statutes, and is not at present important for us to consider. It is, however, a fact not without significance that all the German states have various courts, in which cases arising in mining operations may be adjudicated, often without the tedious forms attendant upon ordinary suits. The English court of the stannaries is an institution of this kind, and the English "cost-book" system of stock companies is also the counterpart of the immemorial *Gewerkschaften* of Germany. Our American mining districts contain many examples of mining partnerships or associations of a similar character: and no doubt it will be found advisable in the course of time to establish courts and rules of procedure adapted especially to this state of things, as has been done in all older states. Further remarks on this subject will be found in the portion on English mining law.

9. The Prussian law in respect to the taxation of mines has been greatly simplified, but there still remain many complicated provisions which must be regarded as legacies of the past. In view of the history of that kingdom under the most remarkable dynasty of modern times, its gradual increase from the original limits of the little duchy of Brandenburg, by constant territorial acquisitions, to its present imperial proportions, and the respect which it has always shown towards existing laws and privileges, and towards its own past contracts and grants, it is not wonderful that those differences in legislation which I have mentioned in a previous chapter as growing up in the petty states of Germany should still be to some extent perpetuated in the provinces of Prussia. The present Prussian mining law is based upon nearly a score of ancient codes, and recognizes many local exceptions to its general provisions. There has been, however, a steady progress towards unity and simplicity, and the general outline of this progress is instructive. According to former laws all mines were bound to pay the sovereign a royalty of one-tenth of their gross product free of mining cost to him. This was reduced by the law of 1851 to one-twentieth; by the law of 1861 a gradual decrease was established amounting to one-fifth of the royalty per annum, until the royalty should be reduced to two per cent.: by the law of 1862 iron mines were declared entirely free of royalty, and a new decree established with regard to all mines, by virtue of which, after January 1, 1865, the royalty was to be but one per cent.; and this is the present amount paid to the state under that head. The state pays its share of the expenses of reducing ores, but receives its percentage of gross product free of mining cost.

But in addition to the royalty there were formerly innumerable taxes and commissions paid by the mines to cover the expenses of the scientific and financial administration carried on by the state. In some provinces (as I have said in a previous chapter) the sovereign had a certain share of the stock of every company as a complimentary gift; and on this he could draw his dividends like any other stockholder, being bound at the same time to pay assessments or forfeit his interest. There were quarterly dues, additional quarterly dues, dues for measurements, for specimens, for inspections, for auditing accounts, for supervision and direction, for affidavits, for weighing, for assaying, for surveying, in short for every act which the government officials performed; and these were not fees but fixed sums assessed upon the mines, as a hotel-keeper on the Rhine charges for candles, attendance, etc., the same amount in every guest's account. All these petty payments are now abolished, and in place of them a regular "tax of supervision," amounting to one per cent. of the value of the product, is levied on mines in actual operation. When surveys or other special services are performed for any mine, the official is merely paid a proper fee for his labor. Many of the services formerly performed by the officials may now be done by others, the authorities reserving only the right to insist upon the employment of competent persons. The tax of supervision of one per cent. is therefore nothing more than a contribution from the mines to secure thorough scientific inspection and direction of their works at a far cheaper rate than would be possible under any other arrangement. What American mining company, even among the wealthiest, could obtain the service of a whole board of able engineers and metallurgists, such as the directors and inspectors of every German mining district, by the payment of one per cent. of its product? Certainly in that vast number of our mines which are just beginning to produce, and need more than any others wise counsel and direction, much time, labor, and money are wasted, because competent direction is too expensive. I think it possible to devise a plan, not inconsistent with American ideas of individual liberty, by which the opportunity to acquire such assistance may be afforded to our mining districts. But a national school must first give us the material in the shape of thoroughly trained engineers, before we can expect either legislation or association to secure so great a reform.

To recapitulate: the Prussian law, apart from local exceptions, imposes a royalty of one per cent., which is net revenue to the state, and a tax of one per cent., which the state expends for the good of the mines themselves. I shall urge, in the sequel, that the United States ought to repudiate the whole doctrine of a royalty, as such, and leave the mines free from taxation under that head. The late bullion tax was something of that nature, and has properly been abolished. But that the mines, thus relieved of all burdens, may rightfully be required to contribute something toward the expense of such necessary provisions for their own benefit as they cannot make, in their isolated condition, for themselves, is a far more reasonable proposition, and one which deserves serious consideration. A tax far lighter than the late bullion tax might be so expended as to save to the mines themselves millions of dollars every year. Prussia received from her mines, in 1865, a little over $9,000,000 gold (American.) This was partly the product of mines actually worked by the state, and partly the royalty from others. The expense incurred by Prussia on account of the mines in the same year was more than $7,000,000, leaving a net profit of only $2,000,000. The steady reduction of taxes under such circumstances shows that the government has adopted the wise and liberal policy of administering the mining law so as to secure, not an immediate revenue to itself, but an energetic and skilful development of the resources of the country, rightly deeming the increased production and use of the metals to be worth more to the nation than a few thousand of dollars, obtained by stifling this most beneficent industry.

The Code of France.—It was the law of April 21, 1810, in the formation of which the Emperor Napoleon I took so large a part, which gave its present constitution to the mining industry of France. Under the ancient monarchy the mines were regarded as a dependency of the royal domain, and only the sovereign could grant permission for their exploitation. Such grants had only a temporary character, and were most frequently encumbered with onerous conditions of payment into the royal treasury, besides those which in the majority of cases must be made to the owner of the soil.

After the abolition of feudal rights, the mines and mineral deposits of France were placed, by the law of July 28, 1791, at the disposal of the nation, and the government was authorized to make "concession" of them; but this concession was at the same time forbidden to be otherwise than temporary; and, moreover, all that part of every mineral deposit lying within a hundred feet of the surface was expressly reserved to the landed proprietor, who also had a right of preference in obtaining the concession. These provisions nearly amounted to a prohibition of general mining. It was made easy to mine in the case of those persons only who, being farmers, would probably not care, or know how to mine; and it is no wonder that, under these restrictions, little progress was made in the exploitation of mineral deposits.

The law of 1810 declared, in accordance with the Code Napoleon, that the property in minerals goes with the property in land; but stipulated that the government might separate the two, granting the mineral right, even in perpetuity, to another than the land-owner, on the single condition of a tribute paid to the latter. It made this property in minerals negotiable and taxable like any other, putting it on a basis as secure as that of real estate. In this way protection was given to capitalists desiring to engage in mining, and an era of prosperity, previously impossible was inaugurated for the mines of France. The law, in making this distinction between surface and subterranean proprietorship, has included in the class of mines only those substances which by reason of their nature or the manner of their occurrence must be exploited in a certain way, according to special rules. All other minerals are left to the proprietor of the soil, and may be worked under a simple permission, or without such permission, subject to the police regulations established by government. *Minieres*, or surface works, such as beds of iron-ore, workable by open excavation, pyritous earths, suitable for the manufacture of copperas, or deposits of peat, require the permission referred to; quarries (*carrieres*) of building-stone, marble, granite, sandstone, &c., require only observance of the police regulations. Mines, in the sense of the law, capable of becoming the objects of a concession, include therefore mineral fuels, bitumens, sulphur, alum, and metalliferous deposits of every kind except the beds of iron specially classed as *minieres*. Among the substances thus legally subject to segregation from the surface proprietorship, only two, mineral fuel and iron, are worked to any large extent in France. Aside from these, there were in that country in 1860, only 247 mines of all kinds, classified as follows:

Graphite and bitumen	50
Pyritic and aluminiferous ores	15
Rock salt and salt springs	29
Antimony	24
Manganese	20
Lead and galena	18
Lead and silver	27
Copper	9
Copper, lead and silver	17
Lead, silver, zinc, copper, and other metals	30
Gold and silver, separate or together	3
Arsenic, separate or with gold and silver	2
Tin	2
Sulphur	1
Total	247

At the time when the law of 1810 was passed, however, the mines of France were not so limited in number. The productive provinces west of the Rhine, which now belong to Prussia, were then included in the empire of Napoleon; and the principles of mining law, as well as the rates of taxation established by the French law of 1810 and the imperial decree of 1811, remained in force under the Prussian supremacy until the end of 1864. The only change made by the Prussian law in regard to loyalty is the subjection of salt mines and springs in those provinces to the state. This was necessary on account of the monopoly of salt maintained by the Prussian government. In all other respects the law of Napoleon virtually continued in west Prussia.

The provisions with regard to taxes were these: Each mine paid a certain fixed sum per annum, according to the size of its field, and also a tax of 5 per cent. on net profits. To this amount one-tenth was added to cover incidentals. The net profit was ascertained by subtracting the cnrrent expenses, only, not the cost of permanent improvements, from the total production. These taxes amounted in the aggregate to about 2 per cent. of the gross product; and since the 1st of January, 1865, they have been replaced by a single tax of that amount. It is, of course, much easier to collect a tax on gross receipts than on net profits, and the result is the same to the mines. Prussia has also declared the iron mines free of tax. Thanks to the law of Napoleon, which swept away with vigorous hand the accumulated privileges and forms of the past, or, perhaps, we might rather say, thanks to the revolution which burned off the forest-growths of centuries and left him an open field, and finally, thanks to the judicious legislation of Prussia, less hampered here than in her eastern provinces, the districts west of the Rhine enjoy one of the simplest and most efficient mining codes in the world.

Mining Law of England.—The English law of mines is, like all English law, the growth of centuries, and complicated with many local regulations and "immemorial customs." The oft-quoted "case of mines," in the reign of Elizabeth, referred the crown right to the common law, and the decision of the judges was that all gold or silver ores belonged to the crown, whether in private or public lands; that any ores containing neither gold or silver belonged to the proprietor of the soil; that the king[1] could grant away mines of gold and silver, but not without express words in his patent, demonstrating his intention to sever the mines from his royal patrimony. It is indeed not improbable that the crown once laid claim to all mines, and it is well known that at a comparatively recent period it was attempted to comprise within the royal prerogative all those of copper and tin on the ground that these ores necessarily contain some portion of gold and silver. In the reign of William and Mary, however, two enactments[2] secured to the subject the enjoyment of all mines in which tin, copper, iron, or lead are found, nothwithstanding any quantity of the precious metals mixed. The property in minerals unsevered from the land, whether held together with the property in the land or separate from it, is what the law terms corporeal hereditament, as distinguished from the mere right to work for them, which is an incorporeal hereditament. Apart from the claims of the crown, the property in minerals is *prima facie* in the owner of the fee of the land, whether in possession, remainder, or reversion, or subject to the tenancy of other persons. But the property in minerals is not necessarily accompanied by the right to work for them.[3] Indeed, when the owner of the fee is not in possession, nobody can work for the minerals; not the tenant, lest he commit a waste;[4] not the lord of the manor, because he has not possession of the surface, nor even of the subsoil. The minerals are part of the demesnes of the manor, and naturally follow the fee in every case. Thus, for instance, minerals found on the sea-shore below ordinary high-water mark, belong *prima facie* to the crown; between the ordinary and extreme high water mark, to the owner of the adjoining freehold; in land suddenly left by the retirement of the sea, to the crown; in land formed by the casting up of alluvial matter, to the lord of the manor. The property in minerals, and the right to search for them, may be vested in other persons than the owner of the fee, by alienation, prescription, or custom.

In the case of alienation there is an important distinction between such a conveyance as confers an estate and such as

[1] Plowden, 31, 310, quoted in Hon. J. Ross Browne's first report, p. 217. The quaint reason given by Onslow in this case was that, "because gold and silver are the most excellent things which the soil contains, the law has appointed them, as in reason it ought, to the person most excellent, and that is the king." (See Pettus, Fodinae Regales.)

[2] 1 Wm. and M., c. 30; 5 Wm. and M., c. 6.

[3] For these and other points, see authorities quoted in Collier's Law of Mines, p. 14, *et seq.*, from which much of this sketch of the English law is taken.

[4] Tenants may dig *open* mines to get for their own use gravel, clay, marl, or manure, and, it has been held, coal and iron also.

merely confers a right to dig, without property in the minerals until severed from the soil. A conveyance of the former class is binding forever, whether the owner of the minerals continues to work for them or not. This distinction of law between an estate in minerals and the right to mine is an important one; it describes exactly the step which the United States government takes, in the mining law of 1866, by which a perpetual estate is granted to those who had up to that time only been able to enjoy a possessory title, conferring the right to mine. According to the English statue of frauds no legal interest in minerals beyond that of a tenancy at will can be created or transferred otherwise than by writing. The effect of this and other statutes is to make an instrument under seal necessary for the conveyance of any interest beyond that of a tenant at will, or for less than three years, as also for the conveyance of a right to dig for minerals. The most general form of conveyance for particular interests are either leases of the minerals or licenses to dig them for a term of years. A license is not exclusive in its nature unless expressly so drawn; the grantor may work himself for the minerals, or he may license other persons to do so. Conflicting claims, arising out of different licenses, would probably be decided in eqnity in favor of the party in possession and actually working.

A lease is necessarily exclusive of the rights of all other persons, vesting in the grantee the absolute possession of the whole of the subject-matter demised.[1] The legal estate in mines can only be alienated in the modes thus noticed; but an equitable interest, with a title to a share of produce, may be acquired by agreement, either written or spoken, expressed or implied, attended with equitable rights against coadventurers, and with legal liabilities to the public. A mining company, for instance, can only acquire title to mines by deed (*i. e.*, by an instrument under seal) or by prescription or custom, of which I shall speak presently; but each stockholder may acquire effective title to his share of profits by virtue of a mere certificate, or, rather, by a mere agreement, of which the certificate is the convenient expression or result. This kind of title in mines is subject to the statutes affecting partnership, joint-stock companies, and cost-book mines.[2]

Prescription and custom, as has already been said, may also vest in other persons than the owner of the feet the property in minerals, or the right to search for them. According to Coke,[1] prescription is a personal usage, as that such an one and his ancestors or those whose estate he hath, have used, time out of mind, to have such an advantage or privilege. Prescription can be claimed only by the owner for the time being of the freehold; an incorporeal hereditament only can be subject of it, and it must be of origin beyond the time of legal memory; in other words, the right to work for minerals, but not the legal estate in them, may be subject of prescription.

Custom is defined to be a usage of the inhabitants of a certain district, and requires three things for its validity: It must have its origin beyond legal memory, ("from time whereof the memory of man runneth not to the contrary;") it must have been uninterupted; and it must be reasonable. The law is very careful to guard against the abuse of this right. In fact, the whole institution of "immemorial custom" is based only upon the principle that it is better to allow certain deviations from the rules of abstract justice laid down for general practice, than to commit the greater injustice of invading the established usages of society, and disappointing the well-grounded confidence of honest citizens therein. The notion that a custom may be arbitrarily created or modified at any given time, "by popular sovereignty," so as to affect the vested rights of property, is foreign to English and to every other law worthy of the name. It really overthrows the whole foundation on which this humane maxim has been built. A good illustration of an immemorial custom, affecting the right to mining property, is the "tin bounding" which formerly prevailed in Cornwall and Devonshire, and is still valid, though comparatively disused in those districts. A charter granted in the third year of King John to the tinners of Cornwall and Devon speaks of it as already ancient.[2] In the recent case of Rogers *vs*, Brenton, 10 Q. B., 26, the custom was stated and confirmed by the jury as follows: "That any person may enter on the waste land of another in Cornwall, and mark out by four corner boundaries a certain area; a written description of the land so marked with metes and bounds, and the name of the person for whose use the proceeding is taken, is recorded in an immemorial local court, called the stannary court, and proclaimed at three successive courts held at stated intervals; if no objection is successfully made by any other person the court awards a writ to the bailiff of the court to deliver possession of the said 'bounds or tin-work' to the bounder, who thereupon has the exclusive right to search for, dig, and take to his own use all tin ore within the described limits, paying to the land-owner a certain customary proportion of the ore raised under the name of toll tin. The right descends to executors, and may be preserved for an indefinite time, either by actually working and paying toll, or by annually renewing the four boundary marks on a certain day." Similar customs exist in Derbyshire, in the forest of Dean, and in various parts of Europe. In the case above alluded to, Rogers, the plaintiff, claimed his exclusive rights

[1] The granting clauses in the form of a lease of metals, with license to dig, use of water, &c., are as follows:

"In consideration of * * * he, the said A B, hath given, granted, and demised, and by these presents doth give, grant and demise unto the said C D, his executors, administrators, and assigns, all copper, and all other ores, metals or minerals (except coals) to be found in, under and throughout the lands and premises comprised within the limits hereinafter described, * * * together with full and free liberty, license, and authority to dig, mine, work and search for the same, and to raise and bring to grass all such copper and other metals and minerals, * * * to carry away and convert the same to his and their own use and uses, and at his and their wills and pleasure to pass and repass, carry and recarry, and to drive, dig, work and make any new or other adit or adits, shaft or shafts, pits, drifts, leats and watercourses in, over, upon and through any part of the said premises, and to use those already made and driven, and to erect thereon any shed or sheds, mill or mills, engine or engines, or other buildings as he * * shall from time to time think necessary and convenient for the more effectually working the premises aforesaid, and for working, washing, dressing, cleaning, manufacturing, bringing about, and making merchantable such copper and other ores, metals and minerals, * * * to have and to hold, use, exercise, and enjoy all and singular the several powers, liberties, and authorities hereby granted and intended so to be, (excepting and reserving and subject as aforesaid,) * * * from the day of the date of these presents for and during the term and time of —— years now next ensuing, and fully to be complete and ended." * * * * *

The grant is qualified by various agreements between the parties. The use of water may be granted for the purpose of mining, subject to the rights and privileges of others already acquired, and to such other reservations as the circumstances require. The time, manner, and amount of payment of rent or royalty is specified (*tribute* is not strictly rent,) and the lessee is bound to keep proper accounts, accessible to the landlord, to work the mine with all reasonable expedition "regularly and effectually, and in every respect according to the most approved modern practice of good miners," etc., etc., with greater or less fulness of detail, according to the whim of the parties. My experience in this country rather favors the drawing of a mining lease in general terms, leaving it for the courts to decide, in case of disagreement, what is fair dealing on either part. Detailed specifications in the lease do not obviate, but complicate, litigation.

[2] The cost-book system in use in Cornwall and Devonshire differs from ordinary partnerships on the one hand, and joint-stock companies on the other. The principal distinction from ordinary trading partnerships appears to be the absence of the *delectus personæ*, and consequently a limited liability: while the organization differs from that of a stock-company in the fact that its powers are not delegated to an aristocracy of directors, but directly exercised by the whole body of shareholders.

The following is the form of transfer of share in a cost-book mine:

"I, —— ——, do hereby, for valuable consideration, sell, assign and transfer unto —— —— —— parts or shares of and in a certain mine of adventure, called ——, situated in the parish of ——, county of ——, together with the like share or proportion of and in all engines, tools, tackle, materials, ores, halvans, moneys, and all other appurtenances thereto belonging, together with all dividends and profits in respect of the said part —— or share, and all interest, privileges and advantages to be derived therefrom. As witness, &c.

"I —— ——, do hereby accept the said —— shares, subject to the same terms and conditions, rules and regulations, as the said —— —— held the same."

[1] 1 Inst., 113.

[2] Quod possint (stammatores nostri) omni tempore libere et quiete abasque alicujus hominis vexatione fodere stammum, et turbas ad stammum fundendum * * * *sicut solebant et consueverunt*, et emere buscam * * * et divertere adquas ad operationem eorum in stammariis *sicut de antiqua consuetudine* consueverunt.

as a bounder, though he had neglected the mine for many years, pleading that the bounds had been regularly renewed. The defendant was agent of a company which had begun to work the mine and refused to recognize the alleged rights of the plaintiff. Much evidence was given concerning the nature and prevalence of the custom. The witnessess agreed that the bounds could be preserved by mere annual renewal without working, and some of them doubted whether even the ceremony of renewal was necessary, except as evidence of the right. They also differed as to the consequence of neglecting to renew on the exact day. None could assign any limit to the surface of land that might be included within the four corners, but it was said to be generally very small. One of the most experienced witnesses remembered a pair of tin-bounds "a quarter of a mile each way," but this was the largest he knew of. Only one instance was recollected by any witness of bounds recently proclaimed; all the wastes of tin-mining districts were supposed to be already under ancient bounds. The jury found, as to the question of fact, a verdict for the plaintiff, on the ground that working was not essential to the custom. The court, however, decided that the custom as found to exist by the jury was unreasonable in as far as it conferred a right to bounds on a person not actually working. The opinion pronounced on this occasion by Lord Denman is a most thorough and elaborate explanation of the principles underlying the case, and deserves to be studied by American legislators. I quote a few passages:[1]

"Upon the ownership of the land, giving a *prima facie* title to minerals, the custom of bounding has been engrafted. * * * In substance it is this: the mine is parcel of the soil; the ownership is in the owner of the soil, but it is a parcel which to discover and bring to the surface, may ordinarily require capital, skill, enterprise, and combination; which while the bowels of the earth, is wholly useless to the owner as well as to the public; and the bringing of which into market is eminently for the benefit of the public.

"If, therefore, the owner of the soil cannot, or will not, do this for himself, he shall not be allowed to lock it up from the public; and, therefore, in such case (unless, by enclosure, he may seem to have devoted the land to other important purposes inconsistent with mining operations, such as agriculture or building) any tinner, *i. e.*, any man employing himself in tin mining, may secure to himself the right to dig the mines under the lands, rendering a certain portion of the produce to the owner of the soil.

"It is right to observe, in passing, how every step, even in this strong invasion of the rights of ownership, still is made with reference to them. In the first place, the land to be bounded must be wastrel; if it be several and enclosed, it must have been anciently bounded while wastrel, and so, in the language of the country, assured for wastrel; the liability must have first attached on it, therefore, before enclosure and devotion to other useful purposes. Then after the tinner or bounder has commenced by cutting turves, and so making out the limits within which he will work, proceedings are to be taken in the stannary courts, of which the owner has noticed, and sufficient time is allowed before the bounder's title becomes complete, during which the owner may still intervene and preserve his rights entire, so as he will exercise them for the benefit of the public. If he abstains from any interference it may well be considered that he has consented to the bounder's proceedings; and the customary render of the portion called toll-tin may be very sufficient consideration to him for what he gives up of his original exclusive rights. * * * This then brings us to the point which was more especially contested on the argument, whether this customary right can exist without continuing *bona fide* to search for tin, and to work the land for mining purposes with the enclosed limits; whether it is sufficient to renew the bonds annually by a new cutting of the turves as at the commencement. Assuming for the present the validity of the custom, if the *bona fide* working within the bounds be made a part of it, and assuming that it is a custom which is to be tried by the tests established by the common law for the ascertaining whether a custom be good or not, it appears to us that without this qualification it cannot be sustained. Customs, especially where they derogate from the general rights of property, must be construed strictly; and above all things, they must be reasonable. Bounding is a direct interference with the common law rights of property; it takes from the owner of the land, who is unable or unwilling at a particular moment to dig for tin under his waste land, the right to do so, it may be forever, and vests it in a stranger, making only the customary render in return; it empowers the stranger not only to extract the mineral from beneath the surface, but to enter on the surface, and cumber it with machinery, buildings, and refuse stuff which the operators below occasion,[1] and all this without the least regard to the convenience or interest of the owner. The only things which make this reasonable are the render of the toll-tin to the owner, and the benefit to the public secured thereby in the extraction of the mineral from the bowels of the earth. Both these are not only lost, but the latter, it may be, positively prevented, may decline to work and yet retain the right to exclude the owner. Instead of insuring that the minerals should be brought to the surface, the custom so construed may be made the means of keeping them locked up within it, and at the same time preventing any improvement in the surface. Many bounds may become the property of the same owners, who may think their interests best served by limiting the supply and diminishing competition, while the owner will decline to spend his capital in building or agricultural improvements, because at any moment the bounder may renew his operations, and entirely without compensation defeat the purposes of his expenditure. If it be said that the public good is best served by that regulated supply which best serves the private interests of the bounder, that wherever it is for the interest of the public that the mine should be worked, the interest of the bounder will be to meet the demand by an adequate supply, and that when the mine is not worked, it is only because it is for the interest equally of both that it should not be; without admitting or denying the truth of these assertions, our answer is that, where such a state of things has existed so long and so decidedly as to amount to reasonable proof that the original purpose with which the bounds were enclosed has been abandoned, it is unreasonable to maintain the bounds themselves. It may have been that the owner did not enclose the land or work for the mineral himself, only on account of a temporary inability, or the temporary existence of the same causes which the bounder now alleges as the ground for his ceasing to work. Why then is he to lose his earlier and better right forever, and under the same circumstances the bounder to preserve his? Another answer is drawn from regarding the original purpose of the custom, which was not founded on the doctrine of demand and supply, but on the expediency simply of bringing the mineral to the surface for the use of men."

In view of these and other considerations, the court held that the provision in question was void, because unreasonable; and there are good grounds for supposing that the unqualified right claimed was also historically to be refuted, as but an abuse of the original limits of the custom.[2] I have quoted this exposition of the law at some length, because the principles laid down are universally applicable and just. They apply with equal force to the case of mines in public lands; and the frequency with which they are violated by the whimsical "regulations" of mining districts in the United States is an evil which requires immediate attention, now that those regulations have been formally recognised as valid to some extent in law, and as furnishing a proper basis for the acquisition of the estate in minerals from the general government. I do not find any traces in the law of England of a recognition of the right to follow mineral deposits in depth outside of the boundaries marked upon

[1] The opinion may be found in 10 Q. B., 26, and the passages here quoted, with others, in Collier's Law of Mines, p. 33 *et seq.*

[1] According to the legal maxim, "Cuicunque ali quid conceditur, conceditur etiam id sine quo res ipsa non esse potuit." The right to obtain minerals comprises the right to do all that is necessary thereto.

[2] The ancient charters were granted to tinners "operantes in stannarriis," and "dum operantur." In Carew's *Survey of Cornwall*, fol. 136, ed. 1769, it is said, "These bounds he is bound to renew once evereie yeere, as also in most places to bestow some time in working the myne, otherwise he loseth his privilege." Collier, quoting from Smirke, gives these and other instances.

the surface. Statutes regulating the manner of working mines, the employment of children, &c., have from time to time been made by Parliament. So, for instance, a bill passed February 14, 1860, provides for the regulation and inspection of mines, and prescribes general rules as to safety lamps, ventilation, guide-rods, &c.[1] The laws and equities relating to mining in England are administered generally by the courts of chancery and common law. There is, however, a court of very ancient origin,[2] called the stannaries court (formerly several courts, called stannary courts, held before the stewards of the four stannaries) and now presided over by the vice-warden of the stannaries. This court has both common law and equitable jurisdiction, concurrent with that of the superior courts and the county courts, and affords an easy and expeditious method of settling such disputes as arise out of mining transactions. The proceedings in equity concern chiefly the mines operated on the cost-book system, and contrast favorably with the prolonged, complicated, and expensive operations of the courts of chancery. The late Prince Albert was lord-warden of the stannaries.

OPEN LETTER OF R. W. RAYMOND RELATIVE TO MINERAL LANDS.

THE principle of the right of the sovereign to the ownership or control of any of the minerals in the earth, apart from proprietorship of the land itself, is not recognized by our laws. The government, like any private proprietor, possesses the surface of its lands, together with all that lies beneath them, to the center of the globe. There is no distinction in this respect between the base and the precious metals, or between the Atlantic and Pacific slopes, or between the areas acquired by the United States from individual States and those obtained by treaties with foreign nations or Indian tribes. So far as I am aware, the government owns the minerals when it owns the land, and not otherwise. The mineral right, however, although it accompanies the surface ownership, is separable by the act of the owner. A farmer in New Jersey may lease or sell the right to mine and carry away all the iron ore in his farm, with the privileges of entry and use of the surface necessary to mining operations, retaining his title in all other respects unimpaired; or he may thus dispose of the right to a single bed or vein of ore, retaining all others. A farmer in Pennsylvania may in a like manner lease or sell all his "coal rights," or the right to one or more specified seams of coal, reserving to himself, undiminished, whatever is not thus transferred. A party owning two adjacent farms may grant the mineral right to a given deposit of coal, ore, or other minerals upon one of them, with the right to follow and mine in the other that deposit only. All these and many varieties of grants actually occur in our Eastern States; and the rights thus conferred, as defined by the agreements creating them, are independent of surface ownership, although in their origin they rest upon the principle that the owner of the surface owns also the minerals beneath it. The government occupies precisely this position towards the public domain. It can do what it likes with its own. There is no "miners' right," created by the discovery of valuable mineral in any part of that domain, except what the government chooses to create by its own voluntary acts. By such acts it is bound, as an individual would be, neither more nor less. It is as free as any individual would be to dispose, as it may see fit, of any rights not already conveyed away; to change its policy at any time; to lease or sell on new conditions, or to decline to lease or sell at all. This elementary statement seems to be required to correct a popular impression that the principles of the law of mines are different in different parts of our country, and that there is some mysterious obstacle in this difference to the introduction of a uniform system. The fact is, that the owner of a gold mine in Georgia might, if he chose, sell his mine on the terms described by the government to purchasers of gold mines in Montana; and the government might, if it chose, by a change in the statute, alter its terms in Montana to conform to the present usual practice in Georgia. The course of Federal legislation in this respect has been dictated by policy. Its object has been to encourage the development of the mineral resources of the public lands, and to transfer the ownership of both land and mineral rights to individual citizens. That this course is wisest in itself, and best adapted to the spirit of our institutions, scarcely admits of question. The policy of administering the public lands as a means of producing revenue, through mines, timber, agriculture, or rents, is one which a highly centralized or despotic government may perhaps pursue; but certainly, is not suited to Democratic or representative government; and even in monarchical states, it has not proved advantageous, as may be inferred from the general tendency in all enlightened nations at the present day, toward the transfer of governmental enterprises to private hands. It may be questioned, perhaps, whether a system by which the government, as in Spain, Portugal, and Mexico, retains the ownership of mines, and leases them upon conditions involving their continuous working, is not calculated to secure a more active and steady mining industry than a system which, conferring individual ownership, permits mines to lie idle at the will of their owners. But I think no one can fail to perceive, upon thorough consideration, that the advantages of the Spanish system are delusive, and that its disadvantages, in the expense of administration and the inducements which it offers to the "robbing" of mines, are greater than its advantages, even if these were real. The tenant of the government mine will work it if it be profitable, of course. He would do the same, if he owned it. When it ceases to be profitable, he may continue operations for a while, rather than lose his lease. But there is no economic gain to the State in forcing its citizens to unremunerative labor. On the contrary, if a mine does not pay, it is best that it should be closed, while labor turns to more productive enterprises; and if a mine is to be closed it is far better that this should be done by an owner than by a tenant, for the owner may hope to resume operations under more favorable circumstances while it is the interest of the tenant, whose abandonment of the property is final, to rob it of all accessible value and leave it in ruins. As for the revenue to be derived from renting mines, two things may be confidently asserted: First, if it were wise to burden the industry of mining with a tax not laid upon other forms of production, this could be done more effectively, conveniently, and equitably by a bullion tax; and secondly, it is not wise to do anything of the kind. I am aware that, a dozen years ago, while the bullion tax was collected by our government, I favored in my report to the Secretary of the Treasury its continuance in a reduced measure, and its devotion to special purposes for the benefit of the mining industries. I will not pause here to explain in what particulars the circumstances and in what particulars my views have changed. It is quite sufficient at present to say that the obvious policy of the government is to treat mining like any other industry, and to administer the mineral lands, like the agricultural lands, with as little machinery and as little interference with private enterprise as possible.

We come, then, to this proposition—the United States is the holder, as the trustee of the people, of a vast area of mineral land. On the whole, it is best to sell this land as fast as possible, not looking for large revenue from its sale, but rather transferring it to private owners at prices that will repay the cost of the surveys and other necessary proceedings, and under conditions that will favor the exploration of its resources. To encourage mining, or at all events to lay no unnecessary burdens upon it, and to get rid of the unproductive property in mineral lands which cannot under our system be made productive by the government—these are the objects to be attained by Federal legislation. In selling the mineral lands should the government make any distinctions as to price? It would have a perfect right to do so; and it seems at first glance a wrong to the people that public property worth many millions of dollars should be given away to those who have no other claim than that of discovery. This point deserves careful consideration. There are three ways in which the government might derive

[1] Levi's Annals of British Legislation, ix., 1861.

[2] Confirmed rather than created by charters, 3 John and 33 Edw. 1, often subsequently recognized and defined, and finely established in its present form during the reign of William IV.

pecuniary benefit from the developed value of the mines on the public domain. It might provide for an estimate of value by its own officers, and a price based on such an estimate. It might sell the mining locations at public auction, thus leaving the estimate of value to competing purchasers. Or, it might reserve a certain percentage of the gross or net product of a mine—an unassessable interest in the property—which, in case of a large and profitable development, would amount to a considerable sum. These three alternatives cover substantially all that could be done in this direction, apart from the actual retention of ownership by the government, and the collection of mine-rents. As to the first of these, it is evident that in most cases no government officer could possibly make a just estimate of the value of a mine, before it had been worked; and no intending purchaser would spend money in developing it, without knowing at what price he could buy it; nor would it be for the interest of any intending purchaser to develop the real value of the property and thereby enhance its price. The sale of locations at auction is open to similar objections. Nobody will explore and develop a piece of mining ground, with the knowledge that every proof of value which he may expose will make its acquisition more costly and more doubtful. But if such sales are to be held without previous exploration of the claims, then the chances are that the prices to be obtained by this method will not exceed the ordinary rates sufficiently to pay for the extra trouble and cost of administration. The third alternative—the reservation of a portion of the proceeds of a mine—would prove in practice, I think, difficult, odious, and unremunerative. It would be really a special tax. If levied upon gross production, it would bear severely on struggling enterprises. If levied upon profits, it would involve an inquisition into private business, a premium on deceit and concealment, and a vast amount of official labor for comparatively small return. It would be like the revenue tax on spirits in difficulty of enforcement, but not in resulting revenue. We may conclude, then, that the true policy of the government is to sell the mineral lands outright at uniform prices and with as little trouble and cost to itself and the purchaser as possible, seeking its profit, not in the direct proceeds of sale, but in the rapid development of natural resources and the establishment of prosperous communities. It remains to be considered whether the present system of Federal mining law, as construed by the courts and administered by the General Land Office, effectively executes this policy; whether it needs reform; and, if so, whether that reform should be of the nature of moderate amendment or radical change. In the discussion of these questions, I shall strive rather to present an impartial statement of both sides then to advocate a definite scheme. No scheme suggested by individual study or experience can claim to be the best under the circumstances; because it is of the very essence of the problem that the system adopted by the government shall be acceptable to the mining communities. The present arrangement, whatever may be its defects, has the positive recommendation that it will work, is working; that it is a growth, and, like all growths, possesses vitality, which mere symmetry without vitality cannot replace; that its evils are known, while those of a new system are unknown. Moreover, it is of the utmost importance that any proposed reform shall be practicable and acceptable, because its failure to be adopted and successfully executed would indefinitely delay, and perhaps defeat, all reform in this department.

The declaration that the Government of the United States "owns the minerals when it owns the land, and not otherwise," might be deemed inexact as to Mexican land grants within our borders, not yet confirmed by United States patents. Such grants, if they did not originally convey to the grantee the mining right, reserved that right to the sovereign; and upon the transfer of sovereignty to the United States, this reserved ownership of the metals passed to our government, which thus became, in these instances, proprietor of the metals in the land otherwise owned by private parties. But the same leading cases in which this rule was laid down (chiefly the so-called Mariposa cases) contain the decision that a patent in confirmation of a Mexican grant is not restricted to the interest transferred by Mexico to its grantee, although such Mexican grant did not convey the precious metals. The practical application of this principle annuls the effect of the preceding one, and justifies the general statement that the right to metals in the soil, as a royal prerogative, is not incident to the sovereignty of the United States or of any single State. The present system of Federal legislation originated in the tacit recognition of miners' customs, and has been gradually developed with perpetual, perhaps excessive, regard to those customs. Its general outlines are so generally known that I shall not burden this letter with a description of them. Still less can I attempt to discuss in detail its doubtful or ambiguous features, although some of these may receive attention in passing. I purpose rather on this occasion to consider directly the evils which seem to attend the operation of our present system, and the possible remedies for such evils. Not all the complaints so loudly made deserve the attention or fall within the proper sphere of the government. People who engage in mining, on the public lands or elsewhere, have no special claim to be protected against the consequences of their own ignorance or over eager credulity. The hazardous nature of the industry is good ground for rejecting the notion, once generally entertained, that special burdens should be laid upon it—that the mines, in some way not demanded of farms and factories and railroads, should "pay the national debt" but it is not good ground for asking the government to furnish the technical knowledge required in mining, or to exercise supervision over mining operations. The general aid given to all the industries of the country by a scientific survey, and a complete statistical review of its resources and activities, is all that can be properly conceded; and this will never prevent the complaints of many adventurers who have suffered damage through the risks and difficulties peculiar to mining. The evils of "speculation" of which we hear so much, cannot be cured by legislation, if, indeed (as I do not believe), they are unmitigated evils, or if, (as I do not believe) speculation could be repressed at all, without producing something worse. We may set aside, then, all those features inherent in the industry of mining itself, as matters which the government cannot mend, and with which it should not meddle. Another set of embarrassments arises from the peculiar present conditions of mining in the public domain. The law-abiding instinct of our people is remarkable. The rudeness and violence often observed in our frontier communities cannot hide from the thoughtful observer the deeper fact that our institutions have bred in the masses a notable capacity for self-government. The very first step in a new mining district is the making of laws; and the degree to which such laws have been respected and enforced by public sentiment is a significant testimony in behalf of democracy. But this state of affairs, though infinitely better than barbarism, and certain, as experience has shown, to pass by peaceful gradations into the complete, lawful organizations of society, necessarily involves much initial confusion, bearing the germs of future trouble. The fundamental right of property fails of adequate definition among a host of pioneers, settling suddenly, like a swarm of bees, in the trackless wilderness. The entrance upon the public lands of population in advance of official surveys, is the most prolific source of embarrassment arising out of the present conditions of mining in those regions. Nearly all the other evils of this class will cure themselves faster than Congress could cure them. This one, however, needs, in my judgment, a special remedy. It will not cure itself under the present system of land surveys. A system is imperatively called for, which will permit the surveys to keep pace with the pioneers. The exact determination of points of reference all over the country, to which local surveys could be referred, and the abandonment of the futile attempt to lay out our whole national area like a checkerboard, with meridians and parallels, would, I think, be a wise and feasible measure, so far as the mineral lands are concerned. Of the agricultural land system I am not qualified to speak; but it seems plain enough that the reform required for the mountain lands, which mostly contain the mines, would be required also for the valleys inextricably intercalated among them, and occupied with mill-sites and ranches. I conclude, then, with regard to the evils, inherent, not in the nature of the mining industry, but in its present conditions in the West, that they are either (1) such as may be left to cure themselves, or (2) such as the local governments of States, Territories, and municipal subdivisions should deal with, as they deal with other matters affecting public peace and the enforcement of contracts; or (3) such as the Federal Government, the owner of the public domain, may measurably remedy by a more nearly adequate provision for the reception of settlers, and the adjustment of their initial relations to the land.

We now come to a class of evils inherited from the earlier (and to some extent, still continuing) local customs. In my official reports (particularly the first, transmitted to Congress in 1869), to which, for brevity's sake, I beg to refer, without further citation, I have discussed at some length the absurdity of permitting the title to mineral lands to rest upon the shifting and untrustworthy basis of an irregular, periodical *plébiscite*, the edicts of which are carried out by irresponsible officials, and the records of which often may be, and often have been, exposed without efficient guardianship, to loss, destruction, mutilation, or falsification. It has repeatedly happened that the disputed possessory title to valuable mining property has turned upon the memory or honesty of contradictory witnesses, concerning records which could not be found, landmarks which had disappeared, "customs" which had been repeatedly amended, repealed and forgotten, and acts performed pursuant to or in violation of such customs by persons who had long since left the district or the world. Even if all mining recorders were sworn officers; if all their records were properly kept and guarded; if the local regulations were carefully prepared, not liable to sudden change, and permanently preserved for reference, there would still be great confusion arising from the lack of uniformity in the methods of acquiring and maintaining title. Something has been done, as I shall hereafter show, to remove the evils inherited from the miners' "customs." What remains to be done is to abolish altogether the irregular and whimsical subdivisions known as "mining districts," with all their officers, and to make all mining titles on the public lands originate in entries duly attested and preserved in duplicate or triplicate by the regular officers of the United States. Once, this would have been difficult and expensive; but I think the time has come when it can be thoroughly done, and will meet with the approval of the mining communities themselves. Should the Federal Government attempt to replace all local regulations with a complete mining code? The answer to this question depends largely upon the meaning of the terms employed. It is evident that in all points within the sphere of State governments, legislation should be left to them; and, by analogy, though not with the same force, we may conclude that similar freedom should be accorded to territorial legislatures. According to the principles already laid down, the United States is simply the owner of certain lands, the development and sale of which it desires to promote. It is the business of the local governments to look after the peace and general welfare of the inhabitants; even considerations of political economy, such as the prevention of irreparable waste, would not justify the Federal authority in doing more than to look after its own property. Consequently, it seems to me, nothing should be done by Congress to establish mining regulations apart from such measures as are required to encourage the exploration and purchase of the public mineral lands, and (as incident to this end) to convey to the purchaser definite and secure title. It may seem desirable, on the whole, that the size of mining claims should be made uniform by law over all the public domain. The present law fixes the maximum length and a maximum and minimum width; but within these limits any size may be fixed by local "custom" or rule; and the liberality of such "custom" is apt to depend upon the number of miners to the acre present when the "custom" is ordained. It must be remembered that the practice of fixing these dimensions by votes of the inhabitants grew up at a time when they involved only the use of the surface for mining purposes, such as dumps, machinery, buildings, &c., and not such an absolute ownership thereof as rendered any intrusion by others an act of trespass. The miner was not limited by his surface in his underground operations; nor did his prior surface right hinder in any way the explorations of other prospectors, or their workings of other veins within the space covered by his claim. Hence, very narrow surface claims were adequate appendages to very large mines. In any attempt to sell its mineral lands, the policy, as well as the clear right, of the United States seems to be to divide the property into parcels of such size as will be at once most convenient to itself and most attractive to the buyer. Under the present law, however, there is no great practical difficulty in consolidating claims so as to obtain a sufficient portion of the main lode, which is the object of the purchase. Moreover, the State and Territorial legislatures have done much, and in many cases have done it admirably, to supersede with definite codes the previous local regulations of the districts. I am inclined to think that the size of the claims, *under the present system*, may be left to them within the limits fixed by the Federal law. If the present law is not changed in any other particular, I do not think it need be changed in this, except so far as to provide for certain cases in which the actual width of a vein at the surface is greater than the width of the claim. This point may be better discussed under a subsequent head.

Passing from the evils inherited from the mining customs, we come to consider such as are the legacy of former Federal legislation. The acts of Congress intended to correct the causes of complaint arising under the absence of all uniform law have entailed upon us some unnecessary complications, which have been further aggravated by conflicting decisions of the Land Office and the courts. The Supreme Court has brought order out of chaos in a number of cases which have reached it; but many moot points remain, and will, perhaps, never be settled, before the necessity of considering them shall have passed away entirely. I refer now to those difficulties only which arise from the features of our earlier laws (principally that of 1866), repealed or amended by later acts with reservation of all vested rights. The law of 1866 has been held in some cases to convey to the patentee under it no real ownership of the surface, but to give him, nevertheless, underground rights which the act of 1872 does not confer. This doctrine was partly overthrown by the decision in the "Eureka case" in 1877; but a recent decision in Utah shows that some courts, at least, hold that, among the vested rights of a locator prior to 1872, the right to follow his vein *on the course* into the ground of a prior locator is included, and cannot be destroyed even by the patent of the United States granted (prior to 1872) to the prior locator. It is claimed also that parties locating under the act of 1866, though they did not apply for patent until after the passage of the act of 1872, had a "vested right" to obtain, under the latter acts, a patent comprising all the privileges granted to patentees under either act. I have elsewhere argued, at length, the unsoundness of these and similar contentions. I mention them here simply to show the nature of the complications inflicted upon us by past legislation. I do not see that legislation is required to remedy this state of things. The number of mining claims located before 1866, held by uninterrupted possessory title ever since, but not made subjects of patents, is not large enough to require a general measure; and the troublesome questions of so-called "vested rights," accruing under the earlier statute will best be settled judicially. This brings us to consider briefly the evils developed in the administration of the present law. There is cause for complaint in the expense of proceedings attendant upon the procurement of surveys and the perfecting of titles. Your inquiries in the mining districts will have shown you that these expenses are not only onerous, but exceedingly irregular, being much greater in some districts than in others. As the true policy of the government is to sell its mineral lands, no unnecessary obstacles in the way of costly proceedings should be interposed. And this point is particularly reasonable in view of the fact that the surveyors who charge whatever they can get for their services have in many cases proved to be somewhat careless workmen; so that there is reason to complain of defective, as well as expensive, preliminary work. Changes in the machinery of the law, whether its general principles are changed or not, will be required to remedy such evils. The multiplicity of officials may be reduced; their duties may be redistributed; and they may be paid by the government, and bound to pay over to the government all their legally-determined fees. The result should be a saving to the people and no loss to the public treasury.

We have considered briefly the inherent, the inherited, and the administrative evils of our Federal system of mining law. We now take up, in conclusion, a fourth class of evils attendant upon that system, namely, those which flow from the main features of the sections of the Revised Statutes constituting our only national mining code, and which requires, as a remedy, important changes in the law, not mere reforms of administrative detail, such as have been alluded to under foregoing heads of this discussion. I repeat the declaration already made as a starting-point, that the true policy and avowed purpose of the government is to sell its mineral lands on such terms as will promote their exploitation. Whatever may be the alternatives to which we are now shut up, we had, in the beginning, the possible course of renting the mines, or in other ways getting a revenue from them. I have already expressed my views on this point, and it may, therefore, be passed without further comment. Assuming, however, that the mineral lands should be definitely disposed of, the government might have, secondly, transferred them to the States as fast as these were organized and admitted, or, thirdly, sold them in large quantities to private persons or corporations. In either case, the expense of surveying and selling in detail would have been saved. But the public advantages sought by the system actually adopted could not have been attained under any plan which permitted a monopoly of the lands, or the growth of conflicting rules in different localities as to the exploration and acquisition of mineral property by individuals. It may fairly be maintained that the retention of the mineral lands by the general government, with a view to their sale under uniform laws, to *bona-fide* miners or mining corporations, was, under the circumstances, wise. But the law, as it stands, fails to secure fully the objects for which it was designed. What it should do, to secure those objects, is to encourage prospecting merely as a preliminary to purchase; to hold out inducements, or even apply pressure, which will lead the "possessory owner" or temporary occupant of a mining claim to become, as soon as practicable, its purchaser; and to give to each purchaser a definite and secure title, as a protection to him, on the one hand, and to the intending purchaser of a neighboring claim on the other. In all these points, the law is more or less defective; and its defects may be classed under two heads. Those which spring from the right to follow a lode in depth outside the side lines of the surface claim constitute the first class; and their consideration involves the question, whether it would be wise and practicable to cease granting this right, and limit by vertical planes drawn through the side-lines as well as the end lines of surface claims the ownership of mines patented hereafter. The defects which may be remedied without this fundamental change in the law constitute another class; and of these I purpose to treat first, concluding my survey of the subject with a consideration of the so-called "side-line question."

Assuming that the right of the mine owner to follow and exploit his lode in depth between the projected end lines of his claim and beyond its side lines should be retained, the present law is still radically defective in several particulars. The theory of it is that, as a preliminary to purchase, the citizen may freely occupy and explore any portion of the public mineral lands not already occupied. This possessory title must be maintained by the performance of a certain amount of work annually. The amount fixed by the law is not enough to secure a real development of the mine; but it is enough to discourage the practice, once common, of the holding of many claims by one adventurer, to the exclusion of those who would gladly work them, and it furnishes a good legal test of the otherwise indefinite act of abandonment. I doubt whether this feature could be changed with advantage. But the present law, by conferring upon the possessory occupant rights as extensive as those of a patentee, and by permitting the possessory title to remain undisturbed and invulnerable for an unlimited period, offers too little inducement to the locator to apply for a patent. Indeed, in a large number of instances, the inducement is the other way. Not only the expense of the proceedings for patent, and the chance of suffering local taxation, as owner of land, to which the mere squatter upon government land would not be subject, operate to the advantage of the mere locater and the disadvantage of the patentee; but the application for a patent involves the precipitation of all pending contests as to title. Adverse claimants must then speak, or forever after hold their peace. The result is, that locators often delay applying for patent, in order not to arouse opposition which they hope to wear out in time; and disputes are thus nursed along, instead of being brought to an issue, and definitely ended. It seems that only two strong inducements to take a patent arise under this law. If a possessory holder wishes to be able to abandon his mine for a while, without losing it, he must get a patent. If he wishes to sell it to a distant capitalist, or to a stock company, he must usually get a patent, because such buyers usually (and always should) insist upon this security against adverse claims. Unless these contingencies arise, there seems to be no special reason for taking patent. In my judgment, the law should limit the period of possessory ownership; should not authorize the working of lodes in depth outside the side lines of locations until after the patent has been applied for (even though, as now, that right be granted by the patent); and should render the holder of a possessory title only incapable of enforcing an ejectment against parties working on his lode beyond his side lines, or of collecting damages, after he has applied for a patent, for ore so extracted by others before he made such application—under which term, in the present connection, I mean to include all the steps required of the applicant for the proof of his claim. It may be said that, under such a law, locators might still go on indefinitely, by the simple expedient of repeated relocation. I admit the force of this objection; and I do not think a prohibition of such relocation by the same parties would be very effectual, since it would be easy for them to evade it by employing others to make the record. But I apprehend that the consideration of the loss of priority in title by relocation would be a powerful objection to the course; and, at all events, it may be safely asserted that the inducements to apply for patents would be stronger than they now are.

I would mention, in passing, the limitation of the right of purchase to citizens as a feature of the law which serves only to annoy foreign purchasers, without preventing them from really holding mines. A citizen may convey his patent "to any person whatever;" and this being the case why not let "any person whatever" buy the mine and get the patent? As it is, foreign corporations manage to control our mines, if they choose; and our citizens are never weary of inviting foreign capital to do so. The law as it now stands, and as it has been in some cases at least construed by the courts, operates to the discouragement of the most enterprising kind of explorations, namely, explorations by shafts or tunnels. Section 2323 of the Revised Statutes says that the owners of a tunnel "shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface." In this grant, I believe the words "on the line thereof" have been so construed by the Land Office as to exclude veins crossing the tunnel, and thus to reduce the section almost to a nullity; but even setting aside this construction, the phrase "to the same extent as if discovered from the surface" is enough to destroy all tunnel claims. For it is held that the discoverer of a vein "from the surface" can acquire no title, not even a possessory one, unless he finds its outcrop, and locates his claim to include that. If I remember correctly, the Land Office has refused to grant a patent for a vein discovered in a tunnel; and I confess it is difficult to see how any other decision could have been made under the circumstances. A patent requires a surface location, and that location must include the outcrop or the "top or apex" of every vein for which the patent gives title. The tunnel section might as well be repealed. It is worth nothing to anybody as it is now framed and interpreted. But I think it would be just to declare that the discoverer, in ground not already occupied, of a vein not previously known to exist, wherever and however he may discover it, by shaft or tunnel, at its outcrop or in depth, shall have the right to locate a claim covering the point of his discovery, and to obtain a patent entitling him to work that vein as if its outcrop were within his claim. I say this would be just; and it would encourage enterprise and promote the discovery of valuable deposits not otherwise likely to be exposed. But it would seriously complicate the relations of patentees and locators. Less effectual, but perhaps more practicable, would be a provision authorizing the record of an underground discovery of a new lode, and giving to the discoverer a certain time within which he may seek for the outcrop or apex of the lode, and, upon finding it, be entitled to locate upon it, with the date of his underground discovery. If the outcrop or apex, when found, should happen to be covered by a patent, that ought to take precedence; but a mere location of later date than the underground discovery ought to give way. The guiding principle here is to encourage prospecting as much as possible; but, above all, to encourage the taking of patents.

Another defect of the law, or its construction, is the vagueness of the title conveyed under it by a patent. There is nowhere in it any definition of the terms "deposits," "veins," "lodes," "ledges," "dips," "variations," "angles," "locations," "claims," &c., which are freely used. Some of them are merely tautological. Such phrases as "vein, lode, or ledge," "dips, variations, and angles," merely lead to hair-splitting constructions by puzzled jurists, who try to discover shades of meaning in what was probably nothing more than aimless rhetoric. The adoption of all the ordinary miner's terms without definition constitutes one of the most troublesome elements of the bondage to local customs which has fettered our legislation. Even if Congress should declare the mining law to be independent of such customs, the declaration would be futile so long as the customs must be appealed to for the interpretation of the law. The meanings of the terms "vein," "lode," and "ledge," for instance, although much clarified by judicial decisions, are still subject to doubt. In a recent case in Colorado (which I cite, not to assail the ruling, but to illustrate this point), it was held that a "contact bed," or deposit, admitted to be legally a vein, did not begin to be a vein at its outcrop, because that was barren of precious metal, but did begin to be a vein, or in other words had its true outcrop or apex, at the point where it first showed by assay "an ounce or more per ton" of silver. Now, any law or construction of law which makes the miner's title dependent upon subtle geological or chemical distinctions is unfortunate. As far as practicable, the statute should be so worded as to avoid such contingencies. Another serious embarrassment of a similar nature arises from the construction which has been put upon the phrase of section 2322, "the top or apex of which lies inside of such surface lines extended downward vertically." Under this clause it has been held that unless a locator includes within the width of his claim the whole width of the outcrop or apex of a lode, he cannot acquire the right to follow that lode beyond his side lines. This ruling has been applied in cases in which the local laws actually forbade the locator to make a claim wide enough to include the lode. It is easy to see that in such a case two or more locations may be made side by side on the same lode, and neither of the locators possess the right to follow it in depth. The remedy appears to be to consider the prior locator or patentee as entitled to the lode, and a slight change in the statute would put this beyond doubt; or else the provisions of section 2320 might be so modified as to forbid the limitation of width in mining claims by local regulation to a less width than that of the vein itself at the surface; or parties holding locations side by side, comprising the outcrop which neither of them singly covers, might be allowed to consolidate their claims and thereby acquire a right which, under the present construction of the law, I suppose they could not acquire by consolidation, since they do not severally possess it beforehand.

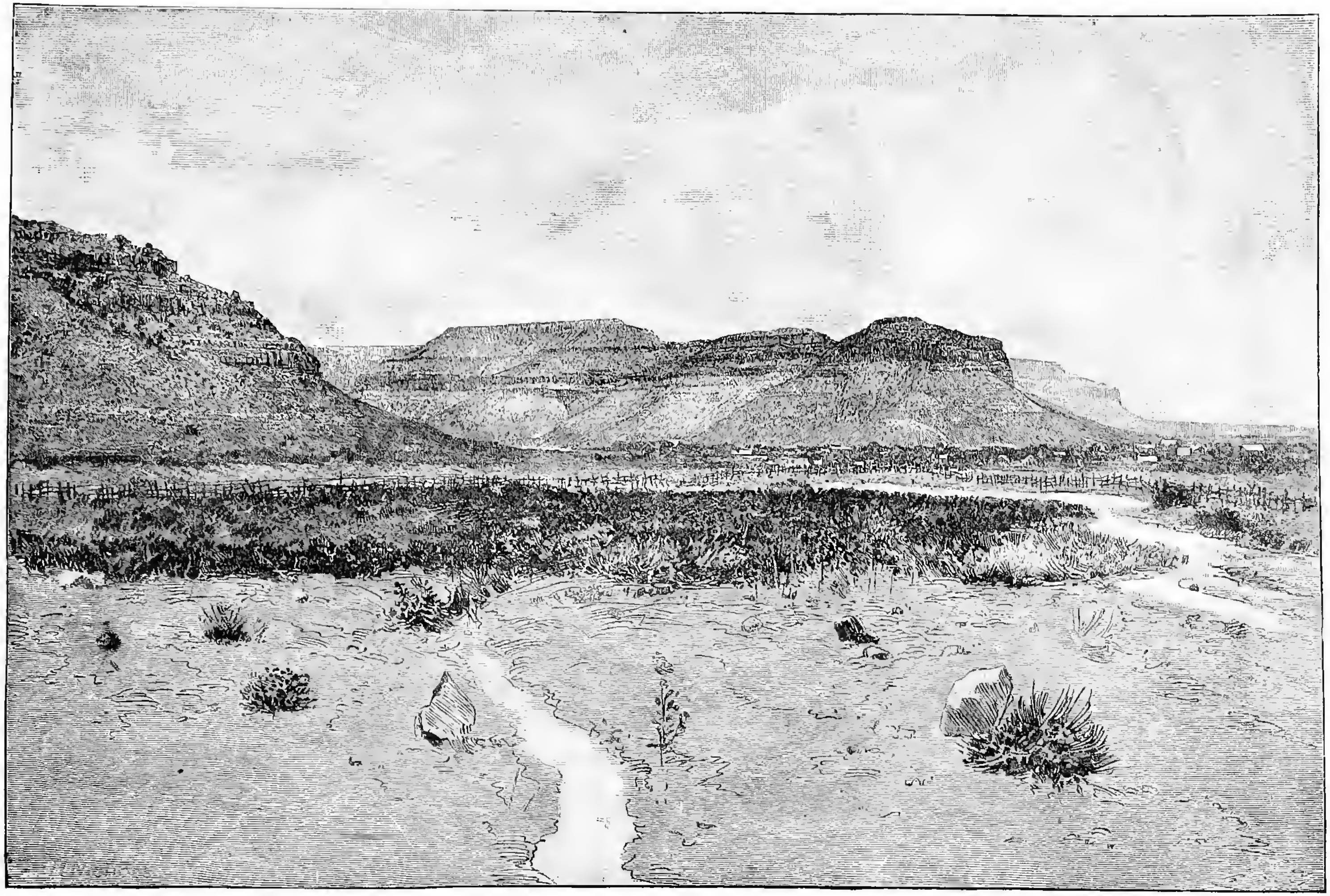
But all these and many more ambiguities and uncertainties arising under the present law have their ultimate origin in the attempt to encourage the purchase and development of mineral lands by granting to the locator and patentee something more and at the same time something less than the contents of his claim, according to the ordinary common-law practice. Strictly speaking, the present system is, as I have shown, equally in accordance with the common law. But the ordinary common-law practice is that the boundaries of the mining rights are the vertical planes drawn through the boundaries of the surface tract. The convenience of this practice is attested by its universality. Land goes from hand to hand in parcels, and even when the mining rights have been alienated the unit of land measurement naturally remains the unit of measurement for the mining right. Our mining law involves endless trouble in its attempt to combine two units, the surface and the lode. Before the law was enacted the miners had but one unit, namely, the lode. Surface ownership there was none, only an easement or privilege of using the surface when necessary for mining operations. It may be questioned whether the present system is an improvement. In the report which I had the honor, as United States Commissioner of Mining Statistics, to present to the Secretary of the Treasury, January 18, 1869, and in which the subject of the mining law was discussed, I used the following language:

"The Spanish and English laws, as I have shown, invariably bound mining claims by vertical, just as the property of land-owners is bounded. The modern Prussian law does the same thing. But, according to the present codes of other German states, and the ancient codes of all, inclined locations may be granted, with the right to follow the vein in depth, without reference to the surface ownership. The American miners' law is unlike either, and, so far as I know, has no parallel in history. It comprehends the vein, its dips, spurs, and angles, to any depth; and under this provision, when two veins are found to meet in depth, the oldest location is held to be the main lode, and the other is confiscated as a 'spur.' (The word 'spur' is omitted from the United States law of 1866; but the sweeping recognition in that law of 'mining customs' virtually restores it.) There is no justice in such a provision. On the other hand, there is no limit in American local regulations as to the distance between parallel locations, which, no matter how closely they lie together, are presumed to be on different veins until proved to be on the same. This state of things both invites and protracts a litigation which is seldom settled except by exhaustion and compromise.

"There are not wanting those who urge the adoption of 'square locations' exclusively as the cure for these evils. But with such, after mature reflection, I cannot agree. The great aim of the government, in disposing of its mines should be to secure their permanent and systematic working. To define the boundaries of mining ground by vertical planes does indeed lessen the danger of litigation; but it also lessens the value of the claim; and, in most cases, the value thus subtracted from one property is not added to any other. Thus, a miner under the Spanish law loses the right to work his vein because, at the depth of 600 feet it passes out of his surface boundaries into the neighboring claim; but the neighbor is not much better off for knowing that 600 feet below the surface he may find a vein of ore. To the miner who has already reached that depth it is valuable; to the miner who must dig and blast 600 feet to find it, it may be worth nothing. Meanwhile it is undoubtedly for the interest of the country that the work should be continued in depth; and the proper person to carry it on is evidently the one who has commenced it and prosecuted it thus far. * * * For the present stage of mining in this country, as for the earlier stages of mining in Germany, the inclined location must be accepted as the best for lodes."

My later reports and publications show a more decided recognition of the advantages of vertical boundary planes, now almost universal among civilized nations. But they also repeat the one consideration, which seemed to me decisive, ten years ago, against that system, and which still constitutes the chief objection to it. I mean the encouragement to deep mining held out by the present system, or, rather, the encouragement to the investment of capital in mining, constitutes in the knowledge that the valuable mineral deposit may be followed indefinitely in depth. Can that advantage be in any way secured under a system of vertical boundaries?

I shall waste no time in vindicating personal consistency in this matter. It might be shown that ten years have changed the conditions of mining in this country and the features of the mining law more than they have changed the views embodied in the long argument from which I have quoted. Our mining districts are better known; it is more easily practicable to measure and define the surface-unit at the beginning of operations; the vague rights granted by miners' custom have been largely shorn and restricted by definition. Above all the present requirement that the survey of a claim shall not be changed after first location, except by relocation (sacrificing prior date of title), and that it shall convey only that portion of the mineral deposit of which it contains the outcrop, top, or apex, utterly revolutionizes



WESTERN SCENERY—VERMILION CLIFF AT KANAB—TRIASSIC—GRAND CAÑON DISTRICT.

SEE PART X.

—FROM U. S. GEOLOGICAL SURVEY REPORT.

the spirit of the former system, and reduces to a slender remainder the "rights of the discoverer." It is no longer possible for a citizen discovering valuable mineral in place to claim it by virtue of priority alone for an indefinite period. He must make haste to find its top or apex or outcrop before any one else; then he must make haste to locate a claim including that upper edge; and by that location, however wisely or unwisely made, he must abide through all subsequent proceedings for title. The certainty of a location carrying absolute ownership of a tract and its contents would be in many cases far better for the miner than this combination of the chance of getting a great deal with the risk of getting nothing. But assuming that a change could be effected in the present administration of the statute, or in the statute itself, by which more freedom should be given to the locator, or assuming that, in the majority of cases, the discoverer actually finds and successfully locates upon the outcrop of his deposit, then there is certainly a real encouragement for him in the knowledge that he can follow the deposit in depth Can this be secured under a system of vertical side boundaries? Two expedients only are suggested. The first is to vary the size of the claim, as the Spanish law does, according to the dip of the deposit. This is open to the gravest objections. It delays the definition of the surface claim (to the manifest injury of neighboring explorers) until the mine has attained a certain depth. The Spanish law makes this depth ten yards, and the dip of the deposit for the first ten yards is taken as the basis for determining the width of the claim (which, however, never exceeds 200 yards on either side of the outcrop). It may fairly be said that this offers little security to the locator. The uppermost thirty feet of a vein are, perhaps, more likely than any other part of it to show a false, local dip. Yet it would not be practicable to require a greater depth, and hence a greater delay, before settling the boundaries of the surface claim.

But if we cannot well vary the size of the claim according to the features of the deposit, the only other expedient is the granting of a tract sufficiently large to offer as great encouragement to miners as is now offered by the peculiarity of the underground ownership. In my report, above quoted, I mentioned 40 acres as the size of the "square location," which would in many districts be necessary to effect this purpose. But that statement needs explanation and qualification. Let us first assume that the location is square in form. The tract of 40 acres is then 1,320 feet square. If the outcrop of a vein runs along one side of it, dipping into the tract—the most favorable case for the locator—the location commands 1,320 feet of the strike, and a distance on the dip indefinitely great as the position of the vein approaches the vertical, and diminishing as it approaches the horizontal, toward a minimum of 1320 feet. Assuming, as an average case, the dip of 45°, the depth of vein within the tract would be about 1,867 feet, and the vertical depth at the point where it leaves the tract 1,320 feet. For many reasons, however, it is not to be supposed that square claims would be generally, or even frequently, so located as to carry the outcrop along one side. Assuming, then, as an average case that the location, of the form and size now under discussion, carries the outcrop through the center, and parallel with two of its sides, we have for a dip of 45° a distance on the dip, within the location, of 933 feet. This is not too much, if a single vein is taken into consideration; and if a mining district is to be surveyed according to the present land-surveying system, with the square mile as a basis, and meridians and parallels as the boundaries, and if such survey is to be independent of the course of the mineral deposits, and the mining locator or purchaser is to be obliged to choose his location among the squares thus defined, I think the square of 1,320 feet, or $\frac{1}{16}$ of a square mile, is at once the most convenient and the smallest which can reasonably be fixed as the size of a claim. But I thought in 1869, and I think still, that the area of forty acres is too great to be accepted by the mining communities, and that the attempt to introduce it would cause much trouble, particularly in districts where several parallel veins might cross such a tract. But few prospectors (sixteen to a square mile) could get a foothold under such a system, and those few would occupy at the outset all the valuable mining ground. Prospecting would be discouraged, and the motive which supplies our new mining camps with the population absolutely necessary for a supply of labor, the establishment of communications, &c., would be almost destroyed.

Hence, I think the attempt to lay out the mineral land in fixed squares would not be wise. If the claims were permitted to have, on the other hand, any form and position, a minimum width (or, better, a maximum length) and maximum area being prescribed, one half the area of 40 acres would suffice to secure substantially equal advantages to the miner; and this is the size which I venture to recommend. Judge Hallett, of Colorado, in an able review of this subject, addressed to your honorable commission, advocates the absence of restrictions as to form and position of locations, fixing the size as not exceeding ten acres, in any form not less than 100 feet wide at any point. This would permit a maximum length of 4,356 feet; and cases might easily arise in which this length would be located. Given, for instance, a well-defined vein or bed, easily worked near the outcrop, and yielding above water level oxidized ores reducible cheaply, say, by amalgamtion, it would be the interest of a locator to take up 4356 feet by 100 feet along such a vein, with the intention of robbing its upper portion by an open cut and then abandoning it. To encourage this would be to discourage systematic and permanent mining. Hence it would, in my judgment, be preferable to fix no minimum width, but a maximum length of location in any direction of 1,500 feet. This length would permit, for the area of 10 acres, a width of about 290 feet, which is, in my judgment not enough. For the area of 20 acres, the width for the maximum length might be 579 feet, which is sufficient to encourage permanent mining. It is true that many, perhaps most, deep mines would extend beyond such a width. For the average case we have been considering, of a vein running through the center of the claim and dipping 45°, this width would give but 410 feet of mining depth; but it may safely be presumed, as Judge Hallett remarks in a letter to the Denver Tribune, that this point will be met by "the ability and disposition of capitalists to gather up a sufficient area for deep mining where the existence of valuable ore may be shown." In other words, a capitalist will buy the neighboring claim if he needs it. Judge Hallett, however, uses this argument in favor of the ten-acre claim. I submit that such a claim is too small to secure the necessary deep mining to satisfy the mine-owner of the permanence and value of the deposit; while, on the other hand, if a rich and valuable vein passes out of a claim of 1,500 by 290 feet, it is likely to enter the adjoining claim at so small a depth below the surface as to invite the owner of that claim to work it himself, or hold it at an exorbitant price. Judge Hallett's proposed claim is less than one-half as large as the maximum now permitted by the United States law. The size which I suggest is nearly the same as the present maximum (1,500 by 600 feet). In all the suggestions which I have heard on this subject, it seems to have been taken for granted that no location should be made until after the discovery within it of "valuable mineral." This phrase is vague enough, and the administration of the part of the law containing it is very likely to be a farce. If the condition could be removed without detriment to the public interest, the whole problem would be greatly simplified. So far as the government is concerned, it seems a simple proposition that if the government is willing to sell agricultural land at $1.25 per acre, and mineral lands at $5 per acre, it would have no reason to object to sell the latter and take the money, leaving to the purchaser the risk of value. We do not ask the settler upon agricultural land to prove the fertility of the soil before we sell it to him. He pre-empts or buys at his own risk. We guard against monopoly of land, so far as we can, by limiting the size of the pre-emption claim. We can do the same thing to the same degree by limiting the size of the mining claim. In neither case can we prevent people who have the desire and the means from buying up farms, or land warrants, or mineral land patents, and then working upon the property or not as they see fit. Under our present system, a patentee may allow his mining property to lie idle if he chooses. If he does so choose it is manifestly immaterial to the public whether there is really a mine there or not. But the locator, we ordain, must have found a valuable mineral deposit, and must bestow upon it, to maintain possessory title, a certain amount of work annually. The only reason that I can discover for this rule is the desire to prevent a mere locator from holding without developing a piece of ground in which, otherwise, some one else might find a valuable mine. If the miners were all owners under patents, we should, and safely could, leave the question of working or not working to their self-interest. Any mine that promised to be profitable would be worked or sold in the course of no very long time. The policy of the government, as I have explained, is to encourage prospecting as a preliminary to purchase; to induce prospectors and possessory owners, by every practicable means, to take patents, and to grant patents on terms so easy and for tracts so small as to favor the miner of limited capital. It seems to me that these ends might be secured by a simple system like the following: Let mining locations be made anywhere on unoccupied public lands, whether any discovery of mineral has taken place or not. Fix the maximum area at 20 acres, and the maximum length at 1,500 feet. Allow the locator to occupy by possessory title for one year—adequate evidence of the boundaries of the location being maintained on the ground as well as in the record. Require a certain amount of work for each 100 feet in length of the location to be performed as a condition of relocation. At any time during the year, if the locator applies for patent, sell him the tract. If he desires to continue to occupy by possessory title, require him to give notice to that effect, together with proof of the performance of the prescribed work, before the end of the year and at the end of the year, *unless some other party has, at least sixty days before, made application to purchase*, issue to the locator the certificate of his possessory title for another year, on the same conditions. But if application to purchase has been made by some other party, and not by the locator, then the latter, during the last sixty days of the year may elect whether he will purchase or vacate the claim. In case no such application has been made, and the locator has not appeared before the close of the year with his proof of work done, let the claim be open to relocation by others.

Under this system, the locator would occupy the position of a tenant, to whom the proprietor should say, "I will let you have this property for one year, with the option to buy it at any time at a nominal price. At the end of the year if you have done a certain small amount of work on the property, I will let you have it for another year, unless a purchaser appears. In that case I shall sell it—to you if you choose, or else to him. But if you neither buy nor improve the property, and no purchaser appears, I shall put somebody else in your place on the same terms as I offer you." Thus we should get clear altogether of the mineral deposit or lode as a unit, and base all proceedings on the land. The officers of the government from the register and surveyor to the judge, would be relieved from the duties of mining experts, and geologists, chemists, and mining captains would no longer be called upon as witnesses to settle by hair-splitting distinctions the right of property. If any radical change in our mining law can be successfully made at the present time, I believe this plan would be as practicable as any, and more beneficial than any, which have come to my notice. If this, or something like this, cannot be adopted, then it seems to me that it would be wiser to amend in detail our present law, rather than attempt changes which would be revolutionary without being remedial. There are many points still needing discussion. Whether the lines of a location should be alterable by resurvey before application for patent (I would say, Yes; the rights of neighboring locators being respected); whether a prospector should have any rights prior to a regular survey and record of location) I would say, Yes; the right to stake off his claim provisionally, and to lose nothing by delay of the government officer in making official survey—all this under proper regulations (whether a prospector simply roaming over the public land, and finding "mineral," should have any right by virtue of discovery (I would say, No; but his commencement to stake off or mark the boundaries of a claim should give him the inchoate right to that claim, to be perfected, however, by continuing and finishing the proceeding); whether one year, as I have suggested, is the proper term; whether sixty days, suggested in another place, is the proper term; whether possessory owners should be notified, by advertisement or otherwise, of applications to purchase, at the end of their term, the claims they are occupying; whether such notice should be given at the expense of the party acquiring the claim, or whether it is sufficient that these facts should be kept in accessible records, and the possessory owner obliged to consult the record thirty days (or some other fixed period) before the end of his year, to discover for himself whether there is a proposing purchaser; how far present possessory owners can be forced to take patents or to accept the terms of the new law (I fear nothing of this kind can be done so long as they obey the terms of the present law)—these and many other questions of detail arise; but I cannot see in any of them difficulties which would constitute insuperable objections to the proposed system, or which would justify me in prolonging further these communications, for the length and diffusiveness of which I ought rather to offer my apologies.

Yours respectfully,

R. W. Raymond.

—From the "Public Domain," by Thos. Donaldson, Public Land Commission.

THE GOVERNMENT ORGANIZATION.

THE following is from the United States Statutes at Large.—

Secretary of the Interior—Section 1. The Secretary of the Interior is charged with the supervision of public business relating to the following subjects:

* * * * * * *

Second. The public lands, including mines.

2 Stat. 716; 5 *id.* 107: 9 *id.* 395; R. S. 441. Wilcox *v.* Jackson, 13 Pet. 498; Maguire *v.* Tyler, 1 Black, 195; Snyder *v.* Sickles, 8 Otto, 203; Wolsey *v.* Chapman, S. C., Oct. T., 1879, in manuscript; Patterson *v.* Tatum, 3 Saw. C. C. 164. 3 Op. Att. Gen. 137; 12 *id.* 250. 2 Laws, Instructions and Opinions, 104; 1 Lester, 681. Hesters *v.* Brennan, 50 Call. 211.

Sec. 2. He shall grant warrants to parties entitled to land heretofore or hereafter given by the United States for military services.

2 Stat. 717; R. S. 456.

Sec. 3. Copies of papers filed in the Interior Department and remaining therein shall be authenticated under the hand of the Secretary and the seal of the General Land Office.

3 Stat. 721; 5 *id.* 111; R. S. 460.

Sec. 4. The bonds of surveyor-general shall be executed and delivered to the Secretary of the Interior.

3 Stat. 697; R. S. 2215. U. S. *v.* Tingley, 5 Pet. 115; U. S. *v.* Stephenson, 1 McLean, C. C. 462; Farrar *v.* U. S., 5 Pet. 373.

Sec. 5. He shall take the necessary measures for the completion of the public-land surveys.

5 Stat. 384; 19 *id.* 121; R. S. 2218.

Sec. 6. He shall discontinue the land office in any district wherein the public lands are reduced to less than one hundred thousand acres, and shall give notice at what convenient existing land office such residue shall be subject to sale.

5 Stat. 455; R. S. 2249; Matthews *v.* Zane's Lessee, 5 Cranch, 95; same case, 7 Wheat. 164.

Sec. 7. He shall make a reasonable allowance for office rent for consolidating land offices, and may approve the employment of clerks by the register.

12 Stat. 131; R. S. 2255.

Sec. 8. He is authorized to repay the purchase money, fees, commissions, and excess payments in cases where the lands have been erroneously sold and the title cannot be confirmed.

4 Stat. 80; 11 *id.* 387; act June 16, 1880; R. S. 2362. 4 Op. Att. Gen. 277. Decisions Sec. Int., Aug. 17, 1849; July 23, 1864; April 15, 1878; Aug. 5, 1878; May 7, 1879; Nov. 20, 1878; July 1, 1879; July 29, 1879; Aug. 12, 1878; Jan. 8, 1880.

Sec. 9. He is authorized to permit innocent parties who purchased and located claims arising under the treaty of September thirty, eighteen hundred and fifty-four, to perfect their entries with cash or military bounty-land warrants.

17 Stat. 340; R. S. 2368. Decisions Sec. Int., July 6, 1876; July 19, 1879; May 6, 1880.

Sec. 10. He is authorized to allow erroneous entries of lands sold at private sale and warrant locations to be corrected; and this authority extends to patented cases upon surrender of the patent with satisfactory relinquishment of title indorsed thereon.

3 Stat. 526; 4 *id.* 301; 10 *id.* 257; R. S. 2369, 2370, 2371.

Sec. 11. When, in the opinion of the President, the public interests require it, he shall cause town-site reservations to be surveyed into lots; shall fix their cash value by appraisement of disinterested persons; and after, offering same at public entry to the highest bidder shall prescribe regulations for sale of the residue at private entry at no less than the appraised values. All such sales shall be conducted by the register and receiver of the proper land district.

12 Stat. 754; R. S. 2381. U. S. *v.* Hare, 4 Saw; C. C. 653.

Sec. 12. He may cause a survey and plat to be made of a city or town, if within twelve months from its establishment on the public domain the parties interested do not file in the General Land Office the showing required by law; and thereafter the minimum price of lots included therein shall be increased fifty per centum.

13 Stat. 344; R. S. 2384.

Sec. 13. He may vary the subdivisional surveys in the State of Nevada from a rectangular form to suit the circumstances of the country.

14 Stat. 86; R. S. 2408. Heydenfeldt *v.* Mining Co., 3 Otto, 634.

Sec. 14. He may authorize the geodetic method of survey in Oregon and California.

9 Stat. 496; 10 *id.* 245; R. S. 2409.

Sec. 15. He may direct a departure from the rectangular mode of survey in the State of California.

10 Stat. 245; R. S. 2410.

Sec. 16. He may direct compensation by the day for surveys in Oregon and California.

10 Stat. 247; R. S. 2411.

Sec. 17. He may prescribe regulations for the location and patenting, free of expense, of any military bounty-land warrant transmitted for that purpose in the General Land Office.

9 Stat. 521; R. S. 2437. Decision Sec. Int., March 1, 1876.

Sec. 18. He may authorize issue of patents in cases of lost military bounty-land warrants.

3 Stat. 317; R. S. 2439.

Sec. 19. He shall cause new bounty-land warrants to be issued in lieu of lost or destroyed warrants, and shall prescribe regulations for the prevention of frauds.

12 Stat. 90; 18 *id.* 111; R. S. 2441, 2442.

Sec. 20. He shall issue patents to the heirs of persons entitled to bounty lands.

5 Stat. 650; R. S. 2443.

Sec. 21. Conjointly with the Attorney-General and the Commissioner of the General Land Office, he shall prescribe regulations for the equitable decision of suspended entries of public lands and of suspended pre-emption claims, and adjudicate in what cases patents shall issue upon the same.

9 Stat. 51; 10 *id.* 258; 11 *id.* 22: 28 *id.* 50; 19 *id.* 244; R. S. 2450, 2451.

Sec. 22. He shall have exclusive control of the Yellowstone Park, with authority to lease portions thereof.

17 Stat. 33; R. S. 2475.

Sec. 23. He shall make accurate lists and plats of the swamp and overflowed lands granted to the several States and transmit same to the governors thereof; and at the request of the governor of any State in which such lands are situate, he shall cause patents to be issued conveying to said State the fee-simple of said lands.

9 Stat. 519: R. S. 2479, 2480. Railroad Co. *v.* Smith, 9 Wall, 95; French *v.* Fyan, 3 Otto, 169; Martin *v.* Marks, 7 *id.* 345. 9 Op. Att. Gen. 253. Clarkson *v.* Buchanan, 53 Mo. 563; Masterson *v.* Marshall, 65 *id.* 94; Funkhouser *v.* Peck, 67 *id.* 20; Busch *v.* Donohue, 31 Mish. 481; Kile *v.* Tubbs, 23 Cal. 431; Kernan *v.* Griffith, 27 *id.* 87; Fremont Co. *v.* R. R. Co., 22 Iowa, 91; R. R. Co. *v.* Brown, 40 *id.* 333; Page Co. *v.* R. R. Co., 40 *id.* 520; Edmonson *v.* Corn, 62 Ind. 17; Gratham *v.* Atkins 62 Ills., 359 Smith *v.* Goodell, 66 *id.* 450; Compton *v.* Prince, 67 *id.* 281; Gaston *v.* Scott, 5 Oreg. 48.

Sec. 24. Indemnity for swamp lands sold by the United States shall not be allowed until approved by the Secretary of the Interior.

10 Stat. 634, 635; R. S. 2482.

Sec. 25. He shall notify the governors of the States of Minnesota and Oregon when public land surveys have been completed and confirmed in said States.

12 Stat. 3; R. S. 2490. Gaston *v.* Scott. 5 Oreg. 48. Decisions Sec. Int., Oct. 13, 1876; Jan. 7, 1879; April 15, 1880.

Sec. 26. He shall sign all requisitions for the advance or payment of money out of the Treasury on estimates or accounts approved or certified by the Commissioner of the General Land Office, subject to the control of the proper accounting officers of the Treasury.

9 Stat. 395; R. S. 444. 1 Lester, 314.

Sec. 27. He shall prescribe the duties of the Assistant Secretary of the Interior, who shall act as the Secretary of the Interior in the absence of that officer.

12 Stat. 369; R. S. 439.

Sec. 28. Upon the survey of lands designated as mineral, the Secretary of the Interior may designate and set apart such portions of the same as are clearly agricultural lands, which lands shall thereafter be subject to pre-emption and sale as other public lands and be subject to all the laws and regulations applicable to the same.

14 Stat. 253; R. S. 2342.

Sec. 29. He shall prescribe regulations for the subdivision of fractional sections.

3 Stat. 566; 4 *id.* 503; R. S. 2397. Gazzam *v.* Phillips' Lessee *et al.*, 20 How., 372. 3 Op. Att. Gen. 281. Decision Com. G. L. O. May 17, 1875.

Sec. 30. It shall be the duty of the Secretary of the Interior to designate one newspaper in each State or Territory, where public lands are situated, for the publication of all Executive proclamations relating to the sale of public lands.

19 Stat. 221.

THE GENERAL LAND OFFICE.

THERE shall be in the Department of the Interior a Commissioner of the General Land Office, who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be entitled to a salary of four thousand dollars a year.

2 Stat. 717; 5 *id.* 107, 17 *id.* 508; R. S. 446.

Sec. 32. The Commissioner of the General Land Office shall perform, under the direction of the Secretary of the Interior, all executive duties appertaining to the surveying and sale of the public lands of the United States, or in anywise respecting such public lands, and, also, such as relate to private claims of land, and the issuing of patents for all grants of land under the authority of the Government.

2 Stat. 7, 16; 5 *id.* 107; 18 *id.* 62, 317; R.S. 453. Foley *v.* Harrison, 15 How. 433; Barnard's Heirs *v.* Ashley's Heirs, 18 *id.* 43; Bell *v.* Hearne, 19 *id.* 252; Castro *v.* Hendricks, 23 *id.* 438; Maguire *v.* Tyler, 1 Black, 195; Harkness *v.* Underhill, 1 *id.* 316; U. S. *v.* Commissioner, 5 Wall, 563; Gaines *v.* Thompson, 7 *id.* 349; Sec'y *v.* McGarrahan, 9 *id.* 228; Johnson *v.* Towsley, 13 *id.* 72, 12 Op. Att. Gen. 250; Le Roy *v.* Clayton, 2 Saw. C. C. 493; Patterson *v.* Tatum, 3 *id.* 164; Le Roy *v.* Jamison, 3 *id.* 369. Lott *v.* Prudhomme, 3 Rob. (La.) 293; Bettis *v.* Amonett, 4 *id.* 364; Foley *v.* Harrison, 5 *id.* 75; Gurdry *v.* Wood, 19 *id.* 234; Lamont *v.* Stinson, 3 Wis. 545; Fremont Co. *v.* R. R. Co., 22 Iowa, 91; Bellows *v.* Todd, 34 *id.* 18; Brill *v.* Stiles, 35 Ills. 305; Aldrich *v.* Aldrich, 37 *id.* 32; Lewis *v.* Lewis, 9 Mo. 183; Pope *v.* Athearn, 42 Cal. 606; Hosmer *v.* Wallace, 47 *id.* 461; Parker *v.* Duff, 47 *id.* 554; McGarrahan *v.* Mining Co., 49 *id.* 331; Hesters *v.* Brennan, 50 *id.* 211; Vance *v.* Kohlburg 50 *id.* 346; Weaver *v.* Fairchild, 50 *id.* 360; Fugy *v.*-Hensley, 52 *id.* 299.

Sec. 33. The Commissioners of the General Land Office shall retain the charge of the seal heretofore adopted for the office, which may continue to be used, and of the records, books, papers, and other property appertaining to the office.

2 Stat. 717; R. S. 445.

Sec. 34. The Commissioner of the General Land Office shall when required by the President, or either House of Congress, make a plat of any land surveyed under the authority of the United States, and give such information respecting the public lands and concerning the business of his office as shall be directed.

2 Stat. 717; R. S. 455.

Sec. 35. All returns relative to the public lands shall be made to the Commissioner of the General Land Office; and he shall have power to audit and settle all public accounts relative to the public lands; and upon the settlement of any such accounts he shall certify the balance, and transmit the account with the vouchers and certificate to the First Comptroller of the Treasury, for his examination and decision thereon.

2 Stat. 717; R. S. 456.

Sec. 36. All exemplifications of patents, or papers on file or of record in the General Land Office, which may be required by parties interested, shall be furnished by the Commissioner upon the payment by such parties at the rate of fifteen cents per hundred words, and two dollars for copies of township plats or diagrams, with an additional sum of one dollar for the Commissioner's certificate of verification with the General Land Office seal; and one of the employes of the office shall be designated by the Commissioner as the receiving clerk, and the amount so received shall, under the direction of the Commissioner, be paid into the Treasury; but fees shall not be demanded for such authenticated copies as may be required by the officers of any branch of the Government, nor for such unverified copies as the Commissioner in his discretion may deem proper to furnish.

13 Stat. 375; R. S. 461. Lane *v.* Bommelmann, 17 Ills. 95; Lacy *v.* Davis, 4 Mich. 140; Gilman *v.* Ripela, 18 *id.* 145; Clark *v.* Hill, 19 *id.* 356; Boyd *v.* Stambaugh, 34 *id.* 348; Ansley *v.* Peterson, 30 Wis. 653; McLean *v.* Bovee, 35 *id.* 27; Kelly *v.* Wallace, 14 Minn. 336; Washburn *v.* Mendenhall, 21 *id.* 332; Barton *v.* Murrain, 27 Mo. 235; Railroad Co. *v.* Moore, 37 *id.* 338; Stephen *v.* Westwood, 25 Ala. 716; Smith *v.* Mosier, 5 Blackf. (Ind.) 51. Cir. G. L. O., July 20, 1875.

Sec. 37. That public lands situated in States in which there are no land offices may be entered at the General Land Office, subject to the provisions of law touching the entry of public lands; and the necessary proofs and affidavits required in such cases may be made before some officer competent to administer oaths, whose official character shall be duly certified by the clerk of a court of record; and moneys received by the Commissioner of the General Land Office for lands entered by cash entry shall be covered into the Treasury.

19 Stat. 315; 20 *id.* 201.

Sec. 38. Upon the discontinuance of any surveying district the authority, powers, and duties in relation to the survey, resurvey, or subdivision of lands therein and all matters and things connected therewith, as previously exercised by the surveyor-general, shall be vested in and devolved upon the Commissioner of the General Land Office; and deputy surveyors or other agents under his direction shall have free access to any field-notes, maps, records, and other papers turned over to the authorities of any State pursuant to law, for the purpose of making copies thereof, without charge of any kind.

10 Stat. 152; R. S. 2219, 2220.

Sec. 39. Appeals from the decision of district officers in cases of contest for the right of pre-emption shall be made to the Commissioner of the General Land Office, whose decision shall be final, unless appeal therefrom be taken to the Secretary of the Interior.

5 Stat. 456; 11 *id.* 326; R. S. 2273. Barnard *v.* Ashley, 18 How. 43; Garland *v.* Wynn, 20 *id.* 6; Lytle *v.* Arkansas, 22 *id.* 193; Harkness *et al. v.* Underhill, 1 Black, 316; Lindsey *v.* Hawse, 2 *id.* 554; Minnesota *v.* Batchelder, 1 Wall. 109; Litchfield *v.* Register and Receiver, 9 *id.* 575; Johnson *v.* Towsley, 13 *id.* 72; Warren *v.* Van Brunt, 19 *id.* 646; Shepley *et al. v.* Cowan *et al.*, 1 Otto, 330. 1 Op. Att. Gen. 201. Laughlin *v.* McGarvey, 50 Cal. 169.

Sec. 40. Where bona-fide settlers, under the homestead or pre-emption laws, have, subsequent to the date of filing their applications to enter not exceeding one quarter-section of public lands, been appointed as register or receiver of the land office of the district in which the lands are located, proof and payment must be made to the satisfaction of the Commissioner of the General Land Office.

17 Stat. 10; R. S. 2287. 4 Op. Att. Gen. 223; 7 *id.* 647.

Sec. 41. The Commissioner of the General Land Office shall have power to establish the maximum charges for surveys and the publication of notices under the mineral laws; and in case of excessive charges for publication he may designate any newspapers published in a land district where mines are situated for the publication of mining notices in such district, and fix the rates to be charged by such paper.

17 Stat. 95; 19 *id.* 52; R. S. 2334.

Sec. 42. Whenever any reservation of public land is brought into market, the Commissioner of the General Land Office shall fix a minimum price not less than one dollar and twenty-five cents per acre, below which such lands shall not be disposed of.

13 Stat. 374; R. S. 2364.

Sec. 43. In case of mistakes in description, the Commissioner is authorized, upon prescribed proof, to correct entries of public lands, where the same do not exceed one half-section, and where the certificate has not been assigned.

4 Stat. 31; R. S. 2372. Wilson *v.* Byns, 77 Ills. 76; Corwan *v.* Johnson, 29 Mo. 84; State *v.* Commissioner, 17 Wis. 248.

Sec. 44. He shall prescribe regulations for the conduct of sales of town lots at public sale and by private entry.

12 Stat. 754; R. S. 2381. Leech *v.* Ranch, 3 Minn. 448.

Sec. 45. The Commissioner shall approve all contracts for the survey of the public lands.

12 Stat. 409; R. S. 2398. Maguire *v.* Tyler, 1 Black, 201; Parke *v.* Ross, 11 How. 362; McKee *v.* U. S. 1 N. & H. 336.

Sec. 46. The instructions issued by the Commissioner of the General Land Office not in conflict with law shall be deemed part of every contract for surveying the public lands.

12 Stat. 409; R. S. 2399.

Sec. 47. Subject to the statutory maximum he shall fix the price per mile for public surveys, and he shall instruct the surveyor-general as to the mode of keeping accounts and making reports of the cost of surveying and platting private land claims.

12 Stat. 409; 18 *id.* 384; R. S. 2400.

Sec. 48. He shall instruct the surveyor-general as to the survey of any townships upon the deposit by settlers of the cost thereof.

12 Stat. 410; R. S. 2401. Cir. G. L. O., March 5, 1880.

Sec. 49. The Commissioner of the General Land Office may authorize, in his discretion, public land in Oregon, densely covered with forests or thick undergrowth, to be surveyed at augumented rates, not exceeding eighteen dollars per mile for standard parallels, fifteen dollars for townships, and twelve dollars for section lines.

16 Stat. 304, 305; R. S. 2404. Decision Sec. Int. June 16, 1879.

Sec. 50. The Commissioner of the General Land Office, in his discretion, may hereafter authorize public lands in California and in Washington Territory, densely covered with forests or thick undergrowth, to be surveyed at augmented rates, not exceeding eighteen dollars per linear mile for standard parallels, sixteen dollars for townships, and fourteen dollars for section lines.

17 Stat. 358; R. S. 2405. Decision Sec. Int., June 16, 1879.

Sec. 51. When geodetic surveys in Oregon and California are authorized by the Secretary of the Interior, the Commissioner shall prescribe the regulations and terms for the execution thereof.

9 Stat. 496; 10 *id.* 245; R. S. 2409.

Sec. 52. Under the direction of the Secretary of the Interior, the Commissioner may allow compensation by the day for public surveys in Oregon and California.

10 Stat. 247; R. S. 2411.

Sec. 53. The Commissioner shall prescribe regulations for the making and execution of assignments of military bounty-land warrants, and for the location thereof.

10 Stat. 3; 11 *id.* 309; R. S. 2414. Bouldin *et al. v.* Massie's Heirs, 7 Wheat. 122. Nichols *v.* Nichols, 3 Pinney (Wis.) 174; Price *v.* Johnston, 1 Ohio St. 390. Duke *v.* Thompson, 16 Ohio 34; Mock *v.* Brammer, 28 *id.* 508; Dupre *v.* McCright, 6 La. 146; B. & M. R. R. Co. *v.* Clingman, 23 Iowa, 306; Waters *v.* Bush, 42 *id.* 255; Dyke *v.* McVey, 16 Ills. 41. Decision Sec. Int., March 1, 1876.

Sec. 54. Pursuant to regulations to be prescribed by the Secretary of the Interior, the Commissioner shall cause to be located, free of expense, military bounty-land warrants transmitted to him for that purpose by the holders thereof.

9 Stat. 521; R. S. 2437. Decision Sec. Int., March 1, 1876.

Sec. 55. The Commissioner shall prescribe regulations for the relocation of military bounty-land warrants erroneously located by actual settlers.

10 Stat. 256; R. S. 2446.

Sec. 56. Conjointly with the Secretary of the Interior and the Attorney-General, he shall prescribe regulations for the equitable decision of suspended entries of public lands and of suspended pre-emption claims, and adjudicate in what cases patents shall issue upon the same, and report such adjudication to Congress.

9 Stat. 51; 10 *id.* 258; 11 *id.* 22; 18 *id.* 50; 19 *id.* 244; R. S. 2450, 2452.

Sec. 57. Upon public notice of at least thirty days by the proper register and receiver, the Commissioner may order into market, without Presidential proclamation, all lands embraced in claims rejected by the board for equitable adjudication, and isolated or disconnected parcels of unoffered lands.

9 Stat. 51; R. S. 2455.

Sec. 58. The Commissioner shall issue patents upon entries confirmed by the board for equitable adjudication, when such entries had been previously patented and the patents surrendered for cancellation.

10 Stat. 258; R. S. 2456.

Sec. 59. The Commissioner shall cause to be prepared, and shall certify, under the seal of the office, such copies of records, books, and papers on file in his office as may be applied for to be used in evidence in courts of justice.

5 Stat. 111; 13 *id.* 375; R. S. 461, 891, 2469, 2470. Galt *v.* Galloway, 4 Pet. 331.

Sec. 60. With the approval of the Secretary of the Interior, the Commissioner may, upon satisfactory proof, allow indemnity to the several States for swamp and overflowed lands granted to them by the act of September twenty-eighth, eighteen hundred and fifty, and sold by the United States prior to March third, eighteen hundred and fifty-seven.

10 Stat. 634, 635; 11 *id.* 251; R. S. 2482. 11 Op. Att. Gen. 467; *id.* July 25, 1877, in manuscript. Decisions Sec. Int. March 31, 1861; May 8, 1861; March 12, 1863; Feb. 8, 1868; Feb. 2, 1874. Decision Com. G. L. O., Feb. 17, 1879.

Sec. 61. The Commissioner, under the direction of the Secretary of the Interior, is authorized to enforce and carry into execution every part of the public land laws not otherwise specially provided for.

R. S. 2478. Bell *v.* Hearne *et al.*, 19 How. 252; Garland *v.* Wynn, 20 *id.* 6. 3 Op. Att. Gen. 93, 104, 697; 10 *id.* 56. Pope *v.* Athearn, 42 Cal. 606; McDowell *v.* Morgan, 28 Ills. 528; Foley *v.* Harrison, 5 La. Ann. 75.

Sec. 62. The Commissioner shall possess and exercise all the powers and authority and perform all the duties heretofore required by law to be performed by the recorder of land titles in Missouri.

18 Stat. 62. Hale *v.* Gaines *et al.*, 22 How. 144; Rector *et al. v.* U. S., 2 Otto, 698; Scull *v.* U. S., 8 *id.* 410; U. S. *v.* Clamorgan, S. C., Oct. T., 1879, in manuscript. 1 Op. Att. Gen. 718. Prim *v.* Horen, 27 Mo. 205; O'Flaherty *v.* Kellogg, 59 *id.* 485. For acts prescribing duties of the recorder of land titles, see 2 Stat. 326, 353, 748, 812; 3 *id.* 86, 121, 329; 4 *id.* 52, 65, 566, 661; 19 *id.* 122.

Sec. 63. It shall be the duty of the Commissioner to issue patents for public lands and private land claims in all cases where the issue thereof is authorized by law.

2 Stat. 716; 5 *id.* 107; R. S. 453. Bell *v.* Hearne, 19 How. 252; Castro *v.* Hendricks, 23 *id.* 438; Polk's Lessee *v.* Wendal *et al.*, 9 Cranch, 87; Hoofnagle *v.* Anderson, 7 Wheat. 212; Patterson *v.* Winn, 11 *id.* 380; Stringer *et al. v.* Young's Lessee, 3 Pet. 320; U. S. *v.* Arredondo, 6 *id.* 691; Bagnell *v.* Broderick, 13 *id.* 436; Stoddard *v.* Chambers, 2 How. 284; Lander *v.* Brant, 10 *id.* 348; Minter *v.* Crommelin, 18 *id.* 87; Field *v.* Seabury, 19 *id.* 323; Garland *v.* Wynn, 20 *id.* 6; Hooper *v.* Scheimer, 23 *id.* 235; Greer *v.* Mezes, 24 *id.* 268; U. S. *v.* Covilland, 1 Black, 339; U. S. *v.* Grimes, 2 *id.* 610; U. S. *v.* Stone, 2 Wall. 525; Hogan *v.* Page, 2 *id.* 605; Beard *v.* Federy, 3 *id.* 478; Hughes *v.* U. S., 4 *id.* 232; U. S. *v.* Com., 5 *id.* 563; Richart *v.* Phelps, 6 *id.* 160; Stark *v.* Starr, 6 *id.* 402; Silver *v.* Ladd, 7 *id.* 29; Maguire *v.* Tyler, 8 *id.* 650; Secretary *v.* McGarrahan, 9 *id.* 298; Meador *v.* Norton, 11 *id.* 442; Johnson *v.* Towsley, 13 *id.* 72; Gibson *v.* Chouteau, 13 *id.* 92; Railway Co. *v.* Prescott, 16 *id.* 603; Henshaw *v.* Bissell, 18 *id.* 255; Langdeau *v.* Haines, 21 *id.* 521; Morton *v.* Nebraska, 21 *id.* 660; Miller *v.* Dale, 2 Otto, 473; Sherman *v.* Buick, 3 *id.* 209; McGarrahan *v.* Mining Co., 6 *id.* 316; Moore *v.* Robbins, 6 *id.* 530; Wirth *v.* Branson, 8 *id.* 118; Snyder *v.* Sickles, 8 *id.* 203; Cowell *v.* Colo. Springs Co., 10 *id.* 55; Simmons v. Wagner, S. C., Oct. T., 1879, in manuscript. Lewis *v.* Baird, 3 McLean, C. C. 56; Nelson *v.* Moon, 3 *id.* 319; Shedds *v.* Sawyer, 4 *id.* 181; Huidekoper *v.* Burrows, 1 Wash. C. C. 109; Mill and Mining Co. *v.* Dangberry, 1 Saw. C. C. 450; LeRoy *v.* Clayton, 2 *id.* 493; Dodge *v.* Perry, 2 *id.* 645; Le Roy *v.* Jamison, 3 *id.* 369; Patterson *v.* Tatum, 3 *id.* 164; Wyth *v.* Haskell, 3 *id.* 574; Hardy *v.* Harbin, 4 *id.* 536; Mackey *v.* Eaton, 2 Dillon, C. C. 41; U. S. *v.* Railway Co., 4 *id.* 397; Seabury *v.* Field, 1 McAllister, C. C. 60; Mezes *v.* Goeler, 1 *id.* 401; Chapman *v.* School Dist., 1 Deady, C. C. 108; Lamb *v.* Storr, 1 *id.* 447. 1 Op. Att. Gen. 44, 45, 159, 458, 718; 2 *id.* 15, 41, 186, 501; 3 *id.* 93, 240, 351, 623, 653; 4 *id.* 120, 149, 150, 319, 329; 5 *id.* 7, 628; 7 *id.* 491, 636, 681; 9 *id.* 108; 12 *id.* 250; 13 *id.* 456; 14 *id.* 601, 624. Stewart *v.* Parish, 6 Ohio, 477; Smith *v.* Stork, 7 *id.* 551; Sullivant *v.* Weaver, 10 *id.* 275; Trimble *v.* Boothly, 14 *id.* 109; Miliker *v.* Starling, 16 *id.* 61; Jackson *v.* Williams, 18 *id.* 69; Subblefield *v.* Boggs, 2 Ohio St. 216; Wood *v.* Ferguson, 7 *id.* 288; Strong *v.* Lehman, 10 *id.* 93; Mathews *v.* Rector, 24 *id.* 439; Buckner *v.* Walcott, 1 Doug. (Mich.) 19; Stockton *v.* Williams, 1 *id.* 546; Clark *v.* Hall, 19 Mich. 356; Johnson *v.* Ballou, 28 *id.* 379; Sands *v.* Davis, 40 *id.* 14; Jackson *v.* Astor, 1 Pinney (Wis.) 137; Parkerson *v.* Brocker, 1 *id.* 174; Lamont *v.* Stimson, 3 Wis. 45; Dillingham *v.* Fisher, 5 *id.* 475; Schnee *v.* Schnee, 23 *id.* 377: Aumont *v.* Green Bay & Miss. Co., 31 *id.* 317; Easton *v.* Lyman, 33 *id.* 34; Arnold *v.* Grimes, 2 Green (Iowa), 77; Cavender *v.* Smith, 3 *id.* 349; Arnold *v.* Grimes, 2 Iowa, 13; Cavender *v.* Smith's Heirs, 5 *id.* 157; Fisher *v.* Warner, 34 *id.* 447; Brison *v.* Cury, 35 *id.* 72; Waters *v.* Bush, 42 *id.* 255; Rankin *v.* Miller, 43 *id.* 11; Steeple *v.* Downing, 60 Ind. 478; Doe *v.* Hill, Breese (Ills.) 236; Moore *v.* Hunter, 6 Ills. 317; Ballance *v.* McFarden, 12 *id.* 317; Gray *v.* McFadden, 12 *id.* 324; Rankin *v.* Curtemus, 12 *id.* 334; Gratham *v.* Atkins, 63 *id.* 359; Vansickle *v.* Haines, 7 Nev. 249; Smith *v.* Pipe, 3 Colo. 187; Starr *v.* Stark, 2 Oreg. 118; White *v.* Allen, 3 *id.* 103; Gold Hill Co. *v.* Ish, 5 *id.* 104; Moore *v.* Wilkinson, 13 Cal. 478; Yount *v.* Howell, 14 *id.* 465; Mott *v.* Smith, 16 *id.* 534; Galup *v.* Armstrong, 22 *id.* 480; Kimball *v.* Semple, 26 *id.* 441; Keeran *v.* Griffith, 34 *id.* 580; Durfee *v.* Plaisted, 38 *id.* 80; Frisbee *v.* Morgues, 39 *id.* 451; Collins *v.* Bartlett, 44 *id.* 371; Canfield *v.* Thompson, 49 *id.* 210; McGarrahan *v.* Mining Co., 49 *id.* 331; Vance *v.* Kohlburg, 50 *id.* 346; Miller *v.* Ellis, 51 *id.* 73; Houghton *v.* Hardenburg, 53 *id.* 181; Cruz *v.* Martinez, 53 *id.* 239; Sarpy *v.* Papin, 7 Mo. 503; Barry *v.* Gamble, 8 *id.* 88; Allison *v.* Hunter, 9 *id.* 749; Cowman *v.* Johnson, 20 *id.* 108; Thomas *v.* Wyatt, 31 *id.* 188; Hill *v.* Miller, 36 *id.* 182; Gibson *v.* Chouteau, 39 *id.* 536; Maguire *v.* Tyler, 40 *id.* 406; Calloway *v.* Trash, 50 *id.* 420; Gaines and Rector *v.* Hale, 26 Ark. 168; Lott *v.* Prudhomme, 3 Rob. (La.) 293; Jenkins *v.* Gibson, 3 La. 203; McGill *v.* McGill, 4 *id.* 262; Foley *v.* Harrison, 5 *id.* 75; Pepper *v.* Dunlap, 9 *id.* 137; Bell *v.* Hearne, 10 *id.* 515; Cage *v.* Danks, 13 *id.* 128; Stemspring *v.* Bennett, 16 *id.* 201; Masters *v.* Eastis, 3 Port (Ala.) 368; Goodlet *v.* Smithson, 5 *id.* 245; Jones *v.* Inge, 5 *id.* 327; Bullock *v.* Wilson, 5 *id.* 338; Innerarity *v.* Mims, 1 Ala. 670; Pollard *v.* Files, 3 *id.* 47; Hines *v.* Greenlee, 3 *id.* 73; Crommelin *v.* Minter, 9 *id.* 594; Etheridge *v.* Doe, 18 *id.* 565. Decision Sec. Int., Sept. 6, 1870. Decision Com. G. L. O., March 21, 1879.

Sec. 64. In case of any claim to land in any State or Territory which has heretofore been confirmed by law, and in which no provision is made by the confirmatory statute for the issue of a patent, it may be lawful, where surveys for the land have been or may hereafter be made, to issue patents for the claims so confirmed, upon the presentation to the Commissioner of the General Land Office of plats of survey thereof, duly approved by the surveyor-general of any State or Territory, if the same be found correct by the Commissioner. But such patents shall only operate as a relinquishment of title on the part of the United States, and shall in no manner interfere with any valid adverse right to the same land, nor be construed to preclude a legal investigation and decision by the proper judicial tribunal between adverse claimants to the same land.

10 Stat. 599: R. S. 2447. Beard *v.* Federy, 3 Wall. 478; Maguire *v.* Tyler, 8 *id.* 650; Langdeau *v.* Haines, 21 *id.* 521; Miller *v.* Dale, 2 Otto, 473; U. S. *v.* Throckmorton, 8 *id.* 61; Snyder *v.* Sickles, 8 *id.* 203. 14 Op. Att. Gen. 624. Decisions Sec. Int., Feb. 21, 1872; Dec. 19, 1878; May 17, 1879. Decisions Com. G. L. O., Sept. 18, 1874; Sept. 19, 1876.

Sec. 65. Where lands have been or may hereafter be granted by any law of Congress to any one of the several States and Territories, and where such law does not convey the fee-simple title of the lands, or require patents to be issued therefor, the lists of such lands which have been or may hereafter be certified by the Commissioner of the General Land Office, under the seal of his office, either as originals or copies of the originals or records, shall be regarded as conveying the fee-simple of all the lands embraced in such lists that are of the character contemplated by such act of Congress and intended to be granted thereby; but where lands embraced in such lists are not of the character embraced by such acts of Congress, and are not intended to be granted thereby, the lists, so far as these lands are concerned, shall be perfectly null and void, and no right, title, claim, or interest shall be conveyed thereby.

10 Stat. 346; 18 *id.* 475; R. S. 2449. Pope's Lessee *v.* Wendal, 9 Cranch, 87; same case, 5 Wheat. 293; Patterson *v.* Winn, 11 *id.* 380; Greenlief *v.* Birth, 6 Pet. 302; Lindsey *v.* Miller. 6 *id.* 666; Galloway *v.* Finley, *et al.*, 12 *id.* 264; Stoddard *v.* Chambers, 2 How. 284; Foxcraft *v.* Martel. 4 *id.* 353; Minter *v.* Crommelin, 18 *id.* 87; Easton *v.* Salisbury, 21 *id.* 426; U. S. *v.* Stone, 2 Wall. 525; U. S. *v.* Hughes, 4 *id.* 236; Maguire *v.* Tyler, 8 *id.* 653; Best *v.* Polk, 18 *id.* 112; Morton *v.* Nebraska, 21 *id.* 660; Sherman *v.* Buick, 3 Otto, 209; Moore *v.* Robbins, 6 *id.* 533; Marquez *v.* Frisbie, S. C., Oct. T., 1879, in manuscript. Le Roy *v.* Clayton. 2 Saw. C. C. 493; Patterson *v.* Tatum, 3 *id.* 164; U. S. *v.* Railroad Co., 4 Dillon, C. C. 397. Hill *v.* Miller, 36 Mo. 182; Railroad Co. *v.* Moon, 37 *id.* 338; Same *v.* Smith, 40 *id.* 310; Shepley *v.* Cowan, 52 *id.* 559; Funkhouser *v.* Peck, 67 *id.* 20; McGill *v.* McGill, 4 La. 262; Huff *v.* Doyle, 50 Cal. 21; McLaughlin *v.* Perrill, 50 *id.* 65; Sutton *v.* Fasset, 51 *id.* 13; Rosecrans *v.* Douglass, 52 *id.* 213. Decisions Sec. Int., May 3, June 26, 1879; May 4, July 17, 21, 28, 1880.

Sec. 66. There shall be in the General Land Office an inferior officer appointed by the Commissioner, to be employed therein as he shall deem proper, to be called the chief clerk. The chief clerk shall perform the duties of the Commissioner of the General Land Office in case of a vacancy in said office, or of the absence or sickness of the Commissioner.

2 Stat. 716; 11 *id.* 301; R. S. 448.

Sec. 67. There shall be in the General Land Office an officer called the Recorder of the General Land Office, who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be entitled to a salary of two thousand dollars a year.

5 Stat. 112, 163, 264; R. S. 447.

Sec. 68. It shall be the duty of the Recorder of the General Land Office, in pursuance of instructions from the Commissioner, to certify and affix the seal of the office to all patents for public lands, and attend to the correct engrossing, recording, and transmission of such patents. He shall prepare alphabetical indexes of the names of patentees and of persons entitled to patents; and he shall prepare such copies and exemplifications of matters on file or recorded in the General Land Office as the Commissioner may from time to time direct. Whenever the office of Recorder shall become vacant, or in case of his sickness or absence, the duties of his office shall be performed *ad interim* by the principal clerk on private land claims.

2 Stat. 717; 5 *id.* 111; R. S. 459. U. S. *v.* Arredondo, 6 Pet. 691; McGarrahan *v.* Mining Co., 6 Otto., 316. Le Roy *v.* Jamison, 3 Saw. C. C. 369. 3 Op. Att. Gen. 140, 168, 630. Galup *v.* Armstrong, 22 Cal. 480; Sands *v.* Davis, 40 Mich. 61.

Sec. 69. All patents issuing from the General Land Office shall be issued in the name of the United States, and be signed by the President and countersigned by the Recorder of the General Land Office; and shall be recorded in the office in books to be kept for the purpose.

2 Stat. 717; 5 *id.* 417; R. S. 458. Steeple *v.* Downing, 60 Ind. 478; Boyce *v.* Stambaugh, 34 Mich. 348; Lane *v.* Bommelmann, 17 Ills. 95; 3 Op. Att. Gen. 623.

Sec. 70. There shall be in the General Land Office a principal clerk of the public lands and a principal clerk on private land claims, who shall be appointed by the President, by and with the advice and consent of the Senate, and shall each be entitled to a salary of one thousand eight hundred dollars a year; and they shall perform such duties as may be assigned to them by the Commissioner of the General Land Office.

5 Stat. 109; R. S. 448.

Sec. 71. The officers, clerks, and employes in the General Land Office are prohibited from directly or indirectly purchasing or becoming interested in the purchase of any of the public lands; and any person who violates this section shall forthwith be removed from his office.

2 Stat. 717; 5 *id.* 112; R. S. 452.

Sec. 72. The President is authorized to appoint, from time to time, by and with the advice and consent of the Senate, a secretary, at a salary of one thousand five hundred dollars a year, whose duty it shall be, under the direction of the President, to sign in his name, and for him, all patents for land sold or granted under the authority of the United States.

5 Stat. 111. R. S. 450. Steeple *v.* Downing, 60 Ind. 478. 3 Op. Att. Gen. 623.

Sec. 73. If at any time the number of patents for lands sold or granted under the authority of the United States is such that they cannot be signed within a reasonable time by the secretary appointed under the preceding section, the President may appoint an assistant secretary to sign the same, but such assistant shall be employed by the express direction of the President, and only for such time as may be necessary to bring up the arrears of patents which may be ready for signature.

9 Stat. 209; R. S. 451.

Sec. 74. In all cases in which land has heretofore or shall hereafter be given by the United States for military services, warrants shall be granted to the parties entitled to such land by the Secretary of the Interior; and such warrants shall be recorded in the General Land Office, in books to be kept for the purpose, and shall be located as is or may be provided by law; and patents shall afterwards be issued accordingly.

2 Stat. 717; R. S. 457. Taylor *et al.*, *v.* Brown, 5 Cranch, 234; Laniviere *v.* Madagan, 1 Dillon, C. C. 455; Rice *v.* Taylor, 2 *id.* 23; Lewis *v.* Baird, 3 McLean, C. C. 56; Price *v.* Johnston, 1 Ohio St. 390; Wood *v.* Ferguson, 7 *id.* 288.

Sec. 75. Whenever any person claiming to be interested in or entitled to land under any grant or patent from the United States applies to the Department of the Interior for copies of papers filed and remaining therein, in anywise affecting the title to such land, it shall be the duty of the Secretary of the Interior to cause such copies to be made out and authenticated, under his hand and the seal of the General Land Office, for the person so applying.

3 Stat. 721; 5 *id.* 111; R. S. 460.

Sec. 77. There shall be in the General Land Office a principal clerk of the surveys, who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be entitled to a salary of one thousand eight hundred dollars a year. He shall direct and superintend the making of surveys, and returns thereof, and all matters relating thereto, which are done through the officers of the surveyor-general, and perform such other duties as may be assigned to him by the Commissioner of the General Land Office.

5 Stat. 110; R. S. 449.

ADMINISTRATION OF THE LAND SERVICE.

THE following have been the various Commissioners.

Commissioners.	*Term of service.*	*Where born.*	*Whence appointed.*
Edward Tiffin	1812–1814	England	Ohio.
Josiah Meigs	1814–1822		Georgia.
John McLean	1822–1823	New Jersey	Ohio.
George Graham	1823–1830		Dist. of Columbia.
Elijah Hayward	1830–1835		Ohio.
Ethan A. Brown	1835–1836	Connecticut	Ohio.
James Whitcomb	1836–1841	Vermont	Indiana.
Elisha M. Huntingdon	1841–1842	New York	-
Thomas H. Blake	1842–1845	Maryland	Indiana.
James Shields	1845–1847	Ireland	Illinois.
Richard M. Young	1847–1849	Kentucky	Illinois.
Justin Butterfield	1819–1852	New Hampshire	Illinois.
John Wilson	1852–1855	Dist. of Columbia	Dist. of Columbia.
Thomas A. Hendricks	1855–1859	Ohio	Indiaoa.
Samuel A. Smith	1859–1860		Tennessee.
Joseph S. Wilson	1860–1861	Dist. of Columbia	Dist. of Columbia.
James M. Edmunds	1861–1866	New York	Michigan.
Joseph S. Wilson	1866–1871	Dist. of Columbia	Dist. of Columbia.
Willis Drummond	1871–1874	Missouri	Iowa.
Samuel S. Burdett	1874–1876	England	Missouri.
James A. Williamson	1876–1881	Kentucky	Iowa.
N. C. McFarland	1881		Kansas.

Duties of the Commissioner.—The Commissioner of the General Land Office is appointed by the President and confirmed by the Senate; receives an annual salary of $4,005 and holds office indefinitely. He performs, under the direction of the Secretary of the Interior, all executive duties appertaining to the surveying and sales of the public lands of the United States, or in any wise respecting such public lands, and also such as relate to private claims of land and the issuing of patents for all lands under the authority of the Government.

Importance of the General Land Office.—The General Land Office holds the records of title to the area known as the public domain, on which are hundreds of thousands of homes. Its records constitute the "Doomsday Book" of the public domain of the United States. All the business pertaining to the survey, disposition, and patenting of the public lands of the United States is transacted through it, or under its order and supervision. No more responsible bureau of the Government exists. Important questions of law often arise in the various divisions of this Office as to rules of evidence, as to boundaries, riparian rights, entries, locations, cultivation improvements, settlement, domicile, expatriation, jurisdiction of executive officers, such as the power of the Commissioner of Pensions to cancel land warrants under various circumstances after they have issued or after they have been located; as to the authority of this Office to set aside or cancel patents after execution, and before delivery and after delivery; as to rights of way and water rights; as to when patents take effect; as to when patents are valid, void, or merely voidable; as to when legal title passes without patent; in construing foreign treaties and Indian treaties; as to forfeitures, abandonments, assignments; as to rights of parties holding scrip of various kinds; as to the rights of owners of lost instruments; as to advancement for surveys, deposits and excess. The laws and decisions of various States and Territories have to be examined to determine who are the lawful wives, widows, heirs, devisees, executors, administrators, or guardians; to determine the jurisdiction of local courts and the validity of proceedings therein, and the legality of judicial sales. Since the organization of the Government about three thousand acts have been passed by Congress concerning the public lands. Many of these acts are composed of numerous sections, and many of these sections present a number of difficult questions of construction. These provisions are generally construed in the first instance by this office; it is often many years before a judicial interpretation is obtained, if ever. The Supreme Court of the United States has on more than one occasion declared that the construction and practice of this Department is entitled to great respect, and such construction is usually followed by the State courts. It is true that many of these enactments have been repealed; but under imperfect administration in former years, titles acquired or supposed to be acquired under such repealed provisions are found to be imperfect, and necessitate an examination and consideration of the early acts of Congress and of the rights of parties thereunder. In determining and in deciding these cases careful opinions must be written deciding the questions of fact and of law, giving reasons for conclusions and citing authorities. Rules of practice in cases before the district land offices, the General Land Office, and the Department of the Interior are provided. (See circular approved October 9, 1878, and revised rules.)

Present Organization.—Commissioner, N. C. McFarland, of Kansas. Chief Clerk, Curtis W. Holcomb, of Connecticut. This bureau is charged with the survey and disposal of the public lands of the United States. There are at the present time, subordinate to the General Land Office, sixteen surveying districts, each in charge of a surveyor-general, with a competent corps of assistants and deputies, through whom the current and annual surveys are made and reported to this bureau. There are also ninety-six land districts, each with an office conveniently located for the sale or other disposal of the public lands. These offices are in the charge of registers, to whom application is made for lands, and receivers of public money, who, as the name indicates, receive all moneys in payment for the same, and are situated in the different public-land States and Territories. The transactions of these subordinate offices are at regular intervals of time reported to the General Land Office, and the duty of classifying, examining, and definitely disposing of the work done in these offices together with supervising and directing the same, forms the principal part of the work of the General Land Office, giving employment to an average of two hundred clerks. In the execution of this work the necessities of the case have led to the system of subdividing the office into divisions, each in charge of a principal clerk, and to each of which respective work is referred when received from the district offices. These divisions are at present designated by letters from A to N, and in all correspondence sent from the bureau the initial letter of the division from which it emanates is marked, in order that the same may be more readily referred to in after days.

Division A.—The chief clerk has charge of this division. Its work consists in receiving, briefing, and properly referring all communications received; in keeping the record of all appointments, resignations, or dismissals in the clerical force of the bureau; in supervising the opening or closing of district land offices; investigating charges against land officers; the matter of official bonds; the drawing of requisitions for printing; the expenditure of the contingent expense fund; and the assignment and general regulation of the clerical force of the bureau. In this division, also, all fees for exemplifications of records are received by a clerk designated for that purpose. The chief clerk is, by law, made the Acting Commissioner during the absence of the Commissioner.

Division B.—This division is in charge of the records of the General Land Office. In this division patents are prepared for all tracts sold or located with warrants or scrip at the district land offices, after such transfers have been properly examined in other divisions of the bureau. A correct record is here kept of all patents issued, and letters transmitting patents are prepared. The original papers forming the basis of patent are here filed, and all patents undelivered or uncalled for are retained in this branch of the office. To this division are finally referred for examination and proper action, the papers in locations made in satisfaction of military bounty-land warrants issued by authority of various acts of Congress. The same reference is made of locations by agricultural college scrip, and the special scrip issued to Porterfield. In this division land warrants and scrip, submitted for official approval, are examined as to genuineness and regularity of assignment. All revolutionary bounty land-scrip is here prepared, as also are patents for lands in the Virginia military district, Ohio. The recorder is appointed by the President, and by law, is required to countersign all patents after they have received the signature of the President. The number of patent records in Division B are as follows:

	Vols.
Military	1,207
Cash	3,652
Home	353
Miscellaneous	375
Total (of 500 pages each)	5,587
Miscellaneous, letter, and other records	1,793
Total books of record	7,380

Division C.—In charge of the principal clerk of public lands. In this division are kept the numerous "tract-books," which show, in well-arranged order, the status of every surveyed tract of land which is or has been included in the public domain. All sales or other disposals of land made and reported in the district offices are noted in the proper places in these books. They also show reservation, for Indian, military, or other purposes, private grants and special appropriations of land. This division has charge of the examination and final action on all entries under the homestead and timber-culture laws, of ordinary private purchase by cash or by sale at public offerings, all selections under internal-improvement grants or under the various grants for educational purposes and locations with land scrip.

Division E.—In charge of the principal clerk of surveys. This division is charged with the supervision of all work relating to the public surveys. Instructions to the surveyors-general relative to the extension of surveys or the examination and correction of erroneous surveys are here prepared. All contracts for surveys by deputy surveyors are here examined and passed upon, and the adjustment of accounts for surveying service made and submitted to the Treasury Department for payment. All returns of surveys are referred to this division for examination as to correctness, and after approval are filed in the division. All records and correspondence relating to Indian, military, light-house, live-oak, or other reservations are in charge of this division. To this division are also referred matters pertaining to the establishment of boundary lines, by astronomical surveys, between States and Territories of the United States. The plats and field-notes of all surveys are retained on the files of this division, in charge of a principal draughtsman, who supervises all work of draughting or copying plats of surveys, and who compiles and prepares the official map of the United States. There are in this division more than 50,000 plats or maps of township and other surveys.

Division M.—To this division are first referred all returns made by registers and receivers of the business of the district land offices. The various dispositions of land are here classified, and the accounts of the registers and receivers are here kept. A strict account is also kept of the five per cent. fund due the States from the sale of public lands within their respective limits; an account of the receipts and expenditures of money collected from depredators of timber lands, and the accounts of sale of Osage and other Indian lands. All applications for repayment of moneys received for lands to which title cannot be given are here examined. In this division is kept a classified statement of all disposals of public lands.

Division N.—The work of this division relates to mineral lands, and has in charge the examination and final disposition of applications for patents for that class of lands, and the adjudication of contests growing out of such applications. Here, also, the mineral or non-mineral classification of given lands is passed upon. All patents for mineral and coal lands are here prepared, and the plats of survey of all mines for which patents are sought are here filed.

Salaries of Officers and Employes of General Land Office.

1 commissioner, at $4,000	$4,000
1 chief clerk, at $2,000	2,000
1 recorder, at $2 000	2,000
1 law clerk, at $2,000	2,000
1 principal clerk public lands, at $1,800	1,800
1 principal clerk private land claims, at $1,800	1,800
1 principal clerk surveys, at $1,800	1,800
6 clerks class four, at $1,800 each	10,800
1 draughtsman, at $1,600	1,600
22 clerks class three, at $1,600 each	35,200
1 assistant draughtsman, at $1,400	1,400
40 clerks class two, at $1,400 each	56,000
80 clerks class one, at $1,200 each	96,000
30 clerks, at $1,000 each	30,000
9 copyists, at $900 each	8,100
9 assistant messengers, at $720 each	6,480
6 packers, at $720 each	4,320
12 laborers, at $660 each	7,920
223	273,220

Other Offices.—The first officer in charge of the surveys of the public lands was called the geographer of the United States. He was appointed under the ordinance of May 20, 1785. Thomas Hutchins was the first and only incumbent of the office. Under the act of May 18, 1796, creating the office, Rufus Putnam, in 1797, was appointed surveyor-general of the Northwest Territory (including Michigan Territory). He remained until 1803. Captain Jared Mansfield, U. S. A. succeeded as surveyor-general from 1803 to 1813. Under Captain Mansfield, aided by the advice of Mr. Jefferson, many and important changes and improvements were made in the surveying system. Josiah Meigs held the office of surveyor-general of this territory from 1813 to 1815. He gave way to Edward Tiffin from 1815 to 1825. These surveyors-general employed a sufficient number of skilful deputy surveyors; who employed a force of men as chain men, &c. They were paid by the mile for each mile of line run, the first rate being $3 per mile. Sections of the country were laid out, over which from time to time Congress or the Treasury Department appointed surveyors-general, who employed deputies, special statutes in most cases regulating this.

Surveyors Prior to 1825.—Aaron Greeley, surveyor of Michigan Territory, 1812; William Rector, surveyor of Illinois, Missouri, and Arkansas, 1814 to 1824; Wm. Clark, surveyor of Illinois, Missouri, and Arkansas, 1824 to 1825; Wm. McRee, surveyor of Illinois, Missouri, and Arkansas, 1825; Isaac Briggs, surveyor south of Tennessee, 1803 to 1807; Seth Pease, surveyor south of Tennessee, 1807 to 1820; Thomas Freeman, surveyor south of Tennessee, 1820 to 1822; John Coffee, surveyor of Alabama, 1817 to 1825; Robert Butler, surveyor of Florida, 1824 to 1825; Silas Bent, surveyor of Louisiana, 1807 to 1813.

Surveyors-general within States or Territories.—May 7, 1822, the first surveying district was created, viz., the State of Ohio, with an officer called a surveyor-general in charge. A surveying district may be a State, a Territory or two or more of any of them joined together for such purpose by law and in charge of a surveyor-general, with assistants. The surveys are made under the contract system, the surveyor-general selecting the deputy, Congress fixing the compensation. These surveying districts are closed by act of Congress when all the public lands are surveyed, and certain archives therein transferred to the State in which the lands lie.

Registers and Receivers.—The offices of register and receiver were created by the act of May 10, 1800. Districts for the sale of lands were made at the same time and by the same act, and this method has since continued. A land district for disposing of lands, with a register and receiver, may cover a State or there may be ten in a State. Land districts are in no wise connected in boundary with surveying districts. They are made by law of Congress, or by the President in mineral districts, and are abolished, consolidated one with another, reduced in area, or closed by Congress or the President. They are simply points for sale and disposition of land, more for the convenience of the people than of the Government. The land being surveyed is duly returned and notice of filing of plats given, and the land laws applicable to the district are put in force by the registers and receivers of the several district land offices, in permitting the settlers and locators to proceed under the law. When closed, their archives are sent to the General Land Office, which during their existence has complete and entire control over them by a system of checks and notations on a set of duplicate plats, notes, and supervises each and all changes made on the plats of the district offices, which are duly reported by them at the end of each month to the General Land Office at Washington. Through the agency of these district offices the United States proceeds to dispose of the public lands in the methods contemplated in the laws providing for sales at ordinary private entry, for pre-emptions, for entries for homestead, timber culture, town site, and mining purposes, and in the laws making grants for specific objects, and exceptional provisions with regard to abandoned military and other reservations.

List of offices of surveyor-general from May 10, 1800, to June 30, 1880.

Surveying district.	*Location of office.*	*When established.*	*Removed or discontinued.*
Ohio	Cincinnati	Act May 7, 1822	To Detroit, Mich.
Indiana and Michigan	Detroit	June, 1845	Abolished.
South of Tennessee:			
Tennessee	Washington	May 7, 1822	To Jackson, Miss.
Mississippi	Jackson	Aug. 1, 1833	Discontinued.
Illinois and Missouri	Saint Louis	Feb. 6, 1829	Abolished.
Florida	Tallahassee	June 31, 1828	To Saint Augustine.
	Saint Augustine	Mar. 9, 1844	To Tallahassee.
	Tallahassee		
Louisiana	Donaldsonville	Act March 3, 1831	To Baton Rouge.
	Baton Rouge	Dec. 9, 1843	To New Orleans.
	New Orleans		
Alabama	Florence	Aug. 25, 1831	Discontinued Aug. 28, 1848.
Chickasaw lands:			
Mississippi	Pontotoc	May 7, 1833	Abolished.
Arkansas	Little Rock	June 30, 1832	Discontinued, 1859.
Wisconsin and Iowa	Dubuque	June 12, 1838	Abolished.
Oregon	Oregon City	Nov. 22, 1850	To Salem.
	Salem		To Eugene City.
	Eugene City		To Portland.
	Portland		
California	San Francisco	Act March 3, 1851	
New Mexico	Santa Fé	Aug. 1, 1854	
Washington Territory	Olympia	Aug. 1, 1854	
Kansas and Nebraska	Fort Leavenworth	Aug. 1, 1854	To Wyandotte City.
	Wyandotte City		To Lecompton.
	Lecompton		To Nebraska City.
	Nebraska City		To Leavenworth City.
	Leavenworth City		To Virginia City.
Utah	Salt Lake City	March 7, 1855	
Nevada	Carson City	March 28, 1861	
	Virginia City	Dec. 11, 1866	
Dakota	Yankton	March 28, 1861	
Colorado	Denver	April 5, 1861	
Arizona	Tucson	May 6, 1863	
Idaho	Boise City	Aug. 13, 1866	
Nebraska and Iowa	Plattsmouth	April 1, 1867	
Montana	Helena	April 18, 1867	
Minnesota	Saint Paul	March 15, 1866	
Wyoming	Cheyenne	March 2,1870	

List of surveying districts where surveys are now in progress, names of surveyors-general, with their compensation and location of offices, to June 30, 1880.

Districts.	*Surveyors-general.*	*Location of offices.*	*Compensation under organic act. (See Rev. Stats., sects. 2208, 2209 and 2210.)*	*Compensation under act of June 15, 1880, fixing salaries fiscal year 1881. (See U. S. Stats., 1879–'80, p. 233.)*
			Per annum.	*Per annum.*
Arizona	John Wasson	Tucson, Ariz	$3,000	$2,500
California	Theo. Wagner	San Francisco, Cal	3,000	2,750
Colorado	Albert Johnson	Denver, Colo	3,000	2,500
Dakota	Henry Espersen	Yankton, Dak	2,000	2,000
Florida	Le Roy D. Ball	Tallahassee, Fla	2,000	1,800
Idaho	Wm. P. Chandler	Boise City, Idaho	3,000	2,500
Louisiana	O. H. Brewster	New Orleans, La	2,000	1,800
Minnesota	J. H. Stewart	Saint Paul, Minn	2,000	2,000
Montana	Roswell H. Mason	Helena, Mont	3,000	2,500
Nebraska	George S. Smith	Plattsmouth, Neb	3,000	2,500
Nevada	E. S. Davis	Virginia City, Nev	2,000	2,000
New Mexico	H. M. Atkinson	Santa Fe, N. Mex	3,000	2,500
Oregon	James C. Tolman	Portland, Oreg	2,500	2,500
Utah	F. Salomon	Salt Lake City, Utah	3,000	2,500
Washington	Wm. McMicken	Olympia, Wash	2,500	2,500
Wyoming	E. C. David	Cheyenne, Wyo	3,000	2,500

List of Local Land Offices (258 in number) under the laws of the United States, from May 10, 1800, to June 30, 1880, by States and Territories, with date of establishment and discontinuance.

State.	*Location.*	*When established.*	*Removed or discontinued.*
Alabama	Cahaba, originally located at Milledgeville, Ga.	Act March 3, 1815	To Greenville.
	Greenville	June 16, 1856	May 11, 1866.
	Huntsville, originally established at Nashville, Tenn., and afterward located at Twickenham.	Act March 3, 1807	
	Saint Stephens	Act March 3, 1803	To Mobile, 1867.
	Mobile		
	Demopolis	Act March 2, 1833	March 30, 1867.
	Tuscaloosa	Act May 11, 1820	To Montgomery, 1866.
	Conecuh C.H. Sparta	Act May 11, 1820	To Elba.
	Elba	April 1, 1854	April 11, 1867.
	Montevallo, Mardisville	Act July 10, 1832	To Lebanon.
	Lebanon	April 12, 1842	To Montgomery.
	Montgomery	Act July 10, 1832.	

State.	*Location.*	*When established.*	*Removed or discontinued.*
Arkansas	Batesville	Act Feb. 17, 1838.	To Little Rock, 1865.
	Little Rock	Act Feb. 17, 1838.	
	Fayetteville	Act June 25, 1832.	To Huntsville.
	Huntsville	Nov. 5, 1860	Closed.
	Dardanelle	May 31, 1871.	
	Washington	Act June 25, 1832.	To Camden.
	Camden	Mar. 20, 1871	
	Helena	Act June 26, 1834	To Little Rock, Jan. 2, 1860.
	Johnson Court-H.	Act July 7, 1838.	To Clarksville.
	Clarksville	Dec. 1, 1847	Closed Feb. 9, 1871.
	Champagnolle	Act Feb. 20, 1845.	Closed 1865. To Washington.
	Harrison	Aug. 11, 1871	
Arizona	Prescott		
	Florence		
California	Benicia	Mar. 3, 1853.	Consolidated with San Francisco.
	Los Angeles	March 3, 1853	
	Marysville	March 3, 1853	
	Humboldt	Act Mar. 29, 1858	
	Stockton	Act Mar. 29, 1858	

List of Local Land Offices (258 in number) under the laws of the United States, etc.—*Continued.*

State.	Location.	When established.	Removed or discontinued
	Visalia	Act Mar. 29, 1858	
	Sacramento	Nov. 4, 1867.	
	San Francisco		
	Shasta	April 17, 1871	
	Susanville	June 15, 1871	
	Independence	May 31, 1873.	To Bodie.
	Bodie	July 10, 1878	
Colorado	Golden City	Act June 2, 1862	To Denver.
	Denver	Sept. 12, 1864	
	Fairplay	Oct. 29, 1867	To Leadville.
	Leadville	July 11, 1879	
	Central City	Dec. 27, 1867	
	Pueblo	Act May 27, 1870	
	Del Norte	Act June 20, 1874.	
	Lake City	May 5, 1877	
Dakota	Vermillion	Act Mar. 2, 1861	To Sioux Falls
	Sioux Falls	June 9, 1873	To Mitchell.
	Mitchell	Oct. 4, 1880.	
	Springfield	Oct. 21, 1870	To Watertown
	Watertown	May 1, 1880	
	Fargo	Act May 5, 1870	
	Yankton	June, 1872	
	Bismarck	Act Apr. 24, 1874	
	Sheridan	May 22, 1877	To Deadwood
	Deadwood	July 2, 1877	
	Grand Forks	Act Jan. 21, 1880.	
Florida	Newnansville	Act Aug. 30, 1842.	To Gainsville, 1867.
	Tallahassee	Act Mar. 3, 1823	To Gainsville.
	Saint Augustine	Act Mar. 3, 1823	To Gainsville, 1867.
	Gainsville	July 11, 1873.	
	Tampa	Act Aug. 5, 1854	Oct. 20, 1858.
	Jacksonville	May 14, 1877	To Gainsville.
Indiana	Jeffersonville	Act Mar. 3, 1807	April 9, 1855.
	Vincennes	Act Mar. 26, 1804.	Discontinued under act of June 12, 1840; reopened by order of April 20, 1853; finally closed Dec. 20, 1861.
	Indianapolis	Act Mar. 3, 1819	March 3, 1877.
	Crawfordsville	Act Mar. 3, 1819	July 1, 1853.
	Fort Wayne	Act May 8, 1822	June 1, 1852.
	La Porte to Winamac	Act Mar. 2, 1833	April 3, 1855.
Idaho	Boise City	Nov. 6, 1866	
	Lewiston	Sept. 23, 1867	
	Oxford	Act Feb. 4, 1879	
Iowa	Dubuque	Act June 12, 1838.	To Marion.
	Marion	Feb. 20, 1843	Closed June 21, 1859.
	Burlington	Act June 12, 1838	To Fairfield.
	Fairfield	August 1, 1842	November 12, 1855.
	Iowa City	Act Aug. 8, 1846	July 8, 1856.
	Chariton	Act Aug. 2, 1852	September 14, 1859.
	Fort des Moines	Act Aug. 2, 1852	
	Kanesville	Act Aug. 2, 1852	To Council Bluffs.
	Council Bluffs		May 31, 1873.
	Decorah	Act Mar. 3, 1855	To Osage.
	Osage		July 6, 1859.
	Fort Dodge	Act Mar. 3, 1855	May 31, 1873.
	Sioux City	Act Mar. 3, 1855	May 31, 1873.
Illinois	Kaskaskia	Act Mar. 26, 1804.	February 25, 1856.
	Shawneetown	Act Feb. 21, 1812	May 2, 1856.
	Edwardsville	Act April 29, 1816.	August 8, 1855.
	Vandalia	Act May 11, 1820.	May 1, 1856.
	Palestine	Act May 11, 1820.	August 14, 1855.
	Springfield	Act May 8, 1822	March 3, 1877.
	Danville	Act Feb. 19, 1831	December 16, 1856.
	Quincy	Act Feb. 19, 1831	August 30, 1855.
	Galena	Act June 26, 1834.	To Dixon.
	Dixon	Act Nov. 2, 1840	September 3, 1855.
	Chicago	Act June 26, 1834.	July 31, 1856.
Kansas	Lecompton	Act July 22, 1854	To Topeka.
	Topeka	Act Sep. 10, 1861	
	Doniphan	March 3, 1857	To Kickapoo.
	Kickapoo	Dec. 3, 1857	To Atchison.
	Atchison	Sept. 6, 1861	December 26, 1863.
	Ogden	March 3, 1857	To Junction City.
	Junction City	Oct. 6, 1859	To Salina.
	Salina	May 1, 1871	
	Fort Scott	March 3, 1857	To Humboldt.
	Humboldt	Sept. 16, 1861	To Mapleton.
	Mapleton	Nov. 1, 1861	To Humboldt.
	Humboldt	May 16, 1862	To Neodesha.
	Neodesha	Dec. 15, 1871	To Independence.
	Independence	Oct. 3, 1871	
	Augusta	Act May 11, 1870	To Wichita.
	Wichita	Feb. 20, 1872	
	Concordia	Act July 7, 1870	
	Cawker City	June, 1872	To Kirwin.
	Kirwin	Jan. 4, 1876	
	Larned	Act June 20, 1874	
	Hays City	Act June 20, 1874	To Wa-Keeney.
	Wa-Keeney	Oct. 20, 1879	
Louisiana	Opelousas	Act March 3, 1811	February 16, 1861-'86.
	Ouachita	Act March 3, 1811	To Monroe.
	Monroe	Dec 23, 1867	To N. Orleans, Jan. 21, [1879.
	New Orleans	Act March 3, 1811	
	Saint Helena C'rt-H.	Act April 25, 1812	To Greensburg.
	Greensburg	Feb. 24, 1837	To Baton Rouge
	Baton Rouge	Jan. 1, 1844	To New Orleans
	Natchitoches	Act July 7, 1838	
Michigan	Detroit	Act March 26, 1804	
	Monroe	Act March 23, 1823	To White Pigeon Prai-[rie.
	White Pigeon Prairie		To Bronson.
	Bronson		To Kalamazoo.
	Kalamazoo		August 16, 1859.

State.	Location.	When established.	Removed or discontinued
	New Monroe	Act Jan. 30, 1833	Act June 12, 1840.
	Genesee	Act June 15, 1836.	To East Saginaw.
	East Saginaw		
	Saulte Ste. Marie	Act Mar. 1, 1847	To Marquette.
	Marquette	July 13, 1857	
	Duncan	May 29, 1854	To Mackinac.
	Mackinac	Mar. 8, 1858	To Traverse City.
	Traverse City	August 2, 1858	Consolidat'd with Reed City.
	Ionia	Act June 15, 1836	To Reed City.
	Reed City	April 1, 1878	
Minnesota.	Brownsville	Act April 12, 1854	To Chatfield.
	Chatfield	June 12, 1856	To Winnebago City.
	Winnebago City	Nov. 4, 1861	To Jackson
	Jackson	Sept. 1, 1869	To Worthington.
	Worthington	April 20, 1874	
	Minneapolis	Act April 12, 1854	To Forest City.
	Forest City	Mar. 22, 1858	To Minneapolis.
	Minneapolis	Nov. 1, 1862	To Greenleaf.
	Greenleaf	July 3, 1866	To Litchfield.
	Litchfield	Jan. 27, 1870	To Benson.
	Benson	June 19, 1870	
	Faribault	Act April 12, 1854	To Saint Peter.
	Saint Peter	Dec. 2, 1854	To New Ulm.
Minnesota.	New Ulm	Mar. 17, 1870	To Tracy.
	Tracy	May 13, 1880	
	Alexandria	Sept., 1868	To Fergus Falls.
	Fergus Falls	Dec. 11, 1876	
	Oak Lake	Act Mar. 12, 1872	To Detroit.
	Detroit		To Crookston.
	Crookston	July 15, 1878	
	Stillwater	May 1, 1853	To Cambridge.
	Cambridge	Dec. 15, 1858	To Sunrise City.
	Sunrise City	July 2, 1860	To Taylor's Falls.
	Taylor's Falls	Oct. 1, 1861	
	Sauk Rapids	Act Aug. 30, 1852.	To Saint Cloud.
	Saint Cloud	April 19, 1858	
	Henderson	Act April 12, 1854	May 9, 1863.
	Buchanan	July 8, 1856	To Portland.
	Portland	June 7, 1859	Name changed to Duluth.
	Duluth		
	Ojibway	July 8, 1866	To Otter Tail City.
	Otter Tail City	May 2, 1859	March 31, 1863.
	Redwood Falls	Act May 21, 1872	
Mississippi	Augusta	Act April 25, 1812 and Mar. 3, 1819	To Paulding.
	Paulding	Jan. 2, 1860	January 12, 1867.
	Washington	Act Mar. 3, 1803	To Jackson, 1866.
	Columbus	Act Mar. 2, 1833	November 1, 1866.
	Mount Salus	Act May 6, 1822	To Jackson.
	Jackson	Aug. 10, 1836	
	Chocchuma	Act Mar. 2, 1833	To Grenada.
	Grenada	July 4, 1840	December 1, 1860.
	Pontotoc	Oct 20, 1822	September 20, 1854.
Missouri.	Saint Louis	Act Mar. 3, 1811	To Boonville, September 1, 1861.
	Franklin	Act Feb. 17, 1818	To Fayette.
	Fayette	July 5, 1832	To Boonville.
	Boonville		
	Jackson	Act Feb. 17, 1818	To Ironton.
	Ironton	July 8, 1861	
	Lexington	Act Mar. 23, 1823	To Clinton.
	Clinton	July 3, 1843	To Warsaw.
	Warsaw	July 18, 1855	To Calhoun.
	Calhoun		February 12, 1863.
	Palmyra	Act May 26, 1824	March 2, 1859.
	Springfield	Act June 26, 1834	Order of March 25, 1863.
	Plattsburg	Act Aug. 29, 1842	April 10, 1859.
	Milan	Act Feb. 26, 1849	April 8, 1859.
Montana	Helena	June 1867	
Nebraska	Omaha City	July 22, 1864	To West Point.
	West Point	May 1, 1869	To Norfolk.
	Norfolk	Sept. 9, 1873	
	Brownsville	Mar. 3, 1857	To Beatrice.
	Beatrice	July 7, 1868	
	Nebraska City	July 3, 1868	To Lincoln.
	Lincoln	Sept. 3, 1868	
	Dakota City	July 3, 1868	To Niobrara.
	Niobrara	Oct. 1, 1875	
	Grand Island	Act July 27, 1868	
	North Platte	Sept. 21, 1872	
	Lowell	Aug. 2, 1872	To Bloomington.
	Bloomington		
Nevada	Carson City	Act July 2, 1862	
	Austin	Oct. 15, 1867	To Eureka.
	Eureka	May 26, 1873	
	Belmont	Dec., 1869	To Pioche.
	Pioche	April 30, 1874	September 14, 1877.
	Aurora	Aug. 1878	To Independence, Cal., May 31, 1873.
	Elko	May, 1873	September 14, 1877.
New M'xico	Santa Fe	Act May 24, 1858	
	La Mesilla	Act Mar. 3, 1874	
Ohio	Marietta	Act May 10, 1800	Act June 12, 1840.
	Zanesville	Act Mar. 3, 1803	Act June 12, 1840.
	Steubenville	Act May 10, 1800	Act June 12, 1840.
	Cincinnati	Act May 10, 1800	Act June 12, 1840.
	Chillicothe	Act May 10, 1800	March 3, 1877.
	Wooster	Act Mar. 3, 1807	Act June 12, 1840.
	Piqua	Act Mar. 3, 1819	June 25, 1855.
	Wappakonnetta	Act Mar. 3, 1819	June 25, 1855.
	Lima	Act Mar. 3, 1819	June 25, 1855.
	Upper Sandusky	Act Mar. 3, 1819	June 25, 1855.

List of local land offices from 1800 to 1880.—*Continued.*

State.	Location.	When established.	Removed or discontinued.
	Defiance	Act Mar. 3, 1819	June 25, 1855.
	Delaware	Act Mar. 3, 1819	Act June 12, 1840.
	Bucyrus	Act Mar. 3, 1819	Act June 12, 1840.
	Tiffin	Act Mar. 3, 1819	Act June 12, 1840.
	Marion	April 23, 1836	February 27, 1845.
Oregon	Oregon City	July 17, 1854	
	Winchester	Mar. 3, 1855	To Roseburg.
	Roseburg	Jan. 3, 1860	
	Le Grand	Dec. 11, 1867	
	Linkville	Jan. 16, 1873	To Lakeview.
	Lakeview	Sept. 1, 1877	
	Dalles	Act Jan. 11, 1875	
Wisconsin.	Green Bay	Act June 26, 1834	To Menasha.
	Menasha	....	
	Muskoday	June 26, 1834	To Mineral Point.
	Mineral Point	May 8, 1843	November 25, 1858.
	Milwaukee	Act June 15, 1836	February 14, 1856.
	Hudson	Act Mar. 2, 1849	To Falls Saint Croix.
	Falls Saint Croix	Aug. 6, 1860	
	Stevens Point	Act July 30, 1852	To Wausaw.
	Wausaw	Aug. 19, 1872	
	La Crosse	Act Aug. 2, 1852	
	Superior City	Act Feb. 24, 1855	To Bayfield, Oct. 5, 1860
	Bayfield	....	
	Eau Claire	Act Mar. 3, 1857	
Washingt'n	Olympia	July 17, 1854	
	Vancouver	Act May 16, 1860	
	Walla Walla	Act Mar. 3, 1871	
	Colfax	Act Aug. 15, 1876	
	Yakima	Act June 16, 1880	
Utah	Salt Lake City	Act Mar. 9, 1869	
	Beaver City	Act April 25, 1876	Consolidated with Salt
Wyoming.	Cheyenne	Act Feb. 5, 1870	Lake City, Aug. 1,
	Evanston	Act Aug. 9, 1876	1877.

List of existing local land offices (96 in number) and names of officers, November 10, 1880.

State or Territory.	Land district.	Register.	Receiver.
Alabama	Huntsville	John M. Cross	W. H. Tancre.
	Montgomery	Pelham J. Anderson	Paul J. Strobach.
Arkansas	Little Rock	Mifflin W. Gibbs	Charles E. Kelsey.
	Camden	Samuel W. Mallory	Alfred A. Tuffts.
	Harrison	John Murphy	Robert S. Armitage.
	Dardanelle	Thomas M. Gibson	Thomas Boles.
Arizona	Prescott	William N. Kelly	George Lount.
	Florence	C. M. K. Paulison	Charles E. Daily.
California.	Marysville	John C. Bradley	Lemuel T. Crane.
	Humboldt	Charles F. Roberts	Solomon Cooper.
	San Francisco	Willi'm R. Wheaton	C. H. Chamberlain.
	Sacramento	Edw. F. Taylor	Henry O. Beatty.
	Stockton	Geo. A. McKenzie.	Otis Perrin.
	Visalia	Jeremiah D. Hyde	Tipton Lindsey.
	Los Angeles	Alfred James	J. W. Haverstick.
	Shasta	William E. Hopping	Adolph Dobrowsky.
	Susanville	William H. Crane	Andrew Miller.
	Bodie	James E Goodall	Henry Z. Osborn.
Colorado	Central City	Richard Harvey	E. W. Henderson.
	Denver City	Louis Dugal	Samuel T. Thompson
	Leadville	John J. Henry	Wm. K. Burchinell.
	Pueblo	Ferd'nd Barndollar	Michael H. Fitch.
	Del Norte	John Cleghorn	Charles A. Brastow.
	Lake City	Henry C. Olney	Corelon B. Hickman
Dakota	Mitchell	B. F. Campbell	John M. Washburn.
	Watertown	Arthur C. Mellette	L. D. F. Poore.
	Bismarck	John A. Rea	Edw. M. Brown.
	Fargo	Horace Austin	Thomas M. Pugh.
	Deadwood	A. S. Stewart	John F. McKenna.
	Yankton	Gustavus A. Wetter	Lot S. Bayless.
	Grand Forks	Byram C. Tiffany	Wm. J. Anderson.
Florida	Gainesville	Lewis A. Barnes	John F. Rollins.
Idaho	Boise City	John B. Milier	James Stout.
	Lewiston	Jonathan M. Howe	Richard J. Monroe.
	Oxford	Aug. Dudenhausen	A. W. Eaton.
Iowa	Des Moines	Felix G. Clarke	H. H. Griffiths.
Kansas	Topeka	Wm. H. Fitzpatrick	George W. Watson.
	Concordia	Boyd H. McEckson	Evan J. Jenkins.
	Wa-Keeney	Benj. J. F. Hanna	Wm. H. Pilkenton.
	Independence	Melville J. Salter	Henry M. Waters.
	Kirwin	Thomas M. Helm	Lewis J. Best.
	Larned	Charles A. Morris	Henry Booth.
	Salina	John M. Hodge	Lewis Hanback.
	Wichita	Richard L. Walker	James L. Dyer.
Louisiana.	New Orleans	George Baldy	William M. Burwell.
	Natchitoches	Louis Dupleix	Alexis E. Lemee.
Michigan	Detroit	J. B. Bloss	John M. Farland.
	East Saginaw.	Charles Doughty	Fred. J. Burton.
	Marquette	Henry M. Stafford.	James M. Wilkinson
	Reed City	Edward Stevenson.	Wm. H. C. Mitchell.
Minnesota.	Benson	Darwin S. Hall	Heman W. Stone.
	Crookston	Thos. C. Shapleigh.	Paul C. Sletten.
	Du Luth	Morris C. Russell	Thos. H. Pressnell.
	Fergus Falls	Soren Listoe	John H. Allen.
	Tracy	Charles B. Tyler	Chas. C. Goodnow.
	Redwood Falls	W. P. Dunnington	W. B. Herriott.
	Saint Cloud	Daniel H. Freeman	William B. Mitchell.
	Taylor's Falls	John B. Owens	George B. Folsom.
	Worthington	Mons Grinager	Justin P. Moulton.
Mississippi.	Jackson	Richard C. Kerr	A. N. Kimball.
Missouri	Booneville	Gustave Reiche	George Ritchey.
	Ironton	George A. Moser	Llewellyn Davis.
	Springfield	George A. C. Wooley	James Dumars.
Montana	Bozeman	Davis Willson	J. V. Bogert.
	Helena	James H. Moe,	Frank P. Sterling.
	Miles City	Edward A. Kriedler	T. P. McElrath,
Nebraska	Beatrice	Hiram W. Parker	Robt B. Harrington.
	Bloomington	Simon W. Switzer	George W. Dorsey.
	Grand Island	Melville B. Hoxie	William Anyan.
	Lincoln	Jos. B. McDowell	C. N. Baird.
	Niobrara	Benj. F. Chambers.	James Stolt.
	Norfolk	Edward S. Butler	William B. Lambert.
	North Platte	Alex. D. Bucksworth	John Taffe.
Nevada	Carson City	C. A. Witherell	Samuel C. Wright.
	Eureka	F. H. Hinckley	Harvey Carpenter.
New Mexico	La Mesilla	George D. Bowman.	Samuel W. Sherfey.
	Santa Fé	John C. Davis	Elias Brevoort.
Oregon	Le Grand	Henry W. Dwight	Daniel Chaplin.
	Lake View	James H. Evans	George Conn.
	Oregon City	Louis T. Barin	John W. Watts.
	Roseburg	Wm. F. Benjamin	James C. Fullerton.
	The Dalles	Laban Coffin	Caleb N. Thornbury.
Washington.	Colfax	Jas. M. Armstrong	Edgar N. Sweet.
	Olympia	Josiah T. Brown	Robert G. Stuart.
	Vancouver	Walter W. Newlin	Samuel W. Brown.
	Walla Walla	Edw. H. Morrison	Alexander Reed.
	Yakima	R. B. Kinne	James M. Adams.
Wisconsin.	Bayfield	John H. Knight	Isaac H. Wing.
	Eau Claire	J. Gardner Callphan	Vincent W. Baylesa.
	Falls of Saint Croix.	Michael Field	Joel F. Nason.
	La Crosse	Ferd. A. Husher	John Ulrich.
	Menasha	George W. Fay	Norman Thatcher.
	Wausaw	Stephen H. Alban	William Callon.
Wyoming	Cheyenne	Edgar W. Mann	William M. Garvey.
	Evanston	William G. Tonn	Henry R. Crosby.
Utah	Salt Lake City	H. McMoster	Moses M. Bane.

Registers and Receivers are paid an annual salary of $500 each, and are allowed fees up to and including $3,000 per annum.

SURVEYS OF THE PUBLIC LANDS.

THE cessions of the several States were organized from time to time into geographical divisions by the laws creating them and the lands were ordered to be surveyed, including lands to which the Indian title had been or would be extinguished. The same proceeding took place with purchased territory in 1803, 1819, 1848, 1850 and 1853. The extension of the surveys being authorized by Congress over a district of country, the Commissioner of the General Land Office directs the surveyor-general of the district, whose office is created by the law prior to extending the surveys, to begin the same.

The Rectangular System.—The land surveys under the United States are uniform and done under what is known as the "rectangular system." This system of surveys was reported from a committee of Congress May 7, 1784. The committee consisted of Thomas Jefferson, chairman; Messrs. Williamson, Howell, Gerry, and Reas. This ordinance required the public lands to be divided into "*hundreds*" of ten geographical miles square, and those again to be subdivided into lots of one mile square each, to be numbered from 1 to 100, commencing in the northwestern corner and counting from west to east and from east to west continuously; and also that the lands thus subdivided should be first offered at public sale. This ordinance was considered, debated, and amended; and on the 3d of May, 1785, on motion of Mr. Grayson, of Virginia, seconded by Mr. Monroe, the size of the townships was reduced to six miles square. It was further discussed until the 20th of May, 1785, when it was finally passed. The origin of this system is not known beyond the committee's report. There had been land surveys in the different colonies for more than a hundred years; still the method of granting land for settlements in vogue in all the colonies was in irregular tracts, except in the colony of Georgia, where, after 1733, eleven townships of 20,000 square acres each were divided into lots of 50 acres each.

The act of cession of the State of Virginia of her western territory provided for the formation of States from the same not less than one hundred nor more than one hundred and fifty miles square. This square form of States may have influenced Mr. Jefferson in favor of a square form of survey, and besides the even surface of the country was known, the lack of mountains and the prevalence of trees for marking it also favoring a latitudinal and longitudinal system. Certain east and west lines run with the parallels of latitude, and the north and south township lines with the meridians. The system as adopted provided for sale in sections of 640 acres, one mile square. In 1820 a quarter-section, or 160 acres, could be purchased. In 1832 sub-divisions were ordered by law into 40-acre tracts or quarter-quarter-sections to settlers, and in 1846 to all purchasers. On May 18, 1796, the ordinance of May 20, 1785, was amended; also on May 10, 1800, on the introduction of land offices and credit sales, and on February 11, 1805; April 24, 1820; April 5, 1832; and May 30, 1862. (For existing laws or surveys see chapter IX, United States Revised Statutes, "Survey of the public lands," sections 2395 to 2413.) Since the inauguration of the system it has undergone modification in regard to the establishment of standard lines and initial points, the system of parallels or correction lines, as also of guide meridians, having been instituted, contributing largely towards its completeness.

Methods and System of Land Parceling Surveys.—Preliminary to surveying a district, a surveying meridian and base line must be established. Since the adoption of the rectangular system of public surveys, May 20, 1785, twenty-four initial points, or the intersection of the principal bases with surveying meridians, have been brought into requisition to secure the certainty and brevity of description in the transfer of public lands to individual ownership. From the principal bases townships of six miles square are run out and established, with regular series of numbers counting north and south thereof, and from the surveying meridians a like series of ranges are numbered both east and west of the principal meridians. During the period of ninety years since the organization of the system the following numerical and independent principal meridians and bases have been initiated, to wit:

The first principal meridian divides the States of Ohio and Indiana, having for its base the Ohio River, the meridian being coincident with 84° 51′ of longitude west from Greenwich. The meridian governs the surveys of public lands in the State of Ohio.

The second principal meridian coincides with 86° 28′ of longitude west from Greenwich, starts from the confluence of the Little Blue River with the Ohio, runs north to the northern boundary of Indiana, and governs the surveys in Indiana and a portion of those in Illinois.

The third principal meridian starts from the mouth of the Ohio River and extends to the northern boundary of the State of Illinois, and governs the surveys in said State *east* of the meridian, with the exception of those projected from the second meridian, and the surveys on the *west* to the Illinois River. This meridian coincides with 89° 10′ 30″ of longitude west from Greenwich.

The fourth principal meridian begins in the middle of the channel of the mouth of the Illinois River, in latitude 38° 58′ 12″ north, and longitude 90° 29′ 56″ west from Greenwich, and governs the surveys in Illinois west of the Illinois River, and west of the third principal meridian lying north of the river. It also extends due north through Wisconsin and Northeastern Minnesota, governing all the surveys in the former and those in the latter State lying east of the Mississippi and the third guide meridian (west of the fifth principal meridian) north of the river.

The fifth principal meridian starts from the mouth of the Arkansas River, and, with a common base-line running due west from the mouth of the Saint Francis River, in Arkansas, governs the surveys in Arkansas, Missouri, Iowa, Minnesota west of the Mississippi, and the third guide meridian north of the river, and in Dakota Territory east of the Missouri River. The meridian is coincident with 90° 58′ longitude west from Greenwich.

The sixth principal meridian coincides with longitude 97° 22′ west from Greenwich, and, with the principal base line intersecting it on the 40th degree of north latitude, extends north to the intersection of the Missouri River and south to the 37th degree of north latitude, controlling the surveys in Kansas, Nebraska, that part of Dakota lying south and west of the Missouri River, Wyoming, and Colorado, excepting the valley of the Rio Grande del Norte, in Southwestern Colorado, where the surveys are projected from the New Mexico meridian. In addition to the foregoing six principal meridians and bases governing public surveys, there have been established the following meridians and bases, viz:

The Michigan meridian, in longitude 84° 19′ 09″ west from Greenwich, with a base-line on a parallel seven miles north of Detroit, governing the surveys in Michigan.

The Tallahassee meridian, in longitude 84° 18′ west from Greenwich, runs due north and south from the point of intersection with the base line at Tallahassee and governs the surveys of Florida.

The Saint Stephen's meridian, longitude 88° 02′ west from Greenwich, starts from Mobile, passes through Saint Stephen's, intersects the base line on the 31st degree of north latitude, and controls the surveys of the southern district in Alabama and of the Pearl River district lying east of the river and south of township 10 north in the State of Mississippi.

The Huntsville meridian, longitude 86° 31′ west from Greenwich, extends from the northern boundary of Alabama as a base, passes through the town of Huntsville, and governs the surveys of the northern district in Alabama.

The Choctaw meridian, longitude 89° 10′ 30″ west from Greenwich, passes two miles west of the town of Jackson, in the State of Mississippi, starting from the base line twenty-nine miles south of Jackson, and terminating on the south boundary of the Chickasaw cession; controlling the surveys east and west of the meridian and north of the base.

The Washington meridian, longitude 91° 05′ west from Greenwich, seven miles east of the town of Washington, in the State of Mississippi, with the base line corresponding with the 31st degree of north latitude, governs the surveys in the southwestern angle of the State.

The Saint Helena meridian, 91° 11′ longitude west from Greenwich, extends from the 31st degree of north latitude, as a base, due south, and passing one mile east of Baton Rouge, controls the surveys in the Greensburgh and the southeastern districts of Louisiana, both lying east of the Mississippi.

The Louisiana meridian, longitude 92° 20′ west from Greenwich, intersects the 31st degree north latitude at a distance of forty-eight miles west of the eastern bank of the Mississippi River, and, with the base line coincident with the said parallel of north latitude, governs the surveys in Louisiana west of the Mississippi.

The New Mexico meridian, longitude 106° 52′ 09″ west from Greenwich, intersects the principal base line on the Rio Grande del Norte about ten miles below the mouth of the Puerco River, on the parallel of 34° 19′ north latitude, and controls the surveys in New Mexico, and in the valley of the Rio Grande del Norte, in Colorado.

The Great Salt Lake meridian, longitude 111° 53′ 47″ west from Greenwich, intersects the base line at the corner of Temple Block, in Salt Lake City, Utah, on the parallel of 40° 46′ 04″ north latitude, and governs the surveys in the Territory of Utah.

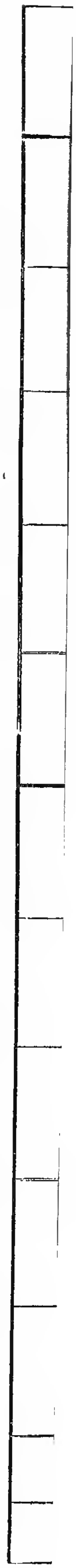
The Boisé meridian, longitude 116° 20′ west from Greenwich, intersects the principal base between the Snake and Boisé Rivers, in latitude 43° 26′ north. The initial monument, at the intersection of the base and meridian, is nineteen miles distant from Boisé City, on a course of south 29° 30′ west. This meridian governs the surveys in the Territory of Idaho.

The Mount Diabolo meridian, California, coincides with longitude 121° 54′ west from Greenwich, intersects the base line on the summit of the mountain from which it takes its name, in latitude 37° 53′ north, and governs the surveys of all Central and Northeastern California and the entire State of Nevada.

The San Bernardino meridian, California, longitude 116° 56′ west from Greenwich, intersects the base line at Mount San Bernardino, latitude 34° 06′ north, and governs the surveys in Southern California lying east of the meridian and that part of the surveys situated west of it which are south of the eight standard parallel south of the Mount Diabolo base line.

The Humboldt meridian, longitude 124° 11′ west from Greenwich, intersects the principal base line on the summit of Mount Pierce, in latitude 40° 25′ 30″ north, and controls the surveys in the northwestern corner of California lying west of the Coast range of mountains and north of township 5 south of the Humboldt base.

The Willamette meridian, is coincident with longitude 122° 44′ west from Greenwich, its intersection with the base line



MAP showing rectangular survey of public land (usual method) with the survey of a Mineral District therein, showing method of Quartz or Lode claim locations.

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is on the parallel of 45° 30′ north latitude, and it controls the public surveys in Oregon and Washington Territory.

The Montana meridian extends north and south from the initial monument established on the summit of a limestone hill, eight hundred feet high, longitude 111° 40′ 54″ west from Greenwich. The base line runs east and west from the monument on the parallel of 45° 46′ 27″ north latitude. The surveys for the entire Territory of Montana are governed by this meridian.

The Gila and Salt River meridian intersects the base line on the south side of the Gila River, opposite the mouth of Salt River, in longitude 112° 15′ 46″ west from Greenwich, and latitude 33° 22′ 57″ north, and governs the public surveys in the Territory of Arizona.

The Indian meridian intersects the base line at Fort Arbuckle, Indian Territory, in longitude 97° 15′ 56″ west from Greenwich, latitude 34° 31′ and governs the surveys in that Territory.

Administration and Method of the Surveys.—The public surveys are controlled by the Commissioner of the General Land Office, and under the immediate superintendence of sixteen surveyors-general in their respective surveying districts into which at present the public lands are divided. The surveyors-general whose offices are conveniently located in their districts and well appointed with personal and other facilities for the business, enter into contracts with professional surveyors, whom they commission as their deputies, and who are thoroughly acquainted with the system and the official requirements in regard to field operations. Surveying contracts describe the particular field-work to be executed, time within which it is to be completed, consideration stipulated at so much per lineal mile of surveying, including all expenses of the surveyor, his party and instruments, together with the proper returns of survey to the office of the surveyor-general, to be accompanied by an affidavit of the surveyor to the effect that the work was performed by him, in his own proper person, in accordance with his contract and the manual of surveying instructions, and in strict conformity to the laws governing the survey. The party of the deputy surveyor generally consists of two chainmen, flagman, axeman, and two moundmen, whose duties are to assist him in running, measuring, and marking the lines, and constructing and setting corner boundaries. They are sworn to perform their respective duties with fidelity before they enter on the same, and on completing the work they make affidavits to the effect that the deputy surveyor was assisted by them in the survey which they describe, and that it has been executed in all respects well and faithfully. To guard the Government from any loss that might be occasioned by erroneous or fraudulent surveys on the part of the surveyor, he is required to give bond, with approved securities, in double the amount of his contract; and when his unfaithfulness is detected the delinquent deputy and his bondsmen are punishable by law, and the surveyor debarred from future employment in like capacity. Upon the return of surveys to the surveyor-general, consisting of original field-notes and a topographical sketch of the country surveyed, the work is examined, and if on applying the usual tests, it is found to be correctly executed, the surveyor-general approves the field-notes; whereupon the draughtsman protracts the same on township plats in triplicate, and, after approving the plats, the surveyor-general files the original in his office, to be ultimately delivered to State authorities upon closing of United States surveys in the States; the duplicate is sent to the local land office to enable the register and receiver of public lands to dispose of the lands embraced in the several townships, and the triplicate is transmitted to the Commissioner of the General Land Office for the information of the Government. The manual of instructions for surveyors-general to regulate the field operations of deputy surveyors, prepared by the Commissioner of the General Land Office, 1855, was, by the second section of the act of May 30, 1862, legalized. This manual was prepared February 22, 1855, by the principal clerk of surveys. It describes the method in the field and is illustrated by diagrams. Special instructions are sometimes issued.

Execution of surveys.—The United States surveyor-general for the district enters into contract with a deputy surveyor, after being commissioned, for the survey of either standards, townships, or sub-divisions. The contract specifies the localities where surveys are to be made, duration of time within which the work is to be returned, the price of survey per lineal mile, including all contingent expenses to be borne by the deputy surveyor, who is required to execute the work in his own proper person, sub-contracting being illegal, and the contract must be approved by the Commissioner of the General Land Office. The lines of public surveys over level ground are measured with a four-pole chain, sixty-six feet in length, 80 chains constituting one lineal mile, but with a two-pole chain where the features of the country are broken and hilly. The lines thus chained are marked through timber land by chops on line trees on each side, and in the absence of such trees those standing nearest the survey on both sides are blazed diagonally toward the line run. Trees standing at the precise spot where legal corners are required are made available. If no such trees are there, then the corners are perpetuated by posts or stones, with inscriptions, and the positions of the same are indicated by witness trees or mounds, the angular bearings and distances from the corner being ascertained and described in the field-notes. The lines intersecting navigable streams, the area of which are excluded from sale, require the establishment of meander corner-posts, the courses and distances meandered by navigable streams governing the calculations from which the true contents of fractional lots are computed and expressed on township plats. Township corner-posts, or stones common to four townships, are set diagonally, properly marked with six notches on each of the four angles set to the cardinal points of the compass; and mile posts on township lines are marked with as many notches on them as they are miles distant from the township corners respectively; the four sides of the township and section posts, which are common to four townships or sections, are marked with the corresponding number of sections. See accompanying diagrams.

The principal meridian, base, standard and guides have been first measured and marked, and the corner boundaries thereon established, the process of surveying and marking the exterior lines of the townships, north and south of the base, and east and west of the meridian, within those standard lines, is shown on accompanying diagrams. The public lands are first surveyed into rectangular tracts, according to the true meridian, noting the variation of the magnetic needle. These tracts are called townships, each six miles square, having reference to an established principal base line on a true parallel of latitude, and to longitude styled principal meridian. Any series of contiguous townships, north or south of each other, constitutes a range; the townships counting from the base, either north or south, and the ranges from the principal meridian, either east or west. Each township is subdivided into 36 sections of one mile square, or 640 acres, in all, 23,040 acres. In establishing and surveying a base-line from the initial point east and west, quarter-section, section, and township corners are established at every 40, 80, and 480 chains, respectively, which are for sections and townships lying north of the base, and not for those situated south. In surveying the principal meridian north and south of the initial point, similar corners are established, which are common for townships lying immediately east or west. Standard parallel or correction lines are run east and west from the principal meridian with similar character of corners, as on the principal base and meridian, and constitute special bases for township lines lying north thereof, the correction lines being run and marked at every four townships, or 24 miles north of the base, and at every five townships, or 30 miles south of the same. Guide meridians are surveyed at distances of every eight ranges of townships, or 48 miles east and west of the principal meridian; the guides north of the principal base starting either from it or from standard parallels. They are closed by meridional lines on other standard parallels immediately north, while those lying south of the principal bases start in the first instance from the first standard parallel south, and are closed by meridional lines on the principal base. Then the guides begin on the second standard parallel south, and close on the first standard parallel south, again starting from the third standard parallel south, and closing on the second standard parallel south, and so on. The closing corners on the principal base and standard parallel are established at points of convergency of the meridians, which occasion a double set of corners on the principal base and correction, or standard parallels, styled "standard corners" and "closing corners." This process requires offsetting of the guide meridians to the extent of the convergency of the meridians on each of the standard parallels and bases.

The principal base, principal meridian, standard parallels, and guide meridians, constitute a framework of the rectangular system of public surveys. Within these limits any errors are avoided which otherwise would result from adhering to the surveys made as the law directs, to the true meridian, in consequence of the convergency of meridians and of measurement over uneven surfaces. The surveys of the standard lines are made with instruments operating independently of the magnetic needle, the magnetic being noted solely to show the true variation. These lines divide the sphere of field operations into parallelograms of 48 by 24 miles north of the principal base and 48 by 30 miles south, the convergency of the meridians in the former instance being greater than in the latter. The parallelograms formed by meridians and parallels are in their turn subdivided into townships, and the latter ultimately into sections with an ordinary but perfectly adjusted compass. These parallelograms also serve to connect distant surveys from those progressing regularly from the initial point, if first required, for the convenience of remote settlements or other considerations. The township lines start from the standard corners, pre-established on the principal base and standard or correction parallels, and are surveyed to the extent required within each parallelogram. On those lines quarter-section, section, and township corners are fixed to govern the subdivisional work of the townships in 36 sections. The sections of one mile square are the smallest tracts, the out-boundaries of which the law requires to be actually surveyed. Their minor subdivisions, represented in dotted lines on the accompanying diagram, are not surveyed and marked in the field. They are defined by law, and the surveyors-general, in protracting township plats from the field-notes of sections, merely designate them in red ink, the lines being imaginary, connecting opposite quarter-section corners in each section from south to north, and from east to west, thereby dividing sections into four quarter-sections of 160 acres each, and these, in their turn, into quarter-quarter-sections, of 40-acre tracts, by imaginary lines, starting from the equidistant points between the section and quarter-section corners to similar points on the opposite sides of the section. Each section containing 640 acres, subdivided into legal subdivisions, affords forty different descriptions, susceptible of being disposed of to purchasers, from 640-acre tracts to 40-acre parcels. This convenient mode of subdividing sections with a view to economy and to facilitate sales of small tracts, although not actually marked on the ground by metes and bounds, yet under laws of Congress are susceptible of demarkation by any surveyor in the different States and Territories in accordance with the field-notes of the original survey made by United States officers. The instruments employed in the field-work by United States surveyors consist of solar compasses, transits, and common compasses of approved construction; four-pole chains and two-pole chains, of 100 and 50 links, respectively, each link of the chain being equal to 7.92 inches. The surveyors' chains are compared with standard chains and standard yard measures furnished surveyors-general by the government. The measurement of the lines of public surveys is horizontal, requiring shortening of the chain over abrupt and undulating surface; the navigable lakes and water-courses are segregated from the land, the same being declared by law public highways and not subject to sale.

Classification or Definition.[1]—Under existing laws the deputy surveyors note the character of the lands in their field-notes, as agricultural, timber, mineral, etc., and the natural and artificial objects. These are entered upon the township plats in detail, showing the topography of the surveyed township. This description is subject to correction or amendment by proof, in the manner indicated by the "Instructions from the General Land Office;" also, "Instructions in cases of contest and charges of fraud." See accompanying map for illustration of classification by a deputy surveyor, being copy of a township plat on file in the district land office at Salt Lake City, Utah, and from which the lands are sold by the district officers.

Geological Surveys under General Land Office.—The lead, copper, and other mineral lands in Iowa, Michigan, Minnesota, Wisconsin and Missouri, were first the subject of a geological survey under the General Land Office, and after this were surveyed under the rectangular or usual system, and sold in legal sub-divisions, the soil carrying with it the mineral. The following table shows the geological surveys of the public domain under the General Land Office:

Geological Surveys of public domain under General Land Office.

State and Territory.	*Names of Geologists.*	*Acts of Congress.*	*United States Statutes.*	*Date of Instructions.*
Southern Peninsula of Michigan	Douglas Houghton	June 17, 1844	Vol. 5, p. 691	June 25, 1844.
Chippewa land district, Wisconsin and Iowa	David Dale Owen	March 3, 1847	Vol. 9, p. 165	April 16, 1847.
Lake Superior land district, Michigan	Charles T. Jackson	March 1, 1847	Vol. 9, p. 146	April 16, 1847.
Ditto.	Whitney & Foster	March 1, 1847	Vol. 9, p. 146	May 16, 1849.
Oregon and Washington	John Evans	March 3, 1853 March 3, 1855	Vol. 10, p. 650	April 14, 1853. March 20, 1855.
Nebraska, Wyoming and Colorado	Ferd. V. Hayden	March 2, 1867	Vol. 14, p. 470	April 29, 1867.
Wyoming and Colorado	Ditto.	July 20, 1868	Vol. 15, p. 119	July 28, 1868.

The geological survey of the Territories of the United States by F. V. Hayden was continued under authority of act of Congress approved March 3, 1869 (15 Stats., p. 306), under the direction of the Secretary of the Interior exclusively, and discontinued on the 30th day of June, 1879. (See 20 Stats., p. 394.)

Method of Surveying Mineral Claims.—Under the provisions of the mining act of July 26, 1866, the surveyors-general of the several districts divided their jurisdictions into mineral surveying districts, by grouping counties or parts of counties, and gave each district a numerical designation from one upward. Deputy mineral surveyors were appointed for each of these districts by the surveyors-general. Lode claims were limited in length to not exceeding 200 feet for each individual, with one additional claim for discovery; no location by an association of individuals to exceed 3,000 feet. The width of locations was regulated by the local rules of miners in each district.

The method of application for survey and return of survey of a mining claim, in compliance with the act above stated, can be found in the act and in the instructions from the General Land Office on this subject, of date January 14, 1867. This system of establishing mineral surveying districts for mineral surveys was discontinued by the act of May 10, 1872. The act of May 10, 1872, was to cure the defects in the act of July 26, 1866, and to complete a system of survey and disposition of mineral lands, containing gold, silver, cinnabar, and other valuable minerals. Under this act the surveyors-general appoint a sufficient number of surveyors of mineral claims, called deputy mineral surveyors. The maximum rates of charges for such surveys may be fixed by the Commissioner of the General Land Office. (See R. S., sec. 2334.) Claimants pay all expenses of survey, and make deposits for platting and other expenses up to the issuing of patents. The statute provides the method of posting and other incidents pertaining to the procedure for obtaining patent. Mineral districts can be formed from the public domain, whether surveyed or not.

Classification of Mineral Land.—The method of classification of mineral lands on the public domain, when the

[1] Section 2409, Revised Statutes, authorizes the Secretary of the Interior to introduce the geodetic method of surveys of public lands in Oregon and California, if he deems it advisable, and section 2410 provides for a departure from the rectangular method of survey in California, if he deems proper. He may also vary the lines of survey from a rectangular form—to suit the circumstances of the country—in Nevada.

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MAP showing method of locating and Surveying Mining Claims in a Mineral District where the lines of the Rectangular system of surveying have not been run.

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lines of the public surveys are being extended over them, is as follows: At the time of survey in the field the deputy surveyor notes on his field-notes (which remain permanently in the surveyor-general's office, a copy being sent to the Commissioner of the General Land Office) the character of the country, both from observation and information from persons, if any there be, having knowledge of the same. This makes up the general topography. He describes the country by sections one mile square. When the deputy makes up his plats he enters upon them the topography noted in his field-notes and returns the same to the surveyor-general, who prepares three copies thereof. One of the township plats, with a copy of the field-notes, is sent to the General Land Office, to be used in checking all entries or changes of entries made in the district land office. If the land surveyed is returned as mineral, the Commissioner at once issues notice to the land office of the district in which the lands lie of the withdrawal of the same from agricultural or entry other than as mineral. Claimants of mining claims may make application for survey to the surveyor-general, as provided by law, and the surveys of their claims will be made by a mineral deputy, with or without reference to the lines of the rectangular system. Still they can and may be used for points of determination and reference. Proof is admissible, upon contest in the district land offices between claimants, as to its mineral or non-mineral character. The register and receiver render an opinion on the case, which is forwarded to and approved or disapproved by the Commissioner of the General Land Office, and after his action is subject to appeal to the Secretary of the Interior. In case the rectangular surveys are not extended over the lands containing mineral, the claimant, whether a mining district has been formed by the miners or not, applies to the surveyor-general who orders a survey by a deputy mineral surveyor, and the law is followed. Mining claims are surveyed whether public lands surveys have been made or not. The survey of a mining claim—lode, vein, or placer—has no reference necessarily to any other surveys or systems of surveys.

Placer claims, not exceeding 160 acres, located in conformity with law may be surveyed independent of the land-parceling surveys; but when they are within the limits of surveyed lands and conform to legal subdivisions, no further survey is necessary. All placer claims after May 10, 1872, must conform as nearly as possible to the land-parceling or rectangular system of surveys. Ten-acre claims are recognized; forty-acre lots being subdivided into ten-acre lots.

The Benefits of the Present System of Land Parceling.—The rectangular system came in at the birth of the public domain. It started prior to the opening of the lands for sale in the territory northwest of the river Ohio, in the survey of the first seven ranges of townships therein adjoining Pennsylvania. It afterward covered the territory south of the river Ohio, and thence was applied to the old Natchez settlement, in the present State of Mississipi. It now extends over portions, if not all, of every land, State, and territory in the Union. It has been in operation for about ninety years, and has been a faithful friend to the settlers on the public domain. In the extensive sphere over which the surveys have progressed from Florida, on the Atlantic, and westward to the Pacific, including all the public land, States and Territories of the Union, with the exception of Alaska, formerly Russian America, the system has worked satisfactorily, furnishing facilities for the acquisition of public lands in any region of the country, and methods for the restoration of landmarks which may be lost or destroyed by time or accident. Adequate means exist in the surrounding landmarks of the adjacent public surveys, whereby missing metes and bounds can be restored in accordance with the original field-notes thereof, and the designations placed on township plats. Its recommendations to the public lie in its economy, simplicity, and brevity of description in deeding the premises by patent and for future conveyancing, and in the convenience of reference from the most minute legal subdivision to the corners and lines of sections, and of townships of given principal base and meridians. Its greatest convenience is its extreme simplicity of description. Any person, by its monuments and markings, can readily find the tract sought for. It was originated for land parceling for sale, and it has answered the purpose. The system now extends over the whole surface of the States of Ohio, Indiana, Illinois, Michigan, Arkansas, Mississippi, Alabama, Missouri, Wisconsin, Iowa, Kansas, and portions of the States of Florida, Louisiana, Nevada, Minnesota, Nebraska, California, Oregon, and Colorado; also in the Territories of Washington, Utah, Montana, Idaho, Wyoming, Arizona, New Mexico, and Dakota, and the Indian Territory. The total area surveyed under this system is 752,557,195 acres in the various land States and Territories, as is shown by the following tabular statement:

Tabular statement showing the number of acres of Public Lands surveyed by the following Land States and Territories up to June 30, 1879, during the present fiscal year, and the total of the Public Lands surveyed up to June 30, 1880; also, the total area of the Public Domain remaining unsurveyed within the same.

Land, States and Territories.	*Area of public lands in States and Territories.*		*Number of acres of public lands surveyed.*				*Total area of public and Indian lands remaining unsurveyed, inclusive of the area of private land claims, estimated at 80,000,000 acres, surveyed up to June 30, 1880.*
	In acres.	*In square miles.*	*Up to June 30, 1879.*	*Prior to June 30, 1879, not heretofore reported.*	*Within the fiscal year ending June 30, 1880.*	*Total up to June 30, 1880.*	
Wisconsin	34,511,360	53,924	34,511,360	...	...	34,511,360	...
Iowa	35,228,800	55,045	35,228,800	...	...	35,228,800	...
Minnesota	53,459,840	83,531	39,536,940	116,224.14	296,253.46	39,949,417	13,510,423
Kansas	51,770,240	80,891	51,770,240	...	...	51,770,240	...
Nebraska	48.636,800	75,995	40,715,571	159.842.68	709,179.33	41,584,593	7,052,207
California	100,992,840	157,801	47,979,543	576,875.65	3,792,630.10	52,349,048	48,643,792
Nevada	71,737,600	112,090	12,372,308	...	928,694.07	13,301,002	58,436,598
Oregon	60,975,360	95,274	21,913,612	101,186.85	1,052,221.85	23,067,020	37,908,340
Washington	44,796,160	69,994	14,736,403	375,176.67	847,595.29	15,959,175	28,836,985
Colorado	66,880,000	104,500	23,354,523	92,196.10	2,775,601.81	26,222,321	40,657,679
Utah	54,064,640	84,476	9,341,375	...	440,585.79	9,781,960	44,282,680
Arizona	72,906,240	113,916	5,499,353	...	308,521.21	5,807,874	67,098,366
New Mexico	77,568,640	121,201	8,843,890	75,603.97	1,624,156.41	10,543,650	67,024,990
Dakota	96,596,480	150,932	22,626,770	*416,708.84	†2,130,808 59	25,174,377	71,422,103
Idaho	55,228,160	86,294	6,933,429	329,726.08	225,637.24	7,488,792	47,739,368
Montana	92,016,640	143,776	11,062,551	...	302,413,55	11,364,964	80,651,676
Wyoming	62,645,120	97,883	9,079,186	...	184,449.68	9,263,635	53,381,485
Missouri	41,836,931	65,370	41,836,931	...	...	41,836,931	...
Alabama	32,462,115	50,722	32,462,115	...	...	32,462,115	...
Mississippi	30,179,840	47,156	30,179,840	...	...	30,179,840	...
Louisiana	26,461,440	41,346	25,232,044	...	80,504.58	25,312,548	1,148,892
Arkansas	33,410,063	52,202	33,410,063	...	...	33,410,063	...
Florida	37,931,520	59,268	30,151,946	23,081.51	...	30,175,027	7,756,493
Ohio	25,576,960	39,964	25,576,960	...	...	25,576,960	...
Indiana	21,637,760	33,809	21,637,760	...	...	21,637,760	...
Michigan	36,128,640	56,451	36,128,640	...	...	36,128,640	...
Illinois	35,465,093	55,414	35,465,093	...	...	35,465,093	...
Indian Territory	44,154,240	68,991	27,003,990	...	...	27,003,990	17,150,250
Alaska	369,529,600	577,390	...	...	...	...	369,529,600
Public Land Strip	6,912,000	10,800	...	...	...	...	6.912,000
Total	1,841,788,922	2,835,606	734,591,236	2,266,712.49	15,699,252,96	752,557,195	1,069,143,727

* 208,299.30 acres are embraced in Red Cloud and Spotted Tail Indian reservations. † 67,063.90 acres are also embraced in same reservations.

Cost of Surveying under the Rectangular System.—The price per mile for surveying has varied with the several acts. Under the ordinance of May 20, 1785, the surveyor was allowed at the rate of $2 per mile for every mile in length he should run, including the wages of chain carriers, markers, and every other expense attending the same. Under the powers to the Board of Treasury to sell western territory, July 23, 1787, the Ohio Company were to survey the lands of their purchase into townships and other subdivisions, as provided in the survey ordinance above set out, at their own expense, and return the plat to the Board of Treasury. Under the ordinance of July 9, 1788, supplemental to the one of May 20, 1785, the surveyors to be appointed by the geographer to lay off lands and locate warrants thereon were to receive for their compensation an allowance to be fixed by the governor and judges of the western territory.

Under the act of 1796, May 18, the President of the United States was to fix the compensation of the assistant surveyors, chain carriers, and axe men, provided the whole expense should not exceed $3 per mile. This price was continued in the act of May 10, 1800. The price was varied, owing to topographical features, as in wooded or swampy country, for which from $3 to $20 have been paid in Missouri and other land states. The several acts of Congress up to 1860 will give prices paid per mile.

Tables showing Cost of Surveys from 1860 to 1881.—The following table will give the variations in prices of surveys from 1860 to 1881:

Statement of rates paid per linear mile from 1860 to 1881, inclusive.

States and Territories.	1860.			1861.			1862.			1863.		
	Standard.	Township.	Section.	Standard.	Township	Section..	Standard.	Township.	Section.	Standard.	Township.	Section.
Arizona	..	..	..	..	..	..	..	..	..	$15	12	10
California	$16	12	12	$16	12	12	$16	12	12	$16	12	12
Colorado	..	..	..	..	..	..	10	8	7	10	8	7
Dakota	10	6	5	10	6	5	10	6	5	10	6	5
Florida	7	6	4	..	..	..	..	..	..	..	..	..
Idaho	..	..	..	..	..	..	..	..	..	..	..	..
Louisiana	8	7	4	..	..	..	..	..	..	..	..	..
Minnesota	10	6	5	10	6	5	10	6	5	10	6	5
Montana	..	..	..	..	..	..	..	..	..	..	..	..
Nebraska	10	6	5	10	6	5	10	6	5	10	6	5
Nevada	..	..	..	..	..	..	20	12	12	15	12	12
New Mexico	10	8	7	10	8	7	10	8	7	10	8	7
Oregon	8	8	8	8	8	8	8	8	8	8	8	6
Utah	20	12	12	20	12	12	20	12	12	20	12	12
Washington	8	8	8	8	8	8	8	8	8	8	8	6

States and Territories.	1864.			1865.			1866.			1867.		
Arizona	$15	12	10	$15	12	10	$15	12	10	$15	12	10
California	16	12	12	16	12	12	15	12	10	15	12	10
Colorado	10	8	7	10	8	7	10	8	7	10	8	7
Dakota	10	6	5	10	6	5	10	7	6	10	7	6
Florida	..	..	..	..	..	..	..	..	..	..	..	..
Idaho	..	..	..	15	12	10	15	12	10	15	12	10
Louisiana	..	..	..	..	..	..	..	..	..	..	..	..
Minnesota	10	9	6	10	7	6	10	7	6	10	7	6
Montana	..	..	..	..	..	..	..	..	..	15	10	8
Nebraska	10	6	5	10	6	5	10	6	5	10	6	5
Nevada	..	..	..	..	..	..	15	12	10	15	12	10
New Mexico	10	8	7	10	8	7	10	8	7	10	8	7
Oregon	8	8	6	8	8	6	15	12	10	15	12	10
Utah	..	..	..	..	..	..	..	..	..	..	..	..
Washington	8	8	6	15	12	10	15	12	10	15	12	10

States and Territories.	1868.			1869.			1870.		
Arizona	$15	12	10	$15	12	10	$15	12	10
California	15	12	10	15	12	16	15	12	10
Colorado	15	12	10	15	12	10	15	12	10
Dakota	10	7	6	10	7	6	10	7	6
Florida	..	..	..	..	..	..	..	..	..
Idaho	15	12	10	15	12	10	15	12	10
Louisiana	..	..	..	..	..	..	..	..	..
Minnesota	10	7	6	10	7	6	10	7	6
Montana	..	..	..	15	12	10	15	12	10
Nebraska	10	6	5	10	7	6	10	7	6
Nevada	15	12	10	15	12	10	15	12	10
New Mexico	10	8	7	10	8	7	15	12	10
Oregon	15	12	10	15	12	10	15 / 18	12 / 15	10 / 12
Utah	..	..	..	15	12	10	15	12	10
Washington	15	12	10	15	12	10	15	12	10
Wyoming	..	..	..	..	..	..	15	12	10

States and Territories.	1871.			1872.			1873.			1874.		
Arizona	$15	12	10	$15	12	10	$15	12	10	$15	12	10
California	15 / 18	12 / 15	10 / 12	15 / 18	12 / 15	10 / 12	15 / 18	14 / 16	12 / 14	...15	14	12
Colorado	15	12	10	15	12	10	15	12	10	15	12	10
Dakota	10	7	6	10	7	6	10	7	6	12	9	8
Florida	10	7	6	10	7	6	10	7	6	10	7	6
Idaho	15	12	10	15	12	10	15	12	10	15	12	10
Louisiana	25	12	8	..	10	8	..	10	8	..	10	8
Minnesota	15	12	10	15	12	10	14	12	10	14	12	10
Montana	15	12	10	15	12	10	15	12	10	15	12	10
Nebraska	10	7	6	10	6	5	12	9	6	12	9	8
Nevada	15	12	10	15	12	10	15	12	10	15	12	10
New Mexico	..	..	..	. / 15 / 10	16 / 12 / 15	. / 10 / 12	15	14 / 16	12 / 16	15	14 / 16	12 / 16
Oregon	15 / 18	12 / 15	10 / 12	15	12	10	15	12	10	15	12	10
Utah	15	12	10	15 / 18	12 / 15	10 / 12	15 / 18	14 / 16	12 / 14	15 / 18	14 / 16	12 / 14
Washington	15	12	10	15	12	10	15	12	10	15	12	10
Wyoming	15	12	10	15	12	10	15	12	10	15	12	10

States and Territories.	1875.			1876.			1877.		
Arizona	$15	12	10	$15	12	10	10 / 13	7	6
California	15 / 18	14 / 16	12 / 14	15 / 18	14 / 16	12 / 14	10 / 13	7	6
Colorado	15 / 18	12 / 16	10 / 14	15 / 18	12 / 16	10 / 14	10 / 13	7	6
Dakota	12	9	8	12	9	8	10	7	6
Florida	12	12	10	12	12	10	10	7	6
Idaho	15 / 18	12 / 16	10 / 14	15 / 18	12 / 16	10 / 14	10 / 13	7	6
Louisiana	..	12	10	..	12	10	10	7	6
Minnesota	15	12	10	15	12	10	10	7	6
Montana	15	12	10	15	12	10	10 / 13	7	6
Nebraska	15	12	10	15	12	10	10	7	6
Nevada	15	12	10	15	12	10	10	7	6
New Mexico	15	12	10	15 / 18	14 / 16	12 / 14	10	7	6
Oregon	15 / 18	14 / 16	12 / 14	15	12	10	10 / 13	7	6
Utah	15	12	10	15 / 18	12 / 16	10 / 14	10 / 13	7	6
Washington	15 / 18	14 / 10	12 / 14	15 / 18	12 / 16	10 / 14	10 / 13	7	8
Wyoming	15 / 18	12 / 16	10 / 14	15	12	10	10 / 13	7	6

States and Territories.	1878			1879.			1880.			1881.		
Arizona	10 / 16	7 / 14	6 / 10	$10 / 16	7 / 14	6 / 10	$10 / 16	7 / 14	6 / 10	$12 / 16	10 / 14	8 / 10
California	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Colorado	10 / 16	7 / 14	6 / 10	10 / 16	7 / 12	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Dakota	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Florida	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	8 / 10	12 / 16	10 / 14	8 / 10
Idaho	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Louisiana	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Minnesota	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Montana	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 16	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Nebraska	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Nevada	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
New Mexico	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Oregon	10 / 16	7 / 14	8 / 10	10 / 16	7 / 14	8 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Utah	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	8 / 10	10 / 16	7 / 14	6 / 10	12 / 18	10 / 14	8 / 10
Washington	10 / 16	7 / 14	8 / 10	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10
Wyoming	10 / 16	7 / 14	6 / 10	10 / 16	7 / 14	0 / 10	10 / 16	7 / 14	6 / 10	12 / 16	10 / 14	8 / 10

Surveying Districts and Offices of Surveyors-General.

Statement showing dates of organization of the several surveying districts since the beginning of the service, dates of closing the offices of surveyors-general in States where the surveys have been completed, and dates when the original surveying archives were delivered to the State authorities.

Name of district.	*Act creating office of surveyor-general.*	*Statutes at large.* Vol.	Page.	Sec.	*Office closed.*	*Archives delivered to State authorities.*	*Remarks.*
Alabama	Apr. 20, 1818	3	466	1	1850.	1850	Originally part of district south of Tennessee, subsequently part of district of northern part of Mississippi Territory.
Arizona	Feb. 24, 1863	12	664	2			Attached to New Mexico by act of July 2, 1864. Attached to California district by act of March 2, 1867. Made separate district, act July 11,1870
Arkansas	June 15, 1832	4	531		March 8, 1859	1861	Archives delivered to state auditor by the register of land office at Little Rock during the war.
California	Mar. 3, 1851	9	617				See remarks for Arizona and Nevada.
Colorado	Feb. 28, 1861	12	172	17			See remarks for Utah, Idaho, and Nevada.
Dakota	Mar. 2, 1861	12	239	17			See remarks for Montana.
Florida	May 8, 1822	3	718				
Idaho	June 29, 1866	14	77				By the act of July 2, 1864, Idaho was attached to the Colorado surveying district.
Illinois and Missouri	Apr. 29, 1816	3	325		October 31, 1863	Illinois, June 16, 1869. Missouri, Oct. 10, 1866.	
Iowa and Wisconsin	June 12, 1838	5	243		June 30, 1866	Iowa, March 23, 1868. Wisconsin, Aug. 1, 1866	
Kansas and Nebraska	July 22, 1854	10	309	10	Kansas, June 30,'76	Kansas, June 30, 1876	By act of July 28, 1866, the surveying district of Nebraska and Iowa was created.
Louisiana	Mar. 3, 1831	4	492				
Minnesota	Mar. 3, 1857	11	212				
Mississippi	Mar. 3, 1817	3	375		October 31, 1849	October 31, 1849	Originally part of district south of Tennessee.
Montana	Mar. 2, 1867	14	542				By act of July 2, 1864, Montana was attached to Dakota surveying district. No surveys made until 1867.
Nebraska and Iowa	July 28, 1866	14	344				See Kansas and Nebraska.
Nevada	Mar. 2, 1861	12	209	17			By act March 14, 1862, Nevada attached to California. Act July 2, 1864, Nevada attached to Colorado. Act July 4, 1866, Nevada separate district.
New Mexico	July 22, 1854.	10	308				See remarks for Arizona.
Northwest of Ohio	May 18, 1796	1	464		May 11, 1857	Ohio, July 29, 1846. Indiana, Dec. 11, 1849. Michigan, May 12, 1857	This district embraced Ohio, Indiana, Illinois, Michigan, Wisconsin, and part of Minnesota. See Illinois and Missouri, also Iowa and Wisconsin.
Oregon	Sept. 27, 1850	9	496				This district embraced Washington Territory which was made a separate district by act of July 17, 1854.
Utah	Feb. 21, 1855	10	611				Attached to Colorado by act March 14, 1862. Made separate district by act of July 16, 1868.
South of Tennessee	Mar. 3, 1803	2	229	10			Act of March 2, 1805, extended powers of surveyor south of Tennessee to Territory of New Orleans. See Ala. and Miss.
Washington	July 17, 1854	10	305	7			Mississippi.
Wyoming	Feb. 5, 1870	16	64				See Oregon.

U. S. LAWS RELATING TO SURVEYS AND SURVEYORS.

Sec. 77. There shall be appointed by the President, by and with the advice and consent of the Senate, a surveyor-general for the States and Territories herein named, embracing, respectively, one surveying district, namely: Louisiana, Florida, Minnesota, Kansas, California, Nevada, Oregon, Nebraska and Iowa, Dakota, Colorado, New Mexico, Idaho, Washington, Montana, Utah, Wyoming, Arizona.

3 Stat. 755; 4 *id.* 492; 9 *id.* 496; 10 *id.* 244, 306, 308, 309, 611; 11 *id.* 212; 12 *id.* 176, 214, 244; 14 *id.* 77, 85, 344, 542; 15 *id.* 91; 16 *id.* 65, 230; 17 *id.* 76; 18 *id.* 18, 34, 121, 122, 123, 201, 303; 19 *id.* 126, 207; R. S. 2207.

Sec. 78. The surveyors-general of Louisiana, Florida, Minnesota, Kansas, Nebraska and Iowa, and of Dakota Territory, shall each receive a salary at the rate of two thousand dollars a year.

3 Stat. 755; 4 *id.* 493; 12 *id.* 244; 17 *id.* 76; R. S. 2208.

Section 79. The surveyors-general of Oregon and of Washington shall each receive a salary at the rate of two thousand five hundred dollars a year.

9 Stat. 496; 10 *id.* 158, 248, 306, 674; 12 *id.* 410; 17 *id.* 76; R. S. 2209.

Sec. 80. The surveyors-general of Colorado, New Mexico, California, Idaho, Nevada, Montana, Utah, Wyoming, and Arizona shall each receive a salary at the rate of three thousand dollars a year.

10 Stat. 244, 308, 611; 12 *id.* 176, 214, 410; 14 *id.* 77, 85, 542; 15 *id.* 91; 16 *id.* 65, 230; 17 *id.* 76; R. S. 2210.

Sec. 81. The salary of each surveyor-general of Florida, Oregon and California shall be paid quarter-yearly, and shall commence from the time he enters into bond, as provided by law.

3 Stat. 756; 9 *id.* 496; 10 *id.* 244; R. S. 2211.

Sec. 82. The surveyor-general's office for Minnesota district shall be located at the city of Saint Paul; that for Idaho Territory at Boise City; that for the district of Nebraska and Iowa at Plattsmouth, in Nebraska; and for each other surveying district at such place as the President, in view of the public convenience, may from time to time direct; and there shall be but one office of surveyor-general in each district.

11 Stat. 212; 13 *id.* 352; 14 *id.* 77, 344; R. S. 2212, 2213.

Sec. 83. Every surveyor-general, while in the discharge of the duties of his office, shall reside in the district for which he is appointed.

5 Stat. 637; R. S. 2414.

Sec. 84. Every surveyor-general shall, before entering on the duties of his office, execute and deliver to the Secretary of the Interior a bond, with good and sufficient security, for the penal sum of thirty thousand dollars, conditioned for the faithful disbursement, according to law, of all public money placed in his hands and for the faithful performance of the duties of his office; and the President has discretionary authority to require a new bond and additional security, under the direction of the Secretary of the Interior, for the lawful disbursement of public moneys.

3 Stat. 697; R. S. 2215, 2216. U. S. *v.* Vanzandt, 11 Wheat. 184; U. S. *v.* Tingey, 5 Pet. 115; Farrar and Brown *v.* U. S., 5 *id.* 373; U. S. *v.* Bradley, 10 *id.* 343; U. S *v.* Linn, 15 *id.* 290; U. S. *v.* Prescott, 3 How. 578; U. S. *v.* Boyd, 5 *id.* 29; Bryan *v.* U. S., 1 Black, 140; Boyden *v.* United States, 13 Wall. 17; Bevans *v.* U. S., 13 *id.* 56; U. S. *v.* Thomas, 15 *id.* 337; U. S. *v.* Stephenson, 1 McLean, C. C. 462; U. S. *v.* Linn, 2 *id.* 501; U. S. *v.* Ward, 3 *id.* 179. 8 Op. Att. Gen. 7. Cir. G. L. O., July 1, 1871; *id.* May 14, 1879. Treasury Cir., July 13, 1871 (Copp's L. L. 783; 1 Lester's L. L. 312, 314).

Sec. 85. The commission of each surveyor-general shall cease and expire in four years from the date thereof, unless sooner vacated by death, resignation, or removal from office.

3 Stat. 697; R. S. 2217. Best *v.* Polk, 18 Wall. 112. Decision Com. G. L. O., Feb. 20, 1858 (1 Lester's L. L. 340).

Sec. 86. Every surveyor-general, except where the President sees cause otherwise to determine, is authorized to continue in the uninterrupted discharge of his regular official duties after the day of expiration of his commission and until a new commission is issued to him for the same office, or until the day when a successor enters upon the duties of such office; and the existing official bond of any officer so acting shall be deemed good and sufficient and in force until the date of the approval of a new bond to be given by him, if recommissioned, or otherwise, for the additional time he may so continue officially to act, pursuant to the authority of this section.

10 Stat. 247; 18 *id.* 62; R. S. 2222.

Sec. 87. Whenever the surveys and records of any surveying district are completed the surveyor-general thereof shall be required to deliver over to the secretary of state of the respective States, including such surveys, or to such other officer as may be authorized to receive them, all the field-notes, maps, records, and other papers appertaining to land titles within the same; and the office of surveyor-general in every such district shall thereafter cease and be discontinued.

5 Stat. 384; 19 *id.* 121; R. S. 2218.

Sec. 88. In all cases of discontinuance, as provided in the preceding section, the authority, powers, and duties of the surveyor-general in relation to the survey, resurvey, or subdivision of the lands therein, and all matters and things connected therewith, shall be vested in and devolved upon the Commissioner of the General Land Office.

10 Stat. 152; R. S. 2219.

Sec. 89. Under the authority and direction of the Commissioner of the General Land Office, any deputy surveyor or other agent of the United States shall have free access to any such field-notes, maps, records, and other papers for the purpose of taking extracts therefrom or making copies thereof without charge of any kind; but no transfer of such public records shall be made to the authorities of any State until such State has provided by law for the reception and safe-keeping of such public records and for the allowance of free access thereto by the authorities of the United States.

10 Stat. 152; 18 *id.* 62; R. S. 2220, 2221.

Sec. 90. Every surveyor-general shall engage a sufficient number of skilful surveyors as his deputies, to whom he is authorized to administer the necessary oaths upon their appointments. He shall have authority to frame regulations for their direction, not inconsistent with law or the instructions of the General Land office, and to remove them for negligence or misconduct in office.

Taylor and Quarlls *v.* Brown, 5 Cranch, 234; Craig *et al. v.* Braxford, 3 Wheat. 594; Ellicott *et al. v.* Pearl, 10 Pet. 412; Brown's Lessee *v.* Clements, 3 How, 650. Reed *v.* Conway, 20 Mo. 22; same case, 26 *id.* 13; Hamil *v.* Carr, 21 Ohio St. 258; Doe *v.* Hildreth, 2 Ind. 274; McClintock *v.* Rodgers, 11 Ills. 279. Cir. G. L. O., June 26, 1880.

Second. He shall cause to be surveyed, measured, and marked, without delay, all base and meridian lines through such points and perpetuated by such monuments, and such other correction parallels and meridians as may be prescribed by law or by instructions from the General Land Office in respect to the public lands within his surveying district, to which the Indian title has been or may be hereafter extinguished.

Gazzam *v.* Phillips' Lessee, 20 How, 372. 3 Op. Att. Gen., 281, 284. Atshire *v.* Hulse, 1 Ohio, 170; Hastings *v.* Stevenson, 2 *id.* 9; McKinney *v.* McKinney, 8 *id.* 423; Hamil *v.* Carr, 21 Ohio St. 258; Hendrick *v.* Eno, 42 Iowa, 411; Saint Louis *v.* Walker, 40 Mo. 383; Jordan *v.* Barrett, 13 La. 24; Fowler *v.* Duval, 11 *id.* 561; Cox *v.* Jones, 47 Cal. 412. Cir. G. L. O., June 26, 1880.

Third. He shall cause to be surveyed all private land claims within his district after they have been confirmed by authority of Congress, so far as may be necessary to complete the survey of the public lands.

Menard's Heirs *v.* Massey, 8 How, 293; Kissell *v.* St. Louis Public Schools, 18 *id.* 19; Stanford *v.* Taylor, 18 *id.* 409; Ballance *v.* Forsyth, 24 *id.* 183; U. S. *v.* Fossat, 25 *id.* 445; Carondelet *v.* St. Louis, 1 Black, 179; U. S. *v.* Sepulveda, 1 Wall. 104; U. S. *v.* Halleck, 1 *id.* 439; U. S. *v.* Billings, 2 *id.* 444; Sutter's case, 2 *id.* 562; U. S. *v.* Pacheco, 2 *id.* 587; Fossat case, 2 *id.* 649; Dehon *v.* Bernal, 2 *id.* 774; U. S. *v.* Armijo, 5 *id.* 444; Higueras *v.* U. S., 5 *id.* 827; Maguire *v.* Tyler, 8 *id.* 650; Lynch *v.* Bernal, 9 *id.* 315; Henshaw *v.* Bissell, 18 *id.* 255; Shepley *et al. v.* Cowan *et al.*, 1 Otto, 330; Miller *et al. v.* Dale *et al.*, 2 *id.* 473; Van Reynegan *v.* Bolton, 5 *id.* 33; U. S. *v.* Throckmorton, 8 *id.* 61; Snyder *v.* Sickles, 8 *id.* 203; Scull *v.* U. S., 8 *id.* 410. Bissell *v.* Henshaw, 1 Saw. C. C. 553; Leroy *v.* Jamison, 3 *id.* 369. Gibson *v.* Chouteau, 39 Mo. 536; Milburn *v.* Hardy, 28 *id.* 514; Funkhouser *v.* Hantz, 29 *id.* 540; Dent *v.* Legesson, 29 *id.* 489; Carondelet *v.* St. Louis, 29 *id.* 527; McGuire *v.* Tyler, 30 *id.* 202; Robins *v.* Eckler, 36 *id.* 494: Clark *v.* Heammerle, 36 *id.* 620; Gibson *v.* Chouteau, 39 *id.* 536; Vasquez *v.* Ewing, 42 *id.* 247; Glasgow *v.* Lindell, 50 *id.* 60; Rector *v.* Gaines, 19 Ark. 70; Ashley *v.* Rector, 20 *id.* 359; Meaux *v.* Breaux, 10 Martin (La.) 364; Moon *v.* Wilkinson, 13 Cal. 478; Boggs *v.* Mining Co., 14 *id.* 279; Mott *v.* Smith, 16 *id.* 534; Johnson *v.* Van Dyke, 20 *id.* 225; McGarrahan *v.* Maxwell, 27 *id.* 75; Treadway *v.* Semple, 28 *id.* 652; Searle *v.* Ford, 29 *id.* 104; Mahoney *v.* Van Winkle, 33 *id.* 448; Morrill *v.* Chapman, 35 *id.* 85; Yates *v.* Smith, 38 *id.* 60; San Diego *v.* Allison, 46 *id.* 163. Decisions Sec. Int., July 16, 1872; Aug. 8, 1876; Aug. 17, 1876; March 16, 1877. Decisions Com. G. L. O., Aug. 18, 1860; Sept. 18, 1874; Nov. 3, 1874; Sept. 18, 1875; Oct. 28, 1875; June 26, 1879. Cir. G. L. O., June 26, 1880.

Fourth. He shall transmit to the register of the respective land offices within his district general and particular plats of all lands surveyed by him for each land district; and he shall forward copies of such plats to the Commissioner of the General Land Office.

Barnard *v.* Ashley, 18 How. 43; Water and Mining Co. *v.* Bugbee, 6 Otto, 165. Hamil *v.* Carr, 21 Ohio St. 258; Doe *v.* Hildreth, 2 Ind. 274; Pope *v.* Athearn, 42 Cal. 606. Com. G. L. O. Instructions to Surveyors-General, April 17, 1879.

Fifth. He shall, so far as is compatible with the desk duties of his office, occasionally inspect the surveying operations while in progress in the field, sufficiently to satisfy himself of the fidelity of the execution of the work according to contract, and the actual and necessary expenses incurred by him while so engaged shall be allowed; and where it is incompatible with his other duties for a surveyor-general to devote the time necessary to make a personal inspection of the work in progress, then he is authorized to depute a confidential agent to make such examination, and the actual and necessary expenses of such person shall be allowed and paid for that service, and five dollars a day during the examination in the field; but such examination shall not be protracted beyond thirty days, and in no case longer than is actually necessary; and when a surveyor-general, or any person employed in his office at a regular salary, is engaged in such special service he shall receive only his necessary expenses in addition to his regular salary.

1 Stat. 464; 13 *id.* 325; 4 *id.* 492; 10 *id.* 245, 247; 18 *id.* 34; 19 *id.* 126; R. S. 2223. Sec. Int. Instructions, July 1, 1874; Sept. 21, 1874. Cir. G. L. O., June 26, 1880.

Sec. 91. Every deputy surveyor shall enter into bond, with sufficient security, for the faithful performance of all surveying contracts confided to him; and the penalty of the bond, in each case, shall be double the estimated amount of money accruing under such contracts, at the rate per mile stipulated to be paid therein. The sufficiency of the sureties to all such bonds shall be approved and certified by the proper surveyor-general.

4 Stat. 493; 10 *id.* 247; R. S. 2230. U. S. *v.* Vanzandt, 11 Wheat. 184; U. S. *v.* Tingey, 5 Pet. 115; Farrar *et al. v.* U. S., 5 *id.* 373; U. S. *v.* Bradley, 10 *id.* 343; U. S. *v.* Linn, 15 *id.* 290. U. S. *v.* Stephenson, 1 McLean, C. C. 462.

Sec. 92. The surveyor-generals, in addition to the oath now authorized by law to be administered to deputies on their appointment to office, shall require each of their deputies, on the return of his surveys, to take and subscribe an oath that those surveys have been faithfully and correctly executed according to law and the instructions of the surveyor-general.

9 Stat. 79; R. S. 2231. Ellicott and Meredith *v.* Pearl, 10 Pet. 412; U. S. *v.* Hanson, 16 *id.* 196; Bollard *et al. v.* Dwight *et al.*, 4 Cranch, 421; Taylor *et al. v.* Brown, 5 *id.* 234. Cir. G. L. O., June 26, 1880.

Sec. 93. The district attorney of the United States, in whose district any false, erroneous, or fraudulent surveys have been executed, shall, upon the application of the proper surveyor-general, immediately institute suit upon the bond of such deputy and the institution of such suit shall act as a lien upon any property owned or held by such deputy or his sureties at the time such suit was instituted.

9 Stat. 79; R. S. 2232.

Sec. 94. In the event of the failure of a deputy in Louisiana to comply with the terms of his contract, unless such failure be satisfactorily shown by him to have arisen from causes beyond his control, he shall forfeit the penalty of his bond on due process of law, and ever afterward be debarred from receiving a contract for surveying public lands.

4 Stat. 493; 18 *id.* 19, 62; 19 *id.* 207, 221; R. S. 2233.

Sec. 95. The official seals heretofore authorized to be provided for the offices of the surveyors-general of Oregon, California, and Louisiana shall continue to be used; and any copy of or extract from the plats, field-notes, records, or other papers on file in those offices respectively, when authenticated by the seal and signature of the proper surveyor-general, shall be evidence in all cases in which the original would be evidence.

10 Stat. 245, 248; R. S. 2224, 2225. U. S. *v.* Delespine's Heirs *et al.*, 12 Pet. 654; U. S. *v.* Wiggins, 14 *id.* 334; Hedrick *v.* Hughes, 15 Wall. 123. Hensley *v.* Tarpey, 7 Cal. 288; Lawrence *v.* Grout, 12 La. Ann. 835.

Sec. 96. All official books, papers, instruments of writing, documents, archives, official seals, stamps or dies which have been heretofore authorized by law to be collected and deposited in the office of the surveyor-general of California shall be safely and securely kept by such surveyor-general in the archives of his office.

11 Stat. 289; R. S. 2229.

Sec. 97. There shall be allowed for clerk hire, office rent, fuel, books, stationery, and other incidental expenses of the several offices of surveyors-general such sums as may be appropriated for such purposes by Congress from year to year.

R. S. 2226, 2227.

Sec. 98. The President is authorized, in any case where he thinks the public interest may require it, to transfer the duties of register and receiver in any district to the surveyor-general of the surveying district in which such land district is located.

12 Stat. 410; R. S. 2228.

Sec. 99. The public lands shall be divided by north and south lines run according to the true meridian, and by others crossing them at right angles, so as to form townships of six miles square, unless where the line of an Indian reservation, or of tracts of land heretofore surveyed or patented, or the course of navigable rivers, may render this impracticable; and in that case this rule must be departed from no further than such particular circumstances require.

McKinney *v.* McKinney, 8 Ohio, 423; Hamil *v.* Carr, 21 Ohio St. 258. Decision Sec. Int., Jan. 28, 1880. Cir. G. L. O., June 26, 1880.

Second. The corners of the townships must be marked with progressive numbers from the beginning, each distance of a mile between such corners must be also distinctly marked with marks different from those of the corners.

Third. The township shall be subdivided into sections, containing, as nearly as may be, six hundred and forty acres each, by running through the same, each way, parallel lines at the end of every two miles; and by making a corner on each of such lines, at the end of every mile. The sections shall be numbered, respectively, beginning with the number one in the northeast section and proceeding west and east alternately through the township with progressive numbers till the thirty-six be completed.

Grogan *v.* Knight, 27 Cal. 516. Decision Sec. Int., April 14, 1879. Cir. G. L. O., June 26, 1880.

Fourth. The deputy surveyors, respectively, shall cause to be marked on a tree near each corner established in the manner described, and within the section, the number of such section, and over it the number of the township within which such section may be; and the deputy surveyors shall carefully note, in their respective field-books, the names of the corner-trees marked and the numbers so made.

Cir. G. L. O., June 26, 1880.

Fifth. Where the exterior lines of the townships which may be subdivided into sections or half-sections exceed, or do not extend six miles, the excess or deficiency shall be specially noted, and added to or deducted from the western and northern ranges of sections or half-sections in such townships, according as the error may be in running the lines from east to west, or from north to south; the sections and half-sections bounded on the northern and western lines of such townships shall be sold as containing only the quantity expressed in the returns and plats respectively, and all others as containing the complete legal quantity.

Knight *v.* Elliott, 57 Mo. 317; Vaughn *v.* Tate, 64 *id.* 491; Waters *v.* Commons, 2 Port. (Ala.) 38; Lewen *v.* Smith, 7 *id.* 428. Decision Sec. Int., April 14, 1879. Cir. G. L. O., June 26, 1880.

Sixth. All lines shall be plainly marked upon trees, and measured with chains, containing two perches of sixteen and one-half feet each, subdivided into twenty-five equal links; and the chain shall be adjusted to a standard to be kept for that purpose.

Bradley *v.* Taylor, 5 Cranch, 191; McIvers *v.* Walker, 9 *id.* 173; Shipp *v.* Miller's Heirs, 2 Wheat. 316; Holmes *v.* Trout, 7 Pet. 171; Brown *v.* Huger, 21 How. 305; Meron *v.* Whitney, 5 Otto, 551; Robinson *v.* Moon, 4 McLean, C. C. 279. Oakley *v.* Stuart, 52 Cal. 521. Cir. G. L. O., June 26, 1880.

Seventh. Every surveyor shall note in his field-book the true situations of all mines, salt licks, salt springs, and mill-seats, which come to his knowledge; all water courses over which the line he runs may pass; and also the quality of the lands.

Newsom *v.* Pryor's Lessee, 7 Wheat. 7; Preston *v.* Bowman, 6 *id.* 580; Patterson *v.* Jenks, 2 Pet. 216.

Eighth. These field-books shall be returned to the surveyor-general, who shall cause therefrom a description of the whole lands surveyed to be made out and transmitted to the officers who may superintend the sales. He shall also cause a fair plat to be made of the townships and fractional parts of townships contained in the lands describing the subdivisions thereof and the marks of the corners. This plat shall be recorded in books to be kept for that purpose; and a copy thereof shall be kept open at the surveyor general's office for public information, and other copies shall be sent to the places of the sale and to the General land office.

1 Stat. 465; 2 *id.* 73; 19 *id.* 348; R. S. 2395. Taylor *et al. v.* Brown, 5 Cranch, 234; Barnard *v.* Ashley, 18 How. 43; Water and Mining Co. *v.* Bugbee, 6 Otto, 165. Rector *v.* Gaines, 19 Ark. 70; Lewen *v.* Smith, 7 Port. (Ala.) 428; Mott *v.* Smith, 16 Cal. 534; Hamil *v.* Carr, 21 Ohio St. 258; Doe *v.* Hildreth, 2 Ind. 274; McClintock *v.* Rodgers, 11 Ills. 279. Decision Sec. Int., Jan. 15, 1878. Decision Com. G. L. O., April 17, 1879.

Sec. 100. The boundaries and contents of the several sections, half-sections, and quarter sections of the public lands shall be ascertained in conformity with the following principles:

First. All the corners marked in the surveys, returned by the surveyor-general, shall be established as the proper corners of sections, or subdivisions of sections, which they were intended to designate; and the corners of half and quarter sections, not marked on the surveys, shall be placed as nearly as possible equidistant from two corners which stand on the same line.

Second. The boundary lines, actually run and marked in the surveys returned by the surveyor-general, shall be established as the proper boundary lines of the sections, or subdivisions, for which they were intended, and the length of such lines, as returned, shall be held and considered as the true length thereof. And the boundary lines which have not been actually run and marked shall be ascertained by running straight lines from the established corners to the opposite corresponding corners; but in those portions of the fractional townships where no such opposite corresponding corners have been or can be fixed, the boundary lines shall be ascertained by running from the established corners due north and south or east and west lines, as the case may be, to the water-course, Indian boundary line, or other external boundary of such fractional township.

Mott v. Smith, 16 Cal. 534; Guin v. Brandon, 29 Ohio St. 656; McClintock v. Rodgers, 11 Ills. 279; Goodman v. Myrick, 5 Oreg. 65. Cir. G. L. O., June 26, 1880.

Third. Each section or subdivision of section, the contents whereof have been returned by the surveyor-general, shall be held and considered as containing the exact quantity expressed in such return; and the half-sections and quarter-sections, the contents whereof shall not have been thus returned, shall be held and considered as containing the one-half or the one-fourth part, respectively, of the returned contents of the section of which they may make part.

2 Stat. 313; R. S. 2396. Lindsey v. Hawes, 2 Black, 554; U. S. v. Pacheco, 2 Wall. 587; Railway Co. v. Schurmier, 7 id. 272; County of Saint Clair v. Livingston, 23 id. 46; Heidekoper v. Brooms, 1 Wash. C. C. 109; Coon v. Pen, 1 Pet. C. C. 496. 2 Op. Att. Gen. 578. Knight v. Elliott, 57 Mo. 317; Vaughn v. Tate, 64 id. 491; Waters v. Commons, 2 Port. (Ala.) 38; Lewen v. Smith, 7 id. 428; Billingsly v. Bates, 30 Ala. 376; Doe v. Hildreth, 2 Ind. 274; Grogan v. Knight, 27 Cal. 516. Decision Com. G. L. O., May 17, 1875. Cir. G. L. O., June 26, 1880.

Sec. 101. In every case of the division of a quarter-section the line for the division thereof shall run north and south, and the corners and contents of half quarter-sections which may thereafter be sold shall be ascertained in the manner and on the principles directed and prescribed by the section preceding, and fractional sections containing one hundred and sixty acres or upwards shall in like manner, as nearly as practicable, be subdivided into half-quarter sections, under such rules and regulations as may be prescribed by the Secretary of the Interior, and in every case of a division of a half-quarter-section, the line for the division thereof shall run east and west, and the corners and contents of quarter quarter-sections, which may therefore be sold, shall be ascertained, as nearly as may be, in the manner and on the principles directed and prescribed by the section preceding; and fractional sections containing fewer or more than one hundred and sixty acres shall in like manner, as nearly as may be practicable, be subdivided into quarter quarter-sections, under such rules and regulations as may be prescribed by the Secretary of the Interior.

3 Stat. 566; 4 id. 503; R. S. 2397. Gazzam v. Phillips' Lessee, 20 How. 372; Railway Co. v. Schurmier, 7 Wall. 272. Buel v. Tuley, 4 McLean, C. C. 268. Wharton v. Littlefield, 30 Ala. 245. 3 Op. Att. Gen. 281, 284. Decision Sec. Int., April 14, 1879. Decision Com. G. L. O., May 17, 1875. Cir. G. L. O., June 26, 1880.

Sec. 102. Whenever in the opinion of the President, a departure from the ordinary method of surveying land on any river, lake, bayou, or water-course would promote the public interest, he may direct the surveyor-general, in whose district such land is situated, and where the change is intended to be made, to cause the lands thus situated to be surveyed in tracts of two acres in width, fronting on any river, bayou, lake, or water-course, and running back the depth of forty acres; which tracts of land so surveyed shall be offered for sale entire, instead of in half quarter sections, and in the usual manner, and on the same terms in all respects as the other public lands of the United States.

4 Stat. 34; R. S. 2407.

Sec. 103. In extending the surveys of the public lands in the State of Nevada, the Secretary of the Interior may vary the lines of the subdivisions from a rectangular form, to suit the circumstances of the country.

14 Stat. 86; R. S. 2408. Heydenfeldt v. Mining Co., 3 Otto, 634.

Sec. 104. The Secretary of the Interior, if he deems it advisable, is authorized to continue the surveys in Oregon and California, to be made after what is known as the geodetic method, under such regulations and upon such terms as have been or may hereafter be prescribed by the Commissioner of the General Land Office; but none other than township lines shall be run where the land is unfit for cultivation; nor shall any deputy surveyor charge for any line except such as may be actually run and marked or for any line not necessary to be run.

9 Stat. 496; 10 id. 245; R. S. 2409.

Sec. 105. Whenever, in the opinion of the Secretary of the Interior, a departure from the rectangular mode of surveying and subdividing the public lands in California would promote the public interests, he may direct such change to be made in the mode of surveying and designating such lands as he deems proper, with reference to the existence of mountains, mineral deposits, and the advantages derived from timber and water privileges; but such lands shall not be surveyed into less than one hundred and sixty acres or subdivided into less than forty acres.

10 Stat. 245; R. S. 2410. Cir. G. L. O., June 26, 1880.

Sec. 106. The public surveys shall extend over all mineral lands, and all subdividing of surveyed lands into lots less than one hundred and sixty acres may be done by county and local surveyors at the expense of claimants; but nothing in this section contained shall require the survey of waste or useless lands.

10 Stat. 15, 21; 16 id. 218; R. S. 2406.

Sec. 107. The printed manual of instructions relating to the public surveys, prepared at the General Land Office, and bearing date February twenty-second, eighteen hundred and fifty-five, the instructions of the Commissioner of the General Land Office, and the special instructions of the surveyor-general, when not in conflict with such printed manual or the instructions of the Commissioner, shall be taken and deemed to be a part of every contract for surveying the public lands.

12 Stat. 409; R. S. 2399. Cir. G. L. O., June 26, 1880.

Sec. 108. Legal subdivisions of forty acres of placer lands may be subdivided into ten-acre lots.

16 Stat. 217; R. S. 2330.

Sec. 109. The surveyor-general of the United States may appoint in each land district containing mineral lands as many competent surveyors as shall apply for appointment to survey mining claims. The expenses of the survey of vein or lode claims, and the survey and subdivision of placer claims into smaller quantities than one hundred and sixty acres, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States deputy surveyor to make the survey. The Commissioner of the General Land Office shall have power to establish the maximum charges for such surveys; and to the end that he may be fully informed on the subject, each applicant shall file with the register a sworn statement of all charges and fees paid by such applicant for surveys, which statement shall be transmitted to the Commissioner of the General Land Office.

17 Stat. 95; 19 id. 52; R. S. 2334. Decision Com. G. L. O., April 20, 1877.

Sec. 110. The surveyor-general of the United States shall prepare or cause to be prepared a plat and field-notes of all mining surveys made by authority of law, which shall show accurately the boundaries of such claims; and, when warranted by the facts, he shall give to the claimant his certificate that five hundred dollars' worth of labor has been expended or improvements made upon the claim by the claimant or his grantors, and that the plat is correct, with such further description by such reference to natural objects or permanent monuments as shall identify the claim, and furnish an accurate description, to be incorporated in the patent.

17 Stat. 92; R. S. 2325.

Sec. 111. Contracts for the survey of the public lands shall not become binding upon the United States until approved by the Commissioner of the General Land Office, except in such cases as the Commissioner may otherwise specially order.

12 Stat. 409; R. S. 2398. Maguire *v.* Tyler, 1 Black, 201; Parks *v.* Ross, 11 How. 362; Spencer *v.* Lapsley, 20 *id.* 264. Reed *v.* Conway, 26 Mo. 13. Decision Sec. Int., Feb. 27, 1878.

Sec. 112. The Commissioner of the General Land Office has power, and it shall be his duty, to fix the prices per mile for public surveys which shall in no case exceed the maximum established by law; and, under instructions to be prepared by the Commissioner, an accurate account shall be kept by each surveyor-general of the cost of surveying and plotting private land claims, to be reported to the General Land Office, with the map of such claim; and patents shall not issue for any such private claim, nor shall any copy of such survey be furnished, until the cost of survey and platting has been paid into the Treasury by the claimant or other party; and before any land granted to any railroad company by the United States shall be conveyed to such company or any persons entitled thereto, under any of the acts incorporating or relating to said company, unless such company is exempted by law from the payment of such cost, there shall first be paid into the Treasury of the United States the cost of surveying, selecting, and conveying the same by the said company or persons in interest.

12 Stat. 409; 18 *id.* 384; 19 *id.* 122; R. S. 2400. Railway Co. *v.* Prescott, 16 Wall. 603; Railway Co. *v.* McShane, 22 *id.* 444; Hannewell *v.* Cass Co., 22 *id.* 464; Colorado Co. *v.* Commissioners, 5 Otto, 259. Decisions Sec. Int., Dec. 17, 1874; Feb. 27, 1878; Feb. 20, 1879; March 5, 1879; April 2, 1879. Decisions Com. G. L. O., April 18, 1867; Aug. 8, 1867; Feb. 17, 1869; March 26, 1870. Cir. G. L. O., June 26, 1880.

Sec. 113. The Commissioner of the General Land Office may authorize, in his discretion, public lands in Oregon, densely covered with forests or thick undergrowth, to be surveyed at augmented rates, not exceeding eighteen dollars per mile per standard parallels, fifteen dollars for townships, and twelve dollars for section lines; and under like conditions he may allow augmented rates in California, and in Washington Territory, not exceeding eighteen dollars per linear mile for standard parallels, sixteen dollars for township, and fourteen dollars for section lines.

16 Stat. 304, 305; 17 *id.* 358; R. S. 2404, 2405. Decision Sec. Int., June 16, 1879. Cir. G. L. O., June 26, 1880.

Sec. 114. Whenever the public surveys, or any portion of them, in the States of Oregon and California, are so required to be made as to render it expedient to make compensation for the surveying thereof by the day instead of by the mile, it shall be lawful for the Commissioner of the General Land Office, under the direction of the Secretary of the Interior, to make such fair and reasonable allowance as, in his judgment, may be necessary to insure the accurate and faithful execution of the work.

10 Stat. 247; R. S. 2411. Decision Sec. Int., June 16, 1879. Cir. G. L. O., June 26, 1880.

Sec. 115. When the settlers in any township, not mineral or reserved by Government, desire a survey made of the same, under the authority of the surveyor-general, and file an application therefor in writing, and deposit in a proper United States depository, to the credit of the United States, a sum sufficient to pay for such survey, together with all expenses incident thereto, without cost or claim for indemnity on the United States, it may be lawful for the surveyor-general, under such instructions as may be given him by the Commissioner of the General Land Office, and in accordance with law, to survey such township and make return thereof to the general and proper local land office, provided the township so proposed to be surveyed is within the range of the regular progress of the public surveys embraced by existing standard lines or bases for the township and subdivisional surveys.

12 Stat. 410; R. S. 2401. Decision Sec. Int., Jan. 28, 1880. Cir. G. L. O., June 27, 1879; March 5, 1880.

Sec. 116. The deposit of money in a proper United States depository, under the provisions of the preceding section, shall be deemed an appropriation of the sums so deposited for the objects contemplated by that section, and the Secretary of the Treasury is authorized to cause the sums so deposited to be placed to the credit of the proper appropriations for the surveying service; but any excesses in such sums over and above the actual cost of the surveys, comprising all expenses incident thereto, for which they were severally deposited, shall be repaid to the depositors, respectively.

13 Stat. 404; R. S. 2402. Cir. G. L. O., June 27, 1879.

Sec. 117. Where settlers make deposits in accordance with the provision of section one hundred and fifteen, the amount so deposited shall go in part payment for their lands situated in the townships, the surveying of which is paid for out of such deposits; or the certificates issued for such deposits may be assigned by endorsement and be received in payment for any public lands of the United States entered by settlers under the pre-emption and homestead laws of the United States, and not otherwise.

16 Stat. 581; 19 *id.* 38; 20 *id.* 352; R. S. 2403. Cir. G. L. O., June 27, 1879.

Sec. 118. Each surveyor-general, when thereunto duly authorized by law, shall cause all confirmed private land claims within his district to be accurately surveyed, and shall transmit plats and field-notes thereof to the Commissioner of the General Land Office for his approval. When publication of such surveys is authorized by law, the proof thereof, together with any objections properly filed and all evidence submitted either in support of or in opposition to the approval of any such survey, shall also be transmitted to said Commissioner.

2 Stat. 326, 352; 3 *id.* 325; 5 *id.* 740; 9 *id.* 242, 633; 10 *id.* 244, 308, 599; 11 *id.* 294; 12 *id.* 172, 209, 369, 409; 13 *id.* 332, 344; 14 *id.* 218; 16 *id.* 64, 304; 18 *id.* 305; 19 *id.* 121, 202; R. S. 2447. Bissell *v.* Penrose, 8 How. 317; Villalobos *v.* U. S., 10 *id.* 541; Ledoux *v.* Black, 18 *id.* 473; U. S. *v.* Fossat, 20 *id.* 413; Brown *v.* Huger, 21 *id.* 305; U. S. *v.* Fossat, 21 *id.* 445; Castro *v.* Hendricks, 23 *id.* 438; Ballance *v.* Forsyth, 24 *id.* 183; U. S. *v.* Sepulveda, 1 Wall. 104; U. S. *v.* Halleck, 1 *id.* 439; U. S. *v.* Vallejo, 1 *id.* 658; Sutter's case, 2 *id.* 562; Fossat case, 2 *id.* 649; Higueras *v.* U. S., 5 *id.* 827; Alviso *v.* U. S., 8 *id.* 337. 12 Op. Att. Gen. 116, 250; 14 *id.* 74, 601. U. S. *v.* Garcia, 1 Saw. C. C. 383; Russell *v.* Henshaw, 1 *id.* 553; Leroy *v.* Jamison, 3 *id.* 369; U. S. *v.* Flint, 4 *id.* 42. Dent *v.* Segerson, 29 Mo. 480; Fowler *v.* Duvall, 11 La. Ann. 561; Waterman *v.* Smith, 13 Cal. 373; Moore *v.* Wilkerson, 13 *id.* 478; Merritt *v.* Judd, 14 *id.* 60; Mott *v.* Smith, 16 *id.* 534; Johnson *v.* Van Dyke, 20 *id.* 225; McGarraghan *v.* Maxwell, 27 *id.* 75; Seale *v.* Ford, 29 *id.* 104. Cir. G. L. O., June 26, 1880.

Sec. 119. It shall be the duty of each surveyor-general, whose respective surveying district includes any portion of the territory embraced, on the twenty-second day of July, eighteen hundred and fifty-four, within the limits of the then Territory of New Mexico, under the instructions of the Secretary of the Interior, to ascertain the origin, nature, character and extent of all claims to lands under the laws, usages, and customs of Spain and Mexico; and for this purpose may issue notices, summons witnesses, administer oaths, and do and perform all other necessary acts in the premises. He shall make a full report on all such claims as originated before the cession of the Territory to the United States by the treaty of Guadalupe Hidalgo, of eighteen hundred and forty-eight, denoting the various grades of title, with his decision as to the validity or invalidity of each of the same under the laws, usages, and customs of the country before its cession to the United States; and shall also make a report in regard to all pueblos existing in the Territory, showing the extent and locality of each, stating the number of inhabitants in the said pueblos, respectively, and the nature of their titles to the land. Such report shall be made according to the form which may be prescribed by the Secretary of the Interior, and shall be laid before Congress for such action thereon as may be deemed just and proper, with a view to confirm bona fide grants and give full effect to the treaty of eighteen hundred and forty-eight between the United States and Mexico; and until the final action of Congress on such claims, all lands covered thereby shall be reserved from sale or other disposal by the Government.

10 Stat. 309. Newhall *v.* Sanger, 2 Otto, 761; Tameling *v.* Emigration Co., 3 *id.* 644; U. S. *v.* Clamorgan and Danterive *v.* U. S., S. C., Oct. T., 1879, in manuscript. 14 Op. Att. Gen. 624. Decisions Sec. Int., Dec. 29, 1862; July 26, 1867; Sept.

6, 1870; July 27, 1871; June 6, 1872; Feb. 21, 1872; March 15, 1872; June 6, 1872; Sept. 2, 1872; Dec. 17, 1872; Feb. 21, 1873; March 21, 1873; March 26, 1873; July 23, 1873; July 31, 1873; Oct. 30, 1873; Feb. 28, 1874; March 17, 1874; June 29, 1874; July 15, 1874; Aug. 15, 1874; Oct. 27, 1874; Dec. 5, 1874; Jan. 23, 1875; March 27, 1875; June 1, 1875; Feb. 4, 1876; April 22, 1876; Aug. 8, 1876; Aug. 12, 1876; Aug. 17, 1876; Dec. 30, 1876; Feb. 7, 1877; Feb. 15, 1877; March 16, 1877; April 15, 1877; June 30, 1877; Nov. 15, 1877; June 12, 1878; July 11, 1878; Aug. 9, 1878; Oct. 24, 1878; May 21, 1879; May 28, 1879; June 9, 1879; June 21, 1879; Aug. 28, 1879; Sept. 20, 1879. Decisions Com. G. L. O., Aug. 18, 1860; June 22, 1870; Dec. 14, 1870; June 17, 1871; Dec. 19, 1871; July 9, 1872; Aug. 13, 1872; Sept. 18, 1874; Nov. 3, 1874; Feb. 12, 1875; June 29, 1875; July 19, 1875; May 13, 1876; May 19, 1876; July 7, 1876; Sept. 19, 1876; Nov. 15, 1876; April 13, 1877; June 22, 1877; June 27, 1877; Feb. 1, 1878; Feb. 21, 1878; April 13, 1878; Nov. 11, 1878; Dec. 2, 1878; March 21, 1879; July 14, 1879; Aug. 14, 1879; Sept. 5, 1879.

Sec. 120. Every person who in any manner, by threat or force, interrupts, hinders, or prevents the surveying of the public lands, or of any private land claim which has been or may be confirmed by the United States, by the persons authorized to survey the same, in conformity with the instructions of the Commissioner of the General Land Office, shall be fined not less than fifty dollars nor more than three thousand dollars, and be imprisoned not less than one nor more than three years.

4 Stat. 417; R. S. 2412.

Sec. 121. Whenever the President is satisfied that forcible opposition has been offered, or is likely to be offered, to any surveyor or deputy surveyor in the discharge of his duties in surveying the public lands, it may be lawful for the President to order the marshal of the State or district, by himself or deputy, to attend such surveyor or deputy surveyor with sufficient force to protect such officer in the execution of his duty, and to remove by force should any be offered.

4 Stat. 417; R. S. 2413.

Sec. 122. The President is authorized to appoint surveyors of public lands, who shall explore such vacant and unappropriated lands of the United States as produce the live-oak and red-cedar timbers, and shall select such tracts or portions thereof, where the principal growth is of either of such timbers, as in the judgment of the Secretary of the Navy may be necessary to furnish for the Navy a sufficient supply of the same. Such surveyors shall report to the President the tracts by them selected, with the boundaries ascertained and accurately designated by actual survey or water-courses.

3 Stat. 347; R. S. 2459. U. S. *v.* Briggs, 9 How. 351.

Sec. 123. The director of the geological survey shall, under the Interior Department, have the direction of the geological survey and the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.

20 Stat. 394.

SURVEYING OF MINING CLAIMS IN COLORADO.

As the system of public land surveys is well understood by those engaged in the engineering profession it would be needless in a sketch of this nature to dwell upon it at any length, and for the purposes of this article it will be found sufficient to accept the divisions as we find them, in ranges, townships, and sections.

In the main it will be found that there is no difference in the pre-emption of agricultural or mineral lands, as both are described as forming a certain portion of whatever section, township, or range they may be located in; in the case of pre-empted timber or agricultural lands, the description is complete when the direct subdivision of a section is given, as, for example, in Fig. 1, the shaded area would be described as the south half of the southeast quarter, of the northwest quarter of Section ——, Township ——, North (or South) Range ——, East (or West) of ——, Principal Meridian.

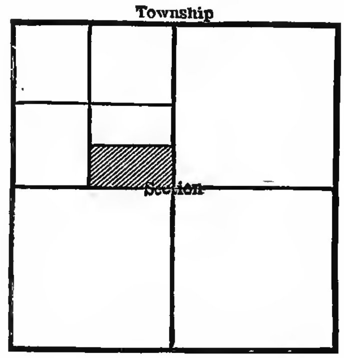


Fig. 1.

In mining districts where aliquot portions of a section are not pre-empted, but claims, consisting generally of rectangles, one hundred and fifty or three hundred feet in width, by fifteen hundred feet in length, a corner of the claim is connected by survey with a corner of the section, and it is thus definitely located.

It is the work of the United States Deputy Marshal Surveyor to survey and locate claims in reference to section corners. In case sectionizing had not progressed to the locality wherein a claim has been established, it is tied to a "locating monument," a description of which will be given later on.

The survey for a mining claim consists of two parts—the survey for location, and the survey for patent.

Before a *valid* location can be made, there are a few points it would be well for the engineer to note in his field book, not that they would in any way affect him or his work, but that they form the basis of the majority of lawsuits, and the benefit of a note made upon the ground, and at the time of survey, would be invaluable; they are: whether, first, the discovery shaft is ten feet deep at its *lowest surface* point; second that there is a true vein exposed, though not necessarily showing mineral; and third, that he has been called upon to survey the claim within ninety days from the date of the discovery of the lode or vein, as shown by the discovery or location stake.

Lodes are discovered in all sorts of ways, some stumbled on, some showing clean mineral in place, and others legitimately prospected for; the latter requiring knowledge, energy, and pertinacity. The prospector, armed with a few days' rations, pan, coffee pot, pick and shovel, a few gads, hammers, etc., starts for some district and commences the ascent of a mountain he may favor; while so doing a close watch is kept for indications or "float-ore," a decomposed ferruginous quartz that has probably become detached from the vein filling and rolled down the mountain side. This float is the prospector's polar star. Still ascending until all trace of it has disappeared, he feels that he has then passed above the apex of the vein he is in search of, and descends until it is again encountered. Reascending, he continues until the area which probably contains the vein is narrowed down to a few yards. An adit is run in the mountain side, or a shaft sunk, to determine further the exact location of the vein. If one is found, then a location stake is planted by which ownership is claimed and which forms the initial point of the survey. On it is written a notice containing the date of the discovery, the name of the lode and its locator, its general direction, and finally the distances to the end lines of the claim. Sixty days subsequent to the date of discovery is given by law, in which the discovery shaft or adit has to be sunk or driven ten feet; and in case no vein matter or wall-rock is exposed, giving evidence of an existing vein at some greater depth, then such shaft must be sunk until the necessary proof is obtained. These sixty days are usually spent in searching for such out croppings on or near the surface as will most thoroughly establish the line of the lode upon the ground;

as it is of the utmost importance that the latter be accurately determined, in order that the apex of the vein may be contained within the side lines for the full length of the claim, as a second location may be made by another prospector upon the extension of the vein discovered, when found outside of the side or end lines of a claim. Before ninety days have elapsed since the discovery of the lode it must be surveyed, and a description of it, with the names of the locators, placed upon record in the county in which the claim was discovered.

Claims are of a uniform length or fifteen hundred feet at present writing, although the widths vary. In five counties, Gilpin, Boulder, Clear Creek, Summit and Park, they are located seventy-five feet on each side of the discovery

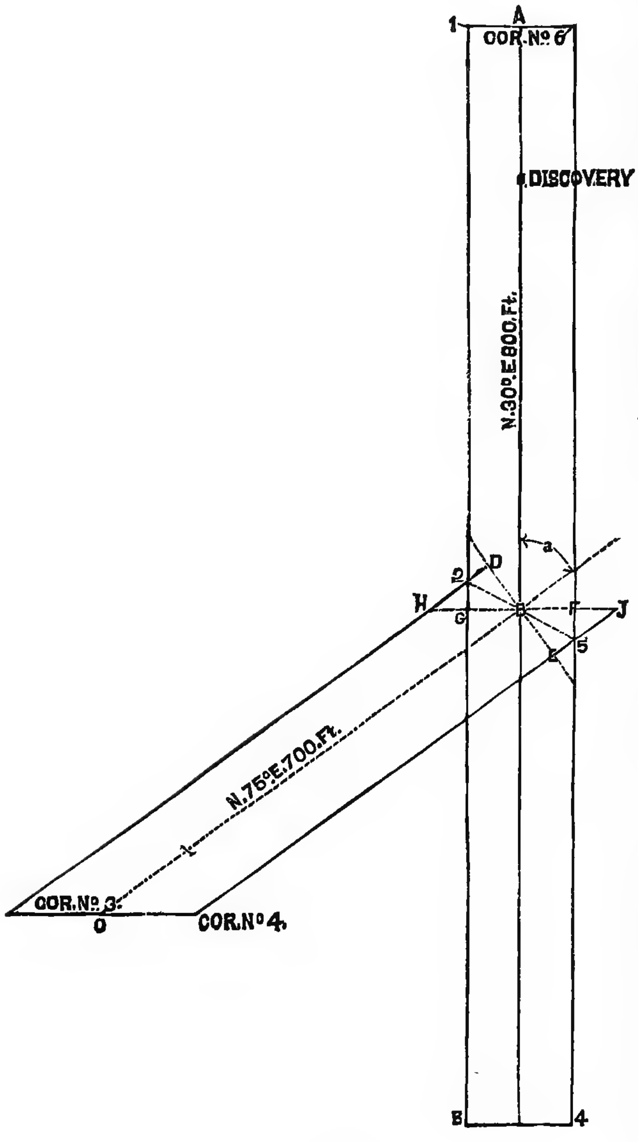


FIG. 2.

shaft (supposed to indicate the position of the vein), and in all others one hundred and fifty feet on each side. The discovery shaft must be in the center of the claim in reference to the side-lines, and in no case can the claim be located so that the distance from the discovery to either side line will exceed the limit of width as placed upon it by the customs of that mining district.

We will suppose the necessary work to be done and the claim is ready for the surveyor. In case the lode is a straight one, a rectangle of the required width is laid out upon the ground, and stakes planted at each corner and at the middle points of the long side lines, each stake being marked with the name of the lode, and "S. E." "S middle," etc., to indicate its position on the ground with regard to the claim, to enable prospectors who go over the same country to keep outside the lines of this location. Mountain bearings are to be given from at least two corners or points, and for *this* work an ordinary compass will suffice, though for many reasons it is best to use a transit, and obtain true courses. If, however, a bend occurs in the outcrop, besides planting stakes at the corners and middle points of the side line, stakes are to be driven at *each* bend in the survey; thus, in the case of a single bend there would be eight stakes required to properly mark the claim on the ground.

The end lines 1—6 and 3—4 or 3—4, as shown in Fig. 2, must in all cases be parallel, and should a bend occur in the lode, the length of one of the end lines 3—4 must be calculated in order that the claim have a uniform width. To illustrate this and the method generally adopted for obtaining the lengths of the side-lines, let us take the case of a single bend in the claim as shown in the same figure. Here we have given the course A B, say N 30° E, eight hundred feet, and B C, N 75° E seven hundred feet. Denote the complement of the angle A B C by a; from the figure it is evident that the side-lines 1—2 and 5—6 are eight hundred feet, and 2—3 and 4—5 are seven hundred feet, plus or minus an increment, it being different in both cases. To determine this increment, through the angle point B draw perpendiculars to the side-lines, the lines F B G and E B D, then will the angle G B D or E B F be equal to the angle a, and E B 5 or G B 2 be equal to ½ a. We now have the line 1—2 equal A B minus G 2, and 5—6 equal to A B plus G 2 or F 5. But G 2 or F 5 is equal to one half the claim-width multiplied by the

$$\tan, \tfrac{1}{2} a \text{ or } \left.\begin{matrix}1-2\\5-6\end{matrix}\right\} = 800 \mp \tfrac{1}{2} W \tan. \tfrac{1}{2} a$$

and similarly 2—3 and 4—5 are equal to

$$B\,B + H\,D - D\,2 \text{ and } B\,C - H\,D + D.$$
$$\text{Or, } 700 + \tfrac{1}{2} W \tan., a - \tfrac{1}{2} W \tan., \tfrac{1}{2} a, \text{ and}$$
$$700 - \tfrac{1}{2} W \tan., a + \tfrac{1}{2} W \tan., \tfrac{1}{2} a, \text{ or}$$
$$L = L \pm \tfrac{1}{2} W (\tan, a \mp, \tan, \tfrac{1}{2} a) \text{ in which}$$

L is equal to the length of the side lines.
L " " " center "
W " " width of claim.
a " " complement of angle between the center lines.

Should a number of bends occur in the claim, it is readily seen that the solution of side lines is entirely similar, and it would be needless to carry the illustration further.

The end-line 3—4 is equal to $\dfrac{W}{\sin a}$

If any two alternate courses are parallel then the side lines of the connecting course are of the same length as the course. The stakes for location work are not generally substantial, being posts two or three inches in diameter and of about as many feet in length, and are not intended for permanent use. When work sufficient to fulfil the requirements of the law ($500) has been done, and the property would seem to justify the additional expense, a patent is applied for to obtain a Government title to the land. This is done by the owners or their representatives, sending a certified copy of the original location as found in the county records, twenty-five dollars and a letter to the Surveyor-General of the State, requesting that an order may be issued to some deputy surveyor to survey the claim. This fee is to pay for the office work necessary for checking the clerical work of the deputy, furnishing blanks, copies of the field-notes of the claim surveyed, etc., etc. Upon receipt of the order to make the survey, the deputy notes the number given to it by the Surveyor-General, and proceeds to make the survey, the claim being thereafter designated by its number. Should additional land be required either for milling or timber purposes, it may be pre-empted with the lode, and all work done upon the latter will be in effect as though done upon the "mill-site, as it is technically called. In this case a number such as 967 A would designate the lode, and 967 B the mill-site, which must in every case be tied together, as often the lode will be found near the summit of a mountain, and the mill-site in the valley half a mile or more distant. The law does not regulate the shape of a mill-site, and its only restriction is that it shall not exceed five acres in area, its survey is in every respect entirely similar to that of a lode-survey as herein described.

The variation of the magnetic needle being so great, ranging from 14° 30, E to 16° E, and its liability to error from local attraction so well known, recourse is made to the solar compass. The old Burt solar which is the basis of every modern one, obtains favor especially with the older surveyors, but the use of a combined solar compass and transit is being rapidly extended. The instruments made by Gurley, of Troy N. Y., are excellent for general use, but require considerable time to set up, the solar attachment being placed upon the telescope. Those furnished by Young & Son, of Philadelphia, are a decided improvement in the matter of time required for adjusting, and in them the attachment is placed under the plates and removed when not in use. For the method of using a solar transit we would refer the reader to text books or a handbook issued by W. & L. E. Gurley, of Troy, and will merely give the outline of field and office work necessary to the procuring of a patent. The fifty foot chain is the principal instrument used for measuring, though there are many places where its use is impossible, and the telemeter takes its place. The length of the side-lines (in case of a bend) having been computed, a meridian is established by solar observation, and the courses and distances are run off on the center line, until an angle point, B, is reached; here the instrument is reset, and the line in which the corners lie (2—5) determined, and the corners located at the end of these lines. Corners are preferably either trees, bowlders or rock in place, and in case they are not found at the exact point, then stone or wooden posts are to be used. If a stone is used, its dimensions must not be less than 4″ × 4″ × 2′, sunk in the ground one foot and protected by a mound of stones; if of wood, then its minimum dimensions are 4″ × 4″ × 4′, sunk *two* feet in the ground and similarly protected by stones; they should be permanently marked with the number of survey and the corner of claim. A square nail pointed chisel is used for stones, and a timber scribe for wooden posts. From *each* corner a bearing is taken to the nearest natural object, such as stumps, trees, bowlders, rocks in place, or any object likely to give permanency to the corner, and serve to fully locate and identify it. If a tree has been used it should be blazed and marked B. T. (bearing tree) together with the number of survey, and if a stone pointer, an X, with the survey number chiseled on it, will suffice.

If mountain or other bearings were given in the original location certificate, they should be verified by solar observation at the respective points from which they were taken. Should it appear that the bearings or courses do not agree after making due allowance for the variation of the needle at that point, then a new certificate of location must be made out, placed upon record, and used as a guide instead of the original one. Close attention must be given to see that the solar survey covers every point embodied in the original certificate, otherwise the work will have to be repeated. It is usual to make in the field-book a diagram of the lode with all details as called for, and verify each point as the survey progresses. While in the field, all improvements, such as shafts, tunnels, drifts, houses, etc., placed upon the claim by the applicant for a patent, and noted with their approximate value and their position in reference to some corner of the claim ascertained. Crossings of roads, fences and creeks are noted, and connecting lines run to the section corner and all adjacent patented surveys, as they must be shown upon the plat and field notes sent to the Surveyor-General. Should, however, there be no section corner within two miles of the claim, then the deputy is directed to establish a "locating monument," which consists of a bar of copper or iron, one inch in diameter, inserted in some prominent bowlder or rock in place, upon which is chiseled, "U. S. L. M.," for United States Locating Monument, and a name is given it by which it is designated, as "U. S. L. M. Chihuahua." Bearings to trees, prominent peaks, the junction of roads, confluence of streams, etc., are to be given, and a full description of it given in the field-notes each time it is used to locate a lode.

The plats are made upon mounted sheets of Whatman's paper, which together with blank field-note paper is furnished by the government to insure uniformity. Lodes are platted on a scale of two hundred feet to one inch, with black boundary lines, and the surface colored except in the case of a conflicting claim which has a prior title, the area in conflict being left white. Mountain and all other bearings are in red, with the course of each one plainly lettered. Each corner is marked "Cor. No. 1, Cor. No. 2" etc. The connection from Cor. No. 1 to the section corner is shown, as is also the section or quarter-section lines in which the claim is placed.

"If in running the exterior boundaries of a claim, it is found that two surveys conflict, the plats and field-notes should show the extent of the conflict, giving the area embraced in both surveys, and also the distance from the established corners at which the exterior boundaries of the respective surveys intersect each other." In notes give area as follows:

Total area	5·16
Less area in conflict with surveys Nos. 967 and 1151	2·00
Leaving a net area	3·16

On the plat the net area only is given. The following will give the general form of field-notes at present in use:

Field-notes of the survey of the claim of G. G. Jones, on the Porter Lode and Mill Site, situated in Griffith Mining District, Clear Creek County, State of Colorado.

Survey began June 1, 1880.
Survey ended June 3, 1880.

Feet.	
	Beginning at the S. E. cor. Sec. 27, T. 3 S. R. 76 W.; thence N. 27° 15′ 39″ W. Var. 15° 30′ E.
7462-84	To Cor. No. 1 beginning, a granite post 26″ × 7″ × 12″ in the ground one foot, and protected by a mound of stones, and is marked 1—973 A; whence cer. No. sur. No. 963 B., Porter Mill site, G. G. Jones, applicant, bears S. 27° 16′ 26″ W., 10.841.2 ft. distant. Republican Mt. bears N. 10° 12′ E., and Democrat Mt., bears N. 16° 14 W.; cor. No. 3, sur. No. 840; Pluto Lode, James Gorman, applicant, bears S. 0° 10′ W. 402 ft. A × 963 A. cut on N. face of bowlder bears S. 23° 15′ W. 21 ft. Thence S. 23° 47′ W.
903.7	To east line of sur. No. 465, bullion Lode, Colorado Mining Company, applicants, and from cor. No. 5 of sur. No. 465 to the same point of intersection, S. 34° 21′ E., 87.2 ft.
1,069.4	To west line of sur. No. 465, and from cor. No. 2 of same survey, S. 34° 21′ E., 133·4 ft. to the point of intersection.
1,243	To road to Georgetown running N. 85° W.
1,500	To Cor. No. 2, a pine post four inches by four inches by four feet, marked 2—963 A, in ground two feet, and in mound of stones, whence a spruce tree 16 inches diameter; blazed and marked B.T. —963 A, bears N. 63° E. 20 ft. Squaw Mt. bears S 83° E., and Little Chief Mt. S. 74° 30′ E. Thence N. 66° 13′ W.
150	To cor. No. 3, a spruce post, etc., etc.

The plat and field-notes being finished and sworn to by the deputy and those that assisted in marking corners, chaining, etc., they are then sent to the Surveyor-General's office for approval. If any clerical error has occurred, or if it be found by calculation that the connecting lines through the several intersecting lodes of the section corner disagree, then the plat and field-notes are returned with a marginal note, as "*cut thro' 465 with sec. cor.*," and the error must be discovered and corrected. If the work be right, then it is platted upon the general map of that section of the country, and two approved copies sent to the deputy, with one copy of the field-notes; another set of both is sent to the U. S. Land office, for government use. The patent for the land is now applied for, and the furthering of it properly belongs to a lawyer, as may readily be imagined, by glancing over the list of "first" or preliminary papers.

A complete abstract of title.

A certified copy of the pre-emption of lode and mill site.

Proof by affidavit of non-mineral character of the mill site.

Affidavit of work done on the lode.

Copy of articles of incorporation of the company, if land is pre-empted by an organization.

Certificate of agency.

Copy of field notes with affidavit of persons assisting on the survey.

Two copies of the plat (as approved).

An approved copy of the same furnished by the Surveyor-General.

Proof of citizenship and peaceable possession of claim.

Proof of posting notice that a patent has been applied for.

But as this paper was intended to give an outline of the method and requirements of claim surveying, it would be tedious to attempt to follow the papers through their official career, and it will suffice to say that it generally consumes a year before the government titles are perfected. The work of claim surveying is not difficult, requiring care alone, and to the young engineer there are few fields that offer inducements at all comparable with Colorado, and especially the lately developed districts of San Juan and Gunnison. The value of engineers' work as *surveyors only* is appended below. General underground or surface work, $10 per day. Locations $6 to $10 each, inclusive of expenses, such as horse-hire and placing the location on record, which costs $1.50. Patents cost all the way from $150 to $225, the official fees of which range from $95 to $140, and are of course included in the above estimate.

—*A paper by Richard A. Parker, C. E., in the School of Mines Quarterly.*

LAND DISTRICTS AND OFFICERS.

Sec. 124. The following are the established boundaries of the existing land districts, with the location of the respective land offices, until changed in pursuance of law, namely:

Mathews *v.* Zane, 5 Cranch, 92; Same case, 7 Wheat. 164; Hellan *v.* Ripley, 3 Rob. (La.) 138.

Missouri.—*Booneville.*—Booneville land district embraces all that part of the State of Missouri which lies north of the line between townships thirty-seven and thirty-eight north, lying west of the line between ranges ten and eleven west and townships thirty-four and thirty-five north of ranges eleven to thirty-three west, inclusive.

Ironton.—The land district of Ironton embraces all that part of the State of Missouri which lies south of the line between townships thirty-seven and thirty-eight north, and east of the line between ranges ten and eleven west of the fifth principal meridian.

Springfield.—The land district of Springfield consists of that portion of the State of Missouri which is situated south of the line between townships thirty-four and thirty-five north, and west of the line between ranges ten and eleven west of the fifth principal meridian.

Alabama.—*Huntsville.*—Huntsville land district includes all that portion of the State of Alabama lying north of Calhoun and Cleburne counties and north of the line between townships fourteen and fifteen south of the base meridian of Huntsville, extending from the western boundary of the State to the western boundary of Calhoun county.

Montgomery.—Montgomery land district includes all that portion of the State of Alabama lying south of townships fourteen and fifteen south of the base meridian of Huntsville, extending from the western boundary of the State to the western boundary of Calhoun county, and south of the northern boundaries of Calhoun and Cleburne counties.

Louisiana.—*New Orleans.*—The land district of New Orleans comprehends within its limits that portion of the State of Louisiana which lies south of the basis parallel of thirty-first degree of north latitude and that portion thereof lying north of the basis and east of range lines three and four west, townships one to thirteen north, inclusive; and also east of range lines five and six west, extending from township fourteen north to northern boundary of State.

Natchitoches.—This land district occupies the north-western part of the State of Louisiana, extending from townships one to thirteen north, inclusive, and west of the line between ranges three and four west; and also from township fourteen north to the north boundary of the State, extending from the line between ranges five and six west of the principal meridian to the western boundary of the State of Louisiana.

Mississippi.—*Jackson.*—The land district of Jackson is co-extensive with the limits of the State of Mississippi.

Michigan.—*Reed City.*—Reed City land dictrict includes all that part of the State of Michigan situated west of the following lines: Townships one to four south, inclusive, west of the line between ranges three and four west; townships five to eight south, inclusive, west of the line between ranges four and five west; townships one to ten north, inclusive, west of the principal meridian; townships eleven to thirty-nine north, inclusive (extending to Lake Huron), west of the line between ranges two and three west, including islands in Lake Michigan and the straits of Mackinac, exclusive of the island of Mackinaw.

East Saginaw.—East Saginaw land district embraces townships six to ten north, inclusive, lying east of the principal meridian and west of the line between ranges eleven and twelve east of said meridian; also townships eleven to twenty-eight north, inclusive, lying east of the line between ranges two and three west of the principal meridian, and west of the line between ranges eleven and twelve east.

Marquette.—Land district embraces the whole extent of the northern peninsula of Michigan, including Drummond Island, Isle Royale, and those adjacent to the Big Bay de Noc.

Detroit.—The land district of Detroit includes all that part of the State of Michigan situated east of the following lines of public surveys, viz: Townships one to five north, inclusive, east of the principal meridian; townships six to nineteen north, inclusive, extending east of the line between ranges eleven and twelve east, townships one to four south, inclusive, lying east of the line between ranges three and four west; townships five to nine south, inclusive, extending from the line between the ranges four and five west. It also includes that part of the State which lies north of the line between townships twenty-eight and twenty-nine north, and east of the line between ranges two and three west of the principal meridian, and extending to Lake Huron, in the southern peninsula of Michigan, comprehending within its limits the island of Mackinaw.

Arkansas.—*Dardanelle.*—Land district is bounded on the east by a line between ranges seventeen and eighteen west of the fifth principal meridian, running north from the base line to the corner common to townships twelve and thirteen north of the base line, on the north by the line between townships twelve and thirteen north, on the west by the western boundary of the State of Arkansas, on the south by the base line.

Little Rock.—The Land district is bounded as follows, viz: Beginning on the south boundary of the State of Arkansas where the line between ranges five and six west of the fifth principal meridian intersects the same; thence north on said range line to the corner common to townships ten and eleven south; thence west on the line between townships ten and eleven south to the line between ranges seventeen and eighteen west; thence north on the said range line to the corner common to townships twelve and thirteen north of the base line; thence east on the line between townships twelve and thirteen north to the line between ranges seven and eight west; thence north along said range line to the north boundary of the State; thence east with the said boundary to the Saint Francis River; thence down said river to the intersection of the thirty-sixth degree of north latitude; thence east along said parallel of north latitude to the Mississippi River; thence down said river to the south boundary of the State of Arkansas; and thence west along said boundary to the point of beginning.

Camden.—Land district is bounded on the north by the base line extending from the west boundary of the State of Arkansas to the intersection of the line between ranges seventeen and eighteen west of the fifth principal meridian; thence south with said range line to the corner common to townships ten and eleven south of the base line; thence east, on the line between townships ten and eleven south, to the intersection of the line between ranges five and six west of the fifth principal meridian; thence south along said range line to the south boundary of the State; thence west with the said boundary to the west boundary of the State; and thence with the west boundary to the place of beginning.

Harrison.—Land district comprises all that part of the State of Aakansas which lies north of the line between townships twelve and thirteen north of the base line, and west of the line between ranges seven and eight west of the fifth principal meridian.

Florida.—*Gainesville.*—The land district of Gainesville is co-extensive with the limits of the State of Florida.

Iowa.—*Des Moines.*—The land district of Des Moines is co-extensive with the limits of the State of Iowa.

Wisconsin.—*Menasha.*—Land district embraces eastern part of the State of Wisconsin lying east of the line between ranges eight and nine east, extending from the south boundary of the State to the corner common to townships fourteen and fifteen north; thence east on said township line to the line between ranges eleven and twelve east; thence north along said range line to the north boundary of the State.

Falls Saint Croix.—Land district is bounded on the north by the fourth correction line north of the base line; on the east by the line between ranges eleven and twelve west of the fourth principal meridian; on the south by the Chippewa and Mississippi Rivers, and on the West by the Saint Croix River.

Wausau.—Land district embraces all that portion of the State of Wisconsin lying north of the line between townships fourteen and fifteen north of the base line, west of the line between ranges eleven and twelve east of the fourth principal meridian; and east of the line between ranges one and two east of the fourth principal meridian.

La Crosse.—Land district is included within the following boundaries, to wit: Beginning on the south boundary of the State of Wisconsin, where the lines between ranges eight and nine east of the fourth principal meridian intersects the same; thence north with the said range line to the corner common to townships fourteen and fifteen north of the base line; thence west with said line to the line between ranges one and two east; thence north along said range line to the corner common to townships twenty-four and twenty-five north; thence west on the line between said townships to the line between ranges eleven and twelve west; thence north with said range line to the intersection with the Chippewa River; thence down said river to its mouth; thence down the Mississippi River to the southern boundary of Wiscousin; and thence east along the said boundary to the place of beginning.

Bayfield.—Land district embraces all that part of the northwestern corner of the State of Wisconsin lying north of the fourth correction line and west of the line between ranges one and two of the fourth principal meridian.

Eau Claire.—Land district is bounded on the north by the fourth correction line running through ranges one east and one to eleven west of the fourth principal meridian; on the west by the line running south between ranges eleven and twelve west to the corner common to townships twenty-four and-twenty five north of the base line; on the south by the line running east between said townships to the line between ranges one and two east of the fourth principal meridian, and on the east by the said range line extending north to the corner common to townships forty and forty-one north of the base line, to the place of beginning.

California.—*San Francisco.*—Land district is bounded as follows: Beginning on the Pacific Ocean where the line between townships twenty-four and twenty five north intersects the ocean, and running thence east with the said township line to the line between ranges ten and eleven west of the Mount Diabolo meridian; thence north on said range line to the corner common to townships twenty-five and twenty-six north; thence east between said townships to the line between ranges seven and eight west; thence south on said range line to the corner common to townships nineteen and twenty north; thence east between said townships to the line between ranges six and seven west; thence south on said range line to the corner common to townships sixteen and seventeen north; thence east between said townships to the line between ranges five and six west; thence south along the line between ranges five and six west to the corner common to townships twelve and thirteen north; thence east between said townships to the line between ranges four and five-west; thence south on said range line to the corner common to townships nine and ten north; thence east between said townships to the line between ranges three and four west; thence south on said range line to the corner common to townships seven and eight north: thence east on the line between townships seven and eight north to the line between ranges three and four east; thence south on the line between ranges three and four east to the first standard north; thence west along said standard to the line between ranges two and three east; thence south on the line between ranges two and three east to the corner common to townships three and four north; thence west between townships three and four north to the line between ranges one and two east; thence south on line between ranges one and two east to the corner common to townships one and two north; thence east to the line between ranges two and three east; thence north betweeen ranges two and three east to the corner common to townships two and three north; thence east on said township line to the line between ranges four and five east; thence south on the line between ranges four and five east to the corner common to townships one and two south of the Mount Diabolo base line; thence east between townships one and two south to the line between ranges five and six east; thence south on said range line to the corner common to townships seven and eight south; thence east on the line between townships seven and eight south to the line between ranges six and seven east; thence south on said range line to the corner common to townships nine and ten south; thence east to the line between ranges seven and eight east; thence south to the corner common to townships ten and eleven south; thence east on line between townships ten and eleven south to the line between ranges eight and nine east; thence south on said range line to the intersection of the third standard south; thence east along said standard to the line between ranges nine and ten east; thence on said range line to the corner common to townships thirteen and fourteen south; thence east on the line between townships thirteen and fourteen south to the line between ranges ten and eleven east; thence south between ranges ten and eleven east to the corner common to townships fifteen and sixteen south; thence east on the line between townships fifteen and sixteen south to the line between ranges eleven and twelve east; thence south to the fourth standard south; thence east along said standard to the line between ranges twelve and thirteen east; thence south on said range line to the corner common to townships eighteen and nineteen south; thence east along said township line to the line between ranges thirteen and fourteen east; thence south to the fifth standard line south; thence east along said standard line to the line between ranges fourteen and fifteen east; thence south to the corner common to townships twenty-two and twenty-three south; thence east on the line between townships twenty-two and twenty-three south to the line between ranges fifteen and sixteen east; thence south on said range line to the corner common to townships twenty-three and twenty-four south; thence east on said township line to the line between ranges sixteen and seventeen east; thence south on said range line to the corner common to townships twenty-six and twenty-seven south; thence east on said township line to the line between ranges seventeen and eighteen east; thence south between said ranges to the corner common to townships twenty-seven and twenty-eight south; thence east on the line between said townships to the line between ranges eighteen and nineteen east; thence south on said range line to the seventh standard line south of the base line; thence east along said standard line to the line between ranges nineteen and twenty east; thence south on said range line to the corner common to townships twenty-nine and thirty south; thence east on said township line to the line between ranges twenty and twenty-one east; thence south on said range line to the corner common to townships thirty and thirty-one south: thence east on said township line to the line between ranges twenty-one and twenty-two east; thence south on said range line to the corner common to townships thirty-one and thirty-two south; thence east on line between townships thirty-one and thirty-two south to the line between ranges twenty-two and twenty-three east; thence south to the eighth standard line south; thence east along said standard line of the Mount Diabolo base line to the line between ranges twenty-three and twenty-four west of the San Bernardino meridian; thence south on said range line to the corner common to townships ten and eleven north of the San Bernardino base line; thence east on line between said townships to the line between ranges twenty and twenty-one west; thence south on said range line to the first standard north of the San Bernardino base line; thence west along said standard line to the Pacific Ocean, and thence northwesterly along the ocean to the place of beginning.

Maryville.—Land district includes all that portion of the State of California situated within the following boundaries: Commencing at a point on the fifth standard parallel north, between ranges seven and eight west, of Mount Diabolo meridian; thence south with said range line to the line between townships nineteen and twenty north; thence east with said line to the line between ranges six and seven west; thence south with said line to the line between townships sixteen and seventeen north; thence east with said line to the line between ranges five and six west; thence south with said line to the line between townships twelve and thirteen north; thence east with said line to the line between ranges four and five west; thence south with said line to the line between townships nine and ten north; thence east with said line to the line between ranges three and four west; thence south with the said line to the line between townships seven and eight north; thence east with said line to the line between ranges three and four east; thence north with said line to the line between townships eleven and twelve north; thence east with said line to the line between ranges four and five east; thence north with said line to the line between townships twelve and thirteen north; thence east with said line to the line between ranges five and six east; thence north with said line to the line between townships thirteen and fourteen north; thence east with said line to the line between ranges six and seven east; thence north with said line to the line between townships sixteen and seventeen north; thence east with said line to the line between ranges eight and nine east; thence north with said line to the line between townships nineteen and twenty north; thence east with said line to the line between ranges nine and ten east; thence north with said line to the fourth standard parallel north; thence east with said parallel to the line between ranges ten and eleven east; thence north with said line to the line between townships twenty-one and twenty-two north; thence east with said line to the line between ranges eleven and twelve east; thence north with said line to line between townships twenty-three and twenty-four north; thence west with said line to the line between ranges eight and nine east; thence north with said line to the fifth standard parallel north; thence west with said parallel to the line between ranges five and six east; thence north with said line to the line between townships twenty-six and twenty-seven north; thence west with said line to the line between ranges four and five east; thence south with said line to the fifth standard parallel north; thence west on said parallel to the place of beginning.

Humboldt.—Land district includes all that portion of the State of California lying west of the line between ranges ten and eleven west of Mount Diabolo meridian, and north of the line between townships twenty-four and twenty-five north, Mount Diabolo base line.

Stockton—Land district is bounded as follows: Beginning at the north-west corner of township five north, range five east of the Mount Diabolo meridian, and running thence east along the first standard north to the line between ranges nine and ten east: thence south to the corner of townships three and four north, ranges nine and ten east; thence east to the line between ranges seventeen and eighteen east; thence north to the corner of townships four and five north, ranges seventeen and eighteen east; thence east to the line between ranges twenty-two and twenty-three east; thence south to the first standard south of the Mount Diabolo base line; thence east along said standard line to the line between ranges twenty-six and twenty-seven east; thence south to the third standard south; thence west along said standard to the line between ranges eight and nine east; thence north to the corner of townships ten and eleven south; thence west to the line between ranges seven and eight east; thence north to the corner of townships nine and ten south; thence west to the line between ranges six and seven east; thence north to the corner of townships seven and eight south; thence west to the line between ranges five and six east; thence north to the corner of townships one and two south; thence west to the line between ranges four and five east; and thence north to the place of beginning.

Visalia—Land district is bounded as follows: Beginning at the northwest corner of township thirteen south, range ten east, of the Mount Diabolo meridian, running thence east along the third standard parallel south to the line between ranges thirty-two and thirty-three east; thence south with said line to the eighth standard parallel south; thence west along said parallel to the line between ranges twenty-two and twenty-three east; thence north with said line to the line between townships thirty-one and thirty-two south; thence west with said line to the line between ranges twenty-one and twenty-two east; thence north with said line to the line between townships thirty and thirty-one south; thence west with said line to the line between ranges twenty and twenty-one east; thence north with said line to the line between townships twenty-nine and thirty south; thence west with said line to the line between ranges nineteen and twenty east; thence north with said line to the seventh standard parallel south; thence west with said parallel to the line between ranges eighteen and nineteen east; thence north with said line to the line between townships twenty-seven and twenty-eight south; thence west with said line to the line between ranges seventeen and eighteen east; thence north with said line to the line between townships twenty-six and twenty-seven south; thence west with said line to the line between ranges sixteen and seventeen east; thence north with said line to the line between townships twenty-three and twenty-four south; thence west with said line to the line between ranges fifteen and sixteen east; thence north with said line to the line between townships twenty-two and twenty-three south; thence west with said line to the line between ranges fourteen and fifteen east; thence north with said line to the fifth standard parallel south; thence west along said parallel to the line between ranges thirteen and fourteen east; thence north with said line to the line between townships eighteen and nineteen south; thence west with said line to the line between ranges twelve and thirteen east; thence north with said line to the fourth standard parallel south; thence west along said parallel to the line between ranges eleven and twelve east; thence north with said line to the line between townships fifteen and sixteen south; thence west with said line to the line between ranges ten and eleven east; thence north with said line to the line between townships thirteen and fourteen south; thence west with said line to the line between ranges nine and ten east; thence north with said line to the place of beginning.

Sacramento—Land district includes all that portion of the State of California situated within the following described boundaries: Commencing at a point where the northern boundary of township nineteen north, Mount Diabolo base line, intersects the eastern boundary of the State of California; thence west along said township line to the line between ranges thirteen and fourteen east; thence north with said line to the line between townships twenty-one and twenty-two north; thence west with said line to the line between ranges ten and eleven east; thence south with said line to the fourth standard parallel north; thence west with said standard to the line between ranges nine and ten east; thence south with said line to the line between townships nineteen and twenty north; thence west with said line to the line between ranges eight and nine east; thence south with said line to the line between townships sixteen and seventeen north; thence west with said line to the line between ranges six and seven east; thence south with said line to the line between townships thirteen and fourteen north; thence west with said line to the line between ranges five and six east; thence south with said line to the line between townships twelve and thirteen north; thence west with said line to the line between ranges four and five east; thence south with said line to the line between townships eleven and twelve north; thence west with said line to the line between ranges three and four east; thence south with said line to the first standard parallel north; thence west with said parallel to the line between ranges two and three east; thence south with said line to the line between townships three and four north; thence west with said line to the line between ranges one and two east; thence south with said line to the line between townships one and two north; thence east with said line to the line between ranges two and three east; thence north with said line to the line between townships two and three north; thence east with said line to the line between ranges four and five east; thence north with said line to the first standard parallel north; thence east along said parallel to the line between ranges nine and ten east; thence south with said line to the line between townships three and four north; thence east with said line to the line between ranges seventeen and eighteen east; thence north with said line to the line between townships four and five north; thence east with said line to the line between ranges twenty-two and twenty-three east; thence north with said line to the intersection of the eastern boundary of California; thence northwesterly with the eastern boundary of California to the intersection of the boundary with the thirty-ninth parallel of north latitude; thence north with said eastern boundary to the place of beginning.

Bodie.—Land district includes all that portion of the State of California situated within the following boundaries: Commencing at a point on the eastern boundary of the State of California, where the line between ranges twenty-two and twenty-three east, Mount Diabolo meridian, intersects said boundary; thence south with said range line to the first standard parallel south; thence east along said parallel to the line between ranges twenty-six and twenty-seven east; thence south with said line to the intersection of the third standard parallel south; thence east along said parallel to the line between ranges thirty-two and thirty-three east; thence south with said range line to the intersection of the eighth standard parallel south; thence east with said parallel to the intersection of the San Bernardino meridian; thence south to the corner of townships eleven and twelve north of San Bernardino base line; thence east to the intersection of the eastern boundary of the State of California; thence northwesterly with said boundary to the place of beginning.

Los Angeles.—Land district is bounded as follows: Beginning at a point of the intersection of the first standard north of the San Bernardino base line with the Pacific Ocean; thence east along said standard line to the line between ranges twenty and twenty-one west of the San Bernardino meridian; thence north to the corner of townships ten and eleven north; thence west to the line between ranges twenty-three and twenty-four west; thence north with said range line to the intersection of the eighth standard line south of the Mount Diabolo base line; thence east with said standard line to the intersection of the San Bernardino meridian; thence south to the corner of townships eleven and twelve north of San Bernardino base line; thence east to the intersection of the eastern boundary of the State of California; thence in a southeasterly direction with said boundary to the intersection of the Colorado River of the West; thence down said river to the intersection of the boundary between the United States and Mexico; thence southwesterly with said boundary to the Pacific Ocean; and thence in a northwesterly direction along the ocean to the place of beginning.

Shasta.—Land district is bounded as follows: Beginning on the northern boundary of the State of California, where the line between ranges ten and eleven west of the Mount Diabolo meridian intersects said boundary; thence east with said boundary to the intersection of the line between ranges five and six east; thence south on said range line to the corner of townships thirty and thirty-one north; thence west to the line between ranges four and five east; thence south to the fifth standard north of the Mount Diabolo base line; thence west along said standard line to the line between ranges ten and eleven west; and thence north with said range line to the north boundary of the State, the point of beginning.

Susanville.—Land district is bounded as follows: Beginning at a point where the north boundary of township nineteen north, Mount Diabolo base line, intersects the eastern boundary of the State of California; thence west on the north boundary of township nineteen north to the corner of townships nineteen and twenty north, ranges thirteen and fourteen east; thence north to the corner of townships twenty-one and twenty-two north, ranges thirteen and fourteen east; thence west to the corner of townships twenty-one and twenty-two north, ranges eleven and twelve east; thence north to the corner of townships twenty-three and twenty-four north, ranges eleven and twelve east; thence west to the corner of townships twenty-three and twenty-four north, ranges eight and nine east; thence north to the corner of townships twenty-five and twenty-six north, ranges eight and nine east; thence west to the corner of townships twenty-five and twenty-six north, ranges five and six east; thence north between ranges five and six east to the corner of townships twenty-six and twenty-seven north, ranges five and six east; thence west to the corner of townships twenty-six and twenty-seven north, ranges four and five east; thence north to the corner of townships thirty and thirty-one north, ranges four and five east; thence east to the corner of townships thirty and thirty-one north, ranges five and six east; thence north along said range line to the northern boundary of the State of California; thence east with the said boundary to the intersection of the eastern boundary of the State; and thence south along the eastern boundary to the place of beginning.

Nevada.—*Carson.*—Land district includes all that portion of the State of Nevada situated within the following described boundaries: Commencing at the northwest corner of the State of Nevada; thence east with the north boundary of the State to the intersection of the line between ranges forty-four and forty-five east of Mount Diabolo meridian; thence south on said range line to the corner of townships twenty-four and twenty-five north of the Mount Diabolo base line; thence west to the line between ranges thirty-nine and forty east; thence south along said range line to the eastern boundary of California; thence northwesterly with the eastern boundary of California to the intersection of the boundary with the thirty-ninth parallel of north latitude; thence north with the eastern boundary of California to the place of beginning.

Eureka.—Land district includes all that portion of the State of Nevada lying south and east of the following described boundaries: Beginning at the northeast corner of the State of Nevada; thence west with the north boundary of the State to the intersection of the line between ranges forty-four and forty-five east of the Mount Diabolo meridian; thence south on said range line to the corner of townships twenty-four and twenty-five north of the Mount Diabolo base line; thence west to the line between ranges thirty-nine and forty east; thence south along said range line to the eastern boundary of the State of California.

Washington Territory.—*Olympia.*—Land district is bounded as follows: Beginning on the boundary line between the United States and the British possessions, and on the summit of the Cascade Mountains, at the nearest range line to the east line of range twelve east of the Willamette meridian; thence south on the nearest range lines on the summit of said mountains to the line dividing townships ten and eleven north of the base line; thence west to the line dividing ranges six and seven west; thence north on said range line to the third standard parallel; thence west to Shoal Water Bay; thence with the Shoal Water Bay to the Pacific Ocean; thence northwesterly with the ocean to the Strait of Juan de Fuca; and thence along the boundary line between the United States and British possessions, running through the said strait and that of De Harro, to the intersection of the forty-ninth parallel of north latitude; and thence due east along said parallel to the place of beginning.

Walla-Walla land district includes all that portion of Washington Territory situated within the following described boundaries: Commencing at the southeast corner of the Territory of Washington at a point where the forty-sixth parallel of north latitude crosses the Snake River; thence west along said parallel to the Columbia River; thence down the Columbia River to the intersection of range line nineteen and twenty east of Willamette meridian; thence north on said range line to the line between townships six and seven north; thence east with said line to the line between ranges twenty-seven and twenty-eight east; thence north with said line to the line between townships sixteen and seventeen north; thence east with said line to the Columbia guide meridian; thence south with said meridian to the line between townships twelve and thirteen north; thence east with said line to its intersection with Snake River; thence up Snake River to its intersection with the eastern boundary Washington Territory; thence continuing up Snake River to the place of beginning.

Colfax.—Colfax land district includes all that portion of Washington Territory situated within the following described boundaries: Commencing at a point where the Columbia guide meridian intersects the third standard parallel in said Territory; thence east along the line of said standard parallel to where the same intersects the Snake River; thence up said Snake River to where the same intersects the boundary line between Washington and Idaho Territory; thence north on said boundary line to where the same intersects the boundary line between Washington Territory and British Columbia; thence west along said line to where the same intersects the aforementioned Columbia guide meridian; thence south along the line of said meridian to the place of beginning.

Yakima land district is bounded by a line commencing at a point of the intersection of the line between townships six and seven north, and between ranges twenty-seven and twenty-eight east of the Willamette meridian; and running westerly along said line between townships six and seven north to the summit of the Cascade Mountains; thence northerly along said summit to the boundary line between the United States and British Columbia; thence east along said line to the Columbia guide meridian; thence south on said meridian to the line between townships sixteen and seventeen north; thence west along said line to the line between ranges twenty-seven and twenty-eight east; thence south along said line to the place of beginning.

Vancouver land district includes all that portion of Washington Territory situated between the following described boundaries: Commencing at a point where the line between townships twelve and thirteen north intersects Shoal Water Bay; thence with the Shoal Water Bay, including any islands therein, to the Pacific Ocean; thence southerly with the ocean to the mouth of Columbia River; thence up the river to the point opposite the line between ranges nineteen and twenty east of Willamette meridian; thence north with said range line to the corner common to townships six and seven north; thence west with said line to the summit of the Cascade Mountains; thence northerly along said summit to the line between townships ten and eleven north; thence west along said line to the line between ranges six and seven west; thence north on said line to the intersection of the third standard parallel north; thence west with said standard parallel to the place of beginning.

Minnesota.—*Taylor's Falls.*—Land district is bounded as follows: Beginning at a point where the northern boundary of township forty-five north of the base line and fourth principal meridian intersects the boundary between the States of Minnesota and Wisconsin; thence south along said boundary to the intersection of the Saint Croix River; thence down with said river to its mouth; thence up the Mississippi River to the intersection of the line between ranges twenty-seven and twenty-eight west of the fourth principal meridian with said river; thence north with said range line to the corner of townships forty-five and forty-six north; and thence east to the place of beginning.

Saint Cloud.—Land district is bounded as follows: Beginning at a point of intersection of the fifth standard parallel north of the base line with the line between ranges thirty-five and thirty-six west of the fifth principal meridian; thence north with the said range line to the boundary line between the United States and British possessions; thence east and southeasterly along said boundary to the intersection of the line between ranges twenty-three and twenty-four west of the fourth principal meridian; thence south with said range line to the corner of townships forty-five and forty-six north; thence west to the line between ranges twenty-seven and twenty-eight west; thence south with said range line to the Mississippi River; thence up the river to the intersection of the line between ranges twenty-four and twenty-five west of the fifth principal meridian with said river; thence south on the line between ranges twenty-four and twenty-five west to the intersection of the fifth standard parallel north; thence west with said standard parallel to the place of beginning.

Du Luth.—Land district is bounded as follows: Commencing at a corner common to townships, forty-five and forty-six north, ranges twenty-three and twenty-four west of the fourth principal merdian; thence north with said range line to the intersection of the boundary line between the United States and the British possessions; thence eastwardly with said boundary to Lake Superior; thence southwesterly with said lake the mouth of Saint Louis River; thence up said river to the intersection of the boundary line between Wisconsin and Minnesota; thence south along said boundary line to the intersection of the line between townships forty-five and forty-six north; and thence west between townships forty-five and forty-six north to the place of beginning

Fergus Falls.—Land district is bounded as follows: On the east by the line between ranges thirty-five and thirty-six west of the fifth principal meridian; on the north by the ninth standard parallel north of the base line, on the south by the sixth standard parallel north: and on the west by the western boundary of the State of Minnesota.

Worthington.—Root River land district is bounded on the south by the boundary line between the States of Iowa and Minnesota; on the west by the western boundary of the State of Minnesota; on the north by the line between townships one hundred and five and one hundred and six north; and on the east by the Mississippi River.

Tracy.—Winona land district is bounded on the north by the line between townships one hundred and ten and one hundred and eleven north; on the south by the line between townships one hundred and five and one hundred and six north of the base line; on the east by the Mississippi River; and on the west by the western boundary of the State of Minnesota.

Benson.—Land district is bounded as follows: Beginning on the Mississippi River at a point of the intersection of the south boundary of township twenty-seven north of the base line fourth principal meridian with said river; thence west on said township line to the southwest corner of township twenty-seven north, range twenty-four west of the fourth principal meridian; thence north to the intersection of the line between townships one hundred and fifteen and one hundred and sixteen north; thence west with said township line to the western boundary of Minnesota; thence north with the western boundary of the State of Minnesota to the intersection of the said boundary with the sixth standard parallel north; thence east with said standard parallel to the intersection of the line between ranges thirty-five and thirty-six west of the fifth principal meridian; thence south along said range line to the intersection of the fifth standard parallel north; thence east with the said standard parallel to the third guide meridian west of the fifth principal meridian; thence north with said third guide meridian to the Mississippi River; thence down the Mississippi River to the place of beginning.

Redwood Falls.—Land district is bounded on the south by the line between townships one hundred and ten and one hundred and eleven north; on the west by the western boundary of the State of Minuesota; on the north by the line between townships one hundred and fifteen and one hundred and sixteen north, extending east from the western boundary of the State of Minnesota to the intersection of the western boundary of township twenty-seven north, range twenty-four west of the fourth principal meridian; thence south with said west boundary of township twenty-seven north to the southwest corner thereof; thence east with the south boundary of township twenty-seven north to the

Mississippi River; thence down the Mississippi River to the intersection of the line between townships one hundred and ten and one hundred and eleven north of the base line.

Crookston.—Land district embraces all that part of the State of Minnesota which lies north of township number one hundred and thirty-six north and west of range number thirty-five west of the principal meridian.

Oregon.—*Oregon City.*—Land district includes all that portion of the State of Oregon situated within the following boundaries: Commencing at the mouth of the Alsea River; thence easterly with said river to its intersection with the third standard parallel south between townships thirteen and fourteen south; thence east with said parallel to the line between ranges eight and nine east of Willamette meridian; thence north with said range line to Columbia River; thence down said river to the Pacific Ocean; thence with the ocean to the place of beginning.

Roseburgh.—Land district includes all that portion of the State of Oregon situated within the following boundaries: Beginning on the southern boundary of the State of Oregon where the line between ranges five and six east of the Willamette meridian intersects said boundary; thence north with said range line to the fourth standard parallel south between townships eighteen and nineteen south; thence east with said parallel to the line between ranges eight and nine east; thence north with said range line to the third standard parallel south between townships thirteen and fourteen south; thence west with said parallel to its intersection with Alsea River; thence with said river to the Pacific Ocean; and thence along the ocean to the south boundary of Oregon; thence east with said south boundary of Oregon to the place of beginning.

Lake View.—Land district includes all that portion of the State of Oregon lying south of the fourth standard parallel south, between townships eighteen and nineteen south, and east of the meridian line between ranges five and six east of the Wilamette meridian.

Le Grand.—Land district includes all that portion of the State of Oregon lying north of the fourth standard parallel south, between townships eighteen and nineteen south, and east of the meridian line between ranges twenty-six and twenty-seven east.

Dalles.—The Dalles land district includes all that portion of the State of Oregon situated within the following boundaries: Commencing at a point on the Columbia River where the line between ranges eight and nine east of Willamette meridian intersects said river; thence south on the said range line to the fourth standard parallel south, between townships eighteen and nineteen south; thence east on said parallel to the line between ranges twenty-six and twenty-seven east; thence north on said range line to the Columbia River; thence down said river to the place of beginning.

Kansas.—The northern land district includes all that portion of the State of Kansas lying west of the third guide meridian west of the sixth principal meridian and north of the line between townships nine and ten south.

Topeka.—Land district is bounded on the north by the boundary line between the States of Kansas and Nebraska; on the east by the Missouri River and the boundary line between the States of Arkansas and Missouri; on the south by the line between townships twenty-two and twenty-three south of the base line; and on the west by the first guide meridian east of the sixth principal meridian.

Independence.—Land district is bounded on the north by the line between townships twenty-two and twenty-three south of the base line; on the east by the western boundary of the State of Missouri; on the south by the south boundary of the State of Kansas; and on the west by the first guide meridian east of the sixth principal meridian.

Concordia.—Republican land district is bounded on the east by the first guide meridian east of the sixth principal meridian; on the south by the second standard parallel south of the base line; on the west by the first guide meridian west; and on the north by the boundary line between the States of Kansas and Nebraska.

Wichita.—Land district includes all that portion of the State of Kansas situated within the following described limits: Beginning at a point on the southern boundary of the State of Kansas where the range line ten and eleven, west sixth principal meridian, intersects the same; thence north with said range line to the line between townships twenty-one and twenty-two south; thence east with said line to the line between ranges five and six west; thence north with said line to the fourth standard parallel south; thence east with said standard parallel to the first guide meridian east; thence south with said guide meridian to the southern boundary of the State of Kansas; thence west with said boundary to the place of beginning.

Salina.—Land district includes all that portion of the State of Kansas situated within the following described boundaries: Commencing at a corner common to the fourth standard parallel south, and the first guide meridian east of the sixth principal meridian; thence west with said standard parallel to the line between ranges five and six west; thence north with said line to the line between townships seventeen and eighteen south; thence west with said line to the line between ranges ten and eleven west; thence north with said line to the third standard parallel south; thence west along said standard parallel to the line ranges fifteen and sixteen west; thence north with said line to the second standard parallel south; thence east along said standard parallel to the first guide meridian east; thence south with said guide meridian to the place of beginning.

Wa—Keeney.—The western land district includes all that portion of the State of Kansas situated within the following described boundaries: Commencing at a point on the western boundary of the State of Kansas, where the fourth standard parallel south intersects the same; thence east with said standard parallel to the line between ranges twenty and twenty-one west of the sixth principal meridian; thence north with said line to the line between townships nineteen and twenty south; thence east with said line to the line between ranges fifteen and sixteen west; thence north with said line to the line between townships nine and ten south; thence west with said line to the western boundary of the State of Kansas; thence south with said boundary to the place of beginning.

Larned.—The Arkansas Valley land district includes all that portion of the State of Kansas situated within the following described boundaries: Commencing at a point on the western boundary of the State of Kansas, where the fourth standard parallel south intersects the same; thence east with said standard parallel to the line between ranges twenty and twenty-one west; thence north with said line to the line between townships nineteen and twenty south; thence east with said line to the line between ranges fifteen and sixteen west; thence north with said line to the third standard parallel south; thence east with said standard parallel to the line between ranges ten and eleven west; thence south with said line to the line between townships seventeen and eighteen south; thence east with said line to the line between ranges five and six west; thence south with said line to the line between townships twenty-one and twenty-two south; thence west with said line to the line between ranges ten and eleven west; thence south with said line to the southern boundary of the State of Kansas; thence west with said boundary to the western boundary of the State; thence north with said boundary to place of beginning.

Kirwin.—The northwestern land district includes all that portion of the State of Kansas situated within the following described boundaries: Commencing at a point on the northern boundary of the State of Kansas where the range line eight and nine west sixth principal meridian intersects the same; thence south with said range line to the second standard parallel south; thence west with said second standard parallel to the line between ranges fifteen and sixteen west; thence north with said line to the line between townships nine and ten south; thence west with said line to the third guide meridian west; thence north with said guide meridian to the northern boundary of the State of Kansas; thence east with said boundary to the place of beginning. March 3, 1881, an additional district was created by Congress, by a law reading as follows:—"That the following described territory in the State of Kansas, to wit: commencing at the southeast corner of township thirty-five, south range thirty-one west of the sixth principal meridian on the south boundary of the State of Kansas thence west on said southern boundary to the western boundary of said State; thence north on said western boundary to the fourth standard parallel south; thence east along said parallel to the northeast corner of township twenty-one south, range thirty-one west, and thence south to the place of beginning, in the State of Kansas, shall constitute an additional land district, to be called the southwestern land district, the location for the office of which shall be designated by the President of the United States, and shall by him from time to time be changed, as the public interest may seem to require."

Nebraska.—Grand Island land district is bounded as follows: Commencing at the corner common to townships twenty and twenty-one north of the base line ranges four and five east of the sixth principal meridian; thence south with said range line to the south shore of Platte River; thence west with said south shore of Platte River to the intersection of range line twenty and twenty-one west; thence north with said line to the line between townships twenty-three and twenty-four north; thence east with said line to the line between ranges eleven and twelve west; thence south with said line to the line between townships twenty and twenty-one north; thence east with said line to the place of beginning.

Beatrice.—Nehama land district is bounded on the north by the line between townships six and seven north of the base line; on the west by the line between ranges eight and nine west of the sixth principal meridian; on the south by the boundary line between Kansas and Nebraska; and on the east by the Missouri River.

Lincoln.—South Platte district is bounded on the south by the line between townships six and seven north of the base line; on the west by the line between ranges eight and nine west of the sixth principal meridian; on the north by the south shore or right bank of Platte River; and on the east by the Missouri River.

Bloomington.—The Republican Valley land district is bounded as follows: Commencing at a point on the southern boundary of Nebraska where the range line eight and nine west, sixth principal meridian, intersects said boundary; thence north with said range line to the south shore of Platte River; thence west with said south shore of Platte River to the line between ranges twenty and twenty-one west; thence south with said line to the line between townships six and seven north; thence west with said line to the line between ranges twenty-five and twenty-six west; thence south with said range line to the southern boundary of the State of Nebraska; thence east with said boundary to the place of beginning.

North Platte.—The western land district includes all that portion of the State of Nebraska situated within the following described boundaries: Commencing at a point on the southern boundary of the State of Nebraska where the range line twenty-five and twenty-six west, sixth principal meridian, intersects said boundary; thence north with said range line to the line between townships six and seven north; thence east with said line to the line between ranges twenty and twenty-one west; thence north with said range line to the northern boundary of the State of Nebraska; thence west with said northern boundary to the eastern boundary of Wyoming; thence south with said boundary to the southern boundary of Colorado; thence east with said boundary to the eastern boundary of Colorado; thence south with said boundary to the southern boundary of Nebraska; thence east with said boundary to the place of beginning.

Niobrara.—Dakota land district includes all that portion of the State of Nebraska situated within the following described boundaries: Commencing at a point on the Missouri River where the south line of the Omaha Indian reservation intersects said river; thence west with said south line to the western boundary of said Indian reservation; thence north along said western boundary to the south line of township twenty-six north; thence west along said line to the line between ranges eleven and twelve west of the sixth principal meridian; thence south with said line to the line between townships twenty-three and twenty-four north; thence west with said line to the line between ranges twenty and twenty-one west; thence north with said line to the northern boundary of the State of Nebraska; thence east and south along the northern and eastern boundary of the State to the place of beginning.

Norfolk.—The Omaha land district is bounded as follows: Commencing at the confluence of the Platte River with the Missouri; thence up the Missouri River to the intersection of the south line of the Omaha Indian reservation; thence along said south line to the western boundary of said Indian reservation; thence north along said western boundary to the south line of township twenty-six north; thence west along said line to the line between ranges eleven and twelve west of the sixth principal meridian; thence south with said line to the line between townships twenty and twenty-one north; thence east along said line to the line between ranges four and five east; thence south with said line to the south shore of Platte River; thence down said river to the place of beginning.

New Mexico.—*Santa Fe* land district includes all that portion of the Territory of New Mexico lying north of the base line.

Mesilla land district includes all that portion of the Territory of New Mexico lying south of the base line.

Idaho.—*Boise City* land district embraces all that portion of Idaho Territory lying west of range line twenty-three and twenty-four west, Boise meridian, extending from the southern boundary of Utah to the southern boundary of Lemhi County, west of the western boundary of Lemhi County, and south of the Salmon River range of mountains.

Lewiston land district consists of all that portion of the Territory of Idaho lying north of the Salmon River range of mountains.

Oxford.—The Oneida land district includes all that portion of Idaho Territory situated within the following described boundaries: Commencing at the southeast corner of said Territory; thence west on the line between said Territory and the Territory of Utah to the line between ranges numbered twenty-three and twenty-four east, Boise meridian; thence north to the southern boundary of Lemhi County; thence west to the western line of said Lemhi County; thence north on said western line of said county to the line between the Territories of Idaho and Montana; thence easterly on said Territorial line to the eastern boundary of the Territory of Idaho; thence south on the line of the eastern boundary of Idaho Territory to the place of beginning.

Montana.—*Miles City.*—Land district comprises all that portion of Montana Territory lying east of range line twenty-seven and twenty-eight east of the principal meridian.

Bozeman.—Land district comprises all that portion of Montana Territory lying south of the first standard parallel north, west of range line twenty-seven and twenty-eight east of the principal meridian, and east of range line two and three west of principal meridian.

Helena.—Land district comprises all that portion of the Territory of Montana lying west of range line two and three west, extending from the southern boundary of the Territory to the first standard parallel north; north of the first standard parallel north, extending from range two and three west to range twenty-seven and twenty-eight east of the principal meridian; and west of range line twenty-seven and twenty-eight east, extending from the first standard parallel north to the boundary line between Montana and British possessions.

Utah.—*Salt Lake City.*—Land district is co-extensive with the limits of the Territory of Utah.

Wyoming.—*Evanston.*—Land district includes all that portion of Wyoming Territory lying west of range line ninety-four and ninety-five west of the sixth principal meridian.

Cheyenne.—Land district includes all that portion of Wyoming Territory lying east of range line ninety-four and ninety-five west of the sixth principal meridian.

Arizona.—*Florence.*—Gila land district comprises all that portion of the Territory of Arizona lying south of the first standard parallel north.

Prescott.—Land district comprises all that portion of the Territory of Arizona lying north of the first standard parallel north.

Colorado.—*Denver.*—Land district includes all that portion of the State of Colorado situated within the following described limits: Commencing at a point on the eastern boundary of the State of Colorado where the second correction line south, sixth principal meridian, intersects said boundary; thence west with said correction line to the line between ranges seventy and seventy-one west; thence north with said line to the line between townships three and four north; thence west with said line to the summit of the continental divide; thence with said summit of the continental divide to the northern boundary of the State; thence east with said boundary line to the eastern boundary of the State; thence south with said boundary line to the place of beginning.

Central City.—Land district includes all that portion of the State of Colorado situated within the following described limits: Commencing at a point on the western boundary of the State of Colorado where the first correction line south intersects said boundary; thence east with said correction line to the line between ranges seventy-one and seventy-two west, sixth principal meridian; thence south on said line to the second correction line south; thence east on said correction line to the line between ranges seventy and seventy-one west; thence north on said line to the line between townships three and four north; thence west with said line to the summit of the continental divide; thence along said summit of the continental divide to the northern boundary of the State; thence west with said boundary line to the western boundary of the state, thence south with said boundary line to the place of beginning.

Del Norte.—Land district includes all that portion of the State of Colorado situated within the following described limits: Commencing at a point on the south boundary of the State of Colorado where range line sixty-nine and seventy west, sixth principal meridian, intersects the said boundary; thence north with said range line to the line between townships twenty-seven and twenty-eight south; thence west with said line to the west line of range seventy-three west; thence north on said line to the intersection of township line forty-five and forty-sixth north, New Mexico principal meridian; thence west with said line to the line between ranges eleven and twelve east, New Mexico principal meridian; thence north with said line to the line between townships forty-six and forty-seven north; thence west with said line to the line between ranges ten and eleven east; thence north with said line to the line between townships forty-seven and forty-eight north; thence west with said line to the first New Mexico guide meridian east; thence north with said guide meridian to the twelfth correction line north; thence west with said correction line to the New Mexico principal meridian; thence south with said principal meridian to the ninth correction line north; thence west with said correction line to the line between ranges four and five west; thence south on said range line to the south boundary of the State; thence east with said boundary to the place of beginning.

Leadville.—Land district includes all that portion of the State of Colorado situated within the following described limits: Commencing at a point on the western boundary of Colorado where the first correction line south intersects said boundary; thence east with said correction line to the line between ranges seventy-one and seventy-two west, sixth principal meridian; thence south with said line to the second correction line south; thence east with said correction line to the line between ranges seventy and seventy-one west; thence south with said line to the third correction line south; thence west with said correction line to the intersection of range line ten and eleven east, township fifty-one north, New Mexico principal meridian; thence south with said line to the line between townships forty-nine and fifty north; thence west with said line to the line between ranges nine and ten east; thence south with said line to the twelfth correction line north; thence west with said correction line to the line between ranges six and seven east; thence north with said line to the line between townships forty-nine and fifty north; thence west with said line to the line between ranges five and six east; thence north with said line to the line between townships fifty and fifty-one north; thence west with said line to the line between ranges four and five east; thence north with said line to the intersection of the third correction line south, sixth principal meridian; thence west with said correction line to the west boundary of the State; thence north with said boundary to the place of beginning.

Lake City.—Land district includes all that portion of the State of Colorado situated within the following described limits: Commencing at a point on the western boundary of Colorado where the third correction line south, sixth principal meridian intersects said boundary, thence east with said correction line to the intersection of range line 4 and 5 east, township 51 N. New Mexico principal meridian; thence south with said range to the line between townships fifty and fifty-one north; thence east with said line to the line between ranges five and six east; thence south with said line to the line between townships forty-nine and fifty north; thence east with said line to the line between ranges six and seven east; thence south with said line to the twelfth correction line north; thence west with said correction line to the New Mexico principal meridian; thence south with said principal meridian to the ninth correction line north; thence west with said correction line to the line between ranges four and five west; thence south with said range line to the south boundary of the State; thence west with said boundary to the western boundary of the State; thence north with said boundary to the place of beginning.

Pueblo.—Land district includes all that portion of the State of Colorado situated within the following described limits: Commencing at a point on the eastern boundary of Colorado where the second correction line south intersects said boundary; thence west with said correction line to the line between ranges seventy and seventy-one west, sixth principal meridian; thence south with said range line to the third correction line south; thence west with said correction line to the intersection of range line ten and eleven east, township fifty-one north, New Mexico principal meridian, thence south with said line to the line between townships forty-nine and fifty north; thence west with said line to the line between ranges nine and ten east; thence south with said line to the twelfth correction line north; thence west with said correction line to the first New Mexico guide meridian east; thence south with said guide meridian to the line between townships forty-seven and forty-eight north; thence east with said line to the line between ranges ten and eleven east; thence south with said line to the line between townships forty-six and forty-seven north; thence east with said line to the line between ranges eleven and twelve east; thence south with said line to the line between townships forty-five and forty-six north; thence east with said line to the intersection of the west line of range seventy-three feet west, sixth principal meridian; thence south with said line to the line between townships twenty-seven and twenty-eight south; thence east with said line to the line between ranges sixty-nine and seventy west; thence south with said range line to the southern boundary of the State; thence east on said boundary to the eastern boundary of the State; thence north on said boundary to the place of beginning.

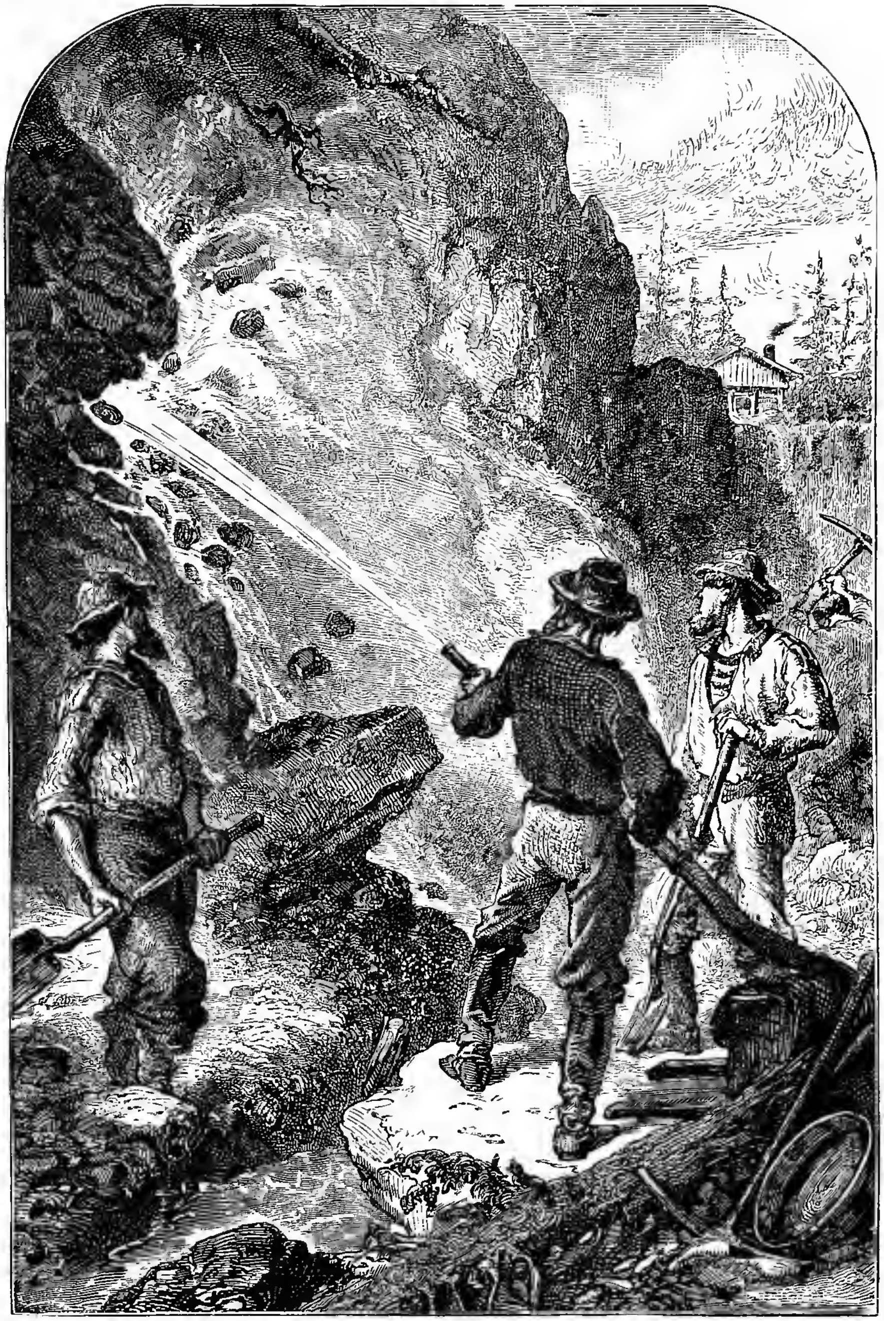
Dakota—*Bismarck.*—Land districts include all that portion of the Territory of Dakota situated within the following described boundaries: Commencing at a point on the western boundary of Dakota where the seventh standard parallel north, fifth principal meridian, intersects said boundary; thence east on said standard parallel to the line between ranges seventy-eight and seventy-nine west; thence north on said line to the line between townships one hundred and twenty-nine and one hundred and thirty north; thence east on said line to the ninth guide meridian; thence north on said guide meridian to the twelfth standard parallel north; thence west with said standard to the tenth guide meridian; thence north on said guide meridian to the boundary line between Dakota and the British possessions; thence west with said line to the western boundary of Dakota; thence south with said western boundary to the place of beginning.

Fargo.—Land district includes all that portion of the Territory of Dakota lying north of township line between townships one hundred and twenty-nine and one hundred and thirty of the fifth principal meridian, south of the twelfth standard parallel, and east of the ninth guide meridian.

Springfield.—The Springfield land district includes all that portion of the Territory of Dakota lying between the third standard parallel north and the township line between townships one hundred and twenty-nine and one hundred and thirty north of the fifth principal meridian and east of the eastern boundary of the Great Sioux Indian Reservation.

Mitchell.—Sioux Falls land district includes all that portion of the Territory of Dakota lying between the third standard parallel north and the base line, and east of the eastern boundary of the Great Sioux Indian Reservation.

Yankton.—The Yankton land district includes all that



MINING LIFE—A FIRST ATTEMPT AT HYDRAULICKING.

—FROM "LA VIE SOUTERRAINE" BY L. SIMONIN

portion of the Territory of Dakota lying south of the base line of the fifth principal meridian.

Grand Forks.—Land district includes all that portion of the Territory of Dakota lying north of the twelfth standard parallel and east of the tenth guide meridian, fifth principal meridian.

Deadwood.—Land district includes all that portion of the Territory of Dakota lying west of the one hundred and second meridian of longitude and south of the forty-fifth parallel of north latitude.

Sec. 125. Whenever the quantity of public land remaining unsold in any land district is reduced to a number of acres less than one hundred thousand, it shall be the duty of the Secretary of the Interior to discontinue the land office of such district; and if any land in any such district remains unsold at the time of the discontinuance of a land office, the same shall be subject to sale at some one of the existing land offices most convenient to the district in which the land office has been discontinued, of which the Secretary of the Interior shall give notice.

5 Stat. 385; R. S. 2248.

Sec. 126. The Secretary of the Interior may continue any land district in which is situated the seat of government of any one of the States, and may continue the land office in such district, notwithstanding the quantity of land unsold in such district may not amount to one hundred thousand acres, when, in his opinion, such continuance is required by public convenience, or in order to close the land system in such State.

5 Stat. 455; R. S. 2249.

Sec. 127. Whenever the cost of collecting the revenue from the sales of the public lands in any district is as much as one-third of the whole amount of revenue collected in such district, it may be lawful for the President, if, in his opinion, not incompatible with the public interest, to discontinue the land office in such district, and to annex the same to some other adjoining land district.

10 Stat. 189, 194; 2250.

Sec. 128. The President is authorized to change the location of the land offices of the several land districts established by law, and to relocate the same from time to time at such point in the district as he deems expedient.

10 Stat. 204, 244; R. S. 2251.

Sec. 129. Upon the recommendation of the Commissioner of the General Land Office, approved by the Secretary of the Interior, the President may order the discontinuance of any land office and the transfer of any of its business and archives to any other land office within the same State or Territory.

12 Stat. 409; R. S. 2252.

Sec. 130. The President is authorized to change and re-establish the boundaries of land districts, whenever, in his opinion, the public interests will be subserved thereby, without authority to increase the number of land offices or land districts, except that he is authorized to establish additional land districts, and to appoint the necessary officers under existing laws, whenever he may deem the same necessary for the public convenience in executing the provisions of the mineral laws.

14 Stat. 252; 16 *id.* 171; R. S. 2253, 2343.

Sec. 131. In case of the division of existing land districts by the erection of new ones, or by a change of boundaries by the President, all business in such original districts shall be entertained and transacted without prejudice or change, until the offices in the new districts are duly opened by public announcement under the direction of the Secretary of the Interior. All sales or disposals of the public lands heretofore regularly made at any land office, after such lands have been made part of another district by any act of Congress, or by any act of the President, are confirmed, provided the same are free from conflict with prior valid rights.

17 Stat. 192; R. S. 2254.

Sec. 1323. The Secretary of the Interior is authorized to make a reasonable allowance for office rent for each consolidated land office; and when satisfied of the necessity therefor, to approve the employment by the register of one or more clerks, at a reasonable per diem compensation, for such time as such clerical force is absolutely required to keep up the current public business, which clerical force shall be paid out of the surplus fees authorized to be charged by section one hundred and thirty-eight, if any; and if no surplus exists, then out of the appropriation for incidental expenses of district land offices; but no clerk shall be so paid unless his employment has been first sanctioned by the Secretary of the Interior.

12 Stat. 131; R. S. 2255. U. S. *v.* Jarvis, 1 Davies, C. C. 274; U. S. *v.* Lowe, 1 Dillon, C. C. 585. 1 Lester's L. L. 314.

Sec. 133. There shall be appointed by the President, by and with the advice and consent of the Senate, a register of the land office and a receiver of public moneys, for each land district established by law.

18 Stat. 34, 122, 295; R. S. 2234. Litchfield *v.* Railway Co., 1 Woolw. C. C. 299. Bullock *v.* Wilson, 5 Port. (Ala.) 338; Hellan *v.* Ripley, 3 Rob. (La.) 138.

Sec. 134. All registers and receivers shall be appointed for the term of four years, but shall be removable at pleasure.

3 Stat. 582; R. S. 2244. Best *v.* Polk, 18 Wall. 112.

Sec. 135. Every register and receiver shall reside at the place where the land office for which he is appointed is directed by law to be kept.

R. S. 2235. [See all acts establishing land districts.]

Sec. 136. Every register and receiver shall, before entering on the duties of his office, give bond in the penal sum of ten thousand dollars, with approved security, for the faithful discharge of his trust.

2 Stat. 73, 75; 10 *id.* 245; R. S. 2236. U. S. *v.* Vanzandt, 11 Wheat. 184; Walton *v.* U. S. 9 *id.* 651; Minor *v.* Mechanics' Bank, 1 Pet. 46; U. S. *v.* Tingey, 5 *id.* 115; Farrar *et al.* *v.* U. S. 5 *id.* 373; U. S. *v.* Boyd, 15 *id.* 187; U. S. *v.* Linn, 15 *id.* 290; U. S. *v.* Irving, 1 How., 250; U. S. *v.* Girault, 11 *id.* 22; U. S. *v.* Prescott, 3 *id.* 578; U. S. *v.* Boyd, 5 *id.* 29; Bryan *v.* U. S., 1 Black, 140; Boyden *v.* U. S., 13 Wall. 17; Bevans *v.* U. S., 13 *id.* 56; U. S. *v.* Thomas, 15 *id.* 337. Alexandria *v.* Corse, 2 Cranch, C. C. 363; U. S. *v.* Stephenson, 1 McLean, C. C. 462; U. S. *v.* Spencer, 2 *id.* 265; U. S. *v.* Ward, 3 *id.* 179. 8 Op. Att. Gen. 7. 1 Lester's L. L. 312, 314.

Sec. 137. Every register and receiver shall be allowed an annual salary of five hundred dollars; and, in addition thereto, each shall be allowed the following fees and commissions, namely:

3 Stat. 466; 12 *id.* 409; R. S. 2237. Dobbins *v.* Commissioners, &c., 16 Pet. 435. Decisions Com. G. L. O., Feb. 20, 1858; May 1, 1871.

First. A fee of one dollar for each declaratory statement filed and for services in acting on pre-emption claims.

5 Stat. 456; 13 *id.* 35; R. S. 2238. Decisions Com. G. L. O., June 17, 1875; Sept. 9, 1879. Cir. G. L. O., Aug. 7, 1872; March 10, 1880.

Second. A commission of one per centum on all moneys received at each receiver's office.

3 Stat. 466; R. S. 2238. U. S. *v.* Dickson, 15 Pet. 141. U. S. *v.* McCarty, 1 McLean, C. C. 306; U. S. *v.* Edwards, 1 *id.* 467. Decision Sec. Int., May 30, 1859. Decision Com. G. L. O., March 6, 1878.

Third. A commission to be paid by the homestead applicant, at the time of entry, of one per centum on the cash price, as fixed by law, of the land applied for; and a like commission when the claim is finally established, and the certificate therefor issued as the basis of a patent.

12 Stat. 393; 16 *id.* 320; R. S. 2238. Decision Sec. Int., March 3, 1874. Decisions Com. G. L. O., May 7, 1877; Sept. 12, 1879. Cir. G. L. O., June 13, 1872; June 17, 1875; March 10, 1880.

Fourth. The same commission on lands entered under any law to encourage the growth of timber on western prairies, as allowed when the like quantity of land is entered with money.

17 Stat. 606; R. S. 2238. Decision Sec. Int., March 3, 1874. Decision Com. G. L. O., Sept. 12, 1879. Cir. G. L. O., Oct. 30, 1873; March 13, 1874; June 17, 1875; March 10, 1880.

Fifth. For locating military bounty-land warrants, issued since the eleventh day of February, eighteen hundred and forty-seven, and for locating agricultural college land scrip, the same commission, to be paid by the holder or assignee of each warrant or scrip, as is allowed for sales of the public lands for cash, at the rate of one dollar and twenty-five cents per acre; but they shall not be entitled to any fees for locating warrants which are authorized by law to be located free of expense by the Commissioner of the General Land Office, nor upon the location of warrants issued prior to the eleventh day of February, eighteen hundred and forty-seven.

9 Stat. 231; 10 *id.* 4; 12 *id.* 505; R. S. 2238, 2437. U. S. *v.* Babbit, 1 Black, 55; same case, 5 Otto, 334. Decision Sec. Int., March 1, 1876. Cir. G. L. O., Feb. 24, 1864; March 15, 1873; June 17, 1875; July 20, 1875; Feb. 13, 1879.

Sixth. A fee, in donation cases, of five dollars for each final certificate for one hundred and sixty acres of land, ten dollars for three hundred and twenty acres, and fifteen dollars for six hundred and forty acres.

12 Stat. 409; R. S. 2238.

Seventh. In the location of lands by States and corporations under grants from Congress for railroads and other purposes (except for agricultural colleges), a fee of one dollar for each final location of one hundred and sixty acres; to be paid by the State or corporation making such location.

13 Stat. 335; 18 *id.* 21; 19 *id.* 52; R. S. 2238. Railway Co. *v.* Prescott, 16 Wall. 603; Railway Co. *v.* McShane, 22 *id.* 444; Hunnewell *v.* Cass Co., 22 *id.* 464. Decisions Com. G. L. O., April 18, 1867; Aug. 8, 1867; Feb. 17, 1869; March 26, 1870.

Eighth. A fee of five dollars per diem for superintending public land sales at their respective offices; and, to each receiver, mileage in going to and returning from depositing the public moneys received by him.

3 Stat. 567; R. S. 2238.

Ninth. A fee of five dollars for filing and acting upon each application for patent or adverse claim filed for mineral lands, to be paid by the respective parties.

17 Stat. 95; R. S. 2238.

Tenth. Registers and receivers are allowed, jointly, at the rate of fifteen cents per hundred words for testimony reduced by them to writing for claimants, in establishing pre-emption and homestead rights.

13 Stat. 35; R. S. 2238. Decision Com. G. L. O., Sept. 1, 1879. Cir. G. L. O., May 24, 1879.

Eleventh. A like fee as provided in the preceding subdivision when such writing is done in the land office, in establishing claims for mineral lands.

17 Stat. 95; R. S. 2238. Decision Com. G. L. O., Sept. 1, 1879. Cir. G. L. O., May 24, 1879.

Twelfth. Registers and receivers in California, Oregon, Washington, Nevada, Colorado, Idaho, New Mexico, Arizona, Utah, Wyoming, and Montana, are each entitled to collect and receive fifty per centum on the fees and commissions provided for in the first, third, and tenth sub-divisions of this section.

13 Stat. 36; R. S. 2238. [See also the several acts establishing land offices for Utah, Wyoming and Montana.]

Thirteenth. A fee of one dollar shall be paid to registers for giving notice of cancellation to any person who has contested, paid the land-office fees, and procured the cancellation of any pre-emption, homestead, or timber-culture entry; the said fee to be paid by the contestant, and not to be reported.

Act of May 14, 1880.

Sec. 138. The register for any consolidated land district, in addition to the fees now allowed by law, shall be entitled to charge and receive for making transcripts for individuals, or furnishing any other record information respecting public lands or land titles in his consolidated land district, such fees as are properly authorized by the tariff existing in the local courts of his district; and the receiver shall receive his equal share of such fees, and it shall be his duty to aid the register in the preparation of the transcripts, or giving the desired record information.

12 Stat. 131; R. S. 2239. Cir. G. L. O., July 19, 1878.

Sec. 139. The compensation of registers and receivers, including salary, fees, and commissions, shall in no case exceed in the aggregate three thousand dollars a year, each; and no register or receiver shall receive for any one quarter or fractional quarter more than a pro-rata allowance of such maximum.

3 Stat. 466; 10 *id.* 4; 11 *id.* 378; 12 *id.* 131, 393, 409, 505; 13 *id.* 36, 335; R. S. 2240. U. S. *v.* Babbit, 1 Black, 55; same case, 5 Otto, 334. Cir. G. L. O., Feb. 20, 1858; May 1, 1871; June 24, 1875; July 19, 1878; May 24, 1879.

Sec. 140. Whenever the amount of compensation received at any land office exceeds the maximum, allowed by law to any register or receiver, the excess shall be paid into the Treasury, as other public moneys.

10 Stat. 204; 12 *id.* 131; R. S. 2241.

Sec. 141. No register or receiver shall receive any compensation out of the Treasury for past services who has charged or received illegal fees; and, on satisfactory proof that either or such officers has charged or received fees or other rewards not authorized by law, he shall be forthwith removed from office.

10 Stat. 4, 306; R. S. 2242.

Sec. 142. The compensation of registers and receivers, both for salary and commissions, shall commence and be calculated from the time they respectively, enter on the discharge of their duties.

10 Stat. 615; R. S. 2243. U. S. *v.* Edwards, 1 McLean, C. C. 467. Cir. G. L. O., Feb 20, 1858; May 1, 1871.

Sec. 143. The receivers shall make to the Secretary of the Treasury monthly returns of the moneys received in their several offices, and pay over such money pursuant to his instructions. And they shall also make to the Commissioner of the General Land Office like monthly returns, and transmit to him quarterly accounts-current of the debits and credits of their several offices with the United States.

5 Stat. 111; R. S. 2245. Cir. G. L. O., July 1, 1871; June 24, 1875; July 19, 1878; May 24, 1879. Treasury Cir., July 13, 1871. 1 Lester's L. L. 312, 314.

Sec. 144. The register or receiver is authorized, and it shall be their duty, to administer any oath required by law or the instructions of the General Land Office, in connection with the entry or purchase of any tract of the public lands; but he shall not charge or receive, directly or indirectly, any compensation for administering such oath.

5 Stat. 384; R. S. 2246.

Sec. 145. If any person applies to any register to enter any land whatever, and the register knowingly and falsely informs the person so applying that the same has already been entered, and refuses to permit the person so applying to enter the same, such register shall be liable therefor to the person so applying, for five dollars for each acre of land which the person so applying, offered to enter, to be recovered by action of debt in any court of record having jurisdiction of the amount.

5 Stat. 112; R. S. 2247.

Sec. 146. All receivers having public money to pay to the United States may pay the same to any depositary constituted by or in pursuance of law, which may be designated by the Secretary of the Treasury, except that the receiver at San Francisco shall pay over such money to the United States assistant treasurer in that city at the office of said assistant treasurer.

9 Stat. 62; 16 *id.* 216, 17 *id.* 435; R. S. 3615, 3616.

Sec. 147. Where bona-fide settlers under the homestead or pre-emption laws have, subsequent to the date of filing their applications to enter not exceeding one quarter-section of public lands, been appointed a register or receiver of the land office of the district in which the lands are located, proof and payment must be made to the satisfaction of the Commissioner of the General Land Office.

17 Stat. 10; R. S. 2287. 4 Op. Att. Gen. 223; 7 *id.* 647.

Special Agent.—Sec. 148. When it is incompatible with his other duties for a surveyor-general of the United States to personally inspect the surveying operations of his district while in progress in the field, he is authorized to depute a confidential agent to make such examination; and the actual and necessary expenses of such person shall be allowed and paid for that service, and five dollars per day during the examination in the field: *Provided,* That such examination shall not be protracted beyond thirty days, and in no case longer than is actually necessary; and when a surveyor-general, or any person employed in his office at a regular salary, shall be engaged in such special service, he or they shall only receive his necessary expenses in addition to his regular salary.

10 Stat. 248; R. S. 2223.

Sec. 149. Any officer or clerk of any of the executive departments of the government who shall be lawfully detailed to investigate frauds, or attempts to defraud, on the Government, or any irregularity or misconduct of any officer or agent of the United States, shall have power to administer oaths to affidavits taken in the course of any such investigation.

16 Stat. 55, 75; U. S. *v.* Bailey, 9 Pet. 238.

Right of officers detailed on special duty to extra compensation: 1 Cranch, 137; U. S. *v.* Ripley, 7 Pet. 18; U. S. *v.* Fillebrown, 7 *id.* 28; Gratiot *v.* U. S., 15 *id.* 336; U. S. *v.* Brown, 9 How. 487; Converse *v.* U. S., 21 *id.* 463; Stanbury *v.* U. S., 8 Wall. 33. U. S. *v.* Jarvis, 1 Davies, C. C. 274. *Definition of office, and power to bind Government;* U. S. *v.* Hartwell, 6 Wall. 385; Whiteside *et al. v.* U. S., 3 Otto, 247. *Reimbursement of expenditures:* U. S. *v.* Jarvis, 2 Ware, C. C. 274, Decisions Sec. Int., July 1, 1874; Sept. 21, 1874. Cir. G. L. O., July 1, 1871.

[The authority to appoint special agents in the administration of the land laws seems to be derived from the annual appropriation bills, and from the general authority incident to the duty of executing the laws.]

SALE AND DISPOSITION OF PUBLIC LANDS.

IN 1806, April 18, Congress, by law, refused to receive in payment for purchases of public lands any more certificate, or receipts of evidence of public debt after April 30, 1806, saving all rights under the old act. This required all payments to be made in cash. Petitions, resolutions, legislative enactments, and personal applications for relief from the pressure of land purchases from the government under the credit system resulted in various acts of relief. March 2, 1809, Congress passed an act to extend time of payment two years for residue of purchase money due. April 30, 1810, and December 12, 1811, Congress further extended the time for purchases made prior to January 1, 1806, and enacted conditions for re-entry of lands by applicants where time of payment had expired and the lands had reverted to the United States. June 30, 1812, Congress ordered that Treasury notes be taken at all land offices for public lands and payments thereon, and that credit should be given for principal and interest thereof. Acts for relief were further passed on April 23, 1812; July 6, 1812; March 3, 1813; February 9, 1814; February 4, 1815; April 24, 1816; April 18, 1818; March 3, 1819; March 30, 1820; March 2, 1821; April 20, 1822; March 3, 1823; May 18, 1824; May 26, 1824. These acts were all operative for the benefit of persons holding not over 640 acres. The Congress of the United States, April 24, 1820, provided for the sale of half quarter-sections, or 80-acre lots of land, and that credit should not be allowed for the purchase-money of any lands after July 1, 1820, but that complete payment must be made by the purchaser or applicant at the time of purchase; and by section 3 of this act, it was provided that the public lands offered should be sold at the "minimum" price of $1.25 per acre at either public or private sale, and provided for the entry or purchase by persons at the several district land offices of all lands which, prior to July 1, had been offered at public sale and remained unsold. It further provided for the sale of reverted lands, which were forfeited for non-fulfilment of purchase terms under the credit system. Previous to this time Congress had, by special acts directed land sales to be made, but by this act it became the duty of the President, and has so continued to this day, to issue proclamations of sale of public lands through the Commissioner of the General Land Office. This act was a great innovation. It reduced the price of all public lands which should be offered to the minimum of $1.25 per acre, and after they were offered (i. e., offered at public sale after due advertising and notice) such as remained unsold were to be held for sale at the district land office at $1.25 per acre, in unlimited quantities of not less than 80 acres (half quarter sections) at private sale. Thus, in the period from 1786 to 1820, the price had fallen from $2 to $1.25 per acre cash, and the quantity which might be sold was reduced from whole townships and eight sections to sections (640 acres), half-sections (320 acres) quarter-sections (160 acres), and half-quarter-sections (80 acres), thus fostering small holdings at a low price, with deed in fee from the Government. The disastrous credit system spread over Ohio, Indiana, Illinois, Missouri, Alabama, Mississippi, Louisiana, Michigan. The general policy of land legislation by Congress was, for the first thirty years, to meet exigencies by temporary enactments from time to time. This policy was continued down to the period of the passage of the pre-emption act of 1841. The stages developed to that period were: the sale by the Board of Treasury prior to May, 1800, under and by order of Congress direct, purchasers of tracts going to Congress by petitions, which were acted on and referred to the Board of Treasury; public sale at $2 per acre in tracts from townships, sections, and quarter sections, until after 1805, when half quarter sections were sold; all lands to be offered; then if not sold at public vendue, to be open to purchase at $2 per acre at private sale.

The act of 1800, May 18, instituted the offices of registers and receivers, who sold land at definite points under orders of the Secretary of the Treasury; afterward, April 25, 1812, under orders of the Commissioner of the General Land Office, then a bureau in the Treasury Department, to whom they were and are now subordinate. The act of April 24, 1820, the general provisions of which have been carried into the Revised Statutes, fixed the minimum price of the public lands at $1.25 per acre. Thereunder the lands were sold to the highest bidder at public sales for not less than the minimum rate per acre, and at private sale, after the offering, at the minimum rate. The general pre-emption law of September 4, 1841, required payment at the minimum rate for lands entered thereunder; that is, the minimum rate fixed by the act of 1820. This is the price required of pre-emptors and parties who commute their homestead entries under section 2301 of the revised Statutes, except where the lands have been enhanced to the double minimum price of $2.50 per acre, in which case the pre-emptor or homesteader is required by law to pay for the same at the increased rate. Congress, upon making grants of alternate sections of land for railroad purposes within certain limits, provided that the sections within such limits reserved to the government should be enhanced to the price of $2.50 per acre. This rate is double that of the minimum rate established by the act of 1820, and is, therefore, termed the "double-minimum rate. These are the existing rates of disposal under the general provisions of law for the sale of the public lands upon bringing them into market, or under the pre-emption statutes and section 2301, Revised Statutes, above mentioned. Lands subject to entry, which had been enhanced to the double minimum price and put in market prior to January, 1860, by reason of railroad grants, were reduced to the minimum price by the act of June 15, 1880.

Disposal of Public Lands by Public Offering and Sale.—In some of the early acts of Congress providing for bringing lands into market dates were fixed for the sales, and the superintendence of the sales was placed under the register of the land office, or the governor or secretary of the Territory. In the act of March 3, 1803, which, among other things, provided for the disposition of lands belonging to the United States south of the State of Tennessee, it was provided that the President of the United States should make public proclamation of the sales, fixing therein a day or days for the same to take place. By this act it was provided that the sales should be made under the direction of the governor of the Mississippi Territory, the surveyor of the lands, and the register of the land office, the sales to take place where the land offices were "kept." The act directing the survey and sale of the public lands in the Territories of Orleans and Louisiana, approved March 3, 1811, provided for proclamation of the sales of lands in the Territory of Louisiana by the President, and that the same should be under the direction of the register and receiver of the land office and the principal deputy surveyor. In the acts of 1803 and 1811 it was directed that the sales remain open for three weeks, and no longer. The statutes and rules at present in force in respect to offerings are briefly stated below. The act of April 24, 1820 (see sections 2360, 2353, eighth subdivision, and 2238, R. S.), provided that the public sales authorized thereby should be kept open two weeks, and no longer; it also provided that the tracts to be sold be offered for sale in half quarter-sections; and thereby registers and receivers were allowed a fee of $5 each per diem for superintending the sales. The act of June 28, 1834 (section 2359, R. S.), provided that lands exposed to public sale by order of the President shall be advertised for a period of not less than three nor more than six months prior to the day of sale, unless otherwise specially provided. The act of August 3, 1846 (section 2455, R. S.), authorized the Commissioner of the General Land Office to order into market after due notice, without the formality and expense of a proclamation of the President, such isolated or disconnected tracts or parcels of unoffered lands which, in his judgment, it would be proper to expose to sale, and required that public notice of the offering for a period of at least thirty days should be given by the district officers pursuant to directions of the Commissioner. It is the rule to resort to published notice in such cases.

By a regulation of the General Land Office, district officers are allowed a crier and a clerk during the progress of the sales, at a stated per diem compensation. Lands are offered for sale by public outcry, at not less than the minimum or double minimum price per acre, as the case may be, and are sold to the highest bidder in case bids are received. Technical quarter-sections are sold in half-quarter-sections. Where practicable the north half of the section should be sold first, the order of offering being as follows: East half of northeast quarter; west half of northeast quarter; east half of northwest quarter; west half of northwest quarter; east half of southeast quarter; west half of southeast quarter; east half of southwest quarter; west half of southwest quarter. Such portions of sections as are designated by numbers on the plats are sold in the order of the numbers, as follows: Lot 1, lot 2, lot 3, lot 4. The regulations require the district officers to keep a complete record in abstract form, day by day, as the sales progress, of each subdivision offered, and to note the sales made in margin thereof, such notings as the following being desirable: Name of purchaser, date of sale, and the number of the certificate of purchase issued as the basis of a patent (which is also the number of the receipt for the purchase-money accompanying the certificate, a duplicate of which is given to the purchaser); and opposite the description of tracts offered, but not sold, the facts are required to be noted as follows: "Offered; no bids." When the sale is closed, it is required that the abstracts of offerings be sent as a part of the official report of the district officers to the General Land Office, after making a copy of the same to be retained as a record in the district office. The practice in regard to making up the official reports of offerings has varied to some extent, but the above is substantially the present method. The authority to proclaim lands for sale is not limited by law to a stated period of time after survey thereof. Of course it is not deemed safe or advisable to proclaim lands for sale prior to survey, even if contracts for survey thereof have been entered into. The President is not empowered to proclaim lands for sale not authorized to be exposed to public sale by law of Congress; the laws authorizing such sales have reference to particular localities therein mentioned. There is no general provision of law authorizing public sales of all the vacant lands of the government, and a portion of the lands in the far west, the Territory of Utah, for instance, is not subject to be proclaimed for sale. The vacant lands generally in the Louisiana purchase are subject to be proclaimed for sale under the act of 1811, referred to above. The lands in Arkansas, Louisiana, Mississippi, Alabama, and Florida, which were restricted to homestead entry by the act of June 21, 1866, were authorized to be brought into market by proclamation for sale at public offerings by the act of June 22, 1876. Lands within the limits of the Pacific Railroad and branches, belonging to the government, in the even-numbered sections, were restricted to homestead and pre-emption entry by the act of March 6, 1868. In view of a resolution of the House of Representatives, which passed some time after the recent war of the rebellion, and the general drift of public sentiment expressed in various ways, it is the present policy to hold lands outside of the Southern States above mentioned, not yet proclaimed for sale, for actual settlers. The following is a printed form for proclamation of sales by the President:

Proclamation by the President of the United States.

In pursuance of an Act of Congress of June 22, 1876, I, Chester A. Arthur, President of the United States of America, do hereby declare and make known that a public sale of valuable Government land will be held at the land office at ————, in the State of ————, on ————, ———— —, ——, at which time will be offered all lands not previously disposed of in the undermentioned townships and parts of townships, viz.:

North of base-line and west of the ——— meridian:

[Here is given lists of townships to be sold.]

Lands appropriated by law for the use of schools, military or other purposes, or reserved for railroad purposes, will be excluded from the sale. The offering of the above lands will be commenced on the day appointed, and will proceed in the order in which they are tabulated in the lists of sectional subdivisions until the whole have been offered and the sales thus closed; but the sale shall not be kept open longer than two weeks, and no private entry of any of the lands will be admitted until the day after the close of the public offering. All lands held at double minimum price will be disposed of at not less than two dollars and fifty cents ($2.50) per acre, and all the lands held at minimum price will be disposed of at not less than one dollar and twenty-five cents ($1.25) per acre. Lists of sectional subdivisions are in the hands of the district officers, and will be open for the examination of those desiring to purchase.

Given under my hand, at the City of Washington, this —— day of ———, A. D. 18—.

CHESTER A. ARTHUR,
President of the United States.

By the President:
N. C. McFarland,
Commissioner of the General Land Office.

Notice to Pre-emption Claimants.

Every person entitled to the right of pre-emption to any of the lands within the townships and parts of townships above enumerated is required to establish the same to the satisfaction of the register and receiver of the ———— land office, and make payment therefor as soon as practicable after seeing this notice, and before the day appointed for the commencement of the public sale of the lands embracing the tract claimed; otherwise such claim will be forfeited.

No pre-emption claim based on a settlement subsequent to the date of this proclamation, and prior to the offering, will be recognized by the Government.

N. C. McFarland,
Commissioner of the General Land Office.

Prices of the Public Lands at Various Periods.—The United States from 1758 to 1880 has sold land at various prices, as follows: *Agricultural lands* at the rates of 12½, 25, 50, 66⅔, and 75 cents, and $1.00, $1.25, and $2.50 per acre. Under the cash sales and pre-emption acts a vast area containing coal, and millions of acres of timber land, have been sold at the foregoing rates. *Mineral lands.*—In Michigan, Wisconsin, and other States lands containing copper and lead were formerly offered at public sale at not less than $5 per acre, and if not then disposed of they were to be held for private sale at that rate. Persons in possession under leases from the War Department, however, were to have preference right of purchase, at the rate of $2.50 per acre. Under present laws, except in the States of Michigan, Wisconsin, Minnesota, Missouri, and Kansas, lands valuable for minerals contained in veins or lodes, or "rock in place," including lead, copper, gold, silver, cinnabar, iron, &c., are sold at the rate of $5 per acre. Lands containing "placer" deposits of minerals are sold at the rate of $2.50 per acre. In the States above excepted all lands are sold as agricultural.

Coal lands are sold at $20 per acre where situated within fifteen miles of a completed railroad; otherwise at $10 per acre. *Desert lands* are sold at $1.25 per acre; *Saline lands* at $1.25 per acre; and *Timber and stone lands* at $2.50 per acre.

Saline Lands.—In the act of Congress of May 18, 1796, which provided for the sale of the public lands in a portion of the territory northwest of the river Ohio, was a proviso that salt springs were to be reserved for the use of the United States, together with a section of one mile square, which should include the spring. A whole township of land was to be reserved with one particular spring named in the act, situated on a creek emptying into the Scioto River. By the act of 1800 the surveyor-general had authority to lease these reserved lands. The acts for the admission of all the public-land States up to Nevada, gave to them all the salines not exceeding twelve in number in the respective States, together with six sections of land with each spring for school purposes and public improvements.

Not subject to entry under pre-emption or homestead law.—In the pre-emption act of September 4, 1841, sec. 10, it was ordered that "no lands on which are situated any known salines, or mines, shall be liable to entry under and by virtue of the provisions of this act." The homestead act of May 20, 1862, reaffirmed the exceptions in the pre-emption act of 1841, and its amendments. Salines were disposed of by special acts of Congress—until after the admission of the State of Nebraska into the Union, March 1, 1867.

Change in Saline Laws.—The act of January 12, 1877 (see circular General Land Office April 10, 1877), provided a new mode of proceeding by which such lands are rendered subject to disposal as other public lands. Under its provisions a hearing is ordered and witnesses are examined as to the character of the land in question, and the testimony taken at the hearing is transmitted to the General Land Office for its decision. Should the tracts be adjudged agricultural, they will be subject to disposal as such. Should the tracts be adjudged saline in character, they would be offered at public sale to the highest bidder for cash, at a price of not less than $1.25 per acre. In case they are not sold, the same will be subject to private sale at a price of not less than $1.25 per acre, in the same manner as other public lands are sold. This law is not operative in the Territories nor in the States of Mississippi, Florida, Louisiana, California, and Nevada, because their former saline grants have not as yet been filled.

Area of Grants to the several States.—The following table shows the area and dates of grants by Congress, of salines to the several States:

States.	*Area.*	*Under what acts of Congress.*
Ohio	24,216	May 18, 1706; April, 30, 1802; March 26, 1804.
Indiana	23,040	April 19, 1816.
Illinois	121,029	April 18, 1818.
Missouri	46,080	March 6, 1820.
Alabama	23,040	December 14, 1819.
Michigan	46,080	June 23, 1836.
Arkansas	46,080	June 23, 1836.
Iowa	46,080	March 3, 1845.
Minnesota	46,080	February 26, 1857.
Oregon	46,080	February 14, 1859.
Kansas	46,080	January 29, 1861.
Nebraska	46,080	April 19, 1864.
Total	559,965	

Note.—With the exception of the States of Ohio, Indiana, and Alabama, each of which were granted thirty-six sections of land lying contiguous to the salt springs, six sections for each, for the use thereof; and of the State of Illinois which was granted all the Springs in the State, and the same quantity of land for each, the remaining States in the above list were each granted twelve springs together with six sections of land for the use of each spring lying contiguous thereto. They were patented by the United States to the several States, which disposed of them as they thought best.

TIMBER AND TIMBER CULTURE.

Sec. 256. All citizens of the United States and other persons, bona-fide residents of the State of Colorado, or Nevada, or either of the territories of New Mexico, Arizona, Utah, Wyoming, Dakota, Idaho, or Montana, and all other mineral districts of the United States, shall be, and are hereby, authorized and are permitted to fell and remove, for building, agricultural, mining, or other domestic purposes, any timber or other trees growing or being on the public lands, said lands being mineral, and not subject to entry under existing laws of the United States, except for mineral entry, in either of said States, territories, or districts of which such citizens or persons may be at the time bona fide residents, subject to such rules and regulations as the Secretary of the Interior may prescribe for the protection of the timber and of the undergrowth growing upon such lands, and for other purposes, provided, that the foregoing provisions shall not extend to railroad corporations.

20 Stat. 88. U. S. *v.* Nelson, 5 Saw C. C. 68. 1 Op. Att. Gen. 471, 475. Rogers *v.* Soggs, 22 Cal. 444. Cir. G. L. O., Aug. 15, 1878 (6 Copp's L. O. 21).

Sec. 257. It shall be the duty of the register and the receiver of any local land office in whose district any mineral land may be situated to ascertain from time to time whether any timber is being cut or used upon any such lands, except for the purposes authorized in the preceding section, within their respective land districts; and, if so, they shall immediately notify the Commissioner of the General Land Office of that fact; and all necessary expenses incurred in making such proper examinations shall be paid and allowed such register and receiver in making up their next quarterly accounts.

20 Stat. 88. Cir. G. L. O., Aug 15, 1878 (6 Copp's L. O. 21).

Sec. 258. Any person or persons who shall violate the provisions of the two next preceding sections, or any rules and regulations in pursuance thereof made by the Secretary of the Interior, shall be deemed guilty of a misdemeanor, and, upon conviction, shall be fined in any sum not exceeding five hundred dollars, and to which may be added imprisonment for any term not exceeding six months.

20 Stat. 89. Cotton *v.* U. S., 11 How. 229; Hutchins *v* King, 1 Wall. 53; Schulenber *v.* Harriman, 21 *id.* 44. U. S. *v.* Nelson, 5 Saw. C. C. 68. 1 Op. Att. Gen. 194, 471, 475. Cir. G. L. O., Aug. 15, 1878 (6 Copp's L. O. 21).

Sec. 259. Surveyed public lands of the United States within the States of California, Oregon, and Nevada, and in Washington Territory, not included within military, Indian, or other reservations of the United States, valuable chiefly for timber, but unfit for cultivation, and which have not been offered at public sale according to law, may be sold to citizens of the United States, or persons who have declared their intention to become such, in quantities not exceeding one hundred and sixty acres to any one person or association of persons, at the minimum price of two dollars and fifty cents per acre; and lands valuable chiefly for stone may be sold on the same terms as timber lands; provided, that nothing herein contained shall defeat or impair any bona-fide claim under any law of the United States, or authorize the sale of any mining claim, or the improvements of any bona-fide settler, or lands containing gold, silver, cinnabar, copper, or coal, or lands selected by the said States under any law of the United States donating lands for internal improvements, education, or other purposes: And provided further, That none of the rights conferred by the act approved July twenty-sixth, eighteen hundred and sixty-six, entitled "An act granting the right of way to ditch and canal owners over the public lands, and for other purposes," shall be abrogated by this act; and all patents granted shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights, as may have been acquired under and by the provisions of said act; and such rights shall be expressly reserved in any patent issued under this act.

14 Stat. 251; 20 *id.* 89; R. S. 2339, 2340, 2341. McFarland *v.* Culbertson, 2 Nev. 280; Peck *v.* Brown, 5 *id.* 81; Eureka Mg. Co. *v.* Way 11 *id.* 171. Decison Com. G. L. O., June 6, 1874 (1 Copp's L. O. 58). Cir. G. L. O., May 1, 1880 (7 Copp's L. O. 26).

Sec. 260. Any person desiring to avail himself of the provisions of this act shall file with the register of the proper district a written statement in duplicate, one of which is to be transmitted to the General Land Office, designating by legal subdivisions the particular tract of land he desires to purchase, setting forth that the same is unfit for cultivation, and valuable chiefly for its timber or stone; that it is uninhabited; contains no mining or other improvements, except for ditch or canal purposes, where any such do exist, save such as were made by or belong to the applicant, nor, as deponent verily believes, any valuable deposit of gold, silver, cinnabar, copper, or coal; that deponent has made no other application under this act; that he does not apply to purchase the same on speculation, but in good faith to appropriate it to his own exclusive use and benefit; and that he has not, directly or indirectly, made any agreement or contract, in any way or manner, with any person or persons whatsoever, by which the title which he might acquire from the Government of the United States should inure, in whole or in part, to the benefit of any person except himself; which statement must be verified by the oath of the applicant before the register or the receiver of the land office within the district where the land is situated; and if any person taking such oath shall swear falsely in the premises, he shall be subject to all the pains and penalties of perjury, and shall forfeit the money which he may have paid for said lands, and all right and title to the same; and any grant or conveyance which he may have made, except in the hands of bona-fide purchasers, shall be null and void.

20 Stat. 89. Cir. G. O. L., May 1, 1880 (7 Copp's L. O. 26.)

Sec. 261. Upon the filing of said statement, as provided in the preceding section, the register of the land office shall post a notice of such application, embracing a description of the land by legal subdivisions, in his office, for a period of sixty days, and shall furnish the applicant a copy of the same for publication, at the expense of such applicant, in a newspaper published nearest the location of the premises, for a like period of time; and after the expiration of said sixty days, if no adverse claim shall have been filed, the person desiring to purchase shall furnish to the register of the land office satisfactory evidence, first, that said notice of the application prepared by the register as aforesaid was duly published in a newspaper as herein required; secondly, that the land is of the character contemplated in this act, unoccupied and without improvements, other than those excepted, either mining or agricultural, and that it apparently contains no valuable deposits of gold, silver, cinnabar, copper, or coal; and upon payment to the proper officer of the purchase money of said land, together with the fees of the register and the receiver, as provided for in case of mining claims in the one hundred and thirty-seventh section, the applicant may be permitted to enter said tract, and, on the transmission to the General Land Office of the papers and testimony in the case, a patent shall issue thereon; provided, that any person having a valid claim to any portion of the land may object, in writing, to the issuance of a patent to lands so held by him, stating the nature of his claim thereto; and evidence shall be taken, and the merits of said objection shall be determined by the officers of the land office, subject to appeal, as in other land cases. Effect shall be given to the foregoing provisions of this act by regulations to be prescribed by the Commissioner of the General Land Office.

17 Stat. 95; 20 *id.* 89. R. S. 2238. McFarland *v.* Culbertson, 2 Nev. 280: Peck *v.* Brown, 5 *id.* 81. Cir. G. L. O., May 1, 1880 (7 Copp's L. O. 26).

Sec. 262. After the passage of this act it shall be unlawful to cut, or cause or procure to be cut, or wantonly destroy any timber growing on any lands of the United States, in said States and Territory, or remove, or cause to be removed, any timber from said public lands, with intent to export or dispose of the same; and no owner, master, or consignee of any vessel, or owner, director, or agent of any railroad shall knowingly transport the same, or any lumber manufactured therefrom; and any person violating the provisions of this section shall be guilty of a misdemeanor, and, on conviction, shall be fined for every such offence a sum not less than one hundred nor more than one thousand dollars; provided, that nothing herein contained shall prevent any miner or agriculturalist from clearing his land in the ordinary working of his mining claim, or preparing his farm for tillage, or from taking the timber necessary to support his improvements, or the taking of timber for the use of the United States; and the penalties herein provided shall not take effect until ninety days after the passage of this act.

20 Stat. 90. Cotton *v.* U. S.. 11 How. 229. U. S. *v.* McEntee, U. S. Dist. Ct. Minn., Oct. 1877. Decision Com. G. L. O., Dec. 11, 1878, (6 Copp's L. O. 76). Cir. G. L. O., Aug. 15, 1878 (6 Copp's L. O. 21); May 1, 1880 (7 *id.* 26).

Sec. 263. Any person prosecuted in said States and territory for violating section two hundred and sixty-eight, who is not prosecuted for cutting timber for export from the United States, may be relieved from further prosecution and liability therefor upon payment, into the court wherein said action is pending, of the sum of two dollars and fifty cents per acre for all lands on which he shall have cut or caused to be cut timber, or removed or caused to be removed the same; provided, that nothing contained in this section shall be construed as granting to the person hereby relieved the title to said lands for said payment; but he shall have the right to purchase the same upon the same terms and conditions as other persons, as provided hereinbefore in this act; and further provided, that all moneys collected under this act shall be covered into the treasury of the United States. And section four thousand seven hundred and fifty-one of the Revised Statutes is hereby repealed, so far as it relates to the States and territory herein named.

20 Stat. 90, 91. U. S. *v.* Nelson, 5 Saw. C. C. 68. Cir. G. L. O., Aug. 15, 1878 (6 Copp's L. O. 21).

Sec. 264. All acts and parts of acts inconsistent with the provisions of the five preceding sections are repealed.

20 Stat. 90, 91.

Sec. 265. The Secretary of the Navy is authorized, under the direction of the President, to cause such vacant and unappropriated lands of the United States as produce the live-oak and red-cedar timbers to be explored, and selection to be made of such tracts or portions thereof, where the principal growth is of either of such timbers, as in his judgment may be necessary to furnish for the Navy a sufficient supply of the same.

3 Stat. 347, 607; 4 *id.* 242; R. S. 2458. U. S. *v.* Briggs, 9 How. 351. Cir. G. L. O., Aug. 8, 1831, (2 Laws, Instructions and Opinions, 455).

Sec. 266. The President is authorized to appoint surveyors of public lands, who shall perform the duties prescribed in the preceding section, and report to him the tracts by them selected, with the boundaries ascertained and accurately designated by actual survey or water courses; and the tracts of land thus selected with the approbation of the President shall be reserved, unless otherwise directed by law, from any future sale of the public lands, and be appropriated to the sole purpose of supplying timber for the Navy of the United States; but nothing in this section contained shall be construed to prejudice the prior rights of any person claiming lands, which may reserved in the manner herein provided.

3 Stat. 347; R. S. 2459. U. S. *v.* Briggs, 9 How. 351. 2 Op. Att. Gen. 524. Cir. G. L. O., Aug. 8, 1831 (2 Laws, Instructions, and Opinions, 455).

Sec. 267. The President is authorized to employ so much of the land and naval forces of the United States as may be necessary effectually to prevent the felling, cutting down, or other destruction of the timber of the United States in Florida, and to prevent the transportation or carrying away any such timber as may be already felled or cut down; and to take such other and further measures as may be deemed advisable for the preservation of the timber of the United States in Florida.

3 Stat. 651. R. S. 2460. Schulenberg *v.* Harriman, 21 Wall. 44.

Sec. 268. If any person shall cut, or cause or procure to be cut, or aid, assist, or be employed in cutting, or shall wantonly destroy, or cause or procure to be wantonly destroyed, or aid, assist, or be employed in wantonly destroying any live-oak or red-cedar trees, or other timber standing, growing, or being on any lands of the United States, which in pursuance of any law passed, or hereafter to be passed, have been reserved or purchased for the use of the United States, for supplying or furnishing therefrom timber for the Navy of the United States; or if any person shall remove, or cause or procure to be removed, or aid, or assist, or be employed in removing from any such lands which have been reserved or purchased, any live-oak or red-cedar trees, or other timber, unless duly authorized so to do, by order, in writing, of a competent officer, and for the use of the Navy of the United States; or if any person shall cut, or cause or procure to be cut, or aid, or assist, or be employed in cutting any live oak or red-cedar trees, or other timber on, or shall remove, or cause or procure to be removed, or aid, or assist, or be employed in removing any live-oak or red-cedar trees or other timber, from any other lands of the United States, acquired or hereafter to be acquired, with intent to export, dispose of, use, or employ the same in any manner whatsoever, other than for the use of the Navy of the United States; every such person shall pay a fine not less than triple the value of the trees or timber so cut, destroyed, or removed, and shall be imprisoned not exceeding twelve months.

4 Stat. 472; R. S. 2461. U. S. *v.* Briggs, 9 How. 351; Cotton *v.* U. S., 11 *id.* 229; Hutchins *v.* King, 1 Wall. 53; Schulenberg *v.* Harriman, 21 *id.* 44. U. S. *v.* McEntee, U. S. Dist. Ct. Minn., Oct. 1877, in manuscript; U. S. *v.* Nelson, 5 Saw. C. C. 68. Kansas *v.* Harrold, 9 Kansas, 194; Stevens *v.* Perrier, 12 *id.* 297; James *v.* Snelson, 3 Mo. 278; Turley *v.* Tucker, 6 *id.* 583; Hower *v.* Higbee, 9 *id.* 259; Keeton *v.* Andsley, 19 *id.* 362; Woodruff *v.* Roberts, 4 La. Ann. 127; Lovett *v.* Noble, 1 Scamm. (Ills.) 185, 11 Ill. 529, Nincher *v.* Schrewsbury, 2 Scamm. Ill. 284; Rogers *v.* Soggs, 22 Cal. 444. 1 Op. Att. Gen. 194, 471, 475; 2 *id.* 524. Decisions Sec. Int., Dec. 26, 1854 (1 Lester's L. L. 629). Decisions Com. G. L. O., Sept. 1, 1865 (Zab. L. L. 891); June 29, 1874. 1 Copp's L. O. 102); Dec. 11, 1878 (6 *id.* 76). Cir. G. L. O. Dec. 24, 1855 (Zab. L. L. 888; Copp's L. L. 658; 1 Copp's L. O. 102); May 2, 1877 (4 Copp's L. O. 55); Aug. 15, 1878 6 *id.* 21); June 27, 1879 (6 *id.* 59); May 1, 1880 (7 *id.* 26).

Sec. 269. If the master, owner, or consignee of any vessel shall knowingly take on board any timber cut on lands which have been reserved or purchased as in the preceding section prescribed, without proper authority, and for the use of the Navy of the United States; or shall take on board any live-oak or red-cedar timber cut on any other lands of the United States, with intent to transport the same to any port or place within the United States or to export the same to any foreign country, the vessel on board of which the same shall be taken, transported, or seized, shall, with her tackle, apparel, and furniture, be wholly forfeited to the United States, and the captain or master of such vessel wherein the same was exported to any foreign country against the provisions of this section shall forfeit and pay to the United States a sum not exceeding one thousand dollars.

4 Stat. 472; R. S. 2462. 4 Op. Att. Gen. 247, 339, 403.

Sec. 270. It shall be the duty of all collectors of the customs within the States of Alabama, Mississippi, Louisiana, and Florida, before allowing a clearance to any vessel laden in whole or in part with live-oak timber, to ascertain satisfactorily that such timber was cut from private lands, or if from public ones, by consent of the Navy Department. And it is also made the duty of all officers of the customs, aud of the land officers within those States, to cause prosecutions to be seasonably instituted against all persons known to be guilty of depredations on, or injuries to, the live-oak growing on the public lands.

4 Stat. 647; R. S. 2468. 4 Op. Att. Gen. 403.

Sec. 271. The Secretary of the Navy is authorized to cause an examination to be made of the condition of all lands in the State of Florida which have been set apart or reserved for naval purposes, excepting the reservation upon which the navy yard at Pensacola is located, and to ascertain whether or not such reserved lands are or will be of any value to the Government of the United States for naval purposes.

20 Stat. 470, 471.

Sec. 272. All of said lands which, in the judgment of the Secretary of the Navy, are no longer required for naval purposes shall, as soon as practicable, be certified by him to the Secretary of the Interior, and be subject to entry and sale in the same manner and under the same conditions as other public lands of the United States: *Provided*, That all persons who have, in good faith, made improvements on said reserved lands so certified on the third day of March, eighteen hundred and seventy-nine, and who occupy the same, shall be entitled to purchase the part or parts so occupied and improved by them, not to exceed one huudred and sixty acres to any one person at one dollar and twenty-five cents per acre within such reasonable time as may be fixed by the Secretary of the Interior.

20 Stat. 471.

Sec. 273. If any person or persons shall knowingly and unlawfully cut, or shall knowingly aid, assist, or be employed in unlawfully cutting, or shall wantonly destroy or injure, or procure to be wantonly destroyed or injured, any timber tree or any shade or ornamental tree, or any other kind of tree, standing, growing, or being upon any lands of the United States, which, in pursuance of law, have been reserved, or which have been purchased by the United States for any public use, every such person or persons so offending, on conviction thereof before any circuit or district court of the United States, shall, for every such offense, pay a fine not exceeding five hundred dollars, or shall be imprisoned not exceeding twelve months: *Provided*, That nothing in this section shall be construed to apply to unsurveyed public lands and to public lands subject to pre-emption and homestead laws, nor to public lands subject to an act to promote the development of the mining resources of the United States, approved May tenth, eighteen hundred and seventy-two.

18 Stat. 481, 482. U. S. *v.* Briggs, 9 How. 351; Cotton *v.* U. S., 11 *id.*, 229: Hutchins *v.* King, 1 Wall. 53. 1 Op. Att. Gen. 194.

Sec. 274. When any lands of the United States, not mineral, shall have been entered and the government price paid therefor in full, no criminal suit or proceeding by or in the name of the United States shall thereafter be had or further maintained for any trespasses upon or for or on account of any material taken from said lands, and no civil suit or proceeding shall be had or further maintained for or on account of any trespasses upon or material taken from the said lands of the United States in the ordinary clearing of land, in working a mining claim, or for agricultural or domestic purposes, or for maintaining improvements upon the land of any bona-fide settler, or for or on account of any timber or material taken or used by any person without fault or knowledge of the trespass, or for or on account of any timber taken or used without fraud or collusion by any person who, in good faith, paid the officers or agents of the United States for the same, or for or on account of any alleged conspiracy in relation thereto: *Provided*, That the provisions of this section shall apply only to trespasses and acts done or committed and conspiracies entered into prior to March first, eighteen hundred and seventy-nine: *And provided further*, That defendants in such suits or proceedings shall exhibit to the proper courts or officer the evidence of such entry and payment, and shall pay all costs accrued up to the time of such entry.

Act of June 15, 1880. U. S. *v.* McEntee, U. S. Dist. Ct. Minn., Oct. 1877, in manuscript. Decision Com. G. L. O., June 29, 1874 (1 Copp's L. O. 152). Cir. G. L. O., July 17, 1880 (7 Copp's L. O. 89).

Sec. 275. The act entitled "An act to amend the act entitled 'An act to encourage the growth of timber on western prairies,'" approved March thirteenth, eighteen hundred and seventy-four, is amended to read as follows: That any person who is the head of a family, or who has arrived at the age of twenty-one years, and is a citizen of the United States, or who shall have filed his declaration of intention to become such, as required by the naturalization laws of the United States, who shall plant, protect, and keep in a healthy, growing condition for eight years ten acres of timber, on any quarter-section of any of the public lands of the United States, or five acres on any legal subdivision of eighty acres, or two and one-half acres on any legal subdivision of forty acres or less, shall be entitled to a patent for the whole of said quarter-section, or of such legal subdivision of eighty or forty acres, or fractional subdivision of less than forty acres, as the case may be, at the expiration of said eight years, on making proof of such fact by not less than two credible witnesses, and a full compliance of the further conditions as provided in the next section: *Provided*, That not more than one quarter of any section shall be thus granted, and that no person shall make more than one entry under the provisions of this law.

20 Stat. 113, 114, 115. Decisions Sec. Int., July 31, 1876 (3 Copp's L. O. 73); Aug. 3, 1876 (3 *id.* 122, Jan. 4, 1877, 3 *id.* 181); Sept. 24, 1877 (4 *id.* 134); Feb. 12, 1879 (6 *id.* 22); Aug. 23, 1879 (6 *id.* 113); Sept. 12, 1879: Dec. 4, 1879 (6 Copp's L. O. 153); April 30, 1880 (7 *id.* 39). Decisions Com. G. L. O., June 10, 1873 (Copp's L. L. 657); June 24, 1873 (*id.* 652: June 6, 1874, *id.* 653; 1 Copp's L. O. 58); June 20, 1874 (Copp's L. L. 658); June 30, 1874 (*id.* 656); Aug. 4. 1874 (*id.* 654; 1 Copp's L. O. 92); Aug. 17, 1874 (1 Copp's L. O. 92); Oct. 23, 1874 (Copp's L. L. 655; 2 Copp's L. O. 39); Dec. 11, 1874 (6 Copp's L. O. 174); Aug. 16, 1875 (2 *id.* 86); March 27, 1876 (3 *id.* 3); June 30, 1876 (3 *id.* 73); July 6, 1876 (3 *id.* 71); July 6, 1876 (3 *id.* 71); July 17, 1876 (3 *id.* 72); Dec. 12, 1876, (3 *id.* 172); Jan. 27, 1877 (3 *id.* 179); April 9, 1877 (4 *id.* 162); July 25, 1877 (4 *id.* 85); Dec. 18, 1879 (6 *id.* 154); March 16, 1880 (7 *id.* 6); April 15, 1880 (7 *id.* 25); May 18, 1880 (7 *id.* 39). Cir. G. L. O., May 3, 1876 (3 Copp's L. O. 38); June 27, 1878 (5 *id.* 77); ——, 1878 (5 *id.* 118). General Cir., Sept. 1, 1879, pp. 23, 26.

Sec. 276. The person applying for the benefits of this law shall, upon application to the register of the land district in which he or she is about to make such entry, make affidavit, before the register or the receiver, or the clerk of some court of record, or officer authorized to administer oaths in the district where the land is situated; which affidavit shall be as follows, to wit: I, ———, having filed my application, number —, for an entry under the provisions of an act entitled "An act to amend an act entitled 'An act to encourage the growth of timber on the western prairies,'" approved ———, 187–, do solemnly swear (or affirm) that I am the head of a family (or over twenty-one years of age), and a citizen of the United States (or have declared my intention to become such); that the section of land specified in my said application is composed exclusively of prairie lands, or other lands devoid of timber; that this filing and entry is made for the cultivation of timber, and for my own exclusive use and benefit; that I have made the said application in good faith, and not for the purpose of speculation, or directly or indirectly for the use or benefit of any other person or persons whatsoever; that I intend to hold and cultivate the land, and to fully comply with the provisions of the law; and that I have not heretofore made an entry under the timber culture laws.

20 Stat. 113, 114, 115. Decisions Sec. Int., May 15, 1876 (3 Copp's L. O. 38); July 31, 1876 (3 *id.* 73); Jan. 4, 1877 (3 *id.* 181); Sept. 24, 1877 (4 *id.* 134); Sept. 12, 1879. Decisions Com. G. L. O., June 6, 1874 (Copp's L. L. 653; 1 Copp's L. O. 58); Aug. 6, 1874 (Copp's L. L. 654); Oct. 23, 1874 (*id.* 655; 2 Copp's L. L. 39); Dec. 11, 1874; Jan. 24, 1879; Dec. 18, 1879 (6 Copp's L. O. 154). Cir. G. L. O., Jan. 8, 1878, (4 Copp's L. O. 167); June 27, 1878 (5 *id.* 77); ——, 1878 (5 *id.* 118). Gen. Cir. G. L. O., Sept. 1, 1879, p. 25.

Sec. 277. Upon filing said affidavit with the register and receiver and on payment of ten dollars, if the tract applied for is more than eighty acres, and five dollars if it is eighty acres or less, he or she shall thereupon be permitted to enter the quantity of land specified and the party making an entry of a quarter-section shall be required to break or plow five acres covered thereby the first year, five acres the second year, and to cultivate to crop or otherwise the five acres broken or plowed the first year; the third year he or she shall cultivate to crop or otherwise the five acres broken the second year, and to plant in timber, seeds, or cuttings the five acres first broken or plowed, and to cultivate and put in crop or otherwise the remaining five acres, and the fourth year to plant in timber, seeds, or cuttings the remaining five acres. All entries of less quantity than one quarter-section shall be plowed, planted, cultivated and planted to trees, tree-seeds, or cuttings, in the same manner and in the same proportion as hereinbefore provided for a quarter-section: *Provided, however*, That in case such trees, seeds, or cuttings shall be destroyed by grasshoppers, or by extreme and unusual drouth for any year or term of years, the time for planting such trees, seeds, or cuttings shall be extended one year for every such year that they are so destroyed: *Provided, further*, That the person making such entry shall, before he or she shall be entitled to such extension of time, file with the register and the receiver of the proper land office an affidavit, corroborated by two witnesses, setting forth the destruction of such trees, and that, in consequence of such destruction, he or she is compelled to ask an extension of time, in accordance with the provisions of this law.

20 Stat. 113, 114, 115. Decisions Sec. Int., May 17, 1876 (3 Copp's L. O. 38); Dec. 23, 1876 (3 *id.* 180); April 2, 1877 (4 *id.* 21); May 29, 1878 (5 *id.* 87); Dec. 4, 1879 (6 *id.* 153); April 30, 1880 (7 *id.* 39); May 31, 1880 (7 *id.* 39). Decisions Com. G. L. O., June 24, 1873 (Copp's L. L. 652); July 25, 1874 (*id.* 653; 1 Copp's L. O. 92); Aug. 4, 1874 (Copp's L. L. 654); Dec. 11, 1874; Jan. 21, 1875 (1 Copp's L. O. 171); Feb. 11, 1875 (Copp's L. L. 654; 1 Copp's L. O. 181); June 28, 1875 (2 Copp's L. O. 54); July 1, 1875 (2 *id.* 54); Sept. 27, 1875 (2 *id.* 100); Dec. 3, 1875 (2 *id.* 133); July 6, 1876 (3 *id.* 72); July 17, 1876 (3 *id.* 71); April 9, 1877 (4 *id.* 162); July 18, 1877 (4 *id.* 162); July 24, 1877 (4 *id.* 85); Jan. 24, 1879; May 18, 1880 (7 Copp's L. O. 39). Cir. G. L. O., April 6, 1874 (Copp's L. L. 649; 1 Copp's L. O. 26). General Cir. G. L. O., Sept. 1, 1879, pp. 25, 27.

Sec. 278. No final certificate shall be given, or patent issued, for the land so entered until the expiration of eight years from the date of such entry; and if, at the expiration of such time, or at any time within five years thereafter, the person making such entry, or, if he or she be dead, his or her heirs or legal representatives, shall prove by two credible witnesses that he or she or they have planted, and, for not less than eight years, have cultivated and protected such quantity and character of trees as aforesaid; that not less than twenty-seven hundred trees were planted on each acre, and that at the time of making such proof that there shall be then growing at least six hundred and seventy-five living and thrifty trees to each acre, they shall receive a patent for such tract of land.

20 Stat. 113, 114, 115. Decisions Sec. Int., Dec. 23, 1876 (3 Copp's L. O. 180); Nov. 14, 1877 (4 *id.* 134); Dec. 22, 1877 (5 5 *id.* 21); Sept. 17, 1878 (5 *id.* 119); April 30, 1880 (7 *id.* 39). Decisions Com. G. L. O., June 24, 1873 (Copp's L. L. 652); Feb. 11, 1875 (*id.* 654); March 11, 1875 (*id.* 655); March 23, 1875 (*id.* 656); June 28, 1875 (2 Copp's L. O. 54); July 1, 1875 (2 *id.* 54); Sept. 2, 1875 (2 *id.* 117); Dec. 3, 1875 (2 *id.* 134); March 10, 1877 (4 *id.* 162); Jan. 8, 1878 (4 *id.* 167); May 18, 1880 (7 *id.* 39). Cir. G. L. O., June 27, 1878 (5 Copp's L. O. 77). General Cir. G. L. O., Sept. 1, 1879, p. 24.

Sec. 279. If at any time after the filing of said affidavit, and prior to the issuing of the patent for said land, the claimant shall fail to comply with any of the requirements of this law, then and in that event such land shall be subject to entry under the homestead laws, or by some other person under the provisions of this law: *Provided*, That the party making claim to said land, either as a homestead settler, or under this law, shall give at the time of filing his application, such notice to the original claimant as shall be prescribed by the rules established by the Commissioner of the General Land Office; and the rights of the parties shall be determined as in other contested cases.

20 Stat. 113, 114, 115. Decisions Sec. Int., March 19, 1877 (4 Copp's L. O. 21); May 28, 1877 (4 *id.* 54); Sept. 17, 1878 (5 *id.* 119); Aug. 23, 1879 (6 *id.* 113); March 4, 1880 (7 *id.* 39); May 31, 1880 (7 *id.* 39). Decisions Com. G. L. O., June 30, 1874 (Copp's L. L. 656); Dec. 11, 1874 (6 Copp's L. O. 174); March 11, 1875 (Copp's L. L. 655); March 23, 1875 (*id.* 656); March 25, 1875 (*id.* 637); Oct. 30, 1875 (2 Copp's L. O. 117); Feb. 18, 1876 (2 *id.* 180); May 11, 1876 (3 *id.* 22); July 20, 1876 (3 *id.* 72); March 30, 1877 (4 *id.* 76); July 13, 1877 (4 *id.* 77); Dec. 4, 1877 (4 *id.* 149); Nov. 1, 1878 (5 *id.* 147); March 4, 1879 (6 *id.* 126); Oct. 22, 1879; Feb. 17, 1880; April 15, 1880 (7 Copp's L. O. 25). Cir. G. L. O., Dec. 28, 1877 (4 *id.* 166); June 27, 1878 (5 *id.* 77); ——, 1878 (5 *id.* 118); General Cir. G. L. O., Sept. 1, 1879, pp. 25, 27.

Sec. 280. No land acquired under the provisions of this law shall, in any event, become liable to the satisfaction of any debt or debts contracted prior to the issuing of the final certificate therefor.

20 Stat. 113, 114, 115. Cir. O. L. O., June 25, 1878 (5 Copp's L. O. 77). General Cir. G. L. O., Sept. 1, 1879, p. 25.

Sec. 281. The Commissioner of the General Land Office is required to prepare and issue such rules and regulations, consistent with this law, as shall be necessary and proper to carry its provisions into effect; and the registers and receivers of the several land offices shall each be entitled to receive two dollars at the time of entry, and the like sum when the claim is finally established and the final certificate issued.

20 Stat. 113, 114, 115.

Sec. 282. The fifth section of the act entitled "An act in addition to an act to punish crimes against the United States, and for other purposes," approved March third, eighteen hundred and fifty-seven, shall extend to all oaths, affirmations, and affidavits required or authorized by this act.

11 Stat. 250; 20 *id.* 113, 114, 115; R. S. 5392. Cir. G. L. O., June 27, 1878 (5 Copp's L. O. 77). General Cir. G. L. O., Sept. 1, 1879, p. 26.

Sec. 283. Parties who have already made entries under the acts approved March third, eighteen hundred and seventy-three, and March thirteenth, eighteen hundred and seventy-four, shall be permitted to complete the same upon full compliance with the provisions of this chapter; that is, they shall, at the time of making their final proof, have had under cultivation, as required by this chapter, an amount of timber sufficient to make the number of acres required by this chapter; and all laws and parts of laws in conflict with the provisions of this chapter are hereby repealed.

17 Stat. 605; 18 *id.* 21; 20 *id.* 113, 114, 115. Decision Sec. Int., March 17, 1879 (6 Copp's L.O. 21). Decisions Com. G.L.O., Feb. 14, 1879 (6 Copp's L. O. 22); April 1, 1879 (6 *id.* 126). Cir. G. L. O., June 27, 1878 (5 Copp's L. O., 77). General Cir. G. L. O., Sept. 1, 1879, p. 24.

Sec. 284. The notices of contest provided by law under the tree-culture laws shall be printed in some newspaper printed in the county where the land in contest lies; and if no newspaper be printed in such county, then in the newspaper printed in the county nearest to such land.

20 Stat. 91. Cir. G. L. O., June 12, 1878 (5 Copp's L. O. 101).

Sec. 285. When any timber-culture claimant shall file a written relinquishment of his claim in the local land office, the land covered by such claim shall be held as open to settlement and entry without further action on the part of the Commissioner of the General Land Office.

Act of May 14, 1880. Decisions Com. G. L. O., Nov. 5, 1875 (2 Copp's L. O. 133); July 18, 1877; Aug. 18, 1877 (4 *id.* 85); Nov. 1, 1878, (5 *id.* 147); March 3, 1880.

Sec. 286. In all cases where any person has contested, paid the land office fees, and procured the cancellation of any timber-culture entry, he shall be notified by the register of the land office of the district in which such land is situated of such cancellation, and shall be allowed thirty days from date of such notice to enter said lands; and the register shall be entitled to a fee of one dollar for the giving of such notice, to be paid by the contestant, and not to be reported.

Act of May 14, 1880. Decisions Sect. Int., March 29, 1877 (3 Copp's L. O. 21); May 28, 1877 (3 *id.* 54).

NOTE.—The following acts authorizing settlers upon the public lands under the pre-emption, homestead and timber-culture laws, whose crops were destroyed by grasshoppers, to absent themselves temporarily from their lands, and extending the time for making final proof, have been passed from time to time by Congress, viz: 18 Stat. 81; 19 *id.* 54, 55, 59, 405; 20 *id.* 88, 169; act of June 4, 1880.

TOWN SITES AND COUNTY SEATS.

Sec. 287. The President is authorized to reserve from the public lands, whether surveyed or unsurveyed, town sites on the shores of harbors, at the junction of rivers, important portages, or any natural or prospective centers of population.

12 Stat. 754; 19 *id.* 392; R. S. 2380.

Sec. 288. When, in the opinion of the President, the public interests require it, it shall be the duty of the Secretary of the Interior to cause any of such reservations, or part thereof, to be surveyed into urban or suburban lots of suitable size, and to fix by appraisement of disinterested persons their cash value, and to offer the same for sale at public outcry to the highest bidder, and thence afterward to be held subject to sale at private entry, according to such regulations as the Secretary of the Interior may prescribe; but no lot shall be disposed of at public sale or private entry for less than the appraised value thereof; and all such sales shall be conducted by the register and receiver of the land office in the district in which the reservations may be situated, in accordance with the instructions of the Commissioner of the General Land Office.

12 Stat. 754; R. S. 2381. Decision Sec. Int., Aug. 28, 1880 (8 Wash. Law. Rep. 574).

Sec. 289. In any case in which parties have already founded, or may hereafter desire to found, a city or town on the public lands, it may be lawful for them to cause to be filed with the recorder for the county in which the same is situated, a plat thereof, for not exceeding six hundred and forty acres, describing its exterior boundaries according to the lines of the public surveys, where such surveys have been executed; also giving the name of such city or town, and exhibiting the streets, squares, blocks, lots, and alleys, the size of the same, with measurements and area of each municipal subdivision, the lots in which shall each not exceed four thousand two hundred square feet, with a statement of the extent and general character of the improvements; such map and statement to be verified under oath by the party acting for and in behalf of the persons proposing to establish such city or town; and within one month after such filing there shall be transmitted to the General Land Office a verified transcript of such map and statement, accompanied by the testimony of two witnesses that such city or town has been established in good faith, and when the premises are within the limits of an organized land district, a similar map and statement shall be filed with the register and receiver, and at any time after the filing of such map, statement, and testimony in the General Land Office it may be lawful for the President to cause the lots embraced within the limits of such city or town to be offered at public sale to the highest bidder, subject to a minimum of ten dollars for each lot; and such lots as may not be disposed of at public sale shall thereafter be liable to private entry at such minimum, or at such reasonable increase or diminution thereafter as the Secretary of the Interior may order from time to time, after at least three months' notice, in view of the increase or decrease in the value of the municipal property. But any actual settler upon any one lot, as above provided, and upon any additional lot in which he may have substantial improvements shall be entitled to prove up and purchase the same as a pre-emption, at such minimum, at any time before the day fixed for the public sale.

13 Stat. 343; R. S. 2382. Towsley *v.* Johnson, 1 Neb. 95; Nevada *v.* Rhodes, 4 Nev. 312; Robinson *v.* Imperial Silver, &c., 5 *id.* 44; Bell *v.* The Bed Rock Tunnel Mining Co., 36 Cal. 214. Decision Com. G. L. O., April 4, 1868 (Zab. L. L. 196). Cir. G. L. O., Aug. 20, 1864 (Zab. L. L. 179; Copp's L. L. 661); Oct. 20, 1865 (Copp's L. L. 678).

Sec. 290. When such cities or towns are established upon unsurveyed lands, it may be lawful, after the extension thereto of the public surveys, to adjust the extension limits of the premises according to those lines, where it can be done without interference with rights which may be vested by sale; and patents for all lots so disposed of at public or private sale shall issue as in ordinary cases.

13 Stat. 344; R. S. 2383.

Sec. 291. If within twelve months from the establishment of a city or town on the public domain, the parties interested refuse or fail to file in the General Land Office a transcript map, with the statement and testimony called for by the provisions of section two hundred and eighty-nine, it may be lawful for the Secretary of the Interior to cause a survey and plat to be made of such city or town, and thereafter the lots in the same shall be disposed of as required by such provisions, with this exception, that they shall each be at an increase of fifty per centum on the minimum of ten dollars per lot.

13 Stat. 344; R. S. 2384.

Sec. 292. In the case of any city or town, in which the lots may be variant as to size from the limitation fixed in section two hundred and eighty-nine, and in which the lots and buildings, as municipal improvements, cover an area greater than six hundred and forty acres, such variance as to size of lots or excess in area shall prove no bar to such city or town claim under the provisions of that section; but the minimum price of each lot in such city or town, which may contain a greater number of square feet than the maximum named in that section, shall be increased to such reasonable amount as the Secretary of the Interior may by rule establish.

13 Stat. 530; R. S. 2385. Cir. G. L. O., April 26, 1855 (Zab. L. L. 181; Copp's L. L. 664); Oct. 20, 1865 (Copp's L. L. 678).

Sec. 293. Where mineral veins are possessed, which possession is recognized by local authority, and to the extent so possessed and recognized, the title to town lots to be acquired shall be subject to such recognized possession and the necessary use thereof; but nothing contained in this section shall be so construed as to recognize any color of title in possessors for mining purposes as against the United States.

13 Stat. 530; R. S. 2386. Decision Sec. Int., March 4, 1879 (6 Copp's L. O. 3). Decisions Com. G. L. O., June 16, 1874 (Copp's L. L. 698); Dec. 3, 1875 (2 Copp's L. O. 150); Oct. 27, 1876 (3 *id.* 114); Nov. 23, 1876 (3 *id.* 131); April 9, 1877 (4 *id.* 46).

Sec. 304. No title shall be acquired, under the foregoing provisions of this chapter, to any mine of gold, silver, cinnabar, or copper; or to any valid mining claim or possession held under existing laws.

14 Stat. 541; 15 *id.* 67; 18 *id.* 254; R. S. 2392. Decision Sec. Int., March 4, 1879 (6 Copp's L. O. 3). Decisions Com. G. L. O., April 21, 1874 (1 Copp's L. O. 19); June 16, 1874 (Copp's L. L. 698); Dec. 23, 1875 (2 Copp's L. O. 150); Oct. 27, 1876 (3 *id.* 114); Nov. 23, 1876 (3 *id.* 131); April 9, 1877 (4 *id.* 46).

MINERAL LANDS.

Sec. 386. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law.

14 Stat. 86; 18 *id.* 466; R. S. 2318. U. S. *v.* Gear, 3 How. 120; Cooper *v.* Roberts, 18 *id.* 73; U. S. *v.* Gratiot, 14 Pet. 526; Sparrow *v.* Strong, 3 Wall. 97; Secretary *v.* McGarrahan, 9 *id.* 298; Morton *v.* Nebraska. 21 *id.* 660; Heydenfeldt *v.* Mining Co., 3 Otto 634. U. S. *v.* Parrott, 1 McAlister, C. C. 272; U. S. *v.* Gratiot, 1 McLean, C. C. 454; Indiana *v.* Miller, 3 *id.* 151. 3 Op. Att. Gen. 277; 5 *id.* 247; 7 *id.* 636; 10 *id.* 184. Heydenfeldt *v.* Mining Co., 10 Nev. 290; Gold Hill Co. *v* Ish, 5 Oreg. 104; Hicks *v.* Bell, 3 Cal. 219; Stoakes *v.* Barrett, 5 *id.* 36; People *v.* Folson, 5 *id.* 373; Conger *v.* Weaver, 6 *id.* 548; Nims *v.* Johnson, 7 *id.* 111; Boggs *v.* Merced Mining Co. 14 *id.* 279; Burdge *v.* Smith, 14 *id.* 380; Moore *v.* Snaw, 17 *id.* 199; Lentz *v.* Victor, 17 *id.* 272; Fremont *v.* Seals, 18 *id.* 434; Rodgers *v.* Sogg, 22 *id.* 444; Rupley v. Welch, 23 *id.* 452; Doran *v.* Railway Co., 14 *id.* 245; Wixon *v.* Bear River Co., 24 *id.* 367; Ah Yew *v.* Choate, 24 *id.* 562; Higgins *v.* Houghton, 25 *id.* 252; Morton *v.* Salambo Mining Co., 26 *id.* 527; Alfred *v.* Barnum, 45 *id.* 482; McLaughlin *v.* Powell. 50 *id.* 64; Titcomb *v.* Kirk, 51 *id.* 288. Decisions Sec. Int., 6 Copp's L. O. 4; 7 *id.* 23. Decisions Com. G. L. O., Copp's Mg. Dec. 308; 2 Copp's L. O. 82; 7 *id.* 4. Cir. G. L. O., April 22, 1880.

Sec. 387. All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs and rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States.

17 Stat. 91; 19 *id.* 52; R. S. 2319. Cooper *v.* Roberts, 18 How. 173; Sparrow *v.* Strong, 3 Wall. 97; Heydenfeldt *v.* Mining Co., 3 Otto, 634; Forbes *v.* Gracey, 4 *id* 762. U.S. *v.* Parrott, 1 McAllister. C. C. 271: Chapman *v.* Toy Long, 4 Saw. C. C. 28; Mt. Diablo Mg. Co. *v.* Callison, 5 Saw. C. C. 439; Stroud *v.* Railway Co., 4 Dillon, C. C. 396. Hibschle *v.* Gildersleeve, U. S. Dist. Ct. Colo. 1880, in manuscript. 14 Op. Att. Gen. 115; *id.* Aug. 6, 1875, in manuscript. Rodgers *v.* Cooney, 7 Nev. 213; Golden Fleece Co. *v.* Cable Mg. Co., 12 *id.* 312; Territory *v.* Lee, 2 Montana, 124; Gold Hill Co. *v.* Ish, 5 Oreg. 204; Hicks *v.* Bell, 3 Cal. 219; Stoakes *v.* Barrett, 5 *id.* 36; Tartar *v.* Spring Creek Co., 5 *id.* 395; Bridge *v.* Underwood, 6 *id.* 45; Mitchell *v.* Hargood, 6 *id.* 148; Conger *v.* Weaver, 6 *id.* 558; Crandell *v.* Woods, 8 *id.* 136; Weimer *v.* Lowrey, 11 *id.* 104; Boggs *v.* Merced Mg. Co., 14 *id.* 279; Henshaw *v.* Clark, 14 *id.* 461; Clask v. Duval, 15 *id.* 85; Smith *v.* Doe, 15 *id.* 100; Moore *v.* Smaw, 17 *id.* 199; Lentz *v.* Victor, 17 *id*, 272; Fremont *v.* Seals, 18 *id.* 433; Logan *v.* Driscoll, 19 *id.* 623; Rupley *v.* Welch, 23 *id.* 452; Ensminger *v.* McIntire, 23 *id.* 593; Doran *v.* Railway Co., 24 *id.* 245; Richardson *v.* McNutty, 24 *id.* 339; Wixon *v.* Bear River Co. 24 *id.* 367; Ah Yew *v.* Choate, 24 *id.* 562; Higgins *v.* Houghton 25 *id.* 252; Morton *v.* Solambo Mg. Co., 26 *id.* 527; Gibson *v.* Puchta, 33 *id.* 310; Levaroni *v.* Miller, 34 *id.* 231; Alford *v.* Barnnm, 45 *id.* 482; McLauglin *v.* Powell, 50 *id.* 64; Laird *v.* Waterford, 50 *id.* 315; Titcomb *v.* Kirk, 51 *id.* 288. Decision Sec. Int., Aug. 26, 1871 (Copp's Mg. Dec. 60); Sept. 3, 1872 (*id.* 140); Jan. 2, 1875 (1 Copp's L. O. 178). Decisions Com. G. L. O., June 7, 1871 (Copp's Mg. Dec. 43); July 10, 1873 (*id* 209); July 15, 1873 (*id.* 316); July 26, 1873 (*id.* 214); May 2, 1874 (1 Copp's L. O. 4); Oct. 23, 1874 (1 *id.* 132); Jan. 30, 1875 (1 *id.* 75); June 30, 1875 (1 *id.* 79); Dec. 3, 1875: April 24, 1876 (3 Copp's L. O. 18); Nov. 13, 1877 (4 *id.* 179); Sept. 30, 1879.

Sec. 388. Mining claims upon veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, heretofore located, shall be governed as to length along the vein or lode by the customs, regulations, and laws in force at the date of their location. A mining claim located after the tenth day of May, eighteen hundred and seventy-two, whether located by one or more persons, may equal, but shall not exceed, one thousand five hundred feet in length along the vein or lode; but no location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located. No claim shall extend more than three hundred feet on each side of the middle of the vein at the surface, nor shall any claim be limited by any mining regulation to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the tenth day of May, eighteen hundred and seventy-two, render such limitation necessary. The end lines of each claim shall be parallel to each other.

17 Stat. 91; 19 *id.* 52; R. S. 2320. Flagstaff Silver Mg. Co. *v.* Tarbet 8 Otto, 463. The Eureka case, 4 Saw. C. C. 302; Mt. Diablo Mg. Co. *v.* Callison 5 *id.* 439. Mallett *v.* Uncle Sam Co., 1 Nev. 188; State *v.* Rhodes, 4 *id.* 312: Foot *v.* National Mg. Co., 2 Montana, 402; Moxon *v.* Wilkinson, 2 *id.* 421; Prosser *v.* Parks 18 Cal. 47; Logan *v.* Driscoll, 19 *id.* 623; Tunnell Co. *v.* Stranahan, 31 *id.* 387; Corea *v.* Frietas, 42 *id.* 339; Harvey *v.* Bryan, 42 *id.* 626; Titcomb *v.* Kirk, 51 *id.* 288. Decision Sec. Int., Aug. 26, 1874 (1 Copp's L. O. 83). Decisions Com. G. L. O., Nov. 6, 1869 (Copp's Mg. Dec. 23); Sept. 22, 1870 (*id.* 32); Aug. 4, 1871 (*id.* 57); Aug. 25, 1871 (*id.* 59): March 19, 1873 (*id.* 164); May 1, 1873 (*id.* 195); May 20, 1873 (*id.* 201); June 17, 1873 (*id.* 207); July 10, 1873 (*id.* 209); Nov. 18, 1873 (*id.* 235); Feb. 11, 1875 (1 Copp's L. O. 179): Dec. 29, 1875 (2 *id.* 146); Aug. 28, 1876 (3 *id.* 82); May 4, 1880 (7 *id.* 35).

Sec. 389. Proof of citizenship, under this chapter, may consist, in the case of an individual, of his own affidavit thereof; in the case of an association of persons unincorporated, of the affidavit of their authorized agent, made on his own knowledge, or upon information and belief; and in the case of a corporation organized under the laws of the United States, or of any State or Territory thereof, by the filing of a certified copy of their charter or certificate of incorporation.

17 Stat. 94; 19 *id.* 52; R. S. 2321. Craig *v.* Braford, 3 Wheat, 594; Governeur's heirs *v.* Robertson, 11 *id.* 332; Cross *v.* De Valle, 1 Wall. 1; Osterman *v.* Baldwin, 6 *id.* 116; Phillips *v.* Moore, 10 Otto, 208. 5 Op. Att. Gen. 551; *id.* Aug. 6, 1875, in manuscript. Jackson *v.* Beech, Johnson's cases, 401. Decisions Sec. Int., Gan. 2, 1874 (1 Copp's L. O. 178); April 1, 1875 (2 *id.* 2): July 29, 1876 (3 *id.* 68); July 26, 1879 (G. L. O. Rep. 1879, p. 157). Decisions Com. G. L. O., June 7, 1871 (Copp's Mg. Dec. 43); Aug. 13, 1872 (*id.* 134); Sept. 17, 1874 (1 Copp's L. O. 98); Oct. 28, 1875 (2 *id.* 114); April 14, 1876 (G. L. O. Rep. 1877, p. 83); July 18, 1876 (3 Copp's L. O. 69).

Sec. 390. The locators of all mining locations heretofore made or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply with the laws of the United States, and with State, Territorial, and local regulations not in conflict with the laws of the United States governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side lines of such surface locations. But their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as above described, through the end lines of their locations, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges. And nothing in this section shall authorize the locator or possessor of a vein or lode which extends in its downward course beyond the vertical lines of his claim to enter upon the surface of a claim owned or possessed by another. No possessory action between individuals, in any court of the United States, for the recovery of any mining title, or for damages to any such title, shall be affected by the fact that the paramount title to the land on which such mines are, is in the United States, but each case shall be adjudged by the law of possession.

13 Stat. 441; 17 *id.* 91; 19 *id.* 52; R. S. 910, 2322. Sparrow *v.* Strong, 3 Wall. 97; Heydenfeldt *v.* Mining Co., 3 Otto, 634; Forbes *v.* Gracey, 4 *id.* 762; Jennison *v.* Kirk, 8 *id.* 453; Flagstaff Silver Mg. Co. *v.* Tarbet, 8 *id.* 463. The 420 Mg. Co. *v.* The Bullion Co., 3 Saw. C. C. 634; The Eureka Case, 4 *id.* 302; Chapman *v.* Toy Long, 4 *id.* 28; Kinney *v.* Con. Va. Mg. Co. 4 *id.* 382; Mt. Diabolo Mg. Co. *v.* Callison, 5 *id.* 439; Hibschle *v.* Gildersleeve, U. S. Dist. Ct. Colo. 1880, in manuscript. Hale *et al. v.* Story Co., 1 Nev. 104, People *v.* Logan, 1 *id.* 109; Leet *v.* John Dare Mg. Co., 6 *id.* 218; Overman Co. *v.* American Mg. Co., 7 *id.* 312; Golden Fleece Co. *v.* Cable Co., 12 *id.* 312; Lincoln *v.* Rogers, 1 Montana, 217; Nelson *v.* O'Neil, 1 *id.* 284; Bucher *v.* Mulverhill, 1 *id.* 306; Robertson *v.* Smith, 1 *id.* 410; Atkins *v.* Hendree, 1 Idaho, 107; Gold Hill Mg. Co. *v.* Ish, 5 Oreg. 104; Patterson *v.* Hitchcock, 3 Colo. 533; Wolfley *v.* Lebanon Mg. Co., 4 *id.* 112; Fitzgerald *v.* Urton, 5 Cal. 308; Bridge *v.* Underwood, 6 *id.* 215; Mitchell *v.* Hargood, 6 *id.* 148; Sims *v.* Smith, 7 *id.* 149; Merced Mg. Co. *v.* Fremont, 7 *id.* 317; O'Keiff *v.* Cunningham, 9 *id.* 589; State *v.* Moore, 12 *id.* 56; Merritt *v.* Judd, 14 *id.* 60; Boggs *v.* Merced Mg. Co., 14 *id.* 279; Henshaw *v.* Clark, 14 *id.* 461; Clark *v.* Duval, 15 *id.* 85; Smith *v.* Doe, 15 *id.* 100; Pennsylvania Mg. Co. *v.* Owens, 15 *id.* 135; Esmond *v.* Chew, 15 *id.* 137; Brown *v.* 49 and 56 Co., 15 *id.* 152; Gillan *v.* Hutchinson, 16 *id.* 154; Coryell *v.* Cain, 16 *id.* 567; Attwood *v.* Fricot, 17 *id.* 38; English *v.* Johnson, 17 *id.* 108; Fremont *v.* Seals, 18 *id.* 433; Gore *v.* McBrayer, 18 *id.* 582; Logan *v.* Driscoll, 19 *id.* 623; Tunnel Co. *v.* Stranahan, 20 *id.* 198; Rogers *v.* Soggs, 22 *id.* 444; Gatewood *v.* McLaughlin, 23 *id.* 178; Hughes *v.* Devlin, 23 *id.* 501; Ensminger *v.* McIntire, 23 *id.* 593; Doran *v.* Railway Co., 24 *id.* 245; Richardson *v.* McNulty, 24 *id.* 339; Wixon *v.* Bear River Co., 24 *id.* 367; Higgins *v.* Houghton, 25 *id.* 252; St. John *v.* Kidd, 26 *id.* 264; Depuy *v.* Williams, 26 *id.* 309; Morton *v.* Solambo Mg. Co., 26 *id.* 527; Hess *v.* Winder, 30 *id.* 349; Tunnel Co. *v.* Stranahan, 31 *id.* 387; Hardenburgh *v.* Bacon, 33 *id.* 356; Gibson *v.* Puchta, 33 *id.* 310; Levaroni *v.* Miller, 34 *id.* 231; Hess *v.* Winder, 34 *id.* 270; Pralus *v.* Jefferson Mg. Co., 34 *id.* 559; Pralus *v.* Pacific Mg. Co., 35 *id.* 30; Clark *v.* Willett, 35 *id.* 535; Maine Boys Co. *v.* Boston Co., 37 *id.* 40; Bradley *v.* Lee, 38 *id.* 362; Correa *v.* Frietas, 42 *id.* 339; Harvey *v.* Bryan, 42 *id.* 626; Gregory *v.* Harris, 43 *id.* 38; Stone *v.* Bumpus, 46 *id.* 218; Quirk *v.* Tralk, 47 *id.* 453; Laird *v.* Waterford, 50 *id.* 315; Titcomb *v.* Kirk, 51 *id.* 288; Phœnix Co. *v.* Lawrence, S. C. Cal. 1880, in manuscript. Decisions Com. G. L. O., Sept. 28, 1878 (5 Copp's L. O. 116); May 4, 1880 (7 *id.* 35).

Sec. 391. Where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins on the line of such tunnel.

17 Stat. 92; 19 *id.* 52; R. S. 2323. Tunnel Co. *v.* Pell, 4 Colo. 507; Titcomb *v.* Kirk, 51 Cal. 288. Decisions Com. G. L. O., Sept. 20, 1872 (Copp's Mg. Dec. 144); April 15, 1873 (*id* 193); Aug. 1, 1873 (*id.* 215); Nov. 3, 1876 (3 Copp's L. O. 130); Aug. 30, 1877 (4 *id.* 102); Jan. 6, 1878 (5 *id.* 134).

Sec. 392. The miners of each mining district may make regulations not in conflict with the laws of the United States, or with the laws of the State or Territory in which the district is situated, governing the location, manner of recording, amount of work necessary to hold possession of a mining claim, subject to the following requirements: The location must be distinctly marked on the ground so that its boundaries can be readily traced. All records of mining claims hereafter made shall contain the name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim. On each claim located after the tenth day of May, eighteen hundred and seventy-two, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year: *Provided*, That the period within which the work required to be done annually on all unpatented claims, so located, shall commence on the first day of January succeeding the date of location of such claim. On all claims located prior to the tenth day of May, eighteen hundred and seventy-two, ten dollars' worth of labor shall be performed or improvements made by the first day of January, eighteen hundred and seventy-five, and each year thereafter, for each one hundred feet in length along the vein until a patent has been issued therefor; but where such claims are held in common, such expenditure may be made upon any one claim; and where a person or company has or may run a tunnel for the purposes of developing a lode or lodes, owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, whether located prior to or since the tenth day of May, eighteed hundred and seventy-two, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same as required by said act. Upon a failure to comply with the foregoing conditions of annual expenditure, the claim or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made: *Provided*, That the original locatros, their heirs, assigns, or legal representatives have not resumed work upon the claim after failure and before such location. Upon the failure of any one of several co-owners to contribute his proportion of the expenditures required hereby, the co-owners who have performed the labor or made the improvements may, at the expiration of the year, give such delinquent co-owner personal notice in writing or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days, and if at the expiration of ninety days after such notice in writing or by publication such delinqent should fail or refuse to contribute his proportion of the expenditure required by this section, his interest in the claim shall become the property of his co-owners who have made the required expenditures.

17 Stat. 92; 18 *id.* 61, 315; 19 *id.* 52; 21 *id.* 61; R. S. 2324. *Location, Record and Evidence:* Campbell *v.* Rankin, 9 Otto, 261. Kinney *v.* Con. Va. Mg. Co., 4 Saw. C. C. 382. Hibschle *v.* Gildersleeve, U. S. Dist. Ct. Colo. 1880, in manuscript. Mallet *v.* Uncle Sam Co., 1 Nev. 108; Van Valkenburgh *v.* Huff, 1 *id.* 142; Chase *v.* Savage Mg. Co., 2 *id.* 9; Rogers *v.* Cooney, 7 *id.* 213; Phillpotts *v.* Blasdell, 8 *id.* 61; Weill *v.* Lucerne Co., 11 *id.* 200; Golden Fleece Co. *v.* Cable Mg. Co., 12 *id.* 312; Gleason *v.* Martin White Co., 13 *id.* 442; Roberts *v.* Wilson, 1 Utah, 292; Conner *v.* McPhee, 1 Montana, 73; King *v.* Edwards, 1 *id.* 235; Bucher *v.* Mulverhill, 1 *id.* 306; Territory *v.* Lee, 2 *id.* 124; Moxon *v.* Wilkinson, 2 *id.* 421; Murley *v.* Ennis, 2 Colo. 300; Sullivan *v.* Hense, 2 *id.* 424; Patterson *v.* Hitchcock, 3 *id.* 533; Wolfley *v.* Lebanon Co., 4 *id.* 112; Sears *v.* Taylor, 4 *id.* 38; Hicks *v.* Bell, 3 Cal. 219; Fairbanks *v.* Woodhouse, 6 *id.* 433; Live Yankee Co. *v.* Oregon Co., 7 *id.* 41; Packer *v.* Heaton, 9 *id.* 569; McGarity

v. Byington, 12 *id.* 431; Water Co. *v.* Mooney, 12 *id.* 534; Pennsylvania Mg. Co. *v.* Owens, 15 *id.* 135; Lombards *v.* Ferguson, 15 *id.* 372; Gillan *v.* Hutchinson, 16 *id.* 154; Roach *v.* Gray, 16 *id.* 383; Attwood *v.* Fricot, 17 *id.* 38; English *v.* Johnson, 17 *id.* 108; Prosser *v.* Parks, 18 *id.* 47; Gore *v.* McBrayer, 18 *id.* 582; Downing *v.* Rankin, 19 *id.* 641; Tunnel Co. *v.* Stranahan, 20 *id.* 198; Kelley *v.* Taylor, 23 *id.* 11; Coleman *v.* Clements, 23 *id.* 245; Maye *v.* Teppin, 23 *id.* 306; Draper *v.* Douglass, 23 *id.* 347; Cary *v.* Campbell, 24 *id.* 634; St. John *v.* Kidd, 26 *id.* 264; Morton *v.* Solambo Mg. Co., 26 *id.* 527; Wilson *v.* Cleveland, 30 *id.* 192; Hess *v.* Winder, 30 *id.* 349; Patterson *v.* Keystone Mg. Co., 30 *id.* 360; Tunnel Co. *v.* Stranahan, 31 *id.* 387; King *v.* Randlett, 33 *id.* 318; Pralus *v.* Jefferson Mg. Co., 34 *id.* 559; Pralus *v.* Pacific Mg. Co., 35 *id.* 30; Bell *v.* Tunnel and Mg. Co., 36 *id.* 214; Bradley *v.* Lee, 38 *id.* 362; Hastings *v.* Devlin, 40 *id.* 358; Harvey *v.* Ryan, 42 *id.* 626; Strang *v.* Ryan, 46 *id.* 33; Meyers *v.* Farquharson, 46 *id.* 190; Quirk *v.* Tralk, 47 *id.* 453; McLaughlin *v.* Powell, 50 *id.* 64; Titcomb *v.* Kirk, 51 *id.* 288; Morenhaut *v.* Wilson, 52 *id.* 226; Stone *v.* Geyser, 52 *id.* 315; Holland *v.* M. A. G. Mg. Co., 53 *id.* 149; Gelcich *v.* Moriarity, 53, 217; Phœnix Co. *v.* Lawrence, Myers *v.* Spooner, S. C. Cal. 1880, in manuscript. Decision Sec. Int., April 1, 1875 (2 Copp's L. O. 2). Decisions Com. G. L. O., May 16, 1873 (Copp's Mg. Dec. 200); Aug. 28, 1876 (3 Copp's L. O. 82); June 13, 1876 (3 *id.* 50); Oct. 20, 1876 (6 *id.* 122).

Expenditures: Mt. Diabolo Mg. Co. *v.* Callison, 5 Saw. C. C. 439. Decisions Sec. Int., Sept. 4, 1872 (Copp's Mg. Dec. 136); March 4, 1879 (6 Copp's L. O 2). Decisions Com. G. L. O., March 11, 1875 (Skidmore, 47); Jan. 6, 1878 (5 Copp's L. O., 134); Aug. 20, 1879 (G. L. O. Rep. 1879, p. 144); Sept. 12, 1879 (*id.* 143); Oct. 20, 1879 (6 Copp's L. O. 122); May 1, 1880 (7 *id.* 20).

Abandonment and Forfeiture: Hibschle *v.* Gildersleeve, U. S. Dist. Ct. Colo. 1880, in manuscript; Mallett *v.* Uncle Sam Co., 1 Nev. 188; Oreamuns *v.* Uncle Sam Co., 1 *id.* 215; Weill *v.* Lucerne Co., 11 *id.* 200; King *v.* Edwards, 1 Montana, 235; Atkins *v.* Hendree, 1 Idaho, 107; Murley *v.* Ennis, 2 Colo. 300; Fairbanks *v.* Woodhouse, 6 Cal. 433; Davis *v.* Butler, 6 *id.* 510; Ferris *v.* Cooper, 10 *id.* 589; Waring *v.* Crow, 11 *id.* 366; Gluckauf *v.* Reed, 22 *id.* 468; Coleman *v.* Clements, 23 *id.* 245; Richardson *v.* McNulty, 24 *id.* 339; Wiseman *v.* McNulty, 25 *id.* 230; St. John *v.* Kidd, 26 *id.* 264; Depuy *v.* Williams, 26 *id.* 309; Wilson *v.* Cleveland, 30 *id.* 192; Bell *v.* Tunnel and Mg. Co., 36 *id.* 214; Judson *v.* Mulloy, 40 *id.* 300; Strang *v.* Ryan, 46 *id.* 33; Morenbaut *v.* Wilson, 52 *id.* 226; Meyers *v.* Spooner, S. C. Cal. 1880, in manuscript.

Relocations: Decisions Sec. Int., Nov. 6, 1873 (Copp's Mg. Dec. 191); May 22, 1878 (5 Copp's L. O. 50); June 29, 1878 (5 *id.* 66). Decisions Com. G. L. O., Sept. 25, 1873 (Copp's Mg. Dec. 225); April 21, 1876 (3 Copp's L. O. 37); Dec. 13, 1878 (5 *id.* 162).

Transfers: Mining Co. *v.* Taylor, 10 Otto, 37. Kinney *v.* Con. Va. Mg. Co., 4 Saw. C. C. 382. Phillpotts *v.* Blasdell, 8 Nev. 61; Weill *v.* Lucerne Co., 11 *id.* 200; Sullivan *v.* Hense, 2 Colo. 424; McCarron *v.* O'Connell, 7 Cal 152; Clark *v.* McElroy, 11 *id.* 154; Jackson *v.* Feather River Co., 14 *id.* 18; Attwood *v.* Fricot, 17 *id.* 38; Tunnel Co. *v.* Stranahan, 20 *id.* 198; Gatewood *v.* McLaughlin, 23 *id.* 178; Antonie Co. *v.* Ridge Co., 23 *id.* 219; Draper *v.* Douglas, 23 *id.* 347; Patterson *v.* Keystone Co., 23 *id.* 575; Richardson *v.* McNulty, 24 *id.* 339; Cary *v.* Campbell, 24 *id.* 634; Copper Hill Mg. Co. *v.* Spencer, 25 *id.* 18; St. John *v.* Kidd, 26 *id.* 264; Duryea *v.* Burt, 28 *id.* 569; Hess *v.* Winder, 30 *id.* 349; Patterson *v.* Keystone Mg. Co., 30 *id.* 360; Goller *v.* Fett, 30 *id.* 481; Settembre *v.* Putnam, 30 *id.* 490; King *v.* Randlett, 33 *id.* 318; Hardenburgh *v.* Bacon, 33 *id.* 356; Blodgett *v.* Potosi Mg. Co., 34 *id.* 227; Felger *v.* Coward, 35 *id.* 650; Meyers *v.* Farquharson, 46 *id.* 190. Decision Com. G. L. O., June 9, 1873 (Copp's Mg. Dec. 202).

Co-owners: The 420 Mg. Co. *v.* The Bullion Co., 3 Saw. C. C. 634. Mallett *v.* Uncle Sam Co., 1 Nev. 188; Chase *v.* Savage Co., 2 *id.* 9; Bucher *v.* Mulverhill, 1 Montana, 306; Murley *v.* Ennis, 2 Colo. 300; Waring *v.* Crow, 11 Cal. 366; Gore *v.* McBrayer, 18 *id.* 582; Rowe *v.* Bacigalluppi, 21 *id.* 633; Coleman *v.* Clements, 23 *id.* 245; Hughes *v.* Devlin, 23 *id.* 501; Wiseman *v.* McNulty, 25 *id.* 230; Morton *v.* Solambo Co., 26 *id.* 527; Duryea *v.* Burt, 28 *id.* 569; Goller *v.* Fett, 30 *id.* 481; Settembre *v.* Putnam, 30 *id.* 490; Jones *v.* Clark, 42 *id.* 180; Taylor *v.* Castle, 42 *id.* 367; Decker *v.* Howell, 42 *id.* 636; Strang *v.* Ryan, 46 *id.* 33. Decisions Com. G. L. O., July 19, 1876 (3 Copp's L. O. 66); June 9, 1877 (4 *id.* 50); Dec. 21, 1877 (5 *id.* 4).

Sec. 393. A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association, or corporation authorized to locate a claim under this chapter, having claimed and located a piece of land for such purposes, who has, or have, complied with the terms of this chapter, may file in the proper land office an application for a patent, under oath, showing such compliance, together with a plat and field-notes of the claim or claims in common, made by or under the direction of the United States surveyor-general, showing accurately the boundaries of the claim or claims, which shall be distinctly marked by monuments on the ground, and shall post a copy of such plat, together with a notice of such application for a patent, in a conspicuous place on the land embraced in such plat previous to the filing of the application for a patent, and shall file an affidavit of at least two persons that such notice has been duly posted, and shall file a copy of the notice in such land office, and shall thereupon be entitled to a patent for the land, in the manner following: The register of the land office, upon the filing of such application, plat, field-notes, notices, and affidavits, shall publish a notice that such application has been made, for the period of sixty days, in a newspaper to be by him designated as published nearest to such claim; and he shall also post such notice in his office for the same period. The claimant at the time of filing this application, or at any time thereafter, within the sixty days of publication, shall file with the register a certificate of the United States surveyor-general that five hundred dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors; that the plat is correct, with such further description by such reference to natural objects or permanent monuments as shall identify the claim, and furnish an accurate description, to be incorporated in the patent. At the expiration of the sixty days of publication the claimant shall file his affidavit, showing that the plat and notice have been posted in a conspicuous place on the claim during such period of publication. If no adverse claim shall have been filed with the register and the receiver of the proper land office at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists; and thereafter no objection from third parties to the issuance of a patent shall be heard, except it be shown that the applicant has failed to comply with the terms of this chapter. Where the claimant for a patent is not a resident of or within the land district wherein the vein, lode, ledge or deposit sought to be patented is located, the application for patent and the affidavits required to be made in this section may be made by his, her, or its authorized agent, where said agent is conversant with the facts sought to be established, and this provision shall apply to all applications for patents to mineral lands pending on the twenty-second day of January, eighteen hundred and eighty.

17 Stat. 92; 19 *id.* R. S. 52, 21 *id.* 61; 2325.

Applications: Decisions Sec. Interior, Nov. 6. 1873 (Copp's Mg. Dec. 191); March 22, 1875 (2 Copp's L. O. 5); June 29, 1875 (G. L. O. Rep. 1876, p. 78); Jan. 3. 1877 (3 Copp's L. O. 196). Decisions Com. G. L. O., Sept 21, 1872 (Copp's Mg. Dec. 145); Feb. 18, 1875 (*id.* 159); March 24, 1873 (*id.* 165); April 15, 1873 (*id.* 188); Jan. 22, 1873 (*id.* 157); Jan. 6, 1874 (*id.* 340, July 21, 1874); (1 Copp's L. O. 66); Aug. 18, 1874 (1 *id.* 83); Dec. 14, 1874 (1 *id.* 146); Jan. 2, 1875 (1 *id.* 178): Feb. 18, 1875 (Copp's Mg. Dec. 159); Aug. 17, 1876); Copp's L. O. 82); Nov. 12, 1875 (2 *id.* 130); Dec. 20, 1875 (2 *id.* 146); April 29, 1876 (3 *id.* 18); April 20, 1877 (4 *id.* 35); Oct. 20, 1879 (6 *id.* 122).

Agents and Attorneys: Decision Sec. Int., March 2, 1880 (7 Copp's L. O. 20). Decisions Com. G. L. O. Aug. 20, 1873 (Copp's Mg. Dec. 222); Aug. 26, 1879 (6 Copp's L. O. 92); Sept. 19, 1879 (G. L. O. Rep. 1879, p. 143); Oct. 20, 1879 (6 Copp's L. O. 122).

Expenditures: Mt. Diabolo Mg. Co. *v.* Callison, 5 Saw C. C. 438. Week's Mg. Laws, 113, 115, 116, 118, 120, 121. Dec. Sec. Int., Sept. 6, 1878 (6 Copp's L. O. 100); June 23, 1879 (7 *id.* 5).

Notice: Wolfley *v.* Lebanon Co. 4 Colo. 112. Decisions Sec. Int. Dec. 5, 1871 (Copp's Mg. Dec. 70); Nov. 24, 1873 (*id.* 169); April 30, 1874 (1 Copp's L. O. 34) Jan. 2, 1875 (1 *id.* 178); April 1, 1875 (2 *id.* 2); Dec. 1, 1876 (3 *id.* 163). Dec. Com. G. L. O.. June 19, 1873 (*id.* 200); Nov. 12, 1873 (*id.* 234); July 21, 1874 (1 Copp's L. O. 66); Nov. 12, 1875 (2 *id.* 130); March 7, 1876 (2 *id.* 180); April 21, 1876 (3 *id.* 18); Dec. 1, 1876 (3 *id.* 163); Jan. 4, 1877 (3 *id.* 196); Aug. 26, 1879 (6 *id.* 92); Oct. 29, 1879; April 30, 1880.

Payment: Decision Com. G. L. O., Jan. 30, 1873 (Copp's Mg. Dec. 157.

Protestants: Dec Sec. Int. April 30, 1874 (1 Copp's L. O. 34; March 24, 1876 4, *id.* 34); Feb. 17, 1877, 3 *id.* 194; March 10, 1877 (4 *id.* 3): July 21, 1879 (6 *id.* 23). Decisions Com. G. L. O., Aug. 17, 1874 (1 Copp's L. O. 81); Oct. 8, 1875 (2 *id.* 115).

Patents: Decisions Sec. Int., Jan. 14, 1873 (Copp's Mg. Dec. 152); Jan. 2, 1875 (1 Copp's L. O. 178); March 22, 1875 (2 *id.* 5); April 1, 1875 (2 *id.* 2); March 4, 1875 (2 *id.* 82); July 21, 1879 (6 *id* 73). Decisions Com. G. L. O., Jan. 21, 1869 (Copp's Mg. Dec. 18); July 22, 1869 (*id.* 21); April 18, 1870 (*id.* 30); Jan. 2, 1872 (*id.* 72); Feb. 27, 1872 (*id.* 79); April 4, 1872 (*id.* 85); April 5, 1872 (*id.* 88); Oct. 2, 1872 (*id.* 146); March 8, 1873 (*id.* 162); July 26, 1873 (*id.* 213); Oct. 22, 1873 (*id.* 227); March 14, 1874 (1 Copp's L. O. 2); June 22, 1875 (2 *id.* 98); Oct. 26, 1875 (2 *id.* 114); Dec. 20, 1875 (2 *id.* 146); Feb. 25, 1876 (2 *id.* 178); Jan. 15, 1880 (6 *id.* 171).

Right of Purchase: The 420 Mg. Co. *v.* The Bullion Co., 3 Saw. C. C. 634: Chapman *v.* Toy Long, 4 *id.* 28. Titcomb *v.* Kirk, 51 Cal. 288.

Surveys: Decisions Sec. Int., May 22, 1878 (5 Copp's L. O. 50); Sept. 6, 1878 (5 *id.* 100); Aug. 2, 1880 (8 Wash. Law. Rep. 540); Aug. 16, 1880. Decisions Com. G. L. O., April 17, 1873 (Copp's Mg. Dec. 193); Sept. 11, 1873 (*id.* 223); Jan. 6, 1874 (*id.* 340); Nov. 5, 1874 (1 Copp's L. O. 133); April 24, 1876 (3 *id.* 18); Aug. 28, 1876 (3 *id.* 82; April 10, 1877 (5 *id.* 51); Nov. 30, 1877 (5 *id.* 18); Oct. 20. 1879 (6 *id.* 122); May 4, 1880 (7 *id.* 35); June 17, 1880 (7 *id.* 51); Aug. 9, 1880 (7 *id.* 82).

Sec. 394. Where an adverse claim is filed during the period of publication, it shall be upon oath of the person or persons making the same, and shall show the nature, boundaries, and extent of such adverse claim, and all proceedings, except the publication of notice and making and filing of the affidavit thereof, shall be stayed until the controversy shall have been settled or decided by a court of competent jurisdiction, or the adverse claim waived. It shall be the duty of the adverse claimant, within thirty days after filing his claim, to commence proceedings in a court of competent jurisdiction, to determine the question of the right of possession, and prosecute the same with reasonable diligence to final judgment; and a failure so to do shall be a waiver of his adverse claim. After such judgment shall have been rendered, the party entitled to the possession of the claim, or any portion thereof, may, without giving further notice, file a certified copy of the judgment-roll with the register of the land office, together with the certificate of the surveyor-general that the requisite amount of labor has been expended or improvements made thereon, and the description required in other cases, and shall pay to the receiver five dollars per acre for his claim, together with the proper fees, whereupon the whole proceedings and the judgment-roll shall be certified by the register to the Commissioner of the General Land Office, and a patent shall issue thereon for the claim, or such portion thereof as the applicant shall appear, from the decision of the court, to rightly possess. If it appears from the decision of the court that several parties are entitled to separate and different portions of the claim, each party may pay for his portion of the claim, with the proper fees, and file the certificate and description by the surveyor-general, whereupon the register shall certify the proceedings and judgment-roll to the Commissioner of the General Land Office, as in the preceding case, and patents shall issue to the several parties according to their respective rights. Nothing herein contained shall be construed to prevent the alienation of the title conveyed by a patent for a mining claim to any person whatever.

17 Stat. 93; 19 *id.* 52; R. S. 2326. The Eureka Case, 4 Saw. C. C. 302. Golden Fleece Co. *v.* The Cable Co., 12 Nev. 312; Sears *v.* Taylor, 4 Colo. 38. Decisions Sec. Int., March 11, 1872 (G. L. O. Rep. 1873, p. 43); May 27, 1872 (G. L. O. Rep. 1873, p. 19); Feb. 24, 1873 (Copp's Mg. Dec. 101); Oct. 28, 1873 (*id.* 161); Aug. 9, 1874 (2 Copp's L. O. 98); Sept. 9, 1874 (1 *id.* 98); Jan. 2, 1875 (1 *id.* 178); March 22, 1875 (2 *id.* 5): Feb. 12, 1876 (2 *id.* 178); Dec. 26, 1876 (3 *id.* 162); Feb. 17, 1877 (3 *id.* 195); Feb. 17, 1877 (G. L. O. Rep. 1877, p. 129); April 17, 1877 (4 Copp's L. O. 34); Jan. 3, 1877 (3 *id.* 196); July 14, 1877 (4 *id.* 66); Sept. 27, 1877 (G. L. O. Rep. 1877, p. 135); May 21, 1879 (6 Copp's L. O. 73): June 25, 1879 (G. L. O. Rep. 1879, p. 148); July 17, 1879 (*id.* 145). Decisions Com. G. L. O., Dec. 29, 1871 (Copp's Mg. Dec. 76); Jan. 14, 1873 (*id.* 156); June 9, 1873 (*id.* 202); Nov. 24, 1873 (*id.* 145); July 21, 1874 (1 Copp's L. O. 66); Oct. 24, 1874 (1 *id.* 132); Dec. 14, 1874 (1 *id.* 146); May 12, 1876 (3 *id.* 36); Dec. 19, 1878 (5 *id.* 162); Sept. 12, 1879 (6 *id.* 105); Sept. 19, 1879 (6 *id.* 105); Feb. 28, 1880 (7 *id.* 50); April 15, 1880 (7 *id.* 51); June 28, 1880 (7 *id.* 50); July 15, 1880 (8 Wash. Law Rep. 461).

Sec. 395. The description of vein or lode claims, upon surveyed lands, shall designate the location of the claim with reference to the lines of the public surveys, but need not conform therewith; but where a patent shall be issued for claims upon unsurveyed lands, the surveyor-general, in extending the surveys, shall adjust the same to the boundaries of such patented claim, according to the plat or description thereof, but so as in no case to interfere with or change the location of any such patented claim.

17 Stat. 94; 19 *id.* 52; R. S. 2327.

Sec. 396. Applications for patents for mining claims under former laws now pending may be prosecuted to a final decision in the General Land Office; but in such cases where adverse rights are not affected thereby, patents may issue in pursuance of the provisions of this chapter; and all patents for mining claims upon veins or lodes heretofore issued shall convey all the rights and privileges conferred by this chapter where no adverse rights existed on the tenth day of May, eighteen hundred and seventy-two.

17 Stat. 94; 19 *id.* 52; R. S. 2328.

Sec. 397. Claims usually called "placers," including all forms of deposit, excepting veins or quartz, or other rock in place, shall be subject to entry and patent, under like circumstances and conditions, and upon similar proceedings, as are provided for vein or lode claims; but where the lands have been previously surveyed by the United States the entry in its exterior limits shall conform to the legal subdivisions of the public lands.

16 Stat. 217; R. S. 2329. Chapman *v.* Toy Long, 4 Saw. C. C. 28. Moxon *v.* Wilkinson, 2 Montana, 421. Decisions Sec. Int., March 4, 1879 (6 Copp's L. O. 4). Decisions Com. G. L. O., Feb. 12, 1872 (Copp's Mg. Dec. 78); April 18, 1873, (*id.* (194); April 25, 1874 (1 Copp's L. O. 18).

Sec. 398. Legal subdivisions of forty acres may be subdivided into ten-acre tracts; and two or more persons, or associations of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; but no location of a placer claim, made after the ninth day of July, eighteen hundred and seventy, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona-fide pre-emption or homestead claim upon agricultural lands, or authorize the sale of the improvements of any bona-fide settler to any purchaser.

16 Stat. 217; R. S. 2330. Campbell *v.* Adams, U. S. Dist. Ct. Colo. 1880, in manuscript. Decisions Com. G. L. O., March 1, 1871 (Copp's Mg. Dec. 40); Jan. 20, 1873 (*id.* 157); July 10, 1873 (*id.* 211); Oct. 23, 1873 (*id.* 229); Nov. 20, 1873 (*id.* 235); Nov. 21, 1874 (1 Copp's L. O. 134); Sept. 20, 1879 (G. L. O. Rep. 1879, p. 143).

Sec. 399. Where placer claims are upon surveyed lands, and conform to legal subdivisions, no further survey or plat shall be required, and all placer-mining claims located after the tenth day of May, eighteen hundred and seventy-two, shall conform as near as practicable with the United States system of public land surveys, and the rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands; and where by the segregation of mineral land in any legal subdivision a quantity of agricultural land less than forty acres remains, such fractional portion of agricultural land may be entered by any part qualified by law, for homestead or pre-emption purposes.

17 Stat. 94; 19 *id* 52; R. S. 2331. Cambell *v.* Adams, U. S. Dist. Ct. Colo. 1880, in manuscript. Decisions Com. G. L. O., May 19, 1873 (Copp's Mg. Dec. 200); Aug. 27, 1873 (*id.* 222).

Sec. 400. Where such person or association, they and their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim; but nothing in this chapter shall be deemed to impair any lien which may have attached in any way whatever to any mining claim or property thereto attached prior to the issuance of a patent.

16 Stat. 217; R. S. 2332. The 420 Mg. Co. *v.* The Bullion Co., 3 Saw. C. C. 634. Davis *v.* Clark, 2 Montana, 310; Maine Boys Co. *v.* Boston Co., 37 Cal. 40.

Sec. 401. Where the same person, association, or corporation is in possession of a placer claim, and also a vein or lode included within the boundaries thereof, application shall be made for a patent for the placer claim, with the statement that it includes such a vein or lode, and in such case a patent shall issue for the placer claim, subject to the provisions of this chapter, including such vein or lode, upon the payment of five dollars per acre for such vein or lode claim, and twenty-five feet of surface on each side thereof. The remainder of the placer claim, or any placer claim not embracing any vein or lode claim, shall be paid for at the rate of two dollars and fifty cents per acre, together with all costs of proceedings; and where such a vein or lode, such as is described in section three hundred and eight-eight, is known to exist within the boundaries of a placer claim, an application for a patent for such placer claim, which does not include an application for the vein or lode claim shall be construed as a conclusive declaration that the claimant of the placer claim has no right of possession of the vein or lode claim; but where the existence of a vein or lode in a placer claim is not known, a patent for the placer claim shall convey all valuable mineral and other deposits within the boundaries thereof.

17 Stat. 94; 19 *id.* 52. R. S. 2333. Decision Com. G. L. O. Oct. 17, 1873 (Copp's Mg. Dec. 226).

Sec. 402. The surveyor-general of the United States may appoint in each land district containing mineral lands as many competent surveyors as shall apply for appointment to survey mining claims. The expenses of the survey of vein or lode claims, and the survey and subdivision of placer claims into smaller quantities than one hundred and sixty acres, together with the cost of publication of notices, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States deputy surveyor to make the survey. The Commissioner of the General Land Office shall also have power to establish the maximum charges for surveys and publication of notices under this chapter; and, in case of excessive charges for publication, he may designate any newspaper published in a land district where mines are situated for the publication of mining notices in such district, and fix the rates to be charged by such paper; and, to the end that the Commissioner may be fully informed on the subject, each applicant shall file with register a sworn statement of all charges and fees paid by such applicant for publication and surveys, together with all fees and money paid the register and the receiver of the land office, which statement shall be transmitted, with the other papers in the case, to the Commissioner of the General Land Office.

17 Stat. 95; 19 *id.* 52; R. S. 2334. Decision Com. G. L. O., Aug. 6, 1872 (Copp's Mg. Dec. 131).

Sec. 403. All affidavits required to be made under this chapter may be verified before any officer authorized to administer oaths within the land district where the claims may be situated, and all testimony and proofs may be taken before any such officer, and when duly certified by the officer taking the same, shall have the same force and effect as if taken before the register and receiver of the land office. In cases of contest as to the mineral or agricultural character of land, the testimony and proofs may be taken as herein provided on personal notice of at least ten days to the opposing party; or if such party cannot be found, then by publication of at least once a week for thirty days in a newspaper, to be designated by the register of the land office as published nearest to the location of such land; and the register shall require proof that such notice has been given.

17 Stat. 95; 19 *id.* 52; R. S. 2335. Decisions Com. G. L. O., July 21, 1874 (1 Copp's L. O. 66); Jan. 27, 1876 (2 *id.* 162).

Sec. 404. Where two or more veins intersect or cross each other, priority of title shall govern, and such prior location shall be entitled to all ore or mineral contained within the space of intersection; but the subsequent location shall have the right of way through the space of intersection for the purposes of the convenient working of the mine. And where two or more veins unite, the oldest or prior location shall take the vein below the point of union, including all the space of intersection.

17 Stat. 96; 19 *id.* 52; R. S. 2336. Decisions Sec. Int., Feb. 24, 1873 (Copp's Mg. Dec. 96, 101); July 21, 1879, (6 Copp's L. O. 73). Decision Com. G. L. O., Feb. 25, 1876 (2 Copp's L. O. 178).

Sec. 405. Where non-mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface-ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz-mill or reduction-works, not owning a mine in connection therewith, may also receive a patent for his mill-site, as provided in this section.

17 Stat. 96; 19 *id.* 52; R. S. 2337. Decisions Sec. Int., April 29, 1876 (3 Copp's L. O. 67). Decisions Com. G. L. O., Oct. 11, 1872 (Copp's Mg. Dec. 147); April 16, 1873 (*id.* 193); May 20, 1873 (*id.* 201); March 10. 1874 (1 Copp's L. O. 4); Oct. 21, 1875 (2 *id.* 114); Sept. 24. 1879.

Sec. 406. As a condition of sale, in the absence of necessary legislation by Congress, the local legislature of any State or Territory may provide rules for working mines, involving easements, drainage, and other necessary means to their complete development; and those conditions shall be fully expressed in the patent.

14 Stat. 252; 19 *id.* 52; R. S. 2338.

Sec. 407. Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

14 Stat. 253; R. S. 2339. Atchison *v.* Peterson, 20 Wall. 507; Basey *v.* Gallagher, 20 *id.* 670; Jennison *v.* Kirk, 8 Otto, 453. Decisions Com. G. L. O., Nov. 23, 1869 (Copp's Mg. Dec. 24); April 16, 1871 (*id.* 42); March 21, 1872 (*id.* 82).

Sec. 408. All patents granted, or pre-emption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights, as may have been acquired under or recognized by the preceding section.

16 Stat. 218; R. S. 2340.

Sec. 409. Wherever, upon the lands heretofore designated as mineral lands, which have been excluded from survey and sale, there have been homesteads made by citizens of the United States, or persons who have declared their intention to become citizens, which homesteads have been made, improved, and used for agricultural purposes, and upon which there have been no valuable mines of gold, silver, cinnabar, or copper discovered, and which are properly agricultural lands, the settlers or owners of such homesteads shall have a right of pre-emption thereto, and shall be entitled to purchase the same at the price of one dollar and twenty-five cents per acre, and in quantity not to exceed one hundred and sixty acres; or they may avail themselves of the provisions of chapter eight, relating to "Homesteads."

14 Stat. 253; R. S. 2341. Ah Yew *v.* Choate, 24 Cal. 562: Alford *v.* Barnum, 45 *id.* 482. Decisions Sec. Int., Feb. 12, 1872 (Copp's Mg. Dec. 77); May 6, 1872 (*id.* 93); July 10. (*id.* 128, 130); Dec. 14, 1872 (*id.* 3, 133); Jan. 1876 (2 Copp's L. O. 146); Feb. 5, 1876 (2 *id.* 180; 3 *id.* 2); Dec. 20, 1876 (4 *id.* 102); April 5, 1877 (4 *id.* 19); June 21, 1877 (5 *id.* 3); Feb. 16, 1878 (5 *id.* 3); March 4, 1879 (6 *id.* 4); Dec. 22, 1879 (7 *id.* 23); April 7, 1880 (7 *id.* 36). Decisions Com. G. L. O., Nov. 14, 1872 (Copp's Mg. Dec, 148); Oct. 21, 1871 (*id.* 60); Dec. 2, 1872 (*id.* 150); March 12, 1873 (*id.* 163); July 10, 1873 (*id.* 208); Nov. 11, 1873 (*id.* 233); Aug. 4, 1874 (2 Copp's L. O. 84); Feb. 18, 1875 (1 *id.* 180); June 21, 1876 (3 *id.* 50); Oct. 24, 1876 (3 *id.* 130); March 21, 1877 (4 *id.* 2); March 26, 1877 (4 *id.* 17); Nov. 6, 1879 (6 *id.* 135). Cir. G. L. O., April 22, 1880 (7 Copp's L. O. 36).

Sec. 410. Upon the survey of the lands described in the preceding section, the Secretary of the Interior may designate and set apart such portions of the same as are clearly agricultural lands, which lands shall thereafter be subject to pre-emption and sale as other public lands, and be subject to all the laws and regulations applicable to the same.

14. Stat. 253; R. S. 2342. Ah Yew *v.* Choate, 24 Cal. 562; Alford *v.* Barnum, 45 *id.* 482. Decisions Sec. Int., Feb. 12, 1872 Copp's Mg. Dec. 77); May 6, 1872 (*id.* 93, July 10, 1872, *id.* 128, 130); Dec. 14, 1872 (*id.* 133); Jan. 3, 1876 (2 Copp's L. O. 146); Feb. 5, 1876 (2 *id.* 180; 3 *id.* 2); Dec. 20, 1876 (4 *id.* 102). April 5, 1877 (4 *id.* 19); June 21, 1877 (5 *id.* 2); Feb. 16, 1878): 5 *id.* 3); March 4, 1879 (6 *id.* 4); Dec. 22, 1879 (7 *id.* 23); April 17, 1880 (7 *id.* 36). Decisions Com. G. L., Nov. 14, 1872 (Copp's Mg. Dec. 148); Oct. 21, 1871 (*id.* 60); Dec. 2, 1872 (*id.* 150) March 12, 1873 (*id.* 163); July 10, 1873 (*id.* 208); Nov. 11, 1873 (*id.* 233); Aug. 4, 1875 (2 Copp's L. O. 84): Feb. 18, 1875 (1 *id.* 180); June 21, 1876 (3 *id.* 50); Oct. 24, 1876 (3 *id.* 130); March, 21, 1877 (4 *id.* 2); March 26, 1877 (4 *id.* 17); Nov. 6, 1879 (6 *id.* 135). Cir. G. L. O., April 22, 1880) 7 Copp's L. O., 36.)

Sec. 411. The President is authorized to establish additional land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this chapter.

14 Stat. 252; R. S. 2343.

Sec. 412. Nothing contained in this chapter shall be construed to impair, in any way, rights or interests in mining property acquired under existing laws; nor to affect the provisions of the act entitled "An act granting to A. Sutro the right of way and other privileges to aid in the construction of a draining and exploring tunnel to the Comstock lode, in the State of Nevada," approved July twenty-five, eighteen hundred and sixty-six.

16 Stat. 218; 17 *id.* 96; 19 *id.* 52; R. S. 2344. Decision Sec. Int., Aug. 30, 1878 (5 Copp's L. O. 198). Decisions Com. G. L. O., March 8, 1873 (5 Copp's Mg. Dec. 162); March 29, 1873 (*id.* 179); May 27, 1876 (3 Copp's L. O. 34).

Sec. 413. The provisions of the preceding sections of this chapter shall not apply to the mineral lands situated in the States of Michigan, Wisconsin, and Minnesota, which are declared free and open to exploration and purchase, according to legal subdivisions, in like manner as before the tenth day of May, eighteen hundred and seventy-two. And any bona-fide entries of such lands within the States named since the tenth day of May, eighteen hundred and seventy-two, may be patented without reference to any of the foregoing provisions of this chapter. Such lands shall be offered for public sale in the same manner, at the same minimum price, and under the same rights of pre-emption as other public lands.

17 Stat. 465; R. S. 2345. Decisions Com. G. L. O., July 21 1876 (3 Copp's L. O. 132).

Sec. 414. Within the State of Missouri and Kansas deposits of coal, iron, lead, or other minerals are excluded from the operation of the preceding sections of this chapter, and all lands in said States shall be subject to disposal as agricultural lands.

19 Stat. 52.

Sec. 415. No act passed at the first session of the Thirty-eighth Congress, granting lands to States or corporations to aid in the construction of roads or for other purposes, or to extend the time of grants made prior to the thirtieth day of January, eighteen hundred and sixty-five, shall be so construed as to embrace mineral lands, which in all cases are reserved exclusively to the United States, unless otherwise specially provided in the act or acts making the grant; and all mineral lands are excepted from the operation and grants of laws heretofore granting lands to the State of Colorado.

13 Stat. 576; 18 *id.* 476; R. S. 2346. Heydenfeldt *v.* Mg. Co. 3 Otto, 634. Boggs *v.* Merced Mg. Co., 14 Cal. 279; Burdge *v.* Smith, 14 *id.* 380; Doran *v.* Railway Co., 24 *id.* 452; Higgins *v.* Houghton, 25 *id.* 252; McLaughlin *v.* Powell, 50 *id.* 64. Decisions Sec. Int., May 20, 1870 (Copp's Mg. Dec. 31); April 28, 1873; April 30, 1879. Decisions Com. G. L. O., Feb. 5, 1879 (5 Copp's L. O. 178); Dec. 19, 1878 (6 *id.* 152).

Sec. 416. Every person above the age of twenty-one years, who is a citizen of the United States, or who has declared his intention to become such, or any association of persons severally qualified as above, shall, upon application to the register of the proper land office, have the right to enter, by legal subdivisions, any quantity of vacant coal lands of the United States not otherwise appropriated or reserved by competent authority, not exceeding one hundred and sixty acres to such individual person, or three hundred and twenty acres to such association, upon payment to the receiver of not less than ten dollars per acre for such lands, where the same shall be situated more than fifteen miles from any completed railroad, and not less than twenty dollars per acre for such lands as shall be within fifteen miles of such road.

17 Stat. 607; R. S. 2337. Strond *v.* Railway Co., 4 Dillon, C. C. 396. Decisions Com. G. L. O., Aug. 11, 1873 (1 Copp's L. O. 2); March 28, 1874 (1 *id.* 3); May 25, 1874 (3 *id.* 34); Nov. 3, 1874 (3 *id.* 135).

Sec. 417. Any person or association of persons severally qualified, as above provided, who have opened and improved, or shall hereafter open and improve, any coal mine or mines upon the public lands, and shall be in actual possession of the same, shall be entitled to a preference right of entry, under the preceding section, of the mines so opened and improved: *Provided,* That when any association of not less than four persons, severally qualified as above provided, shall have expended not less than five thousand dollars in working and improving any such mine or mines, such association may enter not exceeding six hundred and forty acres, including such mining improvements.

17 Stat. 607; R. S. 2348.

Sec. 418. All claims under the preceding section must be presented to the register of the proper land district within sixty days after the date of actual possession and the commencement of improvements on the land, by the filing of a declaratory statement therefor; but when the township plat is not on file at the date of such improvement, filing must be made within sixty days from the receipt of such plat at the district office; and where the improvements shall have been made prior to the expiration of three months from the third day of March, eighteen hundred and seventy-three, sixty days from the expiration of such three months shall be allowed for the filing of a declaratory statement, and no sale under the provisions of this section shall be allowed until the expiration of six months from the third day of March, eighteen hundred and seventy-three.

17 Stat. 607; R. S. 2349. Decision Com. G. L. O., Aug. 11, 1873 (1 Copp's L. O. 3).

Sec. 419. The three preceding sections shall be held to authorize only one entry by the same person or association of persons; and no association of persons any member of which shall have taken the benefit of such sections, either as an individual or as a member of any other association, shall enter or hold any other lands under the provisions thereof; and no member of any association which shall have taken the benefit of such sections shall enter or hold any other lands under their provisions; and all persons claiming under section four hundred and seventeen shall be required to prove their respective rights and pay for the lands filed upon within one year from the time prescribed for filing their respective claims; and upon failure to file the proper notice, or to pay for the land within the required period, the same shall be subject to entry by any other qualified applicant.

17 Stat. 607; R. S. 2350.

Sec. 420. In case of conflicting claims upon coal lands where the improvements shall be commenced, after the third day of March, eighteen hundred and seventy-three, priority of possession and improvement, followed by proper filing and continued good faith, shall determine the preference right to purchase. And also where improvements have already been made prior to the third day of March, eighteen hundred and seventy-three, division of the land claimed may be made by legal subdivisions, to include, as near as may be, the valuable improvements of the respective parties. The Commissioner of the General Land Office is authorized to issue all needful rules and regulations for carrying into effect the provisions of this and the four preceding sections.

17 Stat. 607; R. S. 2351.

Sec. 421. Nothing in the five preceding sections shall be construed to destroy or impair any rights which may have attached prior to the third day of March, eighteen hundred and seventy-three, or to authorize the sale of lands valuable for mines of gold, silver or copper.

17 Stat. 607; R. S. 2352.

Sec. 440. All navigable rivers, within the territory occupied by the public lands, shall remain and be deemed public highways; and, in all cases where the opposite banks of any streams not navigable belong to different persons, the stream and the bed thereof shall become common to both.

1 Stat. 468; 2 *id.* 235; R. S. 2476.

Sec. 441. The right of way for the construction of highways over public lands, not reserved for public uses, is hereby granted.

14 Stat. 253; R. S. 2477. Railway Co. *v.* Gordon, S. C. Mich., Oct. T. 1879 (7 Copp's L. O. 158.)

Sec. 442. If any rail or plank road or macadamized turnpike company to whom the right of way or sites for watering places, depots and work-shops over and through the public lands of the United States was granted by the act of Congress approved August fourth, eighteen hundred and fifty-two, and by the acts amendatory thereto, shall at any time after its completion be discontinued or abandoned by said company or companies, the grants made by said acts shall cease, and determine, and the lands shall revert back to the United States.

10 Stat. 28, 29, 683; 12 *id.* 577. Decision Com. G. L. O., July 16, 1857.

Sec. 443. The locators of all mining locations heretofore made or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply with the laws of the United States, and with State, territorial, and local regulations not in conflict with the laws of the United States governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and all veins, lodes and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side lines of such surface locations. But their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as above described, through the end lines of their locations, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges. And nothing in this section shall authorize the locator or possessor of a vein or lode which extends in its downward course beyond the vertical lines of his claim to enter upon the surface of a claim owned or possessed by another.

17 Stat. 91; 19 *id.* 52; R. S. 2322.

Sec. 444. Where two or more veins of mining claims intersect or cross each other, the owners of the mine last located shall have the right of way through the space of intersection for the purposes of the convenient working of the mine.

17 Stat. 96; 19 *id.* 52; R. S. 2336.

Sec. 445. As a condition of sale, in the absence of necessary legislation by Congress, the local legislature of any State or Territory may provide rules for working mines, involving easements, drainage, and other necessary means to their complete development; and those conditions shall be fully expressed in the patent.

14 Stat. 252; 19 *id.* 52; R. S. 2338.

Sec. 446. Whenever by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

14 Stat. 253; R. S. 2339.

Sec. 447. All patents granted, or pre-emption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights, as may have been acquired under or recognized by the preceding section.

16 Stat. 218; R. S. 2340.

MISCELLANEOUS PROVISIONS RELATING TO THE PUBLIC LANDS.

Sec. 466. The Commissioner of the General Land Office is authorized to decide upon principles of equity and justice, as recognized in courts of equity, and in accordance with regulations to be settled by the Secretary of the Interior, the Attorney-General, and the Commissioner, conjointly, consistently with such principles, all cases of suspended entries of public lands and of suspended pre-emption land claims, and to adjudge in what cases patents shall issue upon the same.

9 Stat. 51; 10 *id.* 258; 11 *id.* 22; 18 *id.* 50; 19 *id.* 244; R. S. 2450. 14 Op. Att. Gen. 636, 645. Decisions Sec. Int., Dec. 27 (1 Leester's L. L. 484); May 12, 1859 (1 *id.* 486); May 26, 1859 (1 *id.* 488); Aug. 12, 1859 (1 *id.* 487); Oct. 6, 1859 (1 *id.* 490); Dec. 2, 1859 (1 *id.* 491); May 19, 1871 (Copp's L. L. 753); Nov. 3, 1871 (*id.* 755); Nov. 13, 1872 (*id.* 755); March 31, 1873 (*id.* 755); April 11, 1876 (3 Copp's L. O. 19); June 27, 1878 (5 *id.* 101); Dec. 5, 1878 (5 *id.* 146); May 28, 1880 (7 *id.* 91). Decision Com., G. L. O., Sept. 3, 1878 (5 Copp's L. O. 117). Rules and Regulations, Oct. 3, 1846 (1 Lester's L. L. 482); March 13, 1847 (1 *id.* 483); March 16, 1854 (1 *id.* 484); April 25, 1877 (G. L. O. Rep. 177, p. 100.

Sec. 467. Every such adjudication shall be approved by the Secretary of the Interior and the Attorney-General, acting as a board; and shall operate only to divest the United States of the title of the lands embraced thereby, without prejudice to the rights of conflicting claimants.

9 Stat. 51; 19 *id.* 244; R. S. 2451. 14 Op. Att. Gen. 636, 645. Decisions Sec. Int., Aug. 12, 1859 (1 Leester's L. L. 487); June 27, 1878 (5 Copp's L. O. 101). Rules and Regulations, Oct. 3, 1846) 1 Leester's L. L. 482); April 25, 1877 (G. L. O. Rep. 1877, p. 100.

Sec. 468. The Commissioner is directed to report to Congress at the first session after any such adjudications have been made a list of the same under the classes prescribed by law, with a statement of the principles upon which each class was determined.

9 Stat. 51; R. S. 2452.

Sec. 469. The Commissioner shall arrange his decisions into two classes; the first class to embrace all such cases of equity as may be finally confirmed by the board, and the second class to embrace all such cases as the board reject and decide to be invalid.

9 Stat. 51; R. S. 2453. Rules and Regulations, Oct 3, 1846 (1 Leester's L. L. 482); April 25, 1877 (G. L. O. Rep. 1877, p. 100.

Sec. 479. In all cases where any oath, affirmation, or affidavit shall be made or taken before any register or receiver, or either or both of them of any local land office in the United States or any Territory thereof, or where any oath, affirmation, or affidavit, shall be made or taken before any person authorized by the laws of any State or Territory of the United States to administer oaths or affirmations, or take affidavits, and such oaths, affirmations, or affidavits are made, used, or filed in any of said local land offices, or in the General Land Office, as well in cases arising under any or either of the orders, regulations, or instructions, concerning any of the public lands of the United States, issued by the Commissioner of the General Land Office, or other proper officer of the Government of the United States, as under the laws of the United States, in any wise relating to or *affecting* any right, claim or title, or any contest therefor, to any of the public lands of the United States, and any person or persons shall, taking such oath, affirmation or affidavit, knowingly, willfully, or corruptly swear or affirm falsely, the same shall be deemed and taken to be perjury, and the person or persons guilty thereof shall, upon conviction, be liable to the punishment prescribed for that offence by the laws of the United States.

11 Stat. 250, 251. People *v.* Kelley, 38 Cal. 145; Barrell *v.* How, 48 *id.* 223; Ainsworth *v.* Miller, 20 Kansas, 220.

Sec. 480. Every person who falsely makes, forges, counterfeits, or alters any letters-patent granted, or purporting to have been granted by the President of the United States; or who passes, utters, or publishes, or attempts to pass, utter, or publish as genuine, any such forged, counterfeited, or falsely altered letters-patent, knowing the same to be forged, counterfeited, or falsely altered, shall be punished by a fine of not more than five thousand dollars, and by imprisonment at hard labor not more than ten years.

4 Stat. 119; R. S. 5416.

Sec. 481. Every person who falsely makes, alters, forges, or counterfeits any bid, proposal, guarantee, official bond, public record, affidavit, or other writing, for the purpose of defrauding the United States, or utters or publishes as true any such false, forged, altered, or counterfeited bid, proposal, guarantee, official bond, public record, affidavit, or other writing, for such purpose, knowing the same to be false, forged, altered, or counterfeited or transmits to or presents at the office of any officer of the United States any such false, forged, altered, or counterfeited bid, proposal, guarantee, official bond, public record, affidavit, or other writing, knowing the same to be false, forged, altered, or counterfeited, for such purpose, shall be imprisoned at hard labor for a period not more than ten years, or be fined not more than one thousand dollars, or be punished by both such fine and imprisonment.

14 Stat. 12; R. S. 5418.

Sec. 482. Every person who falsely makes, alters, forges, or counterfeits; or causes or procures to be falsely made, altered, forged, or counterfeited; or willingly aids or assists in the false making, altering, forging, or counterfeiting, any deed, power of attorney, order, certificate, receipt, or other writing, for the purpose of obtaining or receiving, or of enabling any other person, either directly or indirectly, to obtain or receive from the United States, or any of their officers or agents, any sum of money; or who utters or publishes as true, or causes to be uttered or published as true, any such false, forged, altered, or counterfeited deed, power of attorney, order, certificate, receipt, or other writing, with intent to defraud the United States, knowing the same to be false, altered, forged, or counterfeited; or who transmits to, or presents at, or causes or procures to be transmitted to, or presented at, any office or officer of the Government of the United States, any deed, power of attorney, order, certificate, receipt, or other writing, in support of, or in relation to, any account or claim, with intent to defraud the United States, knowing the same to be false, altered, forged, or counterfeited, shall be imprisoned at hard labor for a period of not less than one year nor more than ten years; or shall be imprisoned not more than five years, and fined not more than one thousand dollars.

3 Stat. 771; R. S. 5421.

Sec. 483. Every person who knowingly and with intent to defraud the United States, has in his possession any false, altered, forged, or counterfeited deed, power of attorney, order, certificate, receipt, or other writing, for the purpose of enabling another to obtain from the United States, or any of their officers or agents any sum of money, shall be fined and imprisoned at the discretion of the court.

3 Stat. 772; R. S. 5422.

Sec. 484. When an occupant of land, having color of title, in good faith has made valuable improvements thereon, and is, in the proper action, found not to be the rightful owner thereof, such occupant shall be entitled in the Federal courts to all the rights and remedies, and, upon instituting the proper proceedings, such relief as may be given or secured to him by the statutes of the State or Territory where the land lies, although the title of the plaintiff in the action may have been granted by the United States after said improvements were so made.

18 Stat. 50.

Sec. 487. Whenever, in any grant of land or other subsidies, made or hereafter to be made, to railroads or other corporations, the United States has reserved the right, or shall reserve it, to appoint directors, engineers, commissioners, or other agents to examine the roads, or act in conjunction with other officers of such company or companies, all the costs, charges, and pay of such directors, engineers, commissioners, or agents shall be paid by the respective companies. Such directors, engineers, commissioners, or agents shall be paid for such services the sum of ten dollars per day, for each and every day actually and necessarily employed, and ten cents per mile for each and every mile actually and necessarily travelled, in discharging the duties required of them, which per diem and mileage shall be in full compensation for such services. In case any company shall refuse or neglect to make such payments, no more patents for lands or other subsidies shall be issued to such company until these requirements are complied with.

14 Stat. 299; R. S. 5259.

The following is an act of Congress approved March 3, 1881:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That if, in any action brought pursuant to section twenty-three hundred and twenty-six of the Revised Statutes, title to the ground in controversy shall not be established by either party, the jury shall so find, and judgment shall be entered according to the verdict. In such case costs shall not be allowed to either party, and the claimant shall not proceed in the land-office or be entitled to a patent for the ground in controversy until he shall have perfected his title.

COAL LANDS.

PRIOR to 1864 coal lands were not specifically noted for reservation or sale, but were disposed of as other public lands under settlement or other laws, until the passage of the pre-emption act of 1841. The act of Congress of July 1, 1864, for the disposal of coal lands and town property on the public domain, authorized the sale of the coal lands which had been excluded from sale, as mines, by the pre-emption act of 1841. Under this act they became subject to pre-emption at the minimum of $20 per acre, after offering, under proclamation of the President, at public sale to the highest bidder, in suitable legal subdivisions. March 3, 1865, an act was passed by Congress supplemental to the act of July 1, 1864, giving citizens of the United States, who were engaged in coal mining for commerce, the right to enter, at the proper district or land office, 160 acres of land, or less, at $20 per acre. The act of March 3, 1873 gave a pre-emption right of 160 acres of coal lands to a person, and 320 acres to an association, upon payment of not less than $10 per acre, where the lands lie not more than 15 miles from a completed railroad, and $20 per acre where the lands lie within 15 miles of such a road; and further provided that when any association of not less than four persons have expended $5,000 in working and improving any mine, located within limits as above, they may make an additional entry of 640 acres at the several limit prices. (See Secs. 2347–2352 R. S.; Regulations of General Land Office, April 15, 1880). The rectangular system of surveys is extended over coal lands, and they are sold in conformity with the legal subdivision thereof. The method of designation or classification, by noting character of land in field-notes by deputy surveyor, and marking on plats, when known, or of proof at the district land office prior to time of filing, is similar to the method of segregation under the mineral act, and is given in detail in the Regulations of the General Land Office.

Estimate of Area of Coal Measure.—The estimated area of coal lands on the public domain, the property of the United States, is as follows:

	Acres.	Acres.
Washington Territory:		
Area	829,440	
Sold	3,350	
		826,(90
Oregon:		
Area	414,720	
Sold	185	
		414,535
California:		
Area	247,820	
Sold	1,800	
		246,020
Colorado:		
Area	1,128,225	
Sold	600	
		1,127,625
Utah:		
Area	2,764,800	
Sold	2,180	
		2,762,620
New Mexico		
Area	10,800	
Sold	720	
		10,080
Wyoming, at least		42,000
Dakota		50,000
Montana, at least		50,000
Arizona, no coal yet discovered.		
Nevada, no coal yet discovered.		
Nebraska, the coal-bearing rocks cover an area of 3,600 square miles, but on account of the smallness of the veins—none exceeding one foot—the coal is of no commercial value.		
Indian Territory, the coal-bearing rocks cover an area of 13,600 square miles.		
Arkansas, the coal-bearing rocks cover an area of 12,000 square miles		
Total		5,528,970

New discoveries in Colorado, Utah, Wyoming, and Dakota will increase the amount given above considerably.

ENTRIES UNDER THE COAL LAND ACTS.

From 1866 to June 30, 1880, under the coal land acts there have been 78 entries at district land offices, containing 10,750.24 acres, for which the United States received $146,999.25, as follows:

State or Territory.	Entries.	Acres.	Amount.
California	18	2,154.79	$32,972 75
Oregon	2	185.18	1,851 80
Utah	13	1,816.54	21,524 00
Washington	26	3,556.92	45,109 00
Wyoming	6	1,355.00	27,100 00
New Mexico	5	721 35	7,220 10
Colorado	8	961.36	11,221 60
Total	78	10,750.24	146,999 25

Cash sales of coal lands by fiscal years to June 30, 1880.

States and Territories.	1866.			1867.			1868.		
	Entries.	Acres.	Amount.	Entries.	Acres.	Amount	Entries.	Acres.	Amount.
California	2	240 00	$4,8ι0 00	1	160.00	$3,200 00	1	100,00	$3,200,00
Oregon	...	...	...	...	...	...	...	...	...
Utah	...	...	...	...	...	...	...	...	...
Washington	...	...	...	...	...	...	...	...	...
Wyoming	...	...	...	...	...	...	...	...	...
New Mexico	...	...	...	...	...	...	...	...	...
Colorado	...	...	...	...	...	...	...	...	...
Total	2	240.00	4,800 00	1	160.00	3,2ᴗ0 00	1	160 00	3,200 00

Cash sales of coal lands by fiscal years to June 30, 1880.—*Continued.*

States and Territories.	1869.			1870.			1871.		
	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.
California	4	200.00	$4,000 00	1	160 00	$3,200 00	2	274,79	$3,772 75
Oregon	...	...	...	...	...	...	...	...	...
Utah	...	...	...	...	...	...	...	...	...
Washington	...	...	...	...	...	...	...	...	...
Wyoming	...	...	...	...	...	...	...	...	...
New Mexico	...	...	...	...	...	...	...	...	...
Colorado	...	...	...	...	...	...	...	...	...
Total	4	200.00	4,000 00	1	160 00	$3,200 00	2	274,79	$3,772 75

States and Territories.	1872.			1873.			1874.		
	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.
California	...	...	...	...	...	...	...	...	...
Oregon	...	...	...	...	...	...	1	160.00	$1.600 00
Utah	...	...	...	...	...	...	...	...	...
Washington	...	...	...	...	...	...	3	484.00	4,848 30
Wyoming	...	...	...	...	...	...	...	...	...
New Mexico	...	...	...	...	...	...	...	...	...
Colorado	...	...	...	...	...	...	...	...	...
Total	...	...	...	...	...	...	4	644.00	6,448 30

States and Territories.	1875.			1876.			1877.		
	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.
California	1	160.00	$1,000 00	2	400.00	$4,000 00	4	440.00	$5,200 00
Oregon	1	25.18	251 80	...	...	...	...	...	...
Utah	4	676.76	7,535 20	1	122 40	1,224 00	4	480.00	4,800 00
Washington	10	1,399.77	13,997 70	3	480.00	6,400 00	3	400.00	4,(00 00
Wyoming	3	440.00	8,800. 00	2	760.00	15,200,0(	1	155.00	3,100 00
New Mexico		...	...		...	...	...	...	...
Colorado		...	...	...	...	...	1	80.00	1,600 00
Total	19	2,601.71	32,184 70	8	1,762.40	26,824 00	13	1,555.00	18,700 00

States and Territories.	1878.			1879.			1880.		
	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.	Entries.	Acres.	Amount.
California	...	...	...	...	...	...	...	...	...
Oregon	...	...	...	...	...	...	...	...	...
Utah	1	160.00	$3,200 00	...	...	...	3	476.48	$4,764 80
Washington	1	40.00	800 00	...	...	...	6	753.15	15,063 00
Wyoming		...	...	...	...	...	...	...	...
New Mexico	...	...	...	...	...	...	6	721.35	7,220 10
Colorado	...	...	...	2	200.80	$2,416 00	5	680.56	7,205 60
Total	2	200.00	4,000 00	2	200.80	2,416 00	19	2,631.54	34,253 50

Laws Governing the Sale of Government Coal Lands.—The act of Congress approved March 3, 1873, entitled "An Act to provide for the sale of the lands of the United States containing coal," is as folllows:

AN ACT to provide for the sale of the lands of the United States containing coal.—SEC. 1.—*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That any person above the age of twenty-one years who is a citizen of the United States, or who has declared his intention to become such, or any association of persons severally qualified as above, shall, upon application to the register of the proper land office, have the right to enter, by legal subdivisions, any quantity of vacant coal lands of the United States not otherwise appropriated or reserved by competent authority, not exceeding one hundred and sixty acres to such individual person, or three hundred and twenty acres to such association upon payment to the receiver of not less than ten dollars per acre for such lands, where the same shall be situated more than fifteen miles from any completed railroad, and not less than twenty dollars per acre for such lands as shall be within fifteen miles of such road.

SEC. 2. That any person or association of persons severally qualified as above who have opened and improved, or shall hereafter open and improve, any coal mine or mines upon the public lands, and shall be in actual possession of the same, shall be entitled to a preference right of entry, under the foregoing provisions, of the mines so opened and improved: *Provided*, That when any association of not less than four persons, severally qualified as in section one of this act, shall have expended not less than five thousand dollars in working and improving any such mine or mines, such association may enter not exceeding six hundred and forty acres, including such mining improvements.

SEC. 3.—That all claims under section two of this act must be presented to the register of the proper land district within sixty days after the date of actual possession and the commencement of improvements on the land by the filing of a declaratory statement therefore: *Provided*, That when the township plat is not on file at the date of such improvement, filing must be made within sixty days from the receipt of such plat at the district office: *And, provided further*, That where the improvements shall have been made prior to the expiration of three months shall be allowed from the passage of this act, sixty days from the expiration of said three months shall be allowed for the filing of a declaratory statement, and no sale under the provisions of this act shall be allowed until the expiration of six months from the date hereof.

SEC. 4.—That this act shall be held to authorize only one entry by the same person or association of persons under its provisions; and no association of persons, any member of which shall have taken the benefit of this act either as an individual or as a member of any other association, shall enter or hold any other lands under the provisions of this act; and no member of any association which shall have taken the benefit of this act shall enter or hold any other lands under its provisions; and all persons claiming under section two hereof shall be required to prove their respective rights and pay for the lands filed upon within one year from the time prescribed for filing their respective claims; and upon failure to file the proper notice, or to pay for the land within the required period, the same shall be subject to entry by any other qualified applicant.

SEC. 5. That in case of conflicting claims upon lands where the improvements shall be hereafter commenced, priority of possession and improvement, followed by proper filing and continued good faith, shall determine the preference right to purchase; and also where improvements have already been made at the date of the passage of this act, division of the land claimed may be made by legal subdivisions, to include, as near as may be, the valuable improvements of the respective parties; and the Commissioner of the General Land Office shall be, and is hereby, authorized to issue all needful rules and regulations for carrying into effect the provisions of this act.

SEC. 6. That nothing in this act shall be construed to destroy or impair any rights which may have attached prior to its passage, or to authorize the sale of lands valuable for mines of gold, silver, or copper.

The Land Commissioner calls attention to the following points:

1. The sale of coal-lands is provided for—

1. By ordinary private entry under section 1.

2. By granting a preference right of purchase based on priority of possession and improvement under section 2.

2. The land entered under either section must be *by legal subdivisions*, as made by the regular United States survey. Entry is confined to surveyed lands; to such as are vacant, not otherwise appropriated, reserved by competent authority, or containing valuable minerals other than coal.

3. Individuals and associations may purchase. If an individual, he must be twenty-one years of age and a citizen of the United States, or have declared his intention to become such citizen.

4. If an association of persons, each must be qualified as above.

5. A person is not disqualified by the ownership of any quantity of other land, nor by having removed from his own land in the same State or Territory.

6. Any individual may enter by legal subdivisions as aforesaid any area not exceeding one hundred and sixty acres.

7. Any association may enter not to exceed three hundred and twenty acres.

8. Any association of not less than four persons, duly qualified, who shall have expended not less than $5,000 in working and improving any coal mine or mines, may enter under section 2 not exceeding six hundred and forty acres, including such mining improvements.

9. The price per acre is $10 where the land is situated *more* than fifteen miles from any completed railroad, and $20 per acre where the land is *within* fifteen miles of such road.

10. Where the land lies *partly within* fifteen miles of such road and in *part outside* such limit, the *maximum* price must be paid for all legal subdivisions the greater part of which lies within fifteen miles of such road.

11. The term "completed railroad" is held to mean one which is actually constructed on the face of the earth; and lands within fifteen miles of any point of a railroad so constructed will be held and disposed of at $20 per acre.

12. Any duly qualified person or association must be preferred as purchasers of those public lands on which they have opened and improved, or shall open and improve, any coal mine or mines, and which they shall have in actual possession.

13. Possession by agent is recognized as the possession of the principal. The clearest proof on the point of agency must, however, be required in every case, and a clearly-defined possession must be established,

14. The *opening and improving* of a coal mine, in order to confer a preference right of purchase, must not be considered as a mere matter of form; the labor expended and improvements made must be such as to clearly indicate the good faith of the claimant.

15. These lands are intended to be sold, where there are adverse claimants therefor, to the party who, by substantial improvements, actual possession, and a reasonable industry, shows an intention to continue his development of the mines in preference to those who would purchase for speculative purposes only. With this view, you will require such proof of compliance with the law, when lands are applied for under section 2 by adverse claimants, as the circumstances of each case may justify.

16. In conflicting claims, where improvement has been made *prior to March* 3, 1873, you will, if each party make subsequent compliance with the law, award the land *by legal subdivisions*, so as to secure to each as far as possible his valuable improvements; there being no provision in the act allowing a joint entry by parties claiming separate portions of the same legal subdivision.

17. In conflicts, when improvements, &c., have been commenced subsequent to March 3, 1873, or shall be hereafter commenced, priority of possession and improvement shall govern the award when the law has been fully complied with by each party. A mere possession, however, without satisfactory improvements, will not secure the tract to the first occupant when a subsequent claimant shows his full compliance with the law.

18. After an entry has been allowed to one party, you will make no investigation concerning it at the instance of any person except on instructions from this office. You will, however, receive all affidavits concerning such case and forward the same to this office, accompanied by a statement of the facts as shown by your records.

19. Prior to entry, it is competent for you to order an investigation, on sufficient grounds set forth under oath of a party in interest and substantiated by the affidavits of disinterested and credible witnesses.

20. Notice of contest, in every case where the same is practicable, must be made by reading it to the party to be cited and by leaving a copy with him. This notice must proceed from your office and be signed by the register or receiver. Where such personal service cannot be made by reason of the absence of the party, and because his whereabouts are unknown, a copy may be left at his residence, or, if this is unknown, by posting a copy in a conspicuous place on the tract in controversy, and by publication in a weekly newspaper having the largest general circulation in the vicinity of the land (where no newspaper shall be specified by this office) for five consecutive insertions, covering a period of four weeks next prior to the trial; and in each case requiring such notice a copy must be forwarded with the returns to this office, accompanied with proof of service by affidavit indorsed thereon.

21. In every case of contest, all papers in the same must be forwarded to this office for review before an entry is allowed to either party.

22. Thirty days from your decision will be allowed by you to enable any party to take an appeal, or file argument to be forwarded to this office.

23. No appeal will be entertained unless the same shall be forwarded through the district land-office.

24. The party may still further appeal from the decision of the Commissioner of the General Land Office to

the Secretary of the Interior. The appeal must be taken within sixty days after service of notice on the party. This may be filed with the district land-officers and by them forwarded, or it may be filed with the Commissioner, and must recite the points of exception.

25. If not appealed, the decision is by law, made final. (See section 10, act of June 12, 1858, United States Statutes, volume 11, page 326.) After appeal, thirty days are usually allowed for filing arguments, and the case is then sent to the Secretary, whose decision is final and conclusive.

26. Manner of obtaining title: First by private entry. The party will present the following application to the register, and will make oath to the same:

I, ——— ———, hereby apply, under the provisions of the act approved March 3, 1873, entitled "An Act to provide for the sale of the lands of the United States containing coal," to purchase the ——— quarter of section ———, in township ——— of range ———, in the district of lands subject to sale at the land office at ———, and containing ——— acres; and I solemnly swear that no portion of said tract is in the possession of any other party; that I am twenty-one years of age, a citizen of the United States (or have declared my intention to become a citizen of the United States), and have never held nor purchased lands under said act, either as an individual or as a member of an association; and I do further swear that I am well acquainted with the character of said described land, and with each and every legal subdivision thereof, having frequently passed over the same; that my knowledge of said land is such as to enable me to testify understandingly with regard thereto; that there is not to my knowledge within the limits thereof any vein or lode of quartz or other rock in place bearing gold, silver, or copper, and that there is not within the limits of said land, to my knowledge any valuable mineral deposit other than coal. So help me God.

——— ———

To this affidavit the register will append the usual jurat.

27. Thereupon the register, if the tract is vacant, will so certify to the receiver, stating the price, and the applicant must then pay the amount of purchase-money.

28. The receiver will then issue to the purchaser a duplicate receipt, and at the close of the month the register and receiver will make returns of the sale to the General Land Office, from whence, when the proceedings are found regular, a patent or complete title will be issued; and on surrender of duplicate receipt such patent will be delivered, at the option of the patentee, either by the Commissioner at Washington or by the register at the district land-office.

29. This disposition at private entry will be subject to any valid prior adverse right which may have attached to the same land, and which is protected by section 2.

30. Second. When the application to purchase is based on a priority of possession, &c., as provided for in section 2, the claimant must, when the township plat is on file in your office, file his declaratory statement for the tract claimed sixty days from and after the first day of his actual possession and improvement. Sixty days, exclusive of the first day of possession, &c., must be allowed.

31. The declaratory statement must be substantially as follows, to wit.

I, ——— ———, being ——— years of age, and a citizen of the United States, (or having declared my intention to become a citizen of the United States,) and never having, either as an individual or as a member of an association, held or purchased any coal-lands under the act approved March 3, 1873, entitled "An Act to provide for the sale of the land of the United States containing coal," do hereby declare my intention to purchase, under the provisions of said act, the ——— quarter of section ———, in township ——— of range ———, of lands subject to sale at the district land-office at ———, and that I came into possession of said tract on the ——— day of ———, A. D. 18—, and have ever since remained in actual possession continuously, and have expended in labor and improvements on said mine the sum of ——— dollars, the labor and improvements being as follows: (here describe the nature and character of the improvements;) and I do furthermore solemnly swear that I am well acquainted with the character of said described land, and with each and every legal subdivision thereof, having frequently passed over the same; that my knowledge of said is such as to enable me to testify understandingly with regard thereto; that there is not, to my knowledge, within the limits thereof any vein or lode of quartz or other rock in place bearing gold, silver, or copper, and that there is not within the limits of said land, to my knowledge, any valuable mineral deposit other than coal.

——— ———

32. When the township plat is not on file at date of claimant's first possession the declaratory statement must be filed within sixty days from the filing of such plat in your office.

33. When improvements shall have been made prior to June 4, 1873, the declaratory statement must be filed within sixty days from that date.

34. No sale under this act will be allowed by you prior to September 4, 1873. One year from and after the expiration of the period allowed for filing the declaratory statement is given within which to make proof and payment, but you will allow no party to make final proof and payment, except on notice as aforesaid to all others who appear on your records as claimants to the same tracts.

35. A party who otherwise complies with the law may enter *after* the expiration of said year, *provided* no valid adverse right shall have intervened. He postpones his entry beyond said year at his own risk, and the Government cannot thereafter protect him against another who complies with the law, and the value of his improvements can have no weight in his favor.

36. One person can have the benefit of one entry or filing *only*. He is disqualified by having made such entry or filing alone, or as a member of an association. No entry can be allowed an association which has in it a single person thus disqualified, as the law prohibits the entry or holding of more than one claim either by an individual or an association. You are to allow no entry, under this act, of lands containing other valuable minerals. You will determine the character of the land under the present rules relative to agricultural and mineral lands. Those that are sufficiently valuable for other minerals to prevent their entry as agricultural lands cannot be entered under this act.

37. Assignments of the right to purchase under this act will be recognized when properly executed. Proof and payment must be made, however, within the prescribed period, which dates from the first day of the possession of the assignor who initiated the claim.

38. You will so construe this act in its application as not to destroy or impair any rights which may have attached prior to March 3, 1873. Those persons who may have initiated a valid claim under any prior law relative to coal-lands will be permitted to complete their entries under the same.

39. You will report at the close of each month as "sales of coal-lands" all filings and entries under this act in separate abstracts, commencing with number *one*, and thereafter proceeding consecutively in the order of their reception. Where a series of numbers has already been commenced by sale of coal-lands you will continue the same without change. The affidavit required from each claimant at the time of actual purchase will be as follows, to wit:

I, ——— ———, claiming the right of purchase under the act of Congress entitled "An Act to provide for the sale of the lands of the United States containing coal," approved March 3, 1873, to the ——— quarter of section ———, in township ——— of range ———, subject to sale at ———, do solemnly swear that I have never had the right of purchase under this act, either as an individual or as a member of an association, and that I have never held any other lands under its provisions; I further swear that I have expended in developing coal mines on said tract in labor and improvements the sum of ——— dollars, the nature of such improvements being as follows: ——— ——— ———; that I am now in the actual possession of said mines, and make the entry for my own use and benefit, and not directly or indirectly for the use and benefit of any other party; and I do furthermore swear that I am well acquainted with the character of said described land, and with each and every legal subdivision thereof, having frequently passed over the same; that my knowledge of said land is such as to enable me to testify understandingly with regard thereto; that there is not, to my knowledge, within the limits thereof any vein or lode of quartz or other rock in place bearing gold, silver, or copper, and that there is not within the limits of said land, to my knowledge, any valuable mineral deposit other than coal. So help me God.

——— ———.

I, ——— ———, of the land office at ———, do hereby certify that the above affidavit was sworn and subscribed to before me this ——— day of ———, A. D. 18—.

——— ———.

40. In case the purchaser shows by an affidavit that he is not personally acquainted with the character of the land, his duly authorized agent who possesses such knowledge may make the required affidavit as to its character; but whether this affidavit is made by principal or agent, it must be corroborated by the affidavits of two disinterested and credible witnesses having knowledge of its character.

MINES ON THE PUBLIC DOMAIN.

THE precious-metal bearing States and Territories of the public domain are California, Colorado, Oregon, Nevada, Idaho, Montana, Wyoming, Utah, New Mexico, Arizona, Dakota and Washington. Lead and copper lands in Arkansas, Missouri, Iowa, Michigan, Minnesota and Wisconsin were sold under special mining laws, the mineral being conveyed with the soil, and are included in cash entries. Under the acts of 1866 and 1872, and the placer act, there have been patented to June 30, 1880, 3,978 lode or vein claims, containing 38,435.11 acres, at $5 per acre, realizing $197,778, and 1,303 placer claims, containing 110,186.03 acres, at $2.50 per acre, realizing $288,767; total, 5,281 claims, containing 148,621.14 acres, and realizing $486,545.

Mineral Reservations in Northwest Territory.—In the ordinance of May 20, 1785, for the disposal of lands in the "Western Territory," it is ordered that there shall be reserved "one-third part of all gold, silver, lead and copper mines, to be sold, or otherwise disposed of as Congress shall hereafter direct," the deed to be given by the Commissioners of the Loan Office, with a clause of reservation in the words of the act. The mineral resources of the country at that time were but little known. Our present Western precious metal regions, and the base-metal belt of the Mississippi, were almost entirely within the domain of France and Spain. The copper regions of Lake Superior had just come into possession of the United States by the definitive treaty of peace with Great Britain. Some gold and lead had been found in the southern colonies—now states—but not on public domain, and economic minerals were but little known or used. The reserving clause in the ordinance of 1785 suggests the reservations as to minerals, by way of royalty or sovereign dues, in some of the crown charters for colonization in America, and further shows the existing doubt as to the policy of the Government in relation to holding, leasing, or selling mines and mineral lands.

Congressional Action.—By resolution of April 16, 1800, Congress authorized the President to employ an agent to collect material information relative to the copper mines on the south side of Lake Superior. This contained a clause "and to ascertain whether the Indian title to such lands as might be required for the use of the United States in case they should deem it expedient to work the said mines, had been extinguished." Thus Congress at this period seems to have had in mind the direct working and control of mines by the United States. March 3, 1807, Congress, by section 5 of an act for the sale of certain lands now in Ohio and Indiana, provided that lead mines in Indiana, with as many contiguous sections of land to each as the President might deem necessary, should be reserved for future disposal by the United States; and—

Any grant which may hereafter be made for a tract of land containing a lead mine which has been discovered previous to the purchase of such tract from the United States shall be considered fraudulent and null; and the President of the United States shall be, and is hereby, authorized to lease any lead mine which has been or may hereafter be discovered in the Indian Territory, for a term not exceeding five years.

This inaugurated the policy of the United States of leasing mineral lands. It will be noted that this reserving clause contained a proviso for reserving lands for mine easements. These reserved adjacent sections were afterwards used by the lessees for dumpage-grounds, and the timber thereupon used for smelting. The leases provided for this, Congress, March 25, 1816, in an act relating to settlers on the public lands of the United States, provided—

That in all cases where the tract of land applied for includes either a lead mine or salt spring, no permission to work the same shall be granted without the approbation of the President of the United States.

This provision of law was continued by two separate acts until March 3, 1819. The House of Representatives, February 8, 1823, by resolution, asked for information in regard to the mining regions of the West. The President in reply transmitted such information as he at that time had (see Ex. Doc. 128, first session Eighteenth Congress). This Congressional inquiry and the reply related to lands containing base metal and iron. By act of March 3, 1829, Congress conferred authority on the President to expose to sale as other public lands "the reserved lead mines and contiguous lands in the State of Missouri," with this qualification, that at least six months' public notice should be given, "with a brief description of the mineral region in Missouri and the lands to be offered for sale, showing the number and the localities of the different mines (then) known, the probability of discovering others, the quality of the ore, the facilities for working it, the further facilities if any, for manufactures of shot, sheet lead, and paints, and the means and expense of transporting the whole to the principal markets of the United States."

February 6, 1839, the House of Representatives—

Resolved, That the President be requested to cause to be prepared a plan for disposal of the public mineral lands, having reference as well to the amount of revenue to be derived from them, and their value as public property, as to the equitable claims of individuals upon them; and that he communicate to Congress all the information in the possession of the Treasury Department relative to their location, value, productiveness, and occupancy, and that he cause such further information to be collected and surveys to be made as may be necessary for this purpose.

Dr. David Dale Owen explored the Territories of Iowa and Wisconsin, by order of the President, under this resolution. (See report of Dr. Owen, Ex. Doc. No. 239, First session Twenty-sixth Congress.) In the pre-emption act September 4, 1841, section 10 provided that "No lands on which are situated any known salines or mines shall be liable to entry under and by virtue of the provisions of this act." In United States *v.* Gear (3 How., 120), the Supreme Court of the United States, 1845, held that the act of June 26, 1834, did not subject lead mines to ordinary sale or pre-emption in certain districts thereby created.

Executive Action as to Mines.—President Polk, December 2, 1845, in his first annual message said:

The present system of managing the mineral lands of the United States is believed to be radically defective. More than a million acres of the public lands, supposed to contain lead and other minerals, have been reserved from sale, and numerous leases upon them have been granted to individuals upon a stipulated rent. The system of granting leases has proved to be not only unprofitable to the Government, but unsatisfactory to the citizens who have gone upon the lands, and must, if continued, lay the foundation of much future difficulty between the Government and the lessees. According to the official records, the amount of rents received by the Government for the years 1841, 1842, 1843, and 1844, was $6,354.74, while the expenses of the system during the same period, including salaries of the superintendents, agents, clerks, and incidental expenses, were $26,111.11, the income being less than one-fourth of the expense. To this pecuniary loss may be added the injury sustained by the public in consequence of the destruction of timber, and the careless and wastful manner of working the mines. The system has given rise to much litigation between the United States and individual citizens, producing irritation and excitement in the mineral region, and involving the Government in heavy additional expenditures. It is believed that similar losses and embarrassments will continue to occur while the present system of leasing these lands remains unchanged. These lands are now under the superintendence and care of the War Department, with the ordinary duties of which they have no proper or natural connection. I recommend the repeal of the present system, and that these lands be placed under the superintendence and management of the General Land Office as other public lands, and be brought into market and sold upon such terms as Congress in their wisdom may prescribe, reserving to the Government an equitable percentage of the gross amount of mineral product, and that the pre-emption principle be extended to resident miners, and settlers upon them, at the minimum price which may be established by Congress.

April 18, 1876, the Attorney-General of the United States, in an opinion respecting the mineral lands on Isle Royal, Lake Superior, held, that "salines, gold, silver, lead, and copper mines" were reserved for "future disposal of Congress."

Cash Sales of Mineral Lands Ordered.—By act approved 11th July, 1846, Congress ordered "the reserved lead mines and contiguous lands in the States of Illinois and Arkansas and" then "Territories of Wisconsin and Iowa" to be exposed to sale as other public lands, with the exception: that six months' notice be given, with brief description of the mineral region, as required by the act of 1829 respecting Missouri; stipulating further that such lands should not be subject to pre-emption until after public offering, and subject to private entry; that upon proof to the register and receiver of any tract containing lead ore, and of being so worked, no bid should be received at less than $2.50 per acre, but if not sold at that price, nor entered at private sale within twelve months thereafter, to be subject to sale as other public lands. (See D. D. Owen's survey.)

By an act of 1st March, 1847, Congress ordered the organization of the Lake Superior district in the upper peninsula of Michigan, directed that a geographical examination and survey be made of those lands, and conferred authority on the President for the public sale, after six months' notice, of such land as contained "copper, lead, or other valuable ores," with description of locality of mines, &c., the minimum price at public sale to be $5 per acre, and where not thus disposed of at public auction, to be subject to private sale at that price. (See Foster and Whitney's survey.) By the act of 3d March, 1847, the Chippewa land district in Wisconsin was organized, a geological examination and survey ordered, and the lands disposed of in like manner to those in the Lake Superior district, in Michigan. Congress March 3, 1849, created the Department ("Home Department") of the Interior, and thereafter the supervision of mineral lands was transferred to the General Land Office in that Department.

Mineral Lands in Charge of the War Department.—The act of July 11th, 1846, and March 1st and 3d, 1847, made a radical change in the method of disposition of mineral lands on the public dominion, abolished leases, and substituted cash sales. The act of 1849 transferred the charge of these lands from the War Department, where they had been since the ordinance of Congress of 1785, to the Department of the Interior. August 28th, 1850, the Attorney-General of the United States held that public lands containing "iron ore merely" are not the "mineral lands" referred to in the second section of the act of March 1st, 1847 (act for the sale of copper, lead, or other valuable ores in Lake Superior district). The act of 26th September, 1850, ordered the mineral lands in the Lake Superior district in Michigan, and Chippewa district in Wisconsin, to be offered at public sale in the same manner, at the minimum, and with same rights of pre-emption as other public lands, but not to interfere with leased rights.

The Discovery of Gold in California.—The discovery of gold at Coloma, Cal., by John W. Marshall, January 19, 1848, necessitated a change in the mineral laws of the United States. Copper, lead, and iron had prior to this been the minerals for which the laws were made. In the ordinance of 1875 gold and silver were reserved out of abundant caution, but now gold had actually been discovered on the public domain, and legislation was necessary. President Fillmore, in his annual message of December 2, 1849, said:

> I also beg leave to call your attention to the propriety of extending at an early day our system of land laws, with such modifications as may be necessary, over the State of California and the Territories of Utah and New Mexico. The mineral lands of California will, of course, form an exception to any general system which may be adopted. Various methods of disposing of them have been suggested. I was at first inclined to favor the system of leasing, as it seemed to promise the largest revenue to the Government and to afford the best security against monopolies, but further reflection and our experience in leasing the lead mines and selling lands upon credit have brought my mind to the conclusion that there would be great difficulty in collecting the rents, and that the relation of debtor and creditor between the citizens and the Government would be attended with many mischievous consequences. I therefore recommend that instead of retaining the mineral lands under the permanent control of the Government, they be divided into small parcels and sold, under such restrictions as to quantity and time as will insure the best price and guard most effectually against combinations of capitalists to obtain monopolies.

December 3, 1849, the Secretary of the Interior, Hon. Thomas Ewing, calling attention of Congress to the discovery of gold in California, said:

> The right to the mines of precious metals, which, by the laws of Spain, remained in the Crown, is believed to have been also retained by Mexico while she was sovereign of the territory, and to have passed by her transfer to the United States. It is a right of the sovereign in the soil as perfect as if it had been expressly reserved in the body of the grant; and it will rest with Congress to determine whether, in those cases where lands duly granted contain gold, this right shall be asserted or relinquished. If relinquished, it will require an express law to effect the object, and if retained, legislation will be necessary to provide a mode by which it shall be exercised. For it is to be observed that the regulation permitting the acquisition of a right in the mines by registry or by denouncement was simply a mode of exercising by the sovereign the proprietary right which he had in the treasure as it lay in and was connected with the soil. Consequently, whenever that right was transferred by the transfer of the eminent domain, the mode adopted for its exercise ceased to be legal, for the same reason that the Spanish mode of disposing of the public lands in the first instance ceased to be legal after the transfer of the sovereignty.
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> Thus it appears that the deposits of gold, wherever found in the Territory, are the property of the United States. Those, however, which are known to exist upon the lands of individuals are of small comparative importance, by far the larger part being upon unclaimed public lands. Still our information respecting them is yet extremely limited; what we know in general is that they are of great extent and extraordinary productiveness, even though rudely wrought.
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> No existing law puts it in the power of the Executive to regulate these mines, or protect them from intrusion. Hence, in addition to our own citizens, thousands of persons, of all nations and languages, flock in and gather gold, which they carry away to enrich themselves, leaving the lands the less in value by what they have abstracted, and they render for it no remuneration, direct or indirect, to the Government or people of the United States. Our laws, so strict in the preservation of public property that they punish our own citizens for cutting timber upon the public lands, ought not to permit strangers, who are not and who never intend to become citizens, to enter at pleasure on these lands, and take from them the gold which constitutes nearly all their value.
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> Some legal provision is necessary for the protection and disposition of these mines, and it is a matter worthy of much consideration how they should be disposed of so as best to promote the public interest and encourage individual enterprise. In the division of these lands regard should be had to the convenience of working every part of them containing gold, whether in the alluvion merely or in the fixed rocks. And, that such division may be made in the best manner practicable to promote the general interest and increase the value of the whole, a geological and mineralogical exploration should be connected with the linear surveys, which should be made with the assistance and under the supervision of a skilful engineer of mines. The mining ordinances of Spain provide a mode of laying out the mines, which applies only to districts where veins of ore occur in the rocks, and where it is to be mined by following the metalliferous dike or stratum in the direction of its dip, and along its line of strike. But the gold which is found in the alluvion in California is continuous over a great extent of country, and it may be wrought upon any lot having surface earth and access to water. This district may be, therefore, divided into small lots, with a narrow front on the margin of the streams, and extending back in the form of a parallelogram. Where gold is found in the rocks *in situ*, the lots to embrace it should be larger, and laid off according to the Spanish method with regard to dip and strike. But so various are the conditions under which the precious metals may be found by a careful geological exploration, that the mode of laying off the ground cannot be safely anticipated, but must be left to the direction, on the spot, of a skilful engineer, whose services will be indispensable. The division, disposition, and management of these mines will require much detail; but, if placed on a proper footing, they may be made a source of considerable revenue. It is due to the Nation at large that this rich deposit of mineral wealth should be made productive, so as to meet, in process of time, the heavy expense incurred in its acquisition. It is also due to those who become the lessees or purchasers of the mines that they should be furnished by the Government with such scientific aid and directions as may enable them to conduct their operations not only to the advantage of the Treasury, but also with convenience and profit to themselves. This scientific aid cannot be procured by individuals, as our people have little experience in mining, and there is not, in the United States, a school of mines, or any in which mining is taught as a separate science. If the United States sell the mineral lands for cash, and transfer at once all title to the gold which they contain, but a very small part of their value will probably be realized. It would be better, in my opinion, to transfer them by sale or lease, reserving a part of the gold collected as rent or seignorage. After mature reflection, I am satisfied that a mint at some convenient point will be advantageous to the miner, and the best medium for the collection and transmission of the gold reserved. Gamboa, a Spanish author of much science and practical observation, and at one time president of the Royal Academy of Mexico, strongly recommended the establishment of a mint in their principal mining district, as a means of collecting and transmitting the rents reserved by the Crown, and especially to give a legitimate currency to the miners, that they might not be compelled from necessity to barter their bullion in violation of law. The same reason would apply here with equal force. When the land is properly divided, it will, in my opinion, be best to dispose of it, whether by lease or sale, so as to create an estate to be held only on condition that the gold

collected from the mine shall be delivered into the custody of an officer of the branch mint. Out of the gold so deposited, there should be retained for rent and assay, or coinage, a fixed per cent., such as may be deemed reasonable, and the residue passed to the credit of the miner, and paid to him at his option in coin or stamped bullion, or its value in drafts on the Treasury or mint of the United States. The gold in the mine, and after it is gathered, until brought into the mint, should be and remain the property of the United States. The barter, sale, gift, or exportation of any portion of it before it shall have been delivered at the mint, and so coined, or assayed and stamped, or its concealment with intent to avoid the payment of rent or seignorage, should involve a forfeiture of the gold itself, and also of the mine. The terms of lease or sale should be favorable to the miner, and the law should be stringent to enforce the payment of seignorage or rents. So far as the surface deposits extend, I am of opinion that leases will, for yet a further reason, be preferable to the sales of lands. If sold, they will pass at once into the hands of large capitalists; if leased, industrious men without capital may become the proprietors, as they can work the mines and pay the rent out of the proceeds. But where gold is found in the rocks in place, the case is different. These must necessarily fall at once into the hands of large capitalists or joint stock companies, as they cannot be wrought without a heavy investment. Some persons, whose opinions are entitled to much weight, apprehend difficulty in collecting the rents, if the mode of disposition which I suggest be adopted; but this, I think, is without a full consideration of the condition of the country and the means of enforcement. Gold, unless coined or stamped at the mint, could not circulate in California against a legal provision, and subject to a penalty such as is suggested. It could not be carried across the continent without risk of loss or detection, which would make the value of insurance equal to the rent. In any other direction it must pass the ports of California, and be there liable to detection. Since the discovery of the mines, gold in California has not ranged higher than $16 per ounce; its actual value is a fraction over $18. The difference between its true value and the highest price at which it has sold, or would probably ever sell, except to houses transacting an open, regular and legal business, is therefore *one-ninth*, being more than half the amount that ought to be reserved as rent or seignorage. If the penalty suggested above should be provided for an attempted evasion, and the ordinary advantages given to the officer or other person who should detect the fraud, as in case of smuggling, it would not be the interest of any one to become a dealer in the prohibited article at a small profit and great risk; nor would the miner risk a sale at a small advance of price, to be obtained at the hazard of a heavy forfeiture. The absolute security of the lawful business, the safety of the fund when deposited in the Treasury of the United States, and the small profit and great risk of attempted frauds, would be reasonable security against them. The property of the United States in the mines of quicksilver, derived from Spain through Mexico, with the eminent domain, is, as I have shown, the same as that to the gold, already considered. Indeed, the laws of Spain asserted more sternly and guarded more strictly the rights of the Crown to that metal than to gold and silver. This arose from the scarcity of quicksilver, it being found in sufficient quantities to be worth mining in but few known places on the globe; while its necessary use in separating silver from its matrix, makes it an essential ingredient in silver mining operations.

Congressional action as to Metals on the Pacific Slope.—Congress, in the act of 27th September, 1850, creating the office of surveyor-general of Oregon, and providing for surveys and making donations to settlers, directs that "no mineral lands, nor lands reserved for salines, shall be liable to any claim under and by virtue of the provisions of that act." This embraces the present Washington Territory. Then, in the 14th article of the treaty with Peru, concluded on 26th July, 1851, it is agreed upon that "Peruvian citizens shall enjoy the same privileges in frequenting the mines, and in digging or working for gold upon the public lands situated in the State of California, as are or may hereafter be accorded by the United States of America to the citizens or subjects of the most friendly nations." Subsequently Congress, in providing by the act of 3rd March, 1853, "for the survey of public lands in California, the granting pre-emption rights therein, and for other purposes," directed that "none other than township lines shall be surveyed where the lands are mineral or are deemed unfit for cultivation;" excluding in express terms "mineral lands" from the pre-emption act of 4th September, 1841, and further interdicting "any person" from obtaining "the benefits of this act by a settlement or location on mineral lands." By the fourth section of the act of 22d July, 1854, to establish "the offices of surveyors-general of New Mexico. Kansas, and Nebraska, to grant donations to actual settlers therein, and for other purposes," it is directed that "none of the provisions of that act shall extend to mineral or school lands, salines, military or other reservations, or lands settled on and occupied for purposes of trade and commerce and not agriculture." The Attorney-General's opinion of February 14, 1866, states that Congress had not then made any provision concerning mineral lands in California, except reserving from pre-emption and donation. The act of July 4, 1866, giving authority for varying surveys in Nevada from "rectangular form to suit the circumstances of the country," reserves from sale "in all cases lands valuable for mines of gold, silver, quicksilver, or copper."

Local Mining Laws in California.—From the discovery of rich gold fields in California, January 19, 1848, to July 26, 1866, there was no mining law of the United States relating to the precious metals on the public domain other than those above set out; and the mineral lands of the United States, copper, lead, &c., had all been disposed of, under the above laws, in blocks conforming to legal subdivisions of the surveys, the soil carrying with it the minerals. In California the Spanish and Mexican law and miners' usage were the law. The fee of the land was in the United States, but the occupancy or the equitable title was recognized by Congress, by resolution of February 27, 1865, which first called attention thereto. Local usage and regulations governed mining camps and towns and regulated the size and conditions of working mining claims. These regulations first applied to placer mining, and afterwards extended over and included quartz claims. The rush of emigrants to California after Marshall's discovery was first from Oregon, Mexico, and the Sandwich Islands. Then followed the emigrants from the older States of the Union. The Mexican miner and Georgia gold-washer joined hands, and local usage, consent, and mutual agreement made law. In 1847 the population of California was estimated at 15,000. In 1850 it was 100,000, and the average increase annually for five or six years was 50,000 souls. There was no Territorial or Congressional form of Government. The military of the United States were in control, enforcing the laws found in existence there when the country came to the United States under the treaty of Gaudalupe Hidalgo, in 1848, and thus continued until December 20, 1849, the date of the organization of the State Government. The condition of the placer mining regions of California in 1848 is shown by the following report made to the Adjutant-General United States Army, by Col. R. B. Mason, First United States Dragoons.

REPORT OF COL. R. B. MASON ON THE GOLD-FIELDS OF CALIFORNIA.

HEADQUARTERS TENTH MILITARY DEPARTMENT,
Monterey, Cal., August, 17, 1848.

SIR:—I have the honor to inform you that, accompanied by Lieut. W. T. Sherman, Third Artillery, acting Assistant Adjutant-General, I started on the 12th of June last to make a tour through the northern part of California. My principal purpose, however, was to visit the newly-discovered gold placer in the valley of the Sacramento.

I had proceeded about forty miles when I was overtaken by an express, bringing me intelligence of the arrival at Monterey of the United States storeship Southampton, with important letters from Commodore Shubrick and Lieutenant-Colonel Burton. I returned at once to Monterey, and dispatched what business was most important, and on the 17th resumed my journey. We reached San Francisco on the 20th, and found that all, or nearly all, its male population had gone to the mines. The town, which a few months before was so busy and thriving, was then almost deserted. On the evening of the 24th the horses of the escort were crossed to Sansolito in a launch, and on the following day we resumed the journey, by way of Bodega and Sonoma, to Sutter's Fort, where we arrived on the morning of the 2d of July. Along the whole route mills were lying idle, fields of wheat were open to cattle and horses, houses vacant and farms going to waste. At Sutter's there was more life and business. Launches were discharging their cargoes at the river, and carts were hauling goods to the fort, where already were established several stores, a hotel, etc. Captain Sutter had only two mechanics in his employ—a wagon-maker and a blacksmith—whom he was then paying $10 per day. Merchants pay him a monthly rent of $100 per room, and whilst I was there a two-story house in the fort was rented as a hotel for $500 a month.

At the urgent solicitation of many gentlemen, I delayed there to participate in the first public celebration of our national anniversary at that fort, but on the 5th resumed the journey and proceeded 25 miles up the American Fork, to a point on it now known as the lower mines, or Mormon diggings. The hillsides were thickly strewn with canvas tents and bush arbors. A store was erected, and several boarding-shanties in operation. The day was intensely hot; yet about 200 men were at work in the full glare of the sun, washing for gold, some with tin pans, some with close-woven Indian baskets, but the greater part had a rude machine known as the cradle. This is on rockers 6 or 8 feet long, open at the foot, and at its head has a coarse grate and sieve; the bottom is rounded, with small cleets nailed across. Four men are required to work this machine; one digs the gravel in the bank close by the stream, another carries it to the cradle and empties it on the grate, a third gives a violent rocking motion to the machine, whilst a fourth dashes water on from the stream itself. The sieve keeps the coarse stones from entering the cradle, the current of water washes off the earthy matter, and the gravel is gradually carried out at the foot of the machine, leaving the gold mixed with fine, heavy black sand above the first cleets. The sand and gold, mixed together, are then drawn off through auger holes into a pan below, are dried in the sun, and afterwards separated by blowing off the sand. A party of four men thus employed at the lower mines averaged $100 a day. The Indians and those who have nothing but pans or willow baskets, gradually wash out the earth and separate the gravel by hand, leaving nothing but the gold mixed with sand, which is separated in the manner before described. The gold in the lower mines is in fine bright scales, of which I send several specimens. As we ascended the south branch of the American Fork the country became more broken and mountainous, and at the saw-mill, 25 miles above the lower washings, or 50 miles from Sutter's, the hills rise to about 1,000 feet above the level of the Sacramento plain. Here a species of pine occurs, which led to the discovery of the gold. Captain Sutter feeling the great want of lumber, contracted, in September last, with a Mr. Marshall to build a saw-mill at that place. It was erected in the course of the past winter and spring—a dam and race constructed; but when the water was let on the wheel, the tail race was found to be too narrow to permit the water to escape with sufficient rapidity. Mr. Marshall, to save labor, let the water directly into the race, with a strong current, so as to wash it wider and deeper. He effected his purpose, and a large bed of mud and gravel was carried to the foot of the race. One day Mr. Marshall, when walking down to the race to this deposit of mud, observed some glittering particles at its upper edge; he gathered a few, examined them, and became satisfied of their value. He then went to the fort, told Captain Sutter of his discovery, and they agreed to keep it secret until a certain grist-mill of Sutter's was finished. It, however, got out and spread like magic. Remarkable success attended the labors of the first explorers, and in a few weeks hundreds of men were drawn thither. At the time of my visit, but little more than three months after its first discovery, it was estimated that upwards of 4,000 people were employed. At the mill there is a fine deposit, or bank of gravel, which the people respect as the property of Captain Sutter, although he pretends to no right to it, and would be perfectly satisfied with the simple promise of pre-emption, on account of the mill which he has built there, at considerable cost. Mr. Marshall was living near the mill, and informed me that many persons were employed above and below him, that they used the same machines as at the lower washings, and that their success was about the same, ranging from 1 to 3 ounces of gold per man daily. This gold too is in scales, a little coarser than those of the lower mines. From the mills Mr. Marshall guided me up the mountain, on the opposite or north bank of the South Fork, where, in the beds of small streams, or ravines, now dry, a great deal of the coarser gold has been found. I there saw several parties at work, all of whom were doing very well. A great many specimens were shown me, some as heavy as 4 or 5 ounces in weight: and I send three pieces, labeled No. 5, presented by a Mr. Spence. You will perceive that some of the specimens accompanying this hold, mechanically, pieces of quartz, that the surface is rough, and evidently molded in the crevice of a rock. This gold cannot have been carried far by water, but must have remained near where it was deposited from the rock that once bound it. I inquired of many people if they had encountered the metal in its matrix, but in every instance they said they had not, but that the gold was invariably mixed with washed gravel, or lodged in the crevices of other rocks. All bore testimony that they had found gold in greater or less quantities in the numerous small gullies or ravines that occur in that mountainous region. On the 7th of July I left the mill and crossed to a small stream emptying into the American Fork, 3 or 4 miles below the saw-mill. I struck this stream (now known as Weber's Creek) at the washings of Sunal & Co, They had about thirty Indians employed, whom they pay in merchandise. They were getting gold of a character similar to that found in the main fork, and doubtless in sufficient quantities to satisfy them. I send you a small specimen, presented by this company of their gold. From this point we proceeded up the stream about 8 miles, where we found a great many people and Indians; some engaged in the bed of the stream, and others in the small side valleys that put into it. These latter are exceedingly rich, and 2 ounces were considered an ordinary yield for a day's work. A small gutter, not more than 100 yards long by 4 feet wide and 2 or 3 feet deep, was pointed out to me as the one where two men, William Daly and Perry McCoon, had, a short time before, obtained in seven days $17,000 worth of gold.

Captain Weber informed me that he knew that these two men had employed four white men and about a hundred Indians, and that, at the end of one week's work, they paid off their party and had left with $10,000 worth of this gold. Another small ravine was shown me from which had been taken $12,000 worth of gold. Hundreds of similar ravines, to all appearances, are as yet untouched. I could not have credited these reports had I not seen, in the abundance of the precious metal, evidence of their truth. Mr. Neligh, an agent of Commodore Stockton, had been at work about three weeks in the neighborhood, and showed me, in bags and bottles, over $2,000 worth of gold; and Mr. Lyman, a gentleman of education and worthy of every credit, said he had been engaged, with four others, with a machine on the American Fork, just below Sutter's saw-mill, that they worked eight days, and that his share was at the rate of $50 a day; but, hearing that others were doing better at Weber's place, they had removed there, and were then on the point of resuming operations.

I might tell of hundreds of similar instances: but, to illustrate how plentiful gold was in the pockets of common laborers, I will mention a simple occurrence which took place in my presence when I was at Weber's store. This store was nothing but an arbor of business, under which he had exposed for sale goods and groceries suited to his customers. A man came in, picked up a box of seidlitz powders, and asked its price. Captain Weber told him it was not for sale. The man offered an ounce of gold, but Captain Weber told him that it only cost 50 cents, and he did not wish to sell it. The man then offered an ounce and a half, when Captain Weber *had* to take it. The prices of all things are high; and yet Indians, who before hardly knew what a breech-cloth was, can now afford to buy the most gaudy dresses. The country on either side of Weber's Creek is much broken up by hills, and is intersected in every direction by small streams or ravines, which contain more or less gold. Those that have been worked are barely scratched, and, although thousands of ounces have been carried away, I do not consider that a serious impression has been made upon the whole. Every day was developing new and rich deposits, and the only apprehension seemed to be that the metal would be found in such abundance as seriously to depreciate in value. On the 8th of July I returned to the lower mines, and on the following day to Sutter's, where, on the 10th, I was making preparations for a visit to the Feather, Yubah, and Bear Rivers, when I received a letter from Commodore A. R. Long, United States Navy, who had just arrived at San Francisco from Mazatlan, with a crew for the sloop-of-war Warren, and with orders to take that vessel to the squadron at La Paz. Captain Long wrote to me that the Mexican Congress had adjourned without ratifying the treaty of peace, that he had letters for me from Commodore Jones, and that his orders were to sail with the Warren on or before the 20th of July. In consequence of these, I determined to return to Monterey, and accordingly arrived here on the 17th of July. Before leaving Sutter's I satisfied myself that gold exists in the bed of the Feather River, in the Yubah and Bear, and in many of the small streams that lie between the latter and the American Fork; also that it had been found in the Cosumnes to the south of the American Fork. In each of those streams the gold is found in small scales, whereas in the intervening mountains it occurs in coarse lumps.

Mr. Sinclair, whose ranche is 3 miles above Sutter's, on the north side of the American, employs about 50 Indians on the North Fork, not far from its junction with the main stream. He had been engaged about five weeks when I saw him, and up to that time his Indians had used simply closely-woven willow baskets. His net proceeds (which I saw) were about $16,000 worth of gold. He showed me the proceeds of his last week's work—fourteen pounds avoirdupois of clean washed gold. The principal store at Sutter's Fort, that of Brannant & Co., had received in payment for goods $36,000 worth of this gold from the 1st of May to the 10th of July; other merchants had also made extensive sales. Large quantities of goods were daily sent forward to the mines, as the Indians, heretofore so poor and degraded, have suddenly become consumers of the luxuries of life. I before mentioned that the greater part of the farmers and rancheros had abandoned their fields to go to the mines; this is not the case with Captain Sutter, who was carefully gathering his wheat, estimated at 40,000 bushels. Flour is already worth at Sutter's $36 a barrel, and soon will be $50. Unless large quantities of bread-stuffs reach the country, much suffering will occur: but as each man is able to pay a large price, it is believed the merchants will bring from Chili and Oregon a plentiful supply for the coming winter. The most moderate estimate I could obtain from men acquainted with the subject was that upwards of 4,000 men were working in the gold district, of whom more than half were Indians, and that from $30,000 to $50,000 worth of gold, if not more. was daily obtained. The entire gold district, with very few exceptions of grants made some years ago by the American authorities, is on land belonging to the United States. It was a matter of serious reflection with me how I could secure to the Government certain rents or fees for the privilege of procuring this gold; but, upon considering the large extent of country, the character of the people engaged, and the small scattered force at my command, I resolved not to interfere, but permit all to work freely, unless broils and crimes should call for interference. I was surprised to learn that crime of any kind was very unfrequent, and that no thefts or robberies had been committed in the gold district. All live in tents, in bush-houses, or in the open air, and men have frequently about their persons thousands of dollars' worth of this gold; and it was to me a matter of surprise that so peaceful and quiet a state of things should continue to exist. Conflicting claims to particular spots of ground may cause collisions, but they will be rare, as the extent of country is so great, and the gold so abundant, that for the present there is room and enough for all; still the Government is entitled to rents for this land, and immediate steps should be devised to collect them, for the longer it is delayed, the more difficult it will become. One plan I would suggest is to send out from the United States surveyors, with high salaries, bound to serve specified periods; a superintendent to be appointed at Sutter's Fort, with power to grant licenses to work on a spot of ground, say 200 yards square, for one year, at a rent of from $100 to $1,000, at his discretion; the surveyors to measure the grounds and place the renter in possession. A better plan, however, will be to have the district surveyed and sold at public auction to the highest bidder, in small parcels, say from 20 to 40 acres. In either case there will be many intruders, whom for years it will be almost impossible to exclude.

The discovery of these vast deposits of gold has entirely changed the character of Upper California. Its people, before engaged in cultivating their small patches of ground and guarding their herds of cattle and horses, have all gone to the mines, or are on their way thither; laborers of every trade have left their work-benches, and tradesmen their shops; sailors desert their ships as fast as they arrive on the coast, and several vessels have gone to sea with hardly enough hands to spread a sail; two or three are now at anchor in San Francisco with no crews on board. Many desertions, too, have taken place from the garrisons within the influence of the mines; 26 soldiers have deserted from the post of Sonoma, 24 from that of San Francisco, and 24 from Monterey. For a few days the evil appeared so threatening that great danger existed that the garrisons would leave in a body; and I refer you to my orders of the 25th of July to show the steps adopted to meet this contingency. I shall spare no exertions to apprehend and punish deserters; but I believe no time in the history of our country has presented such temptations to desert as now exist in California. The danger of apprehension is small, and the prospect of higher wages certain; pay and bounties are trifles, as laboring men at the mines can now earn in *one day* more than double a soldier's pay and allowance for a month, and even the pay of a Lieutenant or captain cannot hire a servant. A carpenter or mechanic would not listen to an offer of less than $15 or $20 a day. Could any combination of affairs try a man's fidelity more than this? And I really think some extraordinary mark of favor should be given to those soldiers who remain faithful to their flag throughout this tempting crisis. No officer can now live in California on his pay. Money has so little value, the prices of necessary articles of clothing and subsistence are so exorbitant, and labor so high, that to hire a cook or servant has become an impossibility, save to those who are earning from $30 to $50 a day. This state of things cannot last forever; yet from the geographical position of California, and the new character it has assumed as a mining country, prices of labor will always be high, and will hold out temptations to desert. I therefore have to report, if the Government wish to prevent desertions here on the part of men, and to secure zeal on the part of officers, their pay must be increased very materially. Soldiers both of the volunteer and regular service discharged in this country should be permitted at once to locate their land warrants in the gold district. Many private letters have gone to the United States giving accounts of the vast quantity of gold recently discovered, and it may be a matter of surprise why I have made no report on this subject at an earlier date. The reason is, that I could not bring myself to believe the reports that I heard of the wealth of the gold district until I visited it myself. I have no hesitation now in saying that there is more gold in the country drained by the Sacramento and San Joaquin rivers than will pay the cost of the present war with Mexico a hundred times over. No capital is required to obtain this gold, as the laboring man wants nothing but his pick, shovel, and tin pan, with which to dig and wash the gravel; and many frequently pick gold out of the crevices of rock with their butcher knives in pieces from one to six ounces.

Mr. Dye, a gentleman residing in Monterey, and worthy of every credit, has just returned from Feather river. He tells me that the company to which he belonged worked seven weeks and two days, with an average of 50 Indians (washers), and that their gross product was 273 pounds of gold. His share, one-seventh, after paying all expenses, is about 37 pounds, which he brought with him and exhibits in Monterey. I see no laboring man from the mines who does not show his two, three, and four pounds of gold. A soldier of the artillery company returned here a few days ago from the mines, having been absent on furlough 20 days; he made by trading and working during that time $1,500. During these 20 days he was travelling 10 or 11 days, leaving but a week, in which he made a sum of money greater than he receives in pay, clothes and rations during a whole enlistment of five years. These statements appear incredible, but they are true. Gold is believed also to exist on the eastern slopes of the Sierra Nevada, and when at the mines, I was informed by an intelligent Mormon that it had been found near the Great Salt Lake by some of his fraternity. Nearly all the Mormons are leaving California to go to the Salt Lake, and this they surely would not do unless they were sure of finding gold there in the same abundance as they now do on the Sacramento. The gold "placer" near the mission of San Fernando has long been known, but has been but little wrought for want of water. This is a spur that puts off from the Sierra Nevada (see Fremont's map), the same in which the present mines occur. There is, therefore, every reason to believe that in the intervening space of 500 miles (entirely unexplored) there must be many hidden and rich deposits. The placer gold is now substituted as currency of this country; in trade it passes freely at $16 per ounce; as an article of commerce its value is not yet fixed. The only purchase I made was of the specimen No. 7, which I got of Mr. Neligh at $12 the ounce. That is about the present cash value in the country, although it has been sold for less. The great demand for goods and provisions made by this sudden development of wealth has increased the amount of commerce at San Francisco very much, and it will continue to increase. I would recommend that a mint be established at some eligible point on the bay of San Francisco, and that machinery, and all the apparatus and workmen, be sent by sea. These workmen must be bound by high wages, and even bonds, to secure their faithful services; else the whole plan will be frustrated by their going to the mines as soon as they arrive in California. If this course be not adopted, gold to the amount of many millions of dollars will pass yearly to other countries, to enrich their merchants and capitalists. Before leaving the subject of mines, I will mention that on my return from the Sacramento I touched at New Almaden, the quicksilver mine of Mr. Alexander Forbes, consul of her Britannic Majesty at Tepic. This mine is in a spur of mountains 1,000 feet above the level of the bay of San Francisco, and is distant in a southern direction from the Pueblo San Jose about 12 miles. The ore (cinnabar) occurs in a large vein dipping at a strong angle to the horizon. Mexican miners are employed in working it, by driving shafts and galleries about 6 feet by 7, following the vein.

The fragments of rock and ore are removed on the backs of Indians in raw-hide sacks. The ore is then hauled in an ox-wagon from the mouth of the mine down to a valley well supplied with wood and water, in which the furnaces are situated. These furnaces are of the simplest construction, exactly like a common bake-oven, in the crown of which is inserted a whaler's trying kettle; another inverted kettle forms the lid. From a hole in the lid a small brick channel leads to an apartment or chamber, in the bottom of which is inserted a small iron kettle. The chamber has a chimney. In the morning of each day the kettles are filled with mineral (broken in small pieces), mixed with lime; fire is then applied, and kept up all day. The mercury, volatilized, passes into the chamber, is condensed on the sides and bottom of the chamber, and flows into the pot prepared for it. No water is used to condense the mercury. During a visit I made last spring, four such ovens were in operation, and yielded in the two days I was there 656 pounds of quicksilver, worth at Mazatlan $1.80 per pound. Mr. Walkinshaw, the gentleman now in charge of this mine, tells me that the vein is improving, and that he can afford to keep his people employed even in these extraordinary times. This mine is very valuable of itself, and becomes the more so, as mercury is extensively used in obtaining gold. It is not at present used in California for that purpose, but will be at some future time. When I was at this mine last spring, other parties were engaged in searching for veins; but none have been discovered that are worth following up, although the earth in that whole range of hills is highly discolored, indicating the presence of this ore. I send several beautiful specimens, properly labeled. The amount of quicksilver in Mr. Forbes' vats on the 15th of July was about 25,000 pounds. I inclose you herewith sketches of the country through which I passed, indicating the position of the mines, and the topography of the country in the vicinity of those I visited. Some of the specimens of gold accompanying this were presented for transmission to the Department by the gentlemen named below; the numbers on the topographical sketch, corresponding to the numbers on the labels of the respective specimens, show from what part of the gold region they were obtained:

1. Capt. J. A. Sutter.
2. John Sinclair.
3. William Glover, R. C. Kirby, Ira Blanchard, Levi Fairfield, Franklin H. Ayer, Mormon Diggings.
4. Chas. Weber.
5. Robert Spence.
6. Sunal & Co.
7. Robert D. Neligh.
8. C. E. Picket, American Fork, Columa.
9. E. C. Kemble.
10. T. H. Green, from San Fernando, near Los Angelos.

A. Two ounces purchased from Mr. Neligh.
B. Sand found in washing gold, which contains small particles.

11. Captain Frisbie, Dry Diggings, Weber's Creek.
12. Cosumnes.
13. Cosumnes, Hartnell's Ranch.
14. A small specimen, supposed to be platina, found mixed with the finer particles of the gold.

I have the honor to be your obedient servant,

R. B. MASON,
Colonel First Dragoons, Commanding.

General R. JONES,
Adjutant General, U. S. A., Washington, D. C.

Mining District under Local Usage—How Organized.—As an illustration of how a miner's camp, and placer mining district as well, was organized in California in the early days and is at the present time, to a certain extent, in many portions of the precious-metal mining States and Territories, the following laws and regulations for the internal government of the encampment of Jacksonville, Cal., in 1850, are herewith given. The residents of the camp or town, twenty or thirty in number, held a meeting in front of Col. Jackson's store on the 20th of January, 1850, and proceeded to organize a placer mining district. This local law, it will be noticed, assumed both civil and criminal jurisdiction, there being no legal tribunals of justice, and this course was necessary for the maintenance of social order:

Mining Camp at Jacksonville, Cal.—Organization and Rules.—Article 1.—The officers of this district shall consist of an alcalde and sheriff, to be elected in the usual manner by the people, and continue in office at the pleasure of the electors.

Art. 2.—In case of the absence or disability of the sheriff the alcalde shall have power to appoint a deputy.

Art. 3.—Civil causes may be tried by the alcalde, if the parties desire it; otherwise they shall be tried by a jury.

Art. 4.—All criminal cases shall be tried by a jury of eight American citizens, unless the accused should desire a jury of twelve persons, who shall be regularly summoned by the sheriff and sworn by the alcalde, and shall try the case according to the evidence.

Art. 5.—In the administration of law, both civil and criminal, the rule of practice shall conform as near as possible to that of the United States, but the forms and customs of no particular State shall be required or adopted.

Art. 6.—Each individual locating a lot for the purpose of mining shall be entitled to twelve feet of ground in width, running back to the hill or mountain and forward to the center of the river or creek, or across a gulch or ravine (except in cases hereinafter provided for), lots commencing in all cases at low-water mark and running at right angles with the stream where they are located.

Art. 7.—In cases where lots are located according to article 6 and the parties holding them are prevented by the water from working the same, they may be represented by a pick, shovel, or bar, until in a condition to be worked; but should the tool or tools aforesaid be stolen or removed, it shall not dispossess those who located it, provided he or they can prove that they were left as required; and said location shall not remain unworked longer than one week, if in condition to be worked; otherwise it shall be considered as abandoned by those who located it (except in cases of sickness).

Art. 8.—No man or party of men shall be permitted to hold two locations, in a condition to be worked at the same time.

Art. 9.—No party shall be permitted to throw dirt, stones, or other obstructions upon located ground adjoining them.

Art. 10.—Should a company of men desire to turn the course of a river or stream for the purpose of mining they may do so (provided it does not interfere with those working below them) and hold and work all the ground so drained, but lots located within said ground shall be permitted to be worked by their owners, so far as they could have been worked without the turning of the river or stream; and this shall not be construed to affect the rights and privileges heretofore guaranteed or prevent redress by suit at law.

Art. 11.—No person coming direct from a foreign country shall be permitted to locate or work any lot within the jurisdiction of this encampment.

Art. 12.—Any person who shall steal a mule, or other animal of draught or burden, or shall enter a tent or dwelling and steal therefrom gold dust, money, provisions, goods, or other articles amounting in value to one hundred dollars or over, shall, on conviction thereof, be considered guilty of felony, and suffer death by hanging. Any aider or abettor therein shall be punished in like manner.

Art. 13.—Should any person wilfully, maliciously, and premeditatedly take the life of another, on conviction of the murder, he shall suffer death by hanging.

Art. 14.—Any person convicted of stealing tools, clothing or other articles, of less value than one hundred dollars, shall be punished and disgraced by having his head and eyebrows close shaved and shall leave the encampment within twenty-four hours.

Art. 15.—The fee of the alcalde for issuing a writ or search-warrant, taking an attestation, giving a certificate or any other instrument of writing shall be five dollars; for each witness he may swear, two dollars; and one ounce of gold dust for each and every case tried before him.

The fee of the sheriff in each case shall be one ounce of gold dust and a like sum for each succeeding day employed in the same case. The fee of the jury shall be half an ounce in each case.

A witness shall be entitled to four dollars in each case.

Art. 16.—Whenever a criminal convict is unable to pay the costs of the case, the alcalde, sheriff, jurors, and witnesses shall render their services free of remuneration.

Art. 17.—In case of the death of a resident of this encampment, the alcalde shall take charge of his effects and dispose of them for the benefit of his relatives or friends, unless the deceased otherwise desire it.

Art. 18.—All former acts and laws are hereby repealed and made null and void, except where they conflict with claims guaranteed under said laws. ABNER PITTS, JR., *Sec.*

Jacksonville, Jan. 20, 1850.

The present method of organizing a Mining District.—This, of course, was in the early days, when there was neither State nor county organization. At this date the following system of organization of mining districts, quartz or placer, obtains: Meetings of two or more miners or others are held. The metes and bounds of the district, quartz or placer, are agreed upon. A code of rules and regulations is made for location and size of claims, a compliance with which gives possessory title to claims. A recorder is elected, who charges a fee for recording, and the district is organized. This proceeding is protected by State or Territorial law, and confirmed by the United States mining laws, which require that claimants shall comply with the local regulations of miners. Thus the titles to properties which may yield millions are initiated.

Executive and Departmental Recommendations.—The Secretary of the Interior, Hon. Caleb B. Smith, in his annual report for 1861 called the attention of Congress to the fact that—

The valuable and extensive mineral lands owned by the Government in California and New Mexico have hitherto produced no revenue. All who chose to do so have been permitted to work them without limitation. It is believed that no other government owning valuable mineral lands has ever refused to avail itself of the opportunity of deriving a revenue from the privilege of mining such lands. They are the property of the whole people, and it would be obviously just and proper to require those who reap the advantages of Mining them to pay a reasonable amount as a consideration for the advantages enjoyed.

And again, in his report for 1862, he urged attention to this subject, and referred to the report of the Commissioner of the General Land Office. The Secretary suggested two systems of disposal. The Commissioner of the General Land Office, in his annual report for 1862, after a review of the area of the precious-metal bearing territory and the yield from the mines, gave the following opinion:

An immense revenue may readily be obtained by subjecting the public mines either to lease under quarterly payments or quarterly tax as seigniorage upon the actual product, under a well-regulated and efficient system, which would stimulate the energies of miners and capitalists by securing to such classes an undisputed interest in localities so specified, and, when the conditions as to payment for the usufruct are complied with, for unlimited periods, and while effecting this with beneficial results to them would relieve the necessities of the Republic.

In 1863 the Commissioner of the General Land Office again called attention to the mineral lands, recommending legislation for—

Opening the mines and minerals of the public domain, the property of the nation, to the occupancy of all loyal citizens, subject, as far as compatible with moderate seigniorage, to existing customs and usages, conceding to the discoverer for a small sum a right to one mine, placer, or lead (quartz), with a pre-emptive right in the same district to an addition claim, both to be held for the term of one year, for testing the value.

Collectors of internal revenue were to be the collectors of royalty. December 6, 1864, President Lincoln called the attention of Congress to the mineral lands, and also to the report of the Secretary of the Interior on the subject. The Secretary of the Interior in his report asks for an appropriation to enable the Department to have made a scientific examination of the principal mining localities, and of the mineral regions generally. Former geological and mineralogical surveys of the public domain had been done under the direction of the Commissioner of the General Land Office and the Interior Department. The Commissioner of the General Land Office, in his report for 1864, entered at length into a description of the precious-metal bearing regions. He repeated the recommendation contained in his report for 1863 (see above), in regard to method of disposition of these lands. The Commissioner of the General Land Office, in his report for 1865, again showed the necessity for Congressional action. The Secretary of the Interior, in his report for 1865, said:

The organization of a bureau of mining was recommended in the last annual report of this Department. The attention of Congress is again invited to the subject. All lands denominated mineral which do not bear the precious metals should be brought into market, and thus placed under the guardianship of private owners. * * Individual proprietorship, it is conceded, would stimulate the development of coal fields, petroleum, deposits of iron, lead, and of other gross metals, and mineral formations. There can, therefore, be no sufficient reason for withholding such mineral lands from market. Congress has not legislated with a view to securing an income from the product of the precious metals from the public domain. It is estimated that two or three hundred thousand able-bodied men are engaged in such mining operations on the public lands, without authority of law, who pay nothing to the Government for the privilege, or for the permanent possession of property worth, in many instances, millions to the claimants.

The existing financial condition of the Nation obviously requires that all our national resources and the product of every industrial pursuit, should contribute to the payment of the public debt. The wisdom of Congress must decide whether the public interest would be better promoted by a sale in fee of these mineral lands, or by raising a revenue from their annual product.

Retrospect of Mining Legislation prior to 1866.—The mining laws of the United States began with the reservation, in the ordinance of May 20, 1785, of one-third part of all gold, silver, lead and copper mined; next came the Indiana act of March 3, 1807, authorizing the lease of lands containing lead, with lease of adjoining land for easements, and forest lands for wood for smelting purposes, for a term of not more than five years. The authority to make leases and to collect rents for the same, was in charge of the War Department (until March 4, 1849), which had a corps of employes, headed by a superintendent, to overlook the business, watch wastage, and receive rents; the act of March 25, 1816—the occupancy and trespass act—provided that the working of lead mines on the public lands was only to be granted after approval by the President.

The first sale of mineral lands was that of the reserved lead mines and contiguous lands in the State of Missouri, under act of March 3, 1829. They were to be exposed for sale as other public lands, at $2.50 per acre; but lead and other mineral lands on the public domain, elsewhere than in Missouri, were still reserved from sale.

The act of July 1, 1846, ordered the reserved lead mines and contiguous lands in Illinois, Arkansas, and the Territories of Wisconsin and Iowa, to be sold as other public lands, after six months' public notice, following the Missouri act of 1829, with the addition of the provision that the lands should be offered and held subject to private entry before pre-emptions were allowed. The register and receiver were to take proof as to character of lands, whether mineral (*i. e.*, containing lead) or agricultural. The act of March 1, 1847, opened for sale lands containing copper, lead, and other valuable ores after geographical examination and survey, and provided that there should be public advertisement of six months, and then public sale at not less than $5 per acre, those not disposed of at public auction to be subject to private sale at $5 per acre. The act of March 3, 1847, ordered sale of mineral lead land in Chippewa District, in Wisconsin, and the act of 1850 ordered sale of the remaining mineral lands in Lake Superior District in Michigan, in the same manner, at the same minimum, and with the same rights of pre-emption, as other public lands. From the period of 1785 to the discovery of the great gold fields of California, in 1848, the legislation of the Congress of the United States as to survey, lease, and sale of mineral lands had been for lead, copper, and other base metals, and applied to the territory in the region of the great lakes in the now States of Michigan, Wisconsin, Minnesota, Iowa, and Illinois, embracing the lead mines at Galena and the point now known as Dubuque (where a miner of that name in 1788 first worked lead mines, and subsequently, under permit from Carondelet, the Spanish governor-general) and the present State of Missouri. Under these various laws, the copper, lead and iron lands (also the silver lands since discovered) of the above-mentioned regions were sold. Since the discovery of gold in paying quantities in California, in 1848, there has been produced in the United States the sum of $1,980,463,792 in gold and silver. All but about $1,000,000 of this sum (which would represent the gold and silver extracted in the States other than public-land States) has been extracted from the lands of the public domain.

Precious Metals from 1848 to 1880.—The following estimate of the yearly production of gold and silver from 1848 to 1880, is from the reports of the Director of the Mint:

Estimate of the production of the precious metals in the United States from 1848 to 1880, by fiscal years.

Date.	*Gold.*	*Silver.*	*Total gold and silver.*
1848	$10,000,000	. . . . .	$10,000,000
1849	40,000,000	$50,000	40,050,000
1850	50,000,000	60,000	50,050,000
1851	55,000,000	50,000	55,050,000
1852	60,000,000	50,000	60 050,000
1853	65,000,000	50,000	65,050,000
1854	60,000,000	50,000	60,059,000
1855	55,000,000	50,000	55,050,000
1856	55,000,000	50,000	55,050,000
1857	55,000,000	50,000	55,050,000
1858	50,000,000	50,000	50,050,000
1859	50,000,000	100,000	60,100,000
1860	46,000,000	150,000	46,150,000
1861	43,000,000	2,000,000	45,000,000
1862	39,200,000	4,500,000	43.700,000
1863	40,000,000	8,500,000	48,500,000
1864	46,000,000	11,000,000	57,000,000
1865	53,225,000	11,250,000	64,475,000
1866	53,500,000	11,000,000	63,500,000
1867	51,725,000	13,500,000	65,225,000
1868	48,000,000	12,000,000	60,000,000
1869	49,500,000	12,000,000	61,500,000
1870	50,000,000	16,000,000	66,000,000
1871	43,000,000	23,000,000	66,000,000
1872	36,000,000	28,750,000	64,750,000
1873	36,000,000	35,750,000	71,750,000
1874	33,490,902	37,324,594	70,815,496
1875	33,467,856	31,727,560	65,195,416
1876	39,929,166	38,783,016	78,712,182
1877	46,897,390	39,793,573	86,690,000
1878	51,206,360	45,281,385	96,487,745
1879	38,899 858	40,812,132	79,711,990
1880	36,000,000	37,700,000	73,700,000
Total	1,520,041,532	460,422,260	1,980,483,792

The ordinance of 1785, for the sale of the Western Territory, reserved one-third part of gold and silver from the public lands. The present gold and silver regions of the West were then in the province of Spain. The laws of the United States, excepting the comprehensive word "mineral," as applied to reserved lands, and the pre-emption act of September 4, 1841, the Oregon act of September 27, 1851, and other incidental mention prior to that time, were silent as to gold, silver, and cinnabar.

The act of March 3, 1853, creating the office of surveyor-general of California, excepted, in express terms, mineral lands from lands subject to entry under the pre-emption act of September 4, 1841, and no person was to have the benefit of the act by settlement or location on mineral lands. The act of July 22, 1851, relating to the surveyor-general's office in New Mexico, etc., provided by the fourth section for the exemption of mineral lands from the operations of the acts named. This was the status at the period of the passage of the first general mining law of the United States, July 26, 1866.

The Condition of the Precious-Metal Bearing Regions Prior to 1866.—In the precious-metal-bearing regions on the public domain in California, Oregon, Nevada, Colorado, and the Territories, there had grown up a system of local regulations governing the location, size, and possession of mining claims, with water rights appurtenant thereto. These regulations were not uniform, but varied with different localities, and at first related only to placer claims. Quartz mining was a secondary stage, and regulations for this system were established as soon as required. Mineral districts were organized by the miners of each particular locality at meetings held for the purpose, and for each district an officer, known as the recorder, was elected, whose duty it was to record, in a book kept for that purpose, all notices of mining locations or claims filed with him. It was generally made essential to the validity of a claim that it should be recorded. These regulations at first rested entirely upon the consent of the miners; but they became recognized as customs by the courts, and were held to be binding in all matters relating to the possessory title to mining claims. In the civil codes enacted by the State or Territorial legislatures these local rules were respected and generally specifically recognized. They sprung from the sterling good sense of the American miner, and were adapted to the wants and necessities of a great industry for which there would otherwise have been no protection. They protected millions of property and aided in opening up a region of incalculable wealth. Prospectors, under this code of laws, with pick, pan, and shovel, on mountain side, amidst winter's rugged grasp, on the plains, under sunny skies, in the quiet nooks and flowery ravines of the lower slopes of the Sierras, lifted from the matrix of nature the golden treasure, and toiled on as safely protected in their property as if in the midst of the highest civilization. These laws protected and controlled the possession, and provided for the distribution of hundreds of millions of dollars of property, and affected the people of a half million square miles of territory. (For a list of mining districts, deputy mineral surveyors, etc., see Preliminary Report Land Commission, 1880, and Reports General Land Office from 1866 to 1880). The Congress of the United States by the act of general mining, July 26, 1866, and the supplemental act of May 10, 1872, confirmed these local usages.

The Mining Act of July 26, 1866.—The act of July 26, 1866, ordered that "the mineral lands of the public domain, both surveyed and unsurveyed," were "to be free and open to exploration and occupation by all citizens of the United States, and those declaring their intention to become citizens, subject to such regulations as may be prescribed by law," and subject also to the local customs or rules of miners in the several mining districts, so far as the same may not be in conflict with the laws of the United States." The second section of this act provided "that whenever any person or association of persons claim a vein or lode of quartz, or other rock in place, bearing gold, silver, cinnabar, or copper, having previously occupied and improved the same according to the local customs or rules of miners in the district where the same is situated, and having expended in actual labor and improvements not less than $1,000," such claimants, where there is no conflict. after filing in "the local land office a diagram of the same," according to local laws, customs, and miners' rules can "enter such tract and receive a patent therefor, granting such mine, together with the right to follow such vein or lode, with its dips, angles, and variations, to any depth." The other sections of the law prescribed with specialty the mode of consummating individual rights, surveys, &c.; also in reference to conflicts, rights of way, priority "of possession," right to the use of water for mining, agricultural, manufacturing, or other purposes; to homesteads existing prior to the date of the act, which are used for agriculture, on which valuable mines are not discovered, the law conferring authority on the Secretary of the Interior for setting apart, after survey, the agricultural lands so as to subject them to pre-emption and sale.

Placer-Mining Act, July 9, 1870—July 9, 1870, Congress, provided for a class of "placer" mining not recognized in the lode act of July 26, 1866 (see Stats. at Large). This act provided for the survey and sale of the placer-mining lands of the United States at $2.50 per acre.

The Mining Act of May 10, 1872.—The mining act of May 10, 1872, amended the original mining act of 1866, and constituted mineral lands a distinctive class subject to special conditions of sale and affixed prices differing wholly from the requirements in these respects as to other lands. It provided for the survey and sale of mineral lands, fixing the price of placer lands at $2.50 per acre and $5 for lode claims, and repealed, in effect, the ditch and water rights' act of July 26, 1866. The present laws for the disposition of the mineral lands of the United States are found in chapter 6, of the Revised Statutes, title "Mineral Lands and Mining Resources," and in the Regulations of the General Land Office of date April 1, 1879.

Provisions of the existing Mining Law.—Under section 2318, Revised Statutes, lands valuable for minerals are reserved from sale except as otherwise expressly directed by law. Section 2319 provides for their location by citizens of the United States or those who have declared their intention to become such. The law covers claims for lands bearing gold, cinnabar, lead, tin, copper, or other valuable deposits, and for the above and other valuable and economic minerals, found in lodes of quartz or other rock in place, titles can be obtained from the United States under the existing laws at $5 per acre. Claims cannot exceed 1,500 feet in length along the vein or lode, and 300 feet on each side of the middle of the vein at the surface, the end lines of the claims to be parallel. No vein or lode claim located after May 10, 1872, can exceed a parallelogram 1,500 feet in length by 600 in width. The size below this maximum may be regulated by State or Territorial laws or the rules of the several mining districts. No local regulation or State or Territorial law can limit a vein or lode claim located since May 10, 1872, to less than 1,500 feet along the vein or course thereof, whether the location is made by one or more persons, nor can surface rights be limited to less than 50 feet in width, unless adverse rights existing on the 10th day of May, 1872, render such lateral limitations necessary. This saving clause is essential from the fact that in many of the mining States and Territories, the local rules did not permit the location of surface ground. There are now three classes of location recognized—those made prior to July 26, 1866; those between that date and May 10, 1872; and those made since May 10, 1872. The variety in size and quantity of locations cannot here be detailed at length. Under the United States mining law, the maximum of a quartz lode or vein claim is 1,500 by 600 feet, and the minimum 1,500 by 50 feet, being about 20.66 acres maximum, or 1.72 acres minimum. Cost of surveys, &c., are paid by the claimants, and the land is paid for at $5 for each acre or fraction of an acre. Locations are made under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable, and not inconsistent with the laws of the United States. The United States has the authority and can provide a general and uniform system of location, areas, &c., entirely superseding the various State, Territorial, and district laws. Some of the mining States and Territories have adopted the United States mining law of May 10, 1872, as to area; others protect other forms and areas of location by law. (For a full statement of the various methods of locations, holdings, miners' rules, &c., see Preliminary Report of Public Land Commission and Testimony, 1880, which gives the methods prevailing, and the legal status in California, Oregon, Nevada, Colorado, Idaho, Dakota, Arizona, Montana, Utah, Washington, Wyoming, and New Mexico).

Cost of Patents to the United States and Claimants.—It costs the United States on an average $20 to patent each mining claim. During the year ending June 30, 1880, there were issued 886 patents to mining claims. All of the work appertaining thereto, involving an examination of the evidence accompanying the entry papers, including that relating to contests, was executed by the mineral division of the General Land Office, at a cost to the government for salaries of $17,600, an average of about $20, in each case. Where the survey and papers have been properly prepared, and no controversey exists, the cost in a particular case will not exceed $3. The cost to the claimant is as problematical as that of a lawsuit. He is required to pay the expense of survey, including platting and other office work of the surveyor-general's office, which will average about $160; also, fees to the register and receiver, $10, and expense of publication of notice, averaging $30; in all, $200. Practically, it is estimated that the average cost to the claimant falls but little, if any, short of $1,000 in each case.

Placer Claims—Patents Therefor.—The proceedings to obtain patent for placer claims, including all forms of deposit, are essentially similar to the proceedings prescribed for obtaining patents for lode or vein claims. But placer claims, when on surveyed lands and conforming to legal subdivisions, require no further plat or survey, and 40-acre subdivisions may be cut into 10-acre lots and sold as placer claims. Where placer claims cannot be conformed to legal subdivisions, survey and plat must be made as on unsurveyed lands; but where such claims are located previous to the public surveys, and do not conform to legal subdivisions, survey, plat, and entry thereof may be made according to the boundaries thereof, provided the location is in all respects legal. These lands are sold at $2.50 for each acre or fraction of an acre. No location of a placer claim made after July 9, 1870, can exceed 160 acres for any one person or association of persons. All placer-mining claims located after May 10, 1872, must conform as nearly as practicable with the United States system of public surveys and the subdivisions of such surveys, and no such locations can include more than 20 acres for each individual claimant. The act of July 9, 1870, absolutely required locations made after its passage to conform to legal subdivisions, but the act of May 10, 1872, modified this requirement by making such conformation necessary only where practicable. The foregoing provisions of law are construed to mean that after the 9th day of July, 1870, no location of a placer claim can be made to exceed 160 acres, whatever may be the number of locators associated together, or whatever the local regulations of the district may allow; and that from and after May 10, 1872, no location made by an individual can exceed 20 acres, and no location made by an association can exceed 20 acres for each person. In order to locate 160 acres, eight *bona-fide* locators are required. No local laws or mining regulations can restrict a placer location to less than 20 acres, although the locator is not compelled to take so much. Mill sites must be located on non-mineral lands not contiguous to the vein or lode, and not exceed five acres, and may be included in the patent for a mine at $5 per acre. (See sec. 2337 R. S.) Tunnel rights, in tunnels run for the development of a vein or lode or for the discovery of mines, are provided. Proprietors of a mining tunnel, run in good faith, are entitled to the possessory right of all blind lodes cut, discovered, or intersected by such tunnel, which were not previously known to exist, within 3,000 feet of the surface or point of commencement of the tunnel, to the same extent as if such lodes had been discovered on the surface, and other parties are prohibited, after commencement of the tunnel, from prospecting for and making location on *the line thereof* and within said distance of 3,000 feet, unless such lodes appear upon the surface or were previously known to exist. (See sec. 2323 R. S.) For requirements necessary to obtain the benefit of this law, see pages 16–17, "Regulations General Land Office, April 1, 1879."

Iron Held to be a Valuable Mineral.—Iron has been held, along with many other minerals when on the public domain, to come within section 2325 of the Revised Statutes, under the denomination of valuable deposits, and can be paid for at the rate of $2.50 or $5 per acre, depending upon whether the deposit is in placer or lode form.

The Policy of the United States in Relation to Mineral Lands.—The policy of the United States in relation to the sale and disposition of the mineral lands of the public domain—beginning with its reservation of portions of the metal therefrom, next occupancy rights, then leases, followed by public offering and private entry and sale, thereafter culminating in the several mineral acts of 1866, 1870, and 1872—now permits their free exploration and development by citizens, or persons who have declared their intention to become citizens; and a nominal price for the lands (placer $2.50, and quartz, gold, silver, cinnabar, or other valuable deposits $5 per acre) is charged should the owner of the possessory title desire to procure a fee-simple title. This price barely covers expenses of making title on the part of the United States. The material wealth added to the circulating medium by extraction from the earth through individuals or corporations, together with costs of mining and extraction, and the great and dangerous risks to fortune caused thereby, are considered equivalents for the value of the land. The United States protects exploration and developments by the miner on the public domain. As an evidence of the liberality of the Nation in this respect, coal lands are sold at from $10 to $20 per acre. Twenty acres of coal land at $20 per acre cost the purchaser $400, while 20 acres of lode mineral land on the Comstock lode at $5 per acre are sold for $100, and, as in the case of the Consolidated Virginia and California mines, may yield more than $60,000,000.

Number of Locations and of Patents.—In the twelve States and Territories containing the precious metals and forming part of the public domain there are known to have been made more than 200,000 mining locations, yet the total number to June 30, 1880, of lode, vein, or other valuable deposit claims to which titles have been obtained by compliance with the mining laws is but 3,978, containing 38,435.11 acres at $5 per acre, and for which the United States have received $197,778. The total number of placer-mining claims patented in the same region by the United States is 1,303, containing 110,186.03 acres, at $2.50 per acre, and for which the United States has received $288,767. In all a total number of 5,281 lode and placer claims have been patented to June 30, 1880, containing in all 148,621.14 acres, for which the Government received a total of $486,545.

Estimate of Area of Western Precious-metal Regions.—The estimated area of the entire precious-metal bearing region of the public domain is 65,000,000 acres, within which lie the veins, lodes, or deposits of precious and valuable minerals. Deducting the 148,621.14 acres already patented, and the grand total remaining, the property of the Nation exceeds 64,800,000 acres, all situated and lying in the States and Territories named in the tables hereto attached, and being south of the Dominion of Canada (British Possessions), west of the Missouri River, and north of the boundary line between Mexico and this country. All of this is independent of the unexplored area within the unorganized Territory of Alaska, which in the future may form no unimportant portion of our precious-metal-bearing country. The above estimate, however, includes a vast number of located claims held and worked under a possessory title alone, there being no statute compelling the claimants to purchase the fee from the Government. For many of these claims applications for patent have been made, but proceedings are suspended either on account of litigation in the courts, initiated in the manner and within the time prescribed by the statute, or by reason of failure of claimants to produce satisfactory evidence of compliance with law and right to purchase and make entry. The difficulties of obtaining patent under existing laws are so great, and the practice of levying blackmail is so extensive, that many mine owners prefer to rely upon their possessory title rather than purchase the fee from the Government.

Patents Issued.

Statement of the number of placer mining claims patented in the several precious metal-bearing States and Territories of the public domain from 1867 to June 30, 1880, together with the acreage and amount paid therefor, under the several mining acts of July 26, 1866, July 9, 1870, and May 10, 1872.

States and Territories.	1867			1870.			1871.		
	No. of placers.	*Acres.*	*Amount.*	*No of placers.*	*Acres.*	*Amount.*	*No. of placers.*	*Acres.*	*Amount.*
California	1	80.70	$405 00	2	71.16	$185 00	36	385.84	$ 9,632 50
Oregon	...	...	...	2	250.00	625 00	6	446.47	1,373 00
Nevada	...	...	...	...	...	...	...	...	...
Idaho	...	...	...	...	...	...	...	...	...
Montana	...	...	...	1	26.24	67 50	14	1,187.37	2,447 50
Wyoming	...	...	...	...	...	...	...	...	...
Utah	...	...	...	...	...	...	...	...	...
Colorado	...	...	...	...	...	...	...	...	...
Dakota	...	...	...	...	...	...	...	...	...

States and Territories.	1872.			1873.			1874.		
	No. of placers.	*Acres.*	*Amount.*	*No. of placers.*	*Acres.*	*Amount.*	*No of placers.*	*Acres.*	*Amount.*
California	79	8,680.57	$ 20,837.00	130	10,748.32	$ 26,973 50	104	9,562.67	$ 23,979 50
Oregon	5	324.06	814.50	4	147.97	445 00	7	288.48	677 50
Nevada	...	...	...	...	...	...	...	...	...
Idaho	...	...	...	...	...	...	...	...	...
Montana	29	2,566.27	6,479.50	66	3,822.08	9,671 50	42	2,714.91	6,842 50
Wyoming	...	...	...	...	...	...	...	...	...
Utah	...	...	...	...	...	...	...	...	...
Colorado	4	482.75	1,207.50	24	1,932 05	4,842 50	13	477.01	1,200 00
Dakota	...	...	...	...	...	...	...	...	...

States and Territories.	1875.			1876.			1877.		
	No. of placers.	*Acres.*	*Amount.*	*No. of placers.*	*Acres.*	*Amount.*	*No. of placers.*	*Acres.*	*Amount.*
California	107	12,439.51	$ 29,874.00	57	6,789.05	$ 16.982.00	67	6,371.49	$ 16,030.00
Oregon	10	697.39	1,745.50	8	468.94	1,276.00	7	386.59	987.50
Nevada	3	400.00	1,000.00	1	160.00	400.00	1	1,280.00	3,200.00
Idaho	...	...	...	...	...	...	...	...	...
Montana	40	1,970.15	4,994.50	17	875.47	2,207.00	12	498.57	1,254.00
Wyoming	...	...	...	4	320.00	1,050.00	...	...	...
Utah	1	8.20	22.50	1	32.28	82.50	...	...	...
Colorado	12	1,248.16	3,272.00	17	1,038.34	2,762.00	17	1,203.83	3,275.00
Dakota	...	...	...	...	...	...	5	25.07	67.50

States and Territories.	1878. *No. of placers.*	1878. *Acres.*	1878. *Amount.*	1879. *No. of placers.*	1879. *Acres.*	1879. *Amount.*	1880. *No. of placers.*	1880. *Acres.*	1880. *Amount.*
California	95	11,409.17	$ 28,615.60	72	4,719.32	$ 14,142.00	36	4,266.55	$ 11,005.00
Oregon	7	414.18	1,055.00	1	20.00	50.00	3	71.90	182.50
Nevada									
Idaho	1	19.86	50.00	12	36.15	185.00			
Montana	15	907.19	2,285.00	15	831.16	2,132.50	17	1,268 09	3,197.50
Wyoming									
Utah				2	40.00	310.00			
Colorado	12	118.31	2,807.50	23	1,799.01	4,632.60	30	2,593.80	6,516.50
Dakota	17	154.17	330.00	4	61.80	172.00	1	1.66	5.00

Recapitulation.

States and Territories.	*No. of placers.*	*Total acres.*	*Total amount.*
California	786	79,620.00	$199,661.00
Oregon	59	3,561.08	9,306.50
Nevada	5	1,840.00	4,600.00
Idaho	3	56.01	235.00
Montana	263	16,677.50	42,099.00
Wyoming	4	320.00	1,050.00
Utah	4	80.48	725.00
Colorado	152	10,943.26	30,515.50
Dakota	27	242.70	574.50
Total	1,303	110,186.03	$288,767.00

Statement of the number of quartz vein or lode, or other valuable deposit mining claims patented in the several precious metal bearing States and Territories of the public domain from 1867 to June 30, 1880, together with the acreage and amount paid therefor, under the several mining acts of July 26, 1866, July 9, 1870, and May 10, 1872.

States and Territories.	1867. *Lodes.*	1867. *Acres.*	1867. *Amount.*	1868. *Lodes.*	1868. *Acres.*	1868. *Amount.*	1869. *Lodes*	1869. *Acres.*	1869. *Amount.*
California	4	138.68	$700.00	2	147.09	$740.00	6	207.84	$1,045.00
Oregon									
Nevada	3	16.19	90.00	26	287.19	1,485.00	34	255.16	1,320.00
Idaho									
Montana				9	63.93	290.00	7	50.52	280.00
Wyoming									
Utah									
Colorado				3	3.42	25.00	27	39.42	245.00
New Mexico									
Arizona									
Dakota									

	1870.			1871.			1872.		
California	6	348.15	$1,756 00	13	740.00	$3,725 00	54	1,182.46	$6,020 00
Oregon				1	13.76	70 00	4	13.76	70 00
Nevada	44	249.53	1,295 00	23	115.23	595 00	26	179.93	925 00
Idaho									
Montana	5	45.70	240 00	2	13.77	75 00	16	73.76	420 00
Wyoming									
Utah				8	49.28	270 00	36	171.46	940 00
Colorado	61	104.93	670 00	72	117.32	775 00	123	189.38	1,340 00
New Mexico	1	20.66	105 50						
Arizona							3	46.63	248 00
Dakota									

	1873.			1874.			1875.		
California	84	1,950.67	$ 10,090 00	81	2,123.69	$9,650 00	88	2,753.86	$ 14,040 00
Oregon									
Nevada	63	459.27	2,370 00	73	741.86	3,450 00	70	706.92	3,620 00
Idaho	1	7.23	40 00	1	6.50	30 00	5	68.50	350 00
Montana	20	85.00	500 00	24	277.98	1,505 00	25	632.40	3,275 00
Wyoming									
Utah	46	252.76	1,365 00	34	84.16	460 00	31	296.68	1,375 00
Colorado	188	342.89	2,146 00	114	222.36	1,500 00	138	453.53	2,645 00
New Mexico				2	13.77	70 00	1	20.66	105 00
Arizona	13	163.49	845 00	6	116.40	600 00	7	133.59	680 00
Dakota									

States and Territories.	1876. *Lodes.*	1876. *Acres.*	1876. *Amount.*	1877. *Lodes.*	1877. *Acres.*	1877. *Amount.*	1878. *Lodes.*	1878. *Acres.*	1878. *Amount.*
California	61	1,701.45	$8,320 00	76	1,696.60	$7,955 00	59	1,167.02	$5.875 00
Oregon									
Nevada	77	872.18	4,450 00	68	737.76	3,865 00	83	814.40	4,180 00
Idaho									
Montana	30	307.40	1,605 00	35	372.02	2,045 00	72	837.96	4,365 00
Wyoming	1	8.89	45 00						
Utah	67	455.87	1,840 00	63	3 5.91	2,010 00	67	617.94	3,160 00
Colorado	173	818.37	4,534 00	139	676.88	3,755 00	242	1,403.79	7,570 00
New Mexico	1	20.66	105 00				2	31.01	160 00
Arizona	10	169.32	870 00	18	207.23	1,065 00	7	97.26	500 00
Dakota							3	17.90	92 00

States and Territories.	1879. *Lodes.*	1879. *Acres.*	1879. *Amount.*	1880. *Lodes.*	1880. *Acres.*	1880. *Amount.*
California	73	1,427.41	$6,875 00	65	508.97	$2,700 00
Oregon	1	20.25	105 00	1	20.66	105 00
Nevada	81	855.17	4,350 00	33	407.28	2,075 00
Idaho						
Montana	51	535.77	2,875 00	26	308.94	1,595 00
Wyoming						
Utah	72	675.10	3,040 00	69	406.06	2,117 00
Colorado	185	1,149.60	6,265 00	207	1,398.47	7,535 00
New Mexico	1	20.66	105 00	2	40.88	210 00
Arizona	12	203.92	1,050 00	9	180.44	945 00
Dakota	15	124.43	670 00	7	46.69	245 00

Recapitulation.

Lode claims patented from 1867 to June 30, 1880.

States and Territories.	*Number of patents.*	*Acres.*	*Received by United States.*
California	672	16,094.23	$79,690 00
Oregon	7	68.43	350 00
Nevada	704	6,596.07	34,070 00
Idaho	7	81.23	420 00
Montana	322	3,605.54	18,990 00
Wyoming	1	8.89	45 00
Utah	473	3,384.92	16,577 00
Colorado	1,672	6,920.36	39,004 00
New Mexico	10	168.24	860 00
Arizona	85	1,318.28	6,765 00
Dakota	25	188.92	1,007 00
No. of claims patented	3,978	38,435.11	197,778 00
Number of placer claims patented from 1866 to June 30, 1880	1,303	110,186.03	288,767 00
Number of vein or lode claims patented from 1866 to June 30, 1880	3,978	38,435.11	197,778 00
Total	5 ,281	148,621.14	486,545 00

Washington Territory, although having no mining claims patented, contains valuable deposits of the precious metals.

SALE AND DISPOSITION OF PUBLIC LANDS.

THE several existing laws for the sale and disposition of the public domain permit entries and locations by individuals, associations, and corporations. A single man, a married man, a single woman, or a married woman, if (legally) the head of a family, citizens of the United States, or have declared their intentions to become such, can have the benefits of the several settlement laws. The theory of the settlement law is that an individual, if he be not already the owner of 320 acres of land, can purchase 160 acres under the pre-emption act after six months settlement, occupation, and improvement, and can acquire 160 acres under the homestead act by residence, improvement, and cultivation for a term of five years, with certain legal rebates as to time of settlement, or can purchase at the end of six months by commutation. Under the several settlement and occupancy laws, however, a person can legally acquire 1,120 acres of the public domain. The existing laws recognize several classes of land, as follows:

Mineral.—"In all cases 'land valuable for minerals' shall be reserved from sale, except as otherwise expressly directed by law." (Section 2318, R. S.)

Timber and stone.—Lands valuable chiefly for timber and stone, unfit for cultivation.

Saline.—Salt Springs.

Town-site lands.—Any unoccupied public lands.

Desert.—Lands which will not, without irrigation, produce an agricultural crop.

Coal lands.—Lands containing coal.

And all others as *agricultural.*

Special laws are provided for each of the seven classes named. Lands reserved or withdrawn "are not subject to entry or location."

Mineral Lands.—Mineral lands are located and sold thereafter in the manner previously described.

Coal Lands.—The public lands of the United States containing coal are disposed of under the act of Congress approved March 3, 1873.

The sale of coal lands is provided for by this act—

1. By ordinary private entry under section 1.

2. By granting a preference right of purchase based on priority of possession and improvement under section 2. The land entered under either section must be *by legal subdivisions*, as made by the regular United States survey. Entry is confined to surveyed lands; to such as are vacant, not otherwise appropriated, reserved by competent authority, or containing valuable minerals other than coal. Individuals and associations may purchase. If an individual, he must be twenty-one years of age and a citizen of the United States, or have declared his intention to become such citizen. If an association or persons, each must be qualified as above. A person is not disqualified by the ownership of any quantity of other land, nor by having removed from his own land in the same State or Territory. Any individual may enter by legal subdivisions as aforesaid any area not exceeding 160 acres. Any association may enter not to exceed 320 acres. Any association of not less than four persons, duly qualified, who shall have expended not less than $5,000 in working and improving any coal mine or mines, may enter under section 2 not exceeding 640 acres, including such mining improvements. The price per acre is $10 where the land is situated *more* than fifteen miles from any complete railroad, and $20 per acre where the land is *within* fifteen miles of such road. Where the land lies *partly within* fifteen miles of such road and in *part outside* such limit, the *maximum* price must be paid for all legal subdivisions the greater part of which lies within fifteen miles of such road. The term "completed railroad" is held to mean one which is actually constructed on the face of the earth, and lands within fifteen miles of any point of a railroad so constructed, will be held and disposed of at $20 per acre. One year from and after the expiration of the period allowed for filing the declaratory statement is given within which to make proof and payment, but no party will be allowed to make final proof and payment, except on notice to all others who appear on the records as claimants to the same tracts.

Saline Lands.—The act of Congress of January 12, 1877, provides that where tracts are found to be saline in character, and therefore under pre-existing laws not subject to disposal, they shall be offered at public sale at not less than $1.25 per acre, and if not then sold shall be thereafter held subject to private entry at the same price, as other public lands. The act provides for an investigation to ascertain by testimony the true character of public lands, where there shall be reason to suppose that they are saline. This act is confined in its operations to States which have had grants of salines which have been fully satisfied, or under which the right of selection has expired by efflux of time. This act excepts from its operations the Territories and the States of Mississippi, Louisiana, Florida, California, and Nevada.

RULINGS OF THE GENERAL LAND OFFICE.

THE following are the rulings of the General Land Office in force October 31, 1881:

Lode-Claims Located prior to May 10, 1872.—2. By an examination of the several sections of the Revised Statutes it will be seen that the *status* of lode-claims located *previous* to the 10th May, 1872, is not changed with regard to their *extent along the lode or width of surface.*

3. Mining rights acquired under such previous locations are, however, enlarged by said Revised Statutes in the following respect, viz.: The locators of all such previously taken veins or lodes, their heirs and assigns, so long as they comply with the laws of Congress and with State, Territoral, or local regulations not in conflict therewith, governing mining-claims, are invested with the exclusive possessory right of all the surface included within the lines of their locations, and of all veins, lodes, or ledges throughout their entire depth, the top or apex of which lies inside of such surface-lines extended downward vertically, although such veins, lodes, or ledges may so depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such locations at the surface, it being expressly provided, however, that the right of possession to such outside parts of said veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as aforesaid, through the end-lines of their locations so continued in their own direction that such planes will intersect such exterior parts of such veins, lodes, or ledges; no right being granted, however, to the claimant of such outside portion of a vein or ledge to enter upon the surface location of another claimant.

4. It is to be distinctly understood, however, that the law limits the possessory right to veins, lodes, or ledges, *other* than the one named in the original location, to such as were not *adversely claimed on May* 10, 1872, and that where such other vein or ledge was so adversely claimed at that date, the right of the party so adversely claiming is in no way impaired by the provisions of the Revised Statutes.

5. In order to hold the possessory title to a mining-claim located prior to May 10, 1872, and for which a patent has not been issued, the law requires that *ten dollars* shall be expended annually in labor or improvements on each claim of *one hundred feet* on the course of the vein or lode until a patent shall have been issued therefor; but where a number of such claims are held in common upon the same vein or lode the aggregate expenditure that would be necessary to hold all the claims, at the rate of ten dollars per hundred feet, may be made upon any one claim; a failure to comply with this requirement in any one year subjecting the claim upon which such failure occurred to relocation by other parties, the same as if no previous location thereof had ever been made, unless the claimants under the original location shall have resumed work thereon after such failure and before such relocation. The first annual expenditure upon claims of this class should have been performed subsequent to May 10, 1872, and prior to January 1, 1875. From and after January 1, 1875, the required amount must be expended *annually* until patent issues. By decision of the honorable Secretary of the Interior, dated March 4, 1879, such annual expenditures are not required subsequent to entry, the date of issuing the patent certificate being the date contemplated by statute.

6. Upon the failure of any one of several co-owners of a vein, lode, or ledge, which has not been entered, to contribute his proportion of the expenditures necessary to hold the claim or claims so held in ownership in common, the co-owners who have performed the labor, or made the improvements, as required by said Revised Statutes, may, at the expiration of the year, give such delinquent co-owner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days; and if upon the expiration of ninety days after such notice in writing, or upon the expiration of one hundred and eighty days after the first newspaper publication of notice, the delinquent co-owner shall have failed to contribute his proportion to meet such expenditures or improvements, his interest in the claim by law passes to his co-owners, who have made the expenditures or improvements as aforesaid. Where a claimant alleges ownership of a forfeited interest under the foregoing provision, the sworn statement of the publisher as to the facts of publication, giving dates and a printed copy of the notice published, should be furnished, and the claimant must swear that the

delinquent co-owner failed to contribute his proper proportion within the period fixed by the statute.

Patents for Veins or Lodes heretofore Issued.—7. Rights under patents for veins or lodes heretofore granted under previous legislation of Congress are enlarged by the Revised Statutes so as to invest the patentee, his heirs or assigns, with title to all veins, lodes, or ledges, throughout their entire depth, the top or apex of which lies within the end and side boundary lines of his claim on the surface, as patented, extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of the claim at the surface. The right of possession to such outside parts of such veins or ledges to be confined to such portions thereof as lie between vertical planes drawn downward through the end-lines of the claims at the surface, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges, it being expressly provided, however, that all veins, lodes, or ledges, the top or apex of which lies inside such surface locations, *other* than the one named in the patent, which were *adversely claimed on the* 10*th May*, 1872, are excluded from such conveyance by patent.

8. Applications for patents for mining-claims pending at the date of the act of May 10, 1872, may be prosecuted to final decision in the General Land Office, and where no adverse rights are affected thereby, patents will be issued in pursuance of the provisions of the Revised Statutes.

Manner of Locating Claims on Veins or Lodes after May 10, 1872.—9. From and after the 10th May, 1872, any person who is a citizen of the United States or who has declared his intention to become a citizen, may locate, record, and hold a mining-claim of *fifteen hundred linear feet* along the course of any mineral vein or lode subject to location; or an association of persons, severally qualified as above, may make joint location of such claim of *fifteen hundred feet*, but in no event can a location of a vein or lode made subsequent to May 10, 1872, exceed fifteen hundred feet along the course thereof, whatever may be the number of persons composing the association.

10. With regard to the extent of surface ground adjoining a vein or lode, and claimed for the convenient working thereof, the Revised Statutes provide that the lateral extent of locations of veins or lodes made after May 10, 1872, shall in no case *exceed three hundred feet on each side of the middle of the vein at the surface*, and that no such surface-rights shall be limited by any mining regulations to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the 10th May, 1872, may render such limitation necessary; the end-lines of such claims to be in all cases parallel to each other. Said lateral measurements cannot extend beyond three hundred feet on *either* side of the middle of the vein at the surface, or such distance as is allowed by local laws. For example: 400 feet cannot be taken on one side and 200 feet on the other. If, however, 300 feet on each side are allowed, and by reason of prior claims but 100 feet can be taken on one side, the locator will not be restricted to less than 300 feet on the other side; and when the locator does not determine by exploration *where* the middle of the vein at the surface is, his discovery shaft must be assumed to mark such point.

11. By the foregoing it will be perceived that no lode-claim located after the 10th May, 1872, can exceed a parallelogram fifteen hundred feet in length by six hundred feet in width, but whether surface-ground of that width can be taken, depends upon the local regulations of State or Territorial laws in force in the several mining-districts; and that no such local regulations or State or Territorial laws shall limit a vein or lode claim to less than fifteen hundred feet along the course thereof, whether the location is made by one or more persons, nor can surface rights be limited to less than fifty feet in width, unless adverse claims existing on the 10th day of May, 1872, render such lateral limitation necessary.

12. It is provided by the Revised Statutes that the miners of each district may make rules and regulations not in conflict with the laws of the United States, or of the State or Territory in which such districts are respectively situated, governing the location, manner of recording, and amount of work necessary to hold possession of a claim. They likewise require that the location shall be so distinctly marked on the ground that its boundaries may be readily traced. This is a very important matter, and locators cannot exercise too much care in defining their locations at the outset, inasmuch as the law requires that all records of mining locations made subsequent to May 10, 1872, shall contain the name or names of the locators, the date of the location, and such a *description of the claim or claims* located, by reference to some natural object or permanent monument, as will identify the claim.

13. The statutes provide that no lode-claim shall be recorded until after the discovery of a vein or lode within the limits of the claim located, the object of which provision is evidently to prevent the appropriation of presumed mineral ground for speculative purposes to the exclusion of *bona fide* prospectors, before sufficient work has been done to determine whether a vein or lode really exists.

14. The claimant should, therefore, prior to locating his claim, unless the vein can be traced upon the surface, sink a shaft, or run a tunnel or drift, to a sufficient depth therein to discover and develop a mineral-bearing vein, lode, or crevice; should determine, if possible, the general course of such vein in either direction from the point of discovery, by which direction he will be governed in marking the boundaries of his claim on the surface. His location notice should give the course and distance as nearly as practicable from the discovery-shaft on the claim, to some permanent, well-known points or objects, such, for instance, as stone monuments, blazed trees, the confluence of streams, point of intersection of well-known gulches, ravines, or roads, prominent buttes, hills, &c., which may be in the immediate vicinity, and which will serve to perpetuate and fix the *locus* of the claim and render it susceptible of identification from the description thereof given in the record of locations in the district, and should be duly recorded.

15. In addition to the foregoing data, the claimant should state the names of adjoining claims, or, if none adjoin, the relative positions of the nearest claims; should drive a post or erect a monument of stones at each corner of his surface-ground, and at the point of discovery or discovery-shaft should fix a post, stake, or board, upon which should be designated the name of the lode, the name or names of the locators, the number of feet claimed, and in which direction from the point of discovery; it being essential that the location notice filed for record, in addition to the foregoing description, should state whether the entire claim of fifteen hundred feet is taken on one side of the point of discovery, or whether it is partly upon one and partly upon the other side thereof, and in the latter case, how many feet are claimed upon each side of such discovery-point.

16. Within a reasonable time, say twenty days after the location shall have been marked on the ground, or such time as is allowed by the local laws, notice thereof, accurately describing the claim in manner aforesaid, should be filed for record with the proper recorder of the district, who will thereupon issue the usual certificate of location.

17. In order to hold the possessory right to a location made since May 10, 1872, not less than one hundred dollars' worth of labor must be performed, or improvements made thereon annually until entry shall have been made. Under the provisions of the act of Congress approved January 22, 1880, the first annual expenditure becomes due and must be performed during the calendar year succeeding that in which the location was made. Expenditure made or labor performed prior to the first day of January succeeding the date of location will not be considered as a part of, or applied upon the first annual expenditure required by law. Failure to make the expenditure or perform the labor required will subject the claim to relocation by any other party having the necessary qualifications, unless the original locator, his heirs, assigns or legal representatives have resumed work thereon after such failure and before such relocation.

18. The expenditures required upon mining-claims may be made from the surface or in running a tunnel for the development of such claims, the act of February 11, 1875, providing that where a person or company has, or may, run a tunnel for the purpose of developing a lode or lodes owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said

MINING LIFE—FALLING IN OF A MINE.

—FROM "LA VIE SOUTERRAINE" BY L. SIMONIN.

lode or lodes, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same.

19. The importance of attending to these details in the matter of location, labor, and expenditure will be the more readily perceived when it is understood that a failure to give the subject proper attention may invalidate the claim.

Tunnel Rights.—20. Sec. 2323 provides that where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins or lodes on the line of said tunnel.

21. The effect of this is simply to give the proprietors of a mining tunnel run in good faith the possessory right to fifteen hundred feet of any blind lodes cut, discovered, or intersected by such tunnel, which were not previously known to exist, within three thousand feet from the face or point of commencement of such tunnel, and to prohibit other parties, after the commencement of the tunnel, from prospecting for and making locations of lodes on the *line thereof* and within said distance of three thousand feet, unless such lodes appear upon the surface or were previously known to exist.

22. The term "face," as used in said section, is construed and held to mean the first working-face formed in the tunnel, and to signify the point at which the tunnel actually enters cover; it being from this point that the three thousand feet are to be counted, upon which prospecting is prohibited as aforesaid.

23. To avail themselves of the benefits of this provision of law, the proprietors of a mining-tunnel will be required, at the time they enter cover as aforesaid, to give proper notice of their tunnel location by erecting a substantial post, board, or monument at the face or point of commencement thereof, upon which should be posted a good and sufficient notice, giving the names of the parties or company claiming the tunnel-right; the actual or proposed course or direction of the tunnel; the height and width thereof, and the course and distance from such face or point of commencement to some permanent well-known objects in the vicinity by which to fix and determine the *locus* in manner heretofore set forth applicable to locations of veins or lodes, and at the time of posting such notice they shall, in order that miners or prospectors may be enabled to determine whether or not they are within the lines of the tunnel, establish the boundary lines thereof, by stakes or monuments placed along such lines at proper intervals, to the terminus of the three thousand feet from the face or point of commencement of the tunnel, and the lines so marked will define and govern as to the specific boundaries within which prospecting for lodes not previously known to exist is prohibited while work on the tunnel is being prosecuted with reasonable diligence.

24. At the time of posting notice and marking out the lines of the tunnel as aforesaid, a full and correct copy of such notice of location defining the tunnel-claim must be filed for record with the mining recorder of the district, to which notice must be attached the sworn statement or declaration of the owners, claimants, or projectors of such tunnel, setting forth the facts in the case; stating the amount expended by themselves and their predecessors in interest in prosecuting work thereon; the extent of the work performed, and that it is *bona fide* their intention to prosecute work on the tunnel so located and described with reasonable diligence for the development of a vein or lode, or for the discovery of mines, or both, as the case may be. This notice of location must be duly recorded, and, with the said sworn statement attached, kept on the recorder's files for future reference.

25. By a compliance with the foregoing much needless difficulty will be avoided, and the way for the adjustment of legal rights acquired in virtue of said section 2323 will be made much more easy and certain.

26. This office will take particular care that no improper advantage is taken of this provision of law by parties making or professing to make tunnel locations, ostensibly for the purposes named in the statute, but really for the purpose of monopolizing the lands lying in front of their tunnels to the detriment of the mining interests and to the exclusion of *bona fide* prospectors or miners, but will hold such tunnel claimants to a strict compliance with the terms of the statutes; and a *reasonable diligence* on their part in prosecuting the work is one of the essential conditions of their implied contract. Neglience or want of due diligence will be construed as working a forfeiture of their right to all undiscovered veins on the line of such tunnel.

Manner of Proceeding to obtain Government Title to Vein or Lode Claims.—27. By section 2325 authority is given for granting titles for mines by patent from the government to any person, association, or corporation, having the necessary qualifications as to citizenship and holding the right of possession to a claim in compliance with law.

28. The claimant is required in the first place to have a correct survey of his claim made under authority of the surveyor-general of the State or Territory in which the claim lies; such survey to show with accuracy the exterior boundaries of the claim, which boundaries are required to be distinctly marked by monuments on the ground. Four plats and one copy of the original field-notes, in each case, will be prepared by the surveyor-general; one plat and the original field-notes to be retained in the office of the surveyor-general, one copy of the plat to be given the claimant for posting upon the claim, one plat and a copy of the field-notes to be given the claimant for filing with the proper register, to be finally transmitted by that officer, with other papers in the case, to this office, and one plat to be sent by the surveyor-general to the register of the proper land-district to be retained on his files for future reference.

29. The claimant is then required to post a copy of the plat of such survey in a conspicuous place upon the claim, together with notice of his intention to apply for a patent therefore, which notice will give the date of posting, the name of the claimant, the name of the claim, mine, or lode; the mining-district and county; whether the location is of record, and if so, where the record may be found; the number of feet claimed along the vein and the presumed direction thereof; the number of feet claimed on the lode in each direction from the point of discovery, or other well-defined place on the claim; the name or names of adjoining claimants on the same or other lodes; or, if none adjoin, the names of the nearest claims, &c.

30. After posting the said plat and notice upon the premises, the claimant will file with the proper register and receiver a copy of such plat, and the field-notes of survey of the claim, accompanied by the affidavit of at least two credible witnesses, that such plat and notice are posted conspicuously upon the claim, giving the date and place of such notice; a copy of the *notice* so posted to be attached to, and form a part of said affidavit.

31. Attached to the field-notes so filed must be the sworn statement of the claimant that he has the possessory right to the premises therein described, in virtue of compliance by himself (and by his grantors, if he claims by purchase) with the mining rules, regulations, and customs of the mining district, State, or Territory in which the claim lies, and with the mining laws of Congress; such sworn statement to narrate briefly, but as clearly as possible, the facts constituting such compliance, the origin of his possession, and the basis of his claim to a patent.

32. This affidavit should be supported by appropriate evidence from the mining recorder's office as to his possessory right, as follows, viz.: Where he claims to be a locator, a full, true, and correct copy of such location should be furnished as the same appears upon the mining records; such copy to be attested by the seal of the recorder, or if he has no seal then he should make oath to the same being correct, as shown by his records; where the applicant claims as a locator in company with others who have since conveyed their interests in the lode to him, a copy of the original record of location should be filed, together with an

abstract of title from the proper recorder, under seal or oath as aforesaid, tracing the co-locator's possessory rights in the claim to such applicant for patent; where the applicant claims only as a purchaser for valuable consideration, a copy of the location record must be filed, under seal or upon oath as aforesaid, with an abstract of title certified as above by the proper recorder, tracing right of possession by a continuous chain of conveyances from the original locators to the applicant, also certifying that no conveyances affecting the title to the claim in question appear of record in his office other than those set forth in the accompanying abstract.

33. In the event of the mining records in any case having been destroyed by fire or otherwise lost, affidavit of the fact should be made, and secondary evidence of possessory title will be received, which may consist of the affidavit of the claimant, supported by those of any other parties cognizant of the facts relative to his location, occupancy, possession, improvements, etc.; and in such case of lost records, any deeds, certificates of location or purchase, or other evidence which may be in the claimant's possession, and tend to establish his claim, should be filed.

34. Upon the receipt of these papers the register will, at the expense of the claimant (who must furnish the agreement of the publisher to hold applicant for patent alone responsible for charges of publication), publish a notice of such application for the period of sixty days, in a newspaper published nearest to the claim; and will post a copy of such notice in his office for the same period. In all cases sixty days must intervene between the first and the last insertion of the notice in such newspaper. When the notice is published in a *weekly* newspaper ten consecutive insertions are necessary; when in a *daily* newspaper the notice must appear in each issue for the required period.

35. The notices so published must be as full and complete as possible, and embrace all the *data* given in the notice posted upon the claim.

36. Too much care cannot be exercised in the preparation of these notices, inasmuch as upon their accuracy and completeness will depend, in a great measure, the regularity and validity of the whole proceeding.

37. The claimant, either at the time of filing these papers with the register, or at any time during the sixty days' publication, is required to file a certificate of the surveyor-general that not less than five hundred dollars' worth of labor has been expended on improvements made upon the claim by the applicant or his grantors; that the plat filed by the claimant is correct; that the field-notes of the survey, as filed, furnish such an accurate description of the claim as will, if incorporated into a patent, serve to fully identify the premises, and that such reference is made therein to natural objects or permanent monuments as will perpetuate and fix the *locus* thereof.

38. It will be the more convenient way to have this certificate indorsed by the surveyor-general, both upon the plat and field-notes of survey filed by the claimant as aforesaid.

39. After the sixty days' period of newspaper publication has expired, the claimant will file his affidavit, showing that the plat and notice aforesaid remained conspicuously posted upon the claim sought to be patented during said sixty days' publication, giving the dates.

40. Upon the filing of this affidavit the register will, if no adverse claim was filed in his office during the period of publication, permit the claimant to pay for the land according to the area given in the plat and field-notes of survey aforesaid, at the rate of five dollars for each acre, and five dollars for each fractional part of an acre, the receiver issuing the usual duplicate receipt therefor. The claimant will also make a sworn statement of all the charges and fees paid by him for publication and surveys, together with all fees and money paid the register and receiver of the land office; after which the whole matter will be forwarded to the Commisioner of the General Land Office and a patent issued thereon if found regular.

41. In sending up the papers in the case the register must not omit certifying to the fact that the notice was posted in his office for the period of sixty days, such certificate to state distinctly when such posting was done and how long continued.

42. The consecutive series of numbers of mineral entries must be continued, whether the same are of lode or placer claims.

43. The surveyor-general must continue to designate all surveyed mineral claims as heretofore by a progressive series of numbers, beginning with lot No. 37 in each township, the claim to be so designated at date of filing the plat, field-notes, etc., in addition to the local designation of the claim; it being required in all cases that the plat and field-notes of the survey of a claim must, in addition to the reference to permanent objects in the neighbourhood, describe the *locus* of the claim with reference to the lines of public surveys by a line connecting a corner of the claim with the nearest public corner of the United States surveys, unless such claim be on unsurveyed lands at a remote distance from such public corner, in which latter case the reference by course and distance to permanent objects in the neighborhood will be a sufficient designation by which to fix the *locus* until the public surveys shall have been closed upon its boundaries.

Adverse Claims.—44. Section 2326 provides for adverse claims, fixes the time within which they shall be filed to have legal effect, and prescribes the manner of their adjustment.

45. Said section requires that the adverse claim shall be filed during the period of publication of notice; that it must be on the oath of the adverse claimant; and that it must show the *nature*, the *boundaries* and the *extent* of the adverse claim.

46. In order that this section of law may be properly carried into effect, the following is communicated for the information of all concerned:

47. An adverse mining-claim must be filed with the register of the same land office with whom the application for patent was filed, or in his absence with the receiver, and within the sixty days' period of newspaper publication of notice.

48. The adverse notice must be duly sworn to by the person or persons making the same before an officer authorized to administer oaths within the land-district, or before the register or receiver; it will fully set forth the nature and extent of the interference or conflict; whether the adverse party claims as a purchaser for valuable consideration or as a locator; if the former, a certified copy of the original location, the original conveyance, a duly certified copy thereof, or an abstract of title from the office of the proper recorder should be furnished, or if the transaction was a mere verbal one he will narrate the circumstances attending the purchase, the date thereof, and the amount paid, which facts should be supported by the affidavit of one or more witnesses, if any were present at the time, and if he claims as a locator he must file a duly certified copy of the location from the office of the proper recorder.

49. In order that the *boundaries* and *extent* of the claim may be shown, it will be incumbent upon the adverse claimant to file a plat showing his entire claim, its relative situation or position with the one against which he claims, and the extent of the conflict. This plat must be made from an actual survey by a United States deputy surveyor, who will officially certify thereon to its correctness; and in addition there must be attached to such plat of survey a certificate or sworn statement by the surveyor as to the approximate value of the labor performed or improvements made upon the claim by the adverse party or his predecessors in interest, and the plat must indicate the position of any shafts, tunnels, or other improvements, if any such exist, upon the claim of the party opposing the application, and by which party said improvements were made.

50. Upon the foregoing being filed within the sixty days as aforesaid, the register, or in his absence the receiver, will give notice in writing to both parties to the contest that such adverse claim has been filed, informing them that the party who filed the adverse claim will be required within thirty days from the date of such filing to commence proceedings in a court of competent jurisdiction to determine the question of right of possession, and to prosecute the same with reasonable diligence to final judgment, and that should such adverse claimant fail to do so, his adverse claim will be considered waived, and the application for patent be allowed to proceed upon its merits.

51. When an adverse claim is filed as aforesaid, the register or receiver will indorse upon the same the precise date of filing, and preserve a record of the date of notifications issued thereon; and thereafter all proceedings on the appli-

cation for patent will be suspended, with the exception of the completion of the publication and posting of notices and plat, and the filing of the necessary proof thereof, until the controversy shall have been adjudicated in court, or the adverse claim waived or withdrawn.

52. The proceedings after rendition of judgment by the court in such case are so clearly defined by the act itself as to render it unnecessary to enlarge thereon in this place.

53. The proceedings to obtain patents for claims usually called placers, including all forms of deposit, are similar to the proceedings prescribed for obtaining patents for vein or lode claims; but where said placer-claim shall be upon surveyed lands, and conform to legal subdivisions, no further survey or plat will be required, and all placer mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public-land surveys and the rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer-claims cannot be conformed to legal subdivisions, survey, and plat shall be made as on unsurveyed lands. But where such claims are located previous to the public surveys, and do not conform to legal subdivisions, survey, plat, and entry thereof may be made according to the boundaries thereof, provided the location is in all respects legal.

54. The proceedings for obtaining patents for veins or lodes having already been fully given, it will not be necessary to repeat them here; it being thought that careful attention thereto by applicants and the local officers will enable them to act understandingly in the matter and make such slight modifications in the notice, or otherwise, as may be necessary in view of the different nature of the two classes of claims, placer-claims being fixed, however, at two dollars and fifty cents per acre, or fractional part of an acre.

55. By section 2330, authority is given for the subdivision of forty-acre legal subdivisions into ten-acre lots, which is intended for the greater convenience of miners in segregating their claims both from one another and from intervening agricultural lands.

56. It is held, therefore, that under a proper construction of the law these ten-acre lots in mining districts should be considered and dealt with, to all intents and purposes, as legal subdivisions, and that an applicant having a legal claim which conforms to one or more of these ten-acre lots, either adjoining or cornering, may make entry thereof, after the usual proceedings, without further survey or plat.

57. In cases of this kind, however, the notice given of the application must be very specific and accurate in description, and as the forty-acre tracts may be subdivided into ten-acre lots, either in the form of squares of ten by ten chains, or of parallelograms five by twenty chains, so long as the lines are parallel and at right angles with the lines of the public surveys, it will be necessary that the notice and application state specifically what ten-acre lots are sought to be patented in addition to the other data required in the notice.

58. Where the ten-acre subdivision is in the form of a square it may be described, for instance, as the "S. E. ¼ of the S. W. ¼ of N. W. ¼," or, if in the form of a parallelogram as aforesaid, it may be described as the "W. ½ of the W. ½ of the S. W. ¼ of the N. W. ¼ (or the N. ½ of the S. ½ of the N. E. ¼ of the S. E. ¼) of section———, township ———, range———," as the case may be; but, in addition to this description of the land, the notice must give all the other data that is required in a mineral application, by which parties may be put on inquiry as to the premises sought to be patented. The proof submitted with applications for claims of this kind must show clearly the character and the extent of the improvements upon the premises.

Inasmuch as the surveyor-general has no duty to perform in connection with the entry of a placer-claim of legal subdivisions, the proof of improvements must show their value to be not less than five hundred dollars and that they were made by the applicant for patent or his grantors.

59. Applicants for patent to a placer-claim, who are also in possession of a known vein or lode included therein, must state in their application that the placer includes such vein or lode. The published and posted notices must also include such statement; and the vein or lode must be surveyed and marked upon the plat; the field-notes and plat giving the area of the lode claim or claims and the area of the placer separately. If veins or lodes lying within a placer location are owned by other parties, the fact should be distinctly stated in the application for patent, and in all the notices. It should be remembered that an application which omits to include an application for a known vein or lode therein, must be construed as a conclusive declaration that the applicant has no right of possession to the vein or lode. Where there is no known lode or vein, the fact must appear by the affidavit of claimant and one or more witnesses.

60. When an adverse claim is filed to a placer application the proceedings are the same as in the case of vein or lode claims, already described.

Quantity of Placer Ground Subject to Location.—61. By section 2330 it is declared that no location of a placer-claim, made after July 9, 1870, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States survey.

62. Section 2331 provides that all placer mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public surveys and the subdivisions of such surveys, and no such locations shall include more than twenty acres for each individual claimant.

63. The foregoing provisions of law are construed to mean that after the 9th day of July, 1870, no location of a placer-claim can be made to exceed one hundred and sixty acres, whatever may be the number of locators associated together, or whatever the local regulations of the district may allow; and that from and after May 10, 1872, no location made by an individual can exceed twenty acres, and no location made by an association of individuals can exceed one hundred and sixty acres, which location of one hundred and sixty acres cannot be made by a less number than eight *bona-fide* locators; and no local laws or mining regulations can restrict a placer location to less than twenty acres, although the locator is not compelled to take so much.

64. The regulations hereinbefore given as to the manner of marking locations on the ground, and placing the same on record, must be observed in the case of placer locations, so far as the same are applicable; the law requiring, however, that where placer-claims are upon *surveyed* public lands the locations must hereafter be made to conform to legal subdivisions thereof as near as practicable.

65. With regard to the proofs necessary to establish the possessory right to a placer-claim, section 2332 provides that "where such person or association, they and their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining-claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim."

66. This provision of law will greatly lessen the burden of proof, more especially in the case of old claims located many years since, the records of which, in many cases, have been destroyed by fire, or lost in other ways during the lapse of time, but concerning the possessory right to which all controversy or litigation has long been settled.

67. When an applicant desires to make his proof of possessory right in accordance with this provision of law, you will not require him to produce evidence of location, copies of conveyances, or abstracts of title, as in other cases, but will require him to furnish a duly certified copy of the statute of limitations of mining-claims for the State or Territory, together with his sworn statement giving a clear and succinct narration of the facts as to the origin of his title, and likewise as to the continuation of his possession of the mining ground covered by his application; the area thereof, the nature and extent of the mining that has been done thereon; whether there has been any opposition to his possession, or litigation with regard to his claim, and, if so, when the same ceased; whether such cessation was caused by compromise or by judicial decree, and any additional facts within the claimant's knowledge having a direct bearing upon his possession and *bona fides* which he may desire to submit in support of his claim.

68. There should likewise be filed a certificate, under seal of the court having jurisdiction of mining cases within the judicial district embracing the claim, that no suit or action of any character whatever involving the right of possession

to any portion of the claim applied for is pending, and that there has been no litigation before said court affecting the title to said claim or any part thereof for a period equal to the time fixed by the statute of limitations for mining-claims in the State or Territory as aforesaid, other than that which has been finally decided in favor of the claimant.

69. The claimant should support his narrative of facts relative to his possession, occupancy, and improvements by corroborative testimony of any disinterested person or persons of credibility who may be cognizant of the facts in the case and are capable of testifying understandingly in the premises.

70. It will be to the advantage of claimants to make their proofs as full and complete as practicable.

Mill-Sites.—71. Section 2337 provides that, "where non-mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface-ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz-mill or reduction-works, not owning a mine in connection therewith, may also receive a patent for his mill-site, as provided in this section."

72. To avail themselves of this provision of law, parties holding the possessory right to a vein or lode, and to a piece of non-mineral land not contiguous thereto, for mining or milling purposes, not exceeding the quantity allowed for such purpose, by section 2337 United States Revised Statutes, or prior laws, under which the land was appropriated, the proprietors of such vein or lode may file in the proper land-office their application for a patent, under oath, in manner already set forth herein, which application, together with the plat and field-notes, may include, embrace, and describe, in addition to the vein or lode, such non-contiguous mill-site, and after due proceedings as to notice, &c., a patent will be issued conveying the same as one claim.

73. In making the survey in a case of this kind, the lode-claim should be described in the plat and field-notes as "Lot No. 37, A," and the mill site as "Lot No. 37, B," or whatever may be its appropriate numerical designation; the course and distance from a corner of the mill-site to a corner of the lode-claim to be invariably given in such plat and field-notes, and a copy of the plat and notice of application for patent must be conspicuously posted upon the mill-site as well as upon the vein or lode for the statutory period of sixty days. In making the entry no separate receipt or certificate need be issued for the mill-site, but the whole area of both lode and mill-site will be embraced in one entry, the price being five dollars for each acre and fractional part of an acre embraced by such lode and mill-site claim.

74. In case the owner of a quartz-mill or reduction-works is not the owner or claimant of a vein or lode, the law permits him to make application therefor in the same manner prescribed herein for mining-claims, and after due notice and proceedings, in the absence of a valid adverse filing, to enter and receive a patent for his mill-site at said price per acre.

75. In every case there must be a satisfactory proof that the land claimed as a mill-site is not mineral in character, which proof may, where the matter is unquestioned, consist of the sworn statement of the claimant, supported by that of one or more disinterested persons capable from acquaintance with the land to testify understandingly.

76. The law expressly limits mill-site locations made from and after its passage to *five acres*.

77. The registers and receivers will preserve an unbroken consecutive series of numbers for all mineral entries.

Proof of Citizenship of Mining-Claimants.—78.—The proof necessary to establish the citizenship of applicants for mining-patents must be made in the following manner: In case of an incorporated company, a certified copy of their charter or certificate of incorporation must be filed. In case of an association of persons unincorporated, the affidavit of their duly authorized agent, made upon his own knowledge, or upon information and belief, setting forth the residence of each person forming such association, must be submitted. This affidavit must be accompanied by a power of attorney from the parties forming such association, authorizing the person who makes the affidavit of citizenship to act for them in the matter of their application for patent.

79. In case of an individual or an association of individuals who do not appear by their duly authorized agent, will be required the affidavit of each applicant, showing whether he is a native or naturalized citizen, when and where born, and his residence.

80. In case an applicant has declared his intention to become a citizen, or has been naturalized, his affidavit must show the date, place, and the court before which he declared his intention, or from which his certificate of citizenship issued, and present residence.

81. The affidavit of the claimant as to his citizenship may be taken before the register or receiver, or any other officer authorized to administer oaths within the land district. If citizenship is established by the testimony of disinterested persons, such testimony may be taken at any place before any person authorized to administer oaths, and whose official character is duly verified.

Appointment of Deputy Surveyors of Mining-Claims—Charges for Surveys and Publications—Fees of Registers and Receivers, &c.—82. Section 2334 provides for the appointment of surveyors of mineral claims, authorizes the Commissioner of the General Land Office to establish the rates to be charged for surveys and for newspaper publications, prescribes the fees allowed to the local officers for receiving and acting upon applications for mining-patents and for adverse claims thereto, &c.

Under this authority of law the following rates have been established as the maximum charges for newspaper publications in mining cases:

a Where a daily newspaper is designated the charge shall not exceed seven dollars for each ten lines of space occupied, and where a weekly newspaper is designated as the medium of publication five dollars for the same space will be allowed. Such charge shall be accepted as full payment for publication in each issue of the newspaper for the entire period required by law.

It is expected that these notices shall not be so abbreviated as to curtail the description essential to a perfect notice, and the said rates established upon the understanding that they are to be in the usual body-type used for advertisements.

b For the publication of citations in contests or hearings involving the character of lands, the charges shall not exceed eight dollars for five publications in weekly newspapers, or ten dollars for publications in daily newspapers for thirty days.

83. The surveyors-general of the several districts, will, in pursuance of said law, appoint in each land-district as many *competent* deputies for the survey of mining-claims as may seek such appointment; it being distinctly understood that all expenses of these notices and surveys are to be borne by the mining-claimants and not by the United States; the system of making *deposits* for mineral surveys, as required by previous instructions, being hereby revoked as regards *field-work;* the claimant having the option of employing *any* deputy surveyor within such district to do his work in the field.

84. With regard to the *platting* of the claim and other *office-work* in the surveyor-general's office, that officer will make an estimate of the cost thereof, which amount the claimant will deposit with any Assistant United States Treasurer, or designated depository, in favor of the United States Treasurer, to be passed to the credit of the fund created by "individual depositors for surveys of the public lands," and file with the surveyor-general duplicate certificates of such deposit in the usual manner.

85. The surveyors-general will endeavor to appoint mineral deputy surveyors, so that one or more may be located in each mining-district for the greater convenience of miners.

86. The usual oaths will be required of these deputies and their assistants as to the correctness of each survey executed by them.

The duty of the deputy mineral surveyor ceases when he has executed the survey and returned the field-notes and preliminary plats thereof with his report to the surveyor-general, and will not be allowed to prepare for the mining claimant the papers in support of an application for patent, or otherwise perform the duties of an attorney before the land-office in connection with a mining-claim.

The surveyors-general and local land-officers are expected to report any infringement of this regulation to this office.

87. The law requires that each applicant shall file with the register and receiver a sworn statement of all charges and fees paid by him for publication of notice and for survey; together with all fees and money paid the register and receiver, which sworn statement is required to be transmitted to this office, for the information of the Commissioner.

88. Should it appear that excessive or exorbitant charges have been made by any surveyor or any publisher, prompt action will be taken with the view of correcting the abuse.

89. The fees payable to the register and receiver for filing and acting upon applications for mineral-land patents are five dollars to each officer, to be paid by the applicant for patent at the time of filing, and the like sum of five dollars is payable to each officer by an adverse claimant at the time of filing his adverse claim.

90. All fees or charges under this law may be paid in United States currency.

91. The register and receiver will, at the close of each month, forward to this office an abstract of mining applications filed, and a register of receipts, accompanied with an abstract of mineral lands sold, and an abstract of adverse claims filed.

92. The fees and purchase-money received by registers and receivers must be placed to the credit of the United States in the receiver's monthly and quarterly account, charging up in the disbursing account the sums to which the register and receiver may be respectively entitled as fees and commissions, with limitations in regard to the legal maximum.

Hearings to Establish the Character of Lands.—93. In every case where it becomes necessary under the law and existing instructions of this office that a hearing be held and testimony taken for the purpose of ascertaining the mineral or agricultural character of land, the local officers are directed to cause the evidence to be taken before a duly qualified officer whose office is located nearest the land in dispute, the distance to be computed by ordinary routes of travel. Whenever the local office comes within this rule, the hearing will be held before the register and receiver.

It is intended to cause these hearings to be held, as far as practicable, in such manner as to afford the least inconvenience to persons interested. Should it appear, therefore, by written stipulation of all the parties that this purpose will best be subserved by the designation of any particular officer authorized to administer oaths within the land district in which the land in controversy is situated, the instructions herein may be departed from in accordance with such stipulation. Such deviation may also be allowed where the officer who would, otherwise, be designated is an interested party, or where, for other good reason, his selection would be improper.

When the evidence is taken before an officer other than the register and receiver, the record should be sealed up, the title of the case indorsed on the envelope, and the whole returned by mail or express to the register and receiver.

On the 27th of April, 1880, in accordance with the directions of the Secretary of the Interior this office revoked the withdrawals theretofore made, upon general information, that vast tracts of public land were mineral in character, and instructed the local officers, in the absence of a specific allegation of the mineral character of land to allow applications for agricultural entry thereof, upon due proof.

Hereafter the only tracts of public land that will be withheld from entry as agricultural land on account of its mineral character, will be such as are returned by the surveyor-general as mineral; and even the presumption which is supported by such return may be overcome by testimony taken at a regular hearing.

94. Hearings to determine the character of land, as practically distinguished, are of two kinds:

1st. Where lands which are sought to be entered and patented as agricultural are alleged by affidavit to be mineral, or when sought as mineral their non-mineral character is alleged.

The proceedings relative to this class are in the nature of a contest between two or more known parties, and the testimony may be taken on personal notice of at least ten days, duly served on all parties, or, if they cannot be found, then by publication, for thirty days in a newspaper of general circulation, to be designated by the register of the land-office as published nearest to the land in controversy. If publication is made in a weekly newspaper, the notice must be inserted in five consecutive weekly issues thereof.

2d. When lands are returned as mineral by the surveyor-general. When such lands are sought to be entered as agricultural, notice must be given by publication for thirty days, as aforesaid.

95. All notices must describe the land, give the name and address of the claimant, the character of his claim, and the time, place, and purpose of the hearing.

Proof of service of notice, when personal, must consist of either acknowledgment of service indorsed on the citation, (which is always desirable,) or the affidavit of the party serving the same, giving date, place, and manner of service, indorsed as aforesaid.

Proof of publication must be the affidavit of the publisher of the newspaper, stating the period of publication, giving dates, stating whether in a daily or weekly issue, and a copy of the notice so published must be attached to, and form a part of, the affidavit.

Proof of posting on the claim must be made by the affidavits of two or more persons who state when and where the notice was posted; that it remained so posted during the prescribed period, giving dates, and a copy of the notice so posted must be attached to, and made a part of, the affidavits.

Proof of notice is indispensable to the regularity of proceedings and must accompany the record in every case.

The expense of notice must in every case be paid by the parties thereto.

96. At the hearing there must be filed the affidavit of the publisher of the paper that the said notice was published for the required time, stating when and for how long such publication was made, a printed copy thereof to be attached and made a part of the affidavit.

97. At the hearing the claimant and witnesses will be thoroughly examined with regard to the character of the land; whether the same has been thoroughly prospected; whether or not there exists within the tract or tracts claimed any lode or vein of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, or copper, or other valuable deposit which has ever been claimed, located, recorded or worked; whether such work is entirely abandoned, or whether occasionally resumed; if such lode does exist, by whom claimed, under what designation, and in which subdivision of the land it lies; whether any placer mine or mines exist upon the land; if so, what is the character thereof—whether of the shallow-surface description, or of the deep cement, blue lead, or gravel deposits; to what extent mining is carried on when water can be obtained, and what the facilites are for obtaining water for mining purposes; upon what particular ten-acre subdivisions mining has been done, and at what time the land was abandoned for mining purposes, if abandoned at all.

98. The testimony should show also the agricultural capacities of the land, what kind of crops are raised thereon, and the value thereof; the number of acres actually cultivated for crops of cereals or vegetables, and within which paticular ten-acre subdivisions such crops are raised; also which of these subdivisions embrace his improvements, giving in detail the extent and value of his improvements, such as house, barn, vineyard, orchard, fencing, etc.

99. It is thought that *bona fide* settlers upon lands really agricultural will be able to show, by a clear, logical and succinct chain of evidence, that their claims are founded upon law and justice; while parties who have made little or no permanent agricultural improvements, and who only seek title for speculative purposes, on account of the mineral deposits known to themselves to be contained in the land, will be defeated in their intentions.

100. The testimony should be as full and complete as possible; and, in addition to the leading points indicated

above, everything of importance bearing upon the question of the character of the land should be elicited at the hearing.

101. Where the testimony is taken before an officer who does not use a seal, other than the register and receiver, the official character of such officer must be attested by a clerk of a court of record, and the testimony transmitted to the register and receiver, who will thereupon examine and forward the same to this office, with their joint opinion as to the character of the land as shown by the testimony.

102. When the case comes before this office, such an award of the land will be made as the law and the facts may justify: and in cases where a survey is necessary to set apart the mineral from the agricultural land in any forty-acre tract, the necessary instructions will be issued to enable the agricultural claimant, *at his own expense*, to have the work done, at his option, either by United States deputy, county, or other local surveyor; the survey in such case may be executed in such manner as will segregate the portion of land actually containing the mine, and used as surface-ground for the convenient working thereof, from the remainder of the tract, which remainder will be patented to the agriculturist to whom the same may have been awarded, subject, however, to the condition that the land may be entered upon by the proprietor of any vein or lode for which a patent has been issued by the United States for the purpose of extracting and removing the ore from the same, where found to penetrate or intersect the land so patented as agricultural, as stipulated by the mining act.

103. Such survey when executed must be properly sworn to by the surveyor, either before a notary public, officer of a court of record, or before the register or receiver, the deponent's character and credibility to be properly certified to by the officer administering the oath.

104. Upon the filing of the plat and field-notes of such survey, duly sworn to as aforesaid, you will transmit the same to the attorney-general for his verification and approval; who, if he finds the work correctly performed, will properly mark out the same upon the original township plat in his office, and furnish authenticated copies of such plat and description both to the proper local land office and to this office, to be affixed to the duplicate and triplicate township plats respectively.

105. In cases where a portion of a forty-acre tract is awarded to an agricultural claimant and he causes the segregation thereof from the mineral portion, as aforesaid, such agricultural portion will not be given a numerical designation as in the case of surveyed mineral claims, but will simply be described as the "Fractional ——— quarter of the ——— quarter of section ———, in township ———, of range ——— meridian, containing ——— acres, the same being exclusive of the land adjudged to be mineral in said forty-acre tract."

106. The surveyor must correctly compute the area of such agricultural portion, which computation will be verified by the surveyor-general.

107. After the authenticated plat and field-notes of the survey have been received from the surveyor-general, this office will issue the necessary order for the entry of the land, and in issuing the receiver's receipt and register's patent certificate you will invariably be governed by the description of the land given in the order from this office.

108. The fees for taking testimony and reducing the same to writing in these cases will have to be defrayed by the parties in interest. Where such testimony is taken before any other officer than the register and receiver, the register and receiver will be entiled to no fees.

109. If, upon a review of the testimony at this office, a ten acre tract should be found to be properly mineral in character, that fact will be no bar to the execution of the settler's legal right to the remaining *non-mineral* portion of his claim, if contiguous.

110. No fear need be entertained that miners will be permitted to make entries of tracts ostensibly as mining claims, which are not mineral, simply for the purpose of obtaining possession and defrauding settlers out of their valuable agricultural improvements; it being almost an impossibility for such a fraud to be consummated under the laws and regulations applicable to obtaining patents for mining claims.

111. The fact that a certain tract of land is decided upon testimony to be mineral in character is by no means equivalent to an award of the land to a miner. A miner is compelled by law to give sixty days' publication of notice, and posting of diagrams and notices, as a preliminary step; and then, before he can enter the land, he must show that the land yields mineral; that he is entitled to the possessory right thereto in virtue of compliance with local customs or rules of mines, or by virtue of the statute of limitations; that he or his grantors have expended, in actual labor and improvements, an amount of not less than five hundred dollars thereon, and that the claim is one in regard to which there is no controversy or opposing claim. After all these proofs are met, he is entitled to have a survey made at his own cost where a survey is required, after which he can enter and pay for the land embraced by his claim.

112. Blank forms for proofs in mineral cases are not furnished by the General Land Office.

RULES OF PRACTICE BEFORE LAND OFFICERS, THE GENERAL LAND OFFICE AND THE DEPARTMENT OF THE INTERIOR.

THE following are the official regulations:

PROCEEDINGS BEFORE REGISTERS AND RECEIVERS.—I. CONTESTS AND HEARINGS.—1. *Initiation of Contests.*—Rule 1.—Contests may be initiated by a party in interest, or by any other person, in the following cases:

1. Alleged abandoned homestead entries. (Revised Statutes, sec. 2297).
2. Alleged abandoned or forfeited timber-culture entries. (20 Stat. 113, sec. 3.)

Rule 2.—In all other cases contests can be initiated only by a party in interest.

Rule 3.—In every case of application for a hearing an affidavit must be filed by the contestant with the register and receiver, fully setting forth the facts which constitute the grounds of contest.

Rule 4.—Where an entry has been allowed and remains of record, the affidavit of the contestant must be accompanied by the affidavits of one or more witnesses in support of the allegations made.

2. *Hearings in contested cases.*—Rule 5.—Registers and receivers may order hearings in the following cases wherein entry has not been perfected and no certificate has been issued as a basis for patent, namely:

1. Contests between pre-emption claimants.
2. Contests between homestead and pre-emption claimants.
3. Contests to clear the record of abandoned homestead entries.
4. Contests to clear the record of abandoned or forfeited timber-culture entries.

Rule 6.—In case of an entry or location of record, on which final certificate has been issued, the hearing will be ordered only by direction of the Commissioner of the General Land Office.

Rule 7.—Applications for hearings under the preceding section must be transmitted by the register and receiver, with special report and recommendation, to the Commissioner for his determination and instructions.

3. *Notice of contest.*—Rule 8.—At least thirty days' notice shall be given of all hearings before the register and receiver, unless, by written consent, an earlier day shall be agreed upon.

Rule 9.—The notice of contest and hearing must conform to the following requirements:

1. It must be written or printed.
2. It must be signed by the register or receiver, or by one of them.
3. It must state the time and place of hearing.
4. It must describe the land involved.
5. It must state the R. and R. number of the entry, and the land office where, and the date when made, and the name of the party making the same.
6. It must give the name of the contestant, and briefly state the grounds and purpose of the contest.
7. It may contain any other information pertinent to the contest.

4. *Service of notice.*—Rule 10.—Personal service shall be made in all cases when possible, if the party to be served is resident in the State or Territory in which the land is situated, and shall consist in the delivery of a copy of the notice to each person to be served.

Rule 11.—Personal service may be executed by any officer or person.

Rule 12.—Notice may be given by publication alone, only when it is shown by affidavit of the contestant, and by such other evidence as the register and receiver may require that personal service cannot be made.

5. *Notice by publication.*—Rule 13.—Notice by publication shall be made by advertising the notice at least once a week for four successive weeks in some newspaper published in the county wherein

the land in contest lies; and, if no newspaper be published in such county, then in the newspaper published in the county nearest to such land.

Rule 14.—Where notice is given by publication a copy of the notice shall be mailed by registered letter to the last known address of each person to be notified, and a like copy shall be posted in a conspicuous place on the land during the period of publication for at least two weeks prior to the day set for hearing.

6. *Proof of service of notice.*—Rule 15.—Proof of personal service shall be the written acknowledgment of the person served, or the affidavit of the person who served the notice attached thereto, stating the time, place, and manner of service.

Rule 16.—When service is by publication the proof of service shall be a copy of the advertisement, with the affidavit of the publisher or foreman attached thereto, showing that the same was successively inserted the requisite number of times and the date thereof.

7. *Notice of interlocutory proceedings.*—Rule 17.—Notice of interlocutory motions, proceedings, orders, and decisions shall be in writing, and may be served personally or by registered letter through the mail.

Rule 18.—Proof of service by mail shall be the affidavit of the person who mailed the notice, attached to the post-office receipt for the registered letter.

8. *Rehearings.*—Rule 19.—Orders for rehearing must be brought to the notice of the parties in the same manner as in case of original proceedings.

9. *Continuances.*—Rule 20.—A postponement of a hearing to a day to be fixed by the register and receiver may be allowed on the day of trial on account of the absence of material witnesses, when the party asking for the continuance makes an affidavit before the register and receiver showing—

1. That one or more of the witnesses in his behalf is absent without his procurement or consent;
2. The name and residence of each witness;
3. The facts to which they would testify if present;
4. The materiality of the evidence;
5. The exercise of proper diligence to procure the attendance of the absent witnesses; and
6. That affiant believes said witnesses can be had at the time to which it is sought to have the trial postponed.

Rule 21.—One continuance only shall be allowed to either party on account of absent witnesses; unless the party applying for a further continuance shall at the same time apply for an order to take the depositions of the alleged absent witnesses.

Rule 22.—No continuance shall be granted when the opposite party shall admit that the witnesses would, if present, testify to the statement set out in the application for continuance.

10. *Depositions*—Rule 23.—Testimony may be taken by deposition in the following cases:

1. Where the witness is unable, from age, infirmity, or sickness, or shall refuse to attend the hearing at the local land-office.
2. Where the witness resides more than fifty miles from the place of travel, computing distance by the usually traveled route.
3. Where the witness resides out of, or is about to leave the State or Territory, or is absent therefrom.
4. Where, from any cause, it is apprehended that the witness may be unable or will refuse to attend; in which case the deposition will be used only in event that the personal attendance of the witness cannot be obtained.

Rule 24.—The party desiring to take a deposition under Rule 23 must comply with the following regulations:

1. He must make affidavit before the register or receiver setting forth one or more of the above named causes for taking such deposition, and that the witness is material.
2. He must file with the register and receiver the interrogatories to be propounded to the witness.
3. He must state the name and residence of the witness.
4. He must serve a copy of the interrogatories on the opposing party, or his attorney.

Rule 25.—The opposing party will be allowed ten days in which to file cross-interrogatories.

Rule 26.—After the expiration of the ten days allowed for filing cross-interrogatories, a commission to take the deposition shall be issued by the register and receiver, which commission shall be accompanied by a copy of all the interrogatories filed.

Rule 27.—The register and receiver may designate any officer authorized to administer oaths within the county or district where the witness resides to take such deposition.

Rule 28.—It is the duty of the officer before whom the deposition is taken to cause the interrogatories appended to the commission to be written out, and the answers thereto to be inserted immediately underneath the respective questions; and the whole, when completed, is to be read over to the witness, and must be by him subscribed and sworn to in the usual manner.

Rule 29.—The officer must attach his certificate to the deposition stating that the same was subscribed and sworn to by the deponent at the time and place therein mentioned.

Rule 30.—The deposition and certificate, together with the commission and interrogatories, must then be sealed up, the title of the cause indorsed on the envelope, and the whole returned by mail or express to the register and receiver.

Rule 31.—Upon receipt of the package at the local land-office, the date when the same is opened must be indorsed on the envelope and body of the deposition by the local land-officers.

Rule 32.—If the officer designated to take the deposition has no official seal, a proper certificate of his official character, under seal, must accompany his return.

Rule 33.—The parties in any case may stipulate in writing to take depositions before any qualified officer, and in any manner.

Rule 34.—All stipulations by parties or counsel must be in writing, and be filed with the register and receiver.

Rule 35.—Registers and receivers are not authorized to cite contestants before any officer other than themselves.

11. *Trials.*—Rule 36.—Upon the trial of a cause the register and receiver may, in any case, and should in all cases when necessary, personally direct the examination of witnesses in order to draw from them all the facts within their knowledge requisite to a correct conclusion by the officers upon any point connected with the case.

Rule 37.—The register and receiver will be careful to reach, if possible, the exact condition and status of the land involved in any contest, and will ascertain all the facts having any bearing upon the rights of parties in interest.

Rule 38.—In pre-emption cases they will particularly ascertain the nature, extent, and value of alleged improvements; by whom made, and when; the true date of the settlement of persons claiming as pre-emptors; the steps taken to mark and secure the claim, and the exact status of the land at that date as shown upon the records of their office.

Rule 39.—In like manner, under the homestead and other laws, the conditions affecting the inception of the alleged right, as well as the subsequent acts of the respective claimants, must be fully and specifically examined.

Rule 40.—Due opportunity will be allowed opposing claimants to confront and cross-examine the witnesses introduced by either party.

Rule 41.—No testimony will be excluded from the record by the register and receiver on the ground of any objection thereto; but when objection is made to testimony offered, the exceptions will be noted, and the testimony, with the exceptions, will come up with the case for the consideration of the Commissioner.

Rule 42.—Upon the day originally set for hearing, and upon any day to which the trial may be continued, the testimony of all the witnesses present shall be taken and reduced to writing.

12. *Appeals.*—Rule 43.—Appeals from the action or decisions of registers and receivers lie in every case to the Commissioner of the General Land Office. (Revised Statutes, sections 453, 2478.)

Rule 44.—After hearing in a contested case has been had and closed, the register and receiver will notify the parties in interest of the conclusions to which they have arrived, and that thirty days are allowed for an appeal from their decision to the Commissioner.

Rule 45.—The appeal must be in writing or in print, and should set forth in brief and clear terms the specific points of exception to the ruling appealed from.

Rule 46.—No appeal from the action or decisions of the register and receiver will be received at the General Land Office unless forwarded through the local officers.

Rule 47.—A failure to appeal from the decision of the local officers will be considered final as to the facts in the case, and will be disturbed by the Commissioner only as follows:

1. Where fraud or gross irregularity is suggested on the face of the papers.
2. Where the decision is contrary to existing laws or regulations.
3. In event of disagreeing decisions by the local officers.
4. Where it is not shown that the party against whom the decision was rendered was duly notified of the decision and of his right of appeal.

Rule 48.—In any of the foregoing cases the Commissioner will reverse or modify the decision of the local officers or remand the case at his discretion.

Rule 49.—All documents once received by the local officers must be kept on file with the cases, and the date of filing must be noted thereon; and no papers will be allowed under any circumstances to be removed from the files or taken from the custody of the register and receiver; but access to the same under proper rules, so as not to interfere with necessary public business, will be permitted to the parties in interest, or their attorneys, under the supervision of those officers.

13. *Reports and opinions.*—Rule 50.—Upon the termination of a contest the register and receiver will render a joint report and opinion in the case, making full and specific references to the postings and annotations upon their records.

Rule 51.—In order that all parties to a contest may have full opportunity to examine the record and prepare their arguments upon the questions at issue, the report of the register and receiver in such cases will not be forwarded until the expiration of the thirty days named in the notice for appeal, unless all parties request its earlier transmission.

Rule 52.—The register and receiver will forward their report, together with the testimony and all the papers in the case, to the Commissioner of the General Land Office, with a brief letter of transmittal, describing the case by its title, the nature of the contest, and the tract involved.

Rule 53.—The local officers will thereafter take no further action affecting the disposal of the land in contest until instructed by the Commissioner.

14. *Taxation of Costs.*—Rule 54.—Applicants for contest must de-

posit with the register and receiver a sufficient sum of money to defray the cost of the proceedings.

Rule 55.—Registers and receivers are not required to make advances from their own funds, nor to incur individual liabilities, for the expense of hearings.

Rule 56.—When testimony is taken by deposition the party in whose behalf the same is taken must pay the costs thereof.

Rule 57.—Parties contesting the validity of homestead and timber-culture entries must pay the costs of the contest.

Rule 58.—In other contested cases the costs may be equitably apportioned between the parties by the register and receiver.

Rule 59.—Only the actual costs of notice, and the legal fees for reducing testimony to writing, or for acting or mineral land applications and protests, can be charged to the parties. (Revised Statutes, sec. 2238).

Rule 60.—Costs of notice will include the costs of all the notices up to the final determination of the case.

Rule 61.—Upon the final disposal of a case, any excess in the sum deposited as security over the amount chargeable to the party making the deposit will be returned to him by the register and receiver.

Rule 62.—When hearings are ordered by the Commissioner or by the Secretary of the Interior, upon the discovery of reasons for suspension in the usual course of examination of entries, the preliminary costs will be provided from the contingent fund for the expenses of local land-offices.

Rule 63.—The preliminary costs provided for by the preceding section will be collected by the register and receiver when the parties are brought before them in obedience to the order of hearing.

Rule 64.—The register and receiver will then require proper provision to be made for such further notification as may become necessary in the usual progress of the case to final decision.

Rule 65.—The register and receiver will append to their report in each case a statement of costs and the amount actually paid by each of the contestants, and also a statement of the amount deposited to secure the payment of the costs, how said sum was apportioned, and the amount returned, if any, and to whom.

Appeals from Decisions Rejecting Applications to Enter Public Lands.—Rule 66.—For the purpose of enabling appeals to be taken from the rulings or action of the local officers relative to applications to file upon, enter, or locate the public lands, the following rules will be observed:

1. The register and receiver will indorse upon every rejected application the date when presented, and their reason for rejecting it.
2. They will promptly advise the party in interest of their action, and of his right of appeal to the Commissioner.
3. They will note upon their records a memorandum of the transaction.

Rule 67.—The party aggrieved will be allowed thirty days from receipt of notice in which to file his appeal in the local land office.

Rule 68.—The register and receiver will promptly forward the appeal to the General Land Office, together with a full report upon the case.

Rule 69.—This report should recite all the facts and the proceedings had, and must embrace the following particulars:

1. A statement of the application and rejection, with the reasons for the rejection.
2. A description of the tract involved and a statement of its status, as shown by the records of the local land office.
3. References to all entries, filings, annotations, memoranda and correspondence shown by the record relating to said tract, and to the proceedings had.

Rule 70.—Rules 43 to 48, inclusive, are applicable to all appeals from the decisions of registers and receivers.

PROCEEDINGS BEFORE SURVEYORS-GENERAL.

Rule 71.—The proceedings in hearings and contests before surveyors-general shall, as to notices, depositions and other matters, be governed, as nearly as may be, by the rules prescribed for proceedings before registers and receivers unless otherwise provided by law.

PROCEEDINGS BEFORE THE COMMISSIONER OF THE GENERAL LAND OFFICE AND SECRETARY OF THE INTERIOR.

Rule 72.—When a contest has been closed before the local land officers, and their report forwarded to the General Land Office, no additional evidence will be admitted in the case unless offered under stipulation of the parties to the record, except where such evidence is presented as the basis of a motion for a new trial or in support of a mineral application or protest; but this rule will not prevent the Commissioner, in the exercise of his discretion, from ordering further investigation when necessary.

Rule 73. After the Commissioner shall have received a record of testimony in a contested case, thirty days will be allowed to expire before any action thereon is taken, unless, in the judgment of the Commissioner, public policy or private necessity shall demand summary action, in which case he will proceed at his discretion, first notifying the attorneys of record of his proposed action.

Rule 74.—When a case is pending on appeal from the decision of the register and receiver or surveyor-general, and argument is not filed before the same is reached in its order for examination, the argument will be considered closed, and thereafter no further arguments or motions of any kind will be entertained except upon written stipulation duly filed, or good cause shown to the Commissioner.

Rule 75.—If, before decision by the Commissioner, either party should desire to discuss a case orally, reasonable opportunity therefor will be given in the discretion of the Commissioner, but only at a time to be fixed by him upon notice to the opposing counsel, stating time and specific points upon which discussion is desired; and except as herein provided, no oral hearings or suggestions will be allowed.

Rule 76.—Motions for rehearings before registers and receivers, or for review or reconsideration of the decisions of the Commissioner or Secretary, will be allowed in accordance with legal principles applicable to motions for new trials at law, after due notice to the opposing party.

Rule 77.—Motions for rehearings and reviews must be filed in the office wherein the decision to be affected by such rehearing or review was made, or in the local land office for transmittal to the General Land Office, and, except when based upon newly-discovered evidence, must be filed within thirty days from notice of such decision.

Rule 78.—Motions for rehearings and reviews must be accompanied by an affidavit of the party, or his attorney, that the motion is made in good faith, and not for the purpose of delay.

Rule 79.—The time between the filing of a motion for rehearing or review and the notice of the decision upon such motion, shall be excluded in computing the time allowed for appeal.

Rule 80.—No officer shall entertain a motion in a case after an appeal from his decision has been taken.

APPEALS FROM THE COMMISSIONER TO THE SECRETARY.

Rule 81.—An appeal may be taken from the decision of the Commissioner of the General Land Office to the Secretary of the Interior, upon any question relating to the disposal of the public lands and to private land claims, except in case of interlocutory orders and decisions, and orders for hearing or other matter resting in the discretion of the commissioner. Decisions and orders forming the above exception will be noted in the record, and will be considered by the Secretary on review, in case an appeal upon the merits be finally allowed.

Rule 82.—When the Commissioner considers an appeal defective he will notify the party of the defect, and if not amended within fifteen days from the date of the service of such notice, the appeal will be dismissed and the case closed.

Rule 83.—In proceedings before the Commissioner in which he shall formally decide that a party has no right of appeal to the Secretary, the party against whom such decision is rendered may apply to the Secretary for an order directing the Commissioner to certify said proceedings to the Secretary, and to suspend further action until the Secretary shall pass upon the same.

Rule 84.—Applications to the Secretary under the preceding rule shall be made in writing, under oath, and shall fully and specifically set forth the grounds upon which the application is made.

Rule 85.—When the Commissioner shall formally decide against the right of an appeal, he shall suspend action on the case at issue for twenty days from service of notice of his decision, to enable the party against whom the decision is rendered to apply to the Secretary for an order, in accordance with Rules 83 and 84.

Rule 86.—Notice of an appeal from the Commissioner's decision must be filed in the General Land Office, and served on the appellee or his counsel, within sixty days from the date of the service of notice of such decision.

Rule 87.—When notice of the decision is given through the mails by the register and receiver, or surveyor-general, five days additional will be allowed by those officers for the transmission of the letter, and five days for the return of the appeal through the same channel, before reporting to the General Land Office.

Rule 88.—Within the time allowed for giving notice of appeal, the appellant shall also file in the General Land Office a specification of errors, which specification shall clearly and concisely designate the errors of which he complains.

Rule 89.—He may also, within the same time, file a written argument with citation of authorities, in support of his appeal.

Rule 90.—A failure to file a specification of errors within the time required will be treated as a waiver of the right of appeal, and the case will be considered closed.

Rule 91.—The appellee shall be allowed thirty days from the expiration of the sixty days allowed for appeal in which to file his argument.

Rule 92.—The appellant shall be allowed thirty days from service of argument of appellee in which to file argument strictly in reply; and no other or further arguments or motions of any kind shall be filed without permission of the Commissioner or Secretary and notice to the opposite party.

Rule 93.—A copy of the notice of appeal, specification of errors, and all arguments of either party, shall be served on the opposite party within the time allowed for filing the same.

Rule 94.—Such service shall be made personally or by registered letter.

Rule 95.—Proof of personal service shall be the written acknowledgment of the party served or the affidavit of the person making the service attached to the papers served, and stating time, place, and manner of service.

Rule 96.—Proof of service by registered letter shall be the affidavit of the person mailing the letter attached to a copy of the post-office receipt.

Rule 97.—Fifteen days, exclusive of the day of mailing will be allowed for the transmission of notices and papers by mail, except in case of notice to resident attorneys, when one day will be allowed.

Rule 98.—Notice of interlocutory motions and proceedings before the Commissioner and Secretary shall be served personally or by registered letter, and service proved as provided in rules 94 and 95.

Rule 99. No motion affecting the merits of a case or the regular order of proceedings will be entertained, except on due proof of service of notice.

Rule 100.—Ex-parte cases and cases in which the adverse party does not appear will be governed by the foregoing rules as to notices of decisions, time for appeal, and filing of exceptions and arguments, as far as applicable. In such cases, however, the right to file additional evidence at any stage of the proceedings to cure defects in the proof or record will be allowed.

Rule 101.—No person hereafter appearing as a party or attorney in any case shall be entitled to a notice of the proceedings who does not at the time of his appearance file in the office in which the case is pending a statement in writing, giving his name and post-office address, and the name of the party whom he represents; nor shall any person who has heretofore appeared in a case be entitled to a notice unless within fifteen days after being requested to file such statement he shall comply with said requirement.

Rule 102.—No person not a party to the record shall intervene in a case without first disclosing on oath the nature of his interest.

Rule 103.—When the Commissioner makes an order or decision affecting the merits of a case or the regular order of proceedings therein, he will cause notice to be given to each party in interest whose address is known.

Attorneys.—Rule 104.—In all cases contested or ex-parte, where the parties in interest are represented by attorneys, such attorneys will be recognized as fully controlling the cases of their respective clients.

Rule 105.—All notices will be served upon the attorneys of record.

Rule 106.—Notice to one attorney in a case shall constitute notice to all counsel appearing for the party represented by him; and notice to the attorney will be deemed notice to the party in interest.

Rule 107.—All attorneys practicing before the General Land Office and Department of the Interior must first file the oath of office prescribed by section 3478 United States Revised Statutes.

Rule 108.—In the examination of any case, whether contested or ex-parte, and for the preparation of arguments, the attorneys employed, when in good standing in the Department, will be allowed full opportunity to consult the record of the case and to examine the abstracts, plats, field-notes, and tract-books, and the correspondence of the General Land Office or of the Department relative thereto, and to make verbal inquiries ot the various chiefs of divisions at their respective desks in respect to the papers or status of said case; but such personal inquiries will be made of no other clerk in the division except in the presence or with the consent of the head thereof, and will be restricted to the hours between 11 A. M. and 2 P. M.

Rule 109.—Any attorney detected in any abuse of the above privileges, or of gross misconduct, upon satisfactory proof thereof, after due notice and hearing, shall be prohibited from further practicing before the Department.

Rule 110.—Should either party desire to discuss a case orally before the Secretary, opportunity will be afforded at the discretion of the Department, but only at a time specified by the Secretary or fixed by stipulation of the parties, with the consent of the Secretary; and in the absence of such stipulation, on written notice to opposing counsel, with like consent, specifying the time when argument will be heard.

Rule 111.—The examination of cases on appeal to the Commissioner or Secretary will be facilitated by filing in printed form such arguments as it is desired to have considered.

Decisions.—Rule 112.—Decisions of the Commissioner not appealed from within the period prescribed become final, and the case will be regularly closed. (Revised Statutes, sec. 2273.)

Rule 113.—The decision of the Secretary, so far as respects the action of the Executive, is final.

Rule 114.—The preceding rules shall take effect on the 1st day of February, 1881.

None of the foregoing rules shall be construed to deprive the Secretary of the Interior of the exercise of the directory and supervisory powers conferred upon him by law.

RECENT DECISIONS AFFECTING RIGHTS UNDER THE MINING LAWS OF THE UNITED STATES.

THE following are of interest:

1. Lizzie Bullock Nos. 1 and 2 Mining Claims.—The rule in case of Big Flat Mining Company *et al. v.* Big Flat Gravel Mining Company (See Annual Report of General Land Office) modified respecting proceedings for survey of mining claims and approval thereof by surveyor general. Instructions issued in pursuance of authority of Secretary's decision.

DEPARTMENT OF THE INTERIOR,

Washington, January 8, 1881.

SIR: I have considered your report of the 28th ultimo, in the matter of the application for patents for the Lizzie Bullock No. 1 and Lizzie Bullock No. 2 mining claims now pending in the district land office at Bodie, Cal., from which it appears that, notwithstanding approved plats of the conflicting claims of the Ivanpah Consolidated Mill and Mining Company were delivered one day prior to the delivery of approved plats of the claims first-above mentioned, the owner of the Lizzie Bullock claims, by extraordinary efforts, was enabled to and did file his applications for patent before the Ivanpah Company had completed its papers for filing application for patents for its claims.

The Ivanpah Company requests that the surveyor-general be at once directed to withdraw the survey issued to Mr. Bidwell, owner of the Lizzie Bullock claims, which conflicts with claims of the company, and that the register and the receiver at Bodie, be directed to receive and file said company's application for patent, and to dismiss the conflicting application for patent filed by Mr. Bidwell, or have the same treated merely as an adverse claim. I agree with your suggestion that the case has passed beyond executive control, as regards a change in the position of the parties. The matters complained of are also beyond the control of this department. The surveys having been found correct by the surveyor-general, and paid for by the party applying for them, and plats thereof having been approved and delivered, are private property, and this department has no authority to withdraw them.

The applications complained of must be allowed to take the usual course in such proceedings.

In your report you suggest that the rule announced in the decision of August 18, 1880, in the case of the Big Flat Mining Company *et al., vs.* the Big Flat Gravel Mining Company, be so modified as to allow a party who first applies for a survey of a mining claim priority over any other applicant for a survey of the same ground, or any portion thereof, not only as to the examination by the surveyor-general of the field work of the deputy-surveyor and delivery of plat, but priority of right to apply for a patent, provided due diligence is exercised in making the application for patent.

I must decline to make any rule interfering with the lawful right of parties to prepare and present in such manner as they see fit their applications for patents for mining claims. It would be manifestly improper to pass upon either the sufficiency or priority of applications by anticipation, or upon applications not presented. The land department can only take jurisdiction when a case is presented for action.

But in view of the reasons presented by you, I think it proper to so modify the rule in question as to require that the mining survey first applied for shall have priority of action in all its stages in the office of the surveyor-general, including the delivery thereof, over any other survey of the same ground, or any portion thereof; and the rule in question is hereby modified accordingly.

This, in my opinion, is the full extent to which departmental authority can properly go in the premises; and if the rule is observed in its true spirit, it will doubtless meet the difficulties which you desire to prevent.

You are authorized to issue all needful instructions for its proper enforcement.

The papers filed with your report are herewith returned.

Very respectfully,

C. SCHURTZ,
Secretary.

THE COMMISSIONER OF THE GENERAL LAND OFFICE.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,

Washington, D. C., March 3, 1881.

GENTLEMEN: On the 8th ultimo the honorable Secretary of the Interior established the following rule in regard to the survey of mining claims, viz: " The mining survey first applied for shall have priority of action in all its stages in the office of the surveyor-general, including the delivery thereof, over any other survey of the same ground or any portion thereof;" and authorized this office to prescribe regulations for the proper enforcement thereof.

In the future, therefore, you will be governed by these regulations:

1st. The surveyor-general should not order or authorize a survey of a claim which conflicts with one previously applied for until the survey first applied for has been completed, examined, approved and platted, and the plats delivered.

2d. When the conflict does not appear until the field-notes of the respective surveys are returned, then the survey first applied for should be first examined, approved and platted, and the plats delivered before the field-notes of the survey last applied for are taken up for examination or plats constructed.

3d. When the survey first authorized is not returned within a reasonable period, and the applicant for a conflicting survey makes affidavit that he believes (stating the reasons for his belief) that such first applicant has abandoned his purpose of having a survey made, or is deferring it for vexatious purposes, to wit, to postpone the subsequent applicant, the surveyor-general shall give notice of such charges to such first applicant, and call upon him for explanation under oath of the delay. He shall also require the deputy mineral surveyor to make a full statement in writing, explanatory of the delay: and if the surveyor-general shall conclude that good and sufficient reasons for such delay do not exist, he shall authorize the applicant for the conflicting survey to proceed with the same; otherwise the order of proceeding shall not be changed. The surveyor-general shall retain on his files all affidavits, &c., relating to the controversy, and in the event of an appeal from his action, shall forward the same to this office.

The deputy surveyors are under your control in the execution of their work, and you will properly instruct them concerning the prompt execution thereof.

4th. Whenever an applicant for a survey shall have reason to suppose that a conflicting claimant will also apply for a survey for patent, he may give a notice in writing to the surveyor-general, particularly describing such conflicting claim, and file a copy of the notice of location of such conflicting claim. In such case the surveyor-general will not order or authorize any survey of such conflicting claim until the survey first applied for has been examined, completed, approved and platted, and the plats delivered.

It is the intent of the rules adopted as aforesaid to furnish the first applicant in good faith for a survey with the opportunity to first present his application for patent at the district land office, and thus secure orderly proceedings. When the field-notes and plats have been delivered, however, it is held by the honorable Secretary that no authority exists to prescribe the order in which the application for patent shall be filed, it being then the right of the party to present his application when he chooses.

Therefore you will seek to avoid errors in the matter of delivery of surveys, and in case of conflicting surveys will postpone the delivery of those last applied for for such temporary period as will be sufficient to enable the first applicant to present his application for patent.

When the survey first applied for is executed and delivered in ignorance of a conflict which speedily thereafter shall appear by the return of a subsequent survey, you will notify the prior party of the existence of the conflict. If, however, the first survey shall have been delivered for any considerable period, at the time the conflict is shown, such notice need not be given.

Acknowledge receipt hereof.

Very respectfully,
A. WILLIAMSON,
Commissioner.

U. S. SURVEYORS-GENERAL.

2. Town Site of Eureka Springs, vs. Conant et al.—Surface of occupation of lode claims considered. Policy of the land department of inserting reservation clauses in mineral and town site patents considered and improved.

DEPARTMENT OF INTERIOR.
Washington, D. C., March 31, 1881.

SIR: I am in receipt of your letter of the 22d instant, accompanied with Senate Ex. Doc., 187, Forty-sixth Congress second session, and a draft of a decision prepared for your signature in the case of Town site of Eureka Springs *vs.* W. R. Conant *et al.*, mineral claimants, and J. K. Northcut *et al.*, Harrison district, Arkansas.

The draft of your decision is submitted, not for any expression of opinion on my part as to the merits of the case, but as illustrative of the existing rule of the department relative to the insertion of clauses of reservation in mineral and town-site patents respectively, reserving in mineral patents the rights of town occupants, and in town-site patents the rights of mineral claimants.

You request my opinion and advice upon the following points:

First. Whether your office should continue to insert the reservation clause, referred to in your letter, in mineral patents, in cases wherein patents for the same land have already issued upon town-site entries.

Second. Whether, in cases like the one in which the draft of decision was prepared, you are justified in deciding what patents should issue, and what clauses of reservation should be inserted therein.

The questions for consideration have relation to town sites in the vicinity of or embracing within their limits lands in which mineral veins exist; and when mineral lands are mentioned herein, it will be understood that lands of this description are meant, and not mineral lands commonly known as placers.

The questions raised by your letter have received the consideration of my predecessors on several different occasions. They were especially considered in the case of the town site of Central City, in which Secretary Chandler, under date of June 7, 1876, affirmed the decision of your immediate predecessor of December 23, 1875 (Copp's L. O. 2, p. 150). Your predecessor's decision was carefully prepared, and treated the questions at length, and it was affirmed upon the grounds and for the reasons therein stated, after full argument. The forms of reservation clauses now employed in the preparation of town-site patents for lands in mineral regions, and of mineral patents for lands within the limits of town sites, are conformable to the opinion expressed in said decision. The doctrine of that decision has not been set aside nor modified. On the contrary, it seems to have been recognized and acquiesced in by Secretary Schurz. (See decisions of this department of October 12, 1880) in the matter of the patent for the town-site of Tombstone, Ariz., and of December 18, 1880, in the matter of the patent to the Little Nettie lode, in the limits of Lead City, Deadwood district, Dak.

The practice of inserting in mineral and town-site patents said clauses of reservation thus established and recognized, and which has prevailed for many years, ought not to be disturbed, unless there is some apparent legal reason for modifying or discontinuing it. There can be no question of my authority to change the practice as to cases not already disposed of, should it be found to be in contravention of law; for it involves simply the construction of statutes relating to the subject under consideration, and the establishment of regulations accordingly.

I agree with the opinion of my predecessor in the matter of the town site of Central City, that the town-site laws contemplate that towns will exist in mining localities, and that by implication town-site entries are permissible which may embrace within their limits valid mining claims, and veins or lodes containing valuable mineral deposits upon which no location has been made. Section 2386 of the Revised Statutes, so far as it relates to the matter under consideration, is as follows:

"Where mineral veins are possessed, which possession is recognized by local authority, and to the extent so possessed and recognized, the title to town lots to be acquired shall be subject to the recognized possession and the necessary use thereof."

This section was taken from and expressed in the very language of the last two provisos to section 2 of the act of March 3, 1865 (13 Statutes, 529), which act was in existence prior to the passage of a general mining law. There was no law then in existence by which mineral claimants could acquire title from the United States, but the act of 1865 recognized their possession to the extent that it was recognized by local laws, and protected it against the right of occupancy and entry by town-site claimants. But the mining acts of July 26, 1866, and May 10, 1872, fully recognized and protected, as does chapter 6 of the Revised Statutes now fully recognize and protect, the possession of mining claims held under local regulations not in conflict with the laws of the United States. Hence the possession mentioned in section 2386 must be held to mean the same as a possession held under the mining statutes of the United States.

Now, in addition to the reservation in favor of mineral claimants expressed in section 2386, section 2392 of the same chapter provides that "no title shall be acquired under the foregoing provisions of this chapter to any mine of gold, silver, cinnabar, or copper; or to any valid mining claim or possession held under existing laws."

Thus it appears that while town-site laws permit occupation and entry of land in mineral regions, they expressly provide that no title shall be acquired thereunder to any mine of gold, silver, cinnabar, or copper, or to any valid mining claim or possession.

It seems to me that nothing could be more proper than to express in the patent the exceptions or reservation thus expressed in the law.

Again, as the law contemplates the occupancy by town-sites, or for town purposes, of lands in the vicinity of mines, or of lands in which mineral veins may be found to exist, and at the same time the existence of mining claims within town-site limits, located before or after the town occupancy has commenced, it clearly contemplates the protection of such occupancy so far as it may be necessary for the proper use of the individual inhabitants of the town, or for streets, alleys, and the like.

Parties owning mining claims must, therefore, hold subject to the legal occupancy of the town or individual lot-holders therein. Hence it is proper to express in mineral patents such reservation in favor of town sites or town-site occupants as the law reognizes.

It is true that section 2322 Revised Statutes provides that "the locators of all mining locations heretofore made, or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply with the laws of the United States, and with the State, Territorial, and local regulations not in conflict with the laws of the United States, governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations." Construing this section with sections 2386 and 2392, it might be contended that the reservation in favor of town sites should only be of such rights of surface occupancy as accrued before the location of the mining claim.

In cases in which there was no waiver or granting away of this right of possession, doubtless that would be the full extent to which the courts would construe the usual clause of reservation to have any force; but while this may be the case, it must be remembered that mineral claimants may yield or waive their right of possession, or make conveyances thereof; and to meet such cases the present clause of reservation would be a great protection to town-site claimants, occupants, or property-holders, as well as to purchasers of mines. As the law stands, no one, whether for the purpose of establishing a town, or for a residence or place of business, or for any other purposes, has the right to intrude or trespass upon the possession of a valid mining claim; and the courts afford ample remedy and protection against such intrusion or trespass, and it is the business as well as the privilege of the mineral claimant to assert his right in this respect, and not the duty of the United States to stand guard over his premises.

As to all mining locations made within town limits after occupancy for municipal purposes, as before stated, they are subject to the prior legal occupancy.

Out of the conflicting claims may grow questions that must be settled by the courts. The government cannot undertake to provide specifically in patents for every such conflicting claim or right. The clauses of general reciprocal reservation will amply protect the rights of all, and in no event can they injure any one, for no more can be conveyed by patent than Congress has authorized; and all that Congress has provided that a party may acquire by a compliance with the law will pass by the patent which Congress has authorized to issue therefor, regardless of any reservations that the executive may insert. In other words, a reservation unauthorized by law is as impotent as a patent issued without authority of law. When parties bring their conflicting claims or rights before the judicial tribunals for adjudication, those tribunals will declare the force and effect of the reservations in the patent.

As at present advised, I see no reason to change the established practice of inserting reservation clauses in town-site and mineral patents; and having thus stated my conclusions, it is unnecessary to further specifically advise you upon the points presented.

S. J. Kirkwood,
Secretary.

The Commissioner of the General Land Office.

3. Mining Claims within patented Town Sites.—

Mining claims can only be located under the mining act upon lands belonging to the United States.

After a town site has been patented, the land embraced therein does not belong to the United States, even if the minerals, do and no location of a mining claim can therefore be made.

Department of the Interior,
General Land Office,
Washington, D. C., June 28,1881.

Sir:—I am in receipt of your communication, dated 7th instant, in which you state that a client of yours, while sinking or excavating on a town lot owned by him in the town of Tombstone, discovered a ledge bearing silver ore, and you request to be informed in his behalf how he may obtain title to the same.

Patent issued for the town site of Tombstone, September 22, 1880, and contained the following clause, to wit: "*Provided,* That no title shall be hereby acquired to any mine of gold, silver, cinnabar, or copper, or to any valid mining claim or possession held under existing laws. *And provided further,* That the grant hereby made is held and declared to be subject to all the conditions, limitations, and restrictions contained in section two thousand three hundred and eighty-six of the Revised Statutes of the United States, so far as the same is applicable thereto.

The effect of this condition which is in terms almost in the exact language of the law authorizing it, is to exclude from the grant, 1st, all valid mining claims located prior to the entry of the town site and held in accordance with existing laws when the town site patent issued; and second, all "mines of gold, silver, cinnabar or copper."

The definition to be placed upon the "terms "mines of gold, silver, cinnabar, or copper," is somewhat doubtful, and I am inclined to think the law refers only to known mines discovered prior to the issuance of patent.

Practically, however, under existing legislation, it is immaterial whether veins not known at the date of patent are excluded from the grant or otherwise.

Conceding that the title thereto remains in the United States, they would not in that case be subject to occupation and purchase under the provisions of the mining act for the reason that said act permits locations of mineral deposits only where the same are situate upon lands belonging to the United States. Even if the title to such veins remains in the United States, the land in which they are situated belongs to the grantees under the town-site patents. Hence such veins would not constitute "valuable mineral deposits in lands belonging to the United States," which alone are subject to location under the terms of the law.

I am therefore of the opinion that under existing legislation your client cannot obtain a patent for the mine discovered by him.

Very respectfully,

C. W. Holcomb,
Acting Commissioner.

Geo. R. Williams, Esq.,
Tombstone, Arizona.

4. Coal Lands.—

The price to be paid for coal lands depends wholly upon its distance from a completed railroad at the date of entry, irrespective of the preferred right of entry.

If at the date of proof and payment the land is more than 15 miles from such a road the price should be not less than $10 per acre; and if it lies within 15 miles, the price should not be less than $20 per acre.

Department of the Interior,
Washington, October 17, 1881.

Sir:—I have considered the question submitted for my consideration by your letter of September 29, ult., viz., the price government should charge for coal lands—whether $10 or $20 per acre—where the land is situated more than 15 miles from any completed railroad at the time the claimant commenced opening and improving the mine and at the date he filed his declaratory statement, but which is within 15 miles of such road at the date of his application to purchase the land.

The answer rests upon a construction of sections 2347, 2348, 2349, and 2350, Revised Statutes. Section 2347 provides that "every person * * * or association of persons * * * shall * * * have the right to enter * * * any quantity of vacant lands * * * not exceeding 160 acres to such individual person, or 320 acres to such association, upon payment to the receiver of not less than $10 per acre for such lands, where the same shall be situated more than 15 miles from any completed railroad, and not less than $20 per acre for such lands as shall be within 15 miles of such road."

Section 2348 provides that "any person or association of persons * * * who have opened and improved, or shall hereafter open and improve, any coal mine or mines upon the public lands, and shall be in actual possession of the same, shall be entitled to a preference right of entry, under the preceding section, of the mines so opened and improved." * * *

Section 2349 provides for the presentation of all claims, under the preceding section, to the register of the proper land district, within sixty days after the date of actual possession and the commencement of improvements on the land, by the filing of a declaratory statement therefor; and if the township plat is not on file at the date of such improvement, the filing must be made within sixty days from receipt of the plat at the district office.

Section 2350 provides that persons claiming under section 2348 shall prove their respective rights and pay for the land filed upon within one year from the time prescribed for filing their respective claims; and upon failure to file the proper notice, or to pay for the land within the required period, the same shall be subject to entry by any other qualified applicant.

These sections are a re-enactment of the act of March 3, 1873, which was not a part of the pre-emption system for the disposition of the public lands, but "An act to provide for the sale of the lands of the United States containing coal."

As an independent act, it must therefore be construed by itself, unaided by other acts, unless by analogy. It is not, in my opinion, difficult of interpretation.

Under the section named, coal lands, when subject to sale, may be disposed of by private cash entry; or, a person opening and improving the same and in actual possession, may acquire a preference right to enter the same by presenting his claim to the district land office within sixty days after the date of his actual possession and commencement of improvements, and filing his declaratory statement therefor within the time required by section 2349, in which case he must prove his right and pay for the land within one year from the time prescribed for filing his claim; in default of which, his preference right expires, and the land becomes subject to entry by another, as provided in section 2350. This preference right is a mere right of entry secured to such person as against others, and affects no other question. If waived by neglect to prove up and pay for the land, it ceases. It has no relation to the price of the land, but to an entry only. The price is otherwise determined.

The provision of section 2348, that the persons named "shall be entitled to a preference right of entry *under the preceding section,*" means, I think, that they may enter the land upon the terms and conditions named in section 2347, which section fixes the prices of the land.

The preference right to enter a tract and the actual entry thereof are quite distinct in their legal significance and effect, and when the statute gives the "right to enter" a tract upon payment of a certain price, it confines the entry to that price, and does not permit the entry to be controlled by conditions affecting the price, which may have existed when the preference right was secured—perhaps a year previously—and when the relation of the land to a completed railroad may have been quite different. The preference right has reference to a subsequent entry, but the price is to be determined at the date of entry, as if the party made private cash entry, and notwithstanding he may have secured a preference right, and is regulated by the relation of the land to the road at the date of proof and payment.

I am of the opinion, therefore, that the price of the land depends wholly upon its distance from a completed railroad at the date of entry, irrespective of the preferred right of entry, and that if at the date of proof and payment (which constitutes the entry) the land is more than fifteen miles from such a road, the price should not be less than $10 per acre, and that if it is within 15 miles, the price should be not less than $20 per acre.

The letter of F. Perkins, accompanying yours of the 29th ult., is herewith returned. Very respectfully,

S. J. KIRKWOOD, Secretary.

The Commissioner of the General Land Office.

5. Relocation by a co-owner—Improvements.—Where a lode mining claim has been located by several persons jointly and during a given year thereafter, the expenditures for labor or improvements necessary to maintain the possessory title have not been made, the claim may be located by one of the former claimants to the exclusion of his co-claimants. Failure to make the required annual expenditures subjects a claim to relocation "in the same manner as if no location of the same had ever been made;" hence labor performed or improvements made by an original locator cannot be claimed by him as a part of the expenditures necessary to entitle him to patent for the relocation.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
Washington, D. C., March 16, 1881.

Sir:—I am in receipt of your communication of the 22d ultimo, requesting instruction for your guidance in certain cases demanding your official action as United States Deputy Mineral Surveyor.

First.—Can one of the locators of a mining claim upon which the necessary amount of expenditures for a given year have not been made, relocate the same as abandoned property, in his own name, and for himself only?

Section 2324, Revised Statutes, after prescribing the value of labor to be performed or improvements to be made annually upon each claim in order to protect the possessory right of locators, provides that "upon a failure to comply with these conditions the claims or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made; provided that the original relocators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location."

From this it will be seen that the only question to be considered in the case stated is whether one of a number of original locators, whose claim has been abandoned, would stand upon the same footing as a stranger to the first location, who by the provision above recited is expressly authorized to relocate such abandoned claim.

It is clear that one of a number of locators of a certain claim can, concurrently with such joint location, locate a separate claim independently of his colocators; and as an abandoned claim reverts to the mass of unappropriated public lands, and becomes subject to a new appropriation, "*in the same manner as if no location of the same had ever been made*," I can see no valid objection to a new adverse location of such claim by one of the former locators.

Second.—Such location being valid, can the locator claim the amount of money actually expended by himself for work on the original location as part of the expenditures required by law to entitle him to receive a patent for the claim so relocated?

As has been stated the right to make such relocation by one of the original locators is found upon the forfeiture or abandonment of the claim consequent upon *his own* dereliction as well as that of his associates. He cannot, therefore, be permitted to assume the dual character of an original claimant and a relocator. Having located the claim in the "same manner as if no location of the same had ever been made," it is not competent for him under existing law to appropriate rights whose extinguishment must have been a necessary precedent to a valid relocation. His rights are the same as those of a party who had no interest in the previous location, neither greater nor less. Very respectfully,

C. W. HOLCOMB, *Acting Commissioner.*

MAX BOEHMER,
United States Deputy Mineral Surveyor, Leadville, Col.

6. Sutro Tunnel.—1. The Sutro tunnel grant includes lands west of the Comstock lode; and the withdrawal therefor operates to the full extent of the grant, notwithstanding the fact that the tunnel has not been constructed west of said lode.

2. Locators in possession of lode claims at the date of the Sutro grant are not required to conform to the provisions of the United States mining laws as regards performance of annual labor, but a compliance with the local laws and regulations prescribed by the legislature of the State of Nevada must be observed.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, May 28, 1881.

GENTLEMEN: This office is advised by your letter of the 14th ultimo that you have allowed the filing of an application for a patent to a mining claim lying about 2,000 feet west of the Comstock lode, and partly within the Sutro tunnel grant, if the lines of said grant were extended beyond the limits of the Comstock lode. You also state that the Sutro tunnel reached the Comstock lode about two years ago, and that while lateral drifts have since been run on said lode, no attempt has been made by the tunnel company to extend their enterprise farther west.

Upon this statement of facts you request the opinion of this office as to whether the withdrawal from sale of the lands within the grant of Adolph Sutro, his heirs and assigns, by the act of July 25, 1866, includes lands west of the Comstock lode, within the 2,000 feet limits of the extended lines of the grant, although the tunnel should never be constructed beyond the Comstock lode, thus prohibiting the government from selling that portion of its domain.

Section 1 of the act of July 25, 1866, granted to A. Sutro, his heirs and assigns, the right of way to construct and excavate a mining, draining and exploring tunnel, and provides that said tunnel "shall commence at some point to be selected by the grantee herein, his heirs and assigns, at the hills near Carson River, and within the boundaries of Lyon County, and extending from said initial point in a westerly direction seven miles, more or less, to and beyond the Comstock lode."

Section 2 gives to the grantee, his heirs and assigns, "the right to purchase at $5 per acre such mineral veins and lodes within 2,000 feet on each side of said tunnel as shall be cut, discovered, or developed by running and constructing the same through its entire extent with all the dips, spurs and angles of such lodes, subject, however, to the provisions of this act, and to such legislation as Congress may hereafter provide. *Provided*, That the Comstock lode, with its dips, spurs, and angles, is excepted from this grant, and all other lodes, with their dips, spurs, and angles, located within the said 2000 feet, and which are or may be, at the passage of this act, and to actual *bona fide* possession of other persons, are hereby excepted from this grant. And the lodes herein excepted, other than the Comstock lode, shall be withheld from sale by the United States."

In accordance with this provision, and upon the filing in this office July 31, 1866, of a preliminary survey showing the initial and terminal points and direction of the proposed tunnel, the lands embraced within the exterior boundaries of the grant, as shown by the plat of said preliminary survey, were withdrawn from sale. Notice of such withdrawal was forwarded to your office by letter of August 1, 1866, together with a diagram showing the line of the tunnel to run "through the public lands from a line dividing sections 1 and 2, in township 16 north, of range 21 east, to section 23 in township 17, of range 20 east, M. D. M."

On July 7, 1876, instructions were issued by this office to the Surveyor general of Nevada for an official survey of the Sutro tunnel grant. Said survey was executed in the same year by Deputy Surveyor Charles T. Hoffman, and was based upon the preliminary survey referred to above. From the plat and field-notes of said official survey it appears the northerly and southerly side lines of the grant were run about three miles beyond the Comstock lode, to the full extent of seven miles from the initial point or eastern line of the grant. The direction and position of these lines, are distinctly indicated by iron monuments, placed at short intervals, and numbered from 1 to 28 on the northerly and from 1 to 33 on the southerly line. Monuments numbered 28 and 33 are respectively the terminal points of the northerly and southerly lines of the grant, and are distant from the initial monuments (1) 36,960 feet or seven miles. The withdrawal from sale, therefore, made by this office is in accordance with the provisions of section 2 of the granting act embracing all lands west as well as east of the Comstock lode within the lines of said survey.

The present length of the Sutro tunnel is about 4 miles, extending from its face to the Comstock lode, thus leaving about 3 miles yet to be constructed west of said lode. There is no provision in the act limiting the grantees to a certain period of time in which to complete their work on pain of forfeiture of the grant. Even if such a provision had been inserted, it would not be within the power of the executive department of the government to enforce the forfeiture, the title of the grantees would remain unimpaired until Congress should by appropriate legislation declare the forfeiture, or provide for the institution of judicial proceedings for that purpose.

It is true that Congress by a clause in the second section of the act reserves to itself the right to alter or modify the provisions of said act, but until Congress sees fit to exercise this right, the privileges extended by this act are not affected by the failure of the company to prosecute their undertaking.

You will, therefore, not permit the entry of so much of the claim referred to in your letter as lies within the limits of the tunnel grant. If the mine is drained, benefited, or developed by the tunnel, the usual condition of payment of royalty to the tunnel company must be inserted in the patent when issued for that portion lying without the limits of the grant. You will be governed in this case and in all similar cases arising in future by the instructions communicated to you by letter of February 18, 1881, in the case of Moore and Morgan lode.

Another question suggested by your communication is whether parties in the *bona fide* possession of claims within the tunnel grant at the date of the act conferring said grant will be "compelled to do their annual labor forever in order to save their claims from falling into the hands of the tunnel company, and never be allowed the right enjoyed by other citizens of procuring government patents."

Section 2 of the act of July 25, 1866, after excepting from the grant all lodes in the actual *bona fide* possession of other persons at the time of the grant, provides that "such lodes shall be abandoned and not worked, possessed, and held in conformity to existing mining rules or such regulations as have been or may be prescribed by the legislature of Nevada, they shall become subject to such right of purchase by the grantee herein, his heirs or assigns."

The general mining act of July 26, 1866, and amended by the act of July 9, 1870, and the act of May, 1872, provide that nothing in said acts "shall be construed to repeal, impair, or in any way affect" the provisions of the Sutro tunnel grant. Hence persons in possession of such lodes at the time of the grant need not conform to the requirements of the mining laws of the United States as to the performance of annual labor. A compliance with the local mining rules, or regulations prescribed by the legislature of Nevada, if any there be, is sufficient for the purpose of maintaining the possessory right to such lodes. If such compliance be productive of hardship, it is a hardship remediable only by legislative action, no power being vested in this office to change or modify the conditions of the grant. Very respectfully,

J. A. WILLIAMSON,
Commissioner.

REGISTER AND RECEIVER, *Carson City, Nev.*

7. Mark Twain Lode.—The instructions of the General Land Office requiring the location, marking of boundaries, and recording of notice of a tunnel run in accordance with section 2323, Revised Statutes, are not applicable to tunnels run for the purposes mentioned in the Act of February 11, 1875. Where a party runs a tunnel to develop a lode already located, notice of intention to run such a tunnel is not required, and no tunnel location need be made.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
Washington, D. C., May 4, 1881.

GENTLEMEN: I have examined the protest submitted by M. D. Cooper against the issuance of patent to Henry M. Hoyt *et al.* for the Mark Twain lode and mill site, lots 344 A and B, situate in Mount Sneffle's mining district, Ouray County, Colorado, and embraced in mineral entry No. 190 of the series of your office.

The record of said entry shows that the Mark Twain lode was duly located, and that the possessory title is vested in the applicants for patent. The application for patent was filed in your office April 30, 1880, due notice of which was given in the manner prescribed by law, the period of publication expiring September 4, 1880. February 3, 1881, the claimants entered and paid for the land.

Mr. Cooper alleges that during the year 1880 no work whatever was performed upon the Mark Twain lode, and that on the 22d of January, 1881, he made a relocation of the same under the name of Ida City lode. Protestant further alleges that "said H. M. Hoyt *et al.* attempted to develop said Mark Twain lode by running a tunnel on the Wheel of Fortune lode [a claim owned by Hoyt *et al.*], a claim or lode distant from said Mark Twain lode about 1200 feet, and lying at right angles with the said Wheel of Fortune lode, the said H. M. Hoyt *et al.* not being owners of the lode or surface ground intervening, * * * and without giving any notice whatever of a tunnel location for the development of said mine or mines," &c.

By an act of Congress, approved February 11, 1875, it is provided that "where a person or company has or may run a tunnel for the purposes of developing a lode or lodes owned by said person or company, the money so expended in said tunnel shall be taken and considered *as expended on said lode or lodes*, whether located prior to or since the passage of said act [May 10, 1872], and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same as required by said act."

Protestant admits that a tunnel has been commenced on the Wheel of Fortune lode and run for the development of the Mark Twain lode, and that a sufficient amount has been expended upon or in said tunnel to maintain the possessory title to said lode during the year 1880, but contends that such expenditures cannot be held to apply to said lode because the line of said tunnel was not located and marked upon the surface of the ground by stakes, because no notice was posted at the mouth or face of such tunnel describing the purpose for which it was run, and because no copy of such notice was filed for record with the mining recorder, &c.

Inasmuch as there is nothing in the law or instructions of this office requiring these things to be done, I fail to perceive the force of the reasons assigned.

Where a tunnel is run for the purpose of discovery of "blind" lodes under the provisions of section 2323, United States Revised Statutes, it is proper and the regulations require that due notice of such tunnel shall be given, in order that other persons may not prospect for lodes along the line of such tunnel, which by law are vested in the tunnel claimants so long as they shall prosecute the tunnel with due diligence.

But these instructions are not applicable to tunnels run, in accordance with the act of February 11, 1875, for the purpose of developing lodes already discovered and located.

Indeed said instructions were promulgated long prior to the passage of said act, and there exists not the slightest reason why any notice whatever should have been given to the world as to the manner in which the claimants proposed to develop their claims, as the rights of third parties could not by any possibility be affected thereby.

Admitting all that is alleged by protestant, there appears to be no reason why patent should not issue to the applicants.

The protest is hereby dismissed.

Very respectfully,

J. A. WILLIAMSON,
Commissioner.

REGISTER AND RECEIVER, *Lake City, Colo.*

CIRCULAR.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C., January 17, 1881.

GENTLEMEN:—Your attention is directed to the following act of Congress and the instructions thereunder:

AN ACT to amend sections twenty-three hundred and twenty-four and twenty-three hundred and twenty-five of the Revised Statutes of the United States concerning mineral lands.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section twenty-three hundred and twenty-five of the Revised Statutes of the United States be amended by adding thereto the following words: "*Provided*, That where the claimant for a patent is not a resident of or within the land district wherein the vein, lode, ledge, or deposit sought to be patented is located, the application for patent and the affidavits required to be made in this section by the claimant for such patent may be made by his, her, or its authorized agent, where said agent is conversant with the facts sought to be established by said affidavits: *And provided*, That this section shall apply to all applications now pending for patents to mineral lands."

SEC. 2.—That section twenty-three hundred and twenty-four of the Revised Statutes of the United States be amended by adding the following words: "*Provided*, That the period within which the work required to be done annually on all unpatented mineral claims shall commence on the first day of January succeeding the date of location of such claim, and this section shall apply to all claims located since the tenth day of May, anno Domini, eighteen hundred and seventy-two.

Approved January 22, 1880.

The first section of this act has reference only to the affidavits mentioned in section 2325 of the Revised Statutes. It is therefore held that it has no reference to the manner of establishing proof of citizenship. An applicant for mining patent who resides in the land district in which the mine is located, if within the district at the time application is made, must make the required affidavits. If he is not so within the district, the affidavits may be made by a duly appointed agent conversant with the facts.

It is held under the second section of the act that labor performed or money expended upon a mining claim prior to the first day of January succeeding the date of location thereof will not be considered as a part of or applied upon the first annual expenditure required by law. Thus upon a claim located at any time during the year 1880 the *period* within which the labor must be performed commences January 1, 1881, and *during* the calendar year 1881 the expenditure must be made, or the claim will be subject to relocation on and after January 1, 1882.

In order to apply the law to a claim located prior to the year 1880 it will be necessary to calculate from the date of location. For instance, upon a claim located in 1875 the first expenditures would be reckoned as due within one year from January 1, 1876, to wit: January 1, 1877, and *annually* thereafter by the calendar year.

Very respectfully,

J. A. WILLIAMSON,
Commissioner.

REGISTERS AND RECEIVERS,
United States District Land Offices.

Expenditures on Mining Claims.—The following is the full text of a decision filed February 25th, 1882, in the case of Du Prat vs. James et al., in Department Two of the Supreme Court of California. It covers several very important points to prospectors, locators, and mine owners:

This is an action to recover possession of a quartz mine. Judgment was rendered for defendants, and plaintiff appealed.

The objections to the answer cannot be sustained. The appeal is from the judgment, and the judgment roll only is inserted in the transcript. The plaintiff did not demur to the answer nor does it appear that he objected to the evidence when offered to prove its allegations. The cause appears to have been tried as if the answer was proper and sufficient in all respects. Such objections as those of plaintiff, will not be permitted to be raised for the first time in this Court. (Racouillat vs. Rene, 32 Cal., 450; Cave vs. Crafts, 53 Id., 135.) The cases of Atherton vs. Fowler, 6 Otto, 513, and Fletcher vs. Mower, 6 Pac. L. J., 521, cited by plaintiff's counsel, have no application to this case.

It is contended that plaintiff was lawfully in possession when defendants made their location of the mine in question, and that defendants had no right to locate when their locations were made. It appears from the findings of fact, that the parties under whom plaintiff claims, properly located the mining claim or claims in question prior to the 10th day of May, 1872, that the defendants entered upon and located the claims or mine partly on the first day of January, 1881, and partly on the fifth day of January, 1881, and that they filed for record with the proper Mining Recorder, the notices of these locations, as required by the rules and regulations of miners, within 30 days from the date of such notices. It further appears from the findings, that the defendants made such locations on the ground that plaintiff had failed to perform the labor required by the Act of Congress of May 10, 1872, and the acts amendatory thereof. By the fifth section of the Act of Congress of May 10th, 1872, it was provided as follows:

"On each claim located after the passage of this Act, and until a patent shall have issued therefor, not less than $100 worth of labor shall be performed or improvements made during each year. On all claims located prior to the passage of this Act, $10 worth of labor shall be performed or improvements made *each year* for each 100 ft. in length along the vein until a patent shall have been issued therefor; but when such claims are held in common, such expenditure may be made upon any one claim; and upon a failure to comply with these conditions, the claim or mine upon which said failure occurred, shall be open to re-location in the same manner as if no location of the same had ever been made." (17 U. S. Stats. at Large, 92).

On the first day of March, 1873, Congress passed an Act by which the provisions of the 5th section of the Act of May 10th, 1872, which requires expenditures of labor and improvements on claims located prior to the passage of said Act, were so amended "that the time *for the first annual expenditure*" on such claims was "extended to the tenth day of June, 1874." (17 U. S. Stats. at Large, 483; Sec. 2324, U. S. Rev. Stats.)

By Section 2324 of the Revised Statutes of the United States it was thus provided:

"On all claims located prior to the tenth day of May, 1872, $10 worth of labor shall be performed or improvements made by the 10th day of June, 1874, and each year *thereafter*, for each 100 ft. in length along the vein until a patent has been issued therefor; but where such claims are held in common, such expenditure may be made upon any one claim; and upon a failure to comply with these conditions, the claim or mine upon which such failure occurred shall be open to re-location in the same manner as if no location of the same had ever been made; *provided*, that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location.

It will be observed that by this section it was provided that the labor to be performed or improvements to be made on claims located prior to the 10th day of May, 1872, were to be performed or made by the 10th day of June, 1874 *and each year thereafter*, until a patent had been issued for such claim. The words "*and each year thereafter*," were here first added to the date mentioned, viz: 10th day of June, 1874. The Revised Statutes of the United States were approved by Act of Congress, passed on the 22d of June, 1874. Section 5,595 of this revision, consisting of 73 titles, declares that these titles embrace the Statutes of the United States, general and permanent in their nature, in force on the 1st day of December, 1873. The acts above referred to, passed prior to the date last named, were repealed by force of section 5,596 of the revision, but all rights accruing or accrued under the Acts repealed were preserved by the provisions of section 5,597.

Congress further amended this 5th section of the Act of 1872, by an Act passed on the 6th day of June, 1874. By this amendment, the time for such "*first annual expenditure*," on claims located prior to the Act of 1872, was extended "to the 1st day of January, 1875." (18 U. S. Stats. at Large, Part 3–61.)

The foregoing Act of the 6th of June, 1874 is not affected by the Revised Statutes, but has as full effect as if passed after the enactment of the revision, *i. e.* after the 22d of June, 1874, and so far as it varies from or conflicts with any provision contained in the revision, has effect as a subsequent statute, and repeals any portion of the revision inconsistent with such statute. This results from the provisions of sections 5601 of the revision.

By the act of the 22d of January, 1880, Congress amended section 2324 of the Revised Statues, by adding thereto the following words: "Provided, that the period within which the work required to be done annually on all unpatented mineral claims shall commence on the first day of January succeeding the date of the location of such claim, and this section shall apply to all claims located since the 10th day of May, A. D. 1872." (See 21st U. S. Stats. at Large, 61.)

The counsel for appellant puts forth a contention in relation to the Act of June 6, 1874, in these words:

"The act of June 6, 1874, only amended the act of May 10, 1872, in extending the time for doing the annual work, which the existing laws required to be done by June 10, 1874, to Jan. 1, 1875, but did not make any arbitrary rule affecting the date of locations made prior to May 10, 1872, so that that act became *functus officio* on the expiration of the 1st of Jan., 1875."

If by this it is intended to say that the act of June 6, 1874, had its full effect on the 1st day of Jan., 1875, and that no provision of law then existed in regard to the work of improvements on a mining claim requiring that they should be performed or made in each year succeeding Jan. 1, 1875, we think the learned counsel has fallen into an error, as an examination of the various acts above referred to will show. What is said herein on this point, relates only to claims located prior to the 10th of May, 1872, such being the character of the claims involved in this case. By the act of May 10, 1872 (see Sec. 5), the labor or improvements required as to such claim were to be performed or made "*each year.*" The first amendment to this act was made on the 1st of March, 1873, and by it the time for "the first annual expenditure" was extended to the 10th day of June, 1874. The legislation on this matter next succeeding, according to the provisions of Sec. 5,601 of the revised statutes was Sec. 2324 of the revision (see quotation from it above), which required the labor or improvements to be performed or made by the 10th of June, 1874, "*and each year thereafter.*" Then came, not in order of time, but as it went into operation, the act of June 6, 1874, by which the time for the "*first annual expenditure*" for labor or improvements, was extended to the 1st of Jan., 1875. But as we have seen, this act has effect so far as it varies from or conflicts with any provision contained in section 2324 of the revision as a subsequent statute, and repeals any portion of the revision inconsistent with it.

The only inconsistency or conflict with the revision, Sec. 2,324, is as to the date to which the first annual expenditure is extended, which, by Sec. 2,324, is to the 10th day of June, 1874, and by the act of June 6, 1874, to the 1st day of January, 1875. There is no conflict or inconsistency so far as regards the words "*and each year thereafter*" in the Sec. 2,324, and they remain. The requirement, then, as enacted by the legislation of Congress, was, after the 22d of June, 1874, that the first annual expenditure must be made by the first day of January, 1875, and each year thereafter. (See Weeks on Mineral Lands, Sec. 69.) This, in our view is the correct interpretation of the acts of Congress relating to the point under discussion. If the act of the 22d of January, 1880, applies to the case in hand, of which we entertain some doubt, the meaning is the same. The learned counsel for appellant seems to labor under the impression that the section 2,324 took effect subsequently to the act of June 6, 1874; but this is a misconception, as will be seen by examining section 5,601 of the revised statutes, above referred to. Upon a failure to comply with the conditions mentioned in section 2,324, among which are those which relate to labor and improvements above stated, by the provisions of the same section, the claim or mine is "open to re-location in the same manner as if no location of the same had ever been made."

The Court found that plaintiff failed to perform the labor or make the improvements thereon as required by law during the year 1880, commencing on the first day of January, 1880, and ending on the 31st of December of the same year; that it was open to re-location on the 1st and 5th days of January, 1881, on which days defendants made their locations. It is argued by counsel for appellant, that the location on the 1st of January, 1881, was premature; that he had all that day to perform the labor or make the improvements required by law. The question is not free from difficulty. The act of 6th of June, 1874, extends the time *to* the 1st day of January, 1875. In Bradley vs. Rice, 13 Maine, 201, in the construction of a conveyance of land, which described a tract of land as running "*to Flying Pond*," the question was whether the tract ran into the pond or was bounded by the water of the pond; the Court said: "To, from and by are terms of exclusion, unless by necessary implication, they are manifestly used in a different sense." The tract of land was held to extend to the pond, excluding any portion of it.

In considering a question of the same character arising upon a deed in Bonney vs. Morrill, 52 Maine, 243, the same Court said: "From" an object or "to" an object "excludes the terminus referred to." The call on which the construction was made described a course as easterly "to land now or formerly owned by Isaac Bonney," etc. The land of Bonney was held to be excluded.

If the question under consideration is to be determined upon the words of the act of the 6th of June, 1874, the 1st day of January, 1881, must be excluded from the time within which the plaintiff had to perform the labor or make the improvements required for the year 1880. But it may be contended that the effect of section 5,601 of the Revised Statutes is merely to substitute the 1st day of January, 1875, for the 10th day of June, 1874, in section 2,324, and that the section ought to be read, making such substitution, thus: "Labor shall be performed, or improvements made *by* the 1st day of January, 1875." If "by" is a word of exclusion, as held in the above-cited case from 13 Maine, then the same conclusion must be reached as above, as to the 1st day of January, 1881, viz.; that it must be excluded from the period during which the labor had to be performed, or the improvements made for the year 1880. In Rankin vs. Woodworth, 3 Penrose and Watts, 46, it was held that a contract to complete work *by* a certain time, means that it shall be done before that time. The contract was dated in February, 1815, and was "to build a sawmill" and "to have it completed by November next." The Court thus expressed itself in regard to it: "By the contract the work was to be finished *by* the ensuing month of November, which in the popular acceptation of the word excludes the month. When a thing is ordered by a particular day, it is with a view of having the use of it on that day. Thus a coat is ordered by Sunday, with a view of wearing it to church. And the popular agrees with the philological import of the word, which is explained by our great lexicographer, by the words 'near, besides, passing, in presence;' all of which denote exclusion."

The proper interpretation of the legislation of Congress on the subject is, in our judgment, that *by* is used as a word of exclusion, and therefore that the plaintiff was not entitled to perform the labor or make the improvements for the year 1880, on the first day of January, 1881. A review of the acts of Congress in regard to this point, leads us to the conclusion that it was the intention of Congress to confine the period, after the first day of Jan., 1875, in which the labor or improvements were to be performed or made by the claimant of a mining claim, to the calendar year, commencing on and including the 1st day of Jan., of the year, and ending with and including the last day—the 31st of December. This seems to be the construction put on this legislation by the officers of the Department of the Interior. (See Sickel's Mining Laws and Decisions, 373, 392, 393, 394.) The Court finds that the plaintiff performed the requisite amount of labor on the mine during the years preceding 1880. The finding as to the year 1880 is, that plaintiff "caused three days *work* to be performed in and upon said claim," but does not find the value of the *work* performed. We cannot see that the work did not amount to $150 in value. It is not found whether this *work* consisted of labor performed or improvements made on the claim. *Non constat*, but it may have been improvements made on the claim worth $150. This Court cannot know judicially whether this work consists of labor or improvements, or what the worth of it was. For the failure to find as to this worth or value which was in issue, the judgment must be reversed and the cause remanded that the worth or value of the work may be found by the Court below. In this course, we pursue the practice adopted in Billings vs. Everett, 52 Cal., 661.

Judgment reversed and cause remanded to the Court below, with an order to the Court to find on the said issue on the evidence taken or on such other evidence as may be adduced as to said issue, and thereupon to proceed to render judgment in accordance with the views expressed in this opinion. So ordered.

Locating Mineral Veins.—In his charge to the jury in the Contention Head Center suit, recently decided at Tombstone, Arizona, Judge W. H. Stilwell said: "Mining law was made for miners. It is plain and simple. It provides that a man or number of men may make a location of certain mineral lands, after they have found a mineral vein, lode or ledge. You have listened to the testimony of miners of great experience, and of men learned in geology. You may find some difficulty in coming to your verdict to reconcile all the testimony that you have listened to, and I will state here that the mining law is simple and general. It would be difficult to give definitions, such as you have listened to that can be fully applied in this or other cases. Therefore the definitions of words found in our statutes are very limited, in fact no definitions regarding a vein, ledge or lode. Courts must be careful of giving definitions of veins, lodes or ledges and trust very much to the wisdom and good judgment of the jury, after listening to the testimony, to find what is a vein, ledge or lode in the case they consider. Miners usually follow ore that will pay, or what they think will lead them to ore that will pay to mine. There are many little seams, as you have heard testified to, running out from large bodies of ore. Some may pay to follow and some may not. What there is of them may be pure, rich and valuable, and yet not pay to follow, and I will add that some of the testimony that you have may have listened to, as a matter of science, may be clear in logic, rich in learning, but as miners it may not pay you to undertake to reconcile all the facts or opinions that you may have listened to before finding your verdict. You are at liberty to consider such part of the testimony as will enable you to arrive at the facts in the case. It will be quite impossible for you in this case to reconcile all the testimony I have illustrated, though as a matter of science the fine distinctions and definitions you have listened to may be true and interesting. A lode, vein or ledge, so far as satisfying the law is concerned, may be defined as a mass or body of mineralized or metalliferous rock in place, surrounded by other different rock. That is about all the definition that I feel can be given from the bench that will apply to many different cases.

I am of the opinion that the coloring on the map, taking these three long spots, are in the meaning of the law, in place. Yet you had testimony before you that they are not where they originally were—that they have been faulted and moved. The mineral, we were told, is not where it was when the vein, lode or ledge was formed, yet they are in place. By rock in place, we mean rock that has not been changed by the elements or gravitation. In coming to your decision as to what is a vein, if you find that there is one here, and whether it embraces the entire porphyry dike, or, simply, as is claimed by the defendants, the mineral embraced within clay selvages, which they call walls, you are at liberty to consider the formation of those other veins, lodes or ledges in the Contention mine. If you are convinced that those veins were formerly one vein, but have been faulted and separated by forces in the earth, you may consider and compare them as to their general formation. In passing upon this vein, ledge or lode, it is for you to say what is the boundary of it and of what it consists. If you come to the opinion that the vein, ledge or lode is simply that described by the defendant, then in making the lines, as I shall hereafter instruct you, you must be guided as to where that vein courses or takes its strike. If you come to the opinion that the porphyry dike is the vein, you shall be guided by the size of that and the strike it takes, in placing those lines about which I will instruct you.

"Regarding the location of mining claims, to make a location, a miner is not compelled or permitted, until he finds a mineral-bearing vein, ledge or lode, and until he is fully satisfied as to its course and strike, that he may locate the claim conformatory thereto. If the location is made before the strike of a vein is or can be ascertained, the principle that the law does not require an impossibility, cannot be used as an excuse for following a vein after it materially departs from the exterior boundaries of a mining claim and does not return to it. A man may locate a mining claim, if he chooses, before he learns the true strike of his vein or ledge; and the law provides what minerals he may extract therefrom. If he makes a mistake in his location, he cannot be excused on the principle that the law does not require an impossibility, and be permitted to follow his vein or ledge before it strikes out beyond the side boundaries of his claim. He must abide by what the law says is embraced in the boundaries of his claim, and about which I will more particularly instruct you. In this case, I instruct you that it is your duty to give to the plaintiff all that you would consider him entitled to if the property claimed by the defendant belonged to the United States. That is to say, if I locate a farm, the boundary of my farm is not different by reason of the fact that the property adjacent may belong to the United States, or any individual; and I am of the opinion that if the property belonging to, or claimed by the defendant, belonged to the United States, the plaintiff would have no right in law to go any farther beyond their side lines than they have in this case. If the defendants are *bona fide* subsequent locators, the law provides that the location shall be made substantially parallel with the strike of the lode or vein, and that the end lines shall be parallel. It is so difficult to do this in all cases, that if the line or rim enters the claim at one corner under the end line and crosses diagonally through the claim and out under the other end line, it is held that the location is good, and the owner of the claim cannot be disturbed, and may follow the vein downward in its dip, to any extent, even though it should so far depart from a perpendicular in its course downward as to extend outside the vertical side lines of such surface locations."

Decisions on Vital Principles.—We include here two decisions that are of great importance, though not so very recent They are from the report of the State Controller of Nevada. The first is an action of ejectment for the possession of certain mining ground, particularly described in the complaint, situated in Eureka mining district, in the County of Eureka, in the State of Nevada.

The Richmond Case.—"The plaintiff in this celebrated case is a corporation created under the laws of California, and the defendant, the Richmond Mining Company, is a corporation created under the laws of Nevada. The other defendants, Thomas Wren and Joseph Potts, are citizens of the latter State. The action was originally commenced in the State Court of Nevada, but upon application of the plaintiff, and upon the ground of its incorporation in another State, and presumed citizenship, from that fact, of its corporators or stockholders in that State, it was transferred to the Circuit Court of the United States. The complaint in the State Court, in addition to the usual allegations of a declaration in ejectment, set forth various grounds upon which was based a prayer for an order restraining the defendants from working the premises in controversy pending the action. The defendants, in their answer to the complaint, not only denied the title of the plaintiff, but made various averments, upon which a like restraining order against the plaintiff was asked. Both orders were granted. This union of a demand in ejectment for the property in controversy with a prayer for provisional equitable relief, is permitted, by the system of procedure which obtains in the State, thus saving the parties the necessity of litigating in two suits, what can as readily, and less expensively, be accomplished in one. But this union is not permitted in the Federal Court; and upon the transfer of the present action, the pleadings of the plaintiff were amended, by substituting a regular complaint in ejectment on the law side of the Court; and a bill was filed for an injunction on its equity side. The defendants answered both, and also filed a cross-bill for an injunction against the plaintiff. By arrangement of the parties, the defendants, Messrs. Wren and Potts, are dropped out of the controversy, and their names may be stricken from the pleadings. The claim for damages is also waived in this action, without prejudice to any future proceedings with respect to them. By stipulation, the case at law, the action of ejectment, is tried by the Court without the intervention of a jury, and the judges sit at San Francisco, instead of Carson, their finding and judgment to be entered in term time in the latter place as though the case were heard and decided there. The testimony taken in the action at law is to be received as depositions in the equity suit, and both cases are to be disposed of at the same time, to the end that the whole controversy between the parties may be settled at once. The premises in controversy are of great value, amounting by estimation to several hundred thousands of dollars, and the case has been prepared for trial with a care proportionate to this estimate of the value of the property; and the trial has been conducted by counsel on both sides with eminent ability.

"Whatever could inform, instruct or enlighten the court, has been presented by them. Practical miners have given us their testimony as to the location and working of the mine. Men of science have explained to us how it was probable that nature in her processes had deposited the mineral where it is found. Models of glass have made the hill, where the mining ground lies transparent, so that we have been able to trace the course of the veins, and see the chambers of ore found in its depths. For myself, after a somewhat extended judicial experience, covering now a period of nearly twenty years, I can say that I have seldom, if ever, seen a case involving the consideration of so many and varied particulars, more thoroughly prepared or more ably presented. And what has added a charm to the whole trial has been the conduct of counsel on both sides, who have appeared to assist each other in the development of the facts of the case, and have furnished an illustration of the truth that the highest courtesy is consisteut with the most earnest contention.

"The mining ground which forms the subject of controversy is situated in a hill known as Ruby Hill, a spur of Prospect Mountain, distant about two miles from the town of Eureka in Nevada. Prospect Mountain is several miles in length, running in a northerly and southerly course. Adjoining its northerly end is the spur called Ruby Hill, which extends thence westerly or in a south-westerly direction. Along and through this hill for a distance slightly exceeding a mile, is a zone of limestone in which, at different places throughout its length, and in various forms, mineral is found, this mineral appearing sometimes in continuous veins, sometimes in apparently isolated chambers, and at other times in what would seem to be scattered grains. And our principal inquiry is to ascertain the character of this zone, in order to determine whether it is to be treated as constituting one lode, or as embracing several lodes, as that term is used in the acts of congress of 1866 and 1872, under which the parties have acquired whatever rights they possess. In this inquiry the first thing to be settled is the meaning of the term in those acts. This meaning being settled, the physical characteristics and the distinguishing feature of the zone will be considered.

"Those acts give no definition of the term. They use it always in connection with the term vein. The act of 1866 provided for the acquisition of a patent by any person or association of persons claiming "a vein or lode of quartz or other rock in place, bearing gold, silver, cinnabar, or copper." The act of 1872 speaks of veins or lodes of quartz, or other rock in place, bearing similar metals or ores. Any definition of the term should, therefore, be sufficiently broad to embrace deposits of the several metals or ores here mentioned. In the construction of statutes, general terms must receive that interpretation which will include all the instances enumerated as comprehended by them. The definition of a lode given by geologists is that of a fissure of the earth's crust filled with mineral matter; or, more accurately, as aggregations of mineral matter containing ores in fissures. (See Von Cotta's Treatise on Ore Deposits, Prime's Translation, 26). But miners used the term before geologists attempted to give it a definition. One of the witnesses in this case, Dr. Raymond, who, for many years, was in the service of the general government as commissioner of mining statistics, and in that capacity had occasion to examine and report upon a large number of mines in the States of Nevada and California, and the Territories of Utah and Colorado, says that he has been accustomed as a mining engineer to attach very little importance to those cases of classification of deposits, which simply involve the referring of the subject back to verbal definitions in the books. The whole subject of the classification of mineral deposits, he states to be one in which the interests of the miner have entirely overridden the reasonings of the chemists and geologists. "The miners," to use his language, "made the definition first. As used by miners, before being defined by any authority, the term lode simply meant that formation by which the miner could be led or guided. It is an alteration of the verb lead; and whatever the miner could follow, expecting to find ore, was his lode. Some formation within which he could find ore, and out of which he could not expect to find ore, was his 'lode.' The term lode-star, guiding-star, or north-star, he adds, is of the same origin. Cinnabar is not found in any fissure of the earth's crust, or in any lode as defined by geologists, yet the acts of Congress speak, as already seen, of lodes of quartz, or rock in place bearing cinnabar. Any definition of lode, as there used, which did not embrace deposits of cinnabar, would be as defective as if it did not embrace deposits of gold or silver. The definition must apply to deposits of all the metals named, if it apply to a deposit of any one of them. Those acts were not drawn by geologists or for geologists; they were not framed in the interests of science, and consequently with scientific accuracy in the use of terms. They were framed for the protection of miners in the claims which they had located and developed, and should receive such a construction as will carry out this purpose. The use of the terms vein and lode in connection with each other in the act of 1866, and their use in connection with the term ledge in the act of 1872, would seem to indicate that it was the object of the legislator to avoid any limitation in the application of the acts which a scientific definition of any of these terms might impose. It is difficult to give any definition of the term as understood and used in the acts of Congress which will not be subject to criticism. A fissure in the earth's crust, an opening in its rocks and strata made by some force of nature, in which mineral is deposited, would seem to be essential to the definition of a lode in the judgment of geologists. But to the practical miner, the fissure and its walls are only of importance as indicating the boundaries within which he may look for and reasonably expect to find the ore he seeks. A continuous body of ore lying within any other similar well-defined boundaries on the earth's surface, and under it, would equally constitute in his eyes a lode. We are of opinion, therefore, that the term, as used in the acts of Congress, is applicable to any zone or belt of mineralized rock lying within boundaries clearly separating it from the neighboring rock. It includes, to use the language cited by counsel, all deposits of mineral matter found through a mineralized zone or belt coming from the same source, impressed with the same forms, and appearing to have been created by the same processes.

Examining, now, with this definition in mind, the features of the zone which separate and distinguish it from the surrounding country, we experience little difficulty in determining its character. We find that it is contained within clearly defined limits, and that it bears unmistakable marks of originating, in all its parts, under the influence of the same creative forces. It is bounded on the south side, for its whole length, at least so far as explorations have been made, by a wall of quartzite of several hundred feet in thickness; and on its north side, for a like extent, by a belt of clay or shale, ranging in thickness from less than an inch to seventy or eighty feet. At the east end of the zone, in the Jackson mine, the quartzite and shale approach so closely as to be separated by a bare seam less than an inch in width. From that point they diverge, until on the surface, in the Eureka mine, they are about five hundred feet apart, and on the surface, in the Richmond mine, about eight hundred feet. The quartzite has a general dip to the north, at an angle of about forty-five degrees, subject to some local variations as the course changes. The clay or shale is more perpendicular, having a dip at an angle of about eighty degrees. At some depth under the surface, these two boundaries of the limestone, descending at their respective angles must come together. In some of the levels worked they are now only from two hundred to three hundred feet apart. The limestone found between these two limits—the wall of quartzite and the seam of clay or shale—has, at some period of the world, been subjected to some dynamic force of nature, by which it has been broken up, crushed, disintegrated and fissured, in all directions, so as to destroy, except in three or four places of a feet each, so far as explorations show, all traces of stratification; thus especially fitting it, according to the testimony of the men of science, to whom we have listened, for the reception of the mineral which, in ages past, came up from the depths below in solution, and was deposited in it. Evidence that the whole mass of limestone has been, at some period, lifted up and moved along the quartzite, is found in the marks of attrition engraved on the rock. This broken, crushed and fissured condition pervades to a greater or less extent the whole body, showing that the same forces which operated upon a part, operated upon the whole, and at the same time. Wherever the quartzite is exposed, the marks of attrition appear. Below the quartzite no one has penetrated. Above the shale the rock has not been thus broken and crushed. Stratification exists there. If in some isolated places there is found evidence of disturbance, that disturbance has not been sufficient to affect the stratification. The broken, crushed and fissured condition of the limestone gives it a specific, individual character by which it can be identified and separated from all other limestones in the vicinity. In this zone of limestones numerous caves or chambers are found, further distinguishing it from the neighboring rock. The limestone being broken and crushed up as stated, the water from above readily penetrated into it, and operating as a solvent, formed these caves and chambers. No similar cavities are found in the rock beyond the shale, its hard and unbroken character not permitting, or at least opposing such actions from the water above. Oxide of iron is also found in numerous places throughout the zone, giving to the miner assurance that the metal he seeks is in his vicinity. This broken, crushed and fissured condition of the limestone, the presence of the oxides of iron, the caves or chambers we have mentioned, with the wall of quartzite and seam of clay bounding it, give to the zone, in the eyes of the practical miner, an individuality—a oneness as complete as that which the most perfect lode in a geological sense ever possessed. Each of the characteristics named, though produced at a different period from the others, was undoubtedly caused by the same forces operating at the same time upon the whole body of the limestone.

Throughout this zone of limestone, as we have already stated, mineral is found in the numerous fissures of the rock. According to the opinions of all the scientific men who have been examined, this mineral was brought up in solution from the depths of the earth below, and would, therefore, naturally be very irregularly deposited in the fissures of the crushed matter, as these fissures are in every variety of form and size, and would also find its way in minute particles in the loose material of the rock. The evidence shows that it is sufficiently diffused to justify giving to the limestone the general designation of mineralized matter—metal-bearing rock. The three scientific experts produced by the plaintiff, Mr. Keyes, Mr. Raymond and Mr. Hunt, all of them of large experience and extensive attainments, and two of them of national reputation, have given it as their opinion, after examining the ground, that the zone of limestone between the quartzite and shale constitute one vein or lode, in the sense in which those terms are used by miners. Mr. Keyes, who for years was superintendent of the mine of the plaintiff, concludes a minute description of the character and development of the ground, by stating that, in his judgment, according to the customs of miners in this country and common sense, the whole of that space should be considered and accepted as a lead, lode or ledge of metal-bearing earth, or rock in place. Dr. Raymond, after giving a like extended account of the character of the ground, and his opinion as to the causes of its formation, and stating with great minuteness the observations he had made, concludes by announcing as his judgment, after carefully weighing all that he had seen, that the deposit between the quartzite and shale is to be considered as a single vein in the sense of the word in which it is used by miners—that is, as a single ore deposit of identical origin, age and character throughout. Dr. Hunt, after stating the result of his examination of the ground and his theory as to the formation of the mine, gives his judgment as follows:

"My conclusion is this: That this whole mass of rock is impregnated with ore; that although the great mass of ore stretches for a long distance above horizontally and along an incline down the foot wall, as I have traced it, from this deposit you can also trace the ore into a succession of great cavities or bonanzas lying irregularly across the limestone, and into smaller caverns or chasms of the same sort; and that the whole mass of the limestone is irregularly impregnated with the ore. I use the word impregnation in the sense that it has penetrated here and there; little patches and stains, ore vugs and caverns and spaces of all sizes and all shapes, irregularly disseminated through the mass. * * * I conclude, therefore, that this great mass of ore is, in the proper sense of the word, a great lode, or a great vein, in the sense in which the word is used by miners; and that practically the only way of utilizing this deposit is to treat the whole of it as one great ore-bearing lode or mass of rock."

This conclusion as to the zone constituting one lode of rock bearing metal, it is true, is not adopted by the men of science produced as witnesses by the defendant, the Richmond Company. These latter gentlemen like the others, have had a large experience in the examination of mines, and some of them have acquired a national reputation for their scientific attainments. No one questions their learning or ability, or the sincerity with which they have expressed their convictions. They agree with the plaintiff's witnesses as to the existence of the mineralized zone of limestone with an underlying quartzite and an overlying shale; as to the broken and crushed condition of the limestone, and substantially as to the origin of the metal and its deposition in the rock. In nearly all other respects they disagree. In their judgment, the zone of limestone has no features of a lode. It has no continuous fissure, says Mr. King, to mark it as a lode. A lode, he adds, must have a foot wall, and a hanging wall, and if it is broad, these must connect at both ends, and must connect downward. Here there is no hanging wall or foot wall; the limestone only rests as a matter of stratigraphical fact on underlying quartzite, and the shale overlies it. And distinguishing the structure at Ruby Hill from the Comstock lode, the same witness says that one is a series of sedimentary beds laid down in the ocean and turned up; the other is a fissure extending between two rocks. The other witnesses of the defendant, so far as they have expressed any opinion as to what constitutes a lode, have agreed with the views of Mr. King. It is impossible not to perceive that these gentlemen at all times carried in their minds the scientific definition of the term as given by geologists, that a lode is a fissure in the earth's crust filled with mineral matter, and disregarded the broader, though less scientific, definition of the miner, who applies the term to all zones or belts of metal-bearing rock lying within clearly marked boundaries. For the reasons already stated, we are of opinion that the Act of Congress uses the term in the sense in which miners understand it.

If the scientific definition of a lode, as made by geologists, could be accepted as the only proper one in this case, the theory of distinct veins existing in distinct fissures of the limestone would be not only plausible, but reasonable; for that definition is not met by the conditions in which the Eureka mineralized zone appears. But as that definition cannot be accepted, and does not meet the case of a lode, as that term is understood by miners, the theory of separate veins, as distinct and disconnected bodies of ore falls to the ground. It is, therefore, of little consequence what name is given to the veins in the limestone, whether they be called pipe veins, rake veins or pipes of ore, or receive the new designation suggested by one of the witnesses, they are but parts of one greater deposit, which permeates in a greater or less degree, with occasional intervening spaces of barren rock, the whole mass of limestone, from the Jackson mine to the Richmond, inclusive. The acts of Congress of 1866 and 1872 dealt with a practical necessity of miners; they were drawn to protect locations on veins or lodes, as miners understood those terms. Instances without number exist, where the meaning of words in a statute has been enlarged or restricted and qualified, to carry out the intention of the legislature. The inquiry, where any uncertainty exists, always is as to what the legislature intended, and when that is ascertained it controls. In a recent case before the Supreme Court of the United States, singing birds were held not to be live animals, within the meaning of a revenue act of Congress. (Reiche *v.* Smythe, 13 Wall. 162). And in a previous case, arising upon the construction of the Oregon donation act of Congress, the term, a single man, was held to include in its meaning an unmarried woman. (Silver *v.* Ladd, 7 Wall. 219.) If any one will examine the two decisions reported as they are in Wallace's Reports, he will find good reasons for both of them.

Our judgment being that the limestone zone in Ruby Hill in Eureka District, lying between the quartzite and shale, constitutes, within the meaning of the act of Congress, one lode of rock bearing metal, we proceed to consider the rights conveyed to the parties by their respective patents from the United States. All these patents are founded upon previous locations, taken up and improved according to the customs and rules of miners in the district. Each patent is evidence of a perfected right in the patentee to the claim conveyed, the initiatory step for the acquisition of which was the original location. If the date of such location be stated in the instrument, the patent will take effect by relation, as of that date, so far as may be necessary to cut off all intervening claimants, unless the prior right of the patentee, by virtue of his earlier location, has been lost by a failure to contest the claim of the intervening claimant, as provided in the act of 1872. As in the system established for the alienation of the public lands, the patent is the consummation of a series of acts, having for their object the acquisition of the title; the general rule is to give it an operation by relation at the date of the initiatory step, so far as may be necessary to protect the patentee against subsequent claimants to the said property. As was said by the Supreme Court, in the case of Shepley *v.* Cowan, 1 Otto, where two parties were contending for the same property, the first in time, in the commencement of proceedings for the acquisition of the title, when the same are regularly followed up, is deemed to be the first in right.

But this principle has been qualified in its application to patents of mining ground, by provisions in the act of 1872, for the settlement of adverse claims before the issue of the patent. Under that act, when one is seeking a patent for his mining location, and gives proper notice of the fact, as there prescribed, any other claimant of an unpatented location, objecting to the patent of the claim, either on account of its extent or form, or because of asserted prior location, must come forward with his objections and present them, or he will afterward be precluded from objecting to the issue of the patent. While, therefore, the general doctrine of relation applies to mining patents so as to cut off intervening claimants, if any there can be, deriving title from other sources, such, perhaps, as might arise from a subsequent location of school warrants, or a subsequent purchase from the State, as in the case of Heydenfeldt *v.* Daney Gold Mining Company, reported in the third of Otto; the doctrine cannot be applied so as to cut off the rights of the earlier patentee, under a later location, where no opposition to that location was made under the statute. The silence of the first locator is, under the statute, a waiver of his priority. But, from the view we take of the rights of the parties under their respective patents and the locations upon which those patents were issued, the question of priority of location is of no practical consequence in the case. The plaintiff is the patentee of several claims on the Ruby Hill lode, but for the purpose of this action it is only necessary to refer to three of them—the patents for the Champion, the At Last and the Lupita or Margaret claims. The first of these patents was issued in 1872, the second in 1876, and the third in 1877. Objection is taken to the validity of the last two, because the end lines of the surface locations patented are not parallel, as required by the act of 1872. But to this objection there are several obvious answers. In the first place, it does not appear upon what locations the patents issued. They may have been, and probably were, issued upon locations made under the act of 1866, where such parallelism in the end lines of the surface locations was not required.

The presumption of the law is, that the officers of the executive department specially charged with the supervision of applications for mining patents, and the issue of such patents, did their duty; and in an action of ejectment, mere surmises to the contrary will not be listened to. If, under any possible circumstances, a patent for a location without such parallelism may be valid, the law will presume that such circumstances existed. A patent of the United States for land, whether agricultural or mineral, is something upon which its holder can rely for peace and security in his possessions. In its potency it is iron-clad against all mere speculative inferences. In the second place, the provision of the statute of 1872, requiring the lines of each claim to be parallel to each other, is merely directory, and no consequence is attached to a deviation from its direction. The essential point was to secure parallel end lines drawn vertically down, and that was done by taking the extreme points of the respective locations on the length of the lode. In the third place, the defect objected to does not affect the defendant, and no one but the Government has the right to complaint. The defendant, The Richmond Mining Company, also holds several patents issued to it upon different locations; but in this case it specially relies upon the patents of the Richmond and Tip Top claims. These patents were issued upon locations made in 1869, which is earlier than any of the locations upon which the patents to the plaintiff were issued, at least so far as we are informed. Upon this fact, and claiming from it that the patents antedate in their operation, by relation, back to their respective locations the patents under which the plaintiff claims, and the further fact that the patents were issued upon locations made in 1866, the defendant relies to defeat the pretensions of the plaintiff. It contends that, inasmuch as the croppings of the vein it works are within the surface of its patented locations, it can follow the vein wherever it leads, though it be outside of the end lines of the locations when vertically drawn down the lode. Its position is that whenever, under the law of 1866, a location was made on a lode or vein, a right was allowed to follow the vein wherever it might lead, without regard to the end lines of the location. This position is urged with great persistence by one of the counsel of the defendant.

The second section of the act of 1866, upon the provisions of which this position is based provides: "That whenever any person or association of persons claims a vein or lode of quartz, or other rock in place, bearing gold, silver, cinnabar or copper, having previously occupied and improved the same according to local custom or rules of miners in the district where the same is situated, and having expended, in actual labor and improvements thereon, an amount of not less than one thousand dollars, and in regard to whose possession there is no controversy or opposing claim, it shall and may be lawful for said claimant, or association of claimants, to file in the local land-office a diagram of the same, so extended, laterally or otherwise, as to conform to the local laws, customs and rules of miners, and to enter such tract and receive a patent therefor, granting such mine, together with the right to follow such vein or lode, with its dips, angles and variations, to any depth, although it may enter the land adjoining, which land adjoining shall be sold subject to this condition." It will be seen by this section that to entitle a party to a patent, his claim must have been occupied and improved according to the local customs or rules of miners of the district, and that his diagram of the same, filed in the land-office, in its extension, laterally or otherwise, must be in conformity with them. The rules of the miners in the Eureka Mining District, adopted in 1865—Laws of the District, as they are termed by the miners—provided that claims of mining ground should be made by posting a written notice on the claimant's ledge, defining its boundaries if possible; that each claim should consist of two hundred feet on the ledge, but claimants might consolidate their claims by locating in a common name, so that in the aggregate no more ground was claimed than two hundred feet for each name, and that each locator should be entitled to all dips, spurs and angles connecting with his ledge; and that a record of all claims should be made within ten days from the date of location. The rules also allowed claimants to hold one hundred feet each side of the ledge for mining and building purposes, but declared that they should not be entitled to any other ledge within this surface. It will be perceived by these rules that they had reference entirely to locations of claims on ledges. It would seem that the miners of the district then supposed that the mineral in the district was only found in veins or ledges, and not in isolated deposits. In February, 1869, new rules were added to those previously passed, authorizing the location of such deposits. These new rules provided that each deposit claim should consist of one hundred feet square, and that the location should take all the mineral within the ground to any depth. In September, 1869, under these rules, square locations and linear locations were made by parties through whom the defendant derives title on what is called the Richmond ledge, and linear locations were made on what is called the Tip Top ledge, with surface locations for mining purposes, both parties claiming with their locations all dips, spurs and angles. It is only of the linear locations we have occasion to speak; it is under them that the defendants assert title to the premises in controversy.

Now, as neither the rules of miners in Eureka Mining District nor the act of 1866, in terms, speak of end lines to locations made on ledges nor, in terms impose any limitation upon miners following these veins wherever they may lead, it is contended that no such limitation can be considered as having existed and be enforced against the defendant. The act of 1866, it is said, recognizes the right of the locator to follow his vein outside of any end lines drawn vertically down when it permits him to obtain a patent granting his mine, "together with the right to follow such vein or lode with its dips, angles and variations to any depth, although it may enter the land adjoining, which land adjoining shall be sold subject to this condition." It is true that end lines are not in terms named in the rules of the miners; but they are necessarily implied; and no reasonable construction can be given to them without such implication. What the miners meant by allowing a certain number of feet on a ledge was, that each locator might follow his vein for that distance on the course of the ledge, and to any depth within that distance. So much of the ledge he was permitted to hold for the working of his vein as could be measured in its width anywhere by the feet on the surface. If this were not so, he might by the bend of his vein hold under the surface, along the course of the ledge, double or treble the amount he could take on the surface. Indeed, instead of being limited by the number of feet prescribed by the rules, he might in some cases oust all his neighbors and take the whole ledge. No construction is permissible which would substantially defeat the limitation of quantity on a ledge, which was the most important provision in the whole system of rules. Similar rules have been adopted in numerous mining districts, and the construction thus given has been uniformly and everywhere followed. We are confident that no other construction has ever been adopted in any mining district in California or Nevada. And the construction is one which the law would require in the absence of any construction by miners. If, for instance, the State were to-day, to deed a block in the city of San Francisco to twenty persons, each to take twenty feet front, in a certain specified succession, each would have assigned to him, by the law, a section parallel with that of his neighbor of twenty feet in width cut through the block. No other mode of division would carry out the grant. The act of 1866 in no respect enlarges the right of the claimant beyond that which the rules of the mining district gave him. The patent which the act allows him to obtain does not authorize him to go outside of the end lines of his claim, drawn down vertically through the ledge or lode. It only authorizes him to follow his veins with its dips, angles and variations to any depth, although it may enter land adjoining; that is, land lying beyond the area included within his surface lines. It is land lying on the side of the claim, not on the ends of it, which may be entered. The land on the ends is reserved for other claimants to explore. It is true as stated by the defendant, that the surface land taken up in connection with a linear location on the ledge or lode is, under the act of 1866, intended solely for the convenient working of the mine, and does not measure the miner's right either to the linear feet upon its course, or to follow the dips, angles and variations of the vein, or control the direction he shall take. But the line of the location taken does measure the extent of the miner's right. That must be along the general course or strike, as it is termed, of the ledge or lode. Lines drawn vertically down at right angles, with a line representing this general course, at the ends of the claimant's line of location, will carve out, so to speak, a section of the ledge or lode within which he is permitted to work, and out of which he cannot pass.

As the act of 1866 requires the applicant for a patent to file in the local office a diagram of his claim, such diagram must necessarily present something more than the mere linear location. It is intended that it should embrace the surface claimed for the working of the mine. In this way the patent of the Richmond claim embraces three acres and a fraction of an acre of surface ground, and five hundred and a half linear feet on the lode. And the patent of the Tip Top embraces nearly four acres of surface ground and six hundred linear feet on the lode. The Act of 1872 preserves to the miner the right acquired under the Act of 1866, and confers upon him additional rights. Under the Act of 1866 he could only hold one lode, or vein, although more than one appeared within the lines of his surface location. The surface ground was allowed him for the convenient working of the lode or vein located, and for no other purpose. It conferred no right to any other lode or vein. But the Act of 1872 alters the law in this respect. It grants to him the exclusive right of possession to a quantity of surface ground, not exceeding a specified amount, and not only the particular lode or vein located, but all other veins, lodes, and ledges, the top or apex of which lies within the surface lines of his location, with the right to follow such veins, lodes or ledges to any depth. But these additional rights are granted subject to the limitation that in following the veins, lodes or ledges, the miner shall be confined to such portions thereof as lie between vertical planes drawn downward through the end lines of his location, and a further limitation upon his right in cases where two or more veins intersect or cross each other. The Act in terms annexes these conditions to the possession not only of claims subsequently located, but to the possession of those previously located. This fact, taken in connection with the reservation of all rights acquired under the Act of 1866, indicates that in the opinion of the Legislature, no change was made in the rights of previous locators by confining their claims within the end lines. The Act simply recognized a pre-existing rule, applied by miners to a single vein or lode of the locator, and made it applicable to all veins or lodes found within the surface lines.

Our opinion, therefore, is that both the defendant and the plaintiff, by virtue of their respective patents, whether issued upon locations under the Act of 1866, or under the Act of 1872, could only follow the veins or lodes lying within lines drawn vertically downward at the end of their respective locations, and that each took the ores found in all veins or lodes, the apex or top of which lay within those lines. The question of priority of location is, therefore, as already stated, of no practical importance in the case. This question can only be important where the lines of one patent overlap those of another patent. Here, neither plaintiff nor defendant could pass outside of the end lines of its own locations, whether they were made before or after those upon which the other party relies. And inasmuch as the ground in dispute lies within the end lines of the plaintiff's patented locations drawn vertically downward, our conclusion is that the ground is the property of the plaintiff, and that judgment must be for its possession in its favor. The same conclusion would be reached if we looked only to the agreement of the parties made on the sixteenth of June, 1873. At that time the plaintiff owned the patented claim called the Lookout claim, adjoining on the north the Richmond claim. The defendant had worked down from an incline in the Richmond and Tip Top into the ore under the surface lines of the Lookout patent. The plaintiff thereupon brought an action for the recovery of the ground and the ores taken from it. A compromise and settlement followed which are contained in an agreement of that date, and were carried out by an exchange of deeds. A map or plat was made showing the different claims held by the two parties. A line was drawn upon this map, on one side of which lay the Champion, the At Last and the Margaret claims, and on the other side lay the Richmond and the Lookout claims. By the agreement of the parties, the plaintiff, on the one hand, was to convey to the defendant the Lookout ground and also all the mining ground lying on the north-westerly side of the line designated, with the ores, precious metals, veins, lodes, ledges, deposits, dips, spurs, or angles, on, in or under the same, and to dismiss all pending actions against the defendant; and on the other hand, the defendant was to pay to the plaintiff the sum of eighty-five thousand dollars, and to convey with warranty against its own acts, all its right, title or interest in and to all the mining ground situated in the Eureka Mining District, on the south-easterly side of the designated line, and in and to all ores, precious metals, veins, lodes, ledges, deposits, dips, spurs or angles, on, in or under the same—"it being," says the agreement, "the object and intention of the said parties hereto to confine the workings of the party of the second part (the Richmond Mining Company) to the north-westerly side of the said line continued downward to the center of the earth, which line is hereby agreed upon as the permanent boundary line between the claims of the said parties."

The deeds executed between the parties the same day were in accordance with this agreement. The deed of the Richmond Mining Company to the plaintiff conveyed all the mining ground lying on the south-easterly side of the designated line, together with all the dips, spurs and angles, and also all the metals, ores, gold and silver-bearing quartz, rock and earth therein, and all the rights, privileges and franchises thereto incident, appendant and appurtenant, or therewith usually enjoyed. The line thus designated, extended down in a direct line along the dip of the lode, would cut the Potts chamber, and give the ground in dispute to the plaintiff. That it must be so extended necessarily follows from the character of some of the claims it divides. As the Richmond and the Champion were vein or lode claims, a line dividing them must be extended along the dip of the vein or lode, so far as that goes, or it will not constitute a boundary between them. All lines dividing claims upon veins or lodes necessarily divide all that the location on the surface carries, and would not serve as a boundary between them if such were not the case. The plaintiff would, therefore, be the owner of the ground in dispute by the deed of the defendant, even if it could not assert such ownership solely upon its patented locations. Our finding, therefore, is for the plaintiff, and judgment must be entered thereon in its favor for the possession of the premises in controversy.

The Shark Paymaster Case.—This is an action to determine the right of possession of certain mining ground in the Ward District, White Pine County. The plaintiff deraigns title from the location of a claim called the Shark, and the defendant is the grantee of the location of the Paymaster. Both claims were located on the same ledge—the Paymaster in July, the Shark in September—and the principal question in the case is as to the validity of the Paymaster location. The facts in regard to this location are very clearly and fully presented by the findings of the District Judge, which embrace the special verdict of a jury upon a number of issues submitted to its decision. No exception whatever is taken by either party to the findings of the jury, and the objections of the appellant to the additional findings of the Court relate rather to the conclusions of law involved than to the facts on which they are based. The question before us is therefore narrowed down to a construction of the legislation of Congress and the local rules of the Ward District governing the location of mining claims. Before entering upon a discussion of the purely legal questions involved in the case, however, it will be best to give a connected statement of the facts, which are as follows:—Mineral deposits were first discovered in what is now the Ward Mining District by Thomas F. Ward, in March, 1872. On the first of May the district was organized, a set of local rules adopted, and (it seems) Ward appointed Recorder. The rules so first adopted were, in their general features, like the rules everywhere prevalent on this coast before the enactment of the Law of Congress of May 10, 1872. Claims were to be located by posting a notice at the point of discovery; the notice to be recorded in fifteen days; this to hold the claim good for one hundred days, within which time a certain amount of work was to be done on the ground in order to hold the claim a year. Each locator was to have fifty feet of the surface on each side of his ledge or vein, but this not to carry the right to any mineral deposit therein distinct from the one located. These rules, so far as they were not inconsistent with the Act of Congress of May 10, 1872, continued in force till the first of October, following, when the miners adopted a new set of rules. Such being the law of the district for the location and holding of claims, Ward, on the seventeenth of July, 1872, discovered the vein or ledge which is now in controversy, and placed upon the croppings at the discovery point the following notice:

"Paymaster location notice.—We, the undersigned, do hereby locate and claim fifteen hundred (1500) feet on this ledge, lode, or deposit of mineral-bearing quartz or rock, with all its dips, spurs, angles and variations, together with all privileges prescribed by the mining laws of the United States and this district, and intend to hold and work the same accordingly. We claim three hundred (300) feet easterly, and twelve hundred (1200) feet westerly, from this monument, running along the course of the vein. This shall be known as the Paymaster.

"Ward Mining District, July 17, 1872, situated about fifteen hundred feet north-west by north, from Mountain Pride lode."

To this notice were appended the names of the locators, and opposite the name of each were set the number of feet (undivided) to which he was to be entitled.

On the following day, July 18, the claim was recorded by Ward, as Mining Recorder of the district, by copying into a small memorandum book, which he carried in his pocket, and which at that time constituted the record book of the district. Subsequently, about the first of August, a larger book was obtained, and the records transcribed from the little book. In the meantime, however, the Paymaster notice, and the record of it, had been changed as follows: It seems that there was some sort of an agreement subsisting between Ward, John Henry, E. C. Hardy, and three others, that they should be equally interested in the locations made by Ward, but in the location of the Paymaster, Ward had omitted Hardy's name, and inserted that of Dave Pierson, who was not a member of the company. A few days after the location and recording of the claim, Henry called Ward's attention to the fact that Pearson's name was improperly on the notice, and Hardy's name improperly omitted. He also objected to the unequal distribution of the claim among the six locators. Ward thereupon changed the notice on the ground, and the record in the little book, by erasing the name of Pearson, and substituting the name of Hardy, and by changing the figures following the names, so as to give to each locator two hundred and fifty feet of the claim. These changes in the notice and in the little book were made before the transcription to the large book, which since the first of August, 1872, has contained the records of the Ward District.

Subsequent developments have shown that the vein or ledge upon which this Paymaster claim was located has a course or strike from south-east to north-west. According to the magnetic meridian (variation 16½°) it runs more nearly east and west. In September, 1872, some work—it does not appear how much—had been done on the Paymaster location, but the course of the vein was not clearly determined. Such being the condition of that claim, on the ninth of September the locator of the Shark discovered the croppings of the same vein at a point about four hundred feet north-west of the location point of the Paymaster, and posted the following notice:

"Shark mine No. 1. Notice:—We, the undersigned, do hereby locate and claim fifteen hundred (1,500) feet on this ledge, lode or deposit of mineral-bearing quartz and rock, with all its dips, spurs, angles and variations, together with all privileges prescribed by the mining laws of the United States and this district, and intend to hold and work the same accordingly. We claim seven hundred and fifty feet on each side of the monument running along the course of the vein. This shall be known as the Shark mine No. 1.

"Ward Mining District, Nye County, Nevada, September 9, 1872.

"JOHN TAYLOR, 375 feet.
"THOMAS CONNOR, 375 feet.
"MATHEW GLEESON, 375 feet.
"CHAS. STRUTENBERGER, 375 feet."

On the following day this notice was recorded, the certificate to the record being as follows:

"Recorded September 10, 1872, at 10 o'clock, A. M. Situated about 600 feet north-easterly from Young American mine, and about 300 feet north-westerly from Paymaster mine.

"THOS. F. WARD, Recorder."

Some significance is attributed to the fact that Ward, the locator of Paymaster, going upon the ground for the purpose of making this record, and necessarily observing the proximity of the Shark to the Paymaster, made no complaint at the time that the Shark locators were on his claim It was not until October, and after some work had been done by the locators of the Shark, that notice was given that they were on the Paymaster vein. They, however, denied that it was the same vein. They claimed a cross vein, and declared that if it turned out that they were on the Paymaster they would give it up. About this time—on October 10th, 1872—John Henry, one of the Paymaster locators, took down their notice and put up another, the same in all respects as the one removed except that it claimed three hundred feet southerly and one thousand two hundred feet northerly from the monument, instead of three hundred feet easterly and one thousand two hundred feet westerly. On the same day he drove down two stakes, one at the north-west end of the Paymaster and the other at the south-east end. They were marked "North-westerly stake of Paymaster" and "South-easterly stake of Paymaster." These stakes were on a line, or very nearly on a line, with the croppings of the vein as now developed, and within a few feet of the center line of claim as now surveyed. At some time subsequent to the change of the notice on the mine, a corresponding change was made in the record of the claim by erasing the words easterly and westerly, and inserting the words southerly and northerly. The jury could not find who made this change in the record, but the District Judge was of the opinion, and so are we, that it was done by Ward and Henry, but without any fraudulent intent. In the meantime, on the first of October, the laws of the district had been changed so as to conform more nearly to the Act of Congress of May 10th, 1872, it being especially provided that locators should have three hundred feet of surface ground on each side of their vein—to include, of course, not only the vein originally located but all veins within the surface lines. (R. S., Sec. 2322.) It is found as a fact that sufficient work has been done under each of these locations to satisfy the requirements of the law of Congress and the rules of the district. The Paymaster location was never marked upon the ground in any other way than by the three stakes on the line of the croppings—one at each end and one at the point of discovery—until it was surveyed for the purpose of the patent application in October, 1875. The Shark location was never marked on the ground in any way, except by the monument at its initial point, until April, 1874, when Gleeson set stakes at the four corners of the surface claim. On these facts the District Judge concluded that the Paymaster location was valid, and, as a consequence, that the subsequent location of the Shark on the same ground was invalid. In accordance with this conclusion, the judgment of the District Court was for the defendant. The plaintiff, appealing from the judgment and from the order denying her motion for a new trial, makes a number of assignments of error, which, however, are all involved in the three propositions following: It is contended:

1. That the Paymaster claim was not located in conformity with the Act of Congress and the rules of the district, and consequently that it was void;

2. That the Paymaster locators, if they ever had a good claim, abandoned it; and,

3. That they are stopped by their own acts from asserting any claim adverse to the Shark.

Keeping these propositions entirely distinct, and confining our attention for the present to the first, it is to be observed that there is no question that the locators of the Paymaster were the original discoverers of the ledge in controversy; that they made a *bona fide* attempt to locate it; that their claim was notorious; that they and their successors have continued to occupy and develop the property; that the Shark locators were aware of the priority of the Paymaster claim, and originally repudiated any intention of locating upon the same vein. These facts being conceded, the only position open to the appellant, and the only position her counsel have attempted to maintain, is, that a mining claim cannot be held except by compliance with certain requirements of the mining laws; that the Paymaster locators did not conform to those requirements, while the locators of the Shark did, and that, as a necessary consequence, the law gives her the property. Aside from the questions of abandonment and estoppel, she claims nothing except from a strict application of the law, regardless of any seeming hardship in depriving the defendant of a mine which its predecessors were the first to discover, claim and develop. There can be no doubt as to the correctness of the position upon which the claim is founded. The United States have granted to their citizens, and to those who have declared their intention to become such, the right to explore and occupy the public mineral lands (U. S. Revised Statutes, sec. 2319). Those qualified locators who comply with the laws of the United States, and the local regulations not in conflict therewith, governing their possessory title, have the exclusive right of possession and enjoyment of their locations: (R. S. 2322.) He who complies with the law has the exclusive right. Therefore, if it is true that the Shark locators complied, and those of the Paymaster did not, the plaintiff must take the mine, no matter who is entitled to the credit of the discovery. What, then, constitutes compliance? The questions involved in this branch of the case have led to a very thorough and elaborate discussion of the mining laws of the United States, and particularly of the Act of Congress of May 10, 1872 (R. S., Sec. 2319 *et seq.*), under which these claims were located, and which embodies the most important features of the mining legislation. The same questions were, to some extent, involved in the case of the Golden Fleece Company *v.* The Cable Consolidated Company (12 Nev. 312), but were not very fully argued, and were discussed in the opinion only so far as seemed to be necessary for the disposition of that case. Some of the conclusions then announced have been questioned by counsel for respondent in this, but after a thorough re-examination of the whole subject, with all the light that has been thrown upon it by the most elaborate argument, oral and written, we remain entirely satisfied with that opinion. So far as it goes, it is a correct exposition of our present understanding of the law. But it does not cover the whole ground and is perhaps not sufficiently explicit upon some of the points adverted to. The magnitude of this case, and the great importance of the subject to a mining community warrant a restatement of our views in a more complete, and we hope, a more convincing form. One of the imperative requirements of the statute, an indispensable condition precedent of a valid location, is that it shall be "distinctly marked on the ground, so that its boundaries can be readily traced (R. S., Sec. 2324)." By reference to the foregoing statement of facts, it will be seen that one of the locators of the Shark, in April, 1874, marked the boundaries of that location by setting stakes at the four corners of the claim. It is conceded that this was a sufficient marking of that location; but it is contended that the Paymaster had been sufficiently marked since October 10, 1872, by means of two stakes at the ends of the claim on the line of the croppings and by the location monument at the point of discovery. Whether this marking was sufficient to answer the requirements of the statute is the principal question in the case, and as a step towards its solution, counsel have devoted a great portion of their argument to the preliminary question, What does a mining claim consist of; what are its essentials, what are its incidents? Is it the surface ground that is located, or is it the vein with the surface as an incident? It is conceived that a determination of this point will greatly facilitate the inquiry as to what sort of marking of boundaries is required. Counsel for appellant contended that the location is of the surface, and stakes at the corners of the claim are essential. Counsel for respondent insists that the location is of the vein as the principal thing, with the surface as a mere incident, and that stakes to define the limits of the claim upon the vein are sufficient.

What we have said in the Golden Fleece case we think expresses the truth in regard to this matter: "It is true that the vein is the principal thing, and that the surface is but an incident thereto; but it is also true that the mining law has provided no means of locating a vein except by defining a surface claim, including the croppings or point at which the vein is exposed, and the part of the vein located is determined by reference to the lines of the surface claim." (12 Nev. 329.) The vein is the principal thing in the sense that it is for the sake of the vein that the location is made; the surface is of no value without it; no location can be made until a vein has been discovered within its limits, and the surface must or at least ought to be located in conformity with the course of the vein. (R. S. 2320.) But the location is of a piece of land including the vein. "A mining claim located after the 10th day of May, 1872, whether located by one or more persons, may equal, but shall not exceed, fifteen hundred feet in length along the vein or lode; but no location of a mining claim shall be until the discovery of the vein or lode within the limits of the claim located. No claim shall extend more than three hundred feet on each side of the middle of the vein at the surface, nor shall any claim be limited by any mining regulation to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the 10th day of May, 1872, render such limitation necessary. The end lines of each claim shall be parallel to each other." (R. S. 2320.) This section alone shows that it is a surface parallelogram not less than fifty feet in width that must be located. But the purpose of the law is more clearly indicated by its granting clauses. What is it that locators have the exclusive right to possess? Having complied with the laws they shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes or ledges may so far depart from a perpendicular in their course downward as to extend outside of the vertical side-lines of such surface locations. (R. S. 2322.) This is the only part of the Act which grants the right to possess any lode, ledge or vein.

The vein originally discovered, and for the sake of which the location is made, is lumped in with other mineral deposits that may happen to exist within the limits of the surface claim, and no part of it is granted except that part the top or apex of which lies inside of the surface lines extended downward vertically. This, it would seem, ought to be conclusive, but the language of section two thousand three hundred and twenty-five is, if possible, still more convincing: "Section 2325. A patent for any land claimed and located for valuable deposits, may be obtained in the following manner: Any person, association, or corporation authorized to locate a claim under this chapter, having claimed and located a piece of land for such purposes," may, by taking the prescribed steps, obtain the title upon the payment of five dollars per acre for the land. Thus it appears that a location on a vein must be made by taking up "a piece of land" to include it. No other means are provided, and it is only upon condition of complying with the law that the locator becomes entitled to anything. The discoverer of a vein may be allowed a reasonable time to trace its course, before being compelled to define his surface claim, and in the meantime may be protected in his claim to one thousand five hundred feet of the vein, but his location will never be complete until his surface claim is defined. That this is the only possible construction of the statute, seems so plain to our minds that we should have thought it superfluous to say a word in defense of our view if we were not aware that an opposite opinion is very largely prevalent.

We think this due to the fact that the custom of locating a vein claim by means of a notice posted on the croppings, and of holding it by record of the notice and work done at the discovery point, without any definition of boundaries, has prevailed so long and so universally on the Pacific Coast that the system has come to be regarded by a great many as something essentially inherent in the nature of things. The right, under such locations, to follow the vein in whatever direction it might run, to the extent claimed in the location notice, taking the adjacent surface necessary for the convenient working of the mine as a mere incident thereto, has been so long recognized and enjoyed as to have almost assumed the character of one of the natural and inalienable rights of man. That the Government, in disposing of its mineral lands, has adopted a radically different system, under which a vein can only be located by means of a surface claim, and held only to the extent that it is included within the surface lines, is a thing too incredible to be believed by those to whom the old customs seemed rooted in the very foundations of justice. But disagreeable as the awakening may be, it is time we were opening our eyes to the fact that a new system has been introduced. The Act of Congress of May 10, 1872, has effected the changes above indicated. Its language is plain, unambiguous; and whatever may be our opinion of the impolicy of the changes effected by it, we are bound to submit and conform ourselves to its requirements. If the terms of the statute left any room for construction, the *argumentum ab inconvenienti* might be entitled to great weight, but it cannot be revoked where the language of the law is so plain as it is in this instance. Besides, we do not share in the opinion that the new system is so utterly bad. Nobody can pretend that it is a great improvement on the system which it displaced. We are willing to admit that cases may arise to which it will be difficult to apply the law, but this only proves that such cases escaped the foresight of Congress, or that, although they foresaw the possibility of such cases occurring, they considered that possibility so remote as not to afford a reason for departing from the simplicity of the plan they chose to adopt. So far, the wisdom of the Congressional plan has been sufficiently vindicated by experience. It is true that veins and ledges are not found to be perfectly regular in their formation—they have not a perfectly straight course even in depth—and near the surface they present still greater irregularities of strike and dip; but still they approximate the ideal vein that Congress seems to have had in view sufficiently nearly to admit an easy application of the law in all cases of conflicting claims that have fallen under their observation. As to the difficulty of establishing surface lines immediately upon the discovery of a vein; that also is conceded. It is a well known fact that the croppings of a vein are always very imperfect and often a very deceptive guide to its course; and it will often be difficult and sometimes impossible to locate a surface claim in conformity with the course of the vein, even after years spent in its development. But all this affords no argument against the system. Unless the miners voluntarily restrict themselves by local regulations, a claim may always be fifteen hundred feet long by six hundred feet wide. Let the discoverer of a vein be ever so unfortunate in locating his claim, he cannot possibly get less than six hundred feet of the vein, while under the old law the most he could get was four hundred feet. How then can it be said that he is subjected to any hardships? So far from restricting his rights, the new law has very greatly enlarged them, and at the same time has made them vastly more certain and secure. Furthermore, we do not understand that the law requires the surface claim to be defined immediately upon the discovery of the vein. We think that under any circumstances the discoverer, if he went to work diligently to trace out its course, would be allowed a reasonable time for that purpose, and in the meantime would be protected in his right to one thousand five hundred feet of the vein. In the absence of any State or Territorial or local regulation prescribing the time to be allowed for tracing, the question as to what should be deemed a reasonable time would have to be determined in view of the facts and circumstances of each case. We said, however, in the Golden Fleece case (12 Nev. 329), and we still think that this is a matter for local regulation under the power delegated to the miners by section 2,324 of the Revised Statutes, to make rules not in conflict with the laws. Any reasonable rule for the provisional holding of a claim, by means of the posting and recording of notice, during the time necessary for tracing would, we feel confident, be favorably viewed by the courts, especially if it required the locator to use diligence in the work of tracing during the time allowed for that purpose. This, however, is a question which we are not called upon to decide in this case. We have been led into this line of argument in response to what has been said by counsel for respondent in regard to the great hardship imposed upon the discoverer of a vein by compelling him to define his surface claim before he could possibly ascertain the course of the vein. If we are right in our opinion that he would be allowed a reasonable time for tracing, the supposed hardship does not exist. If we are wrong, and if the discoverer must set his stakes without stopping to trace the vein, even then, as we have shown, he is better off since than he was before the statute. His surface lines will necessarily include at least six hundred feet of the vein, and may include upward of one thousand six hundred. In the latter case he may be compelled to readjust his lines so as to take only one thousand five hundred feet, but in any case he can secure six hundred feet. Before the statute he could claim no more than four hundred feet of the vein, and of that he was not secure for a day. The moment he developed rich ore he was beset by trespassers, and in order to enjoin them from stealing his property, was obliged to trace the vein between them and the location point. He was harassed with litigation, and his means often entirely consumed in the prosecution of work not necessary for the development of his mine, but essential for the vindication of his title. Under the new law this source of vexation and expense is entirely swept away. Within his surface lines the discoverer of a vein is secure, and he might well consent to sacrifice something in the extent of his claim for the sake of that security.

So far, however, from having to make such a sacrifice, his claim, at the very worst, is more ample than it ever was before. Sound policy, therefore, concurs with the language of the statute in sustaining our conclusion that a vein can only be located by means of a service claim. How soon after the discovery of the vein "the location must be distinctly marked on the ground so that its boundaries can be readily traced" (R. S. 2324), we do not decide; but until it is so marked we are clear that the location is not complete, and the law has not been complied with. So far we agree entirely with the views of counsel for appellant; but, although we are satisfied that a location must be of a surface claim, and that the boundaries and extent of the claim must be clearly defined by stakes or marks on the ground, it does not appear to be a necessary consequence that the least admissible markings is by posts or monuments at all the corners of the claim. We are aware that the Commissioner of the Land Office has recommended the planting of posts at the corners, and the erection of a signboard with the name of the claim, the names of the locators, etc., at the location point; and undoubtedly a compliance with these recommendations would be sufficient to satisfy the law in this particular. But at the same time we think it may be satisfied by something less. There is, after all, something in the fact that it is a mining claim, and not an agricultural claim that is being located: and some account should be taken of the customs, habits and circumstances of a mining community in determining what is a sufficient marking of a mining claim. The vein is always the principal object that the locator has in view; it is generally, after location and work at the location point, a conspicuous feature of the locality; it is the first thing that attracts the attention of mining men; the surface claim by which it is to be located ought to conform to its course; the end lines must be parallel; and, as they ought to conform to the dip of the ledge as nearly as practicable, they ought to be at right angles to the side lines, so that if the centre-line of the claim is once established, the boundaries are thereby fixed, and may be readily traced. The object of the law in requiring the location to be marked on the ground is to fix the claim—to prevent floating or swinging—so that those who in good faith are looking for unoccupied ground in the vicinity of previous locations may be enabled to ascertain exactly what has been appropriated in order to make their locations on the residue. We concede that the provisions of the law designed for the attainment of this object are most important and beneficent, and that they ought not to be frittered away by construction. But it must be remembered that the law does not in express terms require the boundaries to be marked. It requires the location to be so marked that its boundaries can be readily traced. Stakes at the corners do not mark the boundaries; they are only a means by which the boundaries may be traced. Why not, then, allow the same efficacy to the marking of a center line in a district where the extent of a claim on each side of the center line is established by the local rules? It would be safer, and therefore better, to comply with the recommendations of the Land-office and erect stakes at the corners of the claim, but if the grand object of the law is attained by the marking of a center line we can see no reason why it should not be allowed to be sufficient.

In this case the locators of the Paymaster marked the center line of their claim on the tenth of October, 1872. No miner, no man of common intelligence, acquainted with the customs of the country, could have gone on the ground and seen the monument, notice and work at the discovery point and the two stakes—one three hundred feet south-east of the location monument, marked "Southeasterly stake of Paymaster," the other twelve hundred feet north-west of the location monument and marked "Northwesterly stake of Paymaster"—in a line with the croppings and the discovery point, without seeing at a glance that they marked the center line of the claim. By the rules of the district and the laws of the land he would have been informed that the boundaries of the claim were formed by lines parallel to the center line and three hundred feet distant therefrom and by end lines at right angles thereto. With this knowledge he could have traced the boundaries and, if such was his wish, ascertained exactly where he could locate with safety. We conclude, therefore, that the Paymaster location was sufficiently marked on October 10, 1872. At that time the Shark location had not been marked in any way, and whether the law allows a locator a reasonable time or not to mark his boundaries—protecting his full claim in the meanwhile—the same result equally follows. If the Paymaster was not marked within a reasonable time after discovery, then certainly the Shark was not, for the first was marked within three months and the latter not until more than eighteen months after discovery; so that the Shark claim was lost by the failure to mark its location within a reasonable time, and such time is allowed, then the Shark was thereby excluded. If no time for tracing is allowed, and the first to mark his boundaries is first in right, then the Paymaster location holds the claim, because it was first defined by monuments on the ground. Unless the Paymaster location failed in some other particular to comply with the law, there is no hypothesis upon which anything can be claimed under the Shark location. But it is contended that the Paymaster location was rendered invalid by non-compliance with the rules of the district and the law of Congress respecting the notice and record of claims. There is no doubt that in order to secure the right of possession to a mining claim there must be a compliance not only with the laws of the United States, but also with such local regulations of the mining district as are not in conflict therewith (R. S. 2324), and if the miners of the Ward District have made the posting and recording of location notices essential, the courts are not at liberty to dispense with them. The original laws of the district were adopted May 1, 1872, ten days prior to the passage of the Act of Congress, which, as we have seen, introduced an entirely new system of making locations—a system in which the preliminary posting and recording of notices is entirely out of place, except as a means of protecting a claim during the time necessary for tracing the ledge and marking the boundaries of the location. When the location is thus marked, all that the notice and record were intended or expected to accomplish is effected in a manner far more satisfactory and complete. In place of a very imperfect, and often misleading notice of what was claimed, there is a plain and unambiguous notice to all the world of the exact position and extent of the location. It might well have been held, therefore, with respect to the rules adopted May 1, 1872, that their requirements as to the posting and recording of notices were superseded by the Act of Congress of May 10, 1872; that they were merged in the higher and more efficacious rule of the statute, or, at least, that if they continued of any force whatever, it was only as a means of protecting a vein discovery during the time reasonably necessary for tracing its course and marking the boundaries of the location, and consequently that if the discoverer chose to mark his location in the beginning, or actually did so at any time before an adverse claim was made, his failure to post and record a notice would count for nothing.

But the rules of the district were revised on the first of October, after the passage of the Act of Congress, and the provisions with respect to the notice and record of claims were readopted without any additional provision for bringing them into sensible relation to the law. They do not purport to supply a means of holding a claim pending the marking of the location on the ground, but stand as substantive and independent requirements, a compliance with which is essential to the validity of a claim. We are not willing, under the circumstances, to go to the extent of holding that their observance can be dispensed with, even where a location has been plainly marked before the making of an adverse claim. We will assume that it was necessary for the locators of the Paymaster not only to have marked their location before the Shark locators complied with the law, but also to have posted and recorded a notice of the claim. Did they do so? There can be no question that the original Paymaster notice was all that the law requires. The only objection to it is that it did not contain in itself a description of the claim by reference to some natural object or permanent monument. It was necessary that it should. It is only the record of the claim that is required to contain such a description; and there are excellent reasons for making a distinction between the notice and the record in this particular. A notice is generally, and for safety ought always to be, posted immediately upon the discovery of the vein, before there is any time to survey the ground, and ascertain the bearings and distances of natural objects or permanent monuments in the neighborhood; and besides, the claim referred to by the notice is always sufficiently identified by the fact that it is posted on or in immediate proximity to the croppings. A notice claiming a location on "this vein" has only one meaning. But the notice is exposed to the danger of removal by adverse claimants, or destruction by the elements, and for permanent evidence of the location its record is provided for. The record, if it consisted of a mere copy of the notice would not identify the claim, and there would be an opportunity as well as a temptation to the locators, upon the discovery of a more valuable mine in the vicinity, to prove, by perjured witnesses, that their notice was posted on that mine. The floating of claims was by no means an infrequent occurrence prior to the act of 1872, and if such attempts were seldom completely successful, they were always vexatious, and often the means of levying a heavy blackmail. It was on this account that the record (not the notice), was required to contain "such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim." (R. S., Sec. 2324). It is a sufficient compliance with this provision of the law if the description of the *locus* of the claim is appended to the notice when it is recorded. But by reference to the foregoing statement of facts it will be seen, that not only did the record of the Paymaster location contain the necessary description, it was also contained in the body of the notice as posted on the ground: "Situated about fifteen hundred feet north-west by north of the 'Mountain Pride lode,'" is the description in the notice; and as no objection to it was made upon the ground that the "Mountain Pride lode" was not a well-known natural object, at that distance, and in that direction from the Paymaster location monument, we presume it was, in fact, a good description. The record also contained the names of the locators and the date of the location, and thus fulfilled every requirement of the Act of Congress. (R. S., Sec. 2324.) But it was changed by Ward and Henry, and it is contended that after those changes it was no longer a good record.

The argument in support of this point is about as follows; Pearson, whose name was in the original notice, as first recorded in the little book, was one of the locators of the claim; he had a vested right, and could not be deprived of his interest by the erasure of his name from the notice and record, and consequently after his name was scratched out, the record no longer contained the names of the locators, and was void. We do not think it is by any means clear that Pearson ever acquired any interest in the claim. It does not appear that he ever assented to the use of his name as a locator by Ward, who actually made the discovery and posted and recorded the notice, and it does appear that there was some sort of arrangement by which Ward was to divide his discoveries equally among those whose names were afterwards signed to the notice. If Pearson had no right to a share in the discovery, and if Ward merely inserted his name by mistake or under some misapprehension, and erased it before the claim had been perfected by work or the marking of its boundaries, it is difficult to see upon what ground he could claim to have ever had any vested right as a locator. But whether he had or not is a question between him and the other locators of the Paymaster. As to outsiders, the notice and record were sufficient. They contained the names of those who claimed to be the locators, and served every purpose of the law—that is, they identified the claimants and the claim.

The subsequent alteration of the notice by changing the words westerly and easterly to northerly and southerly had no effect on the rights of the parties. The only purpose of those words was to show in which direction from the discovery point the claim extended one thousand two hundred feet, and in which direction its extent was only three hundred feet. Either set of words served the purpose equally well. No doubt when the vein was first discovered, its course seemed to be east and west; after a certain amount of development, it seemed to run north and south; and the notice was changed for the perfectly innocent and even laudable purpose of giving to all whom it might concern a better description of the claim. The corresponding alteration in the record was made with the same motive—at least the court finds that it was done without any fraudulent intent; and certaintly it was wholly immaterial. There was no swinging of the location effected by this change in the notice and record. The claim was never fixed until the stakes were set; and so far as the notice was concerned, it claimed one thousand five hundred feet of the vein, no matter where it might run. If it was good for anything it was good for what it claimed, pending the marking of the location. The changes and erasures in the record were certainly irregular; and if they had been material, or if they had not been satisfactorily explained, might have afforded good grounds for excluding it from evidence.

But they were satisfactorily explained. They were not designed to defraud any one, and had no such effect. We think that the comments of the District Judge on this matter are very just. Mining recorders are a class of officials that must be treated with a great deal of forbearance and indulgence. They are often entirely ignorant of legal forms, and have no appreciation of the horror with which an ordinary lawyer views the erasure or alteration of records and other documents. Where no fraud or deception is intended, their blunders are not to be construed into crimes.

This disposes of the first proposition of the appellant. The second and third are entirely without merit, and as they relate to well-settled doctrines of the law, they will be briefly adverted to. There is not the slightest evidence of an intention on the part of the Paymaster location to abandon their claim. The act of Henry in changing the language of the notice on the 10th of October, 1872, proves only that he had abondoned the opinion that the course of the ledge was east and west. So far from proving an intention to abandon a foot of his claim on the ledge, it proves exactly the reverse.

Nor do the facts present a single element of estoppel.

Each party had exactly the same means of information. When the Shark location was made, it was as much the business of its locators to know whether it was on the Paymaster vein, as it was of Ward, the recorder. The truth probably is, that no one at that time thought the two claims would conflict. It is idle, therefore, to say that any culpable silence on the part of Ward caused the expenditure of labor and money on the Shark. If the locators of that claim were deceived, it was their fault and they must suffer the consequences.

As to the change in the Paymaster's notice from east and west to north and south, that was, as we have seen, wholly immaterial. The simultaneous setting of the stakes entirely superseded the calls of the notice, and was the first thing that ever fixed the boundaries of the claim. If after that the Shark locators continued at work, they did so with their eyes wide open, as they did everything else from the beginning to the end of their attempts to locate the ground. From the outset they had the same opportunities to know the truth that the other party had. If they have any better claim to the property than the defendant, it is not because they were deceived or misled, but only because they can show a technical compliance with the law, while their adversaries cannot. It is upon this ground alone that their case has any semblance of strength, and upon this ground we think it entirely fails. The judgment and order appealed from ought to be affirmed, and it is so ordered.

Beatty, J.

I concur: Leonard, J.

Since the foregoing opinion was written two cases (Gelsich *v.* Moriarty et. al., and Holland et. al. *v.* Mount Auburn G. Q. Mining Company) have been decided by the Supreme Court of California, in both of which it is assumed, as a point beyond question, that the marking of a mining location on the ground so that its boundaries can be readily traced is absolutely essential to the validity of the claim. This is in perfect accordance with our own views, as above expressed. But in the latter of these cases it seems also to be held that the marking of the centre line of the claim is not sufficient to satisfy the requirements of the law. The opinion of the Court is very brief, and no reasons are assigned for the conclusions reached. We have however, been led by that decision to thoroughly reconsider our own opinion on this point and the arguments of counsel *pro* and *con.* The result is that we are satisfied of the correctness of our first conclusion. A mining claim consists of a certain breadth of surface, to be laid off on each side of the line of the croppings, with the mineral deposits included therein. The centre line, as a matter of course, is to be a straight line conforming to the general strike of the vein, as nearly as that can be ascertained. The side lines are to be parallel to the centre line, and if, as we assume to be the proper construction of the law, the end lines must be parallel and conform to the dip of the vein, which is at right angles to its strike, it follows, with the conclusiveness of a mathematical demonstration that when the centre line is once definitely fixed the boundary lines can be traced (that is, followed out) with absolute certainty. It may be that they could not be traced as easily and readily as if stakes were set at the corners, but the difference would be very slight and of no practical consequence. In any case, we think that the law should receive as liberal and beneficial a construction as is consistent with the object which Congress undoubtedly had in view in passing it. That object, we are satisfied, was not to save intending locators a slight amount of labor in tracing older claims, but it was to make the boundaries of such older claims certain and immovable; to put an end forever to the shifting and floating of claims; to do away with an existing and intolerable evil. The whole object of the law is accomplished whenever, from the monuments on the ground, the boundaries of a mining claim can be traced with absolute certainty and without any practical difficulty, and for that purpose a definitely fixed centre line is sufficient.

Beatty, J.

I concur: Leonard, J.

By Hawley, C. J., Concurring.—I concur in the conclusions reached by the Court, that the judgment of the District Court ought to be affirmed; but I am unwilling to give an unqualified approval of the construction given to the mining laws of the United States.

If I entertained the opinion, as expressed by the Court, that "it is a surface parallelogram not less than fifty feet in width that must be located;" that the location on a vein "must be made by taking up a piece of land to include it;" that a vein can "only be located by means of a surface claim, and held only to the extent that it is included in the surface lines," and if—upon these points—I agreed "entirely with the views of counsel for appellant, I should be inclined to agree with their conclusions that it is the surface location that "must be distinctly marked on the ground so that its boundaries can be distinctly traced."

But I do not believe that it was the intention of Congress, by the passage of the several Acts referred to in the opinion of the Court, to produce an entire revolution in the system of locating mining claims. Some very important changes have been made and the rights of the locators have been enlarged and made more specific; but, in my judgment, it is—as it was under the old system—the vein of quartz, the lode, that is the principal thing constituting the location. The surface ground is but an incident thereto. The location of such a mining claim is distinctly marked on the ground so that its boundaries can be readily traced, by the placing of stakes along the lode and at the ends of the location, or by such other monuments or marks as will clearly designate the number of feet in length and the particular lode located. In my judgment, the location need not, necessarily, be the making up of "a piece of land" in the form of a parallelogram. When the vein or lode is sufficiently identified and marked, as above stated, the laws of the local district fix the number of feet in width—of the surface ground—to which the locator is entitled. It being, of course, understood that "no claim shall extend more than three hundred feet on each side of the middle of the vein at the surface, nor shall any claim be limited by any mining regulation to less than twenty-five feet on each side of the middle of the vein at the surface."

I differ with the court upon another point discussed in the opinion. I think that after the vein or lode is properly located the locator thereof has the right to fifteen hundred feet along the course of the lode, "in whatever direction it runs, irrespective of the vertical side lines of the surface boundaries" (dissenting opinion, Golden Fleece *v.* Cable Consolidated, 12 Nev., 331), and that he would only be entitled to fifteen hundred feet in length, although the vein took such a course as to embraee more than fifteen hundred feet within the ends lines of his surface location.

HAWLEY, C. J.

Other Decisions.—The following are taken from Carpenter's Mining Code:

David C. Patterson vs. Hiram Hitchcock. Bull of the Woods—American Case. 3 Colorado Reports, 533.

Opinion by Elbert, J.

Error is assigned upon the refusal of the court below to give the following instruction: "It is essential to a mining claim that it should be made upon the line of a lode; and it is therefore incumbent on the defendant, in making out his defense, to show that the vein of the American mine runs into or through the ground in controversy. If he has offered no testimony to show that the vein of the American lode enters, or passes across the territory of the Bull of the Woods location, and there are no other proofs in the case from which you can find that fact, the defendant must fail, and the plaintiff would be entitled to a verdict." Error is also assigned on the refusal of the court to admit evidence to show that the American lode did not cross the Bull of the Woods lode, although the location crossed it. There was no error in refusing the instruction. When a locator has shown a compliance with the requirements of the law in making his location, he is entitled, *prima facie*, to all the rights which the law attaches to a valid location. The extent to which a location must be *on* a lode in order to its validity *prima facie*, is fairly measured by the extent to which it is necessary to show it on the lode, in order to entitle the locator to state his boundaries, make his record, and if he desires, perfect his title by patent. The refusal of the court to allow Paterson to show that, although the American location crossed the Bull of the Woods lode, the American vein or lode did not cross it, present a more difficult question. May a location, *prima facie* valid, be defeated, in whole or in part, by showing a termination or departure of the vein at some point within or along the side lines of the location? The evidence of Van Wittering, respecting the underground workings within the limits of the intersection of the two locations, did not connect the workings with the American lode or show its actual presence; much less did it show that the American vein extended to or across the vein of the Bull of the Woods. The question presented is, therefore, unembarrassed by any question of fact. Both locations are made under the Act of 1872. It will be observed that the right secured by section three of the Act attach to the locations made, in the language of the section, "*on* any mineral vein, lode or ledge." To arrive as a whole; accepting the broader or doubtful expressions of one section, as limited or explained by other sections. The term "*on* any mineral vein, lode or ledge," must be read in the light of the requirements of section two of the Act. This section limits the location to 1,500 feet in length "along the vein or lode," and declares that "no claim shall extend more than 300 feet on each side of the middle of the vein at the surface." These provisions are plain and explicit, and require, not in express terms it is true, but by necessary implication, that the location should be on the lode the entire extent of the 1,500 feet. With a location off the lode, compliance with the law would be impossible in the matter of width, as the basis of measurement provided by the law would have no existence. By necessary implication, the work requisite to fix the course and position of the lode was also contemplated in order to enable the locator to embrace it within the lines of his location.

These requirements interpret the expression, "on a vein or lode," as used in section three of the Act. They afford undoubted evidence that this was the character of locations to which it was intended that the rights conferred by the section should attach. It is claimed, however, that a mislocation, however it may affect the miner's right to the lode located, will not affect his right to the surface ground, either in whole or in part; that under the Act of 1872, the "surface ground is not a dependent grant. Under the Act of 1866, a surface ground was allowed for the convenient working of the lode or vein, and for no other purpose." Such is the language of Justice Field, in the case of the Eureka Mining Company *vs.* The Richmond Mining Company, 4 Sawyer, 302. Under this Act the right to surface ground was clearly dependent upon the right to the lode located. It failing, all incidents thereto attaching would also necessarily fail, although the Act of 1872 enlarges the rights of the locator by a grant of "all the veins, lodes and ledges, the top or apex of which lie within his surface lines." We are still of the opinion that his right to the surface ground, continues dependent upon his right to the principal lode, and that his right to other lodes within the surface limits is equally dependent. This enlargement of the rights of the locator, was doubtless intended to stimulate his enterprise by increasing his reward; but the controlling reason was to prevent the controversies which were constantly arising, respecting veins or lodes connected or associated with the lode claimed. These controversies abstracted the full and proper enjoyment of the principal lode granted, and the design was to settle and prevent them. In this, and in the case of surface ground, it was intended to grant that which was associated with the principal lode by proximity, within prescribed limits. When this association ceases in the case of surface ground, the reason for granting it ceases. A *mineral vein or lode* is a leading term in both Acts. There must be a lode discovered and appropriated by compliance with the requisites of location.

This is the prominent and pronounced subject of the grant. This is what the miner has discovered, and claimed by right of discovery. The security of his title thereto, was the practical necessity with which the Act dealt; all else, we think, incident thereto, under the Act of 1866, the right to the surface ground, under the Act of 1872, both the right to the surface ground, and the right to other veins, lodes and ledges. The principal lode constitutes the measure of the miner's right to the surface ground, as the surface ground when thus determined, in turn constitutes the measure of his right to other veins, lodes and ledges, subject to the express limitations of the law. It follows, therefore, that if the lode located, terminates at any point within the location, or departs at any point from the side lines, that the location beyond such point, and to that extent, is defeasible, if not void.

Wolfy and Skinner vs. The Lebanon Mining Company. Bell Tunnel—Ben Harding Case. 4 *Colorado Reports*, 112.

Opinion by Thatcher, C. J.

This was an action of ejectment to recover the possession of eight hundred feet of the Ben Harding lode. The evidence tended to show that the Ben Harding lode in its general course or strike, departed from the vertical side lines of the location as described in the patent, and entered the Bell Tunnel lode location, which was also patented. At common law, a grant of land carries with it all that lies beneath the surface to the center of the earth. This rule, except so far as modified by statute, must extend to the plaintiff's patent. There may be a grant of the mineral, separate from the surface of the earth. The Ben Harding patent must be construed under the Act of 1866. The second section of that Act provides, "that it shall be lawful for the claimant of a vein or lode, to file in the local land office a diagram of the same, so extended laterally or otherwise, as to conform to the local laws, customs and rules of miners, and to enter such tract and to receive a patent therefor, granting such mine, together with the right to follow such vein or lode with its dips, angles and variations *to any depth*, although it may enter the land adjoining, which land adjoining shall be sold subject to this condition." This section is a departure from the common law doctrine, and permits the patentee to follow his lode in its downward course to any depth although it is carried by its dips, angles and variations, beyond its side lines, while the words "*to any depth*," limit the direction in which the mine may be pursued beyond the side lines. The claimant is required to file in the land office a diagram of his vein or lode. This is his own act. Before making such diagram, the law contemplates that he shall so far expose and develop the lode as to be able to trace its course. If the plat made by the surveyor does not cover the lode, he will not be permitted to shift his lines so as to include the lode. The error is his own, not that of the government officer who acts under the direction of the claimant. However tortuous might be the course of the lode, the claimant has a right to follow it up and prepare his diagram so as to include it. There are no words in the Act which require the diagram to be in the form of a parallelogram or any other particular form. The Act requires that there must be a discovered lode, whose *locus* must be embraced in the limits of the diagram. The surface ground and the lode are not independent grants. It is not the purpose of the law to grant surface ground without a discovered lode. The lode is the principal thing, and the surface ground incident thereto.

In conveying a segment of the earth located under the provisions of the Act, it is the intention of Congress to convey a mine contained within that segment as the substance of the grant. The Act appeals to the industry of the miner to make sure that the lode is within his location. The higher his diligence the greater his reward. If by lack of care he makes a location not embracing the lode he seeks to secure, he cannot be heard to complain because others have explored and occupied the adjacent territory containing the claim he might have embraced in his diagram. If, as the evidence tends to show, the Bell Tunnel lode is but a continuation of the Ben Harding lode (after its departure from the vertical side lines), extending through the adjacent location, there is no principle of law or justice, in the absence of an express statutory provision, by which the patentee of the last named lode can encroach upon the premises embraced by the Bell Tunnel lode location, and deprive the owner thereof of the fruits of his discovery. Before a claimant is entitled to a patent under the Act of 1866, he must comply with all its provisions, the leading object of which is to require that the claimant, before applying for a patent, shall ascertain the exact location of his lode and fix by his diagram that location, so that the public may be apprised of its limits and may thereafter with safety explore and occupy adjacent tracts. It is insisted that if not by the terms of the Act of 1866, then by virtue of territorial legislation and local customs and rules of miners, the patentee of the Ben Harding lode was entitled to follow the course of the discovered lode beyond his own side lines, and that the Act of 1866 was to recognize and confirm these rules and customs. The Act confirmed such legislation of local rules, *so far as the same may not be in conflict with the laws of the United States*. The Acts of Congress are paramount to all local laws, and the patentee takes under the laws of the United States. The right of the locator to the possession of his claim and to appropriate to his own use the mineral deposits therein under the Acts of Congress, is full and complete, and he need not take steps to obtain patent for the land.

There is no time prescribed in which he shall apply for the patent. Ample time is given to ascertain the precise *situs* of his lode, with reference to adjacent land. The surface and the lode are both the subject of the grant. The patent operates to convey, not only the circumscribed tract of land, but also the lode contained therein, with the right to follow the same in its downward course into adjoining premises, but not to follow it when in its general strike it departs from the vertical side lines. In the latter case, after its departure, it is the subject of location by whomsoever it may be discovered. If, then, as the evidence tends to show, the ledge on which the Ben Harding lode was located deflected in its general strike from the patented side lines, the patentee is not entitled, in virtue of his patent, to its possession beyond the side lines, as against one who has subsequently located it and patented it.

In the case of the Flagstaff Silver Mining Company, of Utah, *vs.* Helen Tarbet, the Supreme Court of the United States, in May, 1879, decided that "a location of a mining claim upon a lode or vein of ore should be laid along the same lengthwise of the course of its apex, at or near the surface, as well under the mining Act of 1866 as under that of 1872. If located otherwise, the location will only secure so much of the lode or vein as it actually covers."

G. W. Hall et als. vs. Equator Mining and Smelting Co. et als. Colorado Central—Equator Case. U. S. Circuit Court.

Trial and opinion by Hallett, J.

Both locations are fifty feet in width, one 1,400 feet, and the other 1,500 feet in length. Their general course is east and west, and they differ in direction about twelve degrees. The greater length of the Equator is eastward from the Colorado Central, and the locations overlap in some such way as the rails of a Virginia fence overlap each other. The east end of the Central location passes over and across the west end of the Equator, so that the end of each location projects beyond the north side line of the other a distance of two or three hundred feet.

The position of the claims with reference to each other seems to indicate that they are cross and intersecting lodes, with an acute angle of twelve degrees. It appears from the evidence that, instead of two lodes intersecting each other in the manner indicated by the locations, there is at the junction of the surface lines, and for a considerable distance east of that point, but one lode, which lies partly in both locations and partly between them, and perhaps extends beyond the north line of the Central patent. At the east end of the Central patent, and the corresponding point on the Equator patent, and thence westward, the unity and entirety of the lode is established by the concurring testimony of all the witnesses, and that, of course, covers all the disputed ground. In the Equator works the south wall of the lode is exposed, but the north wall has not been found there or in the Central openings. We may, however, assume the existence of a lode, the northern limit of which is at present unknown.

We then have, as shown by the evidence, the Equator location on the south side of that lode, with the foot-wall coming to the surface pretty near the central line of that location. On the foot-wall and following it westward to and through the disputed ground, there is a mineral vein—that word being used to describe a tabular sheet of ore, as distinguished from the gangue of the lode.

We have also the Central location, a part of the lode within the walls, but not touching either of them. So also in the Central location there is a vein of ore, less distinct, perhaps, than the other, but distinguishable from the general mass of crevice material. With these locations both parties claim the entire lode, the plaintiffs by virtue of their earlier discovery and location, to which they say their patent must relate, and thus secure to them the prior right. The principal question is, whether by locating a part of the width of outcrop the whole may be taken—of several collateral locations on the course of a lode, where the top or outcrop is of sufficient breadth to admit of more than one, are not all of equal dignity and force within their own lines? This question will admit but one answer, with such modifications as may be hereafter suggested. The Acts of Congress require a location to be along the course of the lode, and to include the top of it. The Equator Company assumed to take the whole lode into their location, and if they failed by their own omission, or because of some restricted provision of the local law, the result is the same. They cannot now claim more than was taken. The same rule is applicable to plaintiff's location.

If, however, a right to the entire lode cannot be asserted under a location covering a part only of its width, as seems to be obvious, the location may be valid for the part described in it. If it is on the top of the lode, it is within the Act, and so ought to be good for the part within the lines extended downward vertically, if for no more. *Prima facie* the patentee must be the owner of all that lies within his lines. He has also the right to pursue veins and lodes which he holds by their outcrop, into other territory. He can only do so in pursuit of a lode or vein that has its top and apex wholly on his own ground, and having but a part of the lode in his territory, he cannot comply with that condition. If, then, two or more collateral locations be made on one and the same vein, and the vein appear to be homogeneous throughout its width, we are authorized to say that each shall be confined within his own lines drawn vertically. The occurrence of veins in other veins, applying the word first to the sheet of ore which is often called the pay streak, and again the general mass of the crevice embracing the ore and gangue, will not be controverted. It is said in Webster's Dictionary that the word "vein" is often limited, in the language of miners, to a layer or course of metal or ore. So in works on topography, fissures are mentioned as occurring within other and probably older fissures, which, if filled, may furnish the conditions of a vein within another and larger vein. I have not heard the word "lode" used in the same sense, but as it means only a vein carrying ore, it would be even more significant than the latter. The word "ledge" is not in use with us. As found in the Acts of Congress, the word "vein" may be taken in the limited sense. To give effect to it in that way, we need not resort to the nice definition and subtle distinctions of geological science. It is enough that such is an accepted use amongst miners. So understood, the word "vein," in the Equator patent, may refer to the sheet or crevice of ore that was found on the south wall of the lode. So, also, the word "vein," in the Central patent, may be regarded as referring to the sheets and bodies of ore found in the plaintiff's openings. If the ore had been distributed throughout the lode with anything like uniformity, we should have been unable to distinguish between the several parts, and as we have already said, each party would then be confined to their own lines. But the vein on the south wall is quite distinct from the general mass of the crevice, and of such strength and continuity as may give it unity and individuality in law and in fact. The vein on the south wall may be held as a separate and distinct location, with the right to follow it in its downward course so long as it retains its individual character. All that has been said is based on the fact, as shown by the evidence, that its top and outcrop are wholly within the Equator ground. If the top and apex of the vein had been in the Central location, some questions would arise concerning the force and effect of the patents within the space in controversy. In the view that has been taken of the case, it has not been found necessary to discuss those questions.

The judgment will be for defendants.

Stevens & Leiter vs. Williams et als. Iron-Grand View Case. U. S. Circuit Court.

Charge to the jury by Hallett, J.

The first matter to which I shall ask your attention is, that the reference in the law is to veins or lodes *in place*, bearing any valuable metals which are here spoken of. The language of the Act is, mining claims upon veins of quartz or other rock *in place*, bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits. That is the language of the Act used in describing the kind of mines or valuable deposits which may be taken under the Act, and the peculiar feature of that description to which I wish to call your attention, is that they are lodes or veins *in place*. The exact language, as I before read, is veins or lodes of quartz or other rock; that is, veins of quartz or other rock, or lodes of quartz or other rock (the last words being added to the first by way of description) that may contain any of these valuable metals. That is to say, any kind of rock bearing any of these metals, but whatever the rock, whether it be quartz or other rock, it must be *in place*. And, as to the meaning of these words, in place, they seem to indicate the body of the country which has not been affected by the action of the elements; which may remain in its original state and condition as distinguished from the superficial mass which may lie above it. There is quite a number of words which may be applied to that superficial deposit; that which is movable, as contrasted with the immovable mass that lies below, such as alluvium, detritus, debris. Perhaps the last word comes as near as any other that is in use, the word *debris*. A witness in another case here used a word which he appeared to have invented for the occasion, which appeared to me particularly significant; he called it "tumble stuff," which conveys to my mind pretty distinctly the idea of that which may have been brought to its position by the action of the elements as distinguished from the vast body of earth which lies below. In speaking of these deposits, which are in veins or lodes, and of the general mass of rock from which they may be distinguished, miners usually call the surrounding mass of rock in which the lodes or veins are found, the country, or the country rock. By that word they signify the character and description of the general body of the mountain, whether it is granite, or gneiss, or syenite, or porphyry, or any other of the many different kinds of rock. They use that word to describe the general mass of rock, of which the mountain is composed, as distinguished from that which is found in the vein or lode. And when this Act speaks of veins or lodes *in place*, it means such as lie in a fixed position in the general mass of country rock, or in the general mass of the mountain. As distinguished from the country rock, this superficial deposit may have been brought into its present position by the elements, may have been washed down from above, or may have come there as alluvium or diluvium, from a considerable distance. Now, whenever we find a vein or lode in this general mass of country rock, we may be permitted to say that it is *in place*, as distinguished from the superficial deposit, and that is true, whatever the character of the deposit may be; that is to say, as to whether it belongs to one class of veins or another; it is *in place* if it is held in the embrace, is inclosed by the general mass of the country. And as to the word vein or lode, it seems to me that these words may embrace any description of deposit which is so situated in the general mass of the country, whether it is described in one way or another; that is to say, whether in the language of the geologist, we say, that it is a bed, or a separated vein, or gash vein, or true fissure vein, or merely a deposit; it matters not what the particular description of it may be, in respect to these distinctions, which are observed by geologists in defining the different classes of deposits that lie in the embrace, or are inclosed by the general mass of the mountain. In all cases I suppose that they are lodes if not veins. It may be true that many of these deposits will not come under the description of veins as known to geologists, but if they are not so described—if they cannot be so correctly described—they are, at least, lodes, and are recognized as such by miners in their search for them. In other words, whenever a miner finds a valuable mineral deposit in the body of the earth, as I have described it, he calls that a lode, whatever its form may be, and however it may be situated, and whatever its extent in the body of the earth. The books make some distinctions between beds, and lodes, and they make distinctions in the different classes of veins, as you have heard from counsel, but these distinctions are not important in relation to this matter of the discovery and taking of these mineral deposits. It has been decided that Congress, in passing this Act, intended by this description to embrace and include all forms of deposit which are located in the general mass of the mountain, by whatever name they may be known, and the distinctions which are adopted by geologists in respect to the different kinds of veins are not important except for one question and for one purpose, which I may invite your attention to further on. So that we may say, gentlemen, with respect to the case which is now before you, that, whether this may be called a true vein or a contract vein, or a bed; whether it lies with the stratification or transversely to it, the matter is of no importance for the purpose of determining this question; it is in any event a lode, if it lies in place within the meaning of this Act. And it is *in place* if it is inclosed and embraced in the general mass of the mountain and immovable in that position. Perhaps I ought to say further, in view of some things that were said by counsel in the argument, that it is not material as to the character of the vein matter; whether it is loose and disintegrated, or whether it is solid material. In these lodes the earth that is found in them, the earthy matter which may be washed or treated with water or steam is often the most valuable part. It was never understood here or elsewhere, so far as I know, that such earthy matter was not embraced in the location because it was of that character. It is the surrounding mass of country rock; it is that which incloses the lode rather than the material of which it is composed which gives it its character; so that even if it be true, as counsel have stated in the course of their arguments, that this is mere sand, is a loose and friable material which cannot be called rock in the strict definition of that word, if that be true, it does not affect the character of the lode. If it were all of that character it would still be a vein or lode *in place*, if the walls on each side, the part which holds the lode, is fixed and immovable.

That is, perhaps, sufficient as to the character of the deposit, and that which may be located in the manner in which the evidence tends to prove that the location was made; and we have now to consider the question which was so much discussed by counsel, as to the location with reference to the top and apex of the vein. And upon that point it is clear, from an examination of the Act, that it was framed upon the hypothesis that all lodes and veins occupy a position more or less vertical in the earth; that is, that they stand upon their edge in the body of the mountain, and these words, top and apex, refer to the part which comes nearest to the surface. The words used are top and apex, as if the writer was somewhat doubtful as to which word would best describe, or best convey, the idea which he had in his mind. It was with reference to that part of the lode which comes nearest to the surface that this description was used; probably the words were not before known in mining industry, at least they are not met with elsewhere, so far as I am informed. Perhaps they were not the best that could have been used to describe the manner in which the lode should be taken and located. But whether that be true or not, they are in the Act of Congress, and there seems to be little doubt as to their meaning; they are not at all ambiguous. In some instances they may, perhaps, refer to the flow of the lode; that is, a part of the lode which has been detached from the body of mineral in the crevice, and flowed down on the surface; in others, where there is no such outcrop, they may mean that part which stands in the solid rock, although below a considerable body of the superficial mass which I have attempted to describe to you. We are all agreed, however—the courts and counsel, every one—that that is the meaning of the words, that they are to be taken in some such sense as that, as being the part of the lode which comes nearest the surface; and the Act requires that the location shall be along the line of this top or apex. Supposing the lode to have a somewhat vertical position in the earth, with this line of outcrop or of appearance on the surface, or nearest to the surface, it shall be taken up and occupied by the claimant as his location, and he must find where this crop and apex is, and make his location with reference to that. So that by this Act he might claim fifteen hundred feet in length along the linear course of the lode, and would have one hundred and fifty feet on each side of it, making it three hundred feet in width and fifteen hundred feet in length.

We have already reached the conclusion in this state, the supreme court of the state has adopted that construction of the law, that if he fails in that in so far as that his location is not upon the line of his lode, that he can claim no more than he has included within his side lines; that is to say, he makes his location with reference to the top of the lode, with which the lines of the location must be parallel; and if he fails in that, if the line of the lode departs from the surface lines of his location anywhere upon the length of it, it is so far an invalid location that he can take nothing of the lode that lies without the lines of the location. This, then, was the method pointed out by this Act, and by the law of the state, for taking up these claims, that it should be along the line and top and apex of the lode, and if this is done, if the location is so made, then the language of the Act is express that he shall have not only so much of the lode within the lines as lies in its linear course, but that if the lode in its downward course into the earth departs from these lines upon the sides, passes out upon its dip, that he shall have that part also which lies beyond. Congress seems to have appreciated the fact, which is known to all miners, that there are very few, probably no lodes that are exactly perpendicular to the surface of the earth; they incline one way or the other—that is, either to the right or left—extending along the course of the lode. It seems to be universally true that they depart from the perpendicular in one direction or the other, and if in so departing—if in their downward course into the earth—they depart from their side lines, or the planes of those lines extending downward vertically, then he is to have that part which lies without, as well as within, the surface lines. The language of the Act upon that point is, "of all veins, lodes and ledges, throughout their entire depth, the top, or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes or ledges may so far depart from the perpendicular in their course downward as to extend outside the vertical side lines of such surface location."

Now it was said with reference to the lode which is now in litigation here, the position was taken by the counsel for the defendant that whenever in its departure from the vertical course, it reaches an inclination which is greater than forty-five degrees, that then it is no departure from the perpendicular, but from a horizontal plane, and therefore it is not within the terms of the Act. That position, gentlemen, is merely a verbal distinction, which goes for nothing at all. Of course, in its departure, it may depart in any degree up to the horizontal plane, and it is still a departure from the perpendicular throughout the whole course, until it comes to a right angle from the perpendicular. I think, perhaps, that we may illustrate that with these books. If we say that this is the vertical position, as you perceive it is, then departing from the perpendicular in every angle as you come from this vertical position, carrying it up until you come to a horizontal position, which is ninety degrees, as I understand it, of the arc of a circle, it is still a departure from the perpendicular. In that view, we have been brought to consider, in the present instance, whether the lode or vein lies in a horizontal position; that is, whether the angle of the vein is between the vertical and horizontal. The rule should be that every departure up to that which I have named is but a departure from the perpendicular, and it appears to be exactly within the provisions of this Act if the vein clearly extends outside of the limits of the surface in any angle between the perpendicular and horizontal. I agree that if we should ever find a lode which in its course extends precisely on the plane of the horizon, and it is extremely doubtful whether we shall ever find one in that position, but if we should ever find a lode which is precisely in that position, there may be some difficulty in locating it under this Act; but if you find, from the evidence, that there is a lode or vein in the position in which this has been described by the witnesses, and that it is in rock in place as I have described it to you, I think there can be no difficulty in the present instance in respect to that.

This brings us to a question, gentlemen, which really is the important question in this case, and that is, whether there is any lode in the position which has been mentioned by the witnesses; and in that connection, in the consideration of that question, the character of the deposit, as to whether it is a true fissure vein, or a contact deposit, or a bed, or something of that kind, is of some value; because in respect to fissure veins we accept the cavity or chasm which is found between the walls, and filled with what they call vein matter, as indicating or showing the existence of the lode, even if the matter which is found in it is not very valuable—that is, if there is anything which usually accompanies valuable ores or minerals. But in respect to this kind of deposit, my impression is that it is to be known, called and regarded as an irregular deposit; one which if it should be interrupted for any considerable distance—that is, if what they call a contact or junction between the porphyry and lime should become barren for a considerable distance—that it should no longer be called a lode. As I understand it this line which exists, which always exists when there is a union of rocks of different ages and different formation, may carry ore or it may not; it may be productive or it may be barren; and if this should be found at any point in its course to become barren and remain so for any considerable distance, I do not see how it could be called a lode in that part of it, so that it could be followed with the result to claim what lies beyond. I should say that with reference to such a line of contact between rocks of different formation, that to find that line of contact in one place, unless there were in it valuable minerals which were carried along with something like a continuous course along the line of contact, that no lode would be discovered. It could not be said that any had been found until such minerals were found. I do not mean by this that any slight interruption for a few feet of the valuable part of the ore would have the effect to show that the deposit was broken in its continuousness.

I do not mean that, nor do I mean that if any dyke or other extraordinary foreign matter should be interposed in the course of the lode so as to cut it off, and it should follow on immediatety after that interruption, that would be regarded as such a displacement in the continuity of the deposit as would deprive it of its regular character. Whenever it may appear that the fissure has existed at one time or at any time, with a continuous body of ore in it which may have been interrupted by some subsequent convulsion, the character of the deposit would remain the same as if the interruptiou had never occurred. But if there was such an intervening space in the contact, as these witnesses call it, barren in its continuity, as might show a separate and distinct body of ore, which had always been such, I should say that it would not pass with the grant of the first. It may help you, gentlemen, for me to express this in other language, and ask you to extend the line which is laid down on that map (showing), for some distance further, and to suppose that in the course of that line, we may say that you find that there is, at the head of the deposit, that nearest the surface, a hundred feet or more of continuous ore, lying upon the line between the porphyry and the lime, and then there should be an interruption of a hundred feet or more of this contact which is perfectly barren; the lime and the porphyry coming together carrying nothing whatever, and below that again, another body similar to that which was found at the head, the position which I think might be taken upon this, the position of these ore bodies, would be that there would be two lodes rather than one, the first above and the second below; but if there is a continuous body of ore, or practically continuous, and there is no such interruption as exhibits other than a casual and fortuitous displacement, then it would be one lode.

I think upon that explanation, gentlemen, you will be able to determine whether there is, in that sense, a fixed body of ore, extending from the upper part of these workings to the end of them; if that is its character, then it is to be regarded as one and the same lode, though it may have departed from the side line to a considerable distance, and have only an angle of thirteen, fourteen or fifteen degrees, as the witnesses have described it, from the plane of the horizon.

There may be other deposits in that neighborhood, gentlemen, which show entirely different features or show the same features, but whether that be true or not, is not a matter for present consideration. We determine these questions only upon what appears in this case, and without reference to any others that may arise in the same locality. Other deposits in this neighborhood may be of an entirely different character; they may be such as cannot in any sense be called lodes at all. Whether this is true or not, is not for present consideration. We determine this case, as I said before, upon the evidence given here, leaving other questions which may arise in respect to other locations, to the facts as they may be developed in respect to them.

The above case was tried the second time in June, 1879, in the United States Circuit Court at Denver. Mr. Justice Miller, of the Supreme Court of the United States, presided and charged the jury. No new construction was placed upon the law. Therefore, Judge Hallett's charge is given above.

H. A. W. Tabor et als. vs. Wirt Dexter et als. New Discovery—Little Chief Case. U. S. Circuit Court.

Opinion on motion for preliminary injunction by Hallett, J.

This is a bill for an injunction by parties owning the New Discovery lode, in California Mining District, against the owners of an adjoining claim called the Little Chief. It is not alleged that the defendants have entered upon or into the New Discovery ground, or that they have in any way interfered with plaintiffs' possession within the limits of the New Discovery location. The charge is that plaintiffs' lode descends into the Little Chief's ground on its dip, and that defendants are there mining and exhausting the ore. In other words, plaintiffs contend that the top of the lode is in their ground and that they have the right to follow upon its downward course into and through adjoining territory. To maintain this position it is necessary to show that the lode is *in place* within the meaning of Sec. 2320, Revised Statutes of the United States. And this depends upon the position of the ore or vein matter in the earth, as whether the inclosing mass is fixed and immovable, more than upon the character of the ore itself. Whether the ore is loose and friable, or very hard, if the inclosing walls are country rock, it may be located as a vein or lode. But if the ore is on top of the ground, or has no other covering than the superficial deposit, which is called alluvium, diluvium, drift or debris, it is not a lode or vein within the meaning of the Act, which may be followed beyond the lines of the location. In this bill it is alleged that the overlying material is boulders and gravel, which cannot be *in place* as required by the Act. Not much is known to the court of the deposits on Fryer Hill, but it would seem from the allegations in this bill that they differ materially from the Iron mine, which has a hanging wall as well as a foot-wall. For the decision of this motion it is enough to say that, where the mass overlying the ore is a mere drift, or a loose deposit, the ore is not in place within the meaning of the Act. Upon principles recently explained, a location on such a deposit of ore may be sufficient to hold all that lies within the lines, but it cannot give a right to ore in other territory, although the ore body may extend beyond the lines. The motion will be denied.

Important Stock Decision.—A coal and iron company bought its lands from E for $500,000, paying him $25,000 in money and $475,000 in its capital stock. Subsequently B sued E for seven-eighths' interest in the land, and had a decree in his favor: and he then sued and recovered $320,049 for coal taken from it by the coal company, and, as that was insolvent, he brought an action against the stockholders who held the shares which had been paid to E in the purchase of the land, claiming that this stock had not been paid for, and that the capital stock created a trust fund for the payment of its debts. In this case, Brant vs. Ehler, the Maryland Court of Appeals, in June, affirmed a decree in favor of the defendants. Judge Robinson, in the opinion, said: 1. The liability for a subscription to the stock of a corporation is founded on contract. Where one agrees to take a certain number of shares, the law implies a promise to pay for them according to the terms of his subscription. If they are sold before all the installments are paid, and are bought with such knowledge, the law implies a promise on the part of the purchaser to pay whatever may be due thereon according to the terms of the original subscription. In such cases the purchaser stands in the shoes of the original subscriber. These are elementary principles about which there can be no contention. But where shares are issued by the company to the subscriber as full-paid shares, and are sold by the subscriber as such, there is no ground on which a promise can be implied on the part of the purchaser, without notice, to be answerable either to the company or to its creditors should the representations on the faith of which he purchased prove to be false. 2. No one will pretend for a moment that in subscribing to the stock of a company the purpose is to create a trust fund for creditors. On the contrary, the object primarily is to furnish means to carry on its business, and to share the profits earned by the corporation, and so long as it is a going concern it has the right, and indeed it is the duty, to manage and dispose of its assets, including stock subscriptions, for the promotion of its own interest. 3. Shares of stock are not, strictly speaking, negotiable instruments, but courts speak of them as *quasi* negotiable; and when they are issued as full-paid shares, and as such sold in open market, the purchaser is not bound to suspect fraud where everything seems fair and conformable to the requirements of the law. Any other doctrine would virtually destroy the transferable nature of such shares, and paralyze the whole of the dealings in the stock of corporations.—*From Bradstreet.*

Timber on Mineral Lands.—A very important decision, of great interest to the mining community, was rendered by Hon. H. M. Teller, Secretary of the Interior, on June 3, 1882, on the question of timber on mineral lands. It is as follows:—

My attention has been called to a number of cases, reported by special agent Hardin, of the so-called trespassers in cutting timber on mineral land in the Territory of Dakota. Notably, in the cases of Frank P. Hardin, who is charged with cutting 72 cords of wood; Peter T. Bye, charged with cutting 25 cords; Henry Bressert charged with cutting 60 cords; J. H. Damon, charged with cutting a like amount. Frank Keller charged with cutting 47 cords, and Albert Holam, charged with cutting 100 cords. All of this wood appears to have been cut off of mineral land of the United States. It also appears by the report of the special agent that the persons charged with the trespass have, in cutting this wood, conformed to the rules of the department as to size of the timber to be cut, etc. It is now proposed to compromise with these persons by allowing them to pay for the wood, at the rate of 50 cents per cord. I do not think, on the statement of facts made by the special agent in the cases of Hardin and Peter B. Bye, that they have been guilty of a trespass in cutting such. I understand that the facts are substantially the same in all the cases mentioned.

The Act of Congress, approved June 3, 1878, entitled "An Act authorizing the citizens of Colorado, Nevada and Oregon, to fell and remove timber from the public domain for mining and domestic purposes," clearly authorizes the cutting of timber on mineral lands of the United States for domestic uses. It does not appear that Peter Bye, or any other of the parties complained of, cut wood for transportation from the Territory, and if cut to be used in Dakota, it is clearly for domestic uses. It has been alleged that the Act of June 3, 1878, does not apply to persons cutting timber on mineral lands for sale, and that to enable any person to have the benefit of that Act, he must cut timber for his personal use, and not for sale. Such a construction defeats the very intent of the Act which was to allow the settler on mineral lands to have the benefit of the timber thereon growing, for use, within the Territory or State where it grew. It cannot be supposed that Congress intended to say by that Act to the inhabitants of the mineral regions, that while they might go on the lands of the United States and cut timber for their use, yet they could not employ others to cut timber for them, or purchase it of those who had cut and prepared it for use. Large and prosperous communities had settled on the mineral lands of the United States, by and with the consent of Congress.

A statute has been passed declaring such occupation lawful, and provisions were made for securing a title to the mines that should be discovered and improved on such lands, yet no provisions had been made by which a title could be secured to the timber growing on such lands, until a mine had been discovered thereon. To have restricted the inhabitants to the use of such timber as should be found on mineral claims alone, would have been folly, for in many instances the mineral claims are destitute of timber. Whole mining districts are frequently compelled to procure their supply outside of their districts, either because the timber in such districts had been carted off and used, or because the district was without timber when first settled.

The area of the territory occupied by actually located mineral claims is entirely too small to supply the communities with timber from such claims alone, and so it became a necessity to appropriate timber on Government lands. In the absence of a law authorizing the purchase of either the timber or the land on which it grew, from the first settlement of mineral regions to 1876, such had been the custom of the miners in all mineral regions. Cities and towns, with churches and school-houses, had been built with timber so taken from the public land. Appeals had been made to Congress, from time to time, to provide by law for the securing of the title to timber on mineral lands. Congress, with the wise policy of keeping the mineral lands of the United States open to further exploration and occupation, had declined to pass any law by which timber on such lands could be monopolized by speculators and capitalists. Woodchoppers and lumbermen had, from the first settlement of mineral regions, cut from the mineral lands wood, mining timber and lumber for buildings, and sold the same to those who could not or did not wish to cut such timber for their own use. It was practically impossible for millmen, miners, and other inhabitants of the country, to go out and fell trees that were to be used to build their mills, timber their mines or supply their families with fuel. About the time of the passage of the Act of 1878 it was alleged that such cutting was in violation of the law, and ought not to be allowed.

To have prevented such cutting would have compelled the abandonment of nearly, if not quite all, the mineral regions of the States and Territories named in the Act. The Act was passed to establish by positive enactment a right claim and exercised without interference on the part of the Government for a period of about 30 years. The construction heretofore given to it by this department has defeated the purposes of the Act, and has not been of any advantage, either to the Government or the people residing on such mineral lands. In most of the regions included in the Act referred to, the timber is of but little value for use outside of the neighborhood in which it grows. A comparatively small amount would bear transportation out of the State or territory, and it cannot be used more advantageously to the people and the Government than in the product of precious metals. If the timber is cut having reference to the rule established by the department as to size, etc., no complaint ought to be made. It has been suggested that the use of wood in the quartz mills and reduction works in the mineral regions is not a use for mining purposes.

I do not think there is anything in that suggestion. Quartz mills and reduction mills are indispensable to a mining community, and such use is clearly within the provisions of the law, and the consumer as fully protected by it as if he had consumed it in his own dwelling. You will, therefore, instruct the special agents now in the States and territories named in the Act of June 3, 1878, to conform to the suggestions herein. The great object of a Governmental supervision of cutting timber in those States and Territories ought not to be to compel the payment for timber so cut, but to prevent an unnecessary waste by cutting the small trees under the size prescribed by the department, and to prevent a waste by fires and other means.

SUMMARY OF THE GENERAL LAND OFFICE ANNUAL REPORT FOR 1881.

THE following is a synopsis of the annual report of the General Land Office for the fiscal year ending with June 30, 1881:

Abstract of operations under the laws relating to the survey and disposal of public and Indian Lands during the fiscal year ending with June 30, 1881.

	Acres.
Cash Sales:	
Private entries	666,229.11
Public Sales	2,279.40
Timber and stone lands	42,987.92
Pre-emption entries	721,146.26
Desert lands	108,560.02
Mineral lands	27,189,68
Coal lands	4,975,58
Excesses	12,339.06
Abandoned military reservations	1,910.21
Total	1,587,617.24

Homestead entries	5,028,100.69
Timber culture entries	1,763,799.35
Locations with military bounty land warrants issued under acts of 1847, 1850, 1852, and 1855	55,662,36
Agricultural college scrip locations	360.00
Supreme court scrip locations	28,253.74
Valentine scrip locations	392.15
Sioux half-breed scrip locations	2,519.27
Chippewa half-breed scrip locations	800.00
Locations with Porterfield scrip	16.86
Lands certified or patented for railroad purposes to States:	
Alabama	383.23
Iowa	73,321.58
Minnesota	483,466.63
Kansas	281,277.28
To corporations:	
Pacific railroads	211,992.04
State selections, approved for—	
School indemnity	15,880.00
Internal improvements	1,760.00
Agricultural colleges	1,370.45
Seminaries	3,964.14
Donation claims	18,237.06
Approved to States as swamp	569,001.18
Total	10,128,175.25

	Acres.	Acres.
Indian lands, sales of, during the fiscal year of 1881:		
Osage ceded	4,622,21	
Osage trust and diminished reserve	613,951,05	
Kansas trust	25,736.52	
Kansas trust and diminished reserve	18,971.86	
Pawnee	15,219.55	
Sioux	50,299.64	
Sac and Fox	57.40	
Cherokee strip	20,086.12	
Otoe and Missouri	18,036.87	
Cherokee school	240.57	
		765,221.80
Which added to the sales of public lands makes a grand total of		10,893,397.05

Cash receipts:	
From sales of public lands	$3,534,550 08
*From sales of Indian lands	1,009,671 63
Homestead fees and commissions	556,766 16
Timber culture fees and commissions	154,739 35
Fees on military bounty land warrant locations	1,484 00
Fees on locations with different classes of scrip	17 00
Fees in pre-emption and other filings	59,366 00
Fees in mining applications and protests	28,310 00
Fees on timber land entries	3,330 00
Fees for reducing testimony to writing, by local officers	47,625 24
Fees on railroad selections	3,581 27
Fees on state selections	4,198 63
Fees on donation claims	1,415 00
Fees for transcripts, furnished by the General Land Office, during the fiscal year of 1881	6,727 90
Total	5,408,804. 16

Surveys.

		Acres.
Total area of the land States and Territories		1,814,788,922
Surveyed up to June 30, 1880	752,557,194	
Surveyed but not heretofore reported	10,561,775	
Surveyed during the fiscal year ending with the 30th of June, 1881	21,788,011	
		784,906,980
Leaving		1,029,881,942

acres of public and Indian lands yet to be surveyed, inclusive of private land claims surveyed at the close of the fiscal year ending with the 30th of June, 1881. The surveys during the past fiscal year show an increase of 6,058,759 acres over those executed during the previous year. This extraordinary showing is mainly attributable to the great demand for surveys under the deposit system, and to which reference is hereinafter made. The sales of public lands as compared with those of the previous fiscal year show a decrease of 3,898,974.60 acres, while the aggregate of cash receipts, under various heads, is greater by 3,118,642.56. During the year there were received 83,864 letters, and 68,427 were written and recorded, covering 60,325 pages of record books, and during the same period there were issued and transmitted 56,979 patents. This amount embraces patents for private land claims, mining claims, lands granted for railroad purposes, swamp lands, Indian lands, and for lands sold under the pre-emption and homestead laws.

There were also audited, adjusted, and reported to the First Comptroller of the Treasury 2,800 accounts, embracing accounts of surveyors general, deputy surveyors, registers, and receivers, special agents, &c., covering 13,350 pages of record.

In all the land districts there is a large and legitimate demand for copies from the official records, and for copies or tracings of the maps and plats of survey, &c. As the country is settled and improved, values increase and interests multiply, the records of the local land offices are more frequently consulted, and such copies more largely required. Those who desire transcripts from the records are willing and desirous to pay for the same, but registers and receivers are precluded, under penalty of removal from office, from receiving fees or other rewards not authorized by law (see section 2242, Revised Statutes), and no authority of law exists for any fee for such copies except in consolidated land districts where, under section 2239, Revised Statutes, such fees are authorized to be charged by the land officers as are authorized by the tariff existing in the local courts of the district. It has, until a comparatively recent date, undoubtedly been the general practice of local officers to furnish such copies, receive pay for the same, and use the money in part at least to pay for clerical labor made necessary by this work. The local officers justified themselves on the general ground that it was by law made their duty to furnish such transcripts, &c., and hence it was no infraction of law to perform a legitimate act and receive pay for the same. This proceeding was clearly illegal, however, and led to abuses of considerable magnitude, upon discovery of which instructions were issued to all the local land officers definitively advising them what fees they were authorized to charge or receive, and forbidding the receipt of any other rewards under penalty of recomendation for dismissal from office.

The matter now is in this condition: there is a legitimate and public necessity for copies from the records and files of district land offices; there is no sufficient appropriation to pay for the clerical labor essential to prepare such copies, and the only way they can be had is by allowing outside parties to have access to the official records and make the copies themselves. This course is obviously unadvisable, and I have the honor to recommend that legislation be speedily had authorizing the preparation of copies by registers and receivers, and a fee for the same at the rate of 15 cents per 100 words and $2 for township plats or diagrams, and that the receivers of the several land offices shall make returns of all moneys so received, and shall pay over the same in the manner now provided by law for other moneys received by them in their official capacity. And, in view of the fact that the clerical labor necessary to be employed will be increased in proportion to the amount of said class of work, I further recommend as absolutely essential to the furnishing of such copies that all moneys received therefor be placed to the credit of the appropriation "for incidental expenses of the several land offices," and be available for clerk hire in said offices under authority of the Secretary of the Interior. I would also recommend that the same provisions be extended to all consolidated land offices and substituted for those of section 2239, Revised Statutes. In this connection I would call attention to sections 460 and 461, Revised Statutes, under which it is made my duty to furnish exemplifications of patents, or papers on file or of record in this office, of parties interested, upon payment of certain rates therein named. The labor thus involved is not expended upon the adjustment of entries—a work so much in arrears and so earnestly demanded by the public, who need their evidences of title at the earliest moment—but relates almost exclusively to patented claims, or to land which is in litigation in the courts; and the fees received for such copies are turned into the Treasury. It is thus apparent that a portion of the clerical labor which Congress provides is diverted from its contemplated channel, and engaged upon work which does not relate to the current disposition of any class of land claims. For the year ending June 30, 1880, there were received and turned into the Treasury for such copies $7,043.05, and for the year ending June 30, 1881, $6,727.90. I recommend legislation to the effect that the moneys so annually received be credited to the appropriation for clerical services in this office for the fiscal year in which they are received, and made available for the payment of the clerical labor necessary for the preparation of said copies.

* This money is deposited by the receivers of public moneys in the United States Treasury, to the credit of the Indian funds, for the benefit of the Indians, under treaty stipulations.

In this connection I would state that, owing to the difficult character of much of the copying done as aforesaid, and to the necessity of careful comparison with the original, the fees authorized to be charged are not estimated to be in excess of the actual cost of the clerical labor expended upon the preparation of exemplifications.

Section 2325, Revised Statutes, specifies the proceedings necessary to obtain a patent to mineral lands. It was held by this department that the application for such a patent, which includes an allegation of compliance with law, must be sworn to by the owner of the claim. By act of January 22, 1880 (page 61, pamphlet edition, statutes of 1879-'80), amendatory of sections 2304 and 2305, Revised Statutes, it was provided that the authorized agent of the claimant might make said affidavit when he was conversant with the facts sought to be established thereby and the claimant was not a resident of the land district wherein the claim was located. In view of the fact that a large proportion of the mining claims are managed by such agents, who are thereby better qualified to make the required affidavit than the owner, I would recommend that the duly authorized agent of the claimant, when conversant with the material facts, be allowed to make said affidavit in any case, and that legislation to that effect be had.

Under sections 2401, 2402, and 2403, Revised Statutes, it is provided that when settlers in any township, not mineral or reserved, desire a survey of the same under authority of the surveyor-general, they shall be entitled thereto, upon filing a written application therefor, and depositing a sum sufficient to pay for the survey and all expenses incident thereto; that said sums so deposited shall be placed to the credit of the proper appropriation for the surveying service, and that the amount so deposited by any such settlers may go in part payment for their lands situated in the township, the surveying of which is paid out of such deposits. By act of March 3, 1879, amendatory of section 2403, Revised Statutes, the certificates issued for such deposits were made assignable by indorsement, and receivable in payment for pre-emption and homestead claims. Since the passage of this act of 1879, the deposits for surveys have increased to an unprecedented extent, the numerous representations which are believed to be true have been made to this office, that lands of no present practical value and on which there are no settlers have been largely surveyed; that applications for surveys are fraudulently prepared by or through the instigation and management of deputy surveyors, who, for the purpose of securing the contract for making the survey, either themselves or through friends advance the money for the deposit, thereafter sell and assign the certificates, and thus reimburse themselves and secure their profit from the surveying contracts. The appropriation for surveys for the last fiscal year was $300,000.

The amount of deposits for the same period, and which was placed to the credit of the said appropriation, was $1,804,166.47, and the amount of the certificates surrendered in payment of pre-emption and homestead claims for the same time was $1,346,109.26. It is believed that the practical result of said act of March 3, 1879, has been to cause the survey of the vast areas of lands of no present, and perhaps of no prospective value, and the surrender of title to valuable lands in payment for such surveys. With the intent to secure as far as possible legitimate proceedings under said law, I issued, September 5, 1881, the following circular instructions to surveyors-general:

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C., September 5, 1881.

TO SURVEYORS-GENERAL:

In order to prevent as far as possible the perpetration of frauds and fraudulent surveys, which have already assumed alarming proportions under the system of deposits by individuals, it is hereby ordered:

I. The surveyors-general shall exercise the most searching scrutiny into the statements of applicants for survey, to satisfy themselves of the truth thereof, and unless found to be *bona fide* in every respect they shall not accept such applications nor furnish the estimates requested.

II. Believing that in a great many instances applications for survey, particularly in sections of country unfit for settlement, have been procured or invited at the instance of deputy surveyors seeking contracts, you are instructed that such proceedings on the part of deputy surveyors are unlawful, and that contracts thus unlawfully procured will not be recognized as valid. The surveyor-general must minutely examine into all applications for surveys under the deposit system. If he is satisfied that the deputy has acted in the manner described, the commission of such deputy shall be forthwith revoked, and the surveyor-general shall report all the facts, with his findings in the case to this office. Upon approval thereof, such deputy shall be deemed unfit to exercise the functions of a deputy surveyor, and the approval of a finding against a deputy will be communicated by this office to each surveyor-general for his information and guidance; and any surveyor-general who shall fail to report such deputy, or who shall employ any deputy so barred, will be open to charges to be preferred by the Commissioner of the General Land Office to the Secretary of the Interior.

III.—Surveyors-general are required to exercise the utmost care and vigilance to prevent frauds and irregularities of any kind regarding surveys under the system of deposits by individuals, as also of surveys made under any other appropriation of moneys by Congress, whether general or special, and they will report each and every fact that may come to their knowledge of any attempted fraud, by whomsoever made, with all obtainable particulars, to this office for consideration and action.

IV.—The plats and field notes of surveys under the system of deposits by individuals, as returned to this office, do not usually show the settlements and improvements of the settlers at whose instance the surveys are ostensibly made. In a majority of instances the location of the settler, whether *bona fide* or otherwise, is entirely omitted, while the improvements, if any, are never noted. In order, therefore, to still further check the abuses and dishonest practices to which this system of surveys has become subject, the attention of surveyors-general and deputy surveyors is specially directed to the requirements of pages 18 and 19 of the Manual of Surveys, and pages 43 and 44 of the Instructions of the Commissioner of the General Land Office, dated May 3, 1881. The requirements therein contained must be strictly adhered to, and surveyors-general are required and enjoined to see to it that their deputies comply therewith.

V.—Surveyors-general are directed to instruct their deputies that they must designate in the field-notes and plats of their surveys the location of each and every settlement within a township surveyed under the deposit system, whether it be permanent in character or not, together with the names of such settlers and their improvements, if any. Cattle corrals are not considered as constituting improvements.

VI.—When no settlers are found within a township surveyed under the system of individual deposits, the field-notes of survey must *distinctly and unequivocally state that fact*, and any omission so to describe and designate the settlements and their surrounding improvements, or the *absence* of one or both in the field-notes and plat, will be deemed a sufficient cause to infer fraud, and the accounts of the deputy will be suspended until such omission shall have been supplied to both plat and field-notes. A suspension of the commission of the deputy will in the meantime take place, and all facts will be reported to this office for consideration and action.

VII.—Surveyors-general are directed to make known to their several deputies the provisions and nature of this order, and will be held strictly accountable for its faithful execution. Ignorance of the terms of this order will not be held an excuse for failure to comply therewith by deputies.

VIII.—This order will be observed by deputies now in the field, and surveyors-general are directed to so inform them with the least practicable delay.

IX.—Surveyors-general are reminded of the important trust confided to them, and are instructed to exercise their whole authority to secure correct and honest surveys and returns by their deputies.

X.—This order will take effect from and after the receipt of the same, and its receipt will be immediately acknowledged by each surveyor-general.

XI.—In every case of a contract heretofore approved which the surveyor-general has reason to believe was fraudulently procured, such contract and the accounts thereunder must be immediately suspended and the facts reported to this office.

Very respectfully,
N. C. MCFARLAND,
Commissioner.

Approved: A. BELL,
Acting Secretary of the Interior.

I am compelled to conclude, however, that there is no effectual remedy for said abuses except by the repeal of said act of March 3, 1879. This act, in its purpose and intent, in my opinion is well adapted to the wants of actual settlers who desire to obtain title to their settlements without being subject to the enforced postponement incident to surveys under the present system; but the temptation to irregularity and fraud are too great, and the means of evading the law too easy, to justify a reasonable expectation that the law can be administered in the public interest. The repeal of said act of March 3, 1879, would still leave their prior provisions as found in Revised Statutes, sections 2401, 2402, and 2403, available for actual settlers; and these provisions are as liberal as, in my judgment, can safely be extended for their relief, for in addition to the irregularities hereinbefore named, it is to be considered that it is very difficult to examine and prove the proper execution of the surveys covering so large areas, and very probable that those who would fraudulently procure a surveying contract would fraudulently execute it. I therefore recommend the repeal of said act of March 3, 1879, and an increased appropriation for surveys.

The fact that the monuments now used to mark the boundary corners of the public surveys on our vast plains, devoid of suitable stone or timber, and very destructible and liable to be wholly obliterated by the rubbing of cattle and other causes, leads me to call attention to the advisability of some provision whereby some metallic monument of cheap but durable form and material could be substituted, at least for township corners.

Examination of Surveys in the Field.—The very unsatisfactory manner in which examinations of surveys in the field are made by deputy surveyors, under the direction of the several surveyors-general, and the general slighting of this very important work, needs, in the opinion of this office, a radical and wholesome change. It is an absurdity to suppose that truthful and honest returns of examinations in every particular will be made by deputy surveyors, upon whom surveyors-general are more than ordinarily dependent for examiners, when it is considered that the examining deputy will at some time, if not already under obligations, have his own work examined by the very deputy whose work he has, if honest, condemned. The temptation of overlooking defects, either in the survey of lines or the marking of the same, has proven too great to be resisted by them. It is safe to say that not one per cent. of the number of examinations are satisfactory to this office in the results obtained. It is therefore earnestly recommended that the amount set apart for examination of surveys, either by appropriation or construction of the law by the Treasury Department as applicable to the same, be disbursed directly by this office, through agents appointed for the purpose, who shall be removable only for cause, and who shall make all examinations required, either at the suggestion of the surveyors-general or at the instance of this office; to report directly to, and be responsible to this office alone, and be in every way independent of the surveyors-general; to receive such fair compensation as may be determined upon by the Secretary of the Interior. It is firmly believed that only by making them independent of the surveyors-general, and responsible to this office alone, that honest and faithful returns of examinations can be secured: that it is the best as well as the cheapest method pecuniarily, and will have a most salutary effect upon the entire surveying service, and is the only means by which to purge the service of worthless and contaminating individuals.

The investigation of trespasses upon the timber lands of the United States has resulted in the apprehension and prosecution of many depredators. Where the trespass was the result of mistake the party has been allowed to settle by the payment of a fair valuation of the timber taken, and many suits have been adjusted by the payment for the timber, when the tresspass was of a character to justify compromise. The government has thus realized a very considerable sum of money for timber so illegally taken, and depredators have been measurably deterred from their business, which was swiftly denuding the public lands of their best timber. The present appropriation, however, is quite insufficient for the necessities of this branch of the service. With it I am unable to keep in the field more than fifteen agents. With this number it is impossible to even cursorily examine the vast timber districts, and extensive depredations undoubtedly are undetected. I earnestly recommend an increased appropriation for this service. Not only will the public interests be subserved by the protection of its timber, but the Treasury will profit by the payments made. The existing provisions of law permitting citizens to fell and remove timber on the public lands for mining and domestic purposes, as found in act of June 3rd, 1878 (20 Statutes, 88), are, in my opinion, very defective. The only lands from which such cutting is authorized are the *mineral* lands.

1st. The mineral lands are to a great extent undefined, and necessarily must so remain.

2d. Large quantities of timber are absolutely necessary for the development of mines, while the said act authorizes the cutting thereon of the timber for other purposes. The purchaser of a mining claim has as much (if not a greater) need for the timber thereon as the agriculturist, and the transportation of timber to the mines from a distance is very expensive.

3d. The law furnishes no relief to such as reside at a distance from such lands. The situation is practically this: The settlers on lands devoid of timber need timber for fuel, building, &c. Very frequently they cannot get it, except from the public lands. If they cannot get it legally, still they will take it, and when taken solely for said purposes it is under circumstances which largely mitigate the technical legal offense.

While parties who steal the public timber for speculation and profit deserve severe punishment, those who use it solely for home purposes under the imperative necessities above mentioned should have their privileges accurately and reasonably defined. I deem the enactment of some law which will accomplish this end to be very desirable and in the public interest.

This office contains the record of original sales of land, and of final adjustments of controversies relating to the public domain. It annually furnishes an immense amount of information to interested parties, at a great outlay of labor. I deem it quite impracticable to give in this communication any full detail of the vast work which has for several years seriously embarrassed this office, because of an insufficient clerical force of the requisite ability. My estimate already submitted to you for the clerical force for the fiscal year ending June 30, 1883, is as follows:

Commissioner	$5,000 00
Deputy commissioner	3,000 00
3 inspectors of surveyor-general and district land offices, at $3,000 each	9,000 00
Chief clerk	2,500 00
Law officer	2,500 00
Recorder	2,000 00
3 principal clerks, of public lands, private lands, and of surveys, at $2,000 each	6,000 00
6 chiefs of division, a $2,000 each	12,000 00
Receiving clerk	2,000 00
Chief draughtsmen	2,000 00
34 clerks of class 4, at $1,800 each	63,000 00
50 clerks of class 3, at $1,600 each	80,000 00
60 clerks of class 2, at $1,400 each	84,000 00
55 clerks of class 1, at $1,200 each	66,000 00
35 copyists, at $900 each	31,500 00
Chief messenger	900 00
8 assistant messengers, at $720 each	5,760 00
6 packers, at $720 each	4,320 00
12 laborers, at $660 each	7,920 00
	389,400 00

It will be observed that the above estimate embraces more clerks at somewhat less salaries than were asked for last year by my predecessor. He did not ask for a greater number of clerks because at that time there was no room to accommodate them, and in the matter of my estimate for salaries I have sought to name the very lowest figures which, in my judgment, would possibly justify a reasonable expectation of retaining what good and competent men are now employed and thoroughly skilled in the business, and of obtaining from the outside a class of ability which the public have a right to expect will be employed to adjust the vast interests committed to this office. I conceive it to be of great importance that a deputy commissioner be speedily authorized for this office. The executive duties devolving upon the head of the bureau are so great and varied, as is well known, that it is impracticable and beyond physical possibilities for any Commissioner to personally discharge them in a proper manner. With a deputy commissioner a division of these duties can be made which will result largely to the benefit of the public business. I therefore recommend that this officer be authorized at as early a date after Congress convenes as may be practicable. I have also estimated for an appropriation for three inspectors of surveyor-general and district land offices, at a salary of $3,000 each. It has been the practice to detail clerks from this office, or employ special agents from the outside, to investigate irregularities and frauds, and to inspect the local offices. This proceeding is however open to serious objection. Not only is the agent comparatively unskilled in most instances, but the system of an occasional examination does not meet the demands of the service. The local land officers are subject to frequent change by death, resignation, or removal, and new and unskilled officers are appointed; errors in business methods are perpetuated, and by reason of defective proceedings in the local offices, claimants frequently suffer, and additional work is imposed upon this office. The local offices should be under continued and intelligent supervision. A system of fraud not infrequently continues for a considerable time before this office is advised of its existence, and then it has but imperfect remedies at its command. In this, as in most other matters, prevention is better than cure. The inspectors named should be tried, trusty, intelligent men, well versed in land laws and in the business of this office. Their duty should be, under direction from this office, to aid in the opening of all new land offices; to instruct new officers in their duties; see that the offices are legally and properly administered; detect and report fraud, irregularities, and inefficient officers, and, in short, to do and perform any duties in connection with the land service for which special agents have heretofore been appointed, or as the Secretary of the Interior or this office may direct. Many of the same reasons which render the employment of Inspectors in the Indian Department advisable apply with equal force to the land service. I am confident that the employment of such inspectors would cost less than the present system, would be far more effective, and would result in speedy improvement of the service.

Mineral Lands Division.—The condition of work in the division of this office having charge of mineral lands is shown by the following statement:

Mineral lands sold from July 1, 1880, to June 30, 1881, acres	27,189.68
Excess over previous year, acres	12,066.94
Mineral entries made from July 1, 1880, to June 30, 1881	1,301
Excess over previous year	529
Mineral applications made from July 1, 1880, to June 30, 1881	1,863
Adverse claims made from July 1, 1880, to June 30, 1881	734
Mineral patents issued from July 1, 1880, to June 30, 1881	727
Mineral entries unexamined July 1, 1880	1,156
Mineral entries examined and suspended July 1, 1881	461
Coal lands sold from July 1, 1880, to June 30, 1881	4,975
Coal filings made from July 1, 1880, to June 30, 1881	263
Coal patents issued from July 1, 1880, to June 30, 1881	9
Mineral contests finally disposed of from July 4, 1880, to June 30, '81	20
Mineral contests not finally disposed of June 30, 1881	94
Mineral contests received from July 1, 1880, to June 30, 1881	33
Letters received from July 1, 1880, to June 30, 1881	5,060
Letters written from July 1, 1880, to June 30, 1881	3,484
Pages of patent record written	4,465

Reports of the Surveyors-General.—From the reports of the surveyors-general we extract the following, as being of interest in this connection:

California.—Theodore Wagner, Surveyor-General for California, in his report for 1881, says: Of the mineral productions of California, gold is, beyond comparison, the most important, the most remarkable gold fields in the world existing in the State. Though the metal has been found east of the Sierra Nevada, among the mountains of the coast, and in various other localities, almost the entire product of the State has been derived from the great auriferous belt in the western slope of the Sierra Nevada, extending from Fort Tejon northward into Oregon, and measuring about 220 miles by 40 wide. Under recent developments the gold deposits of the north and south extremities of this belt, which were considered as of comparatively little importance, have shown a surprising richness. The principal mining operations are, however, carried on in the central portion, embracing the western parts of Mariposa, Tuolumne, Calaveras, Amador, El Dorado, Placer, Nevada, Sierra Plumas, and the eastern part of Yuba and Butte Counties.

The gold, with rare exceptions, is found in the native or metallic state. It is never perfectly pure, but is alloyed with more or less silver, and sometimes also with small quantities of other metals. It occurs extensively in two distinct and well-defined conditions, viz., in the solid rock, usually in veins, and in alluvial deposits in the form of minute scales, coarse grains, and larger pieces, more or less water-worn and mixed with sand and gravel. From this circumstance three distinct modes of mining have arisen; viz., placer, hydraulic, and quartz or vein mining. In the first named the metal is obtained by washing the auriferous gravel, by which process, the gold, owing to its great specific gravity, is speedily separated from the sand and earthy matter. Owing to the simplicity of the process placer mining was at first chiefly carried on, but it has been largely superseded by hydraulic and quartz mining, which requires more capital, skill, and complicated machinery.

In hydraulic mining, a body of water in a compact, continuous stream is directed with great force upon the walls or banks of auriferous earth and cemented gravel deposits, which, in most instances, are prepared for the action of the water, by heavy charges of blasting powder placed in small

United States Public Lands.—Where they lie.

	Land States and Territories.	Area of Public Lands in States and Territories.		Number of Acres of Public Lands Surveyed.				Total Area of Public and Indian Lands Remaining Unsurveyed, inclusive of the area of Private Land Claims Surveyed up to June 30, 1881.
		In acres.	*In square miles.*	*Up to June 30, 1880.*	*Prior to June 30, 1880, not heretofore reported.*	*Within the Fiscal Year ending June 30, 1881.*	*Total up to June 30, 1881.*	
1	Alabama	32,462,115	60,722	32,462,115			32,462,115	
2	Alaska	369,529,600	577,390					369,529,600
3	Arizona	72,906,240	113,916	5 807,874		5,096	5,812,970	67,093,270
4	Arkansas	33,410,063	52,202	33,410,063			33,410,063	
5	California	100,992,640	157,801	52,349,048	4,322,662	888,308	57,560,018	43,432,622
6	Colorado	66,880,000	104,500	26,222,321	1,369,278	7,435,084	35,026,683	31,853,317
7	Dakota	96,596,480	150,982	25,174,377	431,783	1,475,655	27,081,815	69,514,665
8	Florida	37,931,520	59,268	30,175,027			30,175,027	7,756,493
9	Idaho	55,228,160	86,294	7,488,792	303,667	60,916	7,853,375	47,374,785
10	Illinois	35,465,093	55,414	35,465,093			35,465,093	
11	Indiana	21,637,760	33,809	21,637,760			21,637 760	
12	Indian Territory	44,154,240	68,991	27,003,990			27,003,990	17,150,250
13	Iowa	35,228,800	55,045	35,228,800			35,228,800	
14	Kansas	51,770,240	80,891	51,770,240			51,770,240	
15	Louisiana	26,461,440	41,346	25,312.548		235,084	25,547,631	913,808
16	Michigan	36,128,640	56,541	36,128,640			36,128,640	
17	Minnesota	53,459,840	83,531	39,949,417	69,159	194,427	40,213,003	13,246,837
18	Mississippi	30,179,840	47,156	30,179,846			30,179,840	
19	Missouri	41,836,931	65,370	41,836,931			41,836,931	
20	Montana	92,016,640	143,776	11,364,964	46,100	348,018	11,759,082	80,257,558
21	Nebraska	48,636,800	75,995	41,554,593	508,143	852,300	42,945,036	5,691,764
22	Nevada	71,737,600	112,090	13,301,002	4,524,598		17,825,600	53,912,000
23	New Mexico	77,568,640	121,201	10,543,650	916,217	3,179,216	14,639,083	62,929,557
24	Ohio	25,576,960	39,964	25,576,960			25,576,960	
25	Oregon	60,975,360	95,274	23,067,020	2,368,722	1,008,324	23,067,020	34,531,294
26	Utah	54,064,640	84,476	9,781,960		294,409	10,076,369	43,988,271
27	Washington	44,796,160	69,994	15,959,175	177,855	231,459	16,368,489	28,427,671
28	Wisconsin	34,511,360	53,924	34,511,360			34,511,360	
29	Wyoming	62,645,120	97,883	9,063,635	48,189	1,055,116	10,366,940	52,278,180
	Total	1,814,788,922	2,835,606	752 557,194	10,561,775	21,788,011	784,906,980	1,029,881,942

tunnels run into them a short distance and then turned to right angles. After the placing of the charge, the tunnels are tightly closed and the powder fired by fuse. Thousands of tons are upheaved by one blast. The matter thus loosened, together with the water, is received in sluices, in which the gold, having precipitated, is collected, while the worthless débris is carried away. In this manner many large hills have been leveled, in some instances to the great detriment of farms and orchards situated in the path of the débris or "slickens" from the mines. The auriferous quartz occurs in veins and ledges, which are very numerous and have a general north-northwest and south-southeast direction, parallel with the central axis of the Sierra Nevada. The rock is crushed in powerful mills, and the gold extracted by amalgamation. The most accurate estimate of the gold product of California since the discovery of that metal in 1848 to January, 1881, is $981,800,000.

Next to gold, probably the most important mining interest of California is the production of quicksilver, which is obtained only from its sulphuret or cinnabar, of which deposits are found at many points. It occurs in the Sierra Nevada and the triassic rocks in the southern portion of the State, but most abundantly in the Coast Range. Ores of silver abound in various parts of the State, and some of them are very rich; but silver mining has not yet been developed to such a degree as to render it of any considerable importance. Argentiferous galena is mined at numerous localities in San Bernardino, Mono, Alpine, and Inyo Counties. The mines of that character in the last-named county exceed in productiveness all others within the State. Argentiferous copper ores are found in that part of the State bordering on Arizona. Iron ores of superior quality exist in the Coast Range Mountains and in other parts of the State. The most valuable deposits are supposed to exist in Placer and Sierra Counties. The ores occur in a belt of metaphoric rock, and are marked by an entire absence of arsenic, sulphur, phosphorus, and such other substances as tend to deteriorate the quality of the metal. The ores are magnetic and of the same variety as those from which the best Swedish and Russian irons are made. A smelting furnace has been erected near Clipper Gap, in Placer County, which turns out about 35 tons of pig-iron per day, but the capacity is capable of being extended almost indefinitely according to demand. About 600 tons of this metal have been thus far smelted, one-third of which has already been used in the foundries of San Francisco. It has by actual test proven greatly superior to the best Scotch pig, having successfully resisted a pressure of over 18,000 pounds to the square inch, while the maximum resistance of Scotch pig is placed at about 6,000 pounds. In less exact tests at the foundries, it has taken sixteen blows to fracture a pig of California iron, while a Scotch pig of the same thickness and area yielded at one blow from a sledge-hammer in the same hands. Experts pronounce the placer iron equal to the famous Salisbury (Connecticut) metal for making car-wheels, owing to its "chilling" qualities. It can readily be rolled into first quality "merchant's bar."

The iron is graded, according to its density, from 1 to 5. Nos. 1 and 2 are extra foundry, suitable for all purposes where soft, tough, and durable iron is required; it takes a fine finish, works with ease in either lathe or planer, and supports a strain double that of the best English or French brands. Nos. 3 and 4 are of a harder nature, the former being a superior car-wheel iron, and both are of extra quality. No. 5 is a white iron, and, where a chill of through-and-through nature is required, especially adapted for stamp-mill, &c. The foundries at Dutch Flat, Grass Valley, and Virginia City, and the rolling-mills at Sacramento and this city, as well as the principal San Francisco foundries, have worked the iron and found that in every essential quality it compares favorably with the best foreign article. The presence of iron ore at Clipper Gap has been known for many years, but the high price of labor and fuel prevented its earlier development. At present an abundant supply of fuel, in the form of charcoal, is obtained from the oak and pine forests adjacent to the mine and furnace. The furnace consumes charcoal at the rate of one and three quarter millions of bushels per annum. The charcoal kilns (which are in Nevada County), mine, and smelting furnace provide employment for about 200 men.

A large deposit of marble in the vicinity furnishes a good flux. Good smelting coal, limestone, and iron ore being near geological neighbors in other regions, there is no good reason why the same geological rule should not prevail at Clipper Gap, or at any other place in the State where iron ore and limestone are known to exist in close proximity to one another, and that future explorations should not develop the presence of coal in the vicinity, which may be substituted for charcoal as fuel when the present convenient supply of timber is exhausted. It is reported that the iron company has ordered from the East all the necessary machinery for a rolling-mill, which will be erected near the furnace. It is the intention to manufacture railroad iron, gas pipe, and such other iron wares as will command a profit on this coast. A nail factory, where the Placer iron is worked, is now in operation near San Quentin, in Marin County. The Pacific coast has for years been supplied with iron and steel from foreign sources, brought us by foreign ships. The annual supply from abroad approximates to about 160,000 tons, valued at $6,000,000 in rough, and in the manufactured state, of course, a much larger sum. Importations from the Atlantic States, not dutiable, amount to about $2,000,000. Large as the consumption has heretofore been on this coast, it must rapidly increase hereafter with the building of railroads, quartz-mills, and hoisting works, and its growing use in the construction of iron pipes, for buildings, naval architecture, and in a thousand other ways. It is a safe calculation that the demand for iron will more than double with every future decade. There is no industry which can contribute more to the wealth of the State.

Returning from this digression we find that deposits of chromic iron and manganese exist in the coast range; copper ore has been found in various localities; sulphuret of copper, or copper pyrites, is found in auriferous quartz lodes in nearly all the mining counties; and platinum is said to abound in the lower parts of the Klamath Valley. In the coast mountains asphaltum exists in immense quantities, and petroleum has been obtained to an extent which justifies the belief that the local demand, at least, can be supplied from the home product. Natural exudations of oil can be traced seeping through the sandstone formation, and showing at the surface, accompanied, more or less, with gas and water. The oil belt commences in Humboldt County and passes through Mendocino, Marin, Contra Costa, Santa Clara, San Luis Obispo, Santa Barbara, and Los Angeles Counties. Deposits of lead and zinc have been discovered, but are yet undeveloped. Tin ore of a rich quality has been found; also plumbago, cobalt in various ores, a large lode of sulphuret of antimony, chalk, and chromium. Alum exists in Santa Clara and Calaveras Counties and at the Geysers and Owen's Lake, where there are hot alum springs. Fine specimens of alabaster, marble, granite, and buhrstone have been obtained. Bismuth, gypsum, and many varieties of precious stones occur throughout the mountains. Fine varieties of porcelain clay exist in many of the mining counties, and clay suitable for making fire-brick is found near Benecia. Beds of hydraulic limestone, occupying a position between the sandstone and the shales, occur in the cretaceous strata, but have not been obtained of sufficient size for use as an ornamental stone. Of the non-metallic mineral productions the most important are coal, borax, sulphur, and salt. In 1860 valuable deposits of coal were discovered on the north slope of Mount Diabolo in beds varying in width from 30 to 50 inches. Bituminous coal of good quality is obtained, which is shipped by rail to the San Joaquin River, five miles distant, and shipped thence by water. Coal also exists in the hills south of Mount Diabolo.

Near the Cajon Pass, in Los Angeles County, extensive coal fields have recently been discovered, no less than seven well-defined veins of coal having been found. Two competing railroads, the Southern Pacific and Atlantic and Pacific, will pass along the border of this belt, assuring quick and cheap transportation facilities. In 1859 remarkable deposits of borax, or biborate of soda, were discovered beneath the waters of Borax Lake, near the south extremity of Clear Lake, in Lake County. The water of the lake, which generally covers about 100 acres at an average depth of 3 feet, is strongly impregnated with borax. Beneath the water, in a thick layer of mud, borax abounds in crystals, some of which are three inches across. This mud has been tested, and found to be charged with borax to a depth of 60 feet. There is another borax lake a few miles northeast of Clear Lake. On the edge of the latter is a group of boiling springs, scattered over an area of about 8 acres, lightly charged with boracic acid, soda, and chlorine. These springs discharge about 300 gallons of water per minute. Sulphur occurs in various parts of the State, but most extensively near Clear Lake and in Colusa County. Near the former place are immense deposits which yield 70 to 80 per cent. of pure brilliant sulphur. Salt is found at various points. The most extensive works are in Alameda County, near the Bay of San Francisco, where the salt annually collected exceeds 10,000 tons. Mineral springs of every variety exist in abundance, some of which are highly esteemed for their medicinal qualities. In San Bernardino Valley are numerous warm springs, with temperatures varying from 108° to 172°.

Montana.—Mr. Rosswell H. Mason, Surveyor-General of Montana, says: The yield from placer mines during the last, has been about the same as for the previous, fiscal year—there being possibly a slight decrease. As labor becomes more plentiful, and wages less, large tracts of land which, at present, would hardly pay for development, will be worked at a profit. There has been a slight increase in the product of gold lodes, some valuable mines have been purchased by eastern and foreign capitalists, who are now developing them, and I look for an increased product of at least fifty per cent. during the present fiscal year. In this connection, it should be stated that there are very few of the mines known distinctively as silver lodes that do not contain some gold. I was informed a few days since by a gentleman who is largely interested in mines and mills, that the bullion produced from his ten-stamp mill at Butte, during the past four years, had contained at least $100,000 in gold.

The increase in the product of silver lodes has been very large, some estimates placing it at double that of the previous fiscal year. It would be impossible for me in the limited time and space at my disposal, to mention even the most prominent silver lodes in the Territory, or enumerate the mills and reduction works erected during the past fiscal year. Large bodies of these ores exist in various parts of Montana, but, except those carrying a large percentage of silver, cannot generally be profitably mined or worked. Copper smelting works have recently been established at Butte, and copper mines in that vicinity are now being profitably developed. Some work has been done upon coal mines, but none upon the vast deposits of iron ore in Montana. If the various railroad projects for this Territory are carried to completion the manufacture of car wheels and castings, iron and steel rails, &c., will form an important branch of industry. The most reliable estimates place the value of export of precious metals during the past fiscal year, inclusive of that contained in base bullion and ores, as follows:

Gold	$3,500,000
Silver	5,000,000
Total value of shipments	8,500,000

Nevada.—Mr. E. S. Davis, Surveyor-General of Nevada, reports: The great wealth of Nevada lies not altogether in her agricultural valleys and mountains of mineral veins. Her most barren and utter deserts bid fair to become the source of her greatest wealth. That nature makes nothing in vain is assured by the fact that discoveries are constantly being made of vast deposits of salt, soda, borax, niter, sulphur, &c., on the desert plains. In the desert hills, that are destitute of vegetation, except scattering, stunted sage brush and greasewood, are also found gypsum, asbestos, silica, kaolin, cinnabar, plumbago, bitumous shale, indications of coal, iron, and many other deposits, as well as veins of copper, antimony, galena, gold, and silver, and other metals, all of which are used extensively in the arts and sciences, trades, and manufactures, and their development will inaugurate new and permanent industries, and prove sources of great profit to those engaged in their production. But little progress has been made in the development of these valuable deposits, solely on account of the want of some cheaper means of transportation than has yet been afforded. But they are coming; already narrow-gauge railroads are being projected and constructed to reach these deposits. The construction of the Carson and Colorado narrow-gauge road had for its primary object the traffic to be derived from the salt and borax deposits in Esmeralda County. When the Carson and Colorado Railroad is completed to Columbus the development of these deposits will begin in earnest, and will prove a bonanza to the owners. The soda deposits in Churchill County have not been fully developed for want of some better means of transportation. The deposit seems to be almost unlimited; it exists in a solid stratified form and looks like ice as it is quarried from the pits. Notwithstanding the long distance it has to be hauled by teams to the railroad, large quantities are shipped to San Francisco.

The niter deposits of Humboldt County was the subject of a very able paper recently read before the California Academy of Sciences by Hon. B. B. Redding. This being a matter of general interest, I shall take the liberty of embodying in this report a condensation of Mr. Redding's highly interesting information on the subject, A number of samples of earth, gathered from different points in the Humboldt Desert, having been forwarded to Mr. Redding, he caused them to be carefully analyzed, and found that some of them contained from fifteen to thirty-five per centum of nitrate of soda. Careful inquiry concerning the climate, geological formation, and salt fields of the desert of Tarapaca in Peru, where are found the deposits of nitrate of soda which furnish the principal supplies to the manufactories of the world, satisfied Mr. Redding that the natural conditions of the Tarapaca and Humboldt deserts were not dissimilar, and it seemed probable to him that, by further exploration, extensive beds of earth and gravel, cemented into masses of salt and nitrate of soda (called *caleche* by the Peruvians), might be found sufficiently rich in nitrates to create an extensive business and make the United States, in this valuable material, independent of Peru and Chili. When it is remembered that nitrate of potash or nitrate of soda are used either directly or indirectly in the manufacture of gunpowder, dynamite, nitro-glycerine, as well as a great many other explosives, and nitric acid, it will be readily seen how large a part niter performs in the commerce and manufacture of civilized nations. To illustrate our present dependence on other nations for nitrates, the records of the Treasury Department show that there were imported into the United States for the year ending June 30, 1879, 76.285,798 pounds of nitrate of soda, valued at the custom-house at $1,384;572. There was also imported the same year of nitrate of potash, crude and refined 9,463,388 pounds, which paid a duty of $89,977.80. In evidence of the increasing dependence of the manufactures of the Pacific coast on niters brought from foreign countries. Mr. Redding calls attention to the fact that for the year ending June 30, 1879, there were imported into San Francisco 10,388,589 pounds of nitrate of soda, valued at $191,278, and 258,253 pounds of nitrate of potash, valued at $11,077, while for the past year ending June 30, 1881, the importation into the port had increased to 14,783,-226 pounds of nitrate of soda, valued at $326,494, and 468,257 pounds of nitrate of potash, valued at $18,358. Or to state the facts in a more condensed form, in two years the consumption of nitrate of soda on the Pacific coast had increased nearly one-third, and of nitrate of potash nearly one-half. As before stated, the great source of supply of nitrate of soda is from a desert in the province of Tarapaca in Peru. This desert, which is about seventy-five miles in length, lies at an elevation of from 3,000 to 4,000 feet, and in its nearest point is not more than 45 miles from the ocean.

The nitrate of soda is found in greater or less quantities over an area of several hundred square miles of this desert. Rains are rare in that region and the country is destitute of water near the surface. In addition to nitrate of soda, the earth of this desert contains chloride of sodium, borates of lime and soda, sulphates of lime and soda, and magnesia. Alumina and iodine always exist with the nitrate of soda. The most extensive works on the desert are at the Pampa, or Taramagal. The plain is supposed to have been at one time a sea lake. Its western border for a width of 2,000 feet is covered with salt. Still further west and adjoining the salt deposit is found the *caleche*, or rough nitrate. The remains of many other lakes are also found on the desert with similar characteristics and with beds of nitrate of soda in similar positions. Mr. J. F.

Flagg, a civil engineer, had charge of one of the most extensive works at Taramagal for extracting nitrate of soda and appears to have studied the climate and geological formation of that part of Peru with much care and attention. A paper from him on the subject was read before the American Institute and published in the American Chemist in 1874. From this and other sources, Mr. Redding learns that the *caleche*, or rough nitrate, is found beneath the surface in insolated masses. Sometimes it is found at a short distance beneath the surface, covered only by a few inches of sand, frequently, at a greater depth, covered by a cap of hard earth and sand indurated with salt. The thickness of the nitrate is from 1 to 10 feet, but does not average more than 3 feet. Beneath the nitrate is a bed of soft sand containing an abundance of crystals of glauberite and small quantities of borates of lime and soda. The *caleche*, or earthy matter containing nitrate of soda, varies in quality from nearly pure common salt containing traces of nitrate up to 50 and occasionally 60 per cent. of nitrate of soda. The miner makes an excavation where he expects to find the nitrate and, if successful, tunnels into the *caleche* and fills the hole with course gunpowder made on the spot, regulating the charge to the amount of earth he proposes to loosen. After the mass has been loosened and broken by the explosion, it is assorted and all of the *caleche* supposed to contain over 10 per cent. is conveyed to the works where the salt and other materials are separated from the nitrate. The average cost of production at the works in Taramagal in 1874, including all expenses of mining, assorting, separating and preparing for the market, was estimated at 1¼ cents per pound.

Thus far nitrate of soda has been found on the Humboldt desert, in this State, and at different points on the southeast side of the Sink of the Humboldt for a distance of 25 miles. The center of the region would be approximately opposite Brown's Station, on the Central Pacific Railroad, latitude 40 north, longitude 118.35 west, elevation 3,925 feet. This region, from the description, resembles the desert of Tarapaca in Peru. Its immense beds of salt indicate that it was at one time below the ocean. In it are found also the borates and sulphates of lime and soda, magnesia and alumina. It is also practically a rainless region. A record of eight years shows that it receives an annual rain-fall of but 4.16 inches. Its average summer temperature is 78°.8 Fahr. The discoverer of these nitrate deposits is Mr. Walter Schmidt, and under his direction Mr. Redding visited the Humboldt desert a few months since. He gives a very encouraging account of his researches, and reports that nitrate of soda is found not only on the desert, but in some of the hills surrounding it. On the southeastern side of the Sink of the Humboldt is a range of trachyte mountains having an elevation above the water of the lake of about 1,200 feet. The general trend of these mountains for about 25 miles is northeast and southwest. The particular range does not appear to be named, other than it is called a part of the west Humboldt range. A hill at the southwestern extremity of the range of a marked red color, is called Niter Hill. On the south side of the hill, about 400 feet above the lake, was shown the nitrate of soda in its matrix, if it may be so described. At this place the trachyte is much broken into irregular seams and readily splits off into conchoidal flakes. In these seams and between these flakes the spaces are filled with nitrate of soda united with chloride of sodium. The seams examined by Mr. Redding were from one-eighth to half an inch wide. Several analyses showed from 20 to 30 per cent. of nitrate of soda, the remainder consisting principally of common salt. Appearances seemed to show that the niter and salt, from whatever source derived, formed on each surface of the seams and grew by accretion in crystalline form until the seam was filled. This was shown by the fact that in many cases where the distances between the two surfaces of the rock were wider than usual a vacant place was left in the centre of the niter. Observation has shown that wherever the crevices were exposed to the light rains of winter the nitrate and salt were dissolved, but that the crevice was always filled with the same material during the hot, dry weather of the next summer. After referring to various theories concerning the formation of the nitrate of soda—generally conceded to be through the evaporation of salt water and the agency of the carbonate of lime—Mr. Redding has reason to believe that the formation goes on with great rapidity on the Humboldt desert, and with cheaper transportation its production is destined to become of great commercial importance. He says: "None of the water courses of this region reach the ocean; all evaporate in the so-called sinks. The light winter rains that dissolve the nitrate must carry it in solution down to the desert, where the water is evaporated. At certain places in the gravel beneath the sand the water will come in contact with decayed shells, which are found beneath the surface in nearly all parts of the desert, and also the decayed vegetable matter from plants which once grew on the spot, as well as from decayed vegetable mater annually brought down by the Humboldt River. Here the process of formation may be renewed. Thus far the largest bodies of *caleche* have been found beneath the surface in the desert; and it is probable that if ever found in sufficient quantity and in sufficently large percentage to pay for working, the profitable deposits will be found on the deserts adjoining the salt deposits. The slight explorations that have thus far been made convinced me that in the event of war or a large advance in the present prices of niter, sufficient can be found in the Humboldt desert to supply all demand in the United States for several years. It may also be mentioned that nitrate of soda has also been found near the sink of the Carson River, and at other points where the streams of Nevada run into desert basins and evaporate.

Among other desert productions of the State may be noted the article of sulphur, which may be produced cheaply and in almost any desired quantity. In Humboldt County, especially, sulphur deposits are numerous, some of them producing the nearly pure brimstone of commerce. These mines or deposits seem to be capable of producing an almost inexhaustible quantity, but the distance from the Central Pacific Railroad is considerable, and the roads are sandy and heavy. To one of these deposits a narrow-gauge railroad is contemplated, connecting with the Central Pacific at Humboldt. In fact these minerals and salines are found in every part of the State, and exist mostly in lands unfit for cultivation. These lines should be surveyed as well as the farming, timber, and mineral land, in order that parties locating them may secure proper titles. With progress of the railroad system now being extended over the State, the development of these great laboratories of nature will continue, and must in the end form industries important to the future of the State.

The mineral outlook of the State is most encouraging. While the annual gold and silver product of what is known as the Comstock mines has been steadily decreasing with the exhaustion of the great ore body in the California and Consolidated Virginia mines, the less prominent mining districts in other portions of the State have assisted in swelling the aggregate yield of the precious metals, so that the mining industry of the State still continues to be of paramount importance. Every mountain range in the State contains mines of gold and silver of greater or less value, and the steady efforts of the prospector are almost daily bringing to light and development new and important mineral deposits.

Beyond the Comstock, the Eureka district continues to be the most promising and productive, the silver appearing in combination with lead, and the ores being reduced by smelting. Reliable authority informs us that two mines in that district—the Eureka Consolidated and the Richmond Consolidated—have alone paid more in dividends to their stockholders than all the mines of Colorado combined, and have declared $919,000 more in dividends than all the mines of Utah, Arizona, and Dakota. The amount already paid to the shareholders of these two mines is but little short of $8,000,000, and late developments show that the great ore bodies of the district are practically inexhaustible. The continuation of the Carson and Colorado Railroad toward the southern boundary of the State will greatly stimulate mineral discovery in Esmeralda County, while the extension of the railroad southward from Eureka can scarcely fail to result in the opening of many new mining districts in Eureka, White Pine, Nye, and Lincoln Counties.

At the present writing the indications of the early discovery of new ore bodies below the barren and exhausted levels of the Comstock are most promising, and I hazard little in predicting that for many years to come this great fissure will sustain its reputation as a leading centre of attraction to mining operators. Yet, whatever developments may determine in regard to the future of the Comstock, Nevada will scarcely fail to maintain its position as the first among all the States and Territories in the production of the precious metals; and the future will show, I think, that the annual yield of the State, referring to a period ten years before, reached its minimum in 1880.

New Mexico.—Mr. Henry M. Atkinson, Surveyor-General for New Mexico, reports: The mining interests of the Territory have made wonderful strides in development, and new discoveries are being made almost daily of silver, gold, copper, iron, and coal. The developments made in the old districts are such as to encourage the owners and attract both home and foreign capital for their development. A serious impediment is met with by the miners and prospectors in searching for mineral upon unconfirmed grants. The last clause of the 8th section of the act of Congress provides that the lands embraced within the limits of a grant shall not be disposed of in any manner until final action by Congress upon the question of the validity or invalidity of the claim. The right to the mineral was not embraced in the grants, they being agricultural and pastoral grants, yet there is no provision permitting the miner to acquire any right to what he may discover upon a tract covered by an agricultural grant, and I suggest that some action be had by Congress which will enable the prospector to secure the benefits of his mineral discoveries upon tracts covered by unconfirmed grants. The mining interests of Southern New Mexico have been seriously interfered with by the depredations of hostile Indians under Victory and Naña, and but little prospecting could be safely engaged in, yet the adventurous miners have made many new and valuable discoveries in the limited area that they have been able to prospect. The northwest portion of the Mescalero Apache Indian Reservation is known to be rich in minerals; and, as it is of no practical use to the Indians, I suggest that it would be advisable to restore to market townships 9, 10, 11, 12, and 13 south, of range 11 east, and townships 9 and 10 south, of range 12 east, and if necessary after the reservation an equivalent of land on the south where Indians will be equally as well provided for. In fact, this reservation ought to be abolished entirely and the Indians disarmed and removed to the Indian Territory or the Eastern States, where they can be surrounded by civilization, and, if the object is to civilize and to Christianize them, they should be placed where it can be done quickly and where they will not be subject to the temptations incident to the border. This suggestion would apply with equal force to all of the wild tribes. The Mescalero Reservation, lying so close to the Mexican border, enables the Indians to commit depredations and seek refuge in Old Mexico, or to plunder the citizens of Mexico and return to the reservation, where they are safe from pursuit. The restoration to market of this reservation, which is known to be very rich in gold, silver and copper, would result in opening up one of the finest mineral sections of New Mexico. To the northward of the reservation and but a few miles distant is the district of the White Oaks, which contains several hundred miners and is a very prosperous camp. To the west and southwest, in Doña Ana County, rich discoveries of mineral have recently been made in what is known as the San Augustin District, lying east and northeast of the towns of Mesilla and Las Cruces, in the Organ range of mountains. Several of the mines in this district were worked many years ago, and the old mines, together with the new discoveries which are now being worked, show considerable bodies of fine ore.

More new and valuable discoveries of mineral have been made the past year in this Territory than in all the years preceding, and there is no industry that will pay as well if properly and intelligently managed. Labor is comparatively cheap, and the seasons are favorable for the prosecution of work every day in the year, and, with the great abundance of fine bituminous and anthracite coal, fuel for smelting and refining purposes can be obtained at a mere nominal cost. The past year has witnessed the introduction of considerable capital, which has been applied in mining operations, yet much more is required, and is sure to follow the completion of the lines of railway now in process of construction through the Territory. While a large portion of New Mexico is arable and produces excellent crops of corn, wheat, &c., yet it is eminently a mineral-producing country, and the time is not far distant when it will take rank among the first of the mineral-producing sections of America.

Utah.—Mr. Frd. Solomon, Surveyor General for Utah, reports: The bullion yield of precious metals during the past fiscal year has not been in arrears with former years, notwithstanding the fact that deep snows have been a severe drawback in many localities. A number of prominent mining camps were thereby stagnated, and the mills shut down. The Ontario, in Uintah mining district, still stands at the head of the larger mines in the country, the regular bullion shipments exceeding in round figures the sum of $200,000 per month, or about $2,500,000 per annum. Ore is found in such vast quantities that the company deems it advisable to double the capacity of their 40-stamp mill. The Horn Silver Mining Company, in San Francisco mining district, has sunk the shaft to a much greater depth, and struck new deposits of ore far richer than those in the upper levels. During the last year the shipments amounted to 443 car loads, or 9,370,712 pounds gross, of which 9,326,126 pounds are lead, and 640,531.13 ounces silver. In addition to this, large quantities of ore which were extracted from the mine have been sold in a crude state. The Great Basin Mining Company, with General P. E. Connor as managing director, in Rush Valley mining district, bas, within the past year, erected hoisting and concentrating works at a total cost of $80,000. The product which the mine yielded during this period amounted to $150,000. The ore is chiefly argentiferous galena. W. S. McCornick & Co., bankers in Salt Lake City, have, during the calendar year ending December 31, 1880, handled bullion to the amount of about $34,000 per week, aggregating about $177,000 per annum.

Large deposits of antimony have recently been found on Mesa Creek, which are worked to great advantage, the products being shipped to California. This mineral is found in two localities, one west of Beaver City, the other in Detroit mining district, Millard County. Not much can be said about these deposits, since very little work has been performed towards developing the same.

The coal basin of Utah originally extended from beyond the northern boundary line of the Territory to about the southern boundary, and from beyond the eastern boundary to the western watershed of the Wasatch Mountains. This original basin was broken by the upheaval of the Uintah Mountains, leaving an island north of said Uintah Range, extending from a point near the headwaters of the Weber River to nearly the northern boundary of the Territory. The coal again appears where Book Cliff Mountains branch off from the Wasatch, and thence extends along the eastern watershed of said Wasatch, and through the lower plateaus terracing off from the same to Green and Colorado rivers and the southern boundary of the Territory. Seven or eight seams have so far been definitely explored, varying from 4 to 30 feet in thickness. The 4-foot seam was first opened in San Pete Valley, but was found to be so much mixed with shale and limestone as to be useless for market, but the same seam has again been tapped in Castle Valley, on Ivy Creek, where it is perfectly clear, and produces the best coke of any coal in this system. A seam of from 8 to 10 feet in thickness has for a long time been worked on Grass and Coal Creeks, in Summit County, from which even at present a great part of the supply of Salt Lake City is drawn. The same seam and a 30-foot seam have also been tapped in Pleasant Valley, which said mines were of sufficient importance to build a narrow-gauge railroad. In Castle Valley the coal lies in the greatest available area, and is now being tapped by the two main branches of the Denver and Rio Grande Railroad in Utah. Castle Valley also contains seams of cannel coal, and some not altogether unimportant seams of jet. The coal, with possibly the single exception of the 4-foot seam is lignite, or belonging to the new sandstone formation.

The main deposits of iron are situated in Iron County, the same extending from Iron Springs to Iron City, about 15 miles square. It is mostly magnetic or specular ore and huge bowlders of hematite, the latter containing a small percentage of silver. Smaller deposits may be found at the head of Hard Scrabble and City Creek Cañons, on the boundary line of Morgan and Salt Lake Counties; also in Tintic mining district, and some on the Provo River, east of Park City. A small bed is also found in connection with the coal in Castle Valley; also a deposit in the Wah-Wah Mountains, Beaver County. Attempts have been made to manufacture iron in this territory, but not with important results, since the necessary capital required for the successful operation of this industry has not been invested. The ore is now chiefly used for fluxing purposes in the different smelters, which consume vast quantities during the year.

A species of mineral wax, peculiar to Utah, and which some scientists have termed "Utahcorite," is found along the Pleasant Valley Railroad, in Soldier Cañon, where it occurs in small seams. Another seam of 20 feet, rather impure, is found at the head of north fork of Nine Mile Creek, near the boundary line between Wasatch and Emery Counties. In connection with this is generally found a first-class quality of bituminous shale, varying in thickness with the different localities. Several varieties of marble have been found in this territory, in such quantities and qualities as to make them of commercial value. A very fine white marble is found on Snake Creek, Wasatch County, also at Frisco, Beaver County; brown marble is found in Spanish Fork Cañon, Utah County, and black marble at the Warm Springs, Salt Lake City. The last two kinds are fossiliferous. Rock salt is found in such large deposits that the term of mountain is perfectly justified. They occur principally around Salina, Sevier County, from which the crude and refined article is shipped to the southern parts of Utah, also to Arizona and Nevada. Gypsum, which always accompanies these deposits, is found in corresponding quantities. The main sulphur beds are situated in Gordon Mining District, Millard County, on and about Cove Creek. They cover nearly 300 acres, and of many openings made by shaft and cut, none shows it to be less than twenty feet thick. At that depth the still active exhalations become intolerable. About 5,000,000 tons of sulphur are in sight, some of which is 98 fine, but the average is about 65; the sulphur beds of Sicily being 20. The commercial value of the Utah find is chiefly a question of transportation. Minor beds are found at the head of main fork of Bear River, in Summit County.

MINING LAWS OF THE STATES AND TERRITORIES.

We append here a number of laws in force in different states and territories, and some that are not in force, for the purpose of showing the direction of changes in the laws. They are compiled from various sources, including the laws of the different States, "Copp's Mining Code," "Carpenter's Mining Law," and "Our Western Empire."

NEVADA.—The following are the main sections of a statute of the State of Nevada approved February 27, 1866:

Sec. 1.—Any six or more persons who are males of the age of twenty-one years and upwards, holding mining claims in any mining district, or who hold mineral lands not within the boundaries of any established mining district, may form a new mining district embracing said claims, at a meeting of such persons to be called by posting for five days in at least five conspicuous places within the limits of such proposed new district, notices in writing stating the place and time for holding such meeting, describing as near as may be the limits of such proposed new district, and signed by not less than five of such persons. At said meeting all males of the age of twenty-one years and upward holding mining claims, or any interest therein, within said limits, may vote, and by a majority vote determine whether said new mining district shall be established, and its boundaries, which shall be within the limits named in said notices; and thereafter the persons so qualified and holding mining claims in such newly established district shall proceed to select a name therefor and elect a district recorder, who shall be qualified as aforesaid. He shall perform all the duties required of him by law, and shall, within thirty days after qualifying, file and record in his office a record of the proceedings of said meeting. No district formed under the provisions of this act shall be divided by any county line. Mining districts now existing may be continued.

Sec. 22.—On and after the second Saturday of July, 1866, all locations of mining claims shall be made in the following manner: On a monument not less than three feet high, firmly established in a conspicuous place on the claim, there shall be placed a plainly-written notice embracing a description of the ground claimed, the date of location, the name of the claim, the name of the company, and the names of the locators, with the number of feet claimed by each, and a copy of said notice, accompanied by a written request for a survey of said claim by the district recorder, shall, within thirty days after the making of such location, be filed in the office of the district recorder of the district in which said claim is located; and in case there be no legally authorized district recorder in and for the district, or the claim be outside of the limits of an organized mining district, then, and in that case, said notice may be filed in the office of the county recorder of the county in which said claim is located; and a written request for a survey by the county surveyor shall be served upon the county surveyor within a reasonable time thereafter; the county surveyor, or his deputy, shall perform all the duties required of a district recorder by the provisions of this act. He shall keep a record of all his transactions in such cases, and for such services he may charge and receive the same fees allowed by law for his services in like cases. Within thirty days after the making of such location there shall be done on said claim, as assessment work, to hold the same up to and including the day preceding the first Saturday of the then following August, excavation involving the removal of fifty cubic feet of earth or loose material, or five cubic feet of solid rock, for each two hundred feet in the claim; and, as soon as may be thereafter, said district recorder shall survey the same and record the notice of survey as provided in section 14 of this act; and said district recorder shall file and record a certificate in regard to the assessment work, which shall be substantially in the following form:

—— DISTRICT,—— COUNTY, NEVADA,—— DAY OF —— MONTH OF YEAR.

This is to certify that on the ——— claim governed by the —— ——— company, surveyed on ——— date, there has been done by or on behalf of said company sufficient work to hold said claim up to the first Saturday of August next.

———, *District Recorder.*

Sec. 23.—Any person may locate mining claims in favor of others, but no person shall be entitled to hold by location more than two hundred feet of any one ledge, except by virtue of discovery of the same, for which he shall be entitled to hold two hundred feet additional. In the case of locations made as extensions, the location of two hundred feet by virtue of discovery is allowed. No claim shall, in the aggregate, exceed in extent two thousand feet on any one ledge.

Sec. 24.—Any location made on a ledge by authority of this act shall be deemed to include all the dips, spurs, angles and variations of said ledge. The locators of any ledge shall be entitled to hold one hundred feet on each side of it, except where they would by so doing invade the territory of a claim previously located.

Sec. 31.—On the first Saturday of August, 1866, at which time the first assessment year shall begin, this act shall supersede all district mining laws, and thereafter said laws shall be considered as repealed: *Provided*, Any and all rights heretofore acquired under and by virtue of such district mining laws shall be determined in accordance with said mining laws existing at the time when said rights were acquired. During the period extending from and including the 1st day of May, 1866, to and including the day immediately preceding the first Saturday of the following August, no claim shall become subject to relocation by reason of the non-performance of assessment work. Locations may be made under this act at any time on and after the second Saturday of July, 1866, at which time the district recorders elected under this act shall, if qualified, enter upon the discharge of their duties, and on and after said second Saturday of July, no location shall be made under district mining laws.

Sec. 32.—The doing of assessment work, or the payment of assessment dues, shall not be required in order to hold a claim during any assessment year, if during the year next preceding such assessment year there has been done on said claim, by or on behalf of the claimants thereof, an amount of work costing, at fair valuation, not less than fifty cents for each foot in said claim; but in all other cases assessment work shall be done or assessment dues shall be paid as provided in this act. Assessment dues shall be paid for every assessment year by the parties holding the claim to the district recorder elected under this act, before the first Saturday of August, commencing the assessment year for which they are paid, except as otherwise provided in this section,

Sec. 33.—Except as otherwise provided in section 32, every mining claim located and held under district mining laws, on which, before the 1st day of May, 1866, there has been work done involving the excavation of fifty cubic feet of earth or loose matter, or five cubic feet of solid rock, for each 200 feet in such claim, shall be subject to assessment dues. On every mining claim located and held under district mining laws, on which such work has not been done before the 1st day of May 1866, assessment work shall be done on or before the day immediately preceding the first Saturday of August, 1866. The doing of such assessment work or the paying of such assessment dues shall enable the owner of said claim to hold the same for the next ensuing assessment year, commencing on the first Saturday of August, 1866.

Sec. 34.—The assessment work done within the thirty days after the location of a claim under this act, as provided in section 22, shall hold the same only up to the beginning of the assessment year following the date of said location, and for such next ensuing assessment year and for every year thereafter, except as provided in section 32 of this act, such claim shall be subject to assessment dues.

Sec. 45.—The extraction of gold or other metals from alluvial or diluvial deposits, generally called placer mining, shall be subject to such regulations as the miners in the several mining districts shall adopt.

March 6, 1879, the following became law:

Sec. 1.—In every mining district in this State in which the seat of government of any county is situated, the county recorder of said county shall be *ex-officio* District Mining Recorder, subject, in the discharge of his duties, to such rules, regulations and compensation, as may be now in force or hereafter prescribed by the mining laws of the mining districts respectively to which this Act is applicable. He shall, as such *ex-officio* Mining Recorder, be responsible on his official bond for the faithful performance of the duties of his office, and the correct and safe keeping of all the records thereof.

Sec. 2.—This act shall take effect and be in force from and after the first day of August, A. D. 1880.

OREGON.—Sec. 1.—That any person, or company of persons, establishing a claim on any quartz lead containing gold, silver, copper, tin, or lead, or a claim on a vein of cinnabar, for the purpose of mining the same, shall be allowed to have, hold, and possess the land or vein, with all its dips, spurs, and angles, for the distance of three hundred feet in length, and seventy-five feet in width on each side of such lead or vein.

Sec. 2.—To establish a valid claim the discoverer or person wishing to establish a claim shall post a notice on the lead or vein, with name or names attached, which shall protect the claim or claims for thirty days; and before the expiration of said thirty days he or they shall cause the claim or claims to be recorded as hereinafter provided, and describing, as near as may be, the claim or claims, and their location; but continuous working of said claim or claims shall obviate the necessity of such record. If any claim shall not be worked for twelve consecutive months it shall be forfeited and considered liable to location by any person or persons, unless the owner or owners be absent on account of sickness, or in the service of their country in time of war.

Sec. 3.—Any person may hold one claim by location, as hereinafter provided, upon each lead or vein, and as many by purchase as the local laws of the miners in the district where such claims are located may allow; and the discoverer of any new lead or vein, not previously located upon, shall be allowed one additional claim for the discovery thereof. Nothing in this section shall be so construed as to allow any person not the discoverer to locate more than one claim upon any one lead or vein.

Sec. 4.—Every person, or company of persons, after establishing such claim or claims, shall, within one year after recording or taking such claim or claims, work or cause to be worked to the amount of fifty dollars for each and every claim, and for each successive year shall do the same amount of work, under penalty of forfeiture of said claim or claims: *Provided*, That any incorporate company owning claims on any lead or vein may be allowed to work upon any one claim the whole amount required as above for all the claims they may own on such lead or vein.

Sec. 5.—It shall be the duty of the county clerk of any county, upon the receipt of a notice of a miners' meeting organizing a miners' district in said county, with a description of the boundaries thereof, to record the same in a book to be kept in his office as other county records, to be called a "book of record of mining claims;" and, upon the petition of parties interested, he may appoint a deputy for such district, who shall reside in said district or its vicinity, and shall record all mining claims and water rights in the order in which they are presented for record; and shall transmit a copy of such record at the end of each month to the county clerk, who shall record the same in the above-mentioned book of record, for which he shall receive one dollar for each and every claim. It shall further be the duty of said county clerk to furnish a copy of this law to his said deputy, who shall keep the same in his office, open at all reasonable times for the inspection of all persons interested therein.

Sec. 6.—Miners shall be empowered to make local laws in relation to the possession of water rights, the possession and working of placer claims, and the survey and sale of town lots in mining camps, subject to the laws of the United States.

Sec. 7.—That ditches used for mining purposes, and mining flumes permanently affixed to the soil, be and they are hereby declared real estate for all intents and purposes whatever.

Sec. 8.—That all laws relative to the sale and transfer of real estate, and the application of the liens of mechanics and laborers therein, be and they are hereby made applicable to said ditches and flumes: *Provided*, That all interests in mining claims known as placer or surface diggings may be granted, sold, and conveyed by bill of sale and delivery of possession as in cases of the sale of personal property: *Provided further*, That the bills of sale or conveyances executed on the sale of any placer or surface mining claim shall be recorded within thirty days after the date of such sale, in the office of the county clerk of the county in which such sale is made, in a book to be kept by the county clerk for that purpose, to be called the record of conveyances of mining claims.

Sec. 9.—Mortgages of interest in placer or surface mining claims shall be executed, acknowledged, recorded, and foreclosed as mortgages of chattels.

Sec. 10.—The county clerk shall be entitled to a fee of one dollar each for every conveyance or mortgage recorded under the provisions of this act.

Lodes, Placers, and Water-rights.—AN ACT to amend Section 1 of Chapter 38 of the Miscellaneous Laws of Oregon, pertaining to mines, as compiled by M. P. Deady and L. F. Lane.

Be it enacted by the Legislative Assembly of the State of Oregon:

Sec. 1.—That section 1 of Chapter 38 of the Miscellaneous Laws of Oregon pertaining to mines, as compiled by Matthew P. Deady and Lafayette Lane, be amended so as to read as follows: That any person or company of persons, establishing a claim on any quartz lead containing gold, silver, copper, tin, or lead, or a claim on a vein of cinnabar, for the purpose of mining the same, shall be allowed to have, hold and possess the land or vein, with all dips, spurs, and angles, for the distance of fifteen hundred feet in length and three hundred feet in width on each side of such lead or vein.

Sec. 2.—That all local laws and regulations now existing in the mining districts of this State that have not been made within two years next preceding the passage of this Act, shall be, and the same are hereby, declared null and void.

Sec. 3.—That from and after the passage of this act, any person, company, or corporation owning placer claims, composed of creek, bench, and hill claims, joining, may represent the whole of said claims by working or mining on any one of the same.

Sec. 4.—That from and after the passage of this act, any person or persons, company or corporation, shall be allowed to represent his or their placer claims, ditches and water rights, as may best suit his or their convenience; *Provided*, that whenever any person, company or corporation, being the owner of any placer mining claim or claims, ditches, and water rights, have or shall abandon the same, and who shall for one year thereafter cease to exercise ownership over said claims, ditches, and water rights, shall be deemed to have lost all title, claim, or interest therein.

Sec. 5.—That whenever any person, company, or corporation have or shall locate a placer claim or claims in conformity to the Act of Congress approved May 10, 1872, and the amendments thereto, the said claim or claims, together with all ditches and water rights appurtenant to, and connected with the same, shall not be subject to any local law or regulation of the mining district in which the same may be situated, but shall thereafter be subject only to the law governing real estate.

Approved October 25, 1880.

IDAHO.—Sec. 1.—That any person or persons who may hereafter discover any quartz, lead or lode shall be entitled to one claim thereon by right of discovery, and one claim each by location.

Sec. 2.—That a quartz claim shall consist of two hundred feet in length along the lead or lode by one hundred feet in breadth, covering and including all dips, spurs and angles within the bounds of said claim, as also the right of drainage, tunneling and such other privileges as may be necessary to the working of said claim.

Sec. 3.—The locator of any quartz claim on any lead or lode shall, at the time of locating such claim, place a substantial stake, not less than three inches in diameter, at each end of said claim, on which shall be a written notice specifying the name of the locator, the number of feet claimed, together with the year, month and day when the same was taken.

Sec. 4.—All claims shall be recorded in the county recorder's office, within ten days from the time of posting notice thereon: *Provided*, That when the claim located is more than thirty miles distant from the county seat the time shall extend to fifteen days.

Sec. 5.—Quartz claims recorded in accordance with the provisions of section 4 of this act shall entitle the person so recording to hold the same to the use of himself, his heirs and assigns: *Provided*, That within six months from and after the date of recording he shall perform, or cause to be performed, thereon work amounting in value to the sum of one hundred dollars.

Sec. 6.—Any person or persons holding quartz claims in pursuance of this act shall renew the notice required in section 3 at least once in twelve months, unless such claimant is occupying and working the same.

Sec. 7.—The conveyances of quartz claims heretofore made by bills of sale or other instruments of writing, with or without seals, shall be construed in accordance with the local mining rules, regulations and customs of miners in the several mining districts, and said bills of sale or instruments of writing concerning quartz claims without seals shall be *prima facie* evidence of sale, as if such conveyance had been made by deed under seal.

Sec. 8.—Conveyances of quartz claims shall hereafter require the same formalities and shall be subject to the same rules of construction as the transfer and conveyance of real estate.

Sec. 9.—The location and pre-emption of quartz claims heretofore made shall be established and proved when there is a contest before the courts, by the local rules, customs and regulations of the miners in each mining district where such claim is located, when not in conflict with the laws of the United States or the laws of this Territory.

Sec. 10.—This act is to take effect and to be in force from and after its approval by the Governor.

Approved February 4, 1864.

Miner's Lien.—Sec. 12.—Every sub-contractor, journeyman, laborer, or other person, performing labor, or furnishing materials for any contractor, in or upon any quartz) claim, ledge, or mine, in working in the same or in the improvement or development thereof in the completion or performance of any contract entered into by any person in this Territory, every such person or person so performing such labor or furnishing such material shall have a lien upon all the interest in such quartz claim, ledge or mine of the person or persons employing him or them, or purchasing such materials with the improvements thereon and appurtenances thereto belonging, and also upon all the interest of the person or persons for whom such person or persons acts as agent, or the owner or owners, for the value of such work, or labor or materials furnished, and all the provisions of this act shall apply in respect to recording, recovering, and enforcing such liens provided for in this section: *provided*, the person or persons claiming such lien shall within thirty days after the performance of such labor or furnishing such materials, give notice in writing to any person or persons, agent or agents, owner or owners, and shall within forty days file their lien in other respects as provided by this act.

Sec. 13.—When any person or persons shall do or perform any work or labor in or upon or for any quartz claim, mine, or ledge, in working the same or in the improvement or development thereof; or in the preparation of the ores thereof for reduction; or in the hauling of the ores thereof; or shall perform labor or service as superintendent, manager, or foreman of any mine or ledge, or shall perform labor as a mechanic or artisan therefor; such person or persons shall have a lien upon all the interests in such quartz claim, ledge, or mine of the person or persons employing him or them, or purchasing such materials, together with the improvements thereon and appurtenances for the value of such work, labor, or services, or materials furnished, and all the provisions of this act respecting the filing, recording and recovering and enforcing mechanics' liens are made applicable to this section: *provided*, the person or persons claiming such liens shall, within sixty days after the completion of such work or labor, or rendering said services or furnishing said materials, file their lien in other respects as provided by this Act.

Sec. 14.—This Act shall be so construed as to include in its provisions bridges, ditches, flumes, aqueducts to create hydraulic power for mining purposes, and all improvements on mining claims. —Extract from an Act approved Jan. 11, 1875.

14.—The amount of work to be done or improvements made during each year, to hold possession of a mining claim, shall be that prescribed by the laws of the United States, to wit: one hundred dollars annually.

15.—Within six months after any set time or annual period herein allowed for the performance of labor or making improvements upon any lode claim, the person on whose behalf such outlay was made, or some person for him, shall make and record an affidavit in substance as follows:

TERRITORY OF DAKOTA, County of ———, } ss.

Before me, the subscriber, personally appeared ———, who, being duly sworn, says that at least ——— dollars' worth of work or improvements were performed or made upon [here describe the claim or claims, or part thereof] prior to the — day of ———, A. D. 18—, situate in ———mining district, county of———, Territory of Dakota. Such expenditure was made by or at the expense of ———, owner of said claim, for the purpose of holding said claim.

[Jurat.] [Signature.]

And such certificate, when recorded in the office of the register of deeds of the county wherein such claim is located shall be *prima facie* evidence of the performance of such labor.

16.—The relocation of abandoned lode claims shall be by sinking a new discovery shaft, and fixing new boundaries, in the same manner as if it were the location of a new claim; or the relocater may sink the original shaft, cut, or adit to a sufficient depth to comply with sections five and seven of this chapter, and erect new or adopt the old boundaries, renewing the posts if removed or destroyed. In either case, a new location stake shall be erected. In any case, whether the whole or part of an abandoned claim is taken, the location certificate must state that the whole or any part of the new location is located as abandoned property.

17.—No location certificate shall claim more than one location, whether the location be made by one or several locators; and if it purport to claim more than one location, it shall be absolutely void, except as to the first location therein described; and if they are described together, or so that it cannot be told which location is first described, the certificate shall be void as to all.

18.—The register of deeds shall be entitled to receive the sum of one dollar for each location certificate recorded and certified by him, and shall furnish the locator or locators with a certified copy of such certificate when demanded, for which he shall be entitled to receive fifty cents.

7. Any open cut, cross cut, or tunnel, at a depth sufficient to disclose the mineral vein or lode, or an adit of at least ten (10) feet in along the lode, from a point where the lode may be in any manner discovered, shall be equivalent to a discovery shaft.

8. The discoverer shall have thirty days from the time of uncovering or disclosing a lode, to sink a discovery shaft thereon.

9. The location, or location certificate, of any lode or claim shall be construed to include all surface ground within the surface lines thereof, and all lodes and ledges throughout the entire depth, the top or apex of which lies inside of such lines extended vertically, with such parts of all lodes or ledges as continue, by dip beyond the side lines of the claim, but shall not include any portion of such lodes or ledges beyond the end lines of the claim, or the end lines continued, whether by dip or otherwise, or beyond the side lines in any other manner than by the dip of the lode.

10. If the top or apex of the lode in its logitudinal course extends beyond the exterior lines of the claim at any point on the surface, or as extended vertically downward, such lode may not be followed in its logitudinal course beyond the point where it is intersected by the exterior.

11. All mining claims now located, or which may be hereafter located, shall be subject to the right of way of any ditch or flume for mining purposes, or of any tramway or pack trail which is now in use, or which may be hereafter laid out across any such location: *Provided always*, That such right of way shall not be exercised against any location duly made and recorded, and not abandoned prior to the establishment of the ditch, flume, tramway, or pack-trail, without consent of the owners, except by condemnation, as in case of land taken for public highways; parol consent to the location of any such casement, accompanied by the completion of the same over the claim, shall be sufficient without writing; *and provided further*, That such ditch or flume be so constructed that the water from such ditch or flume shall not injure vested rights by flooding or otherwise.

12. When the right to mine is in any case separate from the ownership or right of occupancy to the surface, the owner or rightful occupant of the surface may demand satisfactory security from the miner, and if it be refused, may enjoin such miner from working until such security is given. The order for injunction shall fix the amount of bond.

13. If at any time the locator of any mining claim heretofore or hereafter located, or his assigns, shall apprehend that his original certificate was defective, erroneous, or that the requirements of the law had not been complied with before filing, or shall be desirous of changing his surface boundaries, or of taking in any part of an overlapping claim which has been abandoned, or in case the original certificate was made prior to the passage of this law, and he shall be desirous of securing the benefit of this act, such locator or his assigns may file an additional certificate subject to the provisions of this act: *Provided*, That such relocation does not interfere with the existing rights of others at the time of such relocation, and no such relocation or the record thereof shall preclude the claimant or claimants from proving any such title or titles as he or they may have held under previous locations.

DAKOTA.—1. The length of any lode claim hereafter located within this Territory may equal, but shall not exceed, fifteen hundred feet along the vein or lode.

2. The width of lode claims shall be one hundred and fifty feet on each side of the center of the vein or crevice; *Provided*, That any county may, at any general election, determine upon a greater width not exceeding three hundred feet on each side of the center of the vein or lode, by a majority of the legal votes cast at said election; and any county, by such vote at such election, may determine upon a less width than above specified; *Provided*, That not less than twenty-five feet on each side of the vein or lode shall be prohibited.

3. That the discoverer of a lode shall, within twenty days from the date of discovery, record his claim in the office of the register of deeds of the county in which such lode is situated, by a location certificate, which shall contain:

(1) The name of the lode.
(2) The name of the locator.
(3) The date of location.
(4) The number of feet in length claimed on each side of the discovery shaft.
(5) The number of feet in width claimed on each side of the vein or lode.
(6) The general course of the lode, as near as may be.

4. Any location certificate of a lode claim which shall not contain the name of the lode, the name of the locator, the date of location, the number of lineal feet claimed on each side of the discovery shaft, the number of feet in width claimed, the general course of the lode, and such description as shall identify the claim with reasonable certainty, shall be void.

5. Before filing such location certificate, the discoverer shall locate his claim by first sinking a discovery shaft thereon sufficient to show a well defined mineral vein or lode; second, by posting at the point of discovery, on the surface, a plain sign or notice containing the name of the lode, the name of the locator, and the date of discovery, the number of feet claimed in length on either side of the discovery, and the number of feet in width claimed on each side of the lode; third, by marking the surface boundaries of the claim.

6. Such surface boundaries shall be marked by eight (8) substan-

tial posts, hewed or blazed on the side or sides facing the claim, and sunk in the ground, to wit: one at each corner, and one at the centre of each side line, and one at each end of the lode. When it is impracticable, on account of rocks or precipitous ground, to sink such posts, they may be placed in a monument of stone.

Arizona.—The following is the statute of Arizona on the registry and government of mines and mineral deposits, with the exception of the sections providing the manner in which the rights of miners shall be enforced by the courts.

Sec. 1.—All mining rights on the public lands of the United States, as well as rights acquired by discovery on the lands of private individuals, are possessory in their character only, and such possessory rights shall be limited, regulated and governed as hereinafter provided.

Sec. 15. Every mining claim or pertenencia is declared to consist of a superficial area of 200 yards square, to be measured so as to include the principal mineral vein or mineral deposits, always having reference to and following the dip of the vein so far as it can or may be worked, with all the earth and minerals therein. But any mining district organized in accordance with the provisions of this chapter may prescribe the dimensions of said mining claim or pertenencia for such district: *Provided*, That in no case the dimensions so prescribed shall exceed the number of yards allowed by this section; *and further provided*, That no such mining district shall diminish the extent of the territorial claim to one pertenencia, as defined in this section.

Sec. 16.—Any person discovering or opening a vein or other mineral deposit in this Territory, not actually worked or legally owned by other parties or registered in accordance with this chapter, shall by properly denouncing and registering the same, be entitled to claim and hold a possessory right to a tract of land to the extent of two mining claims or pertenencias, including the said vein or mineral deposit, and conforming as nearly as possible to the general direction thereof, each to be measured 200 yards long by 200 yards wide, the direction of the lines to be determined by the person claiming.

Sec. 17.—If two or more persons are associated, and have formed a company for the exploration and working of mines, and one or several shall make discoveries of mineral deposits in consequence thereof, said company so engaged in exploration shall be entitled to denounce and register one discovery claim only upon each lode.

Sec. 18.—It shall be lawful for the claimants of a mine or mineral lands to locate and take possession of public lands for a mill site and other necessary works connected therewith, which shall not exceed one quarter section, containing a stream or other water suitable for the purpose. They shall have a right to place a dam or other obstructions on such stream, and to divert its water for the above uses and purposes. They shall, within the time and in the manner prescribed in this chapter for the registration and denouncement of mines, proceed to denounce and register the same with the clerk of the probate court, and they shall be known as auxiliary lands. And if within three years from the day their notice of claim is so recorded they shall expend in fitting the same for a mill, or in placing a mill or reduction works thereon, the sum of $100, they may cause the record of such works to be made and proceedings for confirming their title to be instituted as provided in section 29 of this chapter, with like effect, and receive a certificate of title as thereon provided, conforming as nearly as they can to the requirements of that section. Instead of the work required by section 32 of this chapter they shall use the machinery or other works erected upon said land for mining purposes at least thirty days in each year. Such claims shall be subject to all the provisions of this chapter which are applicable to mining rights, and may be abandoned and relocated. All rights to auxiliary lands acquired under the laws of any mining district before this act takes effect shall be valid, and the owners of the same, upon complying with the provisions of this section, may take the like proceedings to confirm their titles, with a like effect.

Sec. 19.—It shall be the duty of all claimants of mining claims, mineral lands and auxiliary tracts, to at once define the extent and boundary of them as nearly as possible, by good substantial monuments or other conspicuous marks, in the presence of the recorder of the mining district, or of some witness who shall prove to the satisfaction of the recorder that the same has been done, and to post up a public notice of their claim at the opening of the principal vein, and to have them properly registered and recorded within three months from the time of first claiming them at the office of the mining district recorder according to the provisions of this chapter. Such record shall give a faithful description of the veins, mineral deposits, and tracts of lands, the character and bearing of the veins or deposits, and their connection with natural monuments or conspicuous objects in the vicinity.

Sec. 20.—No person shall change his original monuments or boundaries of mineral or other lands, but if a subsequent investigation makes this convenient or necessary, and it can be done without prejudice to other parties, then such change shall take place by the sanction of the judge of the probate court, provided they are properly recorded, and the new boundaries and monuments fixed at once when the original ones are removed.

Sec. 21.—All minerals, woods, waters, earths and vegetation found within the boundaries of any tract of land registered and claimed for mining shall be exclusively used by him or them who are legally entitled to the possession of the land wherein or whereon they are situated, so long as they are used for mining purposes only: *Provided*, That no one shall have the right to prevent transient persons from using the waters along the public highways, where they were provided by nature in natural tanks, springs, streams, or otherwise, nor from making such equitable disposition of the waters as the legislature shall prescribe.

Sec. 22.—No person shall have the right to impede or inconvenience travelling by fencing up the public roads, filling them up with rubbish, or undermining them so as to endanger their safety, neither shall any one change their established direction without sanction of the proper authorities.

Sec. 23.—Whenever two or more persons or parties explore and prospect one and the same vein, and at or about the same time but at different places, and without knowledge of each other, then he or they who shall prove first occupancy shall have the right of first location, taking the principal point of excavation as the center of their claim or claims on each side along the general direction of such vein or deposit. The other parties shall proceed by the same laws after the others have fixed their boundaries. Should there be left vacant ground between the different parties, then it shall be at the option of the first discoverers so to change their boundaries as shall best suit them, and have them recorded accordingly. Any other parties shall locate in the order of the time of their arrival on the vein or mineral deposit.

Sec. 24.—Whenever two or more parties shall select the same mine or mineral deposit for exploration, and the parties first on the ground, knowing the other parties to be at work, shall fail to give warning, either verbally or in writing, of their priority claim on such vein or deposit, then that portion of the mine situated between the main excavations of the two parties shall be equally divided between them, irrespective of the number of members each company may have: *Provided*, That the intervening portions shall not exceed the quantity of land allowed by the provisions of this chapter.

Sec. 25.—The laws and proceedings of all mining districts established in this Territory for the denouncement, registration, and regulation of mines, mining claims, mineral lands, and auxiliary lands, prior to the day this act takes effect, are hereby legalized and declared to be as valid and binding in all courts of law as if enacted by this legislative assembly, to the extent and under the conditions and restrictions herein contained.

I.—All rights, claims, and titles to any veins, mineral lands, or mineral deposits, and auxiliary lands, acquired before this act takes effect, under, by virtue of, and in conformity to the laws of said mining districts, are hereby declared to be valid and legal, and shall be respected and enforced in all courts of this Territory, when sustained by the evidence herein provided; but no amount of work done thereon shall be construed to give a perpetual title thereto, but shall give such title only and such rights and privileges as are provided in section 29 of this chapter; and no person who was at the time of the location of his claim an inhabitant of this Territory shall forfeit his claim because he was not a resident also of the mining district in which his said claim was located. And no such right, claim, or title shall be considered as abandoned provided the claimant shall within six months from the day this act takes effect file with the clerk of the probate court of the county in which his claim is situated a brief description of the same, giving the name of the district in which the lode is situated, and of the lode or lodes, and the extent of his claim thereon, with a declaration that he intends to retain and work the same according to law, unless such claim has been forfeited and subject to re-location under the laws of such mining district before this act takes effect.

II.—All records and all papers required by the laws of said mining district to be deposited with the recorders of said district for record shall be received as evidence of their contents in all courts of this Territory, and shall not be rejected for any defects in their form, when their contents may be understood, but shall be valid to the extent provided by said mining laws, except as hereinbefore restricted: *Provided*, That such records and papers are deposited with or recorded by the clerk of the probate court of the county in which said mining district is located, and within three months from the time this act takes effect; and if said records or papers are lost or mutilated, or if such recorder of a mining district shall neglect or refuse to deposit the same as aforesaid, an affidavit of their contents made by any person interested therein, or certified or sworn copies thereof, may be so recorded, and shall have the like effect.

III. All conveyances of mines, mining rights, mineral and auxiliary lands made prior to the time this act takes effect shall be valid and binding to pass the title of the grantor thereof, although defective in form and execution, if their contents can be understood, and as such shall be received and regarded in all courts of this Territory: *Provided*, That such conveyances shall be deposited with or recorded by the clerk of the probate court of the county where said mines are situated, within three months from the time this act takes effect, and if lost or mutilated, copies or affidavits of their contents, executed as aforesaid, may be recorded as provided above.

Sec. 26.—Every recorder, register, clerk or other recording officer, of every such mining district, or who has at any time acted as such recording officer within three months after this act takes effect, shall deposit with the clerk of the probate court of the county in which said district or greater part thereof is situated, all records which he has so kept, and all papers deposited in his hands for record, and papers so made or deposited with his predecessors in said office, which are in his hands as aforesaid, or he shall so deposit certified copies of the same. And such records and other papers shall be securely kept by such clerk, open in office hours to public inspection, and copies of the same duly certified by him shall be received in all courts of justice, and have the same effect as the originals. And any such recorder, register, or other recording officer of each mining district who shall neglect or refuse to comply with the provisions of this section shall be liable in damages to the party injured thereby, and shall be liable to be punished by the judge of probate of the county in which said mining district, or the greater part thereof, is situated, for contempt, by fine not exceeding $5000 and imprisoned not more than one year, and shall be incapable of holding any such office and mining claim.

Sec. 27.—Mining districts now existing may be continued or new mining districts may be established in the manner and for the purposes hereinafter provided.

I. The recorder of every mining district now existing shall at the same time that he deposits the records of said districts with the clerk of the probate court, as the last preceding section requires, take an oath before the judge of said court that he will faithfully perform the duties of his office until another recorder shall be elected and qualified in his place, which oath shall be recorded by the clerk of the probate court. He shall record in a book to be kept by him for that purpose all notices of claims or rights to veins, mineral deposits, mineral lands, and auxiliary lands which may be left with him to be recorded, and shall note on all papers which may be received by him to be recorded, the time when they were so received by him, and they shall be considered as recorded from that time. He shall, when requested by any such claimant, go with him to his claim and see that the same is measured by metes and bounds, and marked by substantial monuments on the surface of the earth, and shall make a record of the same, and of the time when it was done, and certify it to be correct, or shall make a record and certificate of the same on the evidence of a credible witness, who was present when the same was done, and is cognizant of the facts, and whose name shall be entered on the record. He shall, when requested by any such claimant, go with him to his claim and examine any shaft that may be sunk by him, or tunnels that may be opened to the same, and make measurements of the same, and a record and certificate as aforesaid; and he shall in like manner examine, measure, or estimate, and make and record a certificate of any work which is required by law to be done by a claimant. And the said recording officer shall, quarterly, file with the clerk of the probate court of the county in which said district is located a copy by him certified of all records made by him for the three months last preceding, which shall be duly recorded by said clerk, and a copy of said record duly certified by him shall be evidence of its contents in all courts of this Territory. And such recording officer shall be liable to all the penalties provided in the preceding section if he shall neglect or refuse to perform any of the acts or duties required of him by this section, but shall not be required to perform any such service until his fees for the same, to be fixed by the mining districts, are paid him, if he requests it. And if any paper deposited with him for record is required to be recorded by the clerk of the probate court, he shall at the time said paper was so deposited with him take and receive the fee fixed by law for recording such paper by said clerk, and pay the said clerk said fee when he deposits said paper with him to be recorded as aforesaid. All such mining districts may make laws not inconsistent with the laws of the Territory, may elect officers for the government of such districts, and fix their compensation, but all such acts and proceedings shall be recorded, and all records and papers thereof filed with the clerk of the probate court as aforesaid.

II.—Any number of persons, not less than twelve, owning mining claims in any mining district, or in any contiguous mining districts, or who have discovered and may wish to denounce a mine or mineral lands, not within the limits of any established mining district, may proceed to make a new mining district at a meeting of persons holding claims in such district so to be established, and of claimants in any districts to be divided or included therein. They shall cause a notice in writing, and specifying the limits of said contemplated district, signed by them, to be posted in three conspicuous places in said district, and if any part of an established district is to be included therein, by leaving a copy of said notice with the recorder of said district at least ten days before the day of said meeting. At said meeting all persons holding claims as aforesaid may vote, and may determine by a majority vote of those present whether said new district shall be established, and its limits, but within the boundaries named in the notice for said meeting, and thereupon the persons holding claims in such newly established district shall proceed to select a name, and make laws therefor, and elect a recorder, who shall be qualified as aforesaid, who shall perform all the duties and be subject to all the liabilities provided in this chapter for such officers, and shall file with the clerk of the probate court as aforesaid a record of the proceedings of this and all subsequent meetings at the time and in the manner herein provided.

Sec. 28.—It shall be the duty of all claimants of mineral tracts to sink at least one shaft of thirty feet in depth, or to run a tunnel of fifty feet in length, in the body of the vein or in the adjoining rock, so as to test the vein from the surface, for the purpose of ascertaining the character and capacity of such mineral deposit, within the space of one year from the day of first taking possession thereof, and they shall notify the recorder of the mining district that said shaft or other work is completed, and that they intend working the vein or mineral deposit. And the recorder shall examine said work in person, and make and record a certificate of the result of such examination which shall contain a statement of the condition and quality of the vein or mineral deposit, the amount of labor performed, and a general view of the results obtained. Said report shall be accompanied by three specimens taken from different parts of the work, which said specimens, with a copy of the record so made by him, shall be filed by him within the time required by this act in the office of the clerk of the probate court. And said clerk shall make a record of the same. Such specimens shall be numbered and described by him, and be preserved for the use of the mineralogical professorship of the University of Arizona.

Sec. 29.—The judge of the probate court, at any time within thirty days after the record made by the clerk of said court, as provided in the preceding section, upon complaint in writing made to him by such claimants, describing fully their claims, stating the labor performed by them, and the certificate thereof, and that the registration of the same has been made as required by law, and requesting that their title thereto may be confirmed, shall cause a summons, under the seal of his court, to be issued, requiring all persons interested to appear at a day named therein, and which shall not be less than sixty days from the day the same was issued, and show cause why the title of such complainants and claimants should not be confirmed, a copy of which complaint and summons duly attested by the clerk of the probate court, shall be published twice in the territorial newspaper, and be kept posted in the office of said clerk from the day of issuing the same to the return day thereof; and if no person shall appear on such return day to contest the right of the claimants to such claims, the judge of probate shall examine all the records filed in the office of his clerk relating to such claims, and if he finds that the said claimants have in all respects complied with the provisions of this chapter, he shall make a decree in substance that the complainants have complied with the laws of this Territory relating to the denouncement and registration of mines, have acquired a perfect title to their claims (describing the same) until the first day of January, A. D. 1868, and forever after unless abandoned by them. And the said clerk shall give the said claimant a copy of such decree, under the seal of the court, which shall be conclusive evidence of title in any proceedings relating to such claims, until they are abandoned. And unless the persons adversely interested and contesting the title of the complainants shall appear on the day named in said complaint, and proceed as hereinafter provided, they shall be forever barred from contesting the title of said complainants to such claims. And if the contestants shall so appear they shall on that day or some day to be fixed by said judge proceed to file an answer, setting forth their claim and case, and the proceedings shall then be conducted in conformity to the provisions of this chapter, and the code of civil practice. And whenever a final decree is made thereon, determining the title to said claim or mine, by said judge, or by any other court on appeal, the said judge shall cause a record to be made in the office of his clerk of such decree, and a certified copy thereof may be made as aforesaid with like effect. And any claimants of mineral lands who before this act takes effect have in any way or under any law acquired a title to such mineral lands, after filing with the clerk of the court their evidence of title and description of claim as required by this chapter, may cause an examination of the shaft sunk by them or other work done by them to be made as aforesaid, and take the like proceedings for the confirmation of their title, with the same effect: *Provided*, This section shall not apply except when the complainants are in possession of such mine or mining rights, claiming title thereto.

Sec. 30.—By reason of the Indian wars and unsettled condition of the country, the time within which a shaft is required to be sunk, or other labor performed on a claim, shall not commence until two years from the day this act takes effect, and all the provisions of this chapter relating thereto are suspended for that time; but any claimant may sink a shaft or do such other labor, and at any time after the record of their claims with the probate court, and thereupon institute proceedings to confirm their titles, and be entitled to all the rights and privileges provided for in this chapter.

Sec. 31.—No single person or company shall be compelled to sink shafts or make other improvements on more than one of the tracts of land claimed by him or them for the same vein or mineral deposit; and any number of claimants on the same vein or mineral deposit, who may unite for said purpose, shall be allowed to concentrate labor, capital, and energy to any one single point which to him or them shall be the best suited to ascertain to the best advantage the general character, quality, and capacity of that particular vein or mineral deposit, and may take the like proceedings to confirm their titles.

Sec. 32.—After the work required by section 28 of this chapter has been performed, and the record thereof made as therein provided, two years shall be allowed the claimants of mineral lands to develop the same, and procure machinery and provide for working the same; and during that time the same shall not be considered abandoned, although no work be done thereon: *Provided*, That in such an event, they shall annually, and before the 1st day of June in each year, file with the clerk of the probate court an affidavit signed by them that they have not abandoned such claims, but intend, in good faith to work them; and said term of two years shall not commence until the first day of January, A.D. 1868. And after the expiration of said term of two years, it shall be obligatory upon claimants to such mineral lands to hold actual possession of them and work the vein, which obligation shall be considered as complied with by doing at least thirty days' work thereon in each year; but if such claimants are prevented from working such vein by the hostility of Indians or other good cause, rendering such working difficult or dangerous, they may, by authority of the judge of probate first obtained, be relieved from performing labor thereon from time to time, but for not more than one year at any one time, during the continuance of such cause.

Sec. 33.—Any person who may discover a mineral vein or deposit as aforesaid, which is not included within a mining district, or which may be in a mining district in which there is no legally authorized recorder, may acquire title thereto, and to auxiliary lands, by giving notice as aforesaid, and recording the same with the clerk of the probate court of the county in which the same is situated, and may take the same proceedings, with the like effect, with the clerk of the probate court that are required to be taken with the recorder of a mining district.

Sec. 34.—Discoverers of mines on lands in the legal ownership or possession of others, and not public lands, before doing the work of sinking the shaft required by section 28 of this chapter, shall pay to such parties such compensation for the use of the same as may be awarded by the judge of probate upon complaint of either party, or shall give bond to such parties for payment of the same, and sureties to be approved by said judge; and whenever it becomes necessary or advantageous to construct tunnels for the purpose of drainage, ventilation, or the better hauling of ores or other subterraneous products or mining materials, it shall be lawful for any party or parties to construct such tunnel or drift through all private and public property: *Provided*, That all damages arising from such subterranean works to the other parties, to be determined as provided above, shall be paid by the parties for whose benefit such tunnelling is done, to be paid before such work is commenced, or security given to the satisfaction of the judge of probate for the payment of the same; but no damages shall be paid on public lands when claims for such lands shall be set up after such tunnel shall have been projected or actually in process of construction: *Provided*, That the lapse of time between projection and actual work shall not exceed ninety days, and that the tunnelling parties give timely notice of their project to any new claimant of the so affected ground.

Sec. 35.—Whenever such tunnel as mentioned in the preceding section shall intersect or traverse mineral deposits, or run along lodes claimed and held by other parties, then it shall be at the option of the owners of such other mineral deposits either to pay one-half of the expense of excavation for the distance that such tunnel runs through their mineral deposits, and secure the whole of the ores excavated, or to divide the ores with the tunnelling parties, the latter paying all expenses of excavation; or, it shall be optional with either party to abandon all claim to the ores excavated.

Sec. 36.—If, in the construction of such subterranean works, new veins or deposits are encountered in ground not claimed or owned by other parties, they shall become the property of the party for whom such tunnel is constructed, and shall be denounced and registered as is required of new mines, and shall be governed by the same laws as are prescribed in this chapter.

Sec. 37.—Any claimant or claimants not complying with any of the foregoing conditions and obligations, shall forfeit all right to any such recorded or unrecorded claims to mineral and auxiliary tracts; and it shall not be lawful for him or them to register such claims anew within a period of three years after such forfeiture. All such tracts shall be free for working and registry to any but those excepted in this section.

Sec. 38.—All veins and mineral deposits situated on public lands, which have not been worked and occupied from the time of the acquisition of the Territory by the United States up to the time of the passage of this chapter, except as herein provided, shall be considered as abandoned and subject to registry and denouncement.

Sec. 39.—All veins and mineral deposits that have been or may be abandoned hereafter shall, in all cases and respects, be governed by the laws regulating the opening and working of new veins and deposits, as prescribed in this chapter.

Sec. 40.—Whenever any mine, vein, or mineral deposit shall have been abandoned or forfeited in accordance with the provisions of this chapter, and registered anew by other parties, it shall be obligatory upon such parties to give the former owners warning thereof, so as to remove from the tract, within the space of three months, anything he or they may think valuable or useful. Such warning shall be given in the nearest newspaper published in the Territory, and by posting it at three of the most conspicuous places in the county where the mine is situated. Three months after the expiration of such warning, any and all buildings, furnaces, arrastras, metals, and every other species of property which may still remain on the ground of such mine, vein, or mineral deposit shall become the undisputed property of the new claimant, without compensation of any kind to any person whatever.

Sec. 41.—Any person taking possession of or entering upon a mining claim or auxiliary lands, registered according to the provisions of this chapter, and before it is abandoned, shall be ousted therefrom in a summary manner by the order of the probate judge, and the malfeaser shall be adjudged to pay all damages and costs consequent thereon.

Sec. 51.—It shall be the duty of persons who may discover and claim mining rights or mineral lands, at the same time that they may define the boundary of their claim or claims to any lode or mine as required by the provisions of this chapter, to lay off and define the boundary of one pertenencia, as required by the provisions of this chapter, adjoining their claim or claims, which shall be the property of the Territory of Arizona. And at the same time that they present their notice of claim or claims to be recorded by the recorder of the mining district, they shall also present to such recorder the claim of said Territory. And, if said discoverers and claimants shall neglect or refuse to present to such recorder the claim of said Territory as aforesaid, they shall forever forfeit all claim to the mine or ledge so discovered by them. Any recording officer recording the claim or claims of such discoverers and claimants, when the claim of said Territory is not filed therewith as aforesaid, shall be subject to all the penalties provided in section 26 of this chapter. Such claim shall be recorded as provided in this chapter for like claims, but no work shall be required to be done thereon, nor shall it be considered to be abandoned so long as it is the property of the Territory; and if sold, the time within which the purchaser shall be required to work said claim shall commence from the day of sale, except when the time is suspended as before provided. Every clerk of the probate court, as soon as he records the said claim, shall send a copy of his record to the treasurer of the Territory, and no fees shall be charged by any recording officer in any matter relating to said claim. And the Territorial treasurer may, at any time after six months from the day he receives such record as aforesaid, and at such time and place as in his opinion will be most for the interest of the Territory, cause such claim to be sold at auction to the highest bidder; but every such sale shall be at least twice advertised in the Territorial newspaper, and be held at his office, or the office of the clerk of the probate court, the recorder of the mining district of the county where the claim is situated. And the treasurer is authorized to make a deed of the same to the purchaser in the name of the Territory; and the amount received by him shall be added by him to any fund now or hereafter provided for the protection of the people of the Territory of Arizona against hostile Indians, and be expended as provided by law. And after all such expenses as are incurred by the Territorial authorities for the purpose of destroying or bringing into subjection all hostile Indian tribes in this Territory are liquidated, then all remaining or accruing funds, out of all or any sales of Territorial mining claims, shall be applied as a sinking fund for school purposes.,

Sec. 52.—The extraction of gold from alluvial and diluvial deposits, generally termed placer mining, shall not be considered mining proper, and shall not entitle persons occupied in it to the provisions of this chapter, nor shall any previous section of this chapter be so construed as to refer to the extraction of gold from the above-mentioned deposits.

Sec. 53.—This chapter shall be in force and take effect from and after the 1st day of January, A. D. 1865.

This is what is known as "Chapter Fifty" of the Howell Code. It has been amended as follows:

An act of placer mines and mining.—Approved December 30, 1865.

3111.—Section 1.—It shall be lawful for any person, company or association who shall place upon the mineral lands of this territory commonly called placer mining grounds, a pump or pumps, having a capacity sufficient to raise at least one hundred gallons of water per minute, with an engine or other power attached thereto, of sufficient power to work the same, with the *bona fide* intention of working the said placer grounds for the purpose of extracting the gold therefrom, to locate an amount of said placer grounds equal in extent to one quarter section, in such form and direction as he or they may elect. *Provided*, that said location shall in no case be more than one mile in length, nor less than one quarter mile in width; and, *Provided*, That said machinery shall be used at least three months in each year for raising water to extract the gold from said grounds, and the presence of machinery upon said grounds shall be the only evidence of title to said grounds; but in no case shall this act be so construed as to mean placer grounds which can be worked by water brought in ditches or flumes from any stream or other deposit of water; and said locations shall not in any case be made upon any grounds in the possession of any miner or miners at the time of location.

3112.—Sec. 2.—This act shall only apply to the county of Yuma.

Sec. 3.—This act shall take effect and be in force from and after its passage.

An act providing for the location and registration of mines and mineral deposits, and for other purposes.—Approved November 5, 1866.

District Rules.—Record.—3113.— Sec. 1.—The mining districts heretofore created in the several counties of this territory are hereby authorized and empowered to make all necessary rules and regulations for the location, registry and working of mines therein: *Provided*, That all locations and registrations of mines and mineral deposits hereafter made in any of the said districts shall be transmitted to the county recorder for record within sixty days after the same shall have been located.

Record.—Fees.—3114.—Sec. 2.—The county recorders of the several counties are authorized and required to procure suitable books in which the record of all mines and mineral deposits shall be kept, which said books shall be paid for out of the county treasury, and they shall receive for their services herein the following fees: For recording and indexing each claim not exceeding one folio, one dollar; and for each additional folio, twenty cents.

Vested Rights.—3115.—Sec. 3.—Nothing in this act shall be so construed as to affect the claims to mines and mineral deposits heretofore located and duly recorded.

3116.—Sec. 4.—The claim of the territory to all mining claims heretofore located is hereby abandoned, and the same are hereby declared open to relocation and registry: *Provided*, That nothing herein contained shall be so construed as to affect mining claims heretofore sold and disposed of by the territory.

Placers.—3117.—Sec. 5.—Nothing in this act shall be construed to apply to placer mines or mining, or other mineral deposits other than those commonly called veins or lode mines.

Acts Repealed.—3118.—Sec. 6.—Chapter fifty of the Howe code, entitled, "Of the registration and government of mines and mineral deposits," as well as all other acts or parts of acts in conflict with the provisions of this act are hereby repealed.

Sec. 7.—This act shall take effect and be in force from and after the first day of January, A. D. 1867.

An Act to provide for the segregation of mining claims.—Approved September 30, 1867.

Partition of Claims.—3119.—Sec. 1.—That whenever any one or more joint owners or tenants in common of gold, silver, copper or mineral-bearing ledges or claims may desire to work or develop such ledges or claims and any other owner or owners thereto shall fail or refuse to join in said work, after due notice of at least thirty days, given by publication in one newspaper printed in the county in which said ledges or claims are located, and if none are printed in said county, then in any newspaper printed in the territory, said notice to have publication in four successive weeks of said paper, said other owner or owners may, upon application to the district court of the district wherein the ledge or claim is situated, cause the interests of said parties so refusing to be set off or segregated as hereinafter set forth.

3120.—Sec. 2.—The owner or owners of any mineral-bearing ledge or claim after the expiration of said thirty days' notice having been given, may, if the party or parties notified fail or refuse to join in the working or developing said ledge or claim, apply to the district court of the district wherein the ledge or claim may be situated, for a partition or segregation of the interest or interests of the party or parties so failing or refusing to join.

3121.—Sec. 3.—The party or parties so applying shall set forth the fact that the said parties have been duly notified, in accordance with section one of this act, and that said party or parties have failed or refused to join in said work; all of which shall be sustained by the oath or affirmation of one or more of the parties applying; and, upon such application being made, the clerk of the said court shall post a notice at the office of the county recorder, and in two other conspicuous places within the district, stating the application, and notifying the parties interested, that unless they appear within sixty days, and show good cause why the prayer of the petitioner should not be granted, that the same will be granted if good cause can be shown.

3122.—Sec. 4.—At the expiration of said sixty days, if the party or parties notified do not appear and show good cause why the prayer of the petitioner should not be granted, the court shall appoint two commissioners to go upon the ground and segregate the claims of the parties refusing to join; and in case they do not agree, they to choose a third party; and said commissioners shall make a report in writing to said court, who shall issue a decree in conformity with said report, which shall be final, except appeal be taken to the supreme court within thirty days after issuance thereof.

3123.—Sec. 5.—The provisions of this act shall not apply to the counties of Yavapai and Pima, and the county of Yuma.

3124.—Sec. 6.—All acts and parts of acts in conflict with the provisions of this act are hereby repealed.

Sec. 7.—This act to take effect and be in force from and after its passage.

An Act Supplementary to Chapter XXXV., Howell Code, "Of the Limitation of Actions." Approved November 5, 1866.

Actions, when Barred.—2111.—Sec. 1.—No action for the recovery of property in mining claims, or for the recovery of possession thereof, shall be maintained unless it appear that the plaintiff, his ancestor, predecessor, or grantor was seized or possessed of the premises in question within two years before the commencement of the action.

2112.—Sec. 2.—No cause of action or defense to an action, founded upon the title to property in mining claims, or to the rents or profits out of the same, shall be effectual unless it appear that the person prosecuting the action, or making the defense, or under whose title the action is prosecuted or the defense is made, be the ancestor, predecessor, or grantor of such person, was seized or possessed of the premises in question within two years before the commencement of the act in respect to which such action is prosecuted or defense made.

2113.—Sec. 3.—All acts or parts of acts in conflict with this act are hereby repealed.

Sec. 4.—This act shall take effect and be in force from and after its passage.

An Act Conferring Jurisdiction of all Mining Claims on the District Court. Approved December 30, 1865.

District Courts, Jurisdiction.—Be it enactsd, etc.:—2366.—Sec. 1.—The district courts of said territory shall have exclusive original jurisdiction of all suits and proceedings relating to mines and mineral and auxiliary lands, and the registry and denouncement of the same, and all the jurisdiction, power, and authority conferred upon the probate courts and probate judges by chapter fifty of the Howell code, entitled, "Of the Registry and Government of Mines and Mineral Deposits," or otherwise, are hereby conferred upon the district courts and district judges respectively.

2367.—Sec. 2.—That section two of title one of said chapter is hereby repealed, and also all the other provisions of said chapter, conferring jurisdiction upon the probate courts and probate judges, over suits and proceedings relating to mines, mineral, and auxiliary lands, as well,as other acts and parts of acts inconsistent with the provisions of this act.

2368.—Sec. 3.—All suits and other proceedings in said probate courts, now pending therein, and over which said probate courts have jurisdiction, are hereby transferred to, and shall be continued in the district court of the county in which said suits and proceedceedings are now pending.

2369.—Sec. 4.—The clerks of the probate courts shall, within thirty days after the publication of this act, transfer to and file in the office of the district courts of their respective counties, all records and papers in suits and proceedings relating to mines, mineral, and auxiliary lands, which records and papers shall be kept and filed by the clerks of said district courts, and when so transferred and filed, said suits and proceedings shall be proceeded with as though commenced in said district courts. *Provided*, That in counties where there shall be no clerks of the district courts, the records and papers shall be transferred and filed as aforesaid within thirty days after the appointment of said clerks, and their acceptance thereof.

Sec. 5.—This act shall take effect and be in force from and after its passage.

COLORADO.—*An Act concerning Mines.*—Be it enacted by the Council and House of Representatives of Colorado:

Extent of Lode Claim.—Section 1. The length of any lode claim hereafter located may equal but not exceed 1,500 feet along the vein.

Dimensions.—Sec. 2. The width of lode claims hereafter located in Gilpin, Clear Creek, Boulder and Summit counties, shall be seventy-five feet on each side of the centre of the vein or crevice; and in all other counties the width of the same shall be 150 feet on each side of the centre of the vein or crevice: *Provided*, That hereafter any county may, at any general election, determine on a greater width, not exceeding 300 feet on each side of the centre of the vein or lode, by a majority of the legal votes cast at said election; and any county, by such vote at such election, may determine upon a less width than above specified.

Certificate of Location,—Sec. 3. The discoverer of a lode shall, within three months from the date of discovery, record his claim in the office of the recorder of the county in which such lode is situated by a location certificate, which shall contain: 1st, the name of the lode; 2d, the name of the locator; 3d, the date of location; 4th, the number of feet in length claimed on each side of the centre of the discovery shaft; 5th, the general course of the lode as near as may be.

When void.—Sec. 4. Any location certificate of a lode claim which shall not contain the name of the lode, the name of the locator, the date of location, the number of lineal feet claimed on each side of the discovery shaft, the general course of the lode, and such description as shall identify the claim with reasonable certainty, shall be void.

Discovery Shaft.—Sec. 5. Before filing such location certificate the discoverer shall locate his claim by first sinking a discovery shaft upon the lode to the depth of at least ten feet from the lowest part of the rim of such shaft at the surface, or deeper, if necessary to show a well-defined crevice. *Second*, by posting at the point of discovery on the surface, a plain sign or notice containing the name of the lode, the name of the locator, and the date of discovery. *Third*, by marking the surface boundaries of the claim.

Staking.—Sec. 6. Such surface boundaries shall be marked by six substantial posts, hewed or marked on the side or sides which are in toward the claim, and sunk in the ground, to wit:—One at each corner and one at the centre of each side line. Where it is practically impossible on account of bed-rock or precipitous ground to sink such posts, they may be placed in a pile of stones.

Open Cuts, etc.—Sec. 7. Any open cut, cross cut or tunnel which shall cut a lode at the depth of ten feet below the surface, shall hold such lode the same as if a discovery shaft were sunk thereon, or an adit of at least ten feet along the lode, from the point where the lode may be in any manner discovered, shall be equivalent to a discovery shaft.

Time.—Sec. 8. The discoverer shall have sixty days from the time of uncovering or disclosing a lode to sink a discovery shaft thereon.

Construction of Certificate.—Sec. 9. The location or location certificate of any lode claim shall be construed to include all surface ground within the surface lines thereof and all lodes and ledges throughout their entire depth, the top or apex of which lies inside of such lines extended downward, vertically, with such parts of all lodes or ledges as continue to dip beyond the side lines of the claim, but shall not include any portion of such lodes or ledges beyond the end lines of the claim, or at the end lines continued, whether by dip or otherwise, or beyond the side lines in any other manner than by the dip of the lode.

Cannot be followed.—Sec. 10.—If the top or apex of a lode in its longitudinal course extends beyond the exterior lines of the claim at any point on the surface, or as extended vertically downward, such lode may not be followed in its longitudinal course beyond the point where it is intersected by the exterior lines.

Right of Way and Right of Surface.—Sec. 11.—All mining claims now located, or which may hereafter be located, shall be subject to the right of way of any ditch or flume for mining purposes, or any tramway or pack-trail, whether now in use or which may be hereafter laid out across any such location: *Provided always,* That such right of way shall not be exercised against any location duly made and recorded and not abandoned prior to the establishment of the ditch or flume, tramway, or pack-trail, without consent of the owner, except by condemnation, as in case of land taken for public highways. Parol consent to the location of any such easement, accompanied by the completion of the same over the claim, shall be sufficient without writings. *And provided further,* That such ditch or flume shall be so constructed that the water from such ditch or flume shall not injure vested rights by flooding or otherwise.

Sec. 12—When the right to mine is in any case separate from the ownership or right of occupancy to the surface, the owner or rightful occupant of the surface may demand satisfactory security from the miner, and if it be refused, may enjoin such miner from working until such security is given. The order for injunction shall fix the amount of the bond.

Re-location of Claims.—Sec. 13.—If at any time the locator of any mining claim heretofore or hereafter located, or his assigns, shall apprehend that his original certificate was defective, erroneous, or that the requirements of the law had not been complied with before filing; or shall be desirous of changing his surface boundaries; or of taking in any part of an overlapping claim which has been abandoned; or in case the original certificate was made prior to the passage of this law, and he shall be desirous of securing the benefits of this act, such locator or his assigns may file an additional certificate, subject to the provisions of this act: *Provided,* That such relocation does not interfere with the existing rights of others, at the time of such relocation; and no such relocation, or the record thereof, shall preclude the claimant or claimants from proving any such title or titles as he or they may have held under previous location.

Proof of Development.—Sec. 14.—The amount of work done, or improvements made during each year, shall be that prescribed by laws of the United States.

Form of Affidavit.—Sec. 15.—Within six months after any set time, or annual period herein allowed for the performance of labor or making improvements upon any lode claim, the person on whose behalf such outlay was made, or some person for him, shall make and record an affidavit in substance as follows:

STATE OF COLORADO, } ss.
County of ———— }

Before me, the subscriber, personally appeared———— who, being duly sworn, said that at least————dollars' worth of work or improvements were performed or made upon [here describe the claim or part of claim] situate in————mining district, county of————State of Colorado. Such expenditure was made by or at the expense of———— owners of said claim, for the purpose of said claim.

[Jurat.] ————(Signature.)

And such signature shall be *prima facie* evidence of the performance of such labor.

Working over Old Claims.—Sec. 16.—The relocation or abandoned lode claims shall be by sinking a new discovery shaft and fixing new boundaries in the same manner as if it were the location of a new claim; or the relocator may sink the original discovery shaft ten feet deeper than it was at the time of abandonment, and erect new or adopt the old boundaries, renewing the posts if removed or destroyed. In either case a new location-stake shall be erected. In any case, whether the whole or part of an abandoned claim is taken, the location certificate may state that the whole or any part of the new location is located as an abandoned property.

Record for Claim.—Sec. 17.—No location certificate shall claim more than one location, whether the location be made by one or several locators. And if it purport to claim more than one location, it shall be absolutely void, except as to the first location therein described. And if they are described together, so that it cannot be told which location is first described, the certificate shall be void as to all.

Sec. 18.—All acts or parts of acts in conflict with this act are hereby repealed.

Sec. 19.—This act shall be in force from and after June 15, 1874. Approved February 13, 1874.

Supplementary Act.—Be it enacted by the Council and House of Representatives of Colorado:

Jurisdiction of Authorities.—Sec. 1.—In all actions pending in any district court of this Territory, wherein the title or right of possession to any mining claim shall be in dispute, the said court, or the judge thereof, may, upon application of any of the parties to such suit, enter an order for the underground as well as the surface survey of such part of the property in dispute as may be necessary to a just determination of the question involved. Such order shall designate some competent surveyor, not related to any of the parties to such suit, or in anywise interested in the result of the same; and upon the application of the party adverse to such application, the court may also appoint some competent surveyor to be selected by such adverse applicant, whose duty it shall be to attend upon such survey, and observe the method of making the same; said second survey to be at the cost of the party asking therefor. It shall also be lawful in such order to specify the names of witnesses named by either party, not exceeding three on each side, to examine such property, who shall hereupon be allowed to enter into such property and examine the same; said court, or the judge thereof, may also cause the removal of any rock, debris, or other obstacle in any of the drifts or shafts of said property, when such removal is shown to be necessary to a just determination of the questions involved: *Provided, however,* That no such order shall be made for survey and inspection, except in open court or in chambers, upon notice of application for such order of at least six days, and not then except by agreement of parties or upon the affidavit of two or more persons that such survey and inspection is necessary to the just determination of the suit, which affidavits shall state the facts in such case, and wherein the necessity for survey exists; nor shall such order be made unless it appears that the party asking therefor has been refused the privilege of survey and inspection by the adverse party.

Writs restoring possession.—Sec. 2.—The said district courts of this State, or any judge thereof, sitting in chancery, shall have, in addition to the power already possessed, power to issue writs of injunction for affirmative relief, having the force and effect of a writ of restitution, restoring any person or persons to the possession of any mining property from which he or they may have been ousted, by force and violence, or by fraud, or from which they are kept out of possession by threats, or whenever such possession was taken from him or them by entry of the adverse party on Sunday or a legal holiday, or while the party in possession was temporarily absent therefrom. The granting of such writ to extend only to the right of possession under the facts of the case in respect to the manner in which the possession was obtained, leaving the parties to their legal rights on all other questions as though no such writ had issued.

Penalties following unlawful entry.—Sec. 3.—In all cases where two or more persons shall associate themselves together for the purpose of obtaining the possession of any lode, gulch or placer claim, then in the actual possession of another, by force and violence, or threats of violence, or by stealth, and shall proceed to carry out such purpose by making threats against the party or parties in possession, or who shall enter upon such lode or mining claim for the purpose aforesaid, or who shall enter upon or into any lode, gulch, placer claim, quartz-mill or other mining property, or not being upon such property, but within hearing of the same, shall make any threats, or make use of any language, signs or gestures, calculated to intimidate any person or persons at work on said property from continuing to work thereon or therein, or to intimidate others from engaging to work thereon or therein, every such person so offending shall, on conviction thereof, be fined in a sum not to exceed $250, and be imprisoned in the county jail not less than thirty days nor more than six months; such fine to be discharged either by payment or by confinement in said jail until such fine is discharged at the rate of $2·50 per day. On trials under this section, proof of a common purpose of two or more persons to obtain possession of property, as aforesaid, or to intimidate laborers as above set forth, accompanied or followed by any of the acts above specified by any of them, shall be sufficient evidence to convict any one committing such acts, although the parties may not be associated together at the time of committing the same.

Force or Violence.—Sec. 4.—If any person or persons shall associate and agree to enter or attempt to enter by force of numbers, and the terror such numbers are calculated to inspire, or by force and violence, or by threats of violence against any person or persons in the actual possession of any lode, gulch or placer claim, and upon such entry or attempted entry, any person or persons shall be killed, said persons, and all and each of them so entering or attempting to enter, shall be deemed guilty of murder in the first degree, and punished accordingly. Upon the trial of such cases, any person or parties cognizant of such entry, or attempted entry, who shall be present, aiding, assisting, or in anywise encouraging such entry, or attempted entry, shall be deemed a principal in the commission of said offence.

Sec. 5.—This act shall take effect and be in force from and after its passage.

Approved February 13, 1874.

Placer Mining Claims.—Be it enacted by the General Assembly of the State of Colorado (March 12, 1879):

Section 1. The discoverer of a placer claim shall, within thirty days from the date of discovery, record his claim in the office of the recorder of the county in which said claim is situated, by a location certificate, which shall contain: *First*, the name of the claim, designating it as a placer claim. *Second*, the name of the locator. *Third*, the date of location. *Fourth*, the number of acres or feet claimed. And. *Fifth*, a description of the claim by such reference to natural objects or permanent monuments as shall identify the claim.

Before filing such location certificate, the discoverer shall locate his claim: *First*, by posting upon such claim a plain sign or notice, containing the name of the claim, the name of the locator, the date of discovery, and the number of acres or feet claimed. *Second*, by marking the surface boundaries with substantial posts, and sunk in the ground, to wit: One at each angle of the claim.

Sec. 2. On each placer claim of one hundred and sixty acres or more heretofore or hereafter located, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made by the first day of August, 1879, and by the first day of August of each year thereafter. On all placer claims containing less than one hundred and sixty acres, the expenditure during each year shall be such proportion of one hundred dollars, as the number of acres bears to one hundred and sixty. On all placer claims containing less than one hundred and sixty acres, the expenditure during each year shall be such proportion of one hundred dollars, as the number of acres bears to one hundred and sixty. On all placer claims containing less than twenty acres, the expenditures during each year shall not be less than twelve dollars; but when two or more claims lie contiguous, and are owned by the same person, the expenditure hereby required for each claim may be made on any one claim; and upon a failure to comply with these conditions, the claim or claims upon which such failure occurred, shall be open to relocation, in the same manner as if no location of the same had ever been made; *provided*, that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location; *provided*, the aforesaid expenditures may be made in building or repairing ditches to conduct water upon such ground, or in making other mining improvements necessary for the working of such claim.

Upon the failure of any one of several co-owners to contribute his proportion of the expenditures required hereby, the co-owners who have performed the labor or made the improvements, may at the expiration of the year, to wit: the 1st of August, 1879, for the locations heretofore made, and one year from the date of locations hereafter made, give such delinquent co-owner personal notice in writing, or if he be a non-resident of the state, a notice by publication in the newspaper published nearest the claim for at least once a week for ninety days, and mailing him a copy of such newspaper if his address be known; and if at the expiration of ninety days after such notice in writing, or after the first publication of such notice, such delinquent should fail or refuse to contribute his proportion of the expenditure required by this action [section], his interest in the claim shall become the property of his co-owners who have made the required expenditures.

Miscellaneous General Laws, 1877.—*Taxation.*—Extract from the Constitution of Colorado:

Art. x, Sec. 3.—Page 58. Mines and mining claims bearing gold, silver, and other precious metals (except the net proceeds and surface improvements thereof), shall be exempt from taxation for the period of ten years from the date of the adoption of this constitution (July 1, 1876), and thereafter may be taxed as provided by law.

Penal Provisions.—764. Sec. 169. If any person shall knowingly have, keep, or use any false or fraudulent scales or weights for weighing gold or gold dust, or any other article or commodity, every such person so offending shall, on conviction, be fined not exceeding five hundred dollars, or imprisoned in the county jail not exceeding six months.

765. Sec. 170. The owner, manager, or agent of any species of quartz mill, arrastra mill, furnace, or cupel, employed in extracting gold from quartz, pyrites, or other minerals, who shall neglect or refuse to account for or pay over and deliver all the proceeds thereof to the owner of such quartz, pyrites, or other minerals, excepting such portion of said proceeds as he is entitled to in return for his services, shall, on conviction, be fined in a sum not exceeding one thousand dollars, or be imprisoned in the penitentiary not exceeding one year.

776.—Sec. 181.—That every person who shall mingle or cause to be mingled with any sample of gold or silver bearing ore, any valuable metal or substance whatever, that will increase or in any way change the value of said ore, with the intent to deceive, cheat, or defraud any person or persons, shall, on conviction thereof, be punished by a fine not less than $500 nor more than $1,000, or by confinement in the penitentiary for a term of not less than one nor more than fourteen years, or by both such fine and imprisonment.

1603.—Sec. 1.—That if any person or persons shall wilfully and maliciously deface, remove, pull down, injure, or destroy any location-stake, side-post, corner-post, land-mark, or monument, or any other legal land boundary monument in this state, designating, or intending to designate the location, boundary, or name of any mining claim, lode, or vein of mineral, or the name of the discoverer, or date of discovery thereof; the person or persons so offending shall be guilty of a misdemeanor, and, on conviction thereof, shall be fined not more than one thousand dollars, or imprisoned not more than one year, at the discretion of the court: *Provided*, that this act shall not apply to abandoned property.

673.—Sec. 78.—Every person who shall mingle or procure to be mingled with any uncoined gold or gold dust now current, or which shall hereafter be current in this state, any counterfeit gold dust, or counterfeit uncoined gold, or any base metal or substance whatever, with intent to utter or pass the same, or to procure the same to be uttered or passed as gold dust or uncoined gold, shall, on conviction thereof, be punished by a fine not to exceed one thousand dollars, or by confinement in the penitentiary for a term not less than one year nor more than fourteen years.

1961.—Sec. 5.—Any person, association, or corporation, or the agent of any person, association, or corporation, who shall knowingly purchase or contract to purchase, or shall make any payment for or on account of any ore, which shall have been taken from any mine or claim, by persons who have taken or may be holding possession of any such mine or claim, contrary to any penal law now in force, or which may be hereafter enacted, shall be considered as an accessory after the fact to the unlawful holding or taking of such mine or claim, and upon conviction shall be subjected to the same punishment to which the principals may be liable.

1962.—Sec. 6.—Any person, association, or corporation, or the agent of any person, association, or corporation engaged in the business of milling, sampling, concentrating, reducing, shipping, or purchasing ores as aforesaid, who shall keep or use any false or fraudulent scales or weights for weighing ore, or who shall keep or use any false or fraudulent assay scales or weights for ascertaining the assay value of ore, knowing them to be false, every person so offending shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be fined in a sum not exceeding one thousand (1,000) dollars, nor less than one hundred (100) dollars, or imprisonment not more than one year, or both, at the discretion of the court.

1063.—Sec. 7.—Any person, corporation, or association, or the agent of any person, corporation, or association, engaged in the milling, sampling, concentrating, reducing, shipping, or purchasing of ores in this state, who shall, in any manner, knowingly alter or change the true value of any ores delivered to him or them, so as to deprive the seller of the result of the correct value of the same, or who shall substitute other ores for that delivered to him or them, or who shall issue any bill of sale or certificate of purchase that does not exactly and truthfully state the actual weight, assay value, and total amount paid for any lot or lots of ore purchased, or who, by any secret understanding or agreement with another, shall issue a bill of sale or certificate of purchase that does not truthfully and correctly set forth the weight, assay value, and total amount paid for any lot or lots of ore purchased by him or them, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined in a sum not exceeding one thousand (1,000) dollars, nor less than one hundred (100) dollars, or imprisonment not more than one year, or both, at the discretion of the court.

1964. Sec. 8.—If any person, lessee, licensee, or employee in or about any mine in this State, shall break and sever, with intent to steal the ore or mineral from any mine, lode, ledge, or deposit in this State, or shall take, remove, or conceal the ore or mineral from any mine, lode, ledge, or deposit, with intent to defraud the owner or owners, lessee, or licensee of any such mine, lode, ledge, or deposit, such offender shall be deemed guilty of felony, and on conviction, shall be punished as for grand larceny.

Drainage.—1830.—Sec. 1.—Whenever contiguous or adjacent mines upon the same or upon separate lodes have a common ingress of water, or from subterraneous communication of the water have a common drainage, it shall be the duty of the owners, lessees or occupants of each mine so related to provide for their proportionate share of the drainage thereof.

Penalty for Non-Compliance.—1831.—Sec. 2.—Any parties so related failing to provide as aforesaid for the drainage of the mines owned or occupied by them, thereby imposing an unjust burden upon neighboring mines, whether owned or occupied by them, shall pay respectively to those performing the work of drainage their proportion of the actual and necessary cost and expense of doing such drainage, to be recovered by an action in any court of competent jurisdiction.

Common Interests.—1832.—Sec. 3.—It shall be lawful for all mining corporations or companies, and all individuals engaged in mining, who have thus a common interest in draining such mines, to unite for the purpose of effecting the same, under such common name and upon such terms and conditions as may be agreed upon; and every such association having filed a certificate of incorporation, as provided by law, shall be deemed a corporation, with all the rights, incidents and liabilities of a body corporate, so far as the same may be applicable.

Subject to Action.—1833.—Sec. 4.—Failing to mutually agree, as indicated in the preceding section for drainage jointly, one or more of the said parties may undertake the work of drainage after giving reasonable notice; and should the remaining parties then fail, neglect or refuse to unite in equitable arrangements for doing the work, or sharing the expense thereof, they shall be subject to an action therefor as already specified, to be enforced in any court of competent jurisdiction.

Action to Recover.—1834.—Sec. 5.—When an action is commenced to recover the cost and expenses for draining a lode or mine, it shall be lawful for the plaintiff to apply to the court, if in session, or to the judge thereof in vacation, for an order to inspect and examine the lodes or mines claimed to have been drained by the plaintiff; or some one for him shall make affidavit that such inspection or examination is necessary for the proper preparation of the case for trial; and the court or judge shall grant an order for the underground inspection and examination of the lode or mines described in the petition. Such order shall designate the number of persons, not exceeding three, besides the plaintiff or his representative, to examine and inspect such lode and mines, and take the measurement thereof, relating to the amount of water drained from the lode or mine, or the number of fathoms of ground mined and worked out of the lode or mines claimed to have been drained, the cost of such examination and inspection to be borne by the party applying therefor. The court or judge shall have power to cause the removal of any rock, debris, or other obstacles in any lode or vein, when such removal is shown to be necessary to a just determination of the question involved: *Provided,* That no such order for inspection and examination shall be made, except in open court or at chambers, upon notice of application for such order of at least three days, and not then except by agreement of parties, nor unless it appears that the plaintiff has been refused the privilege of making the inspection and examination by the defendant or defendants, or his or their agent.

Water Rights.—1835.—Sec. 6.—That hereafter, when any person or persons, or corporation, shall be engaged in mining or milling, and in the prosecution of such business shall hoist or raise water from mines or natural channels, and the same shall flow away from the premises of such persons or corporations, to any natural channel or gulch, the same shall be considered beyond the control of the party so hoisting or raising the same, and may be taken and used by other parties the same as that of natural water-courses.

1836.—Sec. 7.—After any such water shall have been so raised, and the same shall have flown into any such natural channel, gulch or draw, the party so hoisting or raising the same shall only be liable for injury caused thereby, in the same manner as riparian owners along natural water-courses.

Explanatory.—1837.—Sec. 8.—The provisions of this act shall not be construed to apply to incipient or undeveloped mines, but to those only which shall have been opened, and shall clearly derive a benefit from being drained.

Evidence.—1838.—Sec. 9.—In trial of cases arising under this act the court shall admit evidence of the normal stand or position of the water while at rest in an idle mine, also the observed prevalence of a common water-level or a standing water-line in the same or separate lodes; also the effect, if any, the elevating or depressing the water by natural or mechanical means in any given lode has upon elevating or depressing the water in the same, contiguous or separate lodes or mines; also the effect which draining or ceasing to drain any given lode or mine had upon the water in the same, or contiguous or separate lodes or mines, and all other evidence which tends to prove the common ingress or subterraneous communication of water into the same lode or mine, or contiguous or separate lodes or mines.

Approved March 16, 1877.

Ore.—1957.—Sec. 1.—That every person, association or corporation that shall be engaged in the business of milling, sampling, concentrating, reducing, shipping or purchasing ores in the State of Colorado, shall keep and preserve a book in which shall be entered at the time of the delivery of each lot of ore:

First.—The name of the party on whose behalf such ore is delivered, as stated.

Second.—The name of the teamster, packer or other persons actually delivering such ore, and the name of the owner of the team or pack train delivering such ore.

Third.—The weight or amount of every such lot of ore.

Fourth.—The name and location of the mine or claim from which it shall be stated that the same has been mined or procured.

Fifth.—The date of delivery of any and all lots or parcels of ore.

1958.—Sec. 2.—Whenever affidavit shall have been made before any police magistrate of any town in this State, or any justice of the peace of any county, by any person, that ore has been stolen from him, stating as near as may be the amount and value of the ore stolen, such person upon presentation of a certified copy of such affidavit, shall have access to such book, and may examine the entries which may have been made therein during a period of fifteen days next preceding the filing of such affidavit: *Provided,* That the person making such affidavit shall, at the time of making the same, have a present interest in the product of the mine or claim from which said ore has been stolen, or in the ore alleged to have been stolen.

1959.—Sec. 3.—Every person, association or corporation that shall fail or refuse to keep the book required by the terms of the first section of this act, or shall fail or refuse to make any proper entry therein, or who shall make any false entry therein, or who shall refuse to any person who may be entitled to the same, as provided by section two (2) of this act, the right of inspection thereof, shall forfeit and pay for each and every violation of the provisions of said section a penalty of not less than fifty (50) nor more than three hundred (300) dollars, to be collected by action of debt at the suit of any person who may sue for the same. In addition to such penalty, any person, association or corporation violating the provisions of said first section, shall be liable at the suit of the party or persons aggrieved, in the proper form of action, for all damages which may accrue to any party or person by reason of such violation. And in all actions the fact that a false entry has been made shall be *prima facie* evidence that the same was made wilfully and knowingly.

1960.—Sec. 4.—If any person, association or corporation shall fail or neglect to make the inquiries necessary to the making of the proper entries in said book, as provided in section one (1) of this act, or shall so negligently make entries therein that any lot of ore cannot be particularly identified, or so negligently that it cannot be perceived therefrom what person delivered any lot of ore or received the proceeds of the same when purchased, or shall fail to keep such book, or shall wilfully suffer the same to be lost or mislaid, so that the same cannot be produced for inspection, such failure or neglect shall not excuse any party defendant in any suit brought under the preceding section from judgment from any penalty prescribed by said section.

Water Rights.—1789.—Sec. 2.—Whenever any person or persons are engaged in bringing water into any portion of the mines, they shall have the right of way secured to them, and may pass over any claim, road, ditch, or other structure; *provided,* the water be guarded so as not to interere with prior rights.

1821.—Sec. 11.—All mining claims now located, shall be subject to the right of way of any ditch or flume for mining purposes, or of any tramway or pack-trail, whether now in use, or which may be hereafter laid out across any such location; *provided, always,* that such right of way shall not be exereised against any location duly made and recorded, and not abandoned prior to the establishment of the ditch, flume, tramway, or pack-trail, without consent of the owner, except by condemnation, as in case of land taken for public highways. Parol consent to the location of any such easement, accompanied by the completion of the same over the claim, shall be sufficient without writings, *and provided further,* that such ditch or flume shall be so constructed that the water from such ditch or flume shall not injure vested rights by flooding or otherwise.

2279.—Sec. 3.—* * And water sold by the inch by any individual or corporation, shall be measured as follows, to wit: Every inch shall be considered equal to an inch square orifice under a five-inch pressure, and a five-inch pressure shall be from the top of the orifice of the box put into the banks of the ditch, to the surface of water; said boxes, or any dot or aperture through which such water may be measured, shall in all cases be six inches perpendicular inside measurement, except boxes delivering less than twelve inches, which may be square, with or without slides; all slides for the same shall move horizontally and not otherwise; and said box put into the banks of ditch shall have a descending grade from the water in ditch of not less than one-eighth of an inch to the foot.

Tailings.—1804.—Sec. 8.—In no case shall any person or persons be allowed to flood the property of another person with water, or wash down the tailings of his or their sluice upon the claim or property of other persons, but it shall be the duty of every miner to take care of his own tailings, upon his own property, or become responsible for all damages that may arise therefrom.

Hauling Quartz.—1805.—Sec. 9.—Every miner shall have the right of way across any and all claims for the purpose of hauling quartz from his claim,

Mining Claims, Real Estate, Actions.—185.—Sec. 26.—The terms " land " and " real estate," as used in this chapter, shall be construed as co-extensive in meaning with the terms "lands, tenements, hereditaments," and as embracing mining claims and other claims, and chattels real. The term "deed" includes mortgages, leases, releases, and every conveyance or encumbrance under seal.

2126.—Sec. 3.—The owner of every claim or improvement, on every tract or parcel of land, has a transferable interest therein, which may be sold in execution or otherwise; and any sale of such improvement is a sufficient consideration to sustain a promise.

2131.—Sec. 8.—Any person settled upon any of the public lands belonging to the United States, may maintain trespass *quare clausum fregit* trespass ejectment, forcible entry and detainer, unlawful detainer, and forcible detainer for injuries done to the possession thereof.

2135—Sec. 12.—Any person who may have a title to occupy any lot or lots within any city or village or village plot, or any lots or mining claim within any mining district in this state, in virtue of a certificate, deed of gift or purchase from the original claimant or claimants, or their assigns, as well as all purchasers under any decree or execution of any of the so-called provisional government courts, peoples' or miners' courts, of the lands, situate within any city or village plot, or any lots, land, or mining claims situate within any mining district, together with the original claimant or claimants of said lots, land, or mining claims, shall be entitled to maintain the actions authorized by the eighth section of this chapter, against any and all persons who shall enter upon and occupy said lots, lands, or mining claims, or any of them; *provided*, it shall be lawful for the citizens of any mining district to declare an abandonment of any creek, river, gulch, bank, or mining claim a forfeiture of the rights of the claimants thereto; in which case the parties claimant shall not be enabled to maintain either of the actions mentioned in section eight of this chapter.

2136.—Sec. 13.—Nothing in this chapter contained shall be construed to deny the right of the United States to dispose of any lands in this state; nor shall the fact that the title to any lots, lands, lodes, or mining claims hath not passed from the United States, be any bar to the recovery of the plaintiff in either of the actions specified in section eight of this chapter. As against the United States, and all persons holding any of said lands under the United States, or the laws thereof, this chapter shall be of none effect and void.

Foreign Corporations.—213.—Sec. 23.—Foreign corporations shall, before they are authorized or permitted to do any business in this state, make and file a certificate signed by the president and secretary of such corporation, duly acknowledged, with the secretary of state, and in the office of the recorder of deeds of the county in which such business is carried on, designating the principal place where the business of such corporation shall be carried on in this state, and an authorized agent or agents in this state residing at its principal place of business upon whom process may be served; and such corporations shall be subjected to all the liability, restrictions and duties which are or may be imposed upon corporations of like character organized under the general laws of this state, and shall have no other or greater powers.

And no foreign or domestic corporation established or maintained in any way for pecuniary profit of its stockholders or members, shall purchase or hold real estate in this state, except as provided for in this Act, and no corporation doing business in this state, incorporated under the laws of any other state, shall be permitted to mortgage, pledge or otherwise encumber its real or personal property situated in this state, to the injury or exclusion of any citizen, citizens or corporations of this state who are creditors of such foreign corporation; and no mortgage by any foreign corporation, except railroad and telegraph companies, given to secure any debt created in any other state, shall take effect as against any citizen or corporation of this state, until all its liabilities due to any person or corporation in this state at the time of recording such mortgage, have been paid and extinguished.

214.—Sec. 24.—Every company incorporated under the laws of any foreign state or kingdom, or of any state or territory of the United States, beyond the limits of this state, and now or hereafter doing business within this state, shall file in the office of the secretary of state a copy of their charter of incorporation, or in case such company is incorporated by certificate under any general incorporation law, a copy of such certificate, and of such general incorporation law, duly certified and authenticated by the proper authority of such foreign state, kingdom or territory.

215.—Sec. 25.—A failure to comply with the provisions of sections twenty-three and twenty-four of this Act shall render each and every officer, agent and stockholder of any such corporation so failing therein, jointly and severally personally liable on any and all contracts of such company made within this state during the time that such corporation is so in default.

NEW MEXICO.—An act to regulate the manner of locating mining claims, and for other purposes.

Be it enacted by the Legislative Assembly of the Territory of New Mexico:

Sec. 1.—That any person or persons desiring to locate a mining claim upon a vein or lode of quartz or other rock in place—bearing gold, silver, cinnabar, lead, tin, copper or other valuable deposit, must distinctly mark the location on the ground, so that its boundaries may be readily traced; and post in some conspicuous place on such location a notice in writing, stating thereon the name or names of the locator or locators, his or their intention to locate the mining claim, giving a description thereof by reference to such natural object or permanent monument as will identify the claim; and also within three months after posting such notice, cause to be recorded a copy thereof in the office of the recorder of the county in which the notice is posted; and it is provided that no other record of such notice shall be necessary.

Sec. 2.—In order to carry out the intent of the preceding section, it is hereby made the duty of the probate judges of the several counties of this Territory, and they are hereby required to provide, at the expense of their respective counties, such book or books as may be necessary and suitable in which to enter the record hereinbefore provided for. The fees for recording such notices shall be ten cents for every one hundred words.

Sec. 3.—That in estimating the worth of labor required to be performed upon any mining claim, to hold the same by the laws of the United States, in the regulation of mines, the value of a day's labor is hereby fixed at the sum of four dollars: *Provided, however*, That in the sense of this statute, eight hours of labor actually performed upon the mining claim shall constitute a day's labor.

Sec. 4.—All locations heretofore made in good faith, to which there shall be no adverse claims, the certificate of which locations have been or may be filed for record and recorded in the recorder's office of the county where the location is made, within six months after the passage of this act, are hereby confirmed and made valid. But where they may appear to be any such adverse claim, the said location shall be held to be the property of the person having the superior title or claim, according to the laws in force at the time of the making of the said locations.

Sec. 5.—An action of ejectment will lie for the recovery of the possession of a mining claim, as well as of any real estate, where the party suing has been wrongfully ousted from the possession thereof, and the possession wrongfully detained.

Sec. 6.—That "an act concerning mining claims," approved January 18, 1865, and an act amendatory thereof, approved January 3d, 1866; also, an act entitled an act to amend certain acts concerning mining claims in the Territory of New Mexico, approved January 1, 1872; be and the same are hereby repealed: *Provided*, That no locations completed under said acts shall be invalidated, or in anywise affected by such repeal.

Sec. 7.—That this act shall take effect and be in full force from and after its passage.

Approved January 11, 1876.

The following is the work of the last legislature of New Mexico:

Be it enacted by the Legislature Assembly of the Territory of New Mexico:

Sec. 1. Hereafter in actions regarding mining claims, proof must be admitted of the customs, usages, or regulations established and in force in the mining district embracing such claim, and such customs, usages or regulations, when not in conflict with the laws of this Territory, or the United States, must govern the decision of the action.

Sec. 2. Any person or persons claiming or staking upon the surface ground of the mining claim of another who has complied with all laws, regulations and customs, shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined in any sum not less than ten, nor more than one hundred dollars, or shall be punished by imprisonment in the county jail not less than ten, or more than ninety days or both, at the discretion of the court.

Sec. 3. Any person or persons who have their stakes, monuments, or notices upon the surface ground of any mining claim belonging to others, shall within sixty days of the passage of this act, remove such stakes, monuments, or notices from the surface ground of such mining claim, and upon failure to do so, shall be subject to the penalties set forth in section two of this act.

Sec. 4. Within sixty days after the period fixed by the United States laws for doing the assessment on mining claims, the owner shall file with the county and district recorders, an affidavit stating that the full amount has been expended as required by law. Failure to file such affidavit as herein required, shall be construed as prima facie evidence of abandonment of such claim or claims; and provided that the fee of such recorder shall not exceed fifty cents; and for each certified record. All laws and parts of laws in conflict with this act are hereby repealed.

This act shall be in full force and effect from and after the first day of April, A. D., 1882.

CALIFORNIA.—*Water Rights.*—1410.—The right to the use of running water flowing in a river or stream, or down a canon or ravine may be aquired by appropriation.

1411.—The appropriation must be for some useful or beneficial purpose, and when the appropriator or his successor in interest ceases to use it for such a purpose, the right ceases.

1412.—The person entitled to the use may change the place of diversion, if others are not injured by such change, and may extend the ditch, flume, pipe or aqueduct by which the diversion is made, to places beyond that where the first use was made.

1413.—The water appropriated may be turned into the channel of another stream and mingled with its water, and then reclaimed; but in reclaiming it the water already appropriated by another must not be diminished.

1414.—As between appropriators, the one first in time is the first in right.

1415.—A person desiring to appropriate water must post a notice, in writing, in a conspicuous place at the point of intended diversion, stating therein:

1. That he claims the water there flowing to the extent of (giving the number) inches, measured under a four-inch pressure:

2. The purposes for which he claims it, and the place of intended use.

3. The means by which he intends to divert it, and the size of the flume, ditch, pipe, or aqueduct in which he intends to divert it,

A copy of the notice must, within ten days after it is posted, be recorded in the office of the Recorder of the county in which it is posted.

1416.—Within sixty days after the notice is posted, the claimant must commence the excavation or construction of the works in which he intends to divert the water, and must prosecute the work diligently and uninterruptedly to completion, unless temporarily interrupted by snow or rain.

1417.—By " completion " is meant conducting the waters to the place of intended use.

1418.—By a compliance with the above rules, the claimant's right to the use of the water relates back to the time the notice was posted.

1419.—A failure to comply with such rules deprives the claimant of the right to the use of the water as against a subsequent claimant who complies therewith.

1420.—Persons who have heretofore claimed the right to water, and who have not constructed works in which to divert it, and who have not diverted nor applied it to some useful purpose, must, after this title takes effect, and within twenty days thereafter proceed as in this Title, provided, or their right ceases. Civil Code, Annotated, Title viii., p. 402.

[The above law expresses the usual manner of securing water rights in the mining states and territories. See Copp's U. S. Mineral Lands.]

*Mineral Lands on School Sections.**—An Act regulating the sale of mineral lands belonging to the State of California.

Sec. 1.—Any person desiring to purchase from this State any portion of any sixteenth or thirty-sixth section, that shall have been designated by United States survey as of a mineral character, or which is so in fact, shall make an affidavit before some officer authorized to administer oaths, that he or she is a citizen of the United States; or, if a foreigner, that he has filed his intention to become a citizen of the United States; that he or she is of lawful age, and desires to purchase said land, giving a description thereof by legal subdivisions; that he or she has not entered any portion of such mineral lands which, together with that applied for in such affidavit, will exceed forty acres; that there is no occupation of said land adverse to that which he or she holds; or, if there be any adverse occupation thereof, then he or she must state the name of such adverse occupant, together with the fact that the plat of the township has been on file six months or over, and that such adverse occupant has been in such occupation six months or over.

Sec. 2.—Any person that shall be in the actual possession of any of said lands described in section one, at the time of the survey thereof by the United States, or at the time of the passage of this act shall be considered a preferred purchaser thereof to the extent of his or her mining claim: *Provided*, he or she make application for the purchase of the same on or before the first day of January, 1877, if the plat of such survey be already filed in the United States Land Office, and if not so filed, then within six months after the filing of such plat as aforesaid.

Sec. 3.—When a contest shall arise as to the mineral character of the lands applied for, or from any other cause, the Surveyor-General, or the Register before whom the contest is made, must, within thirty days after the adverse application is filed, unless sooner referred at the request of either claimant, make an order referring such contest to the Superior Court of the county within which the land is situated, and must enter such order in the proper book of his office, and forward a copy thereof to the clerk of the court to which the reference is made. Upon the filing of a copy of such order with the clerk of the court, either party may commence an action in said court to determine the conflict, and the court shall have full and complete jurisdiction to hear and determine the same. Unless an action shall be commenced within ninety days after the copy of the order of reference shall have been filed with the clerk of the court, the party making such demand, or the adverse claimant, if the case is referred without demand, shall be deemed to have waived and surrendered his or her right to purchase, and the Surveyor-General or Register shall proceed as though his or her application had not been made.

Sec. 4.—All lands sold under the provisions of this act shall be sold for the sum of two dollars and fifty cents per acre in United States gold coin, payable to the Treasurer of the county in which the lands are situated, within fifty days from the date of the approval by the Surveyor-General; and in case said payment is not made within said fifty days, the land described in the location shall revert to the State without suit, and said location shall be and become null and void. All payments made to the County Treasurer as above provided, shall be paid over and accounted for as other moneys received for State lands are required to be paid over and accounted for.

Sec. 5.—The Surveyor-General and Register shall, in the matter of approving locations, issuing certificates of purchase or patents, or in other proceedings relating to the sale of lands of a mineral character, which proceedings are not provided for in this act, proceed in the same manner as is now provided for the sale of sixteenth and thirty-sixth sections which are not of a mineral character.

Sec. 6.—All patents issued by the State to any portion of any sixteenth or thirty-sixth section shall be subject to any vested and accrued water-rights, ditches, and reservoirs used in connection therewith, acquired by priority of possession under local customs and the decisions of the courts, and the right of way for the construction of ditches and canals for mining and other purposes, over all of the sixteenth and thirty-sixth sections owned by the State, is hereby granted and confirmed.

Sec. 7.—After the passage of this act, no patents shall be issued for any of the lands described in this act upon which, at the time of the application therefor, there was and still is any actual *bona fide* mining claim, except to the person who is the owner of such mining claim under local mining customs; and when an applicant for such lands, not owning such mining claim, shall have paid the purchase-money therefor, in whole or in part, he may present his certificate of purchase and receive in exchange therefor, from the Register, a certificate showing the whole amount paid; and the Controller, upon the surrender of such certificate, must draw his warrant in favor of the person surrendering such certificate, for the amount therein specified, on the Treasurer of the State, who must pay the sum out of the funds into which the purchase money was paid: *Provided*, That the owner of such mining-claim, under such mining customs, shall apply to purchase the same within six months after the plat of the township containing such land shall have been filed in the local United States land office, on or before the first day of January, 1877: *And provided further*, That any owner of a *bona fide* mining claim who shall have entered into an agreement with the applicant for any portion of a sixteenth or thirty-sixth section upon which said mining claim is situated, for the procurement of a title for the same, shall not avail himself of the provisions of this section. The Governor of this State shall not sign any patent contrary to the provisions of this act.

UTAH.—*Of Mines and Mining.*—AN ACT to provide rules for the working and development of mines.—Approved February 16, 1872.—(1218) Sec. 1.—Be it enacted by the Governor and Legislative Assembly of the Territory of Utah: That any citizen of the United States, and any person who shall have declared his intention to become such, who shall hereafter discover any mineral deposit, lead, or lode, bearing gold, silver, tin, platina, copper, or cinnabar, shall be entitled to one claim thereon, by right of discovery, and one claim by right of location: *Provided*, That no person shall be entitled to more than one claim by right of location, on any one lead or lode.

(1219) Sec. 2.—Any person or persons who shall willfully or maliciously tear down or deface a notice posted on any mining claim, or take up or destroy any stake or monument, marking any such claim, or interfere with any person lawfully in possession of said claim, or who shall alter, erase, deface, or destroy any record kept by a mining recorder, shall be guilty of misdemeanor, and upon conviction thereof shall be punished by a fine of not less than twenty-five nor more than one hundred dollars, or by imprisonment for not less than ten days nor more than six months, or by both such fine and imprisonment. Justices of the Peace, in their respective counties, shall have jurisdiction of such offences.

(1220) Sec. 3.—Any person wrongfully entering upon any mine or mining claim, and carrying away ores therefrom, or extracting or selling ores from any mine, being the property of another, shall be liable to the owner or owners of said ore for three times the value thereof, recoverable by an action at law; and should the plaintiff file his affidavit that the defendant did unlawfully take such ores, the defendant may be arrested and held to bail, as in cases for the recovery of the possession of personal property unjustly detained.

(1221) Sec. 4.—Any person or persons who shall perform any work or labor upon any mine, or furnish any material therefor, in pursuance with any contract made with the owner or owners of such mine, or of any interest therein, shall be entitled to a miner's lien for the payment thereof upon all the interest, right, and property in such mine, by the person or persons contracting for such labor or materials at the time of making such contract; said lien may be enforced in the same manner and with the same effect as a mechanic's lien, as provided by the laws of Utah.

Records and Mining Rules.—AN ACT in relation to proving the records and mining rules and regulations of the mining districts of the Territory, and for other purposes.—Approved February 18, 1876.—(1222) Sec. 1.—Be it enacted by the Governor and Legislative Assembly of the Territory of Utah: That copies of notices of location of the mines, lodes, and veins, and of tunnel sites recorded in the several mining districts, and of the mining rules and regulations in force in the several districts, in like manner recorded, shall be receivable in all the courts of this Territory, as *prima facie* evidence of such notices, rules, and regulations: *Provided*, The recorder of the district shall certify under his hand and seal that such copies are full, true, and perfect copies from the records in his custody. The seal of the office of the mining recorder so certifying, affixed to such certificate, shall be *prima facie* evidence of the fact of the election and qualification and official character of such mining recorder.

(1223) Sec. 2.—It shall be the duty of the county recorder of the several counties of this Territory, to record the mining rules and regulations of the several mining districts in their respective coun-

* This law only applies to sections on which minerals are discovered after survey.

ties; and when so recorded, certified copies thereof shall be received in all the courts of this Territory, as *prima facie* evidence of such rules and regulations.

(1224) Sec. 3.—The mining recorders of the several mining districts shall be allowed the same fees for recording and making copies of any records in their custody as are now allowed by law for like services to county recorders. And it shall be the duty of each mining recorder, upon request and payment or tender of the fees therefor, to make and deliver to any person requesting the same, duly certified copies of any records in his custody; and for a failure so to do, or for receiving larger fees for any such service than those herein provided, such mining recorder shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be subjected to the same penalties provided against public officers in section twenty of the act entitled, "An act to regulate fees and compensation for official and other services in the Territory of Utah," passed February 20, 1874.

(1225) Sec. 4.—Recorders of mining districts shall, for the purpose of this act, be deemed public officers, and the records in their custody shall be deemed public records, and they are hereby required to keep an official seal.

WYOMING.—*Development of Mining Resources.*—An Act to provide for the development of the Mining Resources of the Territory of Wyoming:

Be it enacted by the Council and House of Representatives of the Territory of Wyoming:

Section 1. Any person or persons who shall have performed work or made improvements or expenditures to the amount of one thousand dollars on any lead, lode, or ledge, the same shall not be subject to relocation under the laws of this Territory; *Provided,* That such quartz claim or claims shall not be abandoned, but shall be represented by the person or persons owning such claim or claims, or by his or their agent or attorney, who shall reside within the district in which such claim or claims may be situated, unless driven from said district by Indians.

Sec. 2. Any person or persons who shall defraud, cheat, or swindle any party or parties by what is known as "salting," that is, by placing or causing to be placed in any placer or quartz claim, or dirt, gravel, or quartz contained therein, any gold, silver, or metals, or minerals which would prove to be a misrepresentation, thereby working injury or loss to any party or parties, shall be deemed guilty of a felony, and, upon conviction thereof, shall be fined in any sum not to exceed five thousand dollars and not less than fifty dollars, together with the cost of prosecution, and may be imprisoned in the territorial penitentiary not more than three years or less than thirty days, or both such fine and imprisonment.

Sec. 3. When parties owning in partnership any claim or claims, or any lead, lode, or ledge, or any one of the parties so owning, shall fail to perform his or her portion of the work, for the period of eight months, or pay the reasonable assessment for the same when said claim is being worked in accordance with the expressed wish of a majority of the persons owning such claims, it may be sold to pay such assessment by the person or persons to whom such assessment may be due, by giving thirty days' notice, published in the nearest newspaper, and by posting notice for thirty days on such claim, giving the amount of assessment due, date of notice, and date of sale.

Sec. 4. The provision of the foregoing section shall not apply to persons residing within the district in which his or her property is situated.

Sec. 5. Any property sold to pay assessments may be redeemed within the period of six months by the person or persons formerly owning such property, or by his or her agents, heirs, or attorneys, by paying the cost of advertising and sale, together with the assessments due, and ten per cent. upon all purchase-money for the same.

Sec. 6. All acts and parts of acts conflicting with this act be, and the same are, hereby repealed.

Sec. 7. This act shall take effect and be in force from and after its passage.

Approved December 16th, 1871.

MINERS' LIENS.—Section 1. That every miner or other person, who, at the request of the owner of any ledge or lode of quartz bearing gold, silver, cinnabar, or copper, or of any coal bank or mine, shall work in or upon such mine or bank, shall have a lien upon such vein or lode, mine or bank, to the amount due at any time when a demand shall be made upon such owner, or his or their agent, for money due for such labor, and payment shall be refused.

Sec. 2. That any person who shall labor as a mechanic, or otherwise, or who shall furnish timber, lumber, rope, nails, or any other material for timbering shafts [or] levels for the mine, who shall furnish any kind of materials for erecting windlass, whim, or other hoisting apparatus upon any vein, mine or coal bank, referred to in the first section, shall also have a lien upon the mide or coal bank for which he furnished such materials, or upon which he performed such labor.

Sec. 3. The party seeking a lien shall proceed, so far as the proceedings are applicable in the same manner, to enforce a lien as by law required in the case of mechanics and other persons seeking to enforce a lien upon dwelling-houses and other buildings, except when other provisions are made by this act.

Sec. 4. When any sum exceeding ten dollars for labor performed by any miner or other person upon or in any mine or coal bank specified in section one of this Act, shall be due and unpaid for ten days, it shall be competent for the person or persons to whom such sum of money shall be due, to file a notice in the office of county recorder in the county where such mine is situated, at any time within thirty days after the last day upon which work was done by him; which said notice shall in substance set forth the fact that the party performed labor (naming the kind) for a party or company (naming the party or company), that such labor was performed under a contract (stating the substance); also, the time when the party commenced and when he ceased to work, the amount still due and unpaid, together with a description of the mine or coal bank upon which such work was performed, which statement shall be verified by the affidavit of the party so filing it, and when filed, the county recorder shall record the same in a "lien-book," the same as required in the case of mechanics' notices of liens.

Sec. 5. The provisions of the next preceding section shall apply to persons who shall furnish materials or work upon any shaft, whim, or other hoisting works, who, by complying with the general provisions of such section, shall have a like lien.

Sec. 6. When notices as provided in the next two preceding sections shall be filed, the lien shall hold not only against the owner of the mine or bank, from the time when the miner or other person began work, but against all persons or company who shall have purchased such mine or coal bank while such miner or other person was employed therein, or furnished materials used therein or thereon.

Sec. 7.—Suit to enforce such lien may be commenced at any time within one year after filing such notice.

Sec. 8.—Any owner of any oil well or spring who shall employ any person to perform any work of any kind around or about any oil well or spring, either in building derricks, buildings, or any kind of machinery, or in boring or drilling, shall be deemed within the provisions of this Act; and all persons performing labor or furnishing materials, shall have like liens upon oil territory which he labored, or for which he furnished materials or the improvements thereon, as miners or other laborers upon or in mines as provided in this Act, and shall proceed in the same manner to enforce a lien.

Sec. 9.—This act shall take effect and be in force from and after its passage.

Approved, December 2d, 1869.

MONTANA.—An act in relation to quartz claims.

Be it enacted by the Legislative Assembly of the Territory of Montana:

Sec. 1.—Any person or persons who shall hereafter discover any mining claim upon any vein or lode bearing gold, silver, cinnabar, lead, tin, copper or other valuable deposit, shall, within twenty days thereafter, make and file for record in the office of the recorder of the county in which said discovery is made, a declaratory statement thereof in writing, on oath, before some person authorized by law to administer oaths, describing such claim in the manner provided by the laws of the United States.

Sec. 2.—That in order to entitle any person or persons to record in the county recorder's office of the proper county, any lead, lode or ledge, there shall first be discovered on said lode, lead or ledge, a vein or crevice of quartz or ore, with at least one well-defined wall.

Sec. 3.—Claims on any lead, lode or ledge, bearing gold, silver, cinnabar, lead, tin, copper or other valuable deposits, hereafter discovered, shsll consist of not more than fifteen hundred linear feet along the lead, lode or ledge, and not more than three hundred feet, and not less than twenty-five feet, on each side from the centre of said lead, lode or ledge, for working purposes. *Provided,* That the provisions of this act shall not be so construed as to include claims recorded prior to the passage of this act.

Sec. 4.—All lode claims heretofore discoversd and recorded pursuant to the law, and the possessory title to which shall have been preserved according to law, shall entitle the owner or owners therof to surface ground along the course of the vein three hundred feet on each side from the centre of said vein. *Provided,* That such width shall not be permitted to interfere with any vested possessory rights of any person or persons, corporation or corporations, which hsve intervened and have been preserved, to the time of the taking effect of this act; but parties desiring to avail themselves hereof shall so signify by a record which shall show that they so elect, or if they so desire, they may limit the surface ground on each side of the centre of the vein to any width not less than twenty-five feet.

Sec. 5.—Any person who shall remove any stake or monument placed on any mining claim, or who shall obliterate, deface or destroy any notice placed thereon, shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be punished by fine not exceeding one hundred dollars, or imprisonment not exceeding one year, or both such fine and imprisonment, in the discretion of the court.

Sec. 6.—All acts and parts of acts in conflict with this act are hereby repealed.

Sec. 7.—This act to take effect and be in force from and after its passage.

Approved February 11, 1876,

Sec. 40.—*Statute of Limitations.*—No action for the recovery of mining claims (lode claims excepted), or for the recovery of possession thereof, shall be maintained, unless it appear that the plaintiff or his assigns was seized or possessed of such mining claims within one year before the commencement of such action.

Sec. 363.—*Customs of Proof.*—In actions respecting mining claims, proof must be admitted of the customs, usages or regulations established and in force at the bar or diggings embracing such claim; and such customs, usages or regulations, when not in conflict with the laws of this territory, must govern the decision of the action.

Illinois.—An Act providing for the health and safety of persons employed in coal mines of the State of Illinois.

Section 1.—*Be it enacted by the People of the State of Illinois, represented in the General Assembly,* That the owner, or agent, or operator, of each and every coal mine in this state, employing ten men or more, shall make, or cause to be made, at the discretion of the inspector, or person acting in that capacity, an accurate map, or plan, of the workings of such coal mine, and of each and every vein thereof; showing the general inclination of the strata together with any material deflections in the said workings, and the boundary lines of said coal mine, and deposit a true copy of said map, or plan, with the Inspector of Coal Mines, to be filed in his office, and another true copy of said map or plan with the Recorder of the County in which said coal mine is situated, to be filed in his office, both of which said copies shall be deposited as aforesaid within three months from the day when this act shall go into effect; and the original, or a copy of such map or plan, shall also be kept for inspection at the office of such coal mine; and during the month of January of each and every year after this act shall go into effect, the said owner, agent, or operator, shall furnish the Inspector and Recorder, as aforesaid, with a statement and further map or plan of the progress of the workings of such coal mine, continued from the last report to the end of the December month just preceding; and the Inspector shall correct his map, or plan of said workings, in accordance with the statement and map or plan thus furnished; and when any coal mine is worked out or abandoned, that fact shall be reported to the Inspector, and the map, or plan, of such coal mine shall be carefully corrected and verified.

Inspector may make map at Cost of Owner.—Sec. 2.—Whenever the owner, agent or operator of any coal mine shall neglect or refuse to furnish the said Inspector and Recorder, as aforesaid, with the statement, the map, or plan, or addition thereto, as provided in the first section of this act, at the times and in the manner therein provided, the said Inspector is hereby authorized to cause an accurate map or plan of the workings of such coal mine to be made at the expense of said owner, agent, or operator, and the cost thereof may be recovered by law from said owner, agent, or operator, in the same manner, as other debts, by suit in the name of the Inspector and for his use.

Escapement Shaft—Roadway—Meaning of "Owner."—Sec. 3.—In all coal mines that are, or have been, in operation prior to the first day of July, in the year of our Lord 1882, and which are worked by, or through, a shaft, slope, or drift, and in which more than ten miners are employed in each twenty-four hours, if there is not already an escapement shaft to each and every said coal mine, or communication between each and every coal mine, and some other contiguous mine, then there shall be an escapement shaft or other communication, such as shall be approved by the Mine Inspector, making at least two distinct means of ingress and egress for all persons employed or permitted to work in such coal mine. Such escapement shaft or other communication with a contiguous mine, as aforesaid, shall be constructed in connection with every vein or stratum of coal worked in such mine; and the time to be allowed for such construction shall be one year when such mine is under one hundred (100) feet in depth; two years when such mine is over one hundred (100) feet in depth, and under three hundred (300) feet; and three years when it is over three hundred (300) feet, and under four hundred (400) feet; and four years when it is over four hundred (400) feet in depth; and five years for all mines over five hundred (500) feet, from the time this act goes into effect; and in all cases where the working force of one mine has been driven up or into the workings of another mine, the respective owners of such mines, while operating the same, shall keep open a roadway at least two and one-half feet high and four feet wide, thereby forming a communication as contemplated in this act; and for a failure to do so, shall be subject to the penalty provided for in section two of this act, for each and every day such roadway is unnecessarily closed, each and every such an escapement shaft shall be separated from the main shaft by such extent of natural strata as shall secure safety to the men employed in such mines; such distance to be left to the discretion of the Mine Inspector, or person acting in that capacity; and in all coal mines that shall go into operation for the first time after the first day of January A. D. 1883, such an escapement or other communication with a contiguous mine, as aforesaid, shall be constructed within one year after such mine shall have been put into operation. And it shall not be lawful for the owner, agent, or operator of any such coal mine, as aforesaid, to employ any person to work therein, or permit any person to go therein for the purpose of working, except such persons as may be necessary to construct such an escapement shaft, unless the requirements of this section shall have first been complied with; and the term "owner" used in this act shall mean the immediate proprietor, lessee or occupant of any coal mine, or any part thereof, and the term "agent" shall mean any person having on behalf of the owner the care or management of any coal mine or any part thereof: *Provided,* Nothing in this section shall be construed to extend the time allowed by law for constructing escapement shafts.

Ventilation—Safety-Lamps.—Sec. 4.—The owner, agent or operator of every coal mine, whether operated by shaft, slope or drift, shall provide and maintain for every such mine a sufficient amount of ventilation, to be determined by the Inspector, at the rate of one hundred cubic feet of air per man per minute, measured at the foot of the down-cast, which shall be forced and circulated to the face of every working place throughout the mine, so that said mine shall be free from standing gas of whatsoever kind; and in all mines where fire damp is generated, every working place where such fire damp is known to exist shall be examined every morning with a safety-lamp by a competent person, before any other persons are allowed to enter. The ventilation required by this section may be produced by any suitable appliances, but in case a furnace shall be used for ventilating purposes, it shall be built in such a manner as to prevent the communication of fire to any part of the works by lining the upcast with incombustible material for a sufficient distance up from said furnace.

Bore Holes.—Sec. 5.—The owner, agent or operator shall provide that bore holes shall be kept twenty feet in advance of the face of each and every working place, and, if necessary, on both sides, when driving towards an abandoned mine, or part of a mine, suspected to contain inflammable gases, or to be inundated with water.

Signals—Hoistways—Who may be employed.—Sec. 6.—The owner, agent or operator of every coal mine operated by shaft shall provide suitable means of signaling between the bottom and top thereof, and shall also provide safe means of hoisting and lowering persons in a cage covered with boiler iron, so as to keep safe, as far as possible, persons descending into and ascending out of such shaft; and such cage shall be furnished with guides to conduct it on slides through such shaft, with a sufficient brake on every drum to prevent accident in the case of the giving out or breaking of the machinery; and such cage shall be furnished with spring catches, intended and provided, as far as possible, to prevent the consequences of cable breaking or the loosening or disconnecting of the machinery; and no props or rails shall be lowered in a cage while men are descending and ascending out of said mine: *Provided,* That the provisions of this section in relation to covering cages with boiler iron, shall not apply to coal mines less than one hundred feet in depth, where the coal is raised by horse-power. No person under the age of twelve years, or females of any age, shall be permitted to enter any mine to work therein, nor shall any boy under the age of fourteen, unless he can read and write, be allowed to work in any mine; any party or person neglecting or refusing to perform the duties required to be performed by sections 4, 5, 6, 7 and 8 shall be deemed guilty of a misdemeanor, and punished by a fine in the discretion of the court trying the same, subject, however, to the limitations as provided by section 10 of this act.

Operating Hoistway—Competent Engineer.—Sec. 7.—No owner, agent or operator of any coal mine operated by shaft or slope, shall place in charge of an engine, whereby men are lowered into or hoisted out of the mines, any but an experienced, competent and sober person not under the age of eighteen years: and no person shall ride upon a loaded cage or wagon used for hoisting purposes in any shaft or slope, and in no case shall more than twelve persons ride on any cage or car at one time: nor shall any coal be hoisted out of any coal mine while persons are descending into such coal mine; and the number of persons to ascend out of or descend into any coal mine on any one cage shall be determined by the Inspector, maximum number so fixed shall not be less than four, nor more than twelve, nor shall be lowered or hoisted more rapidly than six hundred feet to the minute.

Boilers Examined—Gincing Shaft—Safety Valves—Signals—Places of Refuge.—Sec. 8.—All boilers used in generating steam in and about coal mines shall be kept in good order, and the agent, owner or operator, as aforesaid, shall have said boilers examined and inspected by a competent boiler-maker or other qualified person, as often as every six months, and oftener, if the Inspector shall deem it necessary, and the result of every such examination shall be certified in writing to the Mine Inspector; and the top of each and every shaft, and the entrance to each and every intermediate working vein shall be securely fenced, by gates properly covering and protecting such shaft and entrance thereto; and the entrance to every abandoned slope, air or other shaft shall be securely fenced off; and every steam boiler shall be provided with a proper steam-gauge, water-gauge and safety-valve; and all undergound self-acting or engine the planes or gangways on which coal-cars are drawn and persons travel, shall be provided with some proper means of signaling between the stopping places and the end of said planes or gangways, and sufficient places of refuge at the sides of such planes or gangways shall be provided at intervals of not more than twenty feet apart.

Accidents—Duty of Inspectors.—Sec. 9.—Whenever loss of life or serious personal injury shall occur by reason of any explosion, or of any accident whatsoever, in or about any coal mine, it shall be the duty of the person having charge of such coal mine to report the facts thereof without delay to the Mine Inspector of the county in which said coal mine is situated; and if any person is killed thereby to notify the Coroner of the county also, or, in his absence, or inability to act, any Justice of the Peace of said county; and the said Inspector shall, if he deems it necessary from the facts reported, immediately go to the scene of said accident, and make such suggestions and render such assistance as he may deem necessary for the safety of the men. And the Inspector shall investigate and ascertain the cause of such explosion or accident, and make a report thereof, which he shall preserve with the other records of his office, to enable him to make such investigations, he shall have power to compel the attendance of witnesses, and administer oaths or affirmations to them; and the cost of such investigations shall be paid by the county in which such accident has occurred, in the same manner as costs of Coroner's inquests are now paid. And the failure of the person in charge of the coal mine, in which any such accident may have occurred, to give notice to the Inspector or Coroner as provided for in this section, shall subject such person to a fine of not less than twenty-five dollars, nor more than one hundred dollars, to be recovered in the name of the State of Indiana, before any Justice of the Peace of such county; and such fine, when collected, shall be paid into the county treasury for the use of the county in which such accident may have occurred.

Fines, Penalties, etc.—Sec. 10.—In all cases in which punishment is provided by fine under this act for any breach of any of its provisions, the fine for a first offense shall not be less than fifty dollars, and not more than two hundred dollars; and for the second offense not less than one hundred dollars, or more than five hundred dollars, in the discretion of the court—except as specially provided for in section 9 of this act.

Inspectors—Oath, Bonds, Compensation—Removal.—Sec. 11.—The County Board in each and every county in this State, in which mining is now or may be hereafter carried on, is hereby authorized, and it is made its duty to appoint an Inspector of Mines at its September meeting, who shall have been a resident of the county for which he is appointed for one year previous to his appointment. He shall be required to enter into a bond to the County Board of said county for a sum not less than one thousand dollars, nor more than three thousand dollars, conditioned upon the due and faithful performance of his duties, said bond to be accompanied by good and sufficient security, to be approved by the said County Board. He shall also take an oath of office as provided for by the constitution, and he shall be required to furnish satisfactory evidence that he has had sufficient practical experience in and around mines to discharge the duties of said office, and to see that the provisions of this act are faithfully complied with. He shall not be interested as owner, stockholder, superintendent, or operator, or be interested in operating any mine during his term of office, which shall be one year, but he may be re-appointed as often as the County Board may think proper. The County Board of such counties shall fix the number of days to be employed by the County Inspector in inspecting the different mines in his county, and enter the same upon the records of said Board. He shall receive such compensation for his time actually employed in the performance of the duties of his office, to be verified by his affidavit, to be not less than three dollars, nor more than five dollars per day, to be paid out of the county treasury. The County Board shall also provide an anemometer and all necessary instruments for testing the air, and in all cases where the Inspector finds the provisions of this act, or any of them, not complied with in operating any mine, it is made his duty to demand, and, if necessary, compel by law, the collection from the owner, or operators, of such mine all expenses of said inspection, as provided in section two (2) of this act: *Provided, however,* That in all cases where the County Commissioners fail or refuse to appoint a competent and experienced Inspector, or where the said Inspector fails to attend to or perform the duties of his office, in accordance with the meaning and intent of this act, the Circuit Court of said county shall, at the request of any ten citizens of said county, and upon proper proof of the incompetency or neglect of said Inspector to properly perform the duties of his office, remove the said Inspector and appoint a properly qualified person to perform the duties of said Inspector for the unexpired term.

Inspector's Duties—Statistics.—Sec. 12.—The Inspector, provided for under this act, shall see that every necessary precaution is taken to insure the health and safety of the workmen therein employed; that the provisions and requirements of this act be faithfully observed and obeyed, and the penalties of the law enforced against all who willfully disobey its requirements. He shall also collect and tabulate the following facts, that is to say: The number of acres of workable coal lands in his county; the number and thickness of the coal beds, and their respective depths below the surface; how they are mined, whether by shaft, slope, or drift; the number of mines in operation, the number of men employed therein, and the aggregate yearly production in tons; together with an estimate of the amount of capital employed in coal mining in his county, and any other information relative to coal mining that he may deem necessary; all of which facts so tabulated, together with a statement of the condition of the mine, as to safety and ventilation, and the general result of his examination into the causes of all accidents in and about the coal mines of his county, he shall fully set forth in an annual report to the Governor, with his recommendations as to such other legislation on this subject as may be proper; he shall also furnish such information as he may have obtained on this subject when called for by the State Geologist.

Inspection of Mines—Refusal of Owner to Permit, etc.—Sec. 13.—It shall be lawful for the Inspector, provided for in this act, to enter, examine and inspect any and all coal mines and machinery belonging thereto, at all reasonable times, by day or by night, but so as not to obstruct or hinder the necessary workings of such coal mine; and the owner, agent, or operator of every such coal mine is hereby required to furnish all necessary facilities for entering upon such examination and inspection; and if the said owner, agent, or operator aforesaid shall refuse to permit such inspection, or to furnish the necessary faciltities for such entry, examination and inspection, the Inspector shall file his affidavit, setting forth such refusal, with the Judge of the Circuit Court in said county in which said mine is situated, enter in term time, or vacation, or, in the absence of said Judge, with the Master in Chancery in said county in which said mine is situated, and obtain an order on such owner, agent, or operator so refusing, as aforesaid, commanding him to permit and furnish such necessary facilities for the inspection of such coal mine, or to be adjudged to stand in contempt of court, and punished accordingly; and if the said Inspector shall, after examination of any coal mine, and the works, and machinery pertaining thereto, find the same to be worked contrary to the provisions of this act, or unsafe for the workmen therein employed, said Inspector shall, through the State's attorney of his county or any attorney, in case of his refusal to act, acting in the name and on the behalf of the State, proceed against the owner, agent, or operator of such coal mine, by injunction without bond, after giving at least two days' notice to such owner, agent, or operator; and said owner, agent, or operator shall have the right to appear before the Judge or Master to whom the application is made, who shall hear the same on affidavits and such other testimony as may be offered in support as well as in opposition thereto, and if sufficient cause appear, the court, or Judge in vacation, by order, shall prohibit the further working of any such coal mine in which persons may be unsafely employed, contrary to the provisions of this act, until the same shall have been made safe and the requirements of this act shall have been complied with, and the court shall award such costs in the matter of the said injunction as may be just; but any such proceedings so commenced shall be without prejudice to any other remedy permitted by law for enforcing the provisions of this act.

Injuries—Remedies in favor of Widow, etc.—Sec. 14.—For any injury to person or property occasioned by any willful violations of this act, or willful failure to comply with any of its provisions, a right of action shall accrue to the party injured for any direct damages sustained thereby, and in case of loss of life, by reason of such willful violation or willful failure, as aforesaid, a right of action shall accrue to the widow of the person so killed, his lineal heirs, or adopted children, or to any other person or persons who were, before such loss of life, dependent for support on the person or persons so killed, for a like recovery of damages for the injuries sustained by reason of such loss of life or lives.

Conduct of Miners—Injuries to Machinery—Disobedience, etc.—Sec. 15. Any miner, workman, or other person, who shall knowingly injure any water gauge, barometer, air course or brattice, or shall obstruct, throw open any air-ways, or carry any lighted lamps or matches into places that are worked by the light of safety lamps, or shall handle or disturb any part of the machinery of the hoisting engine, or open a door in the mine and not have the same closed again, whereby danger is produced either to the mine or those at work therein; or who shall enter into any part of the mine against caution; or who shall disobey any order given in pursuance of this act; or who shall do any willful act whereby the lives and health of persons working in the mine, or the security of the mine or miners, or the machinery thereof, is endangered, shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by fine or imprisonment, at the discretion of the court.

Timber for Props, etc.—Sec. 16. The owner, agent, or operator of any coal mine shall keep a sufficient supply of timber where required to be used as props, so that the workmen may at all times be able to properly secure the said workings from caving in; and it shall be the duty of the owner, agent, or operator to send down all such props when required.

Repeal.—Sec. 17. All acts or parts of acts inconsistent with the provisions of this act are hereby repealed.

Ohio.—The following now (May 14, 1881) forms the law of the State:

Sec. 290.—The inspector of mines shall be appointed by the governor, by and with the advice and consent of the senate, and shall hold his office for four years; and no person shall be appointed unless he is possessed of a competent knowledge of chemistry, geology, and mineralogy, and has a practical knowledge of mining engineering, and of the different systems of working and ventilating coal mines, and of the nature and properties of the noxious and poisonous gases of mines, particularly fire damp.

Sec. 291.—Before entering upon the discharge of the duties of the office, the inspector shall give bond to the state in the sum of five thousand dollars, with sureties, to be approved by the governor, conditioned for the faithful performance of his duties; the bond, with his oath of office, and approval of the governor endorsed thereon, shall be forthwith deposited with the secretary of state.

Sec. 292.—The inspector shall give his whole time and attention to the duties of his office, and shall examine all mines in the state, as often as his other duties will permit, to see that the provisions of this chapter are obeyed; and the inspector may enter, inspect and examine any mine in the state, and the works and machinery belonging thereto, at all reasonable times, by night or by day, but so as not to unnecessarily obstruct or impede the working of the mine, and to make inquiry into the state and condition of the mine, as to ventilation and general security; and the owner and agent of such mine are hereby required to furnish the means necessary for such entry and inspection, of which inspection the inspector shall make a record, noting the time and all the material circumstances; and the person having charge of any mine, whenever loss of life occurs by accident connected with the working of such mine, or by explosion, shall give notice forthwith, by mail or otherwise, to the inspector of mines, and to the coroner of the county in which such mine is situated, who shall hold an inquest upon the body of the person or persons whose death has been caused, and inquire carefully into the cause thereof, and shall return a copy of the finding and all the testimony to the inspector.

SEC. 293. The inspector, while in office, shall not act as an agent, or as a manager, or mining engineer, or be interested in operating any mine; and he shall annually make report to the governor of his proceedings and the condition and operation of the mines of the state, enumerating all accidents in or about the same, and giving all such other information as he thinks useful and proper, and making such suggestions as he deems important as to further legislation on the subject of mining.

Sec. 294.—The inspector shall have an office in the state house, in which shall be carefully kept the maps and plans of all mines in the state, and all records and correspondence papers, and apparatus, and property pertaining to his duties, belonging to the state, and which shall be handed over to his successor in office.

Sec. 295.—There shall be provided for the inspector all instruments and chemical tests necessary for the discharge of his duties under this chapter, which shall be paid for on the certificate of inspector, and which shall belong to the state.

Sec. 296.—The owner or agent of every coal mine, shall make, or cause to be made, an accurate map or plan of the working of such mine, on a scale of not less than one hundred feet to the inch, showing the area mined or excavated, and the location and connection with such excavation of the mine of the lines of all adjoining lands, and the name or names of each owner or owners, so far as known, marked on each tract, a true copy of which map the owner or agent shall deposit with the inspector, and another copy of which shall be kept at the office of such mine; and the owner or agent shall, every four months thereafter, file with the inspector a statement and plan of the workings of such mine up to that date, which statement and plan shall be so prepared as to enable the inspector to mark the same on the original map or plan herein required to be made, and in case of refusal on the part of the owner or agent to make and file the map or plan, or the addition thereto, the inspector is authorized to cause an accurate map or plan of the whole of said mine to be made, at the expense of the owner thereof, the cost of which shall be recoverable against the owner, in the name of the person or persons making the map or plan, which shall be made in duplicate, one copy being delivered to the inspector and the other left in the office of the mine: and he shall, on being paid the proper cost thereof, on demand of any person interested in the working of such mine, or owner of adjoining lands, furnish an accurate copy of any map or plan of the working of such mine.

Sec. 297.—It is unlawful for the owner or agent of any coal mine worked by a shaft, wherein over fifteen thousand square yards have been excavated, to employ or permit any person to work therein, unless there are, to every seam of coal worked in each mine, at least two separate outlets, separated by natural strata of not less than one hundred feet in breadth, by which shaft or outlets distinct means of ingress and egress are always available to the persons employed in the mine; but it is not necessary for the two outlets to belong to the same mine; the second outlet need not be made until fifteen thousand yards have been excavated in such mine; and to all other coal mines, whether slopes or drifts, two such openings or outlets must be provided within twelve months after fifteen thousand yards have been excavated therein; and in case such outlets are not provided as herein stipulated, it shall not be lawful for agent or owner of such mine to permit more than ten persons to work therein at any one time. In case a coal mine has but one shaft, slope, or drift, for the ingress or egress of the men working therein, and the owner thereof does not own suitable surface-ground for another opening, he may select and appropriate any adjoining land for that purpose and for approach thereto, and shall be governed in his proceeding in appropriating such land by the provisions of law in force providing for the appropriation of private property by corporations, and such appropriations may be made, whether he is a corporator or not; but no land shall be appropriated under the provisions of this chapter until the court is satisfied that suitable premises cannot be obtained by contract on reasonable terms.

Sec. 298.—The owner or agent of every coal mine, whether shaft, slope, or drift, shall provide and maintain for every such mine, an amount of ventilation of not less than 100 cubic feet, per minute, per person employed in such mine, which shall be circulated and distributed throughout the mine in such a manner as to dilute, render harmless, and expel the poisonous and noxious gases from each and every working-place in the mine, and no working-place shall be driven more than 120 feet in advance of a break-through, or air-way, and all break-throughs, or air-ways, except those last made near the working-faces of the mine, shall be closed up and made air-tight, by brattice, trap-doors, or otherwise, so that the currents of air in circulation in the mine may sweep to the interior of the mine, where the persons employed in such mine are at work, and all mines governed by the statutes shall be provided with artificial means of producing ventilation, such as forcing, or suction fans, exhaust steam, furnaces, or other contrivances, of such capacity and power, as to produce and maintain an abundant supply of air, and all mines generating fire-damp shall be kept free from standing gas, and every working-place shall be carefully examined, every morning, with a safety-lamp, by a competent person, or persons, before any of the workmen are allowed to enter the mine.

Sec. 299.—The owner or agent of every coal mine operated by shaft, in all cases where human voice cannot be distinctly heard, shall, forthwith, provide and maintain a metal tube from the top to the bottom of such shaft, suitably calculated for the free passage of sound therein, so that conversation may be held between persons at the bottom and top of the shaft: and there shall also be provided an approved safety-catch, and a sufficient cover overhead, on all carriages used for lowering and hoisting persons, and in the top of every shaft an improved safety-gate, and an adequate brake shall be attached to every drum or machine used for lowering or raising persons in all shafts or slopes.

Sec. 300.—No owner or agent of any coal mine operated by a shaft or slope shall place in charge of any engine used for lowering into or hoisting out of such mine persons employed therein, any but experienced, competent, and sober engineers; and no engineer in charge of such engine shall allow any person, except such as may be deputed for that purpose, by the owner or agent, to interfere with it or any part of the machinery, and no person shall interfere or in any way intimidate the engineer in the discharge of his duties: and in no case shall more than ten men ride on any cage or car at any one time, and no person shall ride upon a loaded cage or car in any shaft or slope.

Sec. 301.—All safety-lamps used for examining coal mines, or which are used in any coal mine, shall be the property of the owner of the mine, and shall be under the charge of the agent thereof, and in all mines, whether they generate fire-damp or not, the doors used in assisting or directing the ventilation of the mine, shall be so hung and adjusted that they will shut of their own accord and cannot stand open, and the mining boss shall keep a careful watch over the ventilating apparatus and the airways, and he shall measure the ventilation at least once a week, at the inlet and outlet, and also at or near the face of all the entries, and the measurements of air so made shall be noted on blanks, furnished by the mine inspector: and on the first day of each month, the mining boss of each mine shall sign one of such blanks, properly filled, with the said actual measurements, and forward same to the mine inspector.

Sec. 302.—No boy under twelve years of age shall be allowed to work in any mine, nor any minor between the ages of twelve and sixteen years, unless he can read and write, and in all cases of miners applying for work, the agent of such mine shall see that the provisions of this section are not violated.

Sec. 303.—In case any coal mine does not, in appliances for the safety of the persons working therein, conform to the provisions of this chapter, or the owner or agent disregards the requirements of this chapter, any court of competent jurisdiction may, on application of the inspector, by civil action in the name of the state, enjoin or restrain the owner or agent from working or operating such mine, with more than ten miners at once, until it is made to conform to the provisions of this chapter; and such remedy shall be cumulative, and shall not take the place of or affect any other proceedings against such owner or agent authorized by law for the matter complained of in such action.

Sec. 304. When written charges of gross neglect of duty or malfeasance in office against any inspector are made and filed with the governor, signed by not less than fifteen coal miners, or one or more operators of mines, together with a bond in the sum of five hundred dollars, payable to the state, and signed by two or more responsible free-holders, and conditioned for the payment of all costs and expenses arising from the investigation of such charges, the governor shall convene a board of examiners, to consist of two practical coal miners, one chemist, one mining engineer, and one operator, at such time and place as he deems best, giving ten days' notice to the inspector or against whom the charges are made, and also to the person whose name appears first in the charges, and the board, when so convened, and having been first duly sworn, truly to try and decide the charges made, shall summon any witnesses so desired by either party, and examine them on oath, which may be administered by any member of the board, and depositions may be read on such examination, as in other cases; and the board shall examine fully into the truth of such charges, and report the result of their investigation to the governor; and the board shall award the costs and expenses of such investigation against the inspector or the persons signing the bond according to their finding, against said inspector or in his favor, which costs and expenses shall include the compensation of such board, of five dollars per day for each member, for the time occupied in the trial, and in traveling from and to their homes; and the attorney-general shall forthwith proceed to collect such costs and expenses, and pay the same into the state treasury, being in the first instance paid out of the state treasury, on the certificate of the president of such board.

Sec. 305.—In all coal mines in the state, the miners employed and working therein, the owners of the land or other persons interested in the rental or royalty of any such mine, shall at all proper times have full right of access and examination of all scales, machinery or apparatus used in or about such mine to determine the quantity of coal mined, for the purpose of testing the accuracy and correctness of all such scales, machinery or apparatus; and such miners, landowners, or other persons, may designate or appoint a competent person to act for them, who shall at all proper times have full right of access and examination of such scales, machinery or apparatus, and seeing all weights and measure of coal mined, and the accounts kept of the same; but not more than one person on behalf of the miners collectively, or one person on behalf of the landowners or other persons interested in the rental or royalty jointly, shall have such right of access, examination and inspection of scales, weights, measures and accounts at the same time, and that such persons shall make no unnecessary interference with the use of such scales, machinery or apparatus; and the miners employed in any mine may, from time to time, appoint two of their number to act as a committee to inspect not oftener than once in every month, the mine and the machinery connected therewith, and to measure the ventilating current, and if the owner, agent, or manager so desires, he may accompany said committee by himself or two or more persons which he may appoint for that purpose; the owner, agent or manager shall afford every necessary facility for making such inspection and measurement, but the committee shall not in any way interrupt or impede the work going on in the mine at the time of such inspection and measurement, and said committee shall, within ten days after such inspection and measurement, make a correct report thereof to the inspector of mines, on blanks to be furnished by said inspector for that purpose; and if such committee make to the inspector a false or untrue report of the mines, such act shall constitute a violation of this section.

Sec. 306.—The provisions of this chapter shall not apply to or affect any coal mine in which not more than ten men are employed at the same time; but on the application of the proprietor of or miners in any such mine, the inspector shall make, or cause to be made, an inspection of such mine, and shall direct and enforce any regulations in accordance with the provisions of this chapter that he deems necessary for the safety of the health and lives of miners.

Sec. 306 (*a*).—The inspector of mines may, with the approval of the governor, appoint an assistant, who shall be a practical miner of not less than five years' experience, and who shall perform such duties as may be required by the inspector, and receive a salary at the rate of twelve hundred dollars ($1,200 00) per annum, and the inspector may, with the consent of the governor, remove such assistant at pleasure and appoint a successor, and may allow the assistant traveling expenses out of his contingent fund.

Sec. 6871.—Whoever knowingly violates any of the provisions of sections two hundred and ninety-eight, two hundred and ninety-nine, three hundred, three hundred and one, three hundred and two, and three hundred and five, of the revised statutes, or does any act whereby the lives or health of the persons or the security of any mine and machinery are endangered, or any miner or other person employed in any mine governed by the statute, who intentionally and willfully neglects or refuses to securely prop the roof of any working place under his control, or neglects or refuses to obey any order given by the superintendent of a mine in relation to the security of the mine in the part thereof where he is at work, and for fifteen feet back from the face of his working place, shall be fined not more than fifty dollars or imprisoned in the county jail not more than thirty days, or both.

Pennsylvania.—An Act providing the means for securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania.

Sec. 1.—*Be it enacted, etc.*, That the owner or agent of every bituminous coal mine or colliery, shall make, or cause to be made, within six months after the passage of this act, an accurate map or plan of the workings of such coal mine or colliery, on a scale not exceeding one hundred feet to the inch, and showing the bearing and distances, which shall be kept for the use of the inspector, in the office at the mine of said coal mine or colliery; and said owner, or agent shall cause, on or before the tenth day of January in every year, a plan of the progress of the workings of such coal mine during the year past, to be marked on the original map or plan of the said coal mine or colliery, and the inspector shall have the right at all times to have possession of any such map or plan at the mines to draw a copy therefrom for his own convenience: *Provided*, If the owner or agent of any coal mine shall neglect or refuse, or from any cause fail, for the period of two months after the time prescribed, to furnish the said map or plan, as hereby required, or if the inspector shall find, or have reason to believe that any map or plan of any coal mine furnished in pursuance of the provisions of this act is materially inaccurate or imperfect, he is hereby authorized to cause a correct map or plan of the actual workings of said coal mine to be made at the expense of the owner thereof, the cost of which shall be recoverable from said owner, as other debts are recoverable by law: *Provided*, That if the map or plan, which he claimed to be incorrect, shall prove to have been correct, then aforesaid expenses shall be paid by the said inspector and may be recovered from him in like manner.

Sec. 2.—It shall not be lawful, after six months from the passage of this act, for the owner or agent of any bituminous coal mine to employ any person at work within said coal mine, or permit any person to be in said coal mine for the purpose of working therein, unless they are in communication with at least two openings separated by natural strata of not less than one hundred and fifty feet in breadth, if the mine be worked by shaft or slope, and of not less than twenty-four feet, if the mine be worked by drift: *Provided*, If the mine be worked by drift, two openings, inclusive of air shaft, shall only be required, if the air shaft can be used for ingress and egress in case of emergency; and that not more than twenty persons shall be employed in the mine at any one time after the expiration of the six months until the second opening shall be reached and made available; and in case of furnace ventilation being used before the second opening is reached, the furnace shall not be placed within forty feet of the foot of the shaft, and shall be well secured from danger from fire by brick or stone walls of sufficient thickness, and the mine while being driven for making and perfecting a second opening; the owner or agent shall provide and maintain a metal tube from the top to the bottom of the slope or shaft, suitably adapted to the free passage of sound, through which conversation may be held between persons at the bottom and at the top of the shaft or slope; also, the ordinary means of signalling to and from the top and bottom of the shaft or slope, and an approved safety-catch, and sufficient cover overhead on every carriage used for lowering and hoisting persons; and the said owner or agent shall see that sufficient flanges or horns are attached to the sides of the drum of every machine that is used for lowering and hoisting persons in and out of the mine, and also that adequate brakes are attached thereto; the main link attached to the swivel of the wire rope shall be made of the best quality of iron, and shall be tested by weights, or otherwise satisfactory to the inspector of mines of the district, and bridle chains shall be attached to the main link from the cross pieces of the carriage, and no single link chain shall be used for lowering or raising persons into or out of said mine, and not more than six persons shall be lowered or hoisted by the machinery at any one time; and only sober, competent and experienced engineers shall be employed.

Sec. 3.—When a second opening is made, one opening shall be set apart exclusively for purposes of ingress and egress, and shall not be clogged or obstructed with machinery, pumps or currents of heated air or steam; if the opening is a shaft it shall be fitted with safe and convenient stairs, at an angle of not more than sixty degrees descent, and with landings at easy and convenient distances; all water coming from the surface or out of the strata in the shaft shall be conducted by rings or otherwise to be prevented from falling down the shaft so as to wet persons who are ascending and descending the stairway of the shaft; if the opening is a slope, it shall be provided with safe and available traveling ways.

Sec. 4.—The owner or agent of every bituminous coal mine, whether shaft, slope or drift, shall within six months after the passage of this act, provide, and thereafter maintain for every such mine, ample means of ventilation, affording one hundred cubic feet per minute for each and every person employed in said mine, which shall be circulated around the main headings and cross headings to an extent that will dilute, carry off and render harmless the noxious gases generated therein; and all mines generating fire-damp shall be kept free of standing gas, and every working place shall be carefully examined every morning with a safety-lamp by a competent person before any workmen are allowed to enter.

Sec. 5.—In order to better secure the proper ventilation of every coal mine and promote the health and safety of the persons employed therein, the owner or agent shall employ a competent and practical inside overseer, to be called mining boss, who shall keep a careful watch over the ventilating apparatus, the air ways, traveling-ways, pumps and pump-timbers, and drainage, and shall see that, as the miners advance their excavations, all loose coal, slate and rock overhead are carefully secured against falling in or upon the traveling ways, and that sufficient timber is furnished of suitable lengths and sizes for the places where they are to be used, and placed in the working places of the miners; and it shall also be the duty of the mining boss to measure the air current, at least once a week; at the inlet and outlet and at or near the face of the headings, and keep a record of such measurements, and report the same to the Inspector of his district once in every month; the safety-lamps used for examining mines or which may be used in working therein, shall be furnished by and be the property of the owner of said mines, and shall be in the charge of the agent of such mines; and in all mines generating explosive gases, the doors used in assisting or directing the ventilation of the mine shall be so hung and adjusted that they will close themselves, or be supplied with springs or pulleys so they cannot be left standing open; and bore-holes shall be kept not less than twelve feet in advance of the face of every working place; and, when necessary, on the sides, if the same is driven towards and in dangerous proximity to an abandoned mine or part of a mine suspected of containing inflammable gases, or which is inundated with water.

Sec. 6.—Any miners, workmen or other person who shall intentionally injure any shaft, lamp, instrument, air-course, or brattice or obstruct or throw open air-ways, or carry lighted pipes or matches into place that are worked by safety-lamps, or handle or disturb any part of the machinery, or open a door and not close it again, or enter any place of the mine against caution, or disobey any order given in carrying out the provisions of this act, or do any other act whereby the lives or the health of persons, or the security of the mines or the machinery, is endangered, shall be deemed guilty of a misdemeanor, and may be punished in the manner provided in the sixteenth section of this act; all machinery about mines shall be properly fenced off, and the top of each shaft and the entrance of every abandoned slope and air or other shaft shall be securely fenced off; and there shall be cut in the side of every hoisting shaft at the bottom thereof a traveling-way sufficiently high and wide to enable persons to pass the shaft in going from one side of the mine to the other, without passing over or under the cage or other hoisting apparatus.

Sec. 7.—If any person, firm or corporation is, or hereafter shall be, seized in his or their own right of coal lands, and it shall not be practicable to comply with the requirements of this act in regard to drainage and ventilation, by means of openings on his or their own land, and the same can be done by means of openings on adjacent lands, he or they may apply by petition to the court of quarter sessions of the proper county, after ten days' notice to the owner or owners, their agent or attorney, setting forth the facts under oath or affirmation, particularly describing the place or places where such opening or openings can be made, and that he or they cannot agree with the owner or owners of the land as to the amount to be paid for the privilege of making such opening or openings; hereupon the said court shall appoint three disinterested and competent citizens of the county to view the grounds designated, and lay out from the point or points mentioned in such petition a passage or passages for air and water, not more than sixteen feet in diameter, by the shortest and most convenient route to the coal of such person, firm or corporation preferring in all cases an opening through the coal strata where the same is practicable; the said viewers shall at the same time assess the damages to be paid by the petitioner or petitioners to the owner or owners of such land for the privilege of making said openings, which damages shall be fully paid before such opening is made; it shall be the duty of said viewers to give notice by at least three written or printed hand-bills, posted on the premises at least five days prior to the time of meeting to attend to the duties of their appointment, setting forth distinctly the time, place and object of their meeting, and also to give personal notice to the parties, their agents and attorneys, where it can be done, and shall within thirty days after their appointment make report of their proceedings to said court, stating the amount of damages awarded, accompanied by a map or plan of said openings; and if no appeal be taken to said court within ten days after notice to the opposite party in interest of the filing thereof, it shall be marked confirmed by the clerk, and the petitioner or petitioners may proceed to make said opening or openings; the pay of the viewers and other costs shall be the same as in road cases, and shall be paid by the petitioner or petitioners.

Sec. 8.—As soon as practicable after the passage of this act, the persons exercising the office of presiding judge of each of the several courts of common pleas in the Fifth, Tenth, and Fourth judicial districts, shall appoint one reputable miner of known experience and in practice at the time, (in the Fifth district the president judge of the court of common pleas number one shall make said appointment), and the Governor shall appoint two mining engineers of like repute and experience and practice at the time, who shall constitute a board of five examiners, whose duty it shall be to inquire into the character and qualifications of candidates for the office of inspector of mines under the provisions of this act. The examiners first appointed, in pursuance of this section, shall meet in the city of Pittsburg, on the fifteenth day of May next, and after being duly organized, having taken and subscribed before any officer authorized to administer the same, the following oath, namely: "We, the undersigned, do solemnly swear (or affirm) that we will perform the duties of examiners of applicants for appointment as inspectors of bituminous coal mines to the best of our abilities, and that in recommending or rejecting said applicants we will be governed by the evidence of qualification to fill the position, under the law creating the same, and not by any consideration of political or other personal favors; that we will certify all whom we may find qualified, according to the true intent and meaning of the act, and none others, to the best of our judgments:" shall proceed to the examination of those who may present themselves as candidates for said office; and they shall certify to the Governor the names of all such applicants as they shall find competent to fill the office, under the provisions of this act, which names, with the certificate and the oath of the examiners, shall be mailed to the Secretary of the commonwealth, to be filed in his office, and shall be valid when recommended by four of the examining board. The qualifications of candidates for said office of inspector of mines, to be inquired into and certified by said examiners, shall be as follows, namely: They shall be citizens of the United States, of temperate habits, of good repute as men of personal integrity, shall have attained the age of thirty years, and shall have had at least five years experience in the workings of the bituminous coal mines of Pennsylvania, and upon the examination they shall give evidence of such theoretical, as well as practical knowledge of the working of coal mines and noxious gases, as will satisfy the examiners of their capability and fitness for the performance of the duties imposed upon inspectors of mines by the provisions of this act. The board of examiners shall, also, at their said meeting, divide the bituminous coal counties of the State into three inspection districts, as nearly equal in regard to the labor to be performed as is possible, taking into consideration the number of mines and the extent of territory; at every subsequent calling of the board of examiners this division may be revised as experience may prove to be advisable. The board of examiners shall each receive five dollars per day and all necessary expenses, to be paid out of the State treasury, upon the filing of the certificates of the examining board, in the office of the Secretary of the Commonwealth, as herein before provided. The Governor shall, from the names so certified, appoint one person to be inspector of mines, for each district, as fixed by the examiners in pursuance of the act, whose commission shall be for four years, to be computed from the fifteenth day of May next. As often as vacancies occur, by death, resignation, or otherwise, in said offices of inspectors of mines, the Governor shall fill the same, by appointment, for the unexpired term, from the names on file in the office of the Secretary of the Commonwealth, until the number shall be exhausted; and whenever this shall occur, the Governor shall cause the aforesaid board of examiners to meet, who shall examine persons that may present themselves for the vacant office of inspector, in the same manner as herein provided, and the board of examiners shall certify to the Governor one person, to be commissioned by him for the office of inspector for the unexpired term; and any vacancies that may occur in the examining board shall be filled in the district where the vacancy occurred. And every four years the Governor shall appoint two mining engineers as before, and shall notify the person exercising the office of president judge of the courts of common pleas of three of the judicial districts of the State, containing bituminous coal mines, selecting them in such order as to allow each district an equal share of such appointments, each to appoint one miner, and the five so appointed shall constitute a new board of examiners, whose duties, terms of service, and compensation, and vacancies that may happen, shall be the same as those first provided for by this section, and from the names that may be certified by them, the Governor shall appoint the inspectors provided for in this act. Nothing in this act shall be construed to prevent the re-appointment of any inspector of bituminous mines. The inspectors of mines shall each receive, for their services, an annual salary of two thousand dollars, to be paid quarterly, by the State Treasurer, and they shall each reside in the district for which they shall be appointed. Each inspector is hereby authorized to procure such instrument and chemical tests and stationery, from time to time, as may be necessary to the proper discharge of his duties, under this act, at the expense of the State, which shall be paid by the State Treasurer, upon accounts duly certified by him, and audited by the proper department of the State. All instruments, plans, book memoranda, notes, et cetera, pertaining to the office, shall be the property of the State, and shall be delivered to their successors in office.

Sec. 9.—Each inspector of bituminous coal mines shall, before entering upon the discharge of his duties, give bond in the sum of five thousand dollars, with sureties, to be approved by the president judge of the district in which he resides, conditioned for the faithful discharge of his duty, and take an oath (or affirmation) to discharge his duties impartially, and with fidelity, to the best of his knowledge and ability.

Sec. 10.—No person, who shall act as a manager or agent of any coal mine, or as a mining engineer, or be interested in operating any coal mine, shall, at the same time, act as inspector of coal mines, under this act.

Sec. 11.—For any injury to person or property, occasioned by any violation of this act, or any wilful failure to comply with its provisions by any owner, lessee or operator of any coal mine or opening, a right of action, against the party at fault, shall accrue to the party injured for the direct damage sustained thereby; and in any case of loss of life, by reason of such violation or willful failure, a right of action, against the party at fault, shall accrue to the widow and lineal heirs of the person whose life shall be lost, for like recovery of damages for the injury they shall have sustained.

Sec. 12.—The inspectors of bituminous coal mines shall each devote the whole of his time to the duties of his office; it shall be his duty to examine the mines in his district as often as possible to see that all the provisions of this act are observed and strictly carried out; and he shall make a record of all examinations of mines, showing the condition in which he finds them, the number of mines in his district, the number of persons employed in and about each mine, the extent to which the law is obeyed, the progress made in the improvement sought to be secured by the passage of this act, the number of accidents and deaths resulting from injuries received in the mines, and all other facts of public interest concerning the condition and progress of mining in his district, which record shall, on or before the first Monday of each month, together with all matters and things furnished him in accordance with the provisions of this act, be filed in the office of the Secretary of Internal Affairs, to be by him recorded and included in the annual report of his department; he shall also, from the time of his commission, make strict and careful inquiry and examination into the condition of the ventilation and drainage of the mines.

Sec. 13.—That the inspectors may be enabled to perform the duties herein imposed upon them, they shall have the right at all times to enter any bituminous coal mine to make examination or obtain information; they shall notify the owners, lessees, or agents immediately of the discovery of any violations of this act and of the penalty imposed thereby for such violation, and in case of such notice being disregarded for the space of ten days, they shall institute a prosecution against the owner, owners, agent, or lessee of the mine, under the provisions of section sixteen of this act; in any case, however, where, in the judgment of the inspector of either district, delay may jeopardize life or limb, he shall at once notify the inspectors of the other districts, whereupon they shall at once proceed to the mine or colliery where the danger exists, and examine into the matter, and if, after full investigation thereof, they shall be agreed in the opinion that there is immediate danger, they shall apply, in the name of the commonwealth, to the court of common pleas of the county in which the mine may be located, for an injunction to suspend all work in and about such mine or colliery; whereupon, said court, if the cause appear to be sufficient, after hearing the parties and their evidence as in like cases, shall issue their writ to restrain the working of said mine or colliery until all cause of danger is removed; and the cost of said proceedings, including the charges of attorney prosecuting said application, shall be borne by the owner of the mine or colliery: *Provided*, that no fee exceeding the sum of tweuty-five dollars shall be taxed in any one case for the attorney prosecuting such case: *Provided further*, that if said court shall find the cause not sufficient, then the case shall be dismissed, and the cost shall be borne by the inspector instituting the proceeding, or the county, at the discretion of the court.

Sec. 14.—Whenever, by reason of any explosion or other accident in any bituminous coal mine or the machinery connected therewith, loss of life or serious personal injury shall occur, it shall be the duty of the person having charge of such mine or colliery to give notice thereof forthwith to the inspector of the district, and if any person is killed thereby, to the coroner of the county, who shall give due notice of the inquest to be held; it shall be the duty of the inspector, upon being notified as herein provided, to immediately repair to the scene of the accident and make such suggestions as may appear necessary to secure the future safety of the men; and if the results of the explosion do not require an investigation by the coroner, he shall proceed to investigate and ascertain the cause of the explosion or accident, and make a record thereof, which he shall file as provided for; and to enable him to make the investigation, he shall have power to compel the attendance of persons to testify, and to administer oaths or affirmations; the cost of such investigation shall be paid by the county in which the accident occurred, in the same manner as costs of inquests held by the coroners or justices of the peace are paid.

Sec. 15.—The court of common pleas of any county in the proper district, upon a petition sigued by not less than fifteen reputable citizens, not less than five of whom shall be miners, owners, or lessees of mines, and with the affidavit of one or more of said petitioners attached, setting forth that any inspector of mines neglects his duties or is incompetent, or that he is guilty of a malfeasance in office, shall issue a citation in the name of the Commonwealth to the said inspector to appear on not less than fifteen days' notice, upon a day fixed before said court, at which time the court shall proceed to inquire into and investigate the allegations of the petitioners; if the court find that the said inspector is neglectful of his duties, or is incompetent to perform the duties of his office, or that he is guilty of malfeasance in office, the court shall certify the same to the Governor, who shall declare the office of said inspector vacant, and proceed in compliance with the provisions of this act to supply the vacancy; the costs of said investigation shall, if the charges are sustained, be imposed upon the inspector, but if the charges are not sustained they shall be imposed upon the petitioners.

Sec. 16.—The neglect or refusal to perform the duties required to be performed, by any section of this act, by the parties therein required to perform them, or the violation of any of the provisions or requirements hereof, shall be deemed a misdemeanor, and shall, upon conviction, be punished by fine of not less than two hundred dollars, nor not exceeding five hundred dollars, at the discretion of the court; and all penalties recovered under this act shall be paid into the treasury of the State.

Sec. 17.—The inspector shall exercise a sound discretion in the enforcement of the provisions of this act, and should the operator or owner be dissatisfied with any decision at which the inspector may arrive, it shall and may be lawful for such operator or owner to apply, by petition, to the court of quarter sessions of the county wherein such mine is located, and said court shall, thereupon appoint three reputable, competent, and disinterested persons, whose duty it shall be to forthwith examine such mines, and hear the proofs and allegations of the inspectors and operator or owner, and make such report, under oath, to court, of the facts as they exist, together with their opinion thereon; and if said report sustains the decisions of the inspector, then the party making application to court shall pay the costs of such proceeding, and if the report is against such decision, then the inspector shall pay the costs, unless the court order otherwise. The report of the said board shall become absolute, unless exceptions thereto shall be filed within ten days after notice of the filing thereof to the owner, operator, or inspector, and if exceptions are filed the court shall hear and determine the same, and the decision shall be final and conclusive.

Sec. 18.—The provisions of this act shall not apply to any mine where ten men, or a less number, are employed, or to any mine which does not generate fire-damp, black-damp, or other dangerous or noxious gases.

Sec. 19.—All laws or parts of laws inconsistent with any of the provisions of this act are hereby repealed.

An act to amend an act entitled "An act to provide the means for securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania."

Sec. 1.—*Be it enacted, etc.*, That the last clause of the eighteenth section of the act of General Assembly, entitled "An act to provide the means for securing the health and safety of persons employed in the bituminous coal mines of Pennsylvania," approved the eighteenth day of April, Anno Domini one thousand eight hundred and seventy-seven, after the word "employed," in the second line of said section, which is as follows: "Or to any mine which does not generate fire-damp, black-damp, or other dangerous or noxious gases," is hereby repealed.

Massachusetts.—The text of the new law on foreign mining is as follows, Chap. 106:—

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:—

Sec. 1.—Every corporation, company, or association chartered or organized by authority other than that of this Commonwealth, for the purpose of engaging without the limits of this Commonwealth in the business of coal mining or other mining, of quarrying or extracting carbonaceous oils from the earth, or of purchasing or holding mines or lands without the said limits, which shall for any period exceeding ten days, establish, set up, have, or keep principal or branch subscription, treasury, or transfer office or agency within this Commonwealth, shall, within thirty days after the setting up or establishment of such office or agency, make and return to the secretary of the Commonwealth a certificate in manner and form to be approved by the commissioner of corporations, and signed and sworn to by its president, treasurer, and a majority of its board of directors or trustees setting forth the name of such corporation, company or association, the name of the State, Territory or foreign country under whose laws it is organized, and whether specially chartered or organized under the general laws thereof, its location in such State, Territory, or country, the location of its mines, quarries, oil wells, or lands, and the amount of its capital stock authorized by its charter or organization, and the amount thereof actually called in by assessment or instalment, the place or places within this Commonwealth in which its office or offices are established or set up, and the names and residences of all those of its officers, directors, trustees, and agents who are citizens or residents of this Commonwealth. Such corporation, company, or association shall also, in said return, designate by his proper name and address, one of said offices or agents, a citizen or resident of this Commonwealth, as attorney upon whom service may be made of all process against such corporation, company, or association in this Commonwealth.

Sec. 2.—Within thirty days after any meeting of the stockholders, members, directors, or trustees of any such corporation, company, or association at which the capital stock is increased or reduced, or any changes made in its board of officers, agents, directors or trustees, a like certificate shall be filed setting forth the facts as then established.

Sec. 3.—The fee for filing and recording the certificates required by Secs. 1 and 2 of this Act shall be $5.00 for each certificate, to be paid to the secretary of the Commonwealth, and by him paid into the State treasury.

Sec. 4.—Each such corporation, company, or association shall semi-annually, between the first and tenth days of June and December in each year, pay to the treasurer of the Commonwealth a tax of one fortieth of one per centum upon the par value of its capital stock as standing, fixed by the corporation, company, or association on the first days of May and November respectively then next preceding; *provided, however*, that said semi-annual tax shall not, for any one of such corporations, companies, or associations exceed the sum of $300. And this tax, when paid, shall be in lieu of that required by Sec. 43 of Chap. 13 of the public statutes.

Sec. 5.—All officers, directors, trustees, and agents of such corporations, companies, or associations, citizens of or resident or commorant within this Commonwealth, shall be jointly and severally liable for all taxes due under said Sec. 43 of Chap. 13 of the public statutes, and for fees required to be paid under the provisions of this Act.

Sec. 6.—This Act shall take effect upon its passage.

Approved March 22, 1882.

Interest Laws of the Different States.

States and Territories.	*Legal.*	*Special.*	*Penalty of Usury.*
Alabama	8 p. c.	. . . .	Loss of interest.
Arizona	10 "	No Limit.	No penalty.
Arkansas	6 "	10 p. ct.	Forfeiture of principal and interest.
California	7 "	No limit.	No penalty.
Colorado	10 "	No limit.	No penalty.
Connecticut	6 "	No limit.	No penalty.
Dakota	7 "	12 p. ct.	Forfeiture of all interest.
Delaware	6 "	6 p. ct.	Forfeiture of contract.
District of Columbia	6 "	10 p. ct.	Forfeiture of all interest.
Florida	8 "	No limit.	No penalty.
Georgia	7 "	8 p. ct.	Forfeiture of excess charged only.
Idaho	10 "	1½ p. ct. per mon.	Three times amt. paid. $100 fine or imprisonment 6 months or both.
Illinois	6 "	8 p. ct.	Forfeiture of all interest.
Indiana	6 "	8 p. ct.	Forfeiture of all excess above 6 per cent.
Iowa	6 "	10 p. ct.	Forfeiture of 10 per cent. on the 100 by the year, on amount of the contract all interests and costs.
Kansas	7 "	12 p. ct.	Forfeiture of excess over 12 per cent.
Kentucky	6 "	6 p. ct.	Forfeiture of all interest over 6 per cent.
Louisiana	5 "	8 p. ct.	Forfeiture of interest.
Maine	6 "	No limit.	No penalty.
Maryland	6 "	6 p. ct.	Forfeiture of excess.
Massachusetts	6 "	No limit where the agreement is in writing.	No penalty; 6 per cent. on judgments.
Michigan	7 "	10 p. ct.	Forfeiture of excess; if voluntarily paid, cannot be recovered by suit.
Minnesota	7 "	10 p. ct.	Forfeiture of contract and interest paid may be recovered.
Mississippi	6 "	10 p. ct.	Forfeiture of all interest.
Missouri	6 "	10 p. ct.	Forfeiture of all interest by the creditor, but the debtor will be required to pay not exceeding 10 per cent. int. on the debt to the public schools.
Montana	10 "	No limit.	No penalty.
Nebraska	7 "	10 p. ct.	Forfeiture of all interest and costs.
Nevada	10 "	No limit.	No penalty.
New Hampshire	6 "	6 p ct.	Forfeiture of three times excess of interest received.
New Jersey	6 "	6 p. ct.	Forfeiture of all interest and costs.
New Mexico	6 "	No limit.	No penalty.
New York	6 "	6 p. ct.	Forfeiture of contract. The lender can recover neither principal nor int.
North Carolina	6 "	8 p. ct.	Forfeiture of the entire interest, and the party paying greater rate than that allowed by law, can, if action commenced within two years, recover double amount of interest paid.
Ohio	6 "	8 p. ct.	Forfeiture of excess over 6 per cent.
Oregon	8 "	10 p. ct.	Forfeiture of principal and interest.
Pennsylvania	6 "	6 p. ct.	Excess can be recovered if suit is brought within six months.
Rhode Island	6 "	No limit.	No penalty.
South Carolina	7 "	7 p. ct.	Forfeiture of all interest.
Tennessee	6 "	6 p. ct.	Forfeiture of all interest over 6 per cent.
Texas	6 "	12 p. ct.	Forfeiture of all interest if specially pleaded by debtor.
Utah	10 "	No limit.	No penalty.
Vermont	6 "	6 p. ct.	Forfeit of excess.
Virginia	6 "	6 p. ct.	Forfeit of all interest. No corporation can plead usury.
Washington Territory	10 "	No limit.	No penalty.
West Virginia	6 "	6 p. ct.	Forfeit of excess.
Wisconsin	7 "	10 p. ct.	Forfeit of all interest. Borrower can recover treble amount of usury, by an action brought within a year.
Wyoming Territory	12 "	No limit.	No penalty.

THE DOMINION OF CANADA.

AREA, 3,483,952 square miles, or 2,229,729,280 acres. The commissioner of lands of the Dominion of Canada, is appointed by and subject to the minister of the interior, and resides at Ottawa. The Crown domains of the several provinces are disposed of under special laws, but the vast area of Dominion lands (corresponding with the public domain of the United States) is disposed of under the provisions of the statute known as the 42d Victoria, May 15th, 1879. Agents, known as agents of Dominion lands, are appointed in the several Territories, viz, Manitoba, Kerwatin, and Northwest Territories. These agents give notice, by publication, of the filing of maps of survey and that the lands are open to cash sale or settlement. Surveyed townships are grouped into "districts," which are numbered from No. 1. These districts each have an agent at a local office. They are subordinate to the agent of the Territory, who is subordinate to the commissioner of the land office at Ottawa. The Dominion does not control public lands in some of the provinces. A surveyor-general of the Dominion is also appointed, under whom the surveys are made. His office is at Ottawa, in the department of the interior. The law relating to the Dominion lands is here given entire. It will be noticed that this statute gives the executive charged with the control and disposition of the public domain large discretionary authority. The body of this act is based upon the best features of the land system of the United States, with beneficial additions. Many features of this statute could be engrafted upon our system with profit.

LAW RELATING TO PUBLIC LANDS IN CANADA.—42 Victoria, Chap. 31.—*An Act to amend and consolidate the several acts respecting the public lands of the Dominion. Assented to May* 15, 1879. —Whereas, it is expedient with a view to the proper and efficient administration and management of certain of the public lands of the Dominion, that the same should be regulated by statute, and divers acts have been passed for that purpose which it is expedient to amend and consolidate: Therefore Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:

Preliminary — Interpretation. — 1. This act shall apply exclusively to the lands included in Manitoba and the several territories of the Dominion, which lands shall be styled and known as Dominion lands; and this act shall be known and may be cited as the "Dominion lands act 1879," and the following terms and expressions therein shall be held to have the meaning hereinafter assigned them, unless such meaning be repugnant to the subject or inconsistent with the context: that is to say:

1. The term Minister of the Interior means the Minister of the Interior of Canada.
2. The term surveyor-general means the said officer, or, in his absence, the chief clerk performing his duties for the time being.
3. The term agent or officer means any person or officer employed in connection with the administration and management, sale or settlement of Dominion lands, and the term local agent means the agent for Dominion lands employed as aforesaid, with respect to the lands in question; and the term land office means the office of any such agent.
4. The term Dominion land surveyor means a surveyor duly authorized under the provisions of this act to survey Dominion lands.
5. The term Crown timber agent means the local officer appointed to collect dues and to perform such other duties as may be assigned to such officer, in respect to the timber on Dominion lands.
6. The term island, as used in connection with timber, means an isolated grove or clump of timber in prairie.
7. The term belt as used in connection with timber, means a strip of timber along the shore of a lake, river or water course.
8. The term section means a section of this act distinguished by a separate number, and the term subsection means a subdivision of any clause distinguished by a separate number or letter in smaller type.
9. The term Canada Gazette means the official gazette of the government, published at Ottawa.

Dominion Lands Office.—2. The department of the Minister of the Interior of Canada shall be charged with the administration and management of the Dominion lands.

1. Such administration and management shall be effected through a branch of the said department, to be known and designated as "The Dominion lands office.

2. Copies of any records, documents, plans, books or papers belonging to or deposited in the said office, attested under the signature of the Minister of the Interior, or the surveyor-general, and of plans or documents in any Dominion lands or surveys office in Manitoba or the Northwest Territories, attested under the signature of the agent or inspector of surveys, as the case may be, in charge of such office, shall be competent evidence in all cases in which the original documents, books, plans, or papers could be evidence.

3. No person employed in or under the Dominion lands office shall purchase any of such lands, except under the authority of an order in council, or shall locate military or bounty land warrants, or land scrip, or act as agent of any other persons in such behalf.

System of Survey.—3. Subject always to the provisions hereinafter made with respect to special cases.

The dominion lands shall be laid off in quadrilateral townships, containing thirty-six sections of one mile square in each except in the case of those sections rendered irregular by the convergence or divergence of meridians as hereinafter mentioned, together with road allowances of one chain and fifty links in width, between all townships and sections.

2. The sections shall be bounded and numbered as shown by the following diagram:

N.

	31	32	33	34	35	36
	30	29	28	27	26	25
W.	19	20	21	22	23	24
	18	17	16	15	14	13
	7	8	9	10	11	12
	6	5	4	3	2	1

E.

S.

3. The townships therefore will, subject to deficiency or surplus from converging or diverging meridians, as the case may be, measure on each side, from centre to centre of the road allowances bounding the same, four hundred and eighty-nine chains: Provided, that the Governor in council may hereafter, should the same be deemed expedient, reduce the width of the road allowances on township and section lines in that part of the territory lying north of the line between townships eighteen and nineteen, and east of the tenth range east of the principal meridians, and west of the fourteenth range west of the said meridians.

4. The lines bounding townships on the east and west sides shall, in all cases, be true meridians, and those on the north and south sides shall be cords intersecting circles of latitude passing through the angles of the townships.

5. The townships shall be numbered in regular order northerly from the international boundary or forty-ninth parallel of latitude, and shall lie in ranges numbered, in Manitoba, east and west from a certain meridian line run in the year 1869, styled the "Principal Meridian," drawn northerly from the said forty-ninth parallel at a point ten miles or thereabouts westwardly from Pembina.

6. In the territories east and west of Manitoba such other governing or guide meridians may be adopted and confirmed by the governor in council as may, from time to time, become expedient.

7. The townships shall be laid out the precise width of four hundred and eighty-nine chains, as aforesaid, on the base lines hereinafter mentioned, and the meridians between townships shall be drawn from such bases, north or south to the depth of two townships, that is to say, to the correction lines hereinafter mentioned.

8. The said forty-ninth parallel or international boundary shall be the first base line, or that for townships one and two. The second base line shall be between townships four and five, the third between townships eight and nine, the fourth between townships twelve and thirteen, the fifth between townships sixteen and seventeen, and so on northerly in regular succession.

9. The correction lines, or those upon which the "jog" resulting from the want of parallelism of meridians shall be allowed, will be as follows, that is to say, on the line between townships two and three, on that between six and seven, on that between ten and eleven, and so on. In other words, they will be those township lines running east and west which are equi-distant from the bases at the depth of two townships.

10. Each section shall be divided into quarter sections of one hundred and sixty acres, more or less, subject to the provisions hereinafter made.

11. In the survey of any and every township, the deficiency or surplus, as the case may be, resulting from convergence or divergence of meridians shall be allowed in the range of quarter sections adjoining the west boundary of the township, and the north and south error in closing on the correction lines from the north or south shall be allowed in the ranges of quarter sections adjoining, and north or south respectively of the said correction lines.

12. The dimensions and area of the irregular quarter sections, resulting from the provision in the next preceding clause, whether the same be deficient or in excess, shall, in all cases, be returned by the surveyor at their actual measurements and contents.

13. Preliminary to the subdivisions into townships and sections of any given portion of country proposed to be laid out for settlement, the same shall be laid out into blocks of four townships each, by projecting the base and correction lines, and east and west meridian boundaries of each block.

1. On these lines, at the time of the survey, all township, section, and quarter section corners shall be marked, which corners shall govern, respectively, in the subsequent subdivision of the block.

2. Only a single row of posts or monuments to indicate the corners of townships, or sections (except as hereinafter provided), shall be placed on any survey line. These posts or monuments, as an invariable rule (with the exception above referred to), shall be placed in the west limit of the road allowances, on north and south lines, and in the south limit of road allowances, on east and west lines; and in all cases shall fix and govern the position of the boundary corner between the two adjoining townships, sections, or quarter sections on the opposite side of the road allowance.

3. Provided that in the case of the township, section, and quarter section corners on correction lines, posts or monuments shall in all cases be planted and marked independently for the townships on either side; those for the townships north of the line, in the north limit of the road allowance; and those for the townships south, in the south limit.

14. The township subdivision surveys of the Dominion lands, according to the system above described, shall be carried out and shall be performed by contract at a certain rate per mile or per acre, fixed from time to time by the governor in council.

15. Legal subdivisions as applicable to the survey, sale, and granting of the Dominion lands, shall be as follows: and it shall be sufficient that such legal subdivisions be severally, as the case may require, designated and described by such names or numbers and areas for letters patent, that is to say:

1. A section or 640 acres;
   A half section or 320 acres;
   A quarter section or 160 acres;
   A half quarter section or 80 acres;
   A quarter quarter section or 40 acres.

2. To facilitate the descriptions for letters patent of less than a half quarter section, the quarter sections composing every section, in accordance with the boundaries of the same as planted or placed in the original survey, shall be supposed to be divided into quarter quarter sections, or forty acres, and such quarter quarter sections shall be numbered as shown in the following diagram, which is intended to show the above proposed subdivisions of a section.

N.

	13	14	12	16
	12	11	10	9
W.	5	6	7	8
	4	3	2	1

E.

S.

3. The area of any legal subdivision as above set forth, in letters patent, shall be held to be more or less, and shall in each case be represented by the exact quantity as given to such subdivision in the original survey.

16. Provided that nothing in this act shall be construed to prevent the lands upon the Red and Assineboine rivers surrendered by the Indians to the late Earl of Selkirk, from being laid out in such manner as may be necessary in order to carry out section thirty-two of the act thirty-third Victoria, chapter three, or to prevent fractional sections or lands bordering on any river, lake, or other water course or public road, from being divided; or such lands from being laid out in lots of any certain frontage and depth, in such manner as may appear desirable; or to prevent the subdivision of sections or other legal subdivisions into wood lots as hereinafter provided; or from describing the said lands upon the Red and Assineboine rivers, or such subdivisions of fractional sections, or other lots, or wood lots, for patent, by numbers according to a plan of record, or by metes and bounds, or by both, as may seem expedient.

Mining Lands.—37. No reservation of gold, silver, iron, copper, or other mines or minerals, shall be inserted in any patent from the Crown granting any portion of the Dominion lands.

38. Any person or persons may explore for mines or minerals on any of the Dominion lands, surveyed or unsurveyed, and not then

marked or staked out and claimed or occupied, and may, subject to the provisions hereinafter contained, purchase the same.

39. Mining lands, if in surveyed townships, may be acquired under the provisions herein contained, and shall be sold in legal subdivisions. When situate in unsurveyed territory and without the limits of the fertile belt, such lands shall be sold in blocks to be called mining locations; and every such mining location, except as hereinafter provided, shall be bounded by lines due north and south and due east and west, astronomically; and each such location shall correspond with one of the following dimensions, namely, eighty chains in length by forty in width, containing three hundred and twenty acres, or forty chains square, containing one hundred and sixty acres, or forty chains in length by twenty in width, containing eighty acres:

1. Provided further, that in case of certain lands proving to be rich in minerals, the Minister of the Interior shall have the power to withdraw such lands from sale, and in lieu thereof institute a system of lease.

2. The rent payable to the Crown under any such lease shall be a royalty, not to exceed two and a half per cent. on the net profits of working.

3. Provided further, that when there are two or more applicants for the same tract, and a prior right in either or any of the applicants is not established to the satisfaction of the Minister of the Interior, the same may be tendered for by the claimants on stated terms of lease, and sold to the highest bidder.

4. Provided also, that in territory supposed to contain minerals the Minister of the Interior may in his discretion reserve from sale alternate locations, or quarter-sections, or other legal subdivisions, with the view of subsequently offering the same either for sale or lease at public competition.

40. Mining locations in unsurveyed territory shall be surveyed by a Dominion land surveyor, and shall be connected with some known point in previous surveys, or with some other known point or boundary (so that the tract may be laid down on the maps of the territory in the Dominion land-office) at the cost of the applicants, who shall be required to furnish, with their application, the surveyor's plan, field-notes and description thereof.

41. No distinction in price shall be made between lands supposed to contain mines or minerals and farming lands, but both classes shall be sold at the uniform price of one dollar per acre; provided that section thirty of this act as regards offering lands at public sale shall apply to coal and mineral lands also, when the same are in surveyed townships.

42. It shall also be lawful for the Minister of the Interior to exempt from the preceding provisions of this act such of the Dominion lands upon or adjoining the banks of rivers or other waters as may be supposed to contain valuable "bar," "bench," or "dry" "diggings" for gold or other precious metals; and the governor in council shall regulate, from time to time, as the same may become necessary and expedient, the nature and size of the claims containing such diggings, and shall fix the terms and conditions upon which the same shall be held and worked, and the royalty payable in respect thereof, and shall appoint and prescribe the duties of such officers as may be necessary to carry out such regulations.

Indian Title.—43. None of the provisions of this act respecting the settlement of agricultural lands or the lease of timber lands, or the purchase and sale of mineral lands shall be held to apply to territory, the Indian title to which shall not at the time have been extinguished.

Coal Lands.—44. Coal lands designated by the government as such are hereby withdrawn from the operation of this act as regards the rights of squatters to homesteads on the Dominion lands in advance of the surveys.

45. The minister of the Interior shall have power to protect any person or persons desiring to carry on coal mining in unsurveyed territory, in the possession of the lands on which such mining may be carried on: Provided, that before entering on the working of such mines, such person or persons make written application to the local agent to purchase such land; such application must be accompanied by a description by a Dominion land surveyor, setting forth generally the situation and the dimensions of such land, and shall also be accompanied by payment of the price thereof, estimating the number of acres (which shall be in the discretion of the Minister, but shall in no case exceed three hundred and twenty) at the rate of one dollar per acre. Such application shall be filed by the agent receiving the same; and on the survey of the township containing the land applied for being effected, the claimant or claimants shall be entitled to a patent for such number of acres, in legal subdivisions, including and covering the mine worked, as shall correspond to the application and to the extent of land paid for.

Provided, that all the operations under this section shall be subject to the rights of the Hudson's Bay Company to sections 8 and 26 as hereinbefore enacted: Provided further, that the survey of the township within which such land may be situate, shall not be delayed beyond a period of five years after the date of the purchase of such land, without the consent of the Hudson's Bay Company thereto first had and obtained.

Provided further, that such mine shall have been continuously worked, to the satisfaction of the Minister of the Interior, during the interim between the application and the survey; but if the same should at any time during such interim cease to be worked for twelve consecutive months, unless the lands in question be no longer valuable for mining purposes, then the claim of the parties to the land shall lapse, and the mine shall be forfeited to the Crown, together with any and all purchase-money which may have been paid to the Government on account thereof.

46. The Minister of the Interior, with the view of preventing undue monopoly in coal lands, may in his discretion, on a township being surveyed, exempt from the sale and settlement provisions of this act, the sections or other legal subdivisions of land which may be said to contain coal, except those on which mining may have been carried on under the next preceding clause; and the same shall be subsequently sold or otherwise dealt with in such manner as may be deemed expedient by the Governor in Council.

Surveys and Surveyors.—83. No person shall act as surveyor of Dominion lands unless he shall, before the fourteenth day of April, 1872, have been duly qualified by certificate, diploma or commission, to survey the Crown lands in some one of the provinces of the Dominion, or shall have become qualified under the provisions hereinafter set forth.

[NOTE.—Subdivision of the lands and the interior surveys of blocks of four townships are done by contract surveyors, the exterior lines of these blocks being run and fixed by the corps of surveyors.]

1. Persons qualified under the said provisions shall be styled "Dominion land surveyors," or "Dominion topographical surveyors," as the case may be.

95. No person shall receive a commission from the said board authorizing him to practice as a Dominion land surveyor until he has attained the full age of twenty-one years and has passed a satisfactory examination before the said board on the following subjects; that is to say: Euclid, first four books, and propositions first to twenty-first of the sixth book; plane trigonometry, so far as it includes solution of triangles; the use of logarithms, mensuration of superficies, including the calculation of the area of right-lined figures by latitude and departure, and the dividing or laying off land; a knowledge of the rules for the solution of spherical triangles, and of their use in the application to surveying of the following elementary problems of practical astronomy:

1. To ascertain the latitude of a place from an observation of a meridian altitude of the sun or of a star;

2. To obtain the local time and the azimuth, from an observed altitude of the sun or a star;

3. From an observed azimuth of a circumpolar star, when at its greatest elongation from the meridian, to ascertain the direction of the latter.

He must be practically familiar with surveying operations and capable of intelligently reporting thereon, and be conversant with the keeping of field notes, their plotting and representation on plans of survey, the describing of land by metes and bounds for title, and with the adjustments and methods of use of ordinary surveying instruments, and must also be perfectly conversant with the system of survey as embodied in the "*Dominion Lands Acts*," and with the manual of standing instructions and regulations published from time to time for the guidance of Dominion land surveyors.

96. The board may examine any candidate on oath (which oath may be administered by any one of the examiners) as to his actual practice in the field and with regard to his instruments.

97. Each person passing the examination prescribed by this act shall receive a commission from the board in accordance with Form E in the schedule to this act constituting him a Dominion land surveyor, and shall jointly and severally, with two sufficient sureties to the satisfaction of the board, enter into a bond in the sum of one thousand dollars to Her Majesty, her heirs and successors, conditioned for the due and faithful performance of the duties of his office, and shall take and subscribe the oath of allegiance, and the following oath, before the board of examiners, any one of whom is hereby empowered to administer the same:

"I, , do solemnly swear (or affirm, as the case may be) that I will faithfully discharge the duties of a Dominion land surveyor according to law, without favor, affection, or partiality. So help me God."

1. Until the above formalities shall have been gone through, the said commission of Dominion land surveyor shall have no effect.

2. The said oaths of allegiance and of office shall be deposited in the Dominion lands office.

3. The said bond shall be deposited and kept in the manner prescribed by law with regard to the bonds given for the like purposes by other public officers of the Dominion, and shall be subject to the same provisions, and shall enure to the benefit of any party sustaining damage by breach of any condition thereof; and the commission shall be registered in the office of the registrar-general of Dominion.

Land Laws of Mexico.—In accordance with Interior Department instructions, I have collected information from authentic sources in reference to the laws of Spain and Mexico respecting minerals and what conditions attached to grants embracing mines.

From the earliest European settlement of the country mining for the precious metals constituted the principal branch of industry in Spanish America, and being the one that yielded the largest revenue to the government, laws and royal ordinances were from time to time passed for the encouragement of the adventurous prospectors and for the protection of the fortunate discoverer of mines of the precious metals; yet, although these laws and ordinances dignified the mining profession by attaching thereto the privileges of nobility, still the government went no further in its liberality than to grant the miner the exclusive privilege of working the mine he might have discovered in the manner required and under the conditions imposed by the laws and ordinances in relation thereto; and when these conditions were disregarded or violated the ownership of the mine, or rather the exclusive right to work it, was lost, and the same reverted to the government, to be acquired by any one else who might undertake to comply with the conditions under which it had been granted to the former owner, the absolute ownership of the mine ever remaining in the government. Joaquin Escriche, in his Diccionario Razonado de Legislacion y Jurisprudencia (a standard authority), under the head of Minas, says: "According to the ancient Roman law, mines of gold, silver, copper, iron, and other metals pertained to the owner of the land on which they were discovered, *erant privati, juris, et in libero privatorum usa juris comercio*, because they are benefits bestowed by nature, to be enjoyed by the owners of the land producing the same. Subsequently the Roman emperor appropriated one-tenth of the products of the mines of every character. "Under the Spanish law a different rule was adopted; mines of gold, silver, lead, and other metals could not be worked without royal permission, since they (and also salt pits) belonged to the king. Any one was permitted to 'dig' in search of minerals or stones on his own lands, or on the lands of others with the consent of the owner, under the condition that the discoverer should receive one-third part of the net proceeds of the discovery, the other two-third parts to be given to the government. Every Spaniard or foreigner was permitted to 'dig' in search of minerals on public or private lands, under the obligation of compensating for the damages occasioned. In Mexico, Venezuela, and Chili the matter of mines is governed by the ordinances of the 22d of May, 1783." (Escriche, new edition, printed 1869, Mina.) As early as the year 1383, Don Alonzo XI issued a "pragmatica" in which it is declared: "That all mines of silver and gold and lead, and of any other metal whatever, of whatsoever kind it may be, in our royal seigniory shall belong to us, therefore no one shall presume to work them without our special license and command; and also the salt springs, basins, and wells which are for making salt, shall belong to us, wherefore we command that they revert to us with the produce of the whole thereof, and that no one presume to intermeddle therein except those to whom the former kings, our predecessors, or we ourselves may give them as a privilege, or who may have held them from time immemorial." (*Vide* Book VI, Title XIII, Law II, Recopilacion de Castilla; Book IX, Title XVIII, Novisima Recopilacion.) The law of Philip II, 1559, declares: That inasmuch as the discoverers of mines, after having discovered and registered them, pretend that by that act alone they have acquired such a right to them that no other person can, within the limits and space of such mines, enter, or try, or work, and that they can thus keep them encumbered without working them themselves or permitting others to do so, by which they prevent the principal produce and profit which belongs as well to us as to our subjects and to the public welfare, since that principally consists in the working and reduction of mines and metals, and not merely in their discovery, we declare and command that such discoverer of the mine or mines of silver, after having made registry in the manner prescribed, shall be obliged within six months to sink and excavate to the depth of three *estados* (a measure of about six feet), and not sinking and excavating his mine to the depth of three *estados*, it may be denounced before the judge and registry made thereof as of a vacant or undiscovered mine. Also, that we reclaim, resume, and incorporate in ourself, in our crown and patrimony, all the mines of gold and silver and quicksilver of these kingdoms, in whatsoever parts and places they may be and are found, whether in royal lands, or in those of lordships, or of the clergy, and whether in public, municipal, or vacant lands, or in inheritances, places, and soils of individuals, notwithstanding the grants which by us and by the kings, our predecessors, have been made to any persons, of whatsoever condition, rank, and dignity they may be. (Book VI, Title XIII, Law IV, Recopilacion de Castilla. Also, Book IX, Title XVIII, Law III, Novisima Recopilacion).

Royal ordinances for the direction, regulation and government of the important body of mining of New Spain and of its royal tribunal general, May 22, 1783.

Article I, Title v, declares: That mines are the property of the royal crown, as well by their nature and origin as by their reunion declared in Law IV, Title XIII, Book VI, Nueva Recopilacion.

Article II, same title, declares: That without separating them from the royal patrimony, they are granted to the subjects of the king in property and possession, in such manner that they may sell, rent, donate, and pass them by will, either in the way of inheritance or legacy, or in any other manner alienate the right which in the mines belongs to them, on the same terms on which they themselves possess it, and to persons capable of acquiring the same.

Article III, same title, declares: That this grant is understood to be with the conditions that the grantees contribute to the royal treasury the prescribed portion of the metals, and that they shall work the mines in the manner prescribed by the ordinances, so that they shall be considered forfeited whenever a failure shall occur in complying with the ordinances in which it is provided, and that they may be granted to any person who for that cause may denounce them.

Article I, Title VI, declares: That the discoverers of one or more mineral hills, absolutely new, may acquire on the principal vein which they may select as many as three *pertenencias*, continued or interrupted, according to the measurements which shall be prescribed, and if they may have discovered more veins, they may have one *pertenencia* on each vein, said *pertenencia* being determined and marked out within ten days. (A *pertenencia* was in extent two hundred *varas*, measured on the vein, the width being determined by the dip or angle thereof, being sufficiently wide to prevent the vein from being cut by a shaft sunk on a side claim, at a depth of less than two hundred *varas*, this being the depth beyond which, in those times, it was considered unprofitable to work a mine.)

Article X, same title, declares: That if the denouncer of a mine does not put up his working-shaft in order nor take possession within sixty days, he shall lose his right, and the mine may be denounced by another.

Article XIV, same title, declares: That any one may discover and denounce a vein or mine, not only in common land but also in the private lands of any individual, provided he pays for the land of which he occupies the surface, and the damage which immediately ensues therefrom, according to the valuation of the experts appointed by both parties, and a third in case of disagreement.

Article II, Title IX, provides: That no one shall be permitted to work mines, without the direction and continual assistance of one of the intelligent and practical experts who in New Spain are called *Mineros* or *Guarda-minas*, who must be examined, licensed and affirmed by one of the professors of mining, which each *Real* or *Asiento* must have.

Article XIII, same title, declares: That as mines require to be worked continually and incessantly in order to procure their metals, and as they require in them works and operations which can be executed only in a long time, and as their re-establishment, if their working be suspended and interrupted, will cost as much as in their original undertaking,—therefore, to obviate this inconvenience, and also to prevent any owners of mines who cannot or will not work them, from keeping them without use, and for a long time impeding by pretended working, the real and effective labor which others might bestow upon them, I order and command that any one who shall for four consecutive months fail to work a mine with four operatives regularly employed and occupied in some interior or exterior work of real utility and advantage, shall thereby forfeit the right which he may have to the mine, and it shall belong to the denouncer who proves its desertion.

Article X, same title, declares: That no mine shall be abandoned without first informing the deputation of the district, in order that it may be published by fixing notices on the doors of the churches and other accustomed places, so that all may have notice thereof.

Article II, Title XIX, grants in favor of scientific professors of mining the privileges of nobility in order that all persons who devote themselves to this important profession and occupation may be considered and treated with all the distinction due to so noble a profession.

According to Escriche, the laws of Spain passed prior to 1821 and the laws of Mexico passed since that date have not changed the fundamental principles laid down in the ordinances of the 22d of May, 1783, in relation to the ownership of mines and the manner of acquiring title thereto; hence these ordinances have been in force in Mexico since the date of their passage in 1783, the Mexican mining laws passed since the year 1821 not having essentially changed the spirit thereof.

From the foregoing it is manifest that under the laws and royal ordinances of Spain, from very early times down to the date of the independence of Mexico, and under the mining laws of Mexico down to the publication of the new edition of Escriche (1869), the miner could acquire no absolute title or fee in any mine discovered by him in any part of the Mexican territory, the usufruct thereof being all that was granted him by the government, and this under such regulations, instructions, and conditions as were imposed by law; and when these conditions were not complied with, the right to work the mine was lost, and could be acquired by any one else who might undertake to comply with the conditions and regulations inseparable from the privilege of working mines. The Spanish and Mexican Governments, in granting lands in Mexico, never in terms reserved the minerals contained therein, for the reason that under the constitutional laws they were reserved by and for the government. For this reason, in the many grants of land made by Spanish and Mexican authorities in Sonora, as well as in California, no mention is made of minerals.

Pastoral and mining pursuits were separate branches of industry, and in a certain sense independent of each other. Both were cherished and protected by the government. To the grazier and agriculturist was granted so much of the soil as he had means to occupy and improve, together with such appurtenances thereto as were necessary to make the occupation of the soil possible and the use thereof valuable; and to tho miner were granted the minerals he might discover in the soil and the usufruct of the mine in which they were found. But to neither of these parties was the grant unconditional. To the grazier were granted lands on condition that he occupied them usefully to himself and to the government, and the abandonment thereof was followed by a forfeiture of title, in which case the land reverted to the government to be re-granted to a more industrious applicant. To the miner was granted the exclusive right to work the mine he might have discovered, on condition that he observe certain rules and regulations established by law and paid to the government a certain portion of the products of the mine; a violation of these conditions was also followed by a forfeiture of such title as he possessed, the usufruct of the mine reverting to the government to be re-granted to a more vigilant and "honest miner."

The objects of the government in granting lands for settlement were the increase of the wealth and population of the country, the spread of the holy Catholic faith, and the extension of the power of the Spanish monarchy; and the motive that induced the granting of privileges to miners was that the royal treasury might be supplied with American gold. No grants of lands or mines were ever made by the Government of Spain or Mexico for speculative purposes. It is true that the lands were sometimes granted as a reward for distinguished services, but in all other cases on condition of occupation.

From a careful consideration of the foregoing laws and ordinances, as well as of the usages and customs of Spain and Mexico, I am forced to the conclusions:

First. That the grantee of land under the Spanish and Mexican Governments acquired no title to the minerals contained in the granted land.

Second. That the title to the minerals contained in the tract granted remained in the government notwithstanding the grant of the land.

Third. That under the Spanish and Mexican laws and ordinances any one had a right to "dig" in search of minerals, under certain conditions, on his own lands or on those belonging to individuals or private persons.

Fourth. That the Government of the United States under the treaty of 1853 for the purchase of a portion of the territory of Sonora succeeded to all the rights and obligations of the Mexican Government in relation to the ceded territory at the date of the treaty.

The result of these conclusions necessarily is: That since our government succeeded to all the rights and obligations of the Mexican Government in relation to the ceded territory it is bound by the treaty to recognize and confirm all rights, titles and privileges, which had been granted by that government to private individuals prior to the cession of the territory, and to carry out the intentions of the Mexican Government toward these having ownership in lands and mines precisely as if there had been no change of sovereignty. It is therefore clear to my mind that any one has at present a right to prospect for minerals on such portions of the ceded territory as may have been granted by the Mexican Government to private individuals, and a right to work any mines that may be found on said lands, under no more onerous conditions than the reasonable ones imposed by the mining laws of Mexico. See Article XIV., Title II., Ordinances May 22d, 1783, heretofore cited.

—A communication from John Wasson, U. S. Surveyor-general, Report Public Lands Commission.

THE DEBRIS QUESTION.

VERY few of our Eastern people interested in mining know anything concerning "the Debris question, a question that has agitated California in the past and threatens her peace for many years to come. Consequently what follows here will be read with deep interest. We begin with some historical matter.

The territory of the ancient Roman empire was situated chiefly in the principal and secondary basins of the Mediterranean, and embracing all of Southern Europe, Northern Africa, and Asia Minor, together with Persia and the remoter East, which may be comprised in this general survey, it included a surface larger than that of all Europe, and at one time or other may have supported a population scarcely less numerous. At the present day this portion of the earth is nearly altogether withdrawn from human use; it is substantially a desert. The causes of this extraordinary desolation are attributed chiefly to disafforesting, and to those destructive forces which operate upon the earth when it is deprived of a due extent of arboreal covering. This disafforestation was largely due to the mining operations of the early races. Not only were the aboriginal forests cut down to supply fuel for smelting purposes, and timbers to support the mining excavations, but their regrowth was prevented by the ravages which mining committed upon the fertile portions of the land. These ravages, however, operated as a more direct and perhaps important source of the general devastation alluded to; and mining for the precious metals may, both directly and indirectly be regarded as the principal agent in the physical, and consequently in the ultimate social, decay of Arabia, (Sabia, Media, &c.), Asia Minor, Greece, Carthage, Spain, Italy, and the Islands of the Mediterranean. In modern times the sinister consequences of mining are to be traced in the desolation of many parts of Mexico, the Isthmus, and the countries of South America, which were overrun by the Spaniards and Portuguese. The desolation that befel the countries of the Mediterranean now awaits those of the Northern Pacific. In California, particularly, it is proceeding at a rate that has already seriously damaged the face of the country.

The process began with the opening of the placer mines, when every part of the land suspected of containing gold was torn up, ransacked, and left to the action of the rains, which conveyed the sand and gravel into the rivers, and strewed them over the arable valleys. The area of surface thus torn up is estimated to have amounted in 1862 to 10,000,000 acres.[1] At the present time it amounts to, perhaps, more than double this area. Before the placers failed to induce further explorations of this sort, hydraulic mining came into vogue. This dates back so early as 1850.[2] Streams of considerable volume are diverted from their natural channels and conducted to great distances in canals or wooden flumes, or sheet-iron pipes, and then directed against the hills, or those vast level surfaces of ground which it is necessary to remove to reach the gold-bearing strata, or which themselves contain deposits of the precious metals.[3] In 1867 there were 6,000 miles (including branches) of artificial watercourses employed for mining purposes in California.[4] It is estimated that up to about the year 1870 some £4 000,000 had been expended in constructing mining ditches,[5] and that the wooden flumes, of which the majority of them consisted, do not last on the average more than six to ten years.[6] In 1871 the total number of mining ditches was 516, their aggregate length 4,800 miles, and their daily supply of water 171,000 miner's inches, each discharging $94\frac{464}{1000}$ths cubic feet an hour. Some of this water is used for only ten hours a day, and all of it for only seven months in the year. One hydraulic company, employing ten men at 16s. per day each, and 200 inches or 4,000 gallons of water, washed down 224,000 cubic feet of earth in six days, and though there was only obtained from it £600 in gold (about $\frac{5}{8}$ths of a penny to the cubic foot) £470 of this was profit. Another company used 2,000 inches, or 40,000 gallons of water for 100 days, and washed down 1,000,000 cubic yards of gravel (containing less than $\frac{1}{4}$th of a penny to the cubic foot), and contained £6,400, of which £2,400 was profit. The cube of earth washed down was 1,100 feet long, 300 feet wide, and 80 feet deep. At the present time, 1879, the number of mining ditches is 640; their aggregate length, 6,585 miles; the daily supply of water, 260,000 inches. As some ditches are used only ten hours a day, this is reckoned equal to 200,000 inches running twenty-four hours a day. As on the average the mines can only be worked so as to equal seven months of full time during the year, the actual consumption of water is about 714,370 million gallons a year, or 1,956 million gallons for each and every day. The present annual yield of gold in the State is about £3,600,000 a year, of which one-third is from quartz

[1] "U. S. Agricultural Report," 1862, p. 598.

[2] Hittel's "Resources," p. 305.

[3] Marsh, p. 632. It must be understood that the "gravel hills" of California are the remains of ancient river beds. These hills were once the bottoms of rivers, and the ancient enclosing hills and high lands have been washed down to a level beneath them; so that the ancient bottoms have become hills. The existing streams, such as the Yuba, cut through them, and expose their auriferous deposits. The natural exposure is called a placer, where the largest pieces of gold were found. Away from the river are the gravel banks, which are now being washed into it by artificial streams of water brought from distant mountains.

[4] "Rep. U. S. Mining Com.," 1870, p. 476.

[5] Hittel's "Resources," p. 306.

[6] Ibid.

mines, and the remainder from hydraulic mining and drifting. The present rate of production from hydraulic mining is expected to remain constant for a century or more to come, with a slight tendency to increase during the first twenty-five years. Naked hills and fertile soils are alike washed away by the artificial torrents brought to these mines, and the material removed—vegetable mould, sand, gravel, pebbles—is carried down by the current, and often spread over ground lying quite out of the reach of natural inundations, burying it to the depth of sometimes twenty-five feet. An orchard valued at £12,000, and another estimated at not less than £40,000, are stated to have been thus sacrificed; and a report from the Agricultural Bureau at Washington computes the annual damage done by this mode of mining at the incredible sum of £2,400,000.[1] The subject having been brought to the attention of the Legislature of California a commission was appointed in the early part of 1878 to investigate the matter. Among the testimony given before it, as published in the newspapers, was the following:—

On Bear river, 50,000 acres of land are liable to be ruined by mining débris; the channel of the river has been filled up, and the water spreads all over the adjoining country; in some parts of the valley the débris is fifteen to twenty feet deep; the land covered by the débris, which consists of sand and gravel, is entirely ruined; the railroad company has been compelled to raise its bridge three times. On the Yuba river 12,000 acres of good land had been destroyed by mining débris; this damage was estimated at £400,000. In 1853 the Yuba was a clear stream; it commenced shoaling badly in 1857; near the mines the bed had been raised 150 feet. In 1874 the city of Marysville alone was damaged to the extent of £100,000. So great is the mass of débris already in the Yuba that if mining were stopped now the sand would continue to come down the river for years. On the Feather river the damage done was of the same character and scarcely less extensive. With one exception the witnesses thought that the remedy lay in the building of levees. The exception was that of a banker of Marysville, who had formerly been a miner, and had had much experience in the industry. He declared that the levees could palliate but not cure the evil, and that this could only be remedied by putting an end to mining.[2]

The Sacramento river commenced shoaling badly in 1853. At Steamboat Slough, where there were formerly ten or twelve feet of water, there were now but five. In other places the water has decreased from five to six fathoms to as many feet. Places where steamers ran in 1850 are now dry land. San Pablo Bay has greatly shoaled. At the city of Sacramento, the river has been lessened in depth 18 feet by mining débris. A bar, nearly an island, has formed in Suisun Bay. The harbor of San Francisco is being rapidly shoaled by deposits washed down from the mines. As it is averred that there is enough "pay dirt" in the gravel beds for a century further of hydraulic mining with existing appliances, it is quite evident that the witness Jewett is right. In the course of a century there will scarcely be a gravel hill, scarcely a trace of the ancient river bed left in the State, and vast tracts of land will, by that time, have been reduced to the condition of deserts of sand and stones While gold mining has thus tended to bestrew the arable lands, fill up the streams, and shoal the harbors of California, silver mining has done much to deprive both that State and Western Nevada of their forest trees.

"Before the devastating hand of the miner was laid upon the timber of the foothills (of California) they formed one of the most delightfully wooded regions of the continent, overspread with a luxuriant carpet of grass and flowers from St. Patrick's day till the Fourth of July, and even later in the summer. Disafforesting has done its work, and turned them into a desert from the last of April till the first rains," about the month of November.[1] In a similar way the Sierras have been shorn of trees to timber the mines of Nevada, the winter's fall of snow has been laid bare to the sun's rays in spring, and the distribution of the waters has been disturbed. Destructive freshets now annually sweep through the valleys of California, and vast inundations cover the lowlands. In 1878 a considerable portion of the Sacramento valley was under water, and the city of Sacramento, the capital of the State, was flooded. The damage to the buildings, roads, and movable property, can only be reckoned in millions.

In short, a process of serious geographical injury is in rapid progress. The bottoms of the rivers are so raised above their former levels that a large proportion of the arable lands, if not already reduced to the condition of swamps, must soon become so, for no system of levees can keep pace with the mass of debris capable of being deposited by the washings of ten thousand millions of gallons of water a day; and no diminution of this process is to be looked for so long as it pays to remove a cubic foot of earth which contains less than a farthing's worth of gold.[2]

—Compiled from Alexander Delmar's "History of Precious Metals."

[1] Marsh, p. 6?3.

[2] Testimony of J. H. Jewett. Another witness, Col. Mendell (a civil engineer, much employed in large works on the Pacific coast) stated that in his opinion from one-third to one-half of the deposits in the rivers and bays was occasioned by ploughing in agriculture. A third witness, Mr. James O'Brien, a practical hydraulic miner and a farmer, thought that about four-fifths of the debris came from the mines, and one-fifth from ploughing; and this opinion seems to be supported by the general weight of the testimony.

The Great Evils of Hydraulic Mining.—Hydraulic mining, a system of mining operation that was a clever product of American mining necessities has proved to have been in addition to a source of good, one of evil. The vast deposits that the unconquerable energy of the placer miner turned into the rivers of the West have been carried downwards to the Pacific and done in many ways much harm. The State Engineer of California ascertained by actual surveys in 1878 that 18,000 acres of valley land on the Yuba river, land that was once the finest bottom land in the State had up to that year been destroyed and buried beneath the mining debris. This vast area had been transformed from a country of magnificent pastures into a barren desert of sand and slickings, alternating with impenetrable jungles of willow swamps. A similar state of affairs existed in the Bear river.

The Land Commission appointed by Congress in March 3, 1879, in the course of its investigations took up this question of mining debris and examined a great many witnesses. The testimony given before the Commission will give the reader an insight into the magnitude and importance of this subject. Mr. G. F. Allardt, civil and hydraulic engineer of San Francisco, gave the following facts concerning the matter:

Although these lands have been exposed to sunshine and rain for years they produce not a blade of grass, nothing but willows and kindred semi-aquatic plants that derive their nourishment chiefly from the stratum of water percolating underneath the surface, and not from the soil itself. From the beginning of hydraulic mining down to the present time the enormous aggregate of 162,000,000 of cubic yards of material has been sluiced out of the hydraulic mines into the Yuba and its tributaries, while the amount now retained in the river above the valley, or lodged in the canyons, will not exceed 12,000,000 cubic yards. This we have from actual surveys. Thus, 150,000,000 cubic yards of solid material have passed the foot-hills and have been deposited on the bottom lands of the Yuba into the waters of the Feather and Sacramento Rivers, the bays of Suisun and San Pablo, and finally into the Bay of San Francisco. (One company alone, the Excelsior Hydraulic Mining Company at Smartsville, admit in a published circular that they have sluiced 1,800,000 cubic yards into the Yuba.) To present to the mind this enormous mass of 150,000,000 cubic yards of material in a more familiar form, it may be stated that such a mass deposited on a farm of 160 acres would cover it to a depth of 581 feet; or, if spread evenly one foot in depth, would cover 93,000 acres or 145 square miles of land, and absolutely destroy the same for agricultural or any other purposes.

The bed of the Yuba at Marysville is now filled up to the level of the streets of that city, where prior to the era of

[1] "San Francisco Chronicle," Feb. 20, 1878.

[2] This ratio is obtained from the actual experience of several of the hydraulic mines. The general average, however, is somewhat higher.

hydraulic mining there was a well-defined channel of clear water from 20 to 25 feet in depth. The authorities of Marysville have just closed a contract amounting to upwards of $50,000 for raising its levees and protecting the city from the further encroachments of the mining debris. The Feather and Sacramento Rivers have shoaled in a lesser degree, but still sufficiently to almost destroy their usefulness as highways of commerce. A resurvey of Suisun Bay recently made under the direction of the United States Coast Survey Department has developed the fact that tules are now growing at points where fifteen years ago there were several fathoms of water. The complete filling up of this bay is a mere question of a few short years, after which San Pablo Bay will become the next settling reservoir, to be followed, finally, by the rapid shoaling of San Francisco Bay, and the eventual destruction of its harbor. This result is sure to follow, the laws of nature make them inevitable, unless, indeed, hydraulic mining be discontinued or unless some adequate works be constructed for arresting the tailings before they reach the valleys or enter the navigable waters of the State. On this head our survey has given us sufficient data to warrant the belief that such works are not only feasible, but entirely within the bounds of a reasonable expenditure of money.

Now, as to the present condition of the Yuba and its hydraulic mines. It is admitted that during the dry season 17,000 miner's inches of water are used daily by the hydraulic mines of the Yuba, and that such miner's inch removes not less than three cubic yards of material in twenty-four hours. This gives a daily total of 51,000 cubic yards. Fully one-half of this amount is held in suspension by the running waters, and carried down the river in the shape of muddy water, or more correctly speaking, in the shape of *liquid mud*, and is deposited as before stated, partly on the bottom lands of the Yuba and partly in the rivers and bays beyond. That is to say, and I wish to emphasize this fact, 25,000 cubic yards of earth and sand, say 43,750 tons, are daily poured from the mountains into the valleys by the hydraulic miners. To use a familiar illustration, suppose it were required to transport this amount on railroad cars; it would take one hundred and ten trains of forty cars each (one train every thirteen minutes) to accomplish the daily task. In the rainy season more water is used and correspondently more material is sent down; moreover, the winter freshets invariably clean out the canyons and sweep away the heavier material that has accumulated at the mining dumps during the low stages of the river. The lighter material runs down with the stream, the heavier material rolls along the bottom with varying velocities, depending on the height and volume of the freshets, and in due course of time finds its way to the level reaches of the river in the foot-hills and the valley.

It is estimated on competent authority that there yet remains between the South and Middle Yubas 700,000,000 cubic yards of known gold-bearing gravel deposits. At the present rate of hydraulicing this will be worked out in about forty years. The hydraulic miners contend that it can be worked successfully only by the present hydraulic method. As it is well known, however, that the gold-bearing stratum in these mines, the "pay-streak," as it is called, is usually at the bottom of the deposits, next to the bed-rock, and that the largest masses of superincumbent earth seldom, if ever, pay working expenses, it may seem pertinent to inquire just here whether the hydraulic method is really the only and the most economical process, and whether the method of *drift mining* would not average more remunerative results. The drift miner, namely, runs his tunnel through and along this pay-streak, and brings to the light the pay-gravel only, from which he extracts the gold in the usual hydraulic way. As all excavations are done by manual labor with pick and shovel, the debris arising from that source is necessarily limited in amount. At a liberal estimate the material taken out of all the drift mines on the Yubas will not exceed a half million cubic yards, the greater portion of which being heavy material remains in the dumps at the mouths of the tunnels and never reaches the water-courses. There are quite a number of so-called drift mines in successful operation in the Yuba belt, some of exceeding richness, notably those on Bald Mountain at Forest City. It is officially reported that the gravel extracted averages over $3 per cubic yard.

Quartz mining is also an industry of growing importance in this section. It consists in exploiting a gold-bearing quartz lode, crushing the quartz in a stamp mill, and obtaining the gold by means of amalgamating pans. One of the largest and most productive quartz mines in the State is the "Sierra Buttes," near Sierra City, on the north fork of the Yuba. Over three hundred men are steadily employed in and about this mine. The tailings from quartz mines are inconsiderable, and their effect upon the flow of the rivers is scarcely appreciable. It remains to mention still another method of gold mining known as *river mining*, or the reworking of the old tailings in the river-beds. This class of mining is confined almost exclusively to the Chinamen; it creates no debris, but merely shifts it from place to place, and does not, therefore, enter as a factor in the debris problem. Much weight has been laid by the miners on the importance of hydraulic mining in supporting a large population, alleged to exceed one hundred thousand inhabitants. This figure is undoubtedly exaggerated. According to my observation, the total number of workmen actually employed in the hydraulic mines of the Yubas does not exceed 1,500 all told, three-fourths of which number, probably, are Chinamen, the white men being engaged only for the higher grades of labor. It is but fair to name the Excelsior Mining Company of Smartsville, as an honorable exception to this custom, all of its employes being white men, most of them men of family. On the other hand, the number of men employed in the quartz and drift mines is very large, all of them, with few exceptions, being white workmen. The Sierra Buttes Company, for instance, employs three hundred men; the Derbec Company, near North Bloomfield, about one hundred; the Bald Mountain mines support a community of over eight hundred souls. Grass Valley and Nevada City, with a joint population of some ten thousand, depend almost exclusively on their quartz mining industry.

In this paper I have confined my remarks mainly to the mines in the Yuba belt, yet there are many extensive hydraulic mines in operation on the Feather, Bear, American, and Mokelumne Rivers, all of which are constantly pouring their tailings into those rivers, thus contributing their quota toward destroying the farming lands and shoaling the navigable waters of the State. Viewing the whole subject of mining debris in its various bearings, and fully recognizing the magnitude of the hydraulic mining industry, and the vast amount of capital invested, yet a candid and impartial observer must necessarily arrive at the following general conclusions:

1st. The process of hydraulic mining is destroying the best agricultural lands of the State.

2d. It is threatening the very existence of the cities of Marysville and Sacramento.

3d. It is rapidly shoaling the navigable waters of the State, and, if continued, will eventually destroy the harbor of San Francisco.

4th. Hydraulic mining, from its very nature, is destructive and ephemeral, and can never become a permanent or desirable industry in any community.

5th. It is chiefly in the hands of rich and powerful corporations who monopolize water privileges and thereby control all the contiguous mining ground, to the exclusion of the citizen miner of limited means.

6th. As the water is made to perform the principal work of the process, the number of laborers employed can never be large.

7th. Justice to the farming interest, the public safety and welfare, alike demand that in future the hydraulic miners be compelled by law to take care of their tailings by means of dams or settling reservoirs, from which the water will return to its proper channel in a condition of comparative purity.

Mr. V. G. Bell, of French Corral, Nevada County, California, a resident of California since 1857, thus spoke of the subject:

Practically, in this matter of debris there is not sufficient account taken of the material collected in the river during the early mining in the State. In the first place mining that was done in the State was, as a matter of course, done in the cañons and gorges, and this went on for some years before the hydraulic mining process came into vogue. I think it was in 1854 that the first hydraulic mining I know of was done. Prior to that time mining had been going on in the gorges and on the surface altogether, and a lot of alluvial material was already removed and stored up, and after the hydraulic process came into use the principal part of the mining had been completed. The first season that we had a flow of tailings or debris was in 1862–'63. All old Californians will recollect that that was a very heavy season and it rained very hard, and the floods ensuing therefrom brought down the whole of this light substance and deposited it in the beds of the streams. That was the first year the Bear and Yuba Rivers were flooded up above their banks. This accumulation of course came from all this washing that had been going on from 1849 up to that time. This light material had accumulated to a considerable extent, but still the floods of 1862–'63 concentrated it and run it down and filled up the rivers and spoiled all the good farming land that there was in the country, which in our section—in Yuba and Nevada Counties—was the bottom land. Outside of the bottom land we did not then consider the land of any value whatever. In fact it seems strange to me that there is farming land in the country. I, as a miner, always looked upon it as a mining country, and I would not have taken a thousand acres of land lying between Marysville and Sacramento as a gift, because I looked upon it as a mining country. After the flood of 1862–'63 the debris covered up all that I considered farming land. This red land that we supposed of no value for farming has turned out to be a very good farming land. Since the floods of 1862–'63, hydraulic mining has improved and got the more modern appliances, and facilities for that kind of mining have increased. They have run long, expensive tunnels to the bottom of the channels, but during the mining of the early days the tops were being washed off and it was the light material from the surface and the gorge diggings that went down. Now we are running off the bottom, and it is just as much as we can do to remove this heavy, rocky material from the mines, and when we shove it through to the river there it stops, and whereas the floods of early days carried down thousands of yards of material there is now really only a very small percentage that is being washed down. It has practically ceased, on account of the heavy nature of the material. There are large fields for hydraulic mining and there is still a great deal of this top material which may come in, but at the same time a very large proportion of it was washed off at an early day, and we are now mining the heavy material at the bottom. The Milton Mining and Water Company during the last mining season spent $40,000 in giant powder to blow up the banks and blast and break the rocks; so that you can imagine something of the kind of work that we have to do in order to break up the rock and break up the material so as to get it into and through the sluices.

Mr. W. H. Drum, of Marysville, California, also a resident since 1857, furnished his experience with the sediment from the rivers:

In 1857 I bought a piece of bottom land on the Yuba, and paid a pretty good price, because I thought it was the best land I had ever seen. When I bought there, the banks of the Yuba were from 20 to 22 feet high at low-water. The stream was clear, with plenty of salmon-fish everywhere. My piece of land was two miles from Bear River, and I had no difficulty with the water. The high water of 1853 barely came out of the river channels, over the banks, and filled a few of the smallest sloughs, but it never came up to the ridges. We got no sediment here, as we call it, until 1862. In that year our water was very high, and it covered the whole bottom, in some places 6 feet deep, but it was comparatively clear in appearance. Yet when it went down we found large banks of sand and much of sediment. The current of the Bear River was rapid. After the fine stuff had passed down, the deposit left was chiefly sand, and not a great deal of it. The first flood left very little, but the succeeding ones, afterwards, left more of it. This has kept going on, from time to time, as the river grew riley and thick with mud, during the winters, until it has now covered the bottoms. I had about 1,030 acres, and it has covered them. It has been doing that now, from time to time, until it has reached the height of 25 feet. All my places are level. I was over there a year ago, looking for some wild cattle I had in the waste, and I could just trace the line of the telegraph poles. The land has filled up within a few feet of the top of the telegraph poles. I am satisfied that it was not so deep as on the other side. It was only from 12 to 20 feet deep all through that body of land. I had about 90 acres that I protected with levees; the remainder was destroyed eight years ago. In 1875 these 90 acres which I protected with levees were destroyed; the water flowed over the levees and filled the ground over 4 or 5 feet. It did not destroy the levees, but flowed over them, thus destroying the remainder of my land. I had a garden, fenced with a strong fence and posts. The tops of these posts have been five feet under for the past six years. They destroyed all my land. My house was 20 feet above the low-water mark in the river, and last winter the water was up to the top of and around the house, and left a sediment of 8 inches. My buildings all sit there still, but they are useless. It cost me $3,500 to put them there, and I had to go away and leave them on that land. I raised 94 bushels and 34 pounds of wheat to the acre on that land. That was a sworn statement before the agricultural fair. I had raised 103 bushels of barley per acre. I raised the first grain that was grown this side of Sacramento. All that land has been destroyed; it is nothing but a swamp now, and you cannot go into it to-day. If I had that land to-day, in good condition, it would be worth $175,000. It is stripped three miles wide and twenty-two miles long. The water has now got up so that the levees will not prevent it from spreading over ten miles; that is, the snow-water that comes down; and the water is at times 2 feet above the highland. It is only the levees that protect it from the land, and when it breaks the levees it runs at random over the plains for five miles. If we had the water come down as it did in 1862, I think it would sweep these levees by the board, and the water would come from the foot-hills at Auburn to the Sacramento River. I do not believe there would be any land that would not be under water. The water ran at that time 6 feet over the land, and the current there was rapid; but now it runs slowly and the channel is entirely obliterated. No man can now tell where the old original channel of the river was. The country then was covered with farms; now it is a wilderness of willow trees, through which a man would have difficulty in finding his way. There was not a shrub on the land then 3 feet high where it was cultivated, and that was the case with all the land around here. There was the Briggs orchard, which was supposed to be worth $300,000. It is not worth anything now. Hundreds of cords of wood were cut off it a few years ago. There was no willow on it in 1862. There were a great many trees in his orchard, and he made a great deal of money out of it, until the debris came, when it was destroyed. It is now a wilderness of willows.

I have found this deposit to be no less than a poison. I have experimented with it for twelve years, and I have not been able to do anything with it. In five years they must put other levees where the levees are now, because the debris is rising 2 feet a year. Opposite the mainland there are four different channels. In this sandy waste, where nothing will grow, the sand is about 26 feet deep, and perhaps 30 feet. There were formerly only one channel where there are now four. The debris fills in and the water cuts another channel. In some places in cutting new channels buildings are swept away. This riley water will weigh 11 pounds to the gallon, while clear water only weighs 8 pounds. In the summer time it is heavier and thicker. In summer it will weigh 12 pounds to the gallon; that was the difficulty with the levees last year. Their owners calculated for the winter water, and the summer water was too heavy for them to withstand it, and their levees were destroyed. I have tested it often in different ways; I have fought the water year after year, and it has driven me steadily back, until I have lost all my land. I have put in crop after crop, and the water would steadily destroy them, until I was driven away. Many other persons, like myself, have spent many years on their farms and have built levees, but when a freshet came they would be destroyed also.

I am well acquainted with Feather River and have been for twenty years. It has filled 8 feet. There is not so much mining on that river. The greatest damage is done on the Feather, Yuba, Bear, and American Rivers.

George Ohleyer, residing in Yuba City, California, made the following statement:

I have lived on Yuba River from 1858 to 1865, and since then I have lived in Sutter County. I was living there before there was any trouble from hydraulic mining and before there was any hydraulic mining, a man, or anything on the Yuba River, about four miles from Yuba City. My occupation was farming and threshing. In early days people did not want the high plains here, they being very dry and worthless as farming lands; so consequently everybody applied for a piece of bottom land; the result was that this Yuba Valley was thickly settled from the left of Yuba to the foot-hills. I am not positive as to distance, but I think it was eleven or twelve miles. This valley bottom land, I should judge, was an average of two-and-a half miles wide. It was thickly settled and was as fine land as I ever saw. In many places it was cultivated right up to the banks of the river and was cultivated along its entire length. I think there was, on an average, a family with hired help, &c., or perhaps twenty-five or thirty persons to the square mile. To-day there is not a foot of one levee on these farms, the people have abandoned the farms, many of them have died, and others have moved away because they have nothing left. During the years 1858–'61 I threshed on both sides of the river, from the mouth of the Yuba River to the foot-hills. I threshed wheat, barley, and oats all along, and could raise corn and vegetables too. All these farms have pretty good buildings on them. The buildings were mostly frame buildings—some of them had fine two-story houses and three-story ones, different and similar houses, and they had barns, which were very well fenced, and had very expensive orchards and vineyards. The land if recovered to-day on a reasonable view of it, in consideration of the orchards and vineyards, would be worth $100 per acre. Some of the grain might not be worth, were one exchanging hands, $100 per acre. A portion of this land, which was covered with buildings then, is now covered with sand. I made a statement before on this subject to the committee, and I will read the following statement which I made and which was printed in one of our newspapers, showing the immense losses that had been sustained by farmers in the river valleys by the inundations of sand, water and sediment at that time. They are as follows:

Twenty-four sections of land destroyed on the Yuba River—15,360 acres—valued at $200 per acre	$3,072,000
Personal property and improvements	3,000,000
Loss and depreciation of property in Marysville	2,000,000
Destruction on Feather River	500,000
Eighteen sections on Bear River—11,520 acres—valued at $100 per acre	1,152,000
Destruction in Yuba County	9,724,000
Assessed value of all property in Yuba County for 1875	5,025,720
Assessed value of all mining property in Yuba County in 1875	298,600

Destruction of property in Sutter County:

Eighteen sections of land on Bear River—11,520 acres, valued at $100 per acre	1,152,000
Personal and improvements	1,000,000
Destruction in southern portions of the county, Coon Creek, and Anourn Ravine	500,000
On Feather River on both sides	500,000
Total in Sutter County	3,152,000

This rather underestimates. Since then this backwater that has been spoken of has injured on Feather River all my land above the confluence with the Yuba River. Below there are many fine orchards that are totally ruined, and below as far as the mouth of the Feather River two millions are almost ruined. It is unsafe to do anything with them. These we attempted to farm, and, having continuous loss of money, most of them failed financially in trying to do anything with the two millions on Feather River. Total in Sutter County, $3,152,000. I also estimated that the amount already spent by the building of levees to protect what was then not wholly destroyed, $1,000,000, and I claim that at that time the levee works were still protecting property that was worth $20,000,000. They had attempted to keep out Feather River at very great expense, but in many places the levee is all blanks, and if it keeps on filling as it has for the last few years we must levee, or we would have to keep building artificial banks, or it will overrun us.

Mr. L. L. Robinson furnished the commission with some comparisons of values between the hydraulic mining interests and the damaged lands:

As to the relative value of farming lands injured by debris from the gravel mines compared with the value of the mines, I desire to state it is a very small percentage. The debris (so called) from the gravel mines alone is not as injurious to farming land as is the case with the tailings from quartz mines and mills, which are poured in large quantities from these sources into the rivers, as the quartz does not decompose, whereas the material held in suspense in the rivers from the gravel washing, after it is deposited on the land in the main valleys, will in a few years make excellent arable land. The industry of hydraulic mining or, as it might properly be called, gravel mining, is a very large and important one in the following counties: Stanislaus, Tuolumne, Calaveras, Amador, El Dorado, Placer, Nevada, Sierra, Plumas, Butte, Yuba, Shasta, Siskiyou, Del Norte, Trinity, and Kalamath. In these counties, and connected directly or indirectly with gravel mining in various ways, at least $100,000,000 has been invested. The most important branch of gravel mining is done by what is known as the hydraulic process. I am personally interested in two mines of this kind, and have been for the past fourteen years. In these two mines, the North Bloomfield and Milton, situated in Nevada County, about $4,000,000 was invested, taking over ten years to get them in complete working operations. In connection with these two mines we have driven, through hard rock, over four miles of tunnel to reach the gravel, the largest single tunnel being nearly two miles in length, constructed at a cost of nearly $600,000. One of these mines, the North Bloomfield, is supplied with about 3,000 miner's inches, or 55,000,000 gallons of water per day of twenty-four hours the year through. The miner's inch of water is 2,230 cubic feet, that will flow in a day of twenty-four hours. This is regulated by an opening an inch square, with a pressure above the opening of six inches. We settled that two years ago by a large series of experiments. The water is brought from a reservoir in the high Sierra Nevadas, 45 miles, through a canal across a most difficult country, at a cost of over half a million of dollars. This reservoir, which consists of two stone dams, one of which is nearly 100 feet high, having a storage of 1,000,000,000 cubic feet of water, was constructed at a cost of $250,000. The other mine, called the Milton, is supplied with about 50,000,000 gallons of water per day, brought 75 miles over a very rough section of mountain country from a reservoir near the summit of the Sierras. The reservoir, which is formed by three stone dams, one of which is among the highest in the world, being nearly 150 feet in height, will hold 900,000,000 cubic feet of water. In the mines of these two companies alone there is used yearly about 1,750,000 miner's inches of water. Each inch of water is equivalent to 2,230 cubic feet. The amount of gravel moved per year by this quantity of water, used as we use it, under a pressure varying from 275 to 400 feet, through nozzzles varying from 6 to 9 inches in diameter, against gravel banks varying from 50 to 400 feet in height, will amount to about 5,000,000 cubic yards, and the gross yield of gold is about $1,000,000 per year, averaging about 20 cents per cubic yard, or 55 to 60 cents per inch of water used. The yield of gold from the gravel mines of this State is about $12,000,000 yearly, averaging about $1,000,000 per month. This yield will continue for the next forty or fifty years to come from this source alone. I do not think it will increase materially, from the fact that the water supply is limited. Nor do I think that the mining machinery and appliances employed at present can be materially enlarged or increased with economy in results. The machinery and appliances connected with this class of mining has about reached its maximum. On the western slope of the Sierras there are some eight or ten counties where gravel mining is the principal industry. The number of such mines, including hydraulic, drift, placer, and river, is very great. At least 100,000 persons derive their support, directly or indirectly, from this kind of mining. To stop it would depopulate nine or ten of our most prosperous counties, ruin a large proportion of our State population, and load down the balance of the State with taxes which they would be unable to bear, and would be most disastrous in all ways.

The damage to the lower rivers, bays, and harbor, caused by gravel mining, has been very much exaggerated. Much the largest portion of the material filling our harbor comes from the operations of the farmers and other causes, and not from the operations of the miners at all. The mining rivers, as they are called, from the gravel mines to their debouchment into the plains, have been filled up to a great extent by the operations of the miners, both gravel and quartz; but even this filling is aided by natural causes. As to the damage caused to the lower rivers, bays, and harbors, by filling, the acts and doings of the farmers and others contribute 15 cubic yards or more where the miners contribute one. In our light soils, upon land at all rolling or inclined and not absolutely level, the constant yearly degradation is very great. And when it is remembered that the area draining in our lower bays and harbors covers nearly 60,000 square miles, it is not to be wondered at that a large amount of material is constantly being poured into them. The general impression is that all the vast amount of material deposited in our lower rivers and bays is from the hydraulic mines, when the fact is that their operations have but a very slight effect upon this filling. In early times in California, before the country was occupied by the Americans, the population was quite limited and scattered. The land was held in large tracts, and was only used for grazing. Our present system of cultivation was unknown, and the surface of the ground was rarely or never broken up by the plow of the farmer. It was protected from washing by the grass roots, and the amount of material washed into the rivers was very limited in quantity; so much so that very little of it ever reached the harbor. Since farming has been carried on by our people upon its present large and increasing scale and area, the yearly increase in the amount of material pouring into the rivers and bays has steadily and rapidly increased, until it has attained such vast proportions as to cause great fears for the future. During the winter months the streams running into the bays and lower rivers are thick with mud. I should say that the degradation of the surface of the country occupied solely by the farmer has been increased, since farming was first commenced in California, say since 1850, from ten to fifty times, depending upon soil and locality. Other causes are also tending to shoal our harbor and its entrance. The most important, perhaps, of these causes are the sewerage and waste from our city and the operations of the railroad company on the Oakland shore. This work is perhaps as injurious, if not more so, than other single causes, for they are not only depositing a very large quantity of new material in the bay, but it is done in such a direction and manner as to cause the rapid shoaling of a large area of San Francisco Bay, diminishing its tidal area, with a consequent injury to our harbor. These grave results, which appear to be inevitable, are certainly not caused by the miners, for their contribution is but a very small percentage of the injury from all other sources. We can measure with much certainty the results of mining operations, and particularly so with hydraulic mining, as in this class of mining our knowledge is derived from close observation and experience. There is used per year in hydraulic mining not exceeding 10,000,000 miner's inches of water (each inch representing 2,230 cubic feet). This quantity of water used under the hydraulic system of mining will move not exceeding 30,000,000 cubic yards of gravel. Of this amount at least 95 per cent. is lodged in the canyons at or near the outlet of the mines. The remainder finds its way into the lower portion of the running rivers, filling them gradually, until by the time it reaches the lower rivers and bays but very little is left. This material is not injurious to any land, on the contrary it is as fertile as the silt or deposit from the Nile or any other alluvial river.

Much the largest portion of the damage committed in proximity to the mining rivers between their outlets at the mouth of the canyons and the main Sacramento River (which has been very much exaggerated) is due to mining upon these rivers and their tributaries long before hydraulic mining was in operation upon a large scale. The placer mines were innumerable, and the amount of material of comparatively light nature moved by the vast number of individual miners engaged in this class of mining was very great indeed. The material was of such a character that it flowed quite readily down the tributaries into the main canyons toward the plains, where a larger portion of it remained until a stormy winter like 1862 came, when the canyons were swept clean to the bed-rock, and the debris was poured into the lower portion of these rivers, filling them up. Since hydraulic mining has attained its present magnitude the material moved is of a much heavier character, and does not pass down the canyons to the plains with the same facility as the lighter material moved from the placer mines. The heavy material moved by the hydraulic process lodges in proximity to the outlets of the mines, fills up the main canyons where it becomes impacted, widens out the beds of these rivers preventing the winter rains from washing it out rapidly by causing the water to spread over a greater area, and impairing its force and power to move the material. In many places these canyons are filled to a depth of one hundred feet or more, and the surface of the river is in consequence widened to several times its normal width. The material thus deposited and impacted will not move down the canyons unless mining ceases. If mining continues as at present, these vast canyons will be constantly filling in the mountains until their beds are raised up to a level with the mining outlets, and as each year fills them more and more the surface of the river-bed becomes wider, while the power of the water to move the material down the canyon will steadily decrease. The miners are now investigating the question of the construction of a series of brush or tree dams in the canyons to aid in retaining both the old and new debris in proximity to where it is first lodged. The miners are, in fact, duplicating the filling of the old rivers from whence they are now moving the material with which they are filled to extract the precious metal contained therein.

Should mining now cease, all the material at present in these canyons (and the quantity is very large indeed) will certainly work down with the water upon the land below the mouths of the canyons on the plains, and so continue for many years to come, to temporarily damage the lands in proximity to and along the course of these rivers after they have debouched from the mountains. There is but little doubt as to the feasibility of retaining the material at present in the canyons in place, as well as to retain a very large per cent. of any new material which may be poured into them from the mines. Nor is there much doubt but that the balance of the material which will be held in suspense in the water can be utilized on the low lands (now valueless) in the main valley below, as well as upon the foot-hill lands in the way of irrigation, by distributing the muddy water over them as is now done to quite an extent in Yuba County successfully. The impounding of such large bodies of water as is contained in the reservoirs of the hydraulic mines has a beneficial effect in two ways; it prevents it from coming down in winter season, thus diminishing the destructive power of these rivers in rainy season and stores it for summer use (when there is very little water in the rivers) for mining and irrigation, equalizing, to a certain extent, the flow of water during the year. The mining reservoirs, costing from $50,000 to $250,000 each, already constructed for hydraulic purposes, can store at least 10,000,000,000 cubic feet of water, which is utilized during the summer or dry season through long lines of canals or ditches, constructed at a cost of from $5,000 to $10.000 per mile. The amount of money expended in construction of these reservoirs and canals exceeds $20,000,000. In the future, when the gravel mines which these works were constructed to supply are exhausted, they will serve to irrigate all the lower slopes of the Sierras for cultivation. No possible system of agriculture could afford to construct such an extensive and expensive system of irrigating works, and although the miners may, in their operations for a few years commit some temporary injury upon a limited quantity of farming lands below them, yet the great benefits which such a vast water system will confer upon the million acres on the lower portion of the western slope of the mountain in the facility and cheapness of irrigation after the mines are exhausted will compensate our State many times over for all the temporary damage now being committed. It is estimated by competent authority that there is yet remaining of known gravel between the South and Middle Yuba Rivers alone about 700,000,000 cubic yards of gravel, which will be mined out by hydraulic process, besides a large amount which will be mined out by drifting. It is safe to estimate that this gravel will yield from $150,000,000 to $200,000,000, and the principal part of it will be mined out during the next thirty or forty years. The gravel mines are situated on and along the mining rivers, at distances varying from 10 to 70 miles from their outlets in the plains, and they will all be exhausted long before these river canyons will be filled to a level with the outlet from the mines. The gravel channels, where the hydraulic mining can be carried on profitably, are well known and can be measured and estimated with considerable accuracy; but the drifting mines in gravel are as yet scarcely known, and this latter class of mining as well as quartz mining (requiring but little water) will continue long after the former class of mining has ceased entirely. The vast gravel deposits where hydraulic mining is carried on cannot be worked in any other way; and there is, in my opinion, no doubt whatever but that the interests of the miners and the comparatively small numbers of farmers and others in the valley injured by mining operations can be harmonized by proper legislation, guided by intelligence and a desire to arrive at results, but it can never be done by litigation guided by those whose interest is subserved by fostering such a course. The interests at stake are of too mementous and important a nature, and the number of persons whose all is invested in mines and whose support depends solely upon mining industry is to great to be interfered with and destroyed by litigation.

The net profits derived from hydraulic mining are not at all excessive, when the risk, length of time necessary to develop a mine, and the amount of money involved and expended, are taken into account. The North Bloomfield Gravel Mining Company was over ten years in opening its mine, and before any net returns were received expended over $3,000,000. The Milton Water and Mining Company was many years in opening its mine, and expended some $2,500,000 before any net return was received by it. Upon such ventures a larger percentage is justifiable than would be the case in any other industry; indeed it is believed that none other than a mining community like California would undertake such a risk requiring so much capital and time. Yet it is believed that none of this class of mines pay over twenty per cent. per year as an average upon the capital invested, with interest, and nothing but the permanence of such a mine as those above mentioned would justify the risk and expenditure in any community. Many first-class hydraulic mines promise more than 20 per cent. but pay less. There is a great number of second-class mines of this kind, running during the rainy season only, which pay their workmen good wages, with but little profit to the owners, and still a larger number of fourth-class, which barely pay their workmen and embarrass their owners. Yet they all find employment for a large number of persons and support for their families.

The gravel miners have gone forward with their enormous works, in the shape of reservoirs, canals, tunnels, and other works, such as have never been equalled in any other portion of the world, under the full cognizance of the United States and State governments, indorsed by the customs and usages of the community, and by the decisions of the courts, and have expended over $100,000,000 in purchasing their claims from the government and developing them, creating a property estimated at $250,000,000 or more in value, and claim that they have acquired by their acts and doings vested rights which cannot, at this late day be taken from them. Hydraulic mining cannot, as a general rule, be carried on with profit on a small scale. It requires a large body of ground to justify the expenditure necessary to open a mine, bring water to, and work it. Hence the necessity of a large capital and consolidation of the smaller claims, which were originally taken up under the mining laws of the United States long ere this kind of mining was introduced. It will be a very serious matter, not only to California, but to the nation at large, if mining is stopped upon this coast on account of the injury committed upon a limited and comparatively small body of farming land and a very limited number of people occupying the same. The value of all the land already damaged, or which ever will be damaged, is certainly not one per cent. of the amount of gold extracted from the mines committing the damage, and the number of people injured financially from these mining operations does not exceed five per cent. of the number which would be injured irreparably if mining was stopped. Our rivers in the great valley of California are extremely alluvial in proportion to their length, and are becoming more so yearly, owing to the physical conformation of our State, the close proximity of the lofty and abrupt mountain ranges, as well as the character of our soils, and the long dry season, followed by a heavy rainy season, and the operations of the farming and mining population. The material brought down by these rivers, highly charged as they are with alluvium, would if utilized, make the valley of the Sacramento and San Joaquin the most productive portion of our continent, and the time is not very far removed when our people will seek to utilize the alluvium instead of finding fault with it, as there are thousands of acres, now valueless, which would become the choicest of agricultural lands if the material held in suspense in our rivers from the farms and mines was utilized, instead of doing injury to our bays and harbors. This subject, upon which the Commission took so much testimony, was not, however, adjudicated upon in the final report of this body. They noted the testimony, considered the subject one for Congressional action and urged that a special commission be appointed to determine it.

A Governmental Report.—Acting, possibly upon the suggestion of the Land Commission the River and Harbor Act of 1880 was made to contain provisional clauses providing for such examinations and surveys as might be found necessary to devise a system of works to prevent further injury to the navigable waters of California from the debris of mines arising from hydraulic mining. This work was entrusted to Lieutenant-Colonel G. H. Wendell, Corps of Engineers, U. S. A. Colonel Wendell carried out his work faithfully and carefully and for so doing was roundly abused by the "Anti Debris Association," California. From Col. Wendell's report submitted we take the following:

The navigable waters of California affected by hydraulic mining consist of the bays of Suisun, San Pablo, and San Francisco, forming the great estuary of California, and of the rivers, the Sacramento, the San Joaquin, and the Feather. The Sacramento River rises in the north and flows in a southerly direction through the great valley, flanked on the east by the Sierra Nevada, and on the west by the coast range. The Feather is a tributary of the Sacramento. The San Joaquin has its source in the south and flows in a northwesterly direction through the valley, uniting with the Sacramento at the upper or eastern end of Suisun Bay. The strait of Carquinez connects Suisun Bay with San Pablo Bay which opens into San Francisco Bay, and, taken as a whole, these separate bays and rivers afford a continuous channel, connecting with the Pacific Ocean through the Golden Gate. The auriferous drift deposits which are worked by the hydraulic process lie on the western slope of the Sierra, in a belt 40 or 50 miles wide, extending from the plains or edge of the valley to altitudes of 4,000 or 5,000 feet. The length of this deposit, measured in a northwesterly direction, parallel to the crest of the Sierra, is about 150 miles, and extends from the Merced river on the south to Chico Creek in the north, with some exceptionally placed deposits lying both north and south of these limits. It may be remarked that in addition there are, on the Klamath and Trinity, one of its branches, quite important places, which are now worked. The detritus is lodged in the rivers, which are neither navigable or tributaries of navigable rivers, so that this separate mining district is not thought to come within the limits of this investigation. The Klamath empties into the Pacific Ocean at a few miles south of the northern boundary of California. The tributaries of the San Joaquin, coming from the Sierra Nevada, and affected by mining, either past or present, are the Merced, the Tuolumne, the Stanislaus, the Calaveras, the Mokelumne, and the Cosumnes. Each of these rivers has small tributaries, which, for the sake of clearness, need not be mentioned by name, but which are to be understood as being included in the designation of the larger tributaries.

The Feather and American are the principal tributaries of the Sacramento, which drain the mining districts. The Feather is a large river draining 3,400 square miles, and includes as its tributaries the Yuba, with its three forks, and the Bear, which rivers are noted as the seat of the principal hydraulic mining operations of California. The Sacramento and San Joaquin rivers near their mouths flow through a delta of considerable extent, the surface of which is below the level of flood waters. The connecting channels surround a number of islands. The soil is extremely fertile, and great efforts have been made, thus far with limited success, to reclaim the land. Insecurity in foundations and the absence of a proper material for making levees, have been the chief difficulties in the way of complete reclamation. On the east side of the Sacramento, close to the river, between the American and Feather, is a basin the level of which is a number of feet below the banks of the main river. This basin is overflowed in every freshet. A similar and more extensive basin lies in the angle between the Sacramento and Feather rivers, extending from the Marysville Butte to the mouth of the Feather, a distance of about 30 miles. This basin is also overflowed at high stages of the river. Its great area and capacity for storage gives it an important influence in determining the flood flow of the river. These features are here mentioned that a future reference to them may be intelligible. Several small streams—the principal of which is Auburn Ravine—carrying mining detritus, and natural tributaries of the Sacramento river, do not reach it directly, but discharge into the basin between the American and Feather. The drainage from the Spring Valley Mine, on the waters of Butte Creek, enters into the Sutter Basin between the Sacramento and Feather rivers, and, therefore, does not reach the Sacramento directly. The lower portions of the Cosumnes, Mokelumne, and Calaveras, all tributaries of the San Joaquin, lie in the delta lands, which receive a part of the mining detritus of these streams, and to this extent relieve the San Joaquin from injury.

Ancient Drainage.—The existing drainage system of the auriferous gravel belt is geologically recent. Mining operations have unveiled an older system, lying higher and oblique to the existing drainage, obliterated during the Pliocene period, by deposits of sand, gravel, clay, and bowlders with gold intermingled. The ancient drainage lines are the loci of modern hydraulic mining operations. Subsequent to the destruction of the ancient channels the whole country was covered by a flow of lava and kindred substances, which yet remains in many places a complete bar to effective mining; when hydraulic mining is practicable the basalt has disappeared or is replaced by volcanic ashes. The existing rivers flow through the mountains in canyons cut down to depths varying from 1,000 to 2,500 feet below the ridges which bound them on either side. The portions of the old drainage lines which remain are on these ridges, and therefore are at considerable elevations above the present river beds. This feature is generally true of the northern portion of the auriferous belt, while in the southern portion of the levels the two systems do not present such marked differences. A considerable elevation above existing river beds is indispensable in hydraulic mining in order to give a good clearance of the tailings. This feature is presented most favorably in the mine on the Yuba, and it is one of the reasons for the great development of the hydraulic industry in that part of the country.

The ancient river beds are again distinguished from the modern by greater width and steeper slopes. In position they are generally oblique to the existing drainage system. So far as mere surface indications are concerned, the old system was completely obliterated. Occupying in the aggregate many square miles in area, the whole surface was filled to the rim rocks with gravel, and over these to a depth often of many hundred feet by a plain of eruptive material, extended from the summit of the Sierra to the valley. The capping of lava has since been lost in many places. In others it is thin, exposing the top surface of the gravel. Under these circumstances it has been impossible to trace out the old drainage system, and it is only by comparison of altitudes and directions of the small portions that have been uncovered by the miner, and tracings here and there of the rim rock, that any inferences can be drawn as to the courses of the ancient rivers. In consequence there are many opinions as to the directions of the drainage. The modern rivers cutting across the old drainage lines swept the gravel and gold down their own beds, and thus formed the bars which so richly repaid the labors of the early miners. Deposits of this kind, whether in the beds or on the banks, or in gulches at small elevations above the beds are workable without much aid from capital. Water can be secured by storage in reservoirs close at hand or be brought by short canals, the construction of which is practicable by the labors of the miners themselves. These river or placer deposits were worked out in a few years, and it was only as they were being exhausted that attention was directed to the higher and larger deposits in the old river beds.

The extent of these deposits is not known. A great part of them is hidden under the lava cap which covers the flanks of the Sierra with more or less continuity. Definite information exists only where the mines have been opened to a considerable extent. When this is the case, the depth of the gravel deposit has been found to be as much as six hundred feet. This is, however, an unusual depth. One hundred and fifty or two hundred feet depth is frequently found. While the deposit is known among the miners as gravel, it is not by any means all gravel, nor is the deposit homogeneous as a rule in any mine or in any district. The vertical section of a mine may show sand on top, with pipe clay, then gravel, first fine and afterwards coarse, generally white, often colored; and in the bottom a large proportion of bowlders, sometimes tons in weight. Stratification on planes either horizontal or inclined may be observed in some cases. The variety in the components and in their arrangement forbids, in a sketch of this kind, any other conclusion than the general one, that the material becomes coarser and heavier as you descend from the surface to the bed-rock. The accepted theory now is that these river beds were filled by detritus brought down by their own currents. If this be true it would follow that the lighter materials, the only ones transportable in the slight slopes of the river when nearly extinct, should be found on top. The different grades of materials are not, however, clearly segregated in their places of deposit. Sand is found everywhere in the vertical section, mixed in greater or less abundance with coarser material. It often happens that the components are found to be cemented, by iron-oxides and silica in solution, into conglomerates that need powder or stamp-mills to disintegrate them. Gold is generally found everywhere in the gravel, but not in equal proportions. The gravel on top is generally poor, and the best pay is near the bed-rock. In cases where the pay is concentrated in a streak four or six feet thick near the bed-rock, it may be secured by stopping out this stratum, leaving the upper mass undisturbed. This is drift mining. Generally, however, the pay is not concentrated, but diffused throughout the gravel in increasing proportion from the top to the bottom. The only way to get the gold in this general case is by the hydraulic process.

The Hydraulic Mining Industry.—The first engineering problem presented in an attempt to work deposits lying at high altitudes is to introduce a sufficient supply of water at an adequate height. The head of a canal fulfilling the necessary conditions must be placed on the river, where its bed is some hundreds of feet higher than the gravel to be worked. The canal must be built for many miles on the steep flanks of the ridges which extend from the main vertebra of the mountains toward the plains. When canals were built, it was found in many cases that the supplying rivers did not in the low stages afford an adequate amount of water. This deficiency was remedied by the construction of reservoirs still higher in the mountains, which retained in storage enough water collected in the season of abundance to supplement the supply during the period of inadequate river flow. In order to apply the water supply to hydraulic mining, a conveyance of detritus from the mines to the dumps has to be provided. This, in the general case, requires the construction of one or more tunnels in bed-rock, the upper end under the lowest point of the gravel to be worked, and the lower end opening if possible into a deep cañon, with room for holding the accumulations of one or more seasons. These sluice tunnels form one of the most expensive adjuncts to hydraulic mining. The longest and most costly single tunnel is that for the North Bloomfield mine, which is nearly eight thousand feet in length, its cost being $500,000. A permanent and sufficient water supply, a good bank of gravel, and a suitable outfall are the conditions for success. The extent and boldness of the engineering operations just referred to are calculated to excite surprise and admiration. Tables follow which give statistics as to the reservoirs, canals and tunnels in a part of the mining field.

Table of Reservoirs on the Yuba, Bear, Feather and American rivers, constructed for Mining purposes.

Name of Company.	*Capacity.*	*Authority.*
	Cubic feet.	
North Bloomfield	1,050,000,000	Hamilton Smith, jr.
Milton Company	650,000,000	Do.
Eureka Lake	1,130,000,000	Do.
South Yuba	1,800,000,000	Do.
Omega and Blue Point	300,000,000	Do.
Spring Valley	300,000,000	Do.
California	600,000,000	Do.
El Dorado	1,070,000,000	Do.
Other small reservoirs on the Feather, Yuba, and American rivers	700,000,000	Do.
Total storage	7,600,000,000	

Incomplete statistics of mining ditches in California, from Mint Report, 1881.

Name.	*Length.*	*Capacity.*	*Grade by feet.*	*Cost.*	*Dim'nsn's in ft.* *Top.*	*Btm.*	*Depth*
	Mls.	*In.*	*Per ml.*				
North Bloomfield, including reservoirs	157	3,200	12 to 16	$708,841	8⅓	5	3½
Milton, including reservoirs	80	3,000	12 to 25	391,579	6	4	3½
Eureka Lake and Yuba ditches	163	5,800	....	723,342	.	..	...
South Yuba ditches	123	7,000	8 to 13	....	6	..	4 to 5
Smartsville ditches	113	5,000	9	1,000,000	8	5	4
Spring Valley and Cherokee	52	2,000	....	....	5	..	3½
Hendricks	46¼	...	6 to 12	136,150	5	..	2
La Grange	20	2,700	7 to 8	500,000	9	6	4
Blue Tent	32	1,800	10	150,000	8	6	4

NOTE.—The length of Smartsville ditches is taken from reports on the mines by Professor Poupelly.

Hydraulic mining, as it is understood in California, is that process by which a natural bank is excavated by a jet of water and conveyed by the same water through the sluices to the dumps. Water does all the work; manual labor is needless in a perfect bank; when bowlders are found too large to pass through the sluice they are sometimes blasted into smaller pieces suitable for the sluices. Where the bank is cemented or contains masses of pipe clay it is shattered by charges of powder. The scale of blasting corresponds to the other features of this kind of mining, 30,000 or 40,000 pounds of powder being on occasions exploded to break up a bank. The method is similar to that used at Lime Point in 1868. In a certain sense all mining is hydraulic. Water is indispensable for the separation of gold in all the processes of mining. But before the introduction of existing appliances water was used for this purpose only. Now water under pressure excavates, water transports the detritus, and with the aid of quicksilver collects the gold. The very moderate amount of human labor required is the secret of the cheapness of this kind of mining. The hydraulic method dates from about 1855. The first efforts in using water under pressure were in rubber or canvass hose, with nozzles of an inch or less diameter. Now nozzles vary from 4 to 9 inches, and pressures are as high as 400 feet. An 8-inch nozzle at North Bloomfield discharges 185,000 cubic feet in an hour, the velocity being 150 feet per second.

This is the culuminating instance of this kind of force. There are, however, frequent instances of one-half or one-third of this hose power being applied. The excavating power of a force of this extent on a bank of gravel is enormous, and in general unless the gravel is very heavy or cemented is much in excess of the transporting power. The latter depends on the grade of the sluice, so that really the latter factor becomes in great part the measure of the quantity of gravel that can be handled, for it is not desirable to excavate more gravel than can be sluiced away. Grades of sluices vary from mine to mine. The topography generally determines the fall of sluices. It is desirable to have a grade of 4 or 5 per cent., very often the grade is necessarily much lower, and in some cases 8 or 9 per cent. The following table, taken from a paper entitled Hydraulic Mining in California, by Augustus J. Bowie, mining engineer, volume vi., Transactions of the American Institute of Mining Engineers, gives the grades of the tunnels of the principal mines on the Yuba River.

Name of mine or tunnel.	*Locality.*	*Length of tunnel.*	*Average grade of tunnel.*	*Reported cost.*
			ft. per 100	$40,000 500,000
Boston	Wolsey's Flat	1,600	7¼	Not complete
North Bloomfield	Humbug Canon	8,000	4½	140,000
Farrel	Columbia Hill	2,200	3½	62,000
English mine	Badger Hill	1,400	7	90,000
American	Below San Juan	3,900	6¼	
Manzanita	Sweetland	1,740	4⅛	165,000
Sweetland Creek	...do.	2,200	4⅔	
Bed-Rock	Below Sweetland	2,600	5¼	
French Corral	French Corral	3,500	4⅔	
Babb	Timbuctoo	1,200	3.80	
Pactolus	do.	1,700	4.16	
Rose's Bar	do.	1,600	4.16	
Blue Gravel	Succor Flat	1,100	4.50	
Pittsburg	do.	900	4.16	
Blue Point	do.	2,250	4.16	
Enterprise	do.	1,200	4.16	
Deer Creek	Mooney's Flat	2,200	3.40	

If the inclination of the sluice be increased, the quantity of material carried off by a given amount of water will increase more rapidly. This fact is well understood; the law has not yet been fully developed. Sometimes it is claimed that the quantity worked will vary with the square of the inclination, that is, if the inclination be doubled the quantity worked will be four-fold. The quantity which an inch of water will handle is its duty. The duty depends on the kind of material. In light gravel, 10 or more yards may be moved to an inch of water taken to be 2,250 cubic feet. In the heavy material of the bed-rock, the same water and grades may not move one-eighth or one-tenth of the former volume. The differences in material, grades, and other circumstances give for each mine a particular duty and thus far have prevented the deduction of the law of change in quantities moved, due to changes in inclination. In particular instances water in sluices of an average grade, the material being of moderate quality, carried 10 or 11 per cent. of gravel in weight otherwise expressed, 2,250 cubic feet of water carried 14,000 pounds of gravel, which in volume is about 4 cubic yards. It may be remarked that when the material is heavy it is carried on the bottom of the sluice, and as a rule only the slightest material is in suspension. So the duty varies in the same mine from the top to the bottom, and from mine to mine. A mean duty adopted by the State engineer is given with the next table, which is assumed as the basis for this report. The quantities of water used in 1880 in the Sacramento Basin were returned by the county assessor and published as an appendix to the report of January 10, 1881. This report not being complete is supplemented by information collected by the State Engineer Department.

Summarized the table is as follows:

Name of stream.	*Quantity of water used in mining and discharged into bed of river in twenty-four hours.*	*State engineers estimate of duty per inch.*	*Amount moved.*
	Inches.	*Cubic yards.*	*Cubic yards.*
Table Mountain or Dry Creek	833.250	3½	2,916,375
Butte Creek	24,000	3	84,000
Feather River	1,259,363	3½	4,407,770
Yuba River	5,458,171	3½	19,103,598
Bear River	1,117,082	3	3,351,246
Dry Creek, No. 2	44,229	3	132,687
American River	1,914,500	4½	8,615,250
Total	10,650,505	......	38,610,926

The amount of material discharged, as found from this computation, and the amount of water used are both less than previous estimates. The quantity of water used in 1880 was about 870,000,000 cubic yards, of which 281,500,000 were stored in reservoirs, as will appear by the preceding table. The following table gives information collected by Lieutenant Payson in regard to rivers south of the American:

Estimate of material moved annually.

River.	*Mine.*	*Ditch.*	*Water used, twenty-four hours.*	*Cubic yards moved per twenty-four hours per inch.*	*Total number cubic yards moved.*	*Summary.*	*Remarks.*
			Inches.			*Cub. yards*	
Cosumnes	Hill Top	American and Sacramento.	456,000	2½	1,140,000	. . .	Much heavy material stored in ravine.
	Various placers	Jordan	48 000	. . . .	40,000	1,180,000	Part of water used for power.
Dry Creek	Irish Hill	American and Sacramento.	162,000	2½	405,000	405,000	Little now reaches any river.
Mule Creek	Various small placers	Johnson's	38,000	1	38,000	38,000	
Sutter Creek	Various placers and hydraulic	Amador Canal	54,750	1	54,750	.	
	Volcano hydraulic	Volcano	365,000	2½	912,500	. .	Not now working dump in bed of dry creek.
	Various placers	Johnson's	38,000	1	38,000	1,695,250	
Jackson Creek.	Various placers and hydraulic M	Amador Canal Company	127,750	1	127,750	. . . . .	
	Near Buena Vista, at head of Jackson Creek.	Dougherty	43,400	1	43,400	171,150	
Mokelumne	Near Campo Seco, Camache and Stockton Ridge.	Mokelumne	61,000	2	122,000	. . .	Bulk of heavy material stored in ravines. Parts of water used for power.
	Railroad Flat, head South Fork	Clark's	45,000	2	90,000	. . . .	
	Near Lancha Plana and Camache	Murray & Dougherty's	118,500	. . .	60,000	272,000	
Calaveras	Near Jenny Lind	Salt Spring Valley Reservation and Union.	365,000	2	730,000	. . .	Formerly in main stream. Heavy material now mostly stored.
	Chile Gulch and Jesu Maria Fork of Calaveras.	Mokelumne	200,750	2½	501,875	. . . .	
	Juniper, at Dogtown, San Domingo Creek.	Union	365,000	2½	912,500	. . .	In bed of streams.
	Near Mokelumne Hill	Cook Brothers	45,000	2	90,000	2,234,375	
Stanislaus	Near Knight's Ferry	(small)	38,720	2	77,440	77,440	In main rivers.
Tuolumne	La Grange and Patricksville	La Grange	812,500	2½	2,031,250	2,031,250	
	Total at present		3,384,370	. . . .	7,414,465	.	

Quartz and drift mining contribute a considerable quantity of detritus, none of which can be exected to remain where discharged from the mines. The product of the quartz mill is impalpable sand. The drift miner leaves the bowlders in the mine and brings out only the gravel. The Chinese mine quite extensively in the beds of the rivers in low stages. They take the water out of the bed in a flume and sink shafts or run drifts in the gravel. While this makes no additional contribution to the amount of gravel in the river bed, it disturbs the equilibrium and facilitates the movement down stream. There are no means of estimating the amount of detritus due to these causes, although they contribute in a sensible degree to the evils due to mining. Professor Price estimates that in the year 1881 two thousand five hundred and forty-six stamps in quartz mills contributed to the drainage lines of the State 1,500,000 tons, otherwise expressed as 1,000,000 cubic yards of detritus. Drift mines are numerous, but there are no statistics of the detritus furnished by them. The Bald Mountain drift mine is reported as coutributing 106,160 cubic yards in a year. There are a large number of quartz mines in the State. Lieutenant Payson found south of the American River in 1880 eight hundred and forty-two stamps running, producing an estimated yearly amount of 567,575 cubic yards of tailings. There is no report in regard to the number in operation north of the American. There are also a large number of drift mines in Sierra and Plumas counties, the production of which either in gold or detritus is not ascertained.[1]

The Economic Aspect of Mining.—It is stated in the testimony in the case of the State of California *versus* The Gold Run Mining Company that the Capital invested in mining in California is about $160,000,000, of which $100,000,000 is in gravel mining. This appears to be a generalized opinion, based upon a partial knowledge of investments. It is not based on detailed information, and is not claimed to be more than an approximation. So far as it applies to gravel mining, the amount is probably in excess. Perhaps it is quite as well for the purposes of this report to be able to say that the invested capital is large as to be able to give the specific amount. This kind of information for a majority of mining properties is quite out of the question. The natural secrecy of business operations and the varied and complicated circumstances of the different properties forbid any attempts in this direction. The assessed valuations might be a guide, but these are now much depressed by litigation, present and prospective. In the cases of the principal hydraulic properties held by incorporated companies information can be obtained.

The following list is believed to be quite accurate, as in most cases the information is taken from books of the companies.

Excelsior Company, of Smartsville	$2,857,166 65
North Bloomfield and Milton	4,079,321 62
Gold Run Company	433,335 00
Blue Tent	755,000 00
El Dorado Deep Gravel	1,008,611 60
Eureka Lake (approximate)	2,500,000 00
South Yuba Company	2,000,000 00
Spring Valley Company	2,000,000 00
La Grange (about)	650,000 00
	$16,283,434, 77

This list includes a number of the principal hydraulic mines of the State, but there is a much larger number of smaller properties not included, in reference to which no information is at hand. A considerable amount of capital is understood to be invested in mining ground acquired for mining purposes. The most important single group of mines not included in the list is that at and about Dutch Flat and tailing into Bear River. Referring to the table next to come, it will be found that there are seventeen counties in California in which mining is a principal industry and in some it is the basis for all industries, in the sense that if it did not exist, the population would mainly disappear. So far as hydraulic mining is concerned Nevada is the county which produces the most gold, two-thirds of its production being credited to hydralic mining. Trinity County production is believed to be nearly all due to earth washing, and the same is true of Shasta and Sierra Counties. Mono County production comes from vein-mining. Attention is invited to the column of remarks in the table, which describes the resources of each county in a general way, and discriminates partially between the different forms of mining. It may be said that the belt of country on the flank of the Sierra Nevada, from the Merced River to Chico, is interested to such an extent in mining interests of one kind or another, that its abandonment would change the condition from prosperity to extreme depression, which might be expected to last until new resources are developed. The table may be used for the purpose of reaching an approximate relation between the production from earth-washings and

[1] Those who desire to obtain a full account of the hydraulic system are referred to a paper on the subject by Augustus J. Bowie, Jr., published in Volume VI, Transactions of the American Institute of Mining Engineers. The geological relations of the gravel will be found fully described in a work by Prof. J. D. Whitney, entitled the Auriferous Gravels of the Sierra Nevada of California, printed for the Museum of Comparative Zoology at Harvard College. These works have been consulted in the preparation of this report, as may be noticed by the references.

that due to the quartz industry. The items are not segregated in sufficient detail to enable one to establish an exact relation, but it cannot be far from one of equality. The table is made from returns to the mint and other official departments, and so far as the production of the precious metals is concerned is apparently incomplete, and perhaps necessarily so. The production stated for the fiscal year ending June 30, 1880, is $15,148,505. It appears from Wells, Fargo & Co.'s estimate that the production of California in 1879 was $18,190,973, and for 1880 $18,276, 166. The production for the fiscal year ending June 30, 1880, embracing half of each of the calendar years of 1879 and 1880, may well be assumed to be the mean production of those two years, which is $18,238,567, an amount $3,098,062 in excess of the tabular statement. It may be supposed that the production from gravel-washing forms a greater proportion of this unreported sum than the quartz production. This supposition is justified by the fact that there are a great number of small properties of this kind, the aggregate production of which is considerable, which would be more likely to be unreported than the quartz industry, which generally involves the investment of considerable capital. Giving weight to this consideration, it appears fair to say that earth-washings may be credited with an annual production of nearly $10,000,000, the quartz-industry being credited with the remainder.

hydraulic mining does not exceed, if it equals, two-thirds of the gross amount credited to earth washings. On the other hand it is proper to remark that somewhat different views are held, as will be observed from the following quotation from Prof. J. D. Whitney, page 368, Auriferous Gravels:

> At the beginning of the present decennium it [the gold production] was probably about $20,000,000 in value, and since that time has slowly and irregularly decreased, the present production being about $18,000,000. Considerably the larger portion of this comes from the hydraulic and tunnel mines, chiefly from the former. The best authorities estimate the present yield from this source at from $12,000,000 to $14,000,000.

While these results are to some extent indefinite, they are nevertheless sufficient to limit error of judgment within bounds compatible with the purposes of this report. The following tables are compiled by Hamilton Smith, jr. They are believed to be the most reliable existing estimate of the production of the precious metals in California.

Products of precious metals in California, 1848 *to December* 31, 1881.—[The figures from 1848 to 1857, inclusive, are based upon estimates made by Mr. Louis A. Garnett, late manager San Francisco Refinery. The estimates from 1858 to 1870, inclusive, are made by Professor Raymond, Official Report as Mining Commissioner, 1874, page 543; from 1871 to December 31, 1881, from the official estimates of Mr. John J. Valentine, superintendent of Wells, Fargo & Co.]

Tabular statement showing condition of mining in California for the fiscal year ending June 30, 1880.

[Compiled from Mint Bureau Returns, United States Census, and State Reports.]

Counties.	*Number of quartz mills.*	*Number of mining ditches*	*Miles of mining ditches.*	*White population in mining counties.*	*Chinese population in mining counties.*	*Gold bullion produced.*	*Silver bullion produced.*	*Total production.*	*Remarks.*
Alpine	3	...	...	589	17	17,113	24,146	41,259	Silver and gold bearing veins.
Amador	12	7	300	10,271	1,115	1,495,053	1,953	1,497,006	Principally from quartz on Mother Lode; three hundred and seventy five stamps running.
Butte	8	...	390	14,937	(*)	430,501	1,247	431,748	Principally from deep placers by hydraulic mining, and agricultural county.
Calaveras	47	26	525	8,057	1,037	320,865	643	321,508	Production divided between quartz and shallow placers.
Colusa	...	...	...	...	...	4,830	78	4,908	Shallow placers; agricultural county.
Del Norte	...	22	87	...	...	215,403	300	215,703	Beach sands and shallow placers.
El Dorado	26	5	600	9,197	1,483	389,383	208	389,591	One third from quartz, balance from drift claims and hydraulic.
Fresno	1	...	...	...	...	143,433	...	143,433	From quartz by arastras; agricultural county.
Humboldt	...	...	...	...	...	153,940	80	154,020	Beach sands and shallow placers; agricultural county.
Inyo	5	1	6	2,928	90	48,648	173,910	222,564	Silver-bearing veins and argentiferous lead ores; principally extracted by smelting.
Kern	4	...	...	...	...	94,214	390	94,604	Gold-bearing quartz veins; agricultural county.
Lassen	2	3	7	...	...	25,900	...	25,900	Gold-bearing veins at Hayden Hill; agricultural and grazing county.
Los Angeles	...	4	21	...	...	7,700	66,300	74,000	Shallow placers; agricultural county.
Mendocino	...	...	...	...	...	733	125	858	Black sands; lumber and agricultural county.
Modoc	...	...	...	...	...	10,000	...	10,000	Supposed to be from adjoining counties; grazing and agriculture.
Mono	10	5	40	7,140	...	2,407,236	582,905	2,990,141	Gold and silver veins at Bodie.
Mariposa	27	...	107	3,642	697	150,017	1,300	151,317	Principally from quartz mining.
Merced	...	...	...	...	...	17,515	...	17,515	From quartz by arastras; agricultural and grazing country.
Nevada	17	217	824	16,820	(*)	2,702,362	70,144	2,772,606	About two-thirds by hydraulic; balance quartz.
Placer	10	22	358	12,030	2,106	835,433	640	836,073	About four-fifths from hydraulic and drift claims; balance quartz.
Plumas	15	34	700	6,312	(*)	857,124	181	857,305	About one-half quartz; balance hydraulic.
Shasta	4	28	650	8,156	1,336	140,455	117,907	258,362	Principally hydraulic mining.
Stanislaus	...	1	15	...	...	73,271	...	73,271	Principally from shallow placers; agricultural county.
San Diego	2	...	...	...	...	81,558	...	81,558	Shallow placers and gold-bearing quartz; agricultural and grazing county.
Sacramento	...	2	200	...	...	342,514	...	342,514	From shallow placers; agricultural county.
Siskiyou	5	6	250	7,049	1,561	434,612	251	434,863	Three-fifths from shallow placers; balance quartz.
Sierra	22	55	366	5,373	1,250	974,332	576	974,908	One-third low-grade quartz; balance drift claims.
Tehama	...	...	...	...	...	1,500	...	1,500	Shallow placers; agricultural and grazing county.
Tuolumne	20	14	190	7,043	805	461,861	1,071	462,932	About one-half from quartz; balance from placers.
Tulare	3	1	...	...	...	1,125	526	1,651	About two-thirds from vein mining; agricultural county.
Trinity	...	25	400	3,052	(*)	326,693	143	326,835	Principally river and shallow placers; quartz by arastras.
Ventura	...	...	...	...	...	354	...	354	Quartz by arastras; grazing county.
Yuba	1	6	100	9,121	(*)	937,360	438	937,798	Gold from hydraulic mines; county has large agricultural interests.
Totals	253	484	6,036	130,717	11,587	14,103,038	1,045,467	15,148,505	

*No returns.

The production of the San Juan ridge in the year 1881 was $1,705,019, of which $144,351.97 was from drift mining. The North Bloomfield, Milton, and American Companies, which produced nearly one-half of the whole hydraulic output, were idle four of the best months of the year under an injunction of Judge Keyser. It is thought that but for the injunction the production of the ridge would have been $2,000,000. The production from washings is nearly all due to deep placer mining, including in this term both hydraulic and drift mining, but no attempt is here made to apportion the production to its various sources. The information at hand leads to the conclusion that the annual production of

1848–1870, inclusive.

1848 } 1849 }	$15,000,000	Brought forward	$648,100,000
1850	45,000,000	1860	45,000,000
1851	75,000,000	1861	40,000,000
1852	85,000,000	1862	34,700,000
1853	75,000,000	1863	30,000,000
1854	65,000,000	1864	26,600,000
1855	65,500,000	1865	28,500,000
1856	65,000,000	1866	25,500,000
1857	57,600,000	1867	25,000,000
1858	50,000,000	1868	22,000,000
1859	50,000,000	1869	22,500,000
		1870	25,000,000
Carry forward	648,100,000	Total	972,900,000

1871.—December 31, 1881, Inclusive.

Year.	Gold.			Silver.			Total.
	Carried by express.	*Carried by other conveyances.*	*Total.*	*Carried by express.*	*Base bullion and ore.*	*Total.*	
1871	$16,167,484	$3,279,870	$19,447,354	$231,870	. . . .	$231,870	$19,679,224
1872	16,493,922	1,649,392	18,143,314	233,668	$673,116	906,784	19,050,098
1873	15,709,956	1,570,995	17,280,951	264,771	480,000	744,771	18,025,722
1874	16 015,568	1,601,556	17,617,124	967,857	1,715,550	2,683,407	20,300,531
1875	14,842,010	1,484,201	16,326,211	387,768	1,039,172	1,426,940	17,753,151
1876	14,635,963	1,463,596	16,099,559	796,308	1,719,940	2,516,248	18,615,807
1877	14,512,123	725,606	15,237,729	1,202,751	1,734,236	2,936,987	18,174,716
1878	16,482,389	824,119	17,306,508	809,431	804,522	1,613,953	18,920,461
1879	16,348,730	817,436	17,166,166	739,440	285,367	1,024,807	18,190,973
1880	16,900,745	845,000	17,745,745	378,567	151,854	530,421	18,276,166
1881, 1st six mos.	8,969,878	448,500	9,418,378	298,264	(?)	298,264	9,716,642
1881, 2d six mos.	7,379,338	368,960	7,748,298	250,318	305,421	555,739	8,304,037
Total	174,458,106	15,079,231	189,537,337	6,561,013	8,909,178	15,470,191	205,007,528

Recapitulation.

	Gold.	Silver.
1848-1857, Garnett	$548,100,000	
1858-1870, Raymond	424,800,000	
1871-December 31, 1881, Valentine	189,537,337	$15,470,191
	1,162,437,337	15,470,191

The diminished product of gold for the last six months of 1881 was largely due to stoppage of several important mines by injunction, being an aggregate of about $1,178,000,000 since California belonged to the United States. Much the greater portion has been derived from gravel found in ancient river beds or eroded from them and afterwards deposited in modern streams or on their banks. It is altogether to be supposed hundreds of millions yet remain untouched and buried in the pliocene gravel. This branch of the subject is here closed with the following extract from an article of Mr. Skidmore, in the Mint report of 1880, which gives information in regard to the yield from gravel:

The following tabular statement of the average yield of auriferous gravel, worked on a large scale by the hydraulic method, has been compiled from the returns of companies who have acquired extensive and exclusive water rights and large areas of ground, embracing the principal enterprises included in the table on page—:

Name of company.	Average height of bank.	Yield per cubic yard.
	Feet.	*Cents.*
Smartsville claims, Yuba County	112	19½
Blue Tent, Nevada County	180	15
North Bloomfield, Nevada County	180 to 260	4 to 6½
Gold Run, Placer County	200	4⅘
Columbia Hill, Milton County	100	4⅓
La Grange, Stanislaus County	18 to 100	2½ to 15½
Patricksville, Stanislaus County	40 to 60	4⅓ to 18½
Dardanelles, Placer County	150	13

But the profits of hydraulic mining do not depend so much upon the contents per cubic yard as upon the facility and economy with which the auriferous material may be moved, cost of water, means of outlet, &c. It is within the personal knowledge of the writer that a claim near Iowa Hill, Placer county, yielded cost of outfit and a fair profit in the season of 1879, when the product was only three cents per cubic yard. In this case the owner possessed a water-right and ditch.

With a view to the presentation of some statistics of the operations of hydraulic companies, with a record of production less than the average, I have selected the data of several claims in Stanislaus county, California. The figures are compiled from a paper on hydraulic mining in California, by Aug. J. Bowie, jr., mining engineer, which will be found in the Transactions of the American Institute of Mining Engineers for 1879. The period covers the operations of two seasons.

Name of claim.	Average height of bank.	Pressure of water.	Cubic yards washed.	Cubic yards of gravel moved per miner's inch.	Yield per miner's inch water.	Yield per cubic yard.
	Feet.	*Feet.*			*Cents.*	*Cents.*
French Hill claim	30	50 to 70	676,968	1.08	14	13
Light claim	45	60	683,244	1.80	12	6⅔
Chesnan claim	28	70	284,932	1.37	23	16
Johnson	30	80	196,632	1.76	8	4
Licard	90	90	155,347	2.89	37	13
For a corresponding period the North Bloomfield of Nevada County, showed the following results	180 to 260	. . . . .	4,104,700	4.5	23	5⅓

Name of claim.	Cost of water per cubic yard.	Cost of labor material, &c., per cubic yards.	Total cost per cubic yard.	Total expenses.	Total yield.
	Cents.	*Cents.*	*Cents.*		
French Hill claim	1.000	5	6	$42,655 83	$90,186 19
Light claim	.006	3	3⅔	25,962 82	45,444 65
Chesnan claim	.008	4	4⅗	15,923 71	47,781 73
Johnson	.006	3	3⅔	7,466 00	9,148 27
Licard	.004	3½	3 9/10	6,205 40	20,197 07
For a corresponding period the North Bloomfield, of Nevada County, showed the following results	.0755	2¼	3	147,912 58	267,007 50

The examples above cited have been selected exclusively from the record of companies who have washed gravel of low grade by hydraulic method with a steady profit. The average yield per cubic yard on the above exhibit would be 7½ cents. In the case of the claims in Stanislaus county, if we take 7½ cents per cubic yard as the average yield, and 45 feet as the height of bank, each acre of gravel washed would yield $5,263.50. In Weaver Basin, Trinity county, the yield has been from $8,000 to $12,000 per acre, where the height of the bank has varied from 30 to 50 feet. These examples are quoted for the purpose of showing the minimum rates of profitable operations where the depth of the gravel is less than 100 feet. The average of the deep washings on the ancient channel claims, where the banks are more than 100 feet in height, would be but little over 10 cents per cubic yard, if we make the estimate from the basis of the returns of the past five years. At the North Bloomfield mine, Nevada county, the yield has not averaged 10 cents per cubic yard. The yield of this company per miner's inch of twenty-four hours for the past ten years has varied from 13½ to 27½ cents, but this has been from top dirt, the bed-rock bench not being reached. But we should not assume from the foregoing statement of the operations of companies hydraulicking low-grade dirt that the richer ground of the deep placers is exhausted. A recent examination of the yield of the Paragon claim, Placer county, California, by F. Von Leight, mining engineer, shows the following results for six seasons (from 1874 to 1879), by the hydraulic method only:

Total production for period	$243,075 85
Dividends paid	119,670 14
Average yield per miner's inch, calculated on a basis of twenty-four hours' inch, under 6-inch pressure	2 54

In this case the lower stratum was washed and the bed-rock stripped. The highest yield per inch was in the season of 1874 and 1875, when $4.04 per inch was realized; the lowest was in season of 1878-'79, when 86½ cents per inch was realized. The largest yield of any season was that of 1875-'76—$90.04, or 3.43 per inch. The company are also engaged in drifting, but the yield and value of ground from that source will be noticed under the head of drift-mining. The system of valuation of ground per cubic yard has long been in disuse in California, by reason of the disparity of conditions of a hydraulic bank, both in respect to its material (whether composed largely of pipe-clay or gravel) and its depth. Thus, several successive hydraulic benches in deep placers may yield, from grass roots to a depth of 100 feet or more, from 5 cents to 20 cents per cubic yard, while the lower or bed-rock stratum will yield from $2 to $6 per cubic yard. In many cases surveys are not made, and the returns are the results of "guessing." The highest returns of the past season by the hydraulic method, where measurement was made, are stated, on the authority of Mr. James Arnott, of Brandy City, Sierra County, to be $1.50 per cubic yard. In this case the bank was 24 feet in height, and the yield included the lower stratum and the bed rock. The product per miner's inch has come to be accepted as the standard of value or hydraulic ground.

Among the defendants enjoined were a number of parties engaged in mining by the drifting process. The language of the decree so far as it relates to fouling or corrupting the waters of the rivers, applies to quartz-mining as well as to all other descriptions of mining. In this case, none of the defendants were vein miners. The decree was overruled by the supreme court of the State on a technical point which did not affect the merits of the case. The distinctions between different kinds of mining so far as they relate to the beds of water-courses as places of deposit, are distinctions of degree and not of principle. As practiced at present they all foul the waters of streams. The impalpable sand products of quartz mines are borne by currents with the greatest facility and are deposited in places where currents are reduced to little or nothing. The detritus from drift mines differs in quality from that of the hydraulic mines in that the former is composed mainly of gravel of ordinary sizes mixed with sand, while the latter contains in addition considerable amounts of large stones and of pipe-clay. To what extent mining can be prosecuted under the conditions expressed in this decree, remains to be seen. Quartz tailings may certainly in some cases, perhaps in many, be impounded in reservoirs near the mills in a way to conform to the conditions. In drift mines the difficulty will be considerably greater owing to the large volume of detritus, while the existence of hydraulic mining is quite inconsistent with the terms of the decree.

Table showing the yield of gravel per cubic yard of hydraulic mines in California, from Mint report, 1880.

Name of claim.	*Location.*	*Cents yield per cubic yard.*	*Authority.*
American Company	Sebastopol, Nevada County	24.0	Hamilton Smith, jr.
Blue Tent	Nevada County	15.0	R. W. Raymond.
Blue Point (1870)	Smartsville, Yuba County	123.0	Hamilton Smith, jr.
Gold Run (1870)	Placer County	04.8	William H. Pette.
Dardanelles and Aro	Forest Hill, Placer County	13.1	Joseph McGillivray.
McCarty's Diggins	Columbia Hill, Nevada County	43.3	J. D. Hague.
Smartsville Mine	Sucker Flat, Yuba County	19.5	Amos Boman.
Union Gravel Mine	Empire Hill	15.0	. . . do
Pactolus Gravel Mine	Yuba County	20.8	. . . do
Blue Gravel Mine	. . do	63.0	. . do
Pittsburg	do	41.0	. . . do
Pactolus	. . . do	44.0	William Ashburner and J. D. Hague.
North Bloomfield	. . . do	12.0 to 16.3	Hamilton Smith, jr.
Spring Valley	Cherokee, Butte County	28.0	R. H. Stretch.
French Corral	Nevada County	33.4 to 47.4	Hamilton Smith, jr.
Manzanita	do	27.4 to 33.3	. . do

The above table extends over a period of ten years' operations, but the yield is not averaged, as it has varied from year to year.

Reference may here be made to the civil and social aspects of the controversy between mining and other interests as developed by the litigation which has been in progress for several years, with a prospect of a long continuance. A very important suit is now in progress before a State court of justice. It is entitled the State of California versus the Gold Run Mining Company. It has occupied the attention of the court for two months, and enlisted the services of some of the ablest counsel in the State. Many of the witnesses are among the ablest and best informed citizens of the State. No case could be watched with more interest by all persons concerned with the prosperity of the State. The issue is the right of miners to discharge detritus into beds of streams. A decision can hardly be expected for several months. In 1878 the case of Keyes versus Little York Gold and Water Company and others, was tried in the tenth judicial district of California. The decree enjoined the defendants in this language, namely, that they—

Be and they are each of them hereby perpetually enjoined and restrained from using the bed of Bear River, or the beds of any or either of its branches, tributaries, ravines, or gulches, as a place of deposit, or as a dump or place of discharge for the tailings or debris of their said mines or mining claims or either of them, and especially from using said beds of said streams or either of them as a place of deposit of the tailings from those mining claims known as the Empire, Christmas Hill, etc. * * * ; and they and each of said defendants are further hereby perpetually restrained and prohibited from fouling and corrupting the water of Bear River, and its branches, tributaries, streams, ravines, and golches, with the tailings or debris from their said mines, or either of them.

Natural Denudation.—A comparison of artificial denudation in mining with that due to natural agencies, if it could be fully made, would be a profitable and interesting step in this investigation. Unfortunately, the data for the determination of natural denudation in the Sacramento basin do not exist. A few observations of the quantities of sediment carried by the Sacramento River have been made, but they are hardly in sufficient numbers to form a basis for calculation. As they exist, the portion due to mining and the portion due to natural agencies cannot be segregated. The physical characteristics of the Sacramento basin affecting the question are condensed from the report of the State engineer, 1880. The total area of the Sacramento basin is 24,708 square miles, of which 4,709 square miles are plains of the main valley. The rainfall in the valley may be averaged at 18 or 20 inches. The Sierra Nevada flanks the valley on the east, with an area of 8,298 square miles, the height of range varying from 7,000 to 11,000 feet. In seasons of ordinarily heavy rainfall this region receives from 24 to 102 inches of rain. The Coast Range flanks the valley on the west, with an area of 3,075 square miles. The Range has considerably less height than the Sierra, and the rainfall is much lighter. At the northern end of the plains lies a mountainous district 5,616 square miles in area, within which lies Mount Shasta, 14,400 feet in height. The rainfall here is larger than in any other part of the districts ranging from 30 to 110 inches.

The area drained by Pit River is stated approximately as 2,950 square miles. The rainfall is unknown, but less than on the Sierra. Three-fourths of the area is thus shown to be mountainous, and the greater part of the mountain area is subject to a very considerable rainfall, which perhaps may be averaged for the whole area of mountains at 35 or 40 inches, and for the area of the basin at about 30 inches. The fall of rain is confined to four or five months, and the greater part usually falls in two months. The precipitation in the higher portions of the Sierra is in the form of snow, which is melted in the months of April, May, and June. The Sierras were originally covered with timber. Along the line of the railroad the hills have been stripped; a young growth is taking its place. Along the whole range there is a large destruction of timber, used for mining and other purposes. Much of it finds its way when manufactured to the valley and other markets in Arizona, being floated from the mountains by V flumes. The Coast Range is comparatively without timber. The mean slope of the basin is, by reason of the great mean altitude, very much in excess of that of most rivers, and particularly of large rivers. In Vol. III of the transactions of the Geological Society of Glasgow, Professor Geikie states the times required by natural agencies to remove an average thickness of one foot of rock in each of several drainage basins, as determined by the amount of sediment carried by the rivers which drain them. They are as follows:

	Years.
Danube basin	6,846
Mississippi basin	6,000
Nile basin	4,723
Ganges basin	2,350
Rhone basin	1,528
Hoang Ho basin	1,464
Po basin	729

Applying the Mississippi rate of one foot of rock removed in 6,000 years to the Sacramento basin, which has an area of 24,708 square miles, it will be found that in one year, 4,250,000 cubic yards of rock will be removed. Converting this volume of specific gravity of 2.5 into sediment having specific gravity of 1.9 it becomes 5,592,110 cubic yards. If we apply the rate of the Po, the yearly denudation of the Sacramento basin would be in rock 34,300,000 cubic yards, or in sediment 43,000,000. The Rhone rate would give 21,950,000 cubic yards of sediment, and the Ganges 13,230,000 cubic yards, as the natural denudation of the Sacramento basin. This comparison would be more satisfactory if we could know that the sediment assumed to be carried by the rivers had been carefully obtained. In the case of the Mississippi, the amount carried in suspension was the subject of more than two years' careful observation, the details of which are to be found in the Physics and Hydraulics of the Mississippi River, page 136. The only statement in regard to the sediment carried by the Po, that is accessible to the writer, is that Lombardini assumes the ratio of sediment to water in volume to be $\frac{1}{300}$, this rate having been determined by Ludini. The extent of the observations upon which the statement is based is unknown; the same is more or less true of the other rivers mentioned in the table.

In the case of the Mississippi, the amount carried on the bottom and not suspended does not result from observation. In area and topography there is a noticeable likeness between the basins of the Po and the Sacramento. The areas are 24,700 for the Sacramento and 26,800 for the Po. The Sierra Nevada and the Coast Range correspond to the Alps and the Apennines, both in the fact that they respectively flank the rivers through a great part of their courses, and also in that the Sierra approaches the Alps in altitudes, and resembles them in heavy deposits of snow; while the Coast Range, like the Apennines, delivers its floods with rapidity, and is comparatively free of snow. The Sierra is distinguished from the Alps by greater breadth, owing to which the proportion of mountain to plain is considerably greater in the Sacramento than in the Po. The lacustrine rivers of the Alps have, however, no adequate counterparts in the Sierra. In point of rainfall the basin of the Po probably surpasses the Sacramento. The slopes of the two basins have a fair correspondence. The denudation of timber on the Sierra is in all probability considerably less than that of the Alps. The average rainfall in the basin of the Mississippi cannot differ much from that of the Sacramento, although the mode of occurrence is altogether different,—the downfall in the Sacramento being confined to a few months in the year. The mean slope of the Sacramento basin is very much in excess of that of the Mississippi. This discussion is altogether of too general a nature to lead to a conclusion more definite than this, namely, that the rate of natural denudation in the basin of the Sacramento is in all probability in excess of that of the Mississippi, and probably less than that attributed to the Po. But whatever may prove to be the position of the Sacramento between these limits of 5,592,110 cubic yards of sediment, representing the Mississippi rate, and 43,000,000 cubic yards, representing the Po rate, we cannot, in any event, help being impressed by the comparison which shows the relations existing between the respective powers of natural forces acting in nature's way, and a part of the same agencies controlled and directed by man, both applied in degradation of the earth's surface. The comparison is more striking when, instead of being applied to the whole area of the Sacramento basin, it is confined to the limits of the field of the Yuba, Bear, and American rivers, where mining exists on the greatest scale. The area of the basins of these tributaries is 3,520 square miles, which is one-seventh of the whole area of the Sacramento basin. Under any rate that we can be justified in assuming for natural denudation, even that of the Po, it will easily be seen that the annual mining denudation in these basins is several times in excess of that due to natural causes. To place this in a more specific light, we may recall that the mining detritus annually placed in the three rivers is quite 31,000,000 cubic yards; while the Po rate of denudation applied to the area of the basins would afford little more than 6,000,000 cubic yards per year. These general considerations are calculated to convey to the minds of those familiar with the natural circumstances of rivers as clear a conception of the magnitude of the problem as would be afforded by a study of its details. They explain the accumulations in the river beds, by making it evident that mining operations contribute more material per year than the floods of that year are able to carry. It also becomes plain that if the mining were to cease now, the floods, being able to transport considerably more material than that due to natural erosion, would then be in a condition to attack deposits in the beds, which are comparatively safe so long as the floods are overloaded as they now are.

Changes in Navigable Waters.—The navigable waters are the channels of the Great Bay, and the Feather, the Sacramento, and San Joaquin rivers. So far as the rivers are concerned, we are not in possession of charts of old date, which compared with recent maps would afford an accurate record of the changes that have occurred in the past generation. Nevertheless, the partial records that exist, and well-established facts developed by inquiry and by comparison of statements made by those who by reason of occupation or residence must be supposed to have knowledge of certain facts, are sufficient to enable a fair general comparison to be made of the present and former conditions of the Sacramento River below the entrance into it of mining detritus. As for the San Joaquin River, no evidence is known to exist showing any change of importance in its channels. A gauge has been observed at the city of Sacramento with more or less continuity, since and including the year 1849, which was the date of the great influx of people into California. The gauge readings of the low stage of the river are here given to include the year 1881:

	Feet.
1849, low-water reading	zero.
1869 . . . do	2.9
1874 . . . do	4.9
1875 . . . do	4.5
1876 . . . do	7.1
1877 . . . do	5.3
1878 . . . do	5.5
1879 . . . do	5.8
1880 . . . do	7.4
1881 . . . do	6.5

It may be observed that the low-water plane was raised 2.9 feet in the twenty years succeeding the beginning of mining, and that the next ten years, from 1869 to 1879, doubled the rise of the plane. The table shows a continuous rise, with some anomalies, which may in part at least be accounted for by the different volumes of the river in its low stages. The difference in volume may be accounted for by difference in rainfall, and also by the influence due to the amount of water contributed from the storage reservoirs of mining companies. A local change in the slope of the river may also be due to variations in the amount of detritus deposited in the Sacramento by the American, which joins the main river at Sacramento. Notwithstanding these variations, the conclusion is plain that the low-water plane at Sacramento has been raised about 6 feet since 1849. As a consequence of the elevation of the bed, the tidal influence which in 1849 extended at least as high as the mouth of the Feather, 25 miles above Sacramento, and was quite 2 feet at Sacramento, is now no longer noticeable above Heacock Shoals, 9 miles below Sacramento.

The tide within the past thirty years rose on these shoals as much as 3 feet. Corroborative evidence of the rise of the bed is afforded at the Russian Embarcadero, 10 miles below Sacramento, which in old times was 3 feet out of the water in the low stage. In 1878, it was found to be 1½ feet under water, showing a rise of surface of about 4½ feet. This is confirmed again by the level of the low-water of 1852, which was fixed at Greene's Ferry, 3 miles above Courtland, by the level at which the branches of a tree were cut off in that year for the accommodation of the ferry boat. This level is 4 feet below low water of 1878. Confirmation of like character is afforded by trustyworthy circumstances needless to record, occurring at the Hog's Back and at Ida Island. The State engineer gives the changes of level in 1880 as 5 to 5½ feet at Sacramento; mouth of Feather, 3 or 4 feet; head of Steamboat Slough, 1½ to 2½ feet. The rise of the low-water plane indicates filling not so much in the pools of the river as on the shoals. All of the shoals below Sacramento have been bored, and samples have been collected under the direction of this office. The deposits are found to be chiefly mining detritus. We may fairly assume that the filling in the pools has at least kept pace with the rising in the low-water plane. This assumption, which is much within probability, and within facts so far as they are known, would make a general filling of the bed between the Feather and Sacramento, a distance of 25 miles, to be 5 feet, and for the 60 miles below Sacramento an average of about 3 feet, to which is to be added the deposit in Steamboat Slough. The State engineer compared a survey of 1854, made by direction of the town council, by the city surveyor, of a portion of the river 2 miles in length in front of the town of Sacramento, with the condition of the river in 1879.

The maximum filling was 25 feet and the average 15 feet. (State Engineer's report 1880, page 31.)

Specific information of this kind for the river as a whole is lacking, therefore no means exist for obtaining an estimate in any detail of the aggregate deposits in the Sacramento River made during the last thirty years. They can only be generally inferred from known facts. Twenty-five miles below Sacramento the river divides into two delta channels, which unite below, the intermediate distance by two channels being 18 miles by Old River, and 12 miles by Steamboat Slough. In the earlier days of navigation and until six or eight years ago, Steamboat Slough was the channel used by all boats and vessels. It is now obstructed by shoals and at low tide carries only about 4 feet, so that its navigation is now for the most part abandoned. Old River is now the navigable channel. The depth on the bars of the river at low water does not appear to have been diminished to a great extent, but the expulsion of tidal influence in whole or in part has resulted in a decrease of effective depth. As the slope of the river increases, it is plain that the low-water discharge will afford a constantly diminishing depth. The decrease on the bars produced to this time has been masked by the absence of tide. As the scouring influence of the tide is diminished, the tendency to deposit is increased. Above the city of Sacramento as far as the Feather, although the deposits have been large, the effective depth appears not to have suffered to any great extent, if at all. The slope in this reach has probably not been much changed. It would not be changed if we supposed the elevation of the surface at the mouth of the Feather to be just equal to that at the mouth of the Sacramento. This may be the case, for although the Feather is the outlet of a more extensive mining field, the main Sacramento into which it empties is at and above this point free of mining detritus. For this reason the minor output of the American may be able to maintain at Sacramento a rise of bed equal to that produced by the Feather. However this may be, the best accessible testimony indicates that there has been no change of effective depth between Sacramento and the mouth of the Feather worthy of notice. The width, however, of portions of this stretch of the river has been considerably diminished. Large deposits of fine mining detritus 10 or more feet above low water, and covered with willow growths, now form the banks for considerable distances, the old banks in rear being indicated by the growth of heavy timber. This is a regulation of the river-bed by the influences of nature, which could not have occurred except for the loads of sediment in the river. The Feather River low-water level at Marysville, the head of navigation, has been raised about 15 feet. The rise in level at the mouth, 30 miles below, is given by the State engineer, already quoted, 3 or 4 feet. The description of the mouth of the Feather, given by the Wilkes exploring expedition, indicates more filling at the mouth. Investigations made by this office in comparing present with former depths on Fish Slough bar and the middle ground, both being in the Sacramento River above the mouth of the Feather, prove quite satisfactorily that in 1878 the filling at the mouth of the Feather was fully 5 feet. At present it can be no less. Taking 15 feet at Marysville, and 5 feet at the mouth, the difference, 10 feet, is to be added to the old fall. This increases the slope of the Feather in its navigable part 4 inches to the mile. This increase has impaired the depth of water and the practicability of navigation to a considerable extent.

Applying to the navigable portion of the Feather the rule adopted for the minimum deposited in the Sacramento, namely, that the average filling is equal to the elevation of the plane of low water, we will have for the thirty miles, from Marysville to the mouth, an average depth of ten feet over the bed of the river. This estimate is thought to be here, as in the Sacramento, considerably below the fact. As a consequence of these changes a higher flood line and greater exposure to overflow now exists for all riparian lands on both these rivers. This is an element of considerable loss to the country, but its description and discussion do not come within the limits of this investigation. The steepening of the slopes when they are low, as they necessarily are in navigable streams, is in the direction of the fulfillment of the condition essential to enable the river to carry the material delivered to it. The steady increase of elevation of the lower water-plane at Sacramento indicates that the relation now existing between slopes and sediments is not that of stable equilibrium, and for the present we must look for the continued increase of slope. If we suppose the weight of sediment presented to the river for transportation to be increased, an increased rate of steepening in slopes must be anticipated. The elevation of the bed of the river is not accompanied by an equal rise in the river banks. The level of the beds approaches more and more the level of the bank. In the cases of the Yuba and Bear, non-navigable streams yet to be described, the level of the beds has risen from a depth a number of feet below the banks to an elevation of several feet above the banks. These instances may be taken to illustrate the ultimate condition of the Sacramento and Feather rivers, under a continuance of the influences to which they are now subjected. The abandonment of existing channels is a consequence to be apprehended. The information that has been obtained in regard to the channels of the bay, results from a study in obedience to a resolution of the House of Representatives, of the 12th of June, 1880, which called for a report upon the causes tending to diminish the tidal area of the bay and the commercial value of the harbor of San Francisco. The report made in obedience to this resolution was published by the House of Representatives, Forty-sixth Congress, third session, Ex. Doc. No. 93. The main facts are here reproduced:

1. A careful comparison of the charts of San Francisco entrance bar, made in 1855 and 1873, shows that the bar had suffered no injury in that interval.

2. A comparison of surveys of the ship's channel of a portion of San Pablo bay, made in 1855, 1863, 1878, shows that between 1855 and 1863, no deposits of much importance were made in the channels. The surveys of 1863 and 1878 are distinguished by a deposit of 76,025,000 cubic yards made in the interval. The depth of deposit averaged over the area of comparison 24⅓ square miles, would be 3.1 feet. The deposit, however, did not occur in the shape of a layer of uniform thickness. It occurs mainly on the flanks of the channel, and has the effect to narrow the channel without

affecting to any noticeable extent the ruling depth. The mean reduction in width of channel between the 18-foot contours obtained by comparison of six cross-sections, is 2,820 feet, which is 22 per cent. of the mean width of 1855. This comparison includes only the channel. The shoal-water areas were necessarily excluded from comparison, owing to the fact that no survey of them has been made since 1855.

3. A comparison of maps of three and a half miles on the Sacramento near its mouth and one mile at the mouth of the San Joaquin, shows a deposit of 2,000,000 cubic yards in the Sacramento, and 500,000 in the San Joaquin between 1867 and 1878. The comparison of charts of Suisun Bay made in 1867 and 1878, shows an extension in area of the shoals, which have not yet been measured in a detailed way. A comparison of charts of Carquinez Straits, during different dates indicates the formation of large deposits in recent years. No opportunity has offered as yet for the investigation of the origin of the deposits in the bays. It would be possible to determine by a sufficient number of samples taken from each locality, whether the deposits are mainly due to either of the two great sources of erosion, the artificial due to mining or the natural. It is to be presumed that both causes are represented in these effects.

Deposits of Detritus in Tributaries of Navigable Waters.—The Yuba and Bear tributaries of the Feather, and the American, a branch of Sacramento, present to inspection large deposits of detritus in their beds and on adjoining alluvial lands. These are in places of temporary lodgment, where they are left by one flood and removed in greater or less degree by the succeeding one. Each movement carries a quota into the navigable streams and maintains the features of these rivers that have been described. The loci of these deposits are determined by the circumstances of the case, among which may be mentioned the character of the detritus as to size and weight, the volume of flood waters and the natural grades of the river beds. Differences of circumstances correspond to widely different localities of deposit. The cañons of the three forks of the Yuba are distinguished by heavy natural grades. The mines on the Yuba afford a large supply of fine material, and the flood discharge is large; consequently we find the upper cañons quite free from deposit, which begins to be important only where the three forks unite to form the main Yuba. On the Bear a great proportion of heavy material is deposited near the head of the river, about and above Dutch Flat. The river does not head in the high Sierra, and, therefore it has not the same flood characteristics as the Yuba. We find a very large and increasing deposit in the vicinity of the mines themselves. In 1879 Professor Pettee found the bed of the Bear, at the crossing between Dutch Flat and Little York, to be 97 feet higher than 1870, and that in the same interval Steep Hollow, between Little York and You Bet, had risen 136 feet. (Volume II., page 425, Auriferous Gravels, by Prof. J. D. Whitney.) The best information available leads to the opinion that the Bear River here is filled 150 feet in depth; Steep Hollow, 250 feet; and the Greenhorn, at the crossing of Nevada and Dutch Flat Road, 200 feet deep. Where the detritus, consists, in part, of heavy cobbles or larger stones, it is supposed to remain where deposited, or at least to be moved slowly. It thus forms a barrier which serves to impound above it a mass of gravel, which otherwise would have traveled further down stream. The steep grade of the Bear River bed below the Dutch Flat dump may be taken to be that which the floods in this stream require to give motion to the heavy material there deposited. The average grade from Dutch Flat, for 10 miles below, to Nevada Railroad bridge is 55 feet to the mile, being about 30 feet at the lower end, and presumably 80 feet at the upper. Over all this distance the cañon is filled and graded—cobbles and large stones above, with diminished sizes below. With the exception of about 11 miles, the river bed is filled from Dutch Flat to the mouth. Below the Nevada Railroad bridge, wherever the grades are in the neighborhood of 25 and 30 feet to the mile, there are large deposits; and where the grade is 40 feet, the amount is noticeably decreased, while in the 11 miles already mentioned as free from deposits, the grade varies between 80 and 140 feet in the mile. On any such grades as have been mentioned, the deposits are mainly of gravel and cobbles, with comparatively little sand. The great reservoirs of sand lie at the exit of the river from the foothills and on the plains below, where the deposit is widened in resemblance to, but not to the same extent as on the Yuba, with grades of from 8 to 5 feet to the mile. Attempts have been made by various parties to estimate the volumes of these deposits. Such attempts must be regarded in the light of conjectures. The circumstances do not permit estimates in the true sense to be made, except with great outlay of time and money. In the case of Keyes *vs.* Little York Gold Washington and Water Company evidence was given by several experts, placing the amount of deposits in the Bear River, above the plains, as 86,000,000 cubic yards, and below the foothills to the mouth 36,000,000 cubic yards; total, 122,000,000. This was in 1878. Similar estimates by Mr. Manson, reported to the State engineer, give the estimated deposits, in 1879, on the Yuba above the foothills as 48,462,100 cubic yards, the great bulk in 8 or 10 miles; and below, 23,284,000; a total of 71,746,100 cubic yards. In the light of later information, it seems probable that this estimate is altogether too low, the deposits in small tributaries not having been taken into account, and the amount in the lower river having been much underestimated. The actual amount is not capable of being ascertained, and the statements are given merely for purposes of illustration. At its escape from the mountains, where the foothills recede and give width to the plain, the Yuba spreads out its load of sand and gravel over a plain of 15,000 to 16,000 acres, which has risen until it now stands above the level of the adjoining country on either side. This plain has a slope of about 10 feet to the mile, varying above and below this limit as you ascend or descend the river bed, being 15 feet at the foothills and 5 feet at Marysville, 10 miles below. The sizes of material have some correspondence to the grades. Ascending the stream one passes to a continually increasing average size of material. While it is nearly all sand below, above it becomes nearly all gravel, with, however, considerable admixtures of different sizes everywhere. This eruption from the mountains has destroyed thousands of acres of alluvial land. The State engineer, in 1880, estimated that 15,220 acres had been seriously injured by these deposits from the Yuba. On the Yuba the great deposits of gravel are found on a grade of 30 feet to 20 feet to the mile. The sands predominate greatly in slopes of 10 feet and below. On grades greater than 40 feet to the mile the cañons are generally quite clear of material, unless it be stones of considerable size. The forks which have been alluded to as quite free from deposits have grades generally exceeding 50 feet to the mile. Mr. Manson supplies the following information in reference to the American River:

The American, a tributary to the Sacramento, presents the following general features and characteristics:

Its water-shed extends to the summit of the Sierra Nevada, and is drained by three principal forks. The northern one of these is the recipient of a large amount of detritus and is much filled up, down to its junction with the Middle Fork. The depth of this deposit is variously estimated; the maximum depth is probably as much as 100 feet. The volume is, as in other instances, a matter of conjecture, but probably does not fall far short of 20,000,000 or 25,000,000 of cubic yards.

The grades upon which this material has found lodgment vary from 46 feet per mile in the upper reaches, where coarse material is lodged, to 23 feet per mile where finer material has been carried. This latter grade is found in a portion of the canyon some 20 miles in length. In this there is economical storage.

After the North and Middle forks join the grade is about 22 feet per mile; the large volume of flood-water sweeps all material out of the canyon of the American, only the coarsest finding lodgment in protected places, and equalizing the inequalities in the original grades. These grades, although lighter than those above, upon which material has lodged, have a larger volume of flood-water passing down them, and hence no deposits of moment have occurred.

The Middle Fork is not so much filled as the North Fork, as hydraulic mining is not so extensive upon it.

The grades in its lower reaches are somewhat less than upon the North Fork, and the canyon is of greater lateral dimensions. Although this portion of the river is suitable for storage, such use is entirely prohibited by the existence of valuable mines in and near the bed of the river, whose destruction would be caused by the storage of debris in this portion of the river. The upper portions of this stream have not been examined for more than 8 or 10 miles farther; here the grades are about 45 feet per mile, and the canyon narrow. Storage is available here for the coarsest material from above.

The South Fork is practically clear of debris; that which has been discharged into it has been of a different character from the bulk of that discharged into the rivers farther north.

The application of the hydraulic process to the ancient river gravel is limited, owing to the lava covering the greater portions of the ancient channels; those portions which were exposed under the edges of this lava cap have been nearly exhausted. Decomposed slate, carrying quartz veins, is extensively mined by the hydraulic process, but the hardness of this material limits the quantity moved in a given time, and the shape of the particles of slate prevents them from being easily transported; hence a larger proportion of the waste products remains on the dumps and in the small tributaries. The finer detritus from the mines in the basin of the South Fork forms an excellent soil, as is shown by the deposits intentionally caused by parties owning land upon which this material can be diverted; its desirable quality can be easily predicated, from the fact that there is a great deal of the surface soil washed.

From the mouth of the canyon to the Sacramento River there have been some 6,000 acres of land covered, and 25 or 30 miles of river-bed, from 200 to 400 feet wide, raised from 5 to 30 feet.

The deposits in the Lower American do not admit of being restrained in the bed of the stream by means that are considered practicable under present circumstances. The amount cannot be specifically stated, but from what precedes it may be conjectured to be twenty or more million yards. The deposits in the upper cañons of the Feather appear from Mr. Manson's account to be very limited. At and below Oroville, however, they become very extensive, in positions where it is difficult if not impossible to exercise control over them. They are a constant injury to the navigable waters below. Being beyond the range of practicable restraints they are foreign to the purposes of this report. Lieutenant Payson estimates the volume of deposits in the bed of the Cosumnes River to be 6,000,000 cubic yards, and the maximum depth of filling to be 20 feet. Reference to his report will show that the same state of affairs exists in all the rivers south of the Cosumnes to the Merced, the degree, however, being very much less than that shown to exist on the Yuba, Bear, and American.

Gravel Workable by Hydraulic Process.—The quantity of auriferous gravel now remaining on the flanks of the Sierra Nevada is practically unlimited. If it were all workable its exhaustion would task the energies of miners for many generations. No practical end could be served by an attempt to estimate the aggregate mass. For several good reasons only a comparatively small portion of the whole can be regarded as workable under existing conditions. The workable quantity in several basins is in a certain sense subject to estimate between limits in an approximate way. Such an estimate is very desirable in order to give a basis for an opinion as to the extent, cost, and duration of any system which may be adopted for the purpose of remedying evils consequent upon mining. The estimates that follow are thought to be sufficient for the present purpose, and any considerable errors that may be found in them can be corrected in the future by more accurate information. All the gravel which will pay a profit under hydraulic processes may be regarded as workable.

Under the most favorable circumstances it is Professor Whitney's opinion that gravel yielding $4\frac{3}{4}$ cents per cubic yard may be worked at a profit. Abundance and cheapness of water are essential, as well as favorable outfall. (Page 371, Auriferous Gravels.) This, however, must be understood to apply only to the light top gravel, which is readily moved. The yield must be much greater to give a profit in the lower portions where bowlders and cemented gravel are frequently encountered. The hydraulic process may be unprofitable, because the gravel does not contain sufficient gold, or because it is overlaid with too much or too hard a capping, or because the outfall is insufficient, or because the supply of water is not at hand. If the gold is found in a pay streak close to the bed rock, it may be more profitable to stope out the pay gravel than to wash the whole superincumbent mass by hydraulic process. Generally speaking, working is a question of richness. If there is no outfall the hydraulic process cannot be applied. If the gravel is rich enough, and there is an outfall, capital can supply all that is required to apply the hydraulic process. Keeping this in view, the approximate estimates of gravel tributary to the Bear River and to the North Fork of the American, contained in Appendix 3, will be intelligible. It will be observed that the material in each of the mines is classified particularly as to size, as cobbles, gravel, sand, lava, ashes, &c. The object of this classification is to afford a basis for calculating amount to be stored, it being generally assumed that the cobbles and bowlders will not be carried far from the mines. It is thought to be safer under our present knowledge, or rather want of knowledge, to regard the whole mass requiring storage, including both the portion which by reason of its fineness is incapable of storage and the heavier portion, which, perhaps, may never reach the reservoirs. We thus make compensation for any error in the underestimation of material. The estimates for the Bear River and the North Fork of the American are based upon an inspection of each mine, but not on the instrumental measurements, which the funds available did not permit to be made.

It appears that the territory tributary to the North Fork of the American contains of workable gravel 75,190,010 cubic yards. In the first-named district are the Gold Run and Iowa Hill Mines. In illustrations of differences that throw more or less discredit on all the estimates of this kind, which, at best, are rude approximations, reference is made to Professor Pettee's conclusions in regard to Gold Run Mine in 1870. (Page 147, Auriferous Gravels.) He estimates the amount washed off south of the railroad at 43,000,000, and the amount remaining at 86,000,000 cubic yards; and adding other claims not yet touched, the gross amount to be mined becomes 125,000,000 cubic yards. In the testimony recently given in the case now under trial at Sacramento, The State of California *vs.* The Gold Run Mining Company, the State engineer gives the amount washed off to date as 52,440,000 cubic yards. Other witnesses estimate the amount remaining in the Gold Run Mine variously from 18,000,000 to 22,000,000 yards. In 1870 Mr. Goodyear estimated gravel to be mined at Iowa Hill at 26,000,000 yards. (Page 119, Auriferous Gravels.)

Mr. Larson's estimate in 1881 is 6,388,800 cubic yards, which allows for nearly 20,000,000 washed between 1870 and 1881. On the ridge south of the American and between it and the Cosumnes, Mr. Manson reports that practicable hydraulic mining is about exhausted. The gravel deposit from Placerville to Sportsman's Hall, 14 miles in length, is lava-capped to depths of 20 to several hundred feet, and the mines are now worked up to the edge of the lava. The lava is regarded as a bar to further use of the hydraulic process. There is, however, a large field for drift mining. In 1870 Mr. Goodyear estimated the quantity remaining subject to the hydraulic process near Placerville, at about 50,000,000 cubic yards. (Page 120, Auriferous Gravels.) Mr. Manson supplies the following information in regard to the gravel deposits on the Georgetown divide, which lies between the South and Middle Forks of the American. Gravel deposits worked on the Georgetown divide are—

(1.) Volcanoville.
(2.) Mount Gregory.
(3.) Rubicon.
(4.) Mount Hope.
(5.) Mount Ross.
(6.) Jones Hill.

All discharge directly or indirectly into the Middle Fork.

Of those *Mounts Hope* and *Ross* have not been worked for four years although belonging to a company having an abundance of water. This deposit is lava-capped. *Jones Hill* has exhausted its claim on the south side of the deposit, and the water has been turned to the north side and preparations made for opening work; claim to have from 400 to 500 inches for nine months in the year. Deposit limited, and lava-capped. The amount on the Forest Hill divide tributary to the Middle Fork of the American has not been ascertained, even approximately. The yearly contribution of detritus is stated by Mr. Manson to be about 2,500,000 cubic yards, and includes that from the south side of the Middle Fork.

The deposit on the San Juan Ridge, between the South and Middle Yuba, is, for several reasons, the most important in the State. It is much the largest deposit, and it lies very favorably for working, the beds of the ancient rivers being elevated some hundreds of feet above the beds of modern streams. The floods in the Yuba may be relied on to carry away the gravel, which is generally light in character. The canal and reservoir systems are more developed than in any other portion of the State, and the yield of gold is greater than that derived from any other equal area. An approximate estimate of the quantity of workable gravel on this ridge was made in 1876 by James G. Hague. The quotation is from a printed report on the water and gravel mining properties belonging to the Eureka Lake and Yuba Canal Company:

The linear extent of the gravel channel and its branches on this ridge is about 25 miles. Deducting liberally for the portion already worked and for that too deeply covered by lava to be available for hydraulic mining, there remain probably not less than 14 miles of channel available for washing, from which only a comparatively small portion of the top gravel has been removed. Below San Juan the gravel body has a surface width of over 1,000 feet, and is, say, 140 feet deep. From Badger Hill to Bloomfield it is for the greater portion very much wider and deeper. At Columbia Hill its surface width varies from 3,000 or 4,000 to 8,000 feet, and it is from 300 to 600 feet deep. The gravel at Lake City is probably 300 or 400 feet deep. At North Bloomfield it is opened to the bed-rock, showing a depth of more than 300 feet. Roughly estimating the average width of the remaining gravel range at 400 yards, and after allowing for the portion worked off, placing its average depth at 70 yards, the sum is an average of, say, 50,000,000 yards per mile, or for 14 miles, say, 700,000,000 yards.

Allowing for the amount washed since 1876, 100,000,000 yards, there remains 600,000,000 to be removed. The working of the lower lying deposits at Columbia Hill will, however, require the driving of a tunnel between two and three miles in length. It may be regarded as doubtful whether under existing circumstances a work of this magnitude will be undertaken. The terms used in the description indicate that it is only approximate, but, while this is the case, no one has attempted a correction, and in the treatise on the Auriferous Gravels, by Prof. J. D. Whitney, Mr. Hague's estimate is adopted. The best information in regard to the extensive mining property of the Excelsior Water and Mining Company, at Smartsville, is derived from reports made in 1879. This property consists of 525 acres of mining ground, which contained, according to Professor Pumpelly, 76,500,000 cubic yards of gravel. Mr. Janin's estimate was 75,000,000 cubic yards. This is expected to produce per cubic yard 25 cents by Mr. Janin's estimate, and 34 cents according to Professor Pumpelly. The lower of these estimates being fulfilled will make the working very profitable. There are other deposits about Smartsville, in regard to which no definite information has been obtained. There are also deposits in the basin of the North Fork of the Yuba, which are noticed in Mr. Manson's appended report, the cubical contents of which we have not the means of stating. They are, however, of much smaller dimensions than those already enumerated. Seven hundred millions of cubic yards may be assumed to represent the amount of gravel, workable by hydraulic process, tributary to the Yuba.

By the estimate carefully considered the quantity of gravel workable by the hydraulic process is, in the Bear and tributaries, in round terms, 50,000,000 cubic yards, which is a comparatively small proportion of the whole amount. The choking of the beds of the river and the tributaries, which are the outfalls of the mines, explains the small amount of the estimate. The debris from the Dutch Flat Mines is unusually heavy, and forms barriers in the river beds which impound a large amount of detritus above. In the Quaker Hill mines the lower gravel can only, under present circumstances, be worked by drifting, there being no outfall for sluices. The top gravel is stated (page 425, Auriferous Gravels) to yield 6⅝ cents per cubic yard. This rate will yield a profit. When the hydraulic process is not applicable, mining may in special cases be continued by drifting. This method is followed in some of these mines. The amount of detritus thus produced is a small percentage of that due to the hydraulic process.

Mr. Manson refers in his report to the prospect of new properties being opened on the Upper Feather, in positions where it will be difficult, if not impossible, to provide restraint for detritus. As for the existing mines on the Feather, it appears that the groups on the upper waters already find natural storage for their detritus in great part, and so long as this condition is fulfilled, the magnitude greater or less of the operations need not be considered.

On the Lower Feather, near Oroville, there are considerable bodies of gravel, the amount of which is not known. It will be seen by Mr. Manson's report that he was unable to find storage for the product of these mines. Lieutenant Payson furnishes the following information in regard to the Cosumnes and rivers south of it. At "Hill Top," on the Cosumnes, the superintendent told me that an estimate had been made, based on their previous rate of working; that they had gravel enough remaining to last from ten to eleven years. I was able to make here a very close estimate of the duty of an inch, stated in my report of last year as 2.4 yards. This, with the water supply of the mine, would indicate for the remaining gravel between 11,000,000 and 12,000,000 yards. From its source this is probably a liberal estimate for the mine, and since it is the only one of any consequence on the river, will probably cover the remaining supply for it; also Jenny Lind mine on the Calaveras. The water supply now is 550 inches for six months in the year. They expect to get soon 1,000 inches throughout the year. The superintendent estimates the gravel remaining as sufficient for twenty-five years at their present rate of progress, or fifteen years with their expected increase in facilities. From the circumstances of the case I think this estimate is made with care. As they probably move from 800,000 to 1,000,000 yards per annum now, this would correspond to a remaining supply of say 22,500,000 yards. This will probably all be worked, and can be safely said to include the total remaining supply for the lower river which lies in such a position that it can be worked. There remain enormous additional amounts in the deposits about Mokelumne Hill, but as described elsewhere they are not favorably situated for working, and the cessation of hydraulic operations for this reason will precede by a long time the exhaustion of the gravel supply. No approximation can be given by me to the quantity now available. The remaining deposit of consequence is found in the newly opened mine at Dogtown (Juniper County). This has not been developed, but promises to be extensive, and has good facilities for working. The only other large mine now in operation on the southern rivers is that at La Grange. This has probably, since it began, moved over 16,000,000 yards. The space left by this removal seems but a small fraction in the area of the remaining deposits. The superintendent told me they considered their supply of gravel as "inexhaustible," but the facilities for working it very bad. The Golden Rock Deposit on the upper Tuolumne I did not see. Its owner told me that the deposit was 10 miles in length and the beds 100 feet deep in places. The aggregate amount of gravel not subject to the hydraulic process, but workable by drift mining must be considerable, and the development of this kind of industry promises to take greater proportions as wages of miners become less. It is probable that this description of mining will continue for several generations.

Remedial Measures.—The statement of the case presented in the preceding pages seems to establish the necessity of measures of remedy or alleviation, even in the event that no further contribution be made to mining detritus in the beds of streams. We may now inquire whether any remedy is practicable and general for all mines and all circumstances, or whether there are mines producing detritus or existing deposits of detritus, so situated as to be beyond the application of a remedy. Mention has been made of basins lying near the Feather and American rivers, the surfaces of which are below the level of average stages of the rivers. It is in some cases possible to direct streams from their present courses and turn them into the low-lying lands, with the effect to make a place of deposit for mining material. Diversion of the rivers in all their stages is essential to this project. Partial diversion or separation of seams into parts, by lessening the transporting power, would aggravate present evils. The present objections on account of expense and other considerations are sufficient to make us defer further reference to the project. If, however, in the future it shall become desirable to undertake a fuller consideration of the scheme, account must be taken of the fact already established that the mining streams are not generally able to carry to these basins in a year anything like the full amount of detritus which they receive. It is in consequence of this fact that their beds when inclosed by high banks are rising year by year, and when not so inclosed are undergoing obliteration. The preservation of river beds and routes of drainage requires that effective restraint be imposed upon mining detritus. Otherwise these drainage lines may be expected to suffer the fate which overtook their prototypes, the Pliocene rivers, which are obliterated by enormous deposits brought down by their own currents. It may be added that the conservation of existing facilities for navigation equally requires restraint of the flow of sand and gravel and that no important improvement of the channels can be expected until this result shall be secured. Under all circumstances, restraint is the first and essential step to any projects whether of alleviation, conservation, or improvement. It has been shown that in the beds of the American, Bear and Yuba there are now lying many millions of cubic yards of material, in positions where it is comparatively harmless, and that each year as a rule adds something to the volume of these deposits, but that whether anything is added or anything subtracted, which is sometimes the case, depends upon the volume and power of the floods. As a rule the mines supply more material annually than the floods are able to transport over the grades in the lower portions of the rivers. If the floods were of sufficient duration, the accumulations would be formed lower down, and in more dangerous positions. Instead of lying in the bed of the Yuba, they would be in the Feather. Taking the Yuba as an instance, the great deposits of finer grades of material are near and below the foot-hills on slopes of 10 feet or less to the mile. The heavier classes of material are found in greater abundance higher up the streams on grades of 20 or 30 feet to the mile. Now if we place across the river beds barriers some feet in height, the slope of the bed above will be reduced, and with it the transporting power of the water. The deposits now taking place will be aided and increased. When the material is gravel and sand, the river bed will be filled to the crest of the dam and be graded back on a slope determined by the nature of the material, the width of the channel, and the volume of the floods. This proposition is not only in harmony with principles of hydraulics, but it is abundantly proven by results of experience on the Bear and American rivers.

When the banks are sloping, as is the case generally in the cañons of the mountain streams, the elevation of the bed increases the width. These slopes are more generally 35°, and an elevation of the bed of 50 feet adds 140 feet to the width. This extended width reduces the heights of floods, the cubes of the heights being proportional to the squares of the widths. Doubling the width reduces the height one-third. The reduction in heights of floods is an important gain in two respects. It reduces the suspending power of the water, and in this way and to some extent favors the deposition of material. It also reduces the exposure of the structure in floods. Another important feature is the increase of the storage volume, consequent upon this increase of width. A permanent structure will make permanent storage, for the reason that it will prevent the river at any time from eroding the deposits to the original bed, which otherwise would take place sooner or later. It may be asked whether the protection afforded in this way will be complete, and include all grades of mining tailings. This cannot be claimed. The suspensory matter of fine sands and clay cannot be restrained in this way or by any other method which does not provide a settling basin in which the water can be maintained in a quiescent state for some time. It may also be expected that during the flood stages in the early period of development, a certain portion of material of every grade may be suspended, and thus pass the crest of the barrier, but it is to be remarked that as the width is increased the suspensory power is diminished, so that the degree of protection becomes greater as the system is developed. We can imagine a condition of a river when comparatively little is carried suspended, and nearly the whole of the material transported is rolled in waves on the bottom. This condition is more and more approached as the dams are raised. It seems therefore to be good policy to give the first dam in the cañons considerable height. It will be understood that permanent protection can be attained only by building dams in proportion to the amount of detritus turned out by the mines. The system must be continued at least as long as the mines are worked. If this system of restraint had proceeded *pari passu* with mining during the past thirty years it can hardly be doubted that the condition of the country affected would to-day have been much better than it is. A system begun now is obliged to deal not only with the current action of the mines, but is also compelled to contend with the accumulated difficulties of thirty years. The same principles apply to the large deposits of finer materials that are found in the plains, particularly on the Yuba and Bear. A considerable mass of detritus has, however, reached positions in which no control can now be exercised, but so far as barriers can be applied to hold the sands in their present position it is thought that they ought to be constructed. In particular mines it is impossible to store all the detritus before it reaches the river-beds, and perhaps in many cases partial storage is possible. It is needless to remark that this kind of storage ought to be insisted on whenever it is practicable. The amount of storage that will be secured by a barrier of given height is in our present state of knowledge to some extent indeterminate. It depends in any case directly upon the grade of equilibrium which the material takes behind the barrier, and this cannot be regarded as constant, for it must depend upon the violence of floods, in which respect there is much variation. It cannot be doubted that as the bed is widened and the height of floods thereby reduced, material of a given size will be found to be in equilibrio on a grade steeper than that of equilibrium in the original bed. This secondary effect of width shows that the storage prism will grow in a greater than arithmetical ratio as the dams are raised and the widths increased. The barriers or dams, to be permanent, must be made of stone in all exposed parts. If wood is used it must be in circumstances where it will be kept wet. In the canyons the dams will consist of a mass of stone blasted from the side hills and deposited with only sufficient care of arrangement that no continuous currents can be established through the structure, and that the velocity of the water shall be broken by repeated falls. For purposes of estimate, the dams are protected with slopes of 1 upon 1, and one upon 4, above and below, respectively, but an arrangement of stones on the lower face to an uniform slope would be a serious error in construction. The more this slope can be broken by falls and the rougher its outline, the more effectually will the destructive action of the water in severe floods be counteracted. In order to fulfill these necessary conditions, it is essential that the quarry shall supply large stones, the larger the better, for exposed positions, and smaller grades to measurably fill the interstices of the larger. Where the foundation is natural rock, it is proposed to use only stone, but in cases where the foundation is gravel or sand, a grillage or mattress of timber or brush will be required to prevent settlement. The purpose of barriers or dams being to restrain sand and gravel, and not to impound water, it is not essential that they shall be impervious, nor can they be water-tight. Being unable to store water, it is impossible to conceive them, in the event of breach, as capable of inflicting disaster upon riparian inhabitants below. Nor could a breach cause an unusual flow, to any great distance, of detritus in a given flood, for the reason already established, that floods are now fully loaded with all the material they are able to carry. The result of a breach, however serious, could therefore be only to restore conditions now existing. Moreover, it is impossible to conceive sudden and wholesale disaster overtaking one of these structures. They may settle, and their usefulness may be impaired, but being simply a mass of large rubble stone without bond, disaster cannot take great proportions or be an element of sudden danger to persons or property. In cases where brush or timber is much cheaper than stone, it will be permissible to use it more freely and make a considerable part of the structure of this material—after covering it with stone. The moisture below the surface of the river-bed may be relied upon to keep the wood wet, and the covering will protect it from the rays of the sun. It may be well to say that while structures for the same purpose have been used in the Alps and Appennines, there has been no occasion elsewhere to require dams of the same dimensions. They are to this degree novel, and their exposure in floods may require attention and expense in repair. The site for the dams ought to be such as will give the maximum storage above, and to this end, the larger the area and the lighter the grade of the river the better will be the position. This system of restraint has been put in operation in a partial and insufficient way by the State of California, in the construction of two brush dams, one in Bear and the other in the Yuba, at the edge of the foot-hills. They were described in the report of January 10, 1881. On this date they were standing intact and doing good service. Later they both met misfortune, and considerable portions of each were carried away. A report of their condition in the summer of 1881 will be found in Appendix 3. They have not been repaired, the State having relinquished any attempt to deal with the engineering features of the case, owing to the unconstitutionality of the act of the legislature under which it was acting.

By a comparison of survey in 1880 and 1881, it was found by the office of the State engineer that 4,851,000 cubic yards were impounded above the Yuba dam. Above the Bear River dam 961,000 cubic yards were impounded. These dams serve the purpose of controlling deposits on the plains to a certain and beneficial degree, and it is thought that good policy requires them to be repaired and raised. Perhaps, subsequently, they ought to be covered with stone. In the application of this system it will be plain, from what precedes, that the Yuba presents the case, of greatest necessity, and requires the greatest storage volume. The American and Bear also require the system. As to the Feather, it appears from the report of Mr. Manson, hereto appended, that the canyons of the Feather are unsuitable for storage, and, what is quite satisfactory under the circumstances, that the extent of mining on its upper waters, and the amount of injury resulting therefrom, are not of such a character as to require remedial measures. It is not so, however, with the mines on the lower Feather, in the neighborhood of Oroville. These mines discharge into the Feather at points below which there is no opportunity to store the detritus.* A group of mines 12 miles north of Oroville, at Cherokee, the principal of which is the Spring Valley mine, at present need no attention, for the reason that they do not contribute to the navigable water any material capable of being stored. The heavier material is stored below the mines, at the edge of the foot-hills, and the remainder is deposited on lands lying between the mines and the Sacramento River. It is thought that no considerable quantity reaches the Sacramento River. In regard to the Cosumnes, and the rivers to the south, the damage done thus far is comparatively insignificant, and the prospects of mining are not very favorable. Reservoir sites have been examined which will serve when the occasion arises for their use. The Calaveras, it is now thought, may be the first of the southern streams to require the application of the system, and an excellent site exists for the purpose. For special information in regard to these rivers, reference may be made to the report of Lieutenant Payson, hereto appended. The following statements embrace the measures and constructions which are recommended for the Yuba, Bear, and American rivers, with estimates of cost of the system maintained for a series of years. It is recommended to occupy at once two sites for storage, and after several years a third. The first and upper site is at the narrows just above the mouth of Deer Creek, which enters the Yuba about 12 miles above the plains. The next two sites are below on the edge of the plains, one at De Guerre Point, and the other the brush barrier built by the State of California. The features of the upper site are these: The width of the river-bed is 270 feet; the banks slope at angles with the horizon between 32 and 50 degrees for a height of 200 feet. There is an abundance of stone in convenient positions, and favorable as to quality and sizes. Mr. Manson observes that it will quarry in pieces varying from 2 to 30 tons. The river for 44,500 feet above has an average width of 300 feet, with a fall of 22 feet per mile. The banks have inclinations of 30 to 35 degrees. The South Yuba joins the river 8 miles above the site. In the future development of the system this stream will afford considerable additional storage. The height of floods is 12 feet. The storage is calculated on a grade behind the dam of 14 feet per mile. The grade of the top surface of the prism is held constant in the calculation. We know that the grade for given material must become steeper as the river-bed is widened. The probable storage is therefore in excess of the tabulated amount. No allowance is made for material necessarily escaping, or for that which may remain stored above the reservoir. Both of these points are assumed at the worst. The estimates are therefore larger than they would have been if allowance had been made for these considerations. The Deer Creek site is below all mining dumps except those of the Smartville Group and the minor output at Sicard Flat and Dry Creek. The length of river-bed taken by the reservoir, formed by a dam 75 feet high on a grade of 14 feet, will be 9 miles, obtained by dividing the height of the dam by the difference between the present grades and that assumed for the future grade. The lower site may be either De Guerre Point, or that of the Brush Barrier, erected by the State in the year 1880. This structure was much injured by natural causes in 1881. Since the date of that report the dam has been injured by fire, applied, it is supposed, by design. Its present condition is worse than when examined, but to what extent is not known. The advantage of restoring this structure is that by its position it exercises restraint of considerable amounts of sand and gravel already in the plains, which otherwise will be free to move below to navigable waters, and serve to threaten the town of Marysville still more. The project consist in repairing the breaks in the dam and restoring it to the original height in the first year, at a cost of $80,000. In the second year to cover it with stone to the depth of 4 feet, raising the height of the dam 4 feet. The estimate contemplates, first the construction of a dam at the Narrows, then the restoration of the Brush Dam and covering it with stone, the De Guerre Dam being the last undertaken. The yearly expenditures for a series of years are given in the accompanying table, as nearly as they can be foreseen.

* This group of mines is in a position to do special injury to Feather River, as may be seen from Mr. Manson's report, Appendix 2, to which reference is made.

Table showing estimates and order of structure upon Yuba River for ten years.

Year.	Structure erected or raised.	Annual cost.	Total cost.	Storage provided by each structure.	Total storage provided.
				Cub c yds.	Cubic yds.
1	Build the Narrows Dam to a height of 75 feet . . .	$224,779	. . . .	. . . . . .	. . . . .
	Repair the Brush Dam	80,000	$325,000	30,000,000	30,000,000
2	Cover Brush Dam with stone .	137,000	462,000	10,000,000	40,000,000
3	Raise the Narrows Dam 25 feet	113,807	576,000	25 000,000	05,000,000
4	Erect De Guerre Dam 5 feet .	100,000	076,000	10,000,000	75,000,000
5	Raise De Guerre Dam 5 feet .	110.000	786,000	15,000,000	90,000,000
6	Raise Narrows Dam 25 feet . .	90,734	876,000	31,000,000	121,000,000
7	No expenditures				
8	Raise De Guerre Dam 5 feet .	74,000	950,000	20,000,000	141,000,000
9	Raise Narrows Dam 25 feet . .	122,000	1,072,000	36,000,000	177,000,000
10	Raise De Guerre Dam 5 feet .	63,000	1,135,000	17,000.000	194,000,000
	Total	1,135,000	. .	194,000,000	. . .

Average yearly cost for ten years, $113,500.
Average yearly storage provided, 19,400,000 cubic yards.

The site elected for a dam in the Bear River Cañon is at or near Van Giesen's Dam. The width of the river-bed averages 53 feet at the site; the side slopes are 15 degrees and 20 degrees. The rock is trap, and the foundation will be on rock. The reservoir space above consists of the river-bed, which in some places is flanked by low banks, which increase the area for storage. The bed for 11 miles above the site is covered to a considerable depth with sand and gravel, on a slope of 25 feet to the mile, the average width being 350 feet. The storage prism is calculated on a grade of 19 feet per mile, being the observed line of deposit due to a dam once occupying the site, and carried out in the past few years. The first structure is estimated at 30 feet in height. The successive additions, with cost and storage capacities thereby acquired, and that due to the repair of the brush structure erected by the State at the débouch of the rivers on the plains, are shown in the following table. A further examination of the levels on the plains needs to be made to settle definitely whether storage after two or three years cannot be secured more thoroughly by occupying lands which lie further down the river, and which have been injured in a greater or less degree by deposits of sand and slickens.

It is recommended to occupy two dam sites on the American, one on the North and one on the Middle Fork. The site on the North Fork is about 1½ miles above the junction of the North and Middle Forks. The width of the river-bed at the site is 75 feet. The banks are hard trap, with slopes of 32 and 42 degrees. The river-bed above the site for about 20 miles has a mean width of 250 feet, and a slope of about 23 feet to the mile, with side slopes of 25 to 30 degrees. The contents of the prism are calculated on a slope of 18 feet to the mile. On the Middle Fork, the site selected is about 12 miles above the junction of North and Middle Forks, and about 2 miles above the mouth of the Cañon Creek. The width of the river-bed is 90 feet, and the slide slopes 42 and 55 degrees. The river-bed above is 125 to 150 feet in width, and the slope 45 feet to the mile. The slopes of the bank vary from 30 to 35 degrees.

Table showing the order recommended for structures on Bear River.

Year.	Structure erected or raised.	Annual cost.	Total cost.	Storage provided by each structure.	Total storage.
				Cubic yds.	Cubic yds.
1	Erect the Van Giesen's Dam 30 feet	$34,600	. . . .	6,700,000	. . . . .
	Repairs, Brush Dam	45,500	$80,100	5,300,000	12,000,000
2	Cover Brush Dam with stone	75,000	155,100	5,000,000	17,000,000
3	No expenditures.				
4	Raise Van Giesen's Dam 10 feet	12,500	167,600	5,800,000	22,800,000
5	Raise Van Giesen's Dam 10 feet	16,400	184,000	9,200,000	32,000,000
6	No expenditures.				
7	Raise Van Giesen's Dam 10 feet	20,500	204,500	10,200,000	42,200,000
8	No expenditures.				
	Total	204,500	. . . .	. . . . .	. . . . .

Average yearly cost for eight years, $25,600.
Average yearly storage provided, 5,200,000 cubic yards.

Table showing the order recommended for structures upon the North and Middle Forks of American River.

Year.	Structure erected or raised.	Annual cost.	Total cost.	Storage provided by each structure.	Total storage provided.
				Cubic yds.	Cubic yds.
1	Erection of North Fork Dam .	24,600	. . . .	5,500,000	. . .
	Erection of Middle Fork Dam Canon Creek	81,900	$106,500	3,400,000	8,900,000
2	Raise Middle Fork Dam 50 feet	38,100	144,600	10,000,000	18,900,000
3	Raise North Fork Dam 10 feet	8,600	153,200	5,400,000	24,300,000
4	No expenditures				
5	Raise North Fork Dam 10 feet	10,800	164,000	7,600,000	31,900,000
6	No expenditures				
7	Raise North Fork Dam 10 feet	13,200	177,200	10,200,000	42,100,000
8	No expenditures				
	Total	177,200	. . . .	. . . .	.

Average yearly cost for eight years, $22,150.
Average yearly storage provided, 5,200,000 cubic yards.

The estimate for the first year's operations on the Yuba, Bear, and American Rivers is $511,600.

The Gold Run Suit.—A matter of such great importance as has been disclosed in the preceding pages could not, of course, keep out of the courts. The State of California brought suit against the Gold Run Mining Company, a company operating the hydraulic process, not only for itself but for others who purchased water for hydraulic mining. The *debris* started by this company found its way into the North Fork of the American River, and so on to the agricultural lands and into the rivers where it blocked the channels. Suit was instituted in 1881, a jury waived, and the trial took place, before Judge Temple of the Superior Bench of California. During the progress of the suit, an Anti-*Debris* Convention was convened at Sacramento, and the following resolutions passed:—

Whereas, At least 100,000 acres of the finest lands in the Sacramento valley have already been destroyed, and hundreds of thousands of acres of such lands are now in imminent danger of destruction by the unrestrained flow of detritus from the hydraulic mines on the headwaters of the several tributaries of the Sacramento and San Joaquin rivers: and, whereas, the said flow of detritus has already filled the channel of many miles of the navigable rivers of the State, and its continuance must result in a very short time in the complete destruction of said rivers and their tributaries, throwing them in broad, shallow, muddy streams over the fairest portion of the State, annihilating not only the productiveness of the lands, but the cities, towns and villages; and,

Whereas, The navigation of the bay is now imperiled, and the harbor itself must at no distant day succumb to this devastating agency, and ruin overtake the metropolis of the Pacific thus completing a picture of desolation never before beheld by the civilized world: and,

Whereas, There are but few individuals or corporations comparatively engaged in this species of mining; and,

Resolved, That it is the duty of the State of California, as a moral person, endowed with rights and resting under obligations, to defend herself against such fearful mutilation, and protect the people of the valleys in the peaceful and undisturbed enjoyment of the fruits of their labor.

Resolved, That we indorse the action of Attorney-general Hart, in bringing suit against some of the hydraulic mining companies, in the name of the State, to test the right of one man in the pursuit of wealth to destroy the property of another, as well as the common heritage of this and future generations—the navigability of the rivers of the state.

Resolved, That as experience has taught us that the water will readily carry off, without serious consequences, the washings of quartz and drift mining, we wish to say in the most emphatic manner to the miners of the State that we have no contest with any one engaged in such mining.

Resolved, That we have no contest with those hydraulic mines which take care of their debris, but are against those, and those only, which wash great areas of earth into our streams.

Resolved, That the political party that does not recognize the just principle that every man must so use his own as not to injure his neighbor, is not worthy the support of the people.

Resolved, That the attention of the press of the State, especially the metropolitan press, is called to the immense importance of this matter, and to the fact that it has, in our judgment, failed to take the comprehensive view of the subject which its importance demands.

Resolved, That the people of Sacramento valley demand of the executive, legislative and judicial branches of the State that just protection of our property for which governments are established and maintained.

Resolved, That the contest already begun against this system of desolation and destruction of our State is a sacred cause, which should enlist the sympathies and active co-operation of all her people; that the burden of the conflict should not be borne by the few who have heretofore struggled to stay this great destroyer, but should be shared by all the people of our great valley; that in order to reinforce those who are now at the front to concentrate all efforts in united action, we do most earnestly recommend that the several Boards of Supervisors present on this occasion meet together and take such action in the premises as will enable their several counties to contribute that aid and encouragement which only united action can bring, and we hereby pledge ourselves to the support of such action.

Resolved, That the action of the Board of Supervisors of Sacramento county in calling this convention together, meets the unqualified approval of the people of this valley.

The testimony at the trial developed some interesting facts. Mr. G. G. Blanchard was examined as to the number of persons engaged in mining along the American and its tributaries, the quantity of material displaced by their operations, etc., and testified: They all tailed into the most convenient places; each miner displaced about 10 cubic yards of material per day; think there were from 15,000 to 20,000 miners at work in Placer county in 1851-52-53; the displacement by each miner would be about 15 cubic yards per day; there is considerable seam mining now done in El Dorado county; in 1861 there were about 15,000 persons depending on mining in that county; there are now perhaps 10,000; prior to 1862 there was probably 50 times as much matterial removed as since; then the earth removed between 1848 and 1862 was light and of vegetable mold; most of the heavy material mined in later years is still in the vicinity of the mines; no man can tell how far any particular kind of material would be carried in suspension in the South Fork; ten per cent. of the material mined in El Dorado county would not go thirty miles from the mine; some of the lighter vegetable mold might reach Sacramento; the natural wash of the river in Eldorado county is now more than twenty-five times as much as from all the mines; the tailings from the mines are saved wherever possible; it makes the best land in the county; about one thousand acres of land have been thus made, from two to ten feet deep; it will raise what the natural land will not; the blue cement rock makes the very best sort of land after it decomposes and crumbles.

Among the witnesses was James Marshall, the discoverer of gold in California. He testified that the whole Sacramento valley was flooded in the winter of 1845-46. He was told at that time by the Indians and those who had resided here in 1830, that during the winter of that year the entire valley was deeply submerged, the only land visible in the valley being the Buttes. The highest water he ever saw in the American river, at Coloma, was in the winter of 1861-62.

Evidence along the banks, near that town, shows that prior to 1848 the river at some time had been two or three feet higher than it has been since that time.

Hon. Niles Searls, among other things, said: The great bulk of litigation brought before me while I was District Judge, was what is termed mining litigation. The habit of the miners of Plumas, Placer, Nevada, Yuba and El Dorado counties, where I have lived, is to wash the earth in order to separate the gold, and then dump the water and debris into the most convenient canyon or ravine. This has been the universal practice in those counties, except the miners have impounded their own debris in order to wash it a second time. After impounded tailings were washed, they were then allowed to escape through the most convenient and available natural channels. I have been through the mining counties from Amador to Siskiyou. This custom of discharging from the mines the debris into the most convenient canyons or ravines, has been the universal custom among all the miners of California, as far as my observation goes, from 1849 up to the present time. This mode of mining is the only way in which the mines could be worked profitably. Gold mining cannot be prosecuted except with the use of water. I am familiar with all the streams in Nevada and some adjoining counties, and all, or nearly all, of the canals in those counties. [Witness described the Eureka Lake, South Yuba, Rock Creek, Bloomfield, Milton and other canals, giving their locations, source of supply, and the mines they furnish with water. He also described the large reservoirs that held back large amounts of the winter's water for use in summer mining.] The canal companies I have mentioned all have large reservoirs at their sources and some of them have a great many. Some of these are natural lakes dammed at their outlet, three or four miles in length, and varying in depth from nothing to 100 feet. The North Bloomfield reservoir, with which I am very familiar, having boated upon and fished in it for cat many times, is about four miles in length, and has an average depth of from 50 to 60 feet. The water from these reservoirs is not discharged until the waters in the creeks, ravines and natural channels fail. The amount of water discharged from the Excelsior, South Yuba, North Bloomfield and Milton mines is at least double the quantity of the water flowing in the Yuba during the dry season. During the dry season, those mines discharge of this stored water, at least 20,000 miners' inches. This amount of water would make a stream 100 feet wide and 3 feet deep. This volume of water confined in a canal, would float most any of our up-river steamers. During the winter of 1850 and 1851, within an area of three miles of Nevada City, there was an estimated population of 20,000. At least 15,000 of this population were engaged in mining. There are not 100 men engaged in hydraulic mining within this same area at the present time. There were several thousand men mining in Sierra County in 1850. Nearly all the early mining was in light soil and shallow surface diggings. The reservoirs supplying the canals for these mines are mostly situated near the summit. The Bowman reservoir occupies the whole of a valley. It was dammed up in a narrow gorge, and the whole valley, several miles in length and a mile wide, was thus flooded. I consider that the storing of water in the winter, and sending it down during the dry season, greatly assists in the navigation of the rivers of California.

Witness was examined minutely regarding the flow of water from the reservoirs referred to in his direct examination; the quantity of water used by miners daily along the Yuba must have been more than 17,000 inches. [The report of the County Assessor showed the quantity to be about 17,000 inches, supposing the miners to have worked 300 days per year.] The mining population in Nevada county has been largely reduced within late years. Resuming, witness stated that when he testified that the practice among miners was to dump their tailings in the most convenient places, he simply stated a fact; there was no compulsion in the matter—they were not obliged to do so; sometimes the nearest canyon was not the most convenient one; monitors did not come into use in hydraulic mining until 1865; before that the ordinary goose-neck was used; powder was first used largely in 1853 or 1854, but in the gravel banks it was not generally used until 1865; the Excelsior, the Milton, the Eureka Lake and North Bloomfield companies do, perhaps, on an average, sometimes three-fourths and sometimes one-third of the mining now done along the Yuba; they use perhaps more than one-half of the water brought in by artificial means, but there is a great deal of mining done by aid of the natural water-channels; during the flood season, the water in most of the ravines is used for mining.

The suit took 45 days to try, and on June 12, 1882, Judge Temple rendered his decision as follows:

The Findings of Fact.—In the Superior Court, Sacramento county, California. The people of the State of California, plaintiff, *vs.* the Gold Run Ditch and Mining Company, defendant. This cause was tried by the court, a jury having been waived. Having fully considered the evidence, I now find the facts as follows:

First.—The Sacramento and American rivers are wholly within the State of California; the latter is a tributary of the former, flowing into it about one mile north of the city of Sacramento.

Second.—The Sacramento is navigable, and has been continuously navigated by steamers, barges, schooners and smaller craft, and up to 1862 was navigated as far as the city of Sacramento without difficulty by steamers of deep drift, to wit, by boats drawing nine or ten feet of water. That said river has been declared navigable by law to the mouth of Middle creek, which is above the confluence of the American and the Sacramento. That since 1862 the navigation of said river has been seriously impaired by deposits of mud and sand therein, which have in part come from hydraulic mines; so that now the city of Sacramento can be reached by boats of deep draft during the high stages of the water only, instead of at all times, as formerly.

Third.—That hydraulic mining, as that term is generally understood, consists in washing and removing from their natural positions into the water-courses and rivers, by means of water, high banks of earth and gravel containing gold, and thereby separating the gold from the earth, sending the residue, consisting of bowlders, cobblestones, gravel, sand and clay, into the water-courses, the larger portion of which finds its way into the principal confluents of the Sacramento river, and is deposited along said streams from the place of discharge or dump to San Pablo and San Francisco bays, the heavier material being first deposited.

Fourth.—Hydraulic mining has been practiced for 20 years to some extent in the mountains of the Sacramento basin. It attained great magnitude as an industry before 1875, and is still extensively carried on, principally in the counties of Butte, Yuba, Sierra Nevada and Placer.

Fifth.—The tailings from some of the hydraulic mines are deposited in the North Fork of the American river, and large quantities thereof have been deposited in the channel of said North Fork and of the American river, throughout its entire course, and a large portion thereof has been washed and carried down into the Sacramento river. That the tailings from other hydraulic mines are washed and carried into the Middle and South Forks of said river, and in the Yuba, Bear and Feather rivers, which are tributaries of the Sacramento.

Sixth.—That the tailings and deposits from said hydraulic mines, with other matter carried by the waters of said rivers has filled up and raised the bed and channels of said Sacramento river to a great extent below the mouth of the American river, to wit, from six to twelve feet, and has filled up and raised the American river below Alder creek from ten to twenty feet, and in places even more. Such filling has been materially increased by the tailings from the hydraulic mines. Such fillings have shallowed the channels of the Sacramento river, and materially impaired the navigation thereof and has materially increased the liability of the Sacramento river and of the American river below Alder creek to overflow their banks, and has caused the frequent floods in said rivers to be more destructive than they otherwise would have been. That the debris from mines, including the mine of the defendant, has materially contributed to such filling of the river channel, and thereby has interfered with and obstructed the free and comfortable use and enjoyment of large portions of the land upon the American and Sacramento rivers. The American river is, however, obstructed by the levees and the levee system of the Sacramento, which cause the water to be dammed up and made to flow back into the American river and over the banks thereof, during the stages of high water in the Sacramento, and thereby large tracts of land are submerged and heavy deposits made thereon, which would not exist but for such levee system, or the defects in the same. That one of the principal sources of damage by the overflow of lands on the Sacramento river is from the erosion of the bank nearly opposite the mouth of the American river and the break in the levee at that point. That the more immediate cause of this erosion and break was the change in the course of the American river, which manifestly would have produced the break and much consequent damage although all mining operations had been suspended.

That during the highest stages of the water of the Sacramento the channel of said river is insufficient, and even if it had not been filled up would have been insufficient to carry one half of the volume of water sent down by its various confluents, and at such times would break the present levees, even though no mining were carried on. Still the mining debris does increase and aggravate all these evils, and renders the problem of controlling the streams and protection of the valleys more difficult and expensive, and causes more land to be injured and the free enjoyment thereof to be interfered with than would have been interfered with or injured but for such mining debris.

Seventh.—That defendant is, and since August, 1870, has been, a corporation under the laws of the State of California, for the purpose of mining by the hydraulic process and selling water to miners and others. That it is now, and for several years last past, it and its predecessor have been in possession of certain mines and mineral land situated adjacent to the North Fork of the American river, on the north side thereof, near town of Gold Run, in Placer county, and consisting of about 500 acres of land. The surface of said land is about 1,000 feet above said North Fork of the American river. All the material of said mine is capable of being worked off into said American river, and consists of about 20,000,000 cubic yards of material, composed mostly of sand, gravel, small stones, cobbles and bowlders, mixed with small particles of gold.

Eighth.—Defendant, by means of ditches and iron pipes, has conducted to its aforesaid mines a large quantity of water, which it is using and will continue to use under a vertical pressure of several hundred feet, to mine its said tracts of mining land by the hydraulic process, discharging water through Little Giants and Monitors, and dumping all the tailings from such mines into the North Fork of the American river.

Ninth.—Said defendant has been mining its said tracts of land for about eight years past in the mode and process aforesaid, and up to the time of commencing this action, and during about five months of each year of said period, has been daily discharging into the said North Fork between 4,000 and 5,000 cubic yards of solid material from its said mine—to wit: of bowlders, cobbles, gravel and sand, making a yearly discharge of at least 600,000 cubic yards, and will continue to discharge that quantity annually, if the working of said mine is permitted to continue, and at such a rate, it will require some 30 years to mine out and exhaust said mineral land.

Tenth.—That a large portion of the material so dumped by the defendant into the North Fork of the American river has been washed down said river by the water and com mingling with tailings from other hydraulic mines, and still other material, which is the produce of natural erosion, has been deposited in the beds and channels of the Sacramento and American rivers, but mostly in the American river, and upon the lands adjacent to said rivers; and by said mining of the defendant and other mines the filling up, raising and shallowing of said rivers has been materially increased, to the impairment of the navigation of the Sacramento river, and to the excessive overflow of the land adjacent to said rivers, to the great injury of said land, and damage, discomfort and annoyance of a great number of citizens of the State, owners of said land and residents of said valley.

Eleventh.—That the power of water to preserve its channels and to clear out and to carry off deposits in the same is proportioned—other conditions remaining the same—to the depth of the stream and the freedom of said water from earthy matters. That the beds of said rivers have already become so widened and filled that the depth of the water therein has been greatly lessened; that said water, at all times, is heavily laden with earthy matters, chiefly from mines; therefore, said rivers are likely to fill more rapidly in the future, in proportion to the quantity of hydraulic tailings, than in the past. That thousands of acres of good land in Sacramento valley have already been covered by such debris, and, if some preventive is not applied, much further and greater injury is likely to ensue in the future, and large tracts of land will probably be rendered, within a few years unfit for cultivation and inhabitancy.

Twelfth.—That the discharge from the defendant's and other mines so fouls the water of the American river at all points below, as to render said water unfit for any domestic use by the inhabitants.

Thirteenth.—That the filling of the beds of said rivers has, to some extent, obstructed the natural and artificial drainage of the valleys of said rivers, and has interfered with the percolation and flow of the water through the soil, and has raised the soil water to such an extent as would naturally increase the tendency to malarial diseases; but I do not find that heretofore, it has had any effect on such diseases, and the material carried down by the rivers is singularly free from matter which could ferment and induce malaria.

Fourteenth.—That if the said acts of defendants and others, mining as aforesaid, are allowed to continue, there is imminent danger that the beds and channels of the lower portion of the American river, and of the Sacramento river below the mouth of the American, will be so filled and choked up by tailings and other deposits that said rivers will be turned from their channels, cutting new water-ways, injuring or destroying immense tracts of land, and probably will result in greatly impairing the navigability of the Sacramento river.

Fifteenth.—That the filling in of said rivers below Alder creek has been accumulating from year to year. The largest deposits were made by the floods of 1861 and 1862, since which time there has been a steady increase in deposit and a slow but constant working down in the channels of the rivers of the heavier material; that it is not possible to determine the proportions of such deposits which come from mines now working in other sources, but it is quite prohable—in fact, almost certain—that very much the larger part of that which injuriously fills the rivers is composed of material dumped into the river from mines within ten years previous to the fill in the river.

Sixteenth.—That the waters of the American river and its tributaries, during the recurrence of high water in each year, move and transport portions of the debris then in the river further down the stream, and the most of such matter finds its way ultimately below Alder creek, which is a point in the American river near where said stream emerges from the foothills, about 27 miles above the mouth of said river.

Seventeenth.—The grade of the American river above the Alder creek to Canyon creek is about 30 ft. per mile. The mine of defendant is about 83 miles, by the river, above Sacramento, and is a blue-gravel mine, and constitutes a portion of the ancient river channels which cross the present river system diagonally.

Eighteenth.—That the Gold Run mine, in 1854 was within the mining district known as Gold Run district. That mining rules and regulations were in force in that district, as in all other districts in this State, which prescribed the size of the mining claims, the manner of locating and recording them, and the amount of work to be performed to enable the locators to hold their claims. Miners' rules and regulations had no force beyond the district. Claims in the Gold Run district were in small parcels, about 100,000 square feet, and were taken, held and worked by a large number of persons, commencing such work in some of the claims as early as 1852, and were so held until sold to defendant, which has since acquired title to said lands by means of patents from the United States. That between the years 1854 and 1874, the upper levels of the Gold Run mines were practically all worked off, leaving the lower portions thereof next to the bed-rock to be worked off. Such lower portions now constitute the mines of the defendant, and yield in gold from 5 to 20 cents per cubic yard. The mining ditch property cost the present company $253,000, including tunnels and all improvements in the same.

Nineteenth.—The rules and regulations of miners did not purport to regulate the mannner in which mining claims should be worked, nor the manner or places in which mining debris should be dumped; but the universal practice was to discharge the tailings into the most convenient stream or gulch, even though it should interfere with claims located in the streams or ravines below. It has been a custom, almost universally acquiesced in, in the mining communities of this State, to regard the streams as common ways for the discharge of mining detritus. The exceptions being where such stream has been previously occupied by some works, such as a ditch to convey water. Such right on the part of the mine owners is, in most cases, essential to the economical working of the mine. Such practice is necessarily confined to the mining localities and has not been recognized or acquiesced in elsewhere, except that the waters of the streams throughout the entire course have been rendered turbid and foul without complaint until within the past few years.

Twentieth.—That neither this State nor the United States has licensed the defendant or any miner to dump his tailings into the streams so as to be transported into any navigable river, stream or bay, nor has this State legalized the same. Nor have the Sacramento or American rivers been dedicated to the use of the miners as a place of deposit, or for a way to transport mining material, nor is either cause of action set forth in the complaint barred by the provisions of Secs. 315, 338 or 343 of the Code of Civil Procedure of this State, or of either or any of said sections.

Twenty-first.—That the acts threatened to be performed by the defendant in continuing to prosecute its mining industry in the manner set out in these findings, as it will do, unless restrained, if allowed to be done, will, in connection with like acts by others, obstruct the navigation of the Sacramento river, and fill up, to some extent, Suisun bay, destroy or injure large amounts of land, and constitute an obstruction to the free use and enjoyment of the property of a large number of citizens of this State.

Twenty-second.—Ancient gravel channels exist, at least 200 miles in extent, from Mariposa county to Siskiyou, crossing the present river system diagonally and at higher altitudes. These channels are from 200 to 2,000 ft. wide, and contain gravel sometimes several hundred feet deep. Gold is distributed quite uniformly throughout the length of the channels. The first mining was generally in the present rivers below where they had washed out the old channels.

Competent persons estimate the entire product of gold from California mines at $1,154,689,036 up to June, 1881, $900,000,000 being from the ancient channels. The present yield varies between $15,000,000 and $20,000,000 per annum, and there is no doubt much more gold still remains in these ancient channels than has been washed out. Present investments in California mines are estimated at $150,000,000, $100,000,000 of which is in hydraulic mines. Some portion of this is, no doubt, in mines which cannot be profitably worked. Mining for gold is the principal industry in 15 counties of the State, and the population of the mining counties is over 100,000. In the past eight years the amount of material washed from hydraulic mines has diminished, owing to change from washing light surface gravel with few bowlders to heavy bottom gravel, and from steep grades in the sluices to light grades. The amount washed from a mine will depend upon the amount of water used, the character of material and grade and size of sluices. Late improvements in hydraulic mining do not increase the amount of material mined. The various mines in the drainage area of the Sacramento river have reservoirs in which they store about 7,600,000 cubic feet of water, which is gradually drawn off in the five months after the middle of July, and to that extent increases the flow in the Sacramento river.

General Finding.—To the foregoing findings of fact I desire to add a general finding, explaining, amplifying and perhaps to some extent qualifying them. The case involves the consideration of the operation on natural forces on a large scale, and many conclusions are necessarily to some extent matters of theory or opinion. Conclusions upon such matters when expressed in legal findings often seem to imply a certitude which does by no means exist. The field of observation is so vast that the full case cannot be presented in the findings; much must be left unexpressed, being presumed to be within the judicial knowledge of the Court; as for instance, the geography and generally the geology of the country over which our inquiries have extended; the nature of the ancient river channels and the different forms and methods of mining which have prevailed, as well as the general history of the country—matters which everyone is presumed to know.

The American River.—The drainage area of the American river is 1,889 square miles, mostly on the western slope of the Sierra Nevada mountains. This slope is composed of numerous deep canyons and ravines, high and steep ridges and lofty mountains. The formation is mostly granitic, is largely covered with deep soil, generally of decomposed granite. Originally, there were very extensive forests of immense pine trees. Since the settlement of the country there has been a continuous destruction of these trees for the lumber, although large forests still remain. Numerous roads have been cut and trails made within this area. Considerable industries in fruit raising are carried on in some places, and every summer thousands of sheep are driven from the valleys into the mountains to be pastured. As early as 1852 there were mining in the American river, in Placer county, 20,000 men, and in El Dorado county, 40,000. The earlier mining was in the bars and beds of the river or its tributaries, or in the dry diggings, which were probably older bars made in former geological periods. The work was chiefly in mining, the gravel and sand composing the river bars into the river, generally leaving the heavier cobbles in the claims. The so-called dry diggings were worked during high water. Much of the material being light soil, we sent down the stream, leaving innumerable small pits and piles of debris on the slopes of the mountains. In the winter of 1852-1853 there was a *large flood*, but from that time until the winter of 1861 and 1862—the memorable flood year—there was no flood of moment. Of course, at this time, an enormous amount of material would naturally be exposed to the transporting power of such deluge, and, accordingly, we find that for the first time the inhabitants of the valleys became aware that the water was filled with sediment which menaced the navigability of the rivers, and which left large deposits of sand upon their margins. It is probable that more sediment was brought down by the river during that year than any year since. It is contended by the defendant that most of the sediment in the river is from other sources than mining. Perhaps this is not so important an inquiry as it is deemed. What proportion of sediment is from mining, and what from other sources it is impossible to determine; but it probably may be safely claimed that the greater portion is from mining deposits made within the periods of the recurring high floods, which are from eight to ten years apart. The Sacramento might be expected to bear 19,000,000 cubic yards of sediment, independently of mining debris, per annum. The drainage area of the American river is about one-twelfth of the Sacramento basin. The erosion upon the American river would, however, naturally be much above the average. Let it be placed at twice the average, and then natural erosion cannot be held responsible for half the material which is carried in suspension to the Sacramento, and which is rolled along the bottom of the river, at least below Alder creek. Again the character of the material is *an important consideration.* Generally the wash from other sources than mining is the very lightest material; the exceptions are land slides and sudden cutting of gullies on the hill sides. The wash from such sources, therefore, would be easily managed by the great volume of the lower rivers, and would be carried in suspension to Suisun bay, which is the great settling reservoir of the basin. The damage to the rivers or the adjacent land would be slight. Mining debris, however, is of all degrees of fineness. The question as to what will be carried down will depend upon the size of the rocks which the water has sufficient force to roll along. In other words, it will furnish the heaviest material which can be transported. This is just the material which naturally fills the rivers below the foothills more or less permanently while slowly but constantly creeping further down the stream. It is probably from this source mostly, rather from causes other than mining, that the material has come which has filled the channels of the Yuba, and the Bear, near their confluence with the Feather. It is contended by the defendant that all the debris which it puts into the

American river (save a small per cent). remains permanently above Rice's bridge—a point about nine miles below Canyon creek—and no question in the case has been more minutely examined. This portion of the river is through a rocky gorge with banks sloping at an angle of from 30 to 40 degrees. According to a profile furnished by the defendant, the grade of the original bed from Canyon creek for about two miles, was over 70 feet per mile; then for a distance of over four miles the average grade was a little less than 40 feet per mile, with occasional spaces of several hundred feet each, in which the grade was ascending. The remaining distance the grade was about 21¼ feet per mile. There is a large fill now in the river, commencing about one-half mile below Canyon creek.

The Surface Grade of the present bed for this portion of the first section which contains any fill one and one-fourth miles is 46 feet per mile. The grade of the next four miles is 40 feet, and the remainder over 36 feet per mile—the last quarter of a mile being 25 feet per mile. Prior to the commencement of the work in the present pit, or lower portion of the mine, it is estimated that there had been washed from the upper, or old washings, 67,000,000 cubic yards of material, which also come into the American river through Canyon creek. Also large quantities of material were placed in the same sections of the rivers from the Iowa Hill mines. The surface of the old washings was principally light red earth, with sand and pipe clay. In the channel, however, the old washing was chiefly composed of gravel, sand and cobble stones. The old mines ceased to be operated because, as the miners say, they ran out of grade, and not because of a change in the character of the material. The banks are of a mixed character of sand, gravel and cobbles, from the top to the bottom. In the present pit, however, there is no pipe clay in the ribbon or channel which will be worked, and none of the red earth, and there is a constant increase in the average size of materials as we approach the red rock. There was no clear line of distinction between the present and old washing. The great proportion of material in the lower pit, therefore, cannot reasonably be heavier than 10 per cent. of largest material in the old washing. It seems that, prior to 1875, this portion of the river was filled with this debris to a much greater depth than at present. All the material was washed out and went down the stream, as also vast quantities of material put in from the Iowa Hill mines. The material in the river is naturally graded as to size down stream; the heavier being first lodged, and then the next in size, and so on.

The heavier material, therefore, cannot hold back the light debris which has been separated by the water, and is constantly washed lower down. If all the detritus from the top washing has gone down over the lower grades of the original bed, certainly that portion of the material in the present pit, which is not heavier than the largest cobbles in the old washing, will pass over the present increased grades of the river, if we suppose that the hill now there is so impact that it will remain. But I think it altogether probable that the profile is incorrect. The surveyor who made it is evidently competent and apparently candid, but he did not measure the depth of the fill. The estimate must be very much in excess or considerable of the old fill must still be there. In either event the case must be taken as established against the defendant—that a considerable portion of the material will and does come down the river. It may be added that at high water the current of the river at this point must have a velocity of at least from six to eight miles per hour. There are few cobbles of bowlders which will exceed 10 inches in diameter. Theoretically they would all come down.

The Conditions in the American River differ widely from those at the Polar Star dump in Bear river, aside from the fact that the material at the Polar Star is heavier and the stream of less force. At the Polar Star, if I have rightly understood the evidence, the fill is immediately at the dump, some of the material rolling up the stream above the point of discharge. The larger bowlders, therefore, do hold back the lighter material. At Canyon creek the material, after it reaches the river, is transported by the water from half a mile to six and eight miles before it finds a lodgment, and is, of course, completely graded by the action of the water, it settles on a steep incline and is so distributed as to build up the bed of the river to a uniform grade. It forms nothing like a dam, but at the upper end rests against the steep grade so as to form a continuous incline, over which most of the material passes, even at ordinary stages of the water while the mine is working. I think it may be assumed that the new grade at Pickering's Bar—46 ft. to the mile—is just the grade over which the heaviest material of the mine will not pass at ordinary winter stages of the river. It certainly all passes over the grade from Canyon creek to Pickering's Bar, and will continue to be completely sorted by the water, and therefore, as it seems to me, a large portion of it must inevitably come down.

The Coarser Material will travel very slowly, probably requiring many years before it reaches Alder creek—10, 20 or more, according to the size. No doubt much which was thrown into the river many years ago is still slowly moving down and, though all mining should cease, will continue to come for many years. This is important, as showing to what extent stopping the work at the mines will afford a remedy. It appears that this part of the injury is easily remedied, and at comparatively little expense, by the erection of dams to impound the debris. If the experts are correct in their conclusions—and I am bound to so conclude—all that is very greatly injurious could be so impounded. Of course during its slow journey the detritus is very greatly comminuted; much of it will be be carried off as clay in suspension; the proportion cannot be determined.

On the American river, and its tributaries, a vast amount of mining was done in early times, and up to this time a great deal is being done beside that by the defendant. No other mine contributes annually more detritus to the river than the defendant; still I am unable to say that defendant's mine alone, without reference to the debris from other mines, materially contributes to the evils mentioned; or, in other words, if there were no mining operations save those of the defendant, I am not prepared to say that it would materially injure the valley lands or the navigation of the river. It is the aggregate of debris from all the mines which produces the injuries mentioned in these findings. The lower portion of the American river is very much filled with debris, and has been, in places, much widened. As yet, however, no such state of things exist there as is seen in the Bear and Yuba near their confluence with the Feather. Perhaps if it were not for that instructive lesson we should not be justified in anticipating all the evils which may yet flow from these constant accumulations.

About one thousand acres of valuable farming land have already been covered with heavy sand along the margin of the American river, and the adjacent lands are subject to frequent overflows. The overflows would probably occur to a considerable extent, although there were no mining. Very much of the trouble from this source comes from backwater, from the Sacramento. In flood times, if the rains have been general, the American is the first to rise. The Sacramento then being at its low state, the flood rushes out loaded with sand and mud, and, with very great velocity, is precipitated on the Yolo shore, and there covers large tracts of land with its sediment. At such times the current is much greater than at any other time, and, of course, a great deal of sediment which has accumulated in the river during slack or low water is carried out.

About fifteen hours after the rise of the American, the flood from the Feather, also surcharged with mud, reaches Sacramento, and 36 hours later the floods of the upper Sacramento. By this the current of the American is checked, and considerable land sometimes remains submerged by back water. At such times, of course, sediment is left both on the lands and in the channel of the river, which otherwise would have gone off in suspension.

SACRAMENTO RIVER.

The plane of low water has been raised about six and one-half feet since 1849 in the Sacramento. The rise in the low-water plane has been continuous since 1868, when the low-water mark was about two feet above the low-water plane of 1849, although in some years, probably for special reasons, it has been higher than in the succeeding year. This indicates that the bed of the river at the shoals has been filled at least six and one-half feet, and probably much more. The consequence is that the influence of the tide is not felt above Haycock shoals—nine miles below the city—it formerly being about two feet at Sacramento. As we go down the river there is a less elevation of the low-water level, indicating an increase in the grade of the river, from which will follow additional force to carry off the sediment.

The levees of the river are insufficient to carry one-half the water during the periods of the higher floods. Breaks are therefore, inevitable, and perhaps have caused, in some localities, greater damage than would have occurred had there been no levees. The levees, to some extent, increase the scouring force of the water, but not so much as would be the case if the water were not at its high stages already surcharged with sediment. The levees, also, somewhat prevent the river from wasting its material along the banks and building up the valley as it builds its own bed, and causes it to carry to its mouth more material than it otherwise would do. As to the islands below Grand island, I conclude from the evidence in this case, that at present they cannot be reclaimed by any practical means. Of course, the quantity of sediment in the river makes the problem more difficult and the means more expensive if they are to be reclaimed; but it would seem evident that this cannot be done at any reasonable cost until they are still further built up by the operation of natural causes.

Sacramento City.—I am compelled, by the weight of the evidence in the case, to find against the plaintiff in the charge that the prosecution of its industry by the defendant, with similar operations by others, has impaired, or to a material extent is likely to impair, the sewerage of Sacramento, or injuriously affect the sanitary condition of the city. The sewers of the city are about seven feet above tide water. The drainage was never into the Sacramento river, and perhaps could not rightfully be there. It does not appear that the city has been deprived of any outlets for its sewerage by debris, nor do I see that the drainage has been interfered with, except during the very highest floods, which may be expected about once in eight years. The interference, at all events, is quite inconsiderable. It is said that the soil-water is raised in the city by sipage, so that cesspools are emptied of their contents. It is natural to think that raising the water level in the river will necessarily raise the level of soil-water in the vicinity. That it does so, to some extent, I cannot doubt. The drainage canal from Sacramento to Snodgrass slough, a distance of 25 miles, has a fall of about six feet. There can be no good drainage under such circumstances without pumping, and I do not see how the debris has made matters worse in this respect. The health of the city has been steadily improving for the last 25 years, and during all that time the city has ranked very high in regard to healthfulness with cities of equal population and similarly situated. There has been manifested during late years, however, some tendency to a change in the character of the disease, from those of a purely malarial character to those of typho-malarial character. This seems to be the usual course of disease in all newly settled countries, and according to the testimony in this case, could not have been otherwise. The slight indication of a typhoid epidemic during one year is nothing more than is to be expected in any city. I am entirely satisfied that the question whether the deposits of debris in the vicinity of Sacramento have affected or will injuriously affect the health of the city is altogether too much a matter of theory to be the foundation of a judgment which shall deprive the defendant of the use of its property.

Fouling the Streams.—The first mining in the river bars and channels discolored the waters to some extent as early as 1853, and the rivers have become more and more discolored by sediment since. The early mining was in well-washed sand and gravel, which contained none of the red earth which has since so highly colored the water. The dry diggings were in red earth, but were prospected only during high water, and therefore during the summer the rivers became reasonably clear. As ditches were constructed, and mining in what are called surface diggings, as contra-distinguished from deep gravel mines, commenced, the water began to be colored as at present, red or yellow. This color is from sesquioxide of iron, which is not found in the deep gravel mines. The cementing material, however contains protoxide salts of iron. Peroxidation of this commences upon its exposure to the air and water. This ferruginous clay is readily transported by the water, and probably is not so peroxidized as to discolor the water while being transported. Washing in the red gravel has greatly diminished since 1875; but probably the water still receives its deep color principally from surface washings. There is evidence of considerable filling in the San Pablo Bay, principally along the channels through the bays. Practically there is yet no impairment of navigation in this bay, and is not likely to be for many years to come. Suisun bay is rapidly filling with sediment, but I conclude from the evidence that the volume of water passing through will always maintain channels sufficient for the purposes of navigation.

Conclusions of Law.—*First.*—That the plaintiff's cause of action and its right to relief in this section demanded, is not barred by all or either of the statutes of limitation pleaded by the defendant in this case or otherwise.

Second.—That defendant has not acquired any right to the use of the bed of the American river, or of the Sacramento river, as places of deposit for its mining tailings, nor to choke or fill with such tailings the channels of said rivers in the valleys thereof, nor to flow or overflow the said lands situate along the bank thereof.

Third.—That the said acts of defendant constitute a public nuisance, in that they are an obstruction of the free use by a considerable number of the citizens of this State of their said lands, situate along the banks of said rivers as aforesaid, so as to interfere with the comfortable enjoyment thereof, and in that they unlawfully obstruct the free passage and use in the customary manner of the said Sacramento river.

Fourth.—The mining customs, usages and regulations authorized by the statutes of this State, or recognized by the decisions of its courts, are local in their operation, and have not and are not intended to have any effect beyond a mining bar, diggings or district in which they have been adopted or recognized.

Fifth.—That the mining laws and mining customs or practices of the said Gold Run mining district, in which said defendant's mines are located, mentioned and referred to in the findings of fact herein, were not intended to and did not and cannot protect the defendant in the doing of the acts, matters and things complained in this action.

Sixth.—That the plaintiff is entitled to a decree of this court restraining and enjoining the defendant, its superintendent, agent and employees, from discharging or dumping into said North Fork of the American river, or into Canyon creek, and also from suffering or causing to flow into said rivers any tailings, bowlders, cobble stones, gravel, sand, clay debris or refuse matter perpetually, or until it shall be first known, upon application made to this court for modification of such degree, that dams shall have been built in said American river, which will prevent the heavier portion of said material, including the coarser sands, from coming below Alder creek, or until some other means equally efficacious shall be adopted to impound liquid debris, and which, in the opinion of the court, upon such application, will certainly prevent sand, and all heavier material than sand, from being carried by the water below Alder creek.

J. TEMPLE,
Superior Judge, presiding.

June 12, 1882.

The Opinion.—The people of the State of California, plaintiff, vs. The Gold Run Ditch and Mining Company, defendant.

This action is brought to restrain the defendant from dumping his tailings into the North Fork of the American river. It is charged that these tailings, being washed down by the current, are deposited in and fill up the channel of the American river below Alder creek, as well as the Sacramento, impairing the navigation, increasing the liability of both to overflow, and making each overflow more destructive, causing deposits upon the farming lands, thereby rendering them unproductive, raising the soil water, which also tends to unproductiveness, and producing malarial and other diseases among the inhabitants of the valley. It is substantially found that much of the tailings come down the streams, filling up the rivers, and producing most of the evils charged. Navigation has been obstructed, much valuable land covered with sand, and that the continuation of the practice will probably be productive of still greater damage. The finding may be considered for the defendant, however, upon the charge that the debris adds materially to the malarial influences, or have obstructed, or will obstruct the sewers of Sacramento, or have injuriously affected the sanitary condition of that city. It is found that mining pollutes the water of the rivers with mud, rendering them less suitable for domestic purposes. And that numerous other persons engaged in the same pursuit contribute debris to the same streams, but for which contribution the rivers would be able to maintain their channels without serious obstruction, notwithstanding the detritus from the mine of defendant. The case is quite unusual in some respects, and I have departed from the customary findings by adding a general finding in which are stated some conclusions in a mode less formal, and some deductions from the evidence, hoping that the special findings will be sufficient to sustain the judgment and that the general conclusions may aid the appellate court in a review of the case. The decision has been more or less delayed by other official work, and somewhat by failure to receive in time the promised briefs, and I especially regret that counsel for the defense have not complied with my repeated request that each party would suggest the points upon which special findings were required. There is no possible utility in an elaborate argument on my part in support of the conclusions to which I have arrived; but, in fairness to counsel, I will briefly state some of the conclusions.

The defense—which may be designated by the terms statute of limitations, prescription, dedication and way of necessity—may be passed with the remark that obviously the plea indicated by each term or phrase cannot be a defense in this case. Indeed, it apppeared to be on the argument neither was really relied upon, but were all used as a convenient means of illustrating and enforcing a more plausible proposition, which may be briefly stated as follows: The customs, usages and practice of miners, which have universally prevailed, and which have everywhere been acquiesced in throughout the State ever since its organization, have sanctioned this use of the navigable streams, and in connection with the recognition and approval of the Government, both State and national, for a long series of years. Every one knowing the practice, and no one objecting, has changed the common law upon this subject—or at least the equitable circumstances exist which bind the consciences of both Governments and which cannot be disregarded by them. The equitable circumstanees alluded to are manifest and could hardly be too strongly stated. So great a calamity to so many people as would result from a judgment in this case, were it to be a precedent, has probably never been produced by any case in the country. And the acts which are said to be wrongful have certainly been tolerated so long without objection, if they have not been encouraged, that no shadow of blame can possibly attach to those who have invested their money in it. If the question were in a legislative body, whether some law which had permitted it, and under the sanction of which it had grown into importance, should be repealed, the suggestion would be irresistible. So it would in an action, perhaps, where it involved only the proprietary rights of the Government, or any interest of the Government, simply considered in its corporate capacity. Such were the facts in the cases cited for the defense. But there can be no estoppel which shall prevent the State from exercising its general governmental powers in providing for good government; and certainly no equities can grow up in favor of one set of citizens as against others by the fact that illegal acts have been long tolerated or that they are convenient in the preservation of a great industry the importance of which has been repeatedly recognized. Here are many citizens complaining that their rights are being violated, their property and their health threatened, and their common highway over navigable waters obstructed by the illegal acts of the defendant and others. To constitute equitable circumstances which can bind the Court in such a case they would need to be such as would legalize the acts claimed to be wrongful. Has, then, the national or State Governments licensed the defendant to make this use of the navigable streams, or in any way legalized the practice? Has the common law in that respect been modified, as claimed by the defendants? It is of course not claimed that any action on the part of the Federal Government has changed the common law of this State. That is not within the authority of that Government. So are the authorities, and they were not needed in so manifest a case. And it would seem equally clear that the United States has not licensed this use of the rivers, and that it cannot do so, nor can it dedicate them to the use of the miners.

For the purpose of this inquiry it may be conceded that it has licensed the miners to enter upon the public land, to prospect and dig for gold; to appropriate the waters from the non-navigable streams and conduct them for long distances, discharging them again—perhaps into streams from which they were not taken—corrupted and surcharged with mining debris, washing the hills down into canyons and the channels of the mountain streams. To make every canyon or gulch a common way for the tailings of all. That it has finally sold to them the mines with the right to extract from them the gold, and with the full knowledge of the mode of working them, and with full knowledge that the practice of miners in this respect was universal and under claim of right. These propositions are not admitted on the part of the plaintiff, but do any or all of them imply the consent of the Government to the deposit of tailings in the navigable rivers? Obviously all these are the acts of a landowner. The Government has suffered this occupation and use of the public land. They can imply nothing more, for the United States has no further rights in the matter, or power over it. It was stated on the argument that Congress may, and perhaps has, devoted these navigable waters to this industry, under the power to regulate commerce. But evidently this cannot be so. The reason given was that gold facilitates commerce. The products of most industries promote commerce. Nothing facilitates it more than a good government and security for property. Under such a construction, the power to regulate commerce with foreign countries and among the States would be the Aaron's rod to swallow all others. The reserved powers of the States would only be exercised by sufferance. Mining is not a branch of commerce, and certainly not of commerce with foreign nations or among the States. But, if Congress did possess the power, the intention to permit the destruction of navigable waters, so extensive and important, could not be inferred from any doubtful acts. Such a policy is opposed to the practice of all civilized people, and to our own traditions especially. It is manifest from a simple statement of the proposition, that no such result was or could have been anticipated. Then the evil was not evident immediately. There does not seem to have been any material injury until 1864, and even yet it is stoutly denied that the tailings materially injure navigation. The suggestion as to the intention to be inferred from the acts committed and industry encouraged apply with equal force to the claim that the State has licensed this use of the navigable waters.

The Legislature and the courts have recognized the fact that the United States has licensed this extraordinary intrusion upon the public land and the rights asserted by the settlers. Beyond this it has provided for their governmental wants as it has for other communities, and has done so, in part, by recognizing the rules and regulations adopted by themselves when they practically had no government, save such as sprang spontaneously from the instinct for order and genius for organization which seems part of the nature of people accustomed to self-government. These were principally to settle their possessory rights to the land, and to subject it to what was then a novel use under our system, As has been said, it, by wise judicial decisions, has molded them into a comprehensive system of common law, embracing not only mining law, but also regulating the use of water for mining purposes. Perhaps these customs and the practices of miners have been the chief agency in modifying the law of riparian rights—if it has been modified—as not suited to our climate and civilization. In all this, however. there is no rule or custom which can justify the claim that by common consent the navigable waters were subjected to the use of mining, so as to allow tailings to be deposited in them to the injury of navigation. The only thing that can be said is that, in the prosecution of a great industry by a great many people, the practice of dumping into the mountain affluents of these streams has been followed for a long time, and that a great deal of money has been invested in the business, in the full belief, justified, to some extent, by long toleration, that it would be permitted to continue, and that extensive villages have grown up dependent upon it. The rules and customs of miners and their practices, or the fact that they have become part of the common law, outside and apart from this long tolerated practice of dumping into these navigable streams, cannot affect this question. The practice of dumping directly into the navigable waters has never existed, and it is difficult to see how long submission to the consequent injury differs in any respect from any other case where a community has tolerated a nuisance for a long time. In other words the defense is an ingenious attempt to evade the rules, *Nullum tempus occussit regi*, the evidence of acquiescence is long endurance. The mischief, however, as has been said, was not immediately apparent. An action could not have been maintained, for lack of evidence of injury, for many years. A public wrong is not made legal, and certainly acquires no vested right to be perpetuated from long forbearance. There being no change in the common law, the case would be remitted to the ordinary defense of the Statute of Limitations. I have concluded to so find that when the heavier debris is completely impounded mining may be resumed, virtually refusing to hold that the plaintiff may enjoin such operations as only corrupt the water with mud and render it less suitable for domestic and other uses. Perhaps I am somewhat moved to this by the consideration that mining can never be prosecuted at all. It will probably be impracticable to impound the lighter portion of the sediment. I confess I shrink from a consequence so far-reaching. It seems to be a conceded fact that this is not materially injurious either to navigation or the riparian lands. Counsel denied that there was any intention to assail the prosecution of drift, seam or quartz mining. There was no material injury from that source. The sediment from such mines is of the same character as the material which cannot be wholly impounded. Perhaps this will not materially add to the permitted evil.

The authority of the Attorney-General to bring the action in the name of the people, has been called in question, and may become a serious question in the Supreme Court. Practically, it was made only on the final argument. Under the circumstances, I do not doubt the propriety of my referring that matter to the Supreme Court. If the point were sustained and the case dismissed, in the event of a rehearal, a new trial would be necessary before the vital questions involved in the controversy could be presented to the appellate tribunal. There have been many cases in that Court brought by the Attorney-General, on the presumption that such power exists. No question of authority was made. A trial court, under such circumstances, may well follow the practice until a precedent is formed.

J. Temple,
Superior Judge.

June 12, 1882.

The Decree.—In the Superior Court of Sacramento county, State of California. The people of the State of California, plaintiff, vs. The Gold Run Ditch and Mining Company, defendant.

This cause having been duly called for trial upon the complaint, and answer, and both parties appearing and waiving a jury trial, the said cause was duly tried before court without a jury, and the court having heard the evidence and the argument of counsel, has duly signed findings of fact and conclusion of law therefrom, which said findings are now duly filed in this court;

Now, therefore, by reason of the premises and of the law, it is considered by the court, and it is ordered, adjudged and decreed: That said defendant, and all the officers, superintendents, foreman, agents and employees thereof, be perpetually enjoined and restrained from discharging or dumping into the North Fork of the American river, or into any stream tributary thereto, and especially into Canyon creek, any boulders, cobblestones, gravel or sand from the mines; also from causing any such material to flow or to be washed into said river from its said mines or tracts of mineral land. Subject, nevertheless, to this, that said defendants may at any time, as it shall be advised, apply to this court to have this decree and restraining order modified or vacated and set aside. And whenever, upon such showing, it shall appear that efficient means have been provided to impound, detain and hold back such tailings at any point on said American river above Alder creek, and that such means are sufficient to detain all boulders, cobblestones, gravel and the heavier sand, then said defendant shall be entitled to have said decree vacated and set aside. It is further adjudged and decreed that plaintiff recover costs herein, taxed at ——.

J. Temple,
Superior Judge, presiding.

June 12, 1882.

Upon this decision the *Mining and Scientific Press* made the following criticism: "The decision in the famous Gold Run suit, is a "setback" to the miners; but it is by no means as bad as it might be, or as bad as a mere casual reading would lead one to infer. An analysis of the decision is much more encouraging to the miners than appears at a glance. The immediate effect will be to depreciate the value of gravel deposits temporarily, and to temporarily depress the mining interests of the State. It will bring down the value of the bonds of the mining companies, depreciate their stocks, and cause them more or less embarrassment, in one way or another.

The case will be appealed, of course. A new trial will be applied for, which will be denied, and the case will then go to the Supreme Court of California. There are several technical points to be made in the appeal, among them the question of the competence of the Attorney-General to bring the action.

The decision gives the miners the right to continue mining, *provided* they impound or detain the boulders, cobbles and heavy sand, which can easily be done. As a matter of fact, in the Gold Run mine, none of this sort of material came down at all. The judge says himself it will take twelve to twenty years for the material to reach navigable waters. The miners can soil the waters with lighter mud if they so choose, and they cannot be prevented from doing this. The general conclusions of the decision are perhaps correct. The miners will accept the decision as rendered with fairness by an able judge. The trial lasted many weary days, and an immense mass of contradictory testimony was presented. Experts on both sides testified voluminously. All this the judge had to thoroughly digest, separate the "wheat from the chaff," and there is no doubt, from reading the decision, that the gentleman has given the whole subject close study, careful attention and impartial judgment. Partisan feelings may bring other conclusions, but a careful reading of the decision will convince most persons that, whether right or wrong in the abstract, the conclusions are evolved from arguments duly weighed and considered. Nine out of ten of the mines are prepared to control their heavy gravel, rocks and sand. In fact, nearly all can do it, and will construct such dams as will keep back the heavy material. They will comply with the decision the more cheerfully, knowing that the expenses for so doing will not exceed those of litigation.

The main point of the decision as we understand it, is this: The miners claimed a prescriptive right to dump the tailings into the stream. The effect of the decision is, that no such rights ever existed or were acquired. The miners thought they had this right, and exercised it in good faith. Judge Temple now decides that they had not; but, at the same time, he says they can carry on their industry, provided they restrain the heavy material. Temporarily, capital will be withdrawn from the hydraulic mining industry, until the whole question is settled. We venture to predict, however, that this will not affect the gold product of California for more than one year. During that time such dams will be constructed as will comply with the conditions of the judgment. The judge has tried the whole case on the *known* damage on Bear and Yuba rivers; and he admits that, as far as the Gold Run mine is concerned, he is "unable to say that this mine, without reference to the debris from other mines, materially contributes to the evils mentioned; or, in other words, if there were no mining operations save those of the defendant, I am not prepared to say that it would materially injure the valley lands or the navigation of the river. It is the aggregate of debris from all the mines which produces the injuries mentioned in these findings."

This paragraph shows that if the miners had confined their defense to that particular mine, the suit would probably not have been lost. But the miners have been liberal in this matter and have met the issues broadly and fairly. There is a sort of a panic just at the moment among hydraulic miners, of course, but second thought will convince the most despondent that if the decision says they must impound the heavier material, it also gives them the right to let the lighter material pass on. It is not the heavy material of which the farmers complain so badly. If the miners contended that they had vested rights to dump tailings into the water-courses, and the judgment is that they have not, the same judgment says they can soil and muddy the waters if they choose. There are now some thirty-two of the larger hydraulic mines under injunction, but they are all working. Dams will be built, jointly or separately, and it is not probable the mines will shut down. By taking the proper means, the industry is allowed to proceed, and the radical measures prompted by those who contend that the whole business shall be stopped, are, of course, to be thrown aside, and have received judicial rebuke. The decision is, in effect, a judicial enunciation of the doctrine that the miners cannot empty their sand into the streams. The miners contended they had vested and prescriptive rights to do this. Judge Temple says they have not. The decision not only settles the question as far as this court can settle it, but also does something unusual for a judicial document, viz., suggests the remedy for the evil complained of."

A word more on the subject. The *Mining and Scientific Press* a few days before Judge Temple's decision was given, contained the following,—an evidence of the distinctive importance of the question:—"It would seem, after all the time, trouble and money spent on the famous Gold Run suit, that the Sacramento people might wait until that was settled before bringing new suits. The Gold Run suit has been argued and is now under advisement by the Judge who tried it. The case was well known to be a test one, and is so recognised by both sides. Now, however, new suits are to be instituted, since Sacramento's Supervisors, by a vote of four ayes to three noes, adopted the following:

Resolved, That George Cadwalader, our special legal counsel, institute and take the necessary legal steps to enjoin and restrain all the hydraulic mines and mining corporations from using the bed of the American river and its tributaries as a place for the deposit of their tailings or mining debris, also all the hydraulic mining companies operating on the Cosumnes river, from using the bed of Cosumnes river for the deposit of their tailings and debris in said river.

'The effect of this resolution,' aptly says the Grass Valley *Union*, in commenting on it, 'if injunctions can be obtained, will stop all kinds of mining on the American and its tributaries—bar and bank minings as well as that generally designated as hydraulic, where a large quantity of water under pressure is used. Bank mining on the American has been carried on for 30 years without interruption, and the only way in which such claims can be worked is by tailing into the streams. These are generally owned by individuals or partnership associations, and not by large corporations, and they could not afford, of themselves, to defend in expensive suits. The proposition to bring a series of suits against the miners has a look of maliciousness on the part of the anti-debris people of Sacramento county. An important suit has been tried, and a decision is pending, in which the right of miners to use the streams for tailings is involved. It is an important legal question, and the final decision will establish the rights of all parties. Why not wait for the outcome of this case, instead of bringing a multiplicity of suits that can only result in vexing defendants, proving very expensive, and creating further embittering feelings.'"

FORMS FOR MINING COMPANIES AND OFFICERS.

UNDER this caption we have gathered together many little things that will be of daily value to Mining Companies and the officers and stockholders of the same, as they are of the essentially practical side of mining life.

Mining Company Charter.—We append here, as an illustration of a Western Charter, the Charter, by-laws, &c., of the Hidalgo Town Mining Company.

Whereas, the undersigned citizens of Colorado desire to organize themselves into a company and become incorporated under the provisions of the statutes of the State of Colorado, for the purpose of founding and laying out a town on the public lands in the State of Colorado, and prospecting for and developing mines in said State, we do make, sign and acknowledge the following articles of incorporation, viz: This is to certify:

First.—That the corporate name of this company shall be The Hidalgo Town and Mining Company.

Second.—The objects of this corporation shall be the founding, surveying, platting and laying out a town in the county of Gunnison and State of Colorado, upon the public lands and acquiring title to the land therefor from the United States, under the provisions of law, and prospecting for minerals and developing mines in the vicinity of said proposed town, and to do all other acts and things necessary to be done to carry out the above-mentioned objects.

Third.—The capital stock of said corporation shall originally be fifteen hundred dollars, divided into fifteen shares of one hundred dollars each, provided that the capital stock may be increased to any sum not exceeding one hundred thousand dollars ($100,000) by the vote of a majority of the stockholders at any regular meeting thereof, previous notice of such proposed action having been given by the publication for one month in some newspaper published in the county where the principal place of business is located, said stock to be non-assessable.

Fourth.—This corporation shall exist for the term of twenty years from the date of filing this certificate, subject to termination under the provisions of the laws of Colorado.

Fifth.—The officers of this corporation shall be a President, Vice President, Secretary, Treasurer, and seven Trustees; those appointed for the first year shall be as follows:

H. E. AUSTIN, President.
O. E. HENRY, Vice-President.
M. S. ADAMS, Secretary.
GEORGE W. MCGOVERN, Treasurer.

J. A. Merriam,
N. H. Heath,
P. Churchfield,
Will C. Ferril,
Joseph H. Schlund,
B. F. Baldwin,
Charles A. Smith. } Trustees.

Who shall hold their office for one year, or until the first annual meeting in May, 1882, and until their successors are elected and qualified, and said officers shall constitute the Board of Directors.

Sixth.—The principal office for the transaction of the business of this company shall be at Silver Cliff, Custer County, Colorado, until such time as the Board of Directors shall establish a different place.

Seventh.—"The Board of Directors" and their successors in office shall have power to make all such by-laws as they may deem proper for the regulation and management of the business affairs of the company, not inconsistent with the terms of this charter.

Eighth.—Thirty-three and one-third per cent. of the capital stock of this company shall be paid by the stockholders within five days from the filing of these articles of incorporation, and the balance of said stock to be paid in installments at such times as may be ordered by the Board of Directors at the regular meeting of said Board.

In witness whereof, we, the undersigned incorporators, have hereunto set our hands and seals this 9th day of April, A. D. 1881.

H. E. Austin, (Seal).
O. E. Henry, (Seal).
M. S. Adams, (Seal).
Geo. W. McGovern, (Seal).
N. H. Heath, (Seal).
P. Churchfield, (Seal).
Will C. Ferrill, (Seal).
B. F. Baldwin, (Seal).
Thomas Hookey, (Seal).
Joseph H. Schlund, (Seal).
Charles A. Smith, (Seal).

STATE OF COLORADO, } ss.
COUNTY OF CUSTER, }

On this, the 18th day of April, A. D. 1881, personally appeared before me the undersigned, a Notary Public in and for the county and State aforesaid, H. E. Austin, O. E. Henry, M. S. Adams, George W. McGovern, N. H. Heath, P. Churchfield, Will C. Ferrill, B. F. Baldwin, Thomas Hookey, Joseph H. Schlund and Charles A. Smith, who are personally known to me to be the identical persons who signed the foregoing instrument of writing, and each for himself acknowledged the execution of the same to be his own free act and deed for the uses and purposes therein set forth.

In witness whereof I have hereunto set my hand and affixed my Notarial seal the day and year last above written.

NOTARY SEAL.

W. P. ALEXANDER,
Notary Public.

BY-LAWS.

Sec. 1.—The first annual meeting of the stockholders of this company shall be held at the office of the principal place of business of the company on the first Monday in May, 1882, and thereafter on the first Monday of May of each year, at which time shall be elected the officers named in the charter, each stockholder being entitled to one vote for each share of stock he may own or represent by proxy.

Sec. 2.—If for any cause the stockholders shall fail to meet on the day named in section 1 of these by-laws for the election of officers, the president may call a meeting of the stockholders for the purpose of electing the officers of the corporation, and the transaction of such other business as may properly come before the annual meeting first giving ten days' notice of such meeting by a notice published in some newspaper of the county where such meeting is to be held.

Sec. 3.—Any vacancy occurring in the board of directors of said company, by death, resignation or other cause, may be filled by the board of directors at a regular meeting of said board, or a meeting of said board called specially for that purpose.

Sec. 4.—The regular meetings of said board shall be held on the first Tuesday of each month, and special meetings may be called by the President, or on the request of five members of said board; personal notice of such meeting being given to the members thereof residing in the county where such meeting is to be held, and as far as practicable, to all the members of said board, at which meeting, no business shall be done but such as is named in said notice.

Sec. 5.—A majority of said Board of Directors shall constitute a quorum for the transaction of any business that may properly come before them.

Sec. 6.—The Board of Directors may appoint a Superintendent, to hold his office during the pleasure of said Board, and fix his compensation and prescribe his powers and duties, in accordance with the provisions of these By-Laws.

DUTIES OF OFFICERS.—*President.*—A. Sec. 7.—It shall be the duty of the President to preside at all meetings of the Board of Directors and meetings of the Stockholders, to sign all bonds, deeds or other contracts entered into by, or in behalf of the Company, to sign all certificates of stock and all orders on the Treasurer for the payment of money, and perform such other duties as are incident to such office.

Vice-President.—B. It shall be the duty of the Vice-President to perform the duties of the President in the absence of the President.

Secretary.—C. The Secretary shall give due notice of all the called meetings of the Stockholders or Board of Directors, prepare and keep proper books of record of the business of the company, and such other books as the Board of Directors may prescribe, receive all moneys to be paid to said company, and pay the same over to the Treasurer, taking his receipt for the same. He shall countersign and register all certificates of stock and other papers and documents requiring the President's signature, and attest the same with the company's seal, countersign and seal all contracts, bonds and deeds entered into by and on behalf of the company, which have been signed or are to be signed by the President, and perform such other duties as are incident to his office and be the custodian of the corporate seal, and may receive such compensation for his services as may from time to time be allowed by the Board of Directors.

Treasurer.—D. The Treasurer shall be the custodian of the funds of the Company, receiving the same from the Secretary, and giving his receipt therefor, and pay out the same only on the order of the President, countersigned by the Secretary. He shall give such bond for the faithful performance of his duties, as may from time to time be prescribed by the Board of Directors, and may be paid such compensation as the Board of Directors may order.

Superintendent.—E. The Superintendent shall under the direction of the Board of Directors, have control of the working and development of the company's mines and general direction and control of the construction of all mills and other buildings ordered to be erected, and perform such other duties as may be prescribed for him by the Board of Directors, and shall receive such compensation as may be allowed by the Board of Directors.

Seal.—Sec. 8.—This company adopts as its corporate seal the following design: "Figure of an elk standing erect surrounded by the words, 'The Hidalgo Town and Mining Company, Incorporated April 28th, 1881. Colorado.'"

Finance.—Sec. 9.—The fiscal year shall end on Saturday preceding the annual meeting of the Stockholders, at which meeting the Secretary and Treasurer shall submit their reports in writing, showing all the receipts and disbursements of funds. And at the same time the Superintendent shall submit a report in writing showing his receipts and disbursements, and all his business transactions for the company, and also the general condition of the affairs of the company, and said officers shall also report to the Board of Directors at any time when ordered to do so by said Board.

Dividends.—Sec. 10.—Dividends may be made by the Board of Directors at any regular meeting of said Board, but not in excess of the surplus funds in the Treasury, and shall be apportioned only to the stock subscribed and issued.

Debts.—Sec. 11.—No debt shall be contracted for the company except by order of the Board of Directors, and then not in excess of the funds actually in the Treasury.

Finance Committee.—Sec. 12.—The President shall appoint a Committee of three on Finance to whom shall be referred all bills and accounts for their approval, and to whom shall also be referred all reports of the Secretary, Treasurer, Superintendent, or other officer of the company in any manner connected with the finances of the company, and the Finance Committee and any member of the Board of Directors shall at all times have access to the books of said officers for the purpose of examination.

Bills and Accounts.—Sec. 13.—All bills against the company shall be itemized, and duly presented to the Board of Directors, and shall not be paid until audited by the Finance Committee and ordered paid by said Board, provided that the Board of Directors may order the Treasurer to pay over to the Superintendent, from time to time, such sums of money as may be necessary to pay for assessment work or other developments or improvements ordered to be made by said Board.

Stock.—Sec. 14.—Transfers of stock shall be made only on the books of the company by the owner in person, or by Attorney upon surrender of the certificate transferred, and when made by Attorney, the power of Attorney shall be filed and remain with the Secretary, who shall be entitled to a fee of fifty cents for each certificate issued by him. When any certificate of stock has been lost or destroyed the owner may apply for a new certificate of such stock and shall be entitled to receive such new certificate upon application to the Board of Directors, accompanied by proof to their satisfaction, showing that such certificate has been lost or destroyed, and also in the discretion of the Board, giving a bond of indemnity, with not less than two good and sufficient sureties to be approved by the Board, securing the company, and any person interested, against liability and loss by reason of the issuance of such new certificate, which bond shall be the only recourse for any person subsequently claiming such stock under the certificate so alleged to have been lost or destroyed.

Amendments.—Sec. 15.—These By-Laws may be amended or repealed, or additional sections passed, at any regular meeting of the Board of Directors, by a vote of two-thirds of all the members of said Board, notice of the proposed amendment having been given at a regular meeting of the Board preceding the one at which action is taken thereon.

ORDER OF BUSINESS.

1. Calling the Roll.
2. Reading the Minutes.
3. Reading Communications.
4. Presentation of Bills.
5. Reports of Standing Committees.
6. Reports of Special Committees.
7. Unfinished Business.
8. Miscellaneous Business.

Adopted July 8th, 1881.

AMENDMENTS TO THE CHARTER.

Be it remembered that at a meeting of the Stockholders of the "Hidalgo Town and Mining Company," held at the office of the Secretary of said company at Silver Cliff, Colorado, on the 9th day of August, A. D. 1881, pursuant to the following notice, to-wit:

STOCKHOLDERS' MEETING,
SILVER CLIFF, COLORADO,
July 8th, 1881.

The Stockholders of the "Hidalgo Town and Mining Company" are hereby notified that a meeting of said company will be held at the office of the Secretary of said company in Silver Cliff, Colorado, on the 9th day of August, 1881, at 8 o'clock P. M., at which time a proposition will be submitted to the company to increase the capital stock of said company to $100,000, according to the provisions of the charter.

M. S. ADAMS, Secretary.

H. E. AUSTIN, President.

And it appearing that notice of said meeting had been duly given in accordance with the provisions of the charter of said company, from the affidavit of W. S. Montgomery, duly filed with the Secretary of said company as follows, viz:

STATE OF COLORADO, Custer County. } ss.

W. S. Montgomery being duly sworn says that for the last six months he has been the editor and publisher of the Daily and Weekly Prospect, a newspaper published in the town of Silver Cliff, Custer County, State of Colorado, and that the annexed and foregoing notice of the Stockholders' meeting of the Hildago Town and Mining Company, has been published in said paper for one month next preceding the date of this affidavit, and that said notice has been published four times in said paper, and further this deponent saith not. W. S. MONTGOMERY.

Subscribed and sworn to before me this ninth day of August, 1881.

NOTARY SEAL.

W. P. ALEXANDER,
Notary Public.

And there being present a quorum for the transaction of business either in person or by proxy the following proceedings were had, to wit:

The President being absent, the meeting was called to order by the Vice President, O. E. Henry, who presided over said meeting. M. S. Adams offered the following resolution, to wit:

Resolved, That the capital stock of this company be increased to one hundred thousand dollars ($100,000), and that the stock be disposed of in accordance with the recommendation of the Committee of Ways and Means, under the direction of the Board of Directors.

The vote on the motion to adopt this resolution was taken by ayes and nays, when it appearing that four-fifths of all the capital stock had voted in favor of its adoption, and none having voted against its adoption, the resolution was declared adopted, and the capital stock of said company was declared to be increased to one hundred thousand dollars.

In witness whereof we have hereunto set our hands and seals this 25th day of November, 1881.

CORPORATE SEAL.

H. E. AUSTIN, President. [SEAL]
M. S. ADAMS, Secretary. [SEAL]

STATE OF COLORADO, Custer County. | ss.

H. E. Austin and M. S. Adams being duly sworn each for himself says that he is President and Secretary of the Hidalgo Town and Mining Company, respectively, and that the above and foregoing is a correct record of the proceedings of said company, with reference to the increase of the capital stock of said company at the meeting of the Stockholders thereof, held August 9th, A. D., 1881, as it appears from the records of said company made at the time of said meeting, and further these deponents say not.

H. E. AUSTIN,
M. S. ADAMS.

Subscribed and sworn to before me this 26th day of November, A. D. 1881.

NOTARY SEAL.

SAMUEL LEIGHTON.
Notary Public.

STATE OF COLORADO, Secretary's Office. | ss.

I, Norman H. Meldrum, Secretary of State of the State of Colorado, do hereby certify that the foregoing is a full, true and complete transcript of the certificate of amendments to the original articles of incorporation of the Hidalgo Town and Mining Company which was filed in this office the thirtieth day of November, A. D., 1881, at 9 o'clock A. M., and admitted to record.

In testimony whereof I have hereunto set my hand and affixed the great seal of the State, at the City of Denver, this first day of December, A. D., 1881.

GREAT SEAL OF THE STATE OF COLORADO.

N. H. MELDRUM,
Secretary of State.

The charter of the Chrysolite company, is a good example of an Eastern charter. It is as follows:

State of New York, City and County of New York, ss.:

We, Horace A. W. Tabor, Drake De Kay and Henry C. Gardiner, citizens of the United States, and a majority of whom are citizens of the State of New York, hereby associate together for the purpose of creating a corporation under the laws of the State of New York, authorizing the formation of corporations for mining and other purposes, and in compliance with the provisions of said laws we do hereby state and certify:

First.—That the corporate name of this company is and shall be the CHRYSOLITE SILVER MINING COMPANY.

Second.—That this company is formed for the sole purpose of mining the ores and minerals contained in the mines known as the Chrysolite, Carboniferous, Little Eva, Vulture, Kit Carson, All Right, Fairview, Pandora, Colorado Chief, Solid Muldoon, Silver and Eaton, and no others, situated in the California Mining District, Lake County, State of Colorado, and separating the metals from such ores and minerals. The said company shall have power to purchase the said mines, to wit: The said Chrysolite, Carboniferous, Little Eva, Vulture, Kit Carson, All Right, Fairview, Pandora, Colorado Chief, Solid Muldoon, Silver and Eaton, and to issue full-paid stock in payment therefor.

Third.—That the amount of capital stock of this company is and shall be ten million dollars, divided into two hundred thousand shares of the par value of fifty dollars each.

Fourth.—That the existence of the company shall continue for the term of fifty years.

Fifth.—That the number of trustees who shall manage the concerns and business affairs of said company is and shall be eleven, and John P. Jones, Daniel S. Appleton, Ulysses S. Grant, Junior, Henry A. V. Post, William Borden, Horace A. W. Tabor, William S. Nichols, Leonidas M. Lawson, Edward B. Dorsey, Arthur Sewell, and Charles A. Whittier, are the names of the persons who shall be the trustees of said company for the first year, and all of whom are citizens of the United States, and a majority citizens and residents of the State of New York.

Sixth.—That the principal office and place of business of said company shall and is to be located in the City and County of New York, State of New York; but the mining operations and the separation of the metals from the ores are to be carried on out of the State of New York, viz.: In the County of Lake, State of Colorado, and elsewhere in said State.

In witness whereof, we have hereto set our hands and seals this twenty-ninth day of September, one thousand eight hundred and seventy-nine.

(Signed), H. A. W. TABOR,
DRAKE DE KAY,
HENRY C. GARDINER.

SEAL.

State of New York, City and County of New York, ss.:

On the 30th day of September, 1879, before me personally came Horace A. W. Tabor, Drake De Kay, and Henry C. Gardiner, to me known, and known to me to be the individuals described in and who executed the foregoing certificate, and severally acknowledged that they executed the same for the uses and purpores therein mentioned.

(Signed) WILLIAM H. CLARKSON,
Notary Public for New York County, N. Y.

State of New York, City and County of New York, ss.:

I, Hubert O. Thompson, Clerk of the said City and County, and Clerk of the Supreme Court of said State for said County, do certify that I have compared the preceding with the original certificate of incorporation of the Chrysolite Silver Mining Company on file in my office, and that the same is a correct transcript therefrom, and of the whole of said original, endorsed, filed 3d October, 1879.

In witness whereof I have hereunto subscribed my name and affixed my official seal this 3d day of October, 1879.

SEAL.

(Signed,) HUBERT O. THOMPSON,
Clerk.

State of New York, Office of the Secretary of State, ss.:

I have compared the preceding with the original certificate of incorporation of the Chrysolite Silver Mining Company, with acknowledgment thereto annexed, filed in this office on the 3d day of October, 1879, and do hereby certify the same to be a correct transcript therefrom, and of the whole of said original.

Witness my hand and seal of office of the Secretary of State, at the City of Albany, this third day of October, one thousand eight hundred and seventy-nine.

SEAL.

(Signed,) GEORGE MOSS,
Deputy Secretary of State.

BY-LAWS.

ARTICLE I.—*Officers*, - Sec. 1.—The officers of this company shall consist of a President, Vice-President, Treasurer, Secretary, General Manager, and Financial Agent. The President and Vice-President must be chosen from the Trustees.

ARTICLE II.—*President.*—Sec. 1.—The President shall be the chief executive agent of the company in the management of its affairs, but subject at all times and in all matters to the control and direction of the Board of Trustees. He shall, when present, preside at all meetings of the Board of Trustees, and perform such other duties as may be required of him by the laws of the State, and by the by-laws of the company, and by the Board of Trustees. He shall sign all contracts, certificates of stock, drafts, acceptances and checks.

Sec. 2.—He shall receive such salary as the Board of Trustees may fix and allow.

Sec. 3.—He may be removed at any time by a majority of the Board of Trustees.

ARTICLE III.—*Vice-President.*—Sec 1.—In the absence of the President, the Vice-President shall possess all the powers and perform all the duties of the President, and receive such compensation for his services as the Board may fix and allow.

ARTICLE IV.—*Treasurer.*—Sec. 1.—It shall be the duty of the Treasurer to receive all the money and funds of the company, and deposit the same in such banking-house as the Board of Trustees shall from time to time direct; and, under the direction of said Board, he shall pay out the same by check, countersigned by the President and Secretary, and not otherwise.

Sec. 2.—He shall keep full and correct books of account, which shall at all times be open to the inspection of any member of the Board. He shall make a report in detail to said Board at least quarterly, and make such other reports and statements at such times as said Board may require.

He shall give such bonds as the Board shall require.

Sec. 3.—He shall be entitled to such compensation for his services as the Board of Trustees may from time to time fix and allow.

ARTICLE V.—*Secretary.*—Sec. 1.—It shall be the duty of the Secretary to keep full and accurate minutes of all proceedings of the Board of Trustees and Executive Committee, and of the Stockholders, in a proper book or books. He shall also keep a list of all persons who are or have been Stockholders within the period of one year, with their names alphabetically arranged.

Sec. 2.—He shall perform such other duties as may be required by the laws of the State, the Board of Trustees, and the By-Laws of the company; and he shall receive such salary as the Board of Trustees may fix and allow.

ARTICLE VI.—*General Manager.*—Sec. 1.—The General Manager shall be the general agent of the company in the State of Colorado. He shall have power to enter upon and take possession of all the mines and property of the company in the State of Colorado.

Sec. 2.—The General Manager shall be subject at all times and in all matters, acts and transactions, to the direction and control of the President of the company and of the Board of Trustees.

Sec. 3.—He shall not have the power to contract any debt or incur any liability on the part of the company exceeding at any time ten thousand dollars in the aggregate, unless previously authorized by the Board of Trustees.

Sec. 4.—He shall be subject to suspension at any time at the will of the President, and to removal by the Board of Trustees; and in case of suspension by the President, the President shall forthwith notify the Trustees of such suspension, and call a meeting of the Board.

Sec. 5.—The General Manager shall receive such compensation for his services as the Board of Trustees may from time to time fix and allow.

ARTICLE VII.—*Trustees.*—Sec. 1.—Regular meetings of the Board of Trustees shall be held at the office of the company on the fifteenth day of each and every month. When this falls on a legal holiday, on the next succeeding day that is not a legal holiday.

Sec. 2.—Special meetings of the Board may be held at any time on notice of two days, by mail or personal service, to each member of said Board, stating the time, place and objects of meeting, to be given by the President or by the Secretary at the request of any two members of the Board, and no business except that so stated can be acted on at such meeting.

Sec. 3.—They shall exercise a general supervision over the affairs of the company, receive and pass upon the reports of the Secretary, Treasurer and Superintendent, declare dividends, audit all bills and accounts against the company, and direct the Secretary in correspondence. They shall have power to delegate from time to time such authority as they may deem necessary to the officers or agents of the company, or to any one or more members acting as a committee. They may appoint a managing director or such other agents as they may deem necessary, define their respective duties, fix their compensation, and remove or suspend them for sufficient cause, except for the removal of the President and amendment of the By-Laws; in this case a majority.

Sec. 4.—Five of the trustees shall constitute a quorum of the Board at any regular or special meeting; but, in the absence of a majority of the Board, the minority shall have power to adjourn such meeting, regular or special.

In case of meetings held for the amendment of the By-Laws or the removal of the President, a majority of the Trustees elected shall be necessary to constitute a quorum.

Sec. 5.—Neither the President nor any other officer or agent of this company shall have power to contract any debt or incur any liability exceeding the sum of ten thousand dollars, without the authority of the Board of Trustees or the Executive Committee.

ARTICLE VIII.—*Executive Committee.*—Sec. 1.—There shall be an Executive Committee, consisting of five Trustees, four of whom shall be appointed by resolution of the Board. The President, or in his absence the Vice President, shall act as the fifth member of such committee.

Sec. 2.—The Executive Committee shall have full power to manage all the business affairs of the company when the Board is not in session, and the acts and proceedings of the said committee shall have the same force and effect as the acts and proceedings of the Board of Trustees, unless the action of said committee shall be disapproved by resolution adopted by the Board at the next meeting of the Board held after such act or proceeding of said committee has been reported to the Board of Trustees.

Sec. 3.—Any officer or employee of the company, excepting the President, may be suspended or removed at will by the Executive Committee.

ARTICLE IX.—*Vacancy and Tenure.*—Sec. 1.—In case of a vacancy occurring from any cause in the Board of Trustees, the same may be filled by appointment made by the Trustees in office.

Sec. 2.—The Trustees, and each and every officer of the company, shall hold office until their or his successors shall have been elected or appointed and have qualified; but nothing in this section shall be so construed as to prevent the removal of any officer as hereinbefore provided.

ARTICLE X.—*Certificates.*—Sec. 1.—The capital stock of this company shall be represented by certificates signed by the President and the Secretary.

ARTICLE XI.—*Seal.*—Sec. 1.—The corporate seal shall bear upon its face, within a circle, the corporate name of the company and date of incorporation.

ARTICLE XII.—*Closing of Books.*—Sec. 1.—The stock books of the company shall be closed for five days previous to any election of Trustees or the date of payment of a dividend; and a list of stockholders prepared at that time shall designate who shall vote or receive dividends.

ARTICLE XIII.—*Stockholders' Meeting.*—Sec. 1.—The annual meeting of the Stockholders for the election of Trustees of this company shall be held in the city of New York on the first Tuesday in October, 1880, and yearly thereafter. Twenty days notice shall be given of the time and place of holding such meeting by the Secretary, by public advertisement in one or more daily newspapers published in the city of New York, and by notice sent by mail to each Stockholder at his residence, as it may appear on the books of the company. A majority of the Stockholders present, either in person or by attorney, shall constitute a quorum.

Sec. 2.—At such election each Stockholder shall be entitled to cast one vote for each share standing in his name, as shall appear by stock list at the time of closing the books. No person shall vote as proxy unless he shall produce and deliver to the Secretary a written authority so to do, signed by the Stockholder whom he represents.

Sec. 3.—The polls shall be open at twelve o'clock noon, and shall remain open until two o'clock in the afternoon of the same day, and on the closing thereof the inspectors shall proceed to count the vote and declare the result.

ARTICLE XIV.—*Amendments.*—Sec. 1.—These By-Laws may be altered, amended or repealed by the Board of Trustees, at any regular or special meeting; but in every or any such alteration, amendment or repeal at least a majority of the members of the Board of Trustees must concur.

FORM OF PATENT FOR PLACER CLAIM.—General Land Office, No. 4,458. Mineral certificate No. 448.

The United States of America to all to whom these presents shall come, greeting:

Whereas, in pursuance of the provisions of the Revised Statutes of the United States, chapter six, title thirty-two, there has been deposited in the General Land Office of the United States the certificate of the register of the land office at Helena, in the Territory of Montana, whereby it appears that, in pursuance of the said Revised Statutes of the United States, James D. Hammond did, on the ninth day of June, A. D. 1879, enter and pay for certain placer mining premises, being mineral entry number four hundred and forty-eight (448) in the series of said office, embracing the west half of the southeast quarter and the southeast quarter of the southwest quarter of section twenty-three (23), and the northeast quarter of the northeast quarter of section twenty-eight (28), in township ten (10) north, of range four (4) east of the principal meridian, containing one hundred and sixty (160) acres of land, more or less, as shown by the official survey and plat of said township; said placer mining claim or lot of land being situate in the Summit Valley mining district, in the county of Lewis and Clarke, and the Territory of Montana, in the district of lands subject to sale at Helena, and commonly known as the "Jennie Placer Mine."

Now know ye, that the United States of America, in consideration of the premises and in conformity with said Revised Statutes of the United States, have given and granted, and by these presents do give and grant, unto the said James G. Hammond, and to his heirs and assigns, the said placer mining premises above described as the west half of the southeast quarter and the southeast quarter of the southwest quarter of section twenty-three (23), and the northeast quarter of the northeast quarter of section twenty-eight (28), in township ten (10) north, of range four (4) east of the principal meridian.

To have and to hold said mining premises, together with all the rights, privileges, immunities and appurtenances of whatsoever nature thereunto belonging, unto the said James G. Hammond, and to his heirs and assigns forever; subject, nevertheless, to the following conditions and stipulations:

First. That the grant hereby made is restricted in its exterior limits to the boundaries of said legal subdivisions, as hereinbefore described, and to any veins or lodes of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, which may hereafter be discovered within said limits, and which are not claimed or known to exist at the date thereof.

Second. That should any vein or lode of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, be claimed or known to exist within the above-described premises at the date hereof, the same is expressly excepted and excluded from these presents.

Third. That the premises hereby conveyed may be entered by the proprietor of any vein or lode of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, for the purpose of extracting and removing the ore from such vein, lode, or deposit, should the same, or any part thereof, be found to penetrate, intersect, pass through, or dip into the mining ground or premises hereby granted.

Fourth. That the premises hereby conveyed shall be held subject to any vested and accrued water rights for mining, agricultural, manufacturing, or other purposes, and rights to ditches and reservoirs used in connection with such water rights as may be recognized and acknowledged by the local laws, customs, and decisions of courts.

Fifth. That in the absence of necessary legislation by Congress, the legislature of Montana may provide rules for working the mining claim or premises hereby granted, involving easements, drainage, and other necessary means to the complete development thereof.

In testimony whereof, I, Rutherford B. Hayes, President of the United States of America, have caused these letters to be made patent, and the seal of the General Land Office to be hereunto affixed.

Given under my hand, at the city of Washington, the tenth day of December, in the year of our Lord one thousand eight hundred and eighty, and of the Independence of the United States the one hundred and fifth.

By the President.

[SEAL.] R. B. HAYES,
By WM. H. CROOK,
Secretary.

S. W. CLARK,
Recorder of the General Land Office.
Recorded, vol. 54, pages 41 and 42.

FORM OF PATENT FOR VEIN OR LODE CLAIM.—General Land Office No. 4398.—Mineral Certificate No. 419.

The United States of America, to all to whom these presents shall come, greeting:

Whereas, in pursuance of the provisions of the Revised Statutes of the United States, chapter six, title thirty-two, there have been deposited in the General Land Office of the United States the plat and field-notes of survey of the claim of John W. Roe upon the Brooklyn lode, accompanied by the certificate of the register of the land-office at Salt Lake City, in the Territory of Utah, whereby it appears that, in pursuance of the said Revised Statutes of the United States, John W. Roe did, on the thirty-first day of December, A. D. 1879, enter and pay for said mining claim or premises, being mineral entry No. 419, in the series of said office, designated by the Surveyor-General as lot No. 60, embracing a portion of the unsurveyed public domain, in the Ophir Mining District in the county of Tooele and Territory of Utah, in the district of lands subject to sale at Salt Lake City, containing one (1) acre and eighty-four hundredths ($\frac{84}{100}$) of an acre of land, more or less, and, according to the returns on file in the General Land Office, bounded, described and platted as follows, with magnetic variation at sixteen (16) degrees and thirty-five (35) minutes east, to wit:

Beginning at corner No. 1, a cottonwood post, four (4) inches in diameter, marked "U. S. L. 60, No. 1"; thence north sixty-five (65) degrees thirty (30) minutes west, fifty (50) feet to centre of southwesterly boundary of the claim, from which discovery bears north twenty (20) degrees east, at the distance of four hundred (400) feet, ninety-eight and seven-tenths ($98\frac{7}{10}$) feet to a point on easterly boundary of lot No. 63, made for the Noyes lode, from which corner No. 1 of lot No. 63 bears south fourteen (14) degrees west at the distance of seventeen and seven-tenths ($17\frac{7}{10}$) feet, one hundred (100) feet to corner No. 2, a cottonwood post four (4) inches in diameter, in mound of stones, marked "U. S. L. 60, No. 2," from which U. S. Mineral Monument No. 6 bears south ten (10) degrees west at the distance of nine hundred and ninety-eight (998) feet; thence from said corner No. 2 north twenty-six (26) degrees east, six (6) feet to a point on easterly boundary of said lot No. 63, from which corner No. 1 of said lot No. 63 bears south fourteen (14) degrees west, at the distance of twenty-three and eight-tenths ($23\frac{8}{10}$) feet, eight hundred (800) feet to corner No. 3, a cottonwood post four (4) inches in diameter, marked "U. S. L. 60, No. 3"; thence south sixty-five (65) degrees thirty (30) minutes east, one hundred (100) feet to corner No. 4, a cottonwood post four (4) inches in diameter, marked "U. S. L. 60, No. 4"; thence south twenty-six (26) degrees west, eight hundred (800) feet to the place of beginning, containing one (1) acre and eighty-four hundredths ($\frac{84}{100}$) of an acre of land more or less, and embracing eight hundred (800) linear feet of the Brooklyn lode, to wit, four hundred (400) linear feet northeasterly and four hundred (400) linear feet southwesterly from discovery on said lode, as represented by yellow shading in the following plat: [Here follows diagram of claim, shaded in yellow.]

Now know ye, That the United States of America, in consideration of the premises, and in conformity with the said Revised Statutes of the United States, have given and granted, and by these presents do give and grant unto the said John W. Roe and to his heirs and assigns, the said mining premises hereinbefore described as lot No. 60, embracing a portion of the unsurveyed public domain, with the exclusive right of possession and enjoyment of all the land included within the exterior lines of said survey not herein expressly excepted from these presents, and of eight hundred (800) linear feet of the said Brooklyn vein, lode, ledge, or deposit for the length hereinbefore described, throughout its entire depth, although it may enter the land adjoining, and also all other veins, lodes, ledges, or deposits throughout their entire depth, the tops or apexes of which lie inside the exterior lines of said survey at the surface extended downward vertically, although such veins, lodes, ledges, or deposits in their downward course may so far depart from a perpendicular as to extend outside the vertical side lines of said survey: *Provided*, That the right of possession hereby granted to such outside parts of said veins, lodes, ledges, or deposits shall be confined to such portions thereof as lie between vertical planes drawn downward through the end lines of said survey at the surface, so continued in their own direction that such vertical planes will intersect such exterior parts of said veins, lodes, ledges, or deposits: *And provided further*, That nothing in this conveyance shall authorize the grantee herein, his heirs or assigns, to enter upon the *surface* of a mining claim owned or possessed by another: To have and to hold said mining premises, together with all the rights, privileges, immunities, and appurtenances of whatsoever nature thereunto belonging, unto the said John W. Roe, and to his heirs and assigns forever, subject, nevertheless, to the following conditions and stipulations:

First. That the grant hereby made is restricted to the land hereinbefore described as lot No. 60, with eight hundred (800) linear feet of the Brooklyn vein, lode, ledge, or deposit for the length aforesaid throughout its entire depth as aforesaid, together with all other veins, lodes, ledges, or deposits throughout their entire depths as aforesaid, the tops or apexes of which lie inside the exterior lines of said survey.

Second. That the premises hereby conveyed, with the exception of the surface, may be entered by the proprietor of any other vein, lode, ledge, or deposit, the top or apex of which lies outside the exterior limits of said survey, should the same in its downward course be found to penetrate, intersect, extend into, or underlie the premises hereby granted, for the purpose of extracting and removing the ore from such other vein, lode, ledge, or deposit.

Third. That the premises hereby conveyed shall be held subject to any vested and accrued water rights for mining, agricultural, manufacturing or other purposes, and rights to ditches and reservoirs used in connection with such water rights as may be recognized and acknowledged by the local laws, customs, and decisions of courts.

Fourth. That in the absence of necessary legislation by Congress, the legislature of Utah may provide rules for working the mining claim or premises hereby granted, involving easements, drainage, and other necessary means to its complete development.

In testimony whereof, I, Rutherford B. Hayes, President of the United States of America, have caused these letters to be made patent, and the seal of the General Land Office to be hereunto affixed.

Given under my hand, at the city of Washington, the tenth day of December, in the year of our Lord one thousand eight hundred and eighty, and of the Independence of the United States the one hundred and fifth.

By the President:

[SEAL.] R. B. HAYES,
By WM. H. CROOK,
Secretary.

S. W. CLARK,
Recorder General Land Office.
Recorded, vol. 54, pages 43 to 45, inclusive.

Rules for forming a Mining District. We append for this illustration the rules adopted May 27th, of this year in the formation of the Calico Mining District of the State of California:

By-Laws of Calico Mining District, adopted May 27th, 1882.—

SEC. 1.—Calico Mining District shall be bounded as follows: Commence at a point about two and a half miles west of the Calico Well, (better known as the little red butte), run thence ten miles north, thence ten miles east, thence ten miles south, thence ten miles west to point of beginning.

SEC. 2.—The name of the district shall be Calico.

SEC. 3.—This district shall have one officer, viz: A Recorder, whose office shall be in Calico.

SEC. 4.—The Recorder shall hold his office for one year, beginning the 1st day of June and ending the last day of May, provided, his successor has been previously elected; otherwise he shall hold office until the election of a successor.

SEC. 5.—It shall be the duty of the Recorder to keep a record-book for the purpose of recording claims and affidavits of assessment work.

SEC. 6.—The Recorder shall receive one dollar for recording claims, fifty cents for recording affidavits, and twenty-five cents for furnishing certificates.

SEC. 7.—It shall be the duty of the Recorder to post notices of election, in three public places, ten days before the expiration of his term.

SEC. 8.—At the request of five miners, the Recorder shall call a miners' meeting. The notice of the meeting shall set forth the object for which it is called.

SEC. 9.—Provided the limits of the district are to be changed or the By-laws amended, the Recorder shall give notice of such changes or amendments twenty days beforehand by posting-notices in three public places in the district.

SEC. 10.—It shall be the duty of the Recorder to turn over to his successor all books and papers pertaining to the archives of the district.

SEC. 11.—The width of lode claims shall be three hundred feet on each side of the center of the vein or crevice.

SEC. 12.—The discoverer of a lode shall, within ninety days from the date of discovery, record his claim in the office of the Recorder of this district, which record shall contain: 1st, the name of the lode; 2d, the name of the locator; 3d, the date of the locations; 4th, the number of feet in length claimed on each side of the centre of the discovery shaft; 5th, the general course of the lode as near as may be.

SEC. 13.—Any location certificate of a lode claim which shall not contain the name of the lode, the name of the locator, the date of location, the number of lineal feet claimed on each side of the discovery shaft, the general course of the lode, and such description as shall identify the claim with reasonable certainty, shall be void.

SEC. 14.—Before filing such location certificate the discoverer shall locate his claim by first sinking a discovery shaft upon the lode, to the depth of at least ten feet from the lowest part of the rim of such shaft at the surface, or deeper if necessary to show a well-defined crevice. Second, by posting at the point of discovery or the surface, a conspicuous notice containing the name of the lode, the name of the locator, and the date of the discovery. Third, by marking the surface boundaries of the claim.

SEC. 15.—The surface boundaries shall be marked by nine substantial posts or monuments, three on each end and three on a line running through the centre.

SEC. 16.—Any open cut, cross-cut or tunnel, which shall cut a lode at the depth of ten feet below the surface, shall hold such lode the same as if a discovery shaft were sunk thereon, or an adit of at least ten feet along the lode, from the point where the lode may be in any manner discovered, shall be equivalent to a discovery shaft.

SEC. 17.—The discoverer shall have sixty days from the time of discovering a ledge or lode to do the necessary work on his claim.

SEC. 18.—If at any time the locator of any mining claim heretofore or hereafter located, or his assigns shall apprehend that his original certificate was defective, erroneous, or that the requirements of the law had not been complied with before filing; or shall be desirous of changing his surface boundaries; or of taking in any part of an overlapping claim which has been abandoned, such locator or his assigns may file an additional certificate; provided that such re-location does not interfere with the existing rights of others at the time of such relocation; and the record thereof shall preclude the claimants from proving any such title or titles as he or they may have held under previous location.

SEC. 19.—The relocation of abandoned lode claims shall be by sinking a new discovery shaft, fixing new boundaries in the same manner as if it were the location of a new claim; or the relocator may sink the original discovery shaft ten feet deeper than it was at the time of abandonment, and erect new or adopt the old boundaries, renewing the monuments if removed or destroyed. In either case a new location stake or monument shall be erected. In any case, whether the whole or part of an abandoned claim is taken, the location certificate may state that the whole or any part of the new location is located as abandoned property.

SEC. 20.—No location certificate shall claim more than one location, whether the location be made by one or several locators; and if it purport to claim more than one location, it shall be absolutely void, except as to the first location therein described. And if they are described together, or so that it cannot be told which location is first described, the certificate shall be void as to all.

SEC. 21.—Within thirty days after performing the assessment work on a claim the person on whose behalf such outlay was made, or some person for him, shall make and record an affidavit in substance as follows:

STATE OF CALIFORNIA, }
COUNTY OF SAN BERNARDINO. }

Before me, the subscriber, personally appeared who being duly sworn said that at least dollars' worth of work or improvements were performed or made upon (here describe claim or part of claim), situate in Calico Mining District, County of San Bernardino, State of California. Such expenditure was made by or at the expense of , owners of said claim. (Signature.)

And such signature shall be prima facie evidence of the performance of such labor.

SEC. 22.—These By-laws shall take effect on the tenth day of June, 1882.

FORMS—NOTICE OF LOCATION.

Notice is hereby given that the undersigned having complied with the requirements of the Chapter Six of Title Thirty-two of the Revised Statutes of the United States, and the local customs, laws and regulations, has located linear feet on the lode [twenty acres of placer mining ground], situated in Mining District, County, , and described as follows:

[*Describe the claim accurately (by courses and distances, if possible,) with reference to some natural object or permanent monument, and mark the boundaries by suitable monuments: if a placer claim is located on surveyed land, describe the legal sub-division.*]

Discovered , 188–. , Locator.
Located , 188–. Recorded , 188–.
Attest:

PROOF OF LABOR.

of *County of* , *ss.*

Before me the subscriber personally appeared , who being duly sworn says that at least dollars' worth of labor or improvements were performed or made upon [here describe claim], situated in mining district, county, of , during the year ending , 188–. Such expenditure was made by or at the expense of , owners of said claim, for the purpose of holding said claim.

[Jurat.] —— —— (Signature).

NOTICE OF FORFEITURE.

—— County, , 188–.

To—(names of all parties who have record title to any portion of the mine). You are hereby notified that I have expended dollars in labor and improvements upon the lode (describe the claim), as will appear by certificates filed , 188 , in the office of the Recorder of said county (or district), in order to hold said premises under the provisions of section 2324 Revised Statutes of the United States, being the amount required to hold the same for the year ending , 188 . And if within ninety days from the service of this notice (or within ninety days after this notice by publication), you fail or refuse to contribute your proportion of such expenditure as a co-owner, your interest in said claim will become the property of the subscriber under said section 2324.

(Signature).

AFFIDAVIT OF FAILURE TO CONTRIBUTE.

of , *County of* , *ss.*

, being duly sworn deposes and says that for the year ending , 188 , he expended at least dollars in labor and improvements upon the lode [or placer claim] (here describe the claim), to hold the same under the laws of the United States and of this (district, Territory or State,): that due notice thereof was personally served upon , co-owners, on the day of , 188 , (or was duly published in the , as appears from the affidavit of the publisher thereof): and that of the said) co-owners have failed or refused to contribute their share of said expenditures within the time required by law.

Subscribed and sworn to before me this day of , 188 .

MINER'S LIEN.

Know all Men by these Presents, That I, , of the county of , of , do hereby give notice of my intention to hold and claim a lien, by virtue of the statute in such case made and provided, upon (describe premises), with all improvements and appurtenances, situated in Mining District, County of , of .

The said lien being claimed and held for and on account of *work and labor done by me as for , owner of said premises* in and upon said premises, from the day of , A. D., 188 , to the day of , A. D., 188 .

The total value of the said work and labor being dollars, upon which there has been paid the sum of dollars, leaving a balance of dollars still due, owing and unpaid to me, the said claimant.

(Signature).

of , County of , ss.

On this day of , A. D. 188 , personally appeared before me the above named , and who being by me first duly sworn, on oath states that the abstract of indebtedness mentioned and described in the foregoing notice, is true and correct, and that there is still due and owing to from the said , for the aforesaid, the sum of dollars and cents.

(Signature).

Subscribed and sworn to before me this day of , A. D. 188 .

(Official Signature).

APPLICATION FOR SURVEY.

, 188 .

To , United States Surveyor-General for :

SIR—In compliance with the provisions of Chapter Six of Title Thirty-two, Revised Statutes of the United States, herewith make application for an official survey of the mining claim known as the mine, claimed by , located in Mining District, in the County of , Township No. , Range No. , base and meridian, in the of , and request that you will send to address an estimate of the amount to be deposited, for the work to be done in your office; and that after such deposit shall have been made, you will cause the said mining claim to be surveyed by , United States Deputy Surveyor at .

Respectfully,

, Claimant.

P. O. Address, , county, .

APPLICATION FOR PATENT.

, County of , ss.

Application for Patent for the Mining Claim.

To the Register and Receiver of the U. S. Land Office at .

, being duly sworn according to law, deposes and says, that in virtue of a compliance with the mining rules, regulations and customs, by himself, the said , and his co-claimants (residence of each should be stated), , applicants for patent herein ha become the owner of and in the actual, quiet and undisturbed possession of linear feet of the vein, lode or deposit, bearing , together with surface ground feet in width, for the convenient working thereof, as allowed by local rules and customs of miners; said mineral claim, vein, lode or deposit and surface ground being situated in the mining district, county of , and of , and being more particularly set forth and described in the official field-notes of survey thereof, hereto attached, dated day of , A. D. 188 , and in the official plat of said survey, now posted conspicuously upon said mining claim or premises, a copy of which is filed herewith. Deponent further states that the facts relative to the right of possession of himself (and his said co-claimants hereinbefore named) to said mining claim, vein, lode or deposit and surface ground, so surveyed and platted, are substantially as follows, to wit:

(*Give full history of the lode,*)

Which will more fully appear by reference to the copy of the original record of location and the abstract of title hereto attached and made a part of this affidavit; the value of the labor done and improvements made upon said claim, by himself and his grantors, being equal to the sum of five hundred dollars, and said improvements consist of (*describe fully*). In consideration of which facts, and in conformity with the provisions of Chapter Six of Title Thirty-two of the Revised Statutes of the United States, application is hereby made for and in behalf of said for a patent from the Government of the United States for the said mining claim, vein, lode, deposit, and the surface ground so officially surveyed and platted.

Subscribed and sworn to before me this day of , A. D. 188 , and I hereby certify that I consider the above deponent a credible and reliable person, and that the foregoing affidavit, to which was attached the field-notes of survey of the mining claim, was read and examined by him before his signature was affixed thereto and the oath made by him.

(Official Signature.)

PROOF OF POSTING NOTICE AND DIAGRAM ON CLAIM.

of , County of , ss.

and , each for himself, and not one for the other, being first duly sworn according to law, deposes and says, that he is a citizen of the United States, over the age of twenty-one years, and was present on the day of , A. D. 188 , when a plat representing the , and certified to as correct by the United States Surveyor-General of , and designated by him as lot No. , together with a notice of the intention of and to apply for a patent for the mining claim and premises so platted, was posted in a conspicuous place upon said mining claim, to wit: Upon . where the same could be easily seen and examined; the notice so conspicuously posted upon said claim being in words and figures as follows, to wit:

Notice of the Application of and for a United States Patent.

Notice is hereby given that in pursuance of Chapter Six of Title Thirty-two of the Revised Statutes of the United States, and , claiming linear feet of the vein, lode or mineral deposit, bearing , with surface ground feet in width, lying and being situated within the mining district, county of , and of , ha made application to the United States for a patent for the said mining claim, which is more fully described as to metes and bounds by the official plat herewith posted, and by the field notes of survey thereof, now filed in the office of the Register of the District of Lands, subject to sale at , which field-notes of survey describe the boundaries and extent of said claim on the surface, with magnetic variation at east, as follows, to wit:

(*Give full description by courses and distances.*)

the said mining claim being of record in the office of the Recorder of , at , in the county and aforesaid, the presumed general course or direction of the said vein, lode or mineral deposit being shown upon the plat posted herewith, as near as can be determined from present developments; this claim being for linear feet thereof, together with the surface ground shown upon the official plat posted herewith, the said vein, lode and mining premises hereby sought to be patented being bounded on the by the mining claim.

Any and all persons claiming adversely the mining ground, vein, lode, premises, or any portion thereof so described, surveyed, platted and applied for, are hereby notified that unless their adverse claims are duly filed as according to law and the regulations thereunder within sixty days from the date hereof, with the Register of the United States Land Office at , in the of , they will be barred, in virtue of the provisions of said statute.

(Names of applicants.)

Dated on the ground this day of , A. D. 188

Witness:

(Name of witnesses.)

Subscribed and sworn to before me this day of , A. D. 188 , and I hereby certify that I consider the above deponents credible and reliable witnesses, and that the foregoing affidavit and notice were read by each of them before their signatures were affixed thereto and the oath made by them.

———— ————

PROOF THAT PLAT AND NOTICE REMAINED POSTED ON CLAIM DURING PROPER PERIOD.

of . County of , ss.

, being first duly sworn according to law, deposes and says, that he is claimant (and co-owner with) in the mining claim, mining district, county, the official plat of which premises, designated by the Surveyor-General as lot No. , together with the notice of intention to apply for a patent therefor, was posted thereon, on the day of , A. D. 188 , as fully set forth and described in the affidavit of and , dated the day of A. D. 188 , which affidavit was duly filed in the office of the Register at in this case; and that the plat and notice so mentioned and described, remained continuously and conspicuously posted upon said mining claim from the day of , A. D. 188 , until and including the day of , A. D. 188 , including the sixty days period during which notice of said application for patent was published in the newspaper.

[Jurat.]

———— ————

(One of the applicants.)

REGISTER'S CERTIFICATE OF POSTING NOTICE FOR SIXTY DAYS.

United States Land Office, at , , 188

I hereby certify that the official plat of the lode designated by the Surveyor-General as lot No. was filed in this office on the day of , A. D. 188 , and that the attached notice of the intention of to apply for a patent for the mining claim or premises embraced by said plat, and described in the field notes of survey thereof filed in said application, was posted conspicuously in this office on the day of , A. D. 188 , and remained so posted until the day of , A. D. 188 , being the full period of sixty consecutive days during the period of publication as required by law; and that said plat remained in this office during that time, subject to examination, and that no adverse claim thereto has been filed.

——— ———, Register.

NOTICE FOR PUBLICATION IN NEWSPAPER.

Mining Application No.———

United States Land Office, , 188

Notice is hereby given that , whose post office address is , has this day filed his application for a patent for linear feet of the mine or vein bearing , with surface ground feet in width, situated in mining district, county of , and of , and designated by the field notes and official plat on file in this office as lot No. , in township , range , of meridian, Said lot No. being described as follows, to wit: Beginning at, etc.

Magnetic variation ; containing acres.

The location of this mine is recorded in the Recorder's office of , in book of The adjoining claimants are

Any and all persons claiming adversely any portion of said mine or surface ground are required to file their adverse claims with the Register of the United States Land Office at , in the of , during the sixty days period of publication hereof, or they will be barred by virtue of the provisions of the statute.

——— ———, Register.

AGREEMENT WITH PUBLISHER.

The undersigned, publisher and proprietor of the , a newspaper, published at , county of , and of , does hereby agree to publish a notice, dated United States Land Office, , required by Chapter Six of Title Thirty-two, Revised Statutes of the United States, of the intention of to apply for a patent for his claim on the lode, situated in mining district, county of , of , and to hold the said alone responsible for the amount due for publishing the same. And it is hereby expressly stipulated and agreed that no claim shall be made against the Government of the United States, or its officers or agents, for such publication.

Winess my hand and seal this day of , A. D. 188

Witness: ——— ———

——— ———

PROOF OF PUBLICATION.

of , *County of* , *ss.*

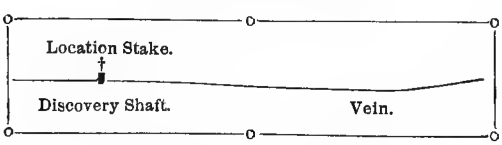
Reprint Copy of Notice of Application. | , being first duly sworn, deposes and says, that he is the of the , a newspaper published at , in county, in the of ; that the notice of the application for a patent for the mining claim, of which a copy is hereto attached, was first published in said newspaper, in its issue dated the of , 188 , and was published in each [daily or weekly] issue of said newspaper for [sixty consecutive days, or nine consecutive weeks] thereafter, the full period of sixty days, the last publication thereof being in the issue dated the of , 188

——— ———

Subscribed and sworn to before me this day of , A. D. 188

[SEAL.] ——— ———, *Notary Public.*

DIAGRAM OF LOCATION.



AFFIDAVIT OF $500 IMPROVEMENT.

of *County of* , *ss.*

and , of lawful age, being first duly sworn according to law, depose and say that they are acquainted with the mining claim in mining district, county and aforesaid, for which has made application for patent under the provisions of Chapter Six of Title Thirty-two, Revised Statutes of the United States, and that the labor done and improvements made thereon by the applicant and his grantors exceed five hundred dollars in value, and said improvements consist of (describe fully).

——— ———.

Subscribed and sworn to before me this day of , A. D. 188–.

——— ———.

STATEMENT OF FEES AND CHARGES.

of , *County of* , *ss.*

, being first duly sworn according to law, deposes and says that he is the applicant for patent for the lode in mining district, county of , of , under the provisions of Chapter Six of Title Thirty-two of the Revised Statutes of the United States, and that in the prosecution of said application he has paid out the following amounts, and no more, viz.: To the credit of the Surveyor-General's office, dollars; for surveying, dollars; for filing in the local land office, dollars; for publication of notice, dollars; and for the land embraced in his claim, dollars.

——— ———.

Subscribed and sworn to before me this day of , A. D. 188–.

SEAL. ——— ———, *Notary Public.*

PROOF OF OWNERSHIP AND POSSESSION IN CASE OF LOSS OR ABSENCE OF MINING RECORDS.

of , *County of* , *ss.*

, and , each for himself, and not one for the other, being first duly sworn according to law, deposes and says that he is a citizen of the United States, over the age of twenty-one years, and a resident of county, , and has resided in mining district, wherein the mine is situated, since day of , 18—. That since that date he has been acquainted with the mine, and with the possessors and workers thereof. That said mine was located and has been possessed and worked in accordance with the customs and usages of miners in said district, and in conformity with the rules and regulations governing the location, holding and working of mining claims, in force and observed in the (State) of . That there are no written records known to deponent existing in said mining district. That affiant is credibly informed and believes that the mine was located in the year 18—, and that if any record was made of said location, and of the names of locators, the same has not been in existence for a long number of years past, and that by reason thereof the names of locators cannot now be ascertained, and no abstract of title from locators to the present owner can be made. That the possession of applicant and his predecessors in interest of said mine has been actual, notorious and continuous, to the positive knowledge of deponent, since his residence in said mining district, and that such possession has been perfected and maintained in conformity with mining usages and customs, and has been acquiesced in and respected by the miners of said district. That applicant's right to the said mine is not in litigation within the knowledge of affiant, and that no action or actions have been commenced affecting the right to said mine since his acquaintance therewith (and that the time for the commencement thereof, as required to be instituted under the provisions of the Statute of Limitations of the of , has long since elapsed). That applicant and his predecessors in interest have expended in the improvement, development and working of said mine a sum of money exceeding dollars, as follows, to wit: .

——— ———.

——— ———.

——— ———.

Subscribed and sworn to before me this day of , A. D. 188–, and I certify that the aforenamed and are credible and respectable persons, to whose affidavit full faith and credit should be given.

SEAL. ——— ———.

AFFIDAVIT OF CITIZENSHIP.

of , *County of* , *ss.*

, being first duly sworn according to law, deposes and says, that he is the applicant for patent for mining claim, situated in mining district, county of ; that he is a native-born citizen of the United States, born in , county of , State of , in the year 18—, and is now a resident of .

——— ———.

Subscribed and sworn to before me this day of , A. D. 188–.

——— ———.

CERTIFICATE THAT NO SUIT IS PENDING.

of , *County of* , *ss.*

I, , clerk of the court in and for county, , do hereby certify that there is now no suit or action of any character pending in said court involving the right of possession to any portion of mining claim, and that there has been no litigation before said court affecting the title to said claim, or any part thereof, for years last past, other than what has been finally decided in favor of .

In witness whereof, I have hereunto set my hand and affixed the seal of said court, at my office in , this day of , A. D. 188–.

SEAL. ——— ———, Clerk of the ——— Court, ———.

Model of a Stock Certificate.—100 Shares.

ORGANIZED UNDER THE LAWS OF THE STATE OF PENNSYLVANIA.

No. 5195 | 100 Shares

Pure Silver Mining Company

Shares, $50 Each.

Capital Stock, $10,000,000.

Location of Mine: GOLD GULCH, SILVERTON, COLORADO.

This Certifies that *John Smith* is entitled to *One Hundred Shares* of the *Full-paid Capital Stock* of the **Pure Silver Mining Company**, transferable only on the books of the Company, in person or by attorney, on surrender of this Certificate. This Certificate is not valid without the signature of the Registrar of Transfers.

200,000 Shares.

Countersigned and Registered, July 1, 1882.

Peter Funk,
Registrar of Transfers.

100.

Richard Roe, PRESIDENT.

John Doe, SECRETARY.

Philadelphia, July 1, 1882.

For Value Received, *I have bargained, sold, assigned and transferred, and by these presents do bargain, sell, assign and transfer unto* **John Thomas,** *the Capital Stock named in the within Certificate, and I do hereby constitute and appoint* **John Thomas** **my** *true and lawful attorney, irrevocable for* **me,** *and in* **my** *name and stead, to have, use, to sell, assign, transfer and set over all or any part of the said stock, and for that purpose to make and execute all necessary acts of assignment and transfer, and one or more persons to substitute with like full power. Dated, July 10, 1882.*

John Smith.

Signed and acknowledged in presence of

Simon Pure.

POWER OF ATTORNEY TO APPLY FOR PATENT.

Know all Men by these Presents, that we, and , do hereby constitute and appoint as our attorney in fact, for us and in our names, to make application to the United States for the entry and purchase of certain Government lands, in mining district, county, of , known as the mining claim and premises; and to have the same surveyed, and to take any and all steps that may be necessary to procure from the Government of the United States a patent to the said lands and premises, granting the same to us. And to do all other acts appertaining to the said survey and entry aforesaid as we ourselves could do by our own act and in our own proper person.

In witness whereof we have hereunto set our hands and affixed our seals the day of , A. D. 188 .

——— ———.
——— ———.

of County of , ss.

On this day of , A. D. 188 , before me, , a Notary Public in and for the , county of , personally appeared , known to me to be the same person whose name subscribed to the foregoing instrument, and acknowledged to me that executed the same.

In witness whereof I have hereunto set my hand and affixed my official seal at my office, the day and year in this certificate first above written.

SEAL.

, *Notary Public.*

PROOF THAT NO KNOWN VEIN EXISTS IN A PLACER MINING CLAIM.

of , County of , ss.

and , of the said county and , being first duly sworn, each for himself, deposes and says, that he is well acquainted with the placer mining claim, embracing , situated in the mining district, in the county of , and of , owned and worked by , applicant for United States patent; that for many years he has resided near, and often been upon said mining premises, and that no known vein or veins of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin or copper, exist on said mining claim, or any part thereof, so far as he knows, and he verily believes that none exist thereon. And further, that he has no interest whatever in the said placer mine of .

Subscribed and sworn to before me this day of , A. D. 188 .

PROTEST AND ADVERSE CLAIM.

United States Land Office, of .

In the matter of the application of , for a United States' patent for the lode or mining claim and the land and premises appertaining to said mine, situated in the mining district, in county, of

To the Register and Receiver of the United States' Land Office at , and to the above-named applicants for patent for the lode .

You are hereby notified that of the city of , county of , and of , and a citizen of the United States of America, is the lawful owner, and entitled to the possession of hundred feet of the said lode or mine described in said application, as shown by the diagram posted on said claim, and the copy thereof filed in the land office with said application, and as such owner this contestant, the said , does protest against the issuing of a patent thereon to said applicant, and does dispute and contest the right of said applicant therefor.

And this contestant does present the nature of his adverse claim, and does fully set forth the same in the affidavit hereto attached, marked Exhibit A, and the further exhibits thereto attached, and made part of said affidavit.

The said therefore respectfully asks the said Register and Receiver that all further proceedings in the matter be stayed, until a final settlement and adjudication of the rights of this contestant can be had in a court of competent jurisdiction.

(Place and Date.)

EXHIBIT A.

of County of , ss.

, being first duly sworn, deposes and says, that he is a citizen of the United States, born in the State of , and is now residing in ; that he is the contestant and protestant named in, and who subscribed the notice and protest hereto annexed. Affiant further says that he is the owner by purchase and in the possession of the (adverse) lode or vein of quartz and other rock in place, bearing and other metals. That the said lode is situated in the mining district, county, of .

[*Full history of the lode should be given as follows* :]

This affiant further says, that on the day of location the premises hereinafter described were mineral lands of the public domain, and entirely vacant and unoccupied, and were not owned, held or claimed by any person or persons as mining ground or otherwise, and that while the same were so vacant and unoccupied and unclaimed, to wit:

On the day of , 18 , (name locators,) each and all of them being citizens of the United States, entered upon and explored the premises, discovered and located the said lode, and occupied the same as mining claims. That the said premises so located and appropriated consist of feet in a erly direction, and feet in a erly direction, as will fully appear by reference to the notice of location, a duly certified copy whereof is hereunto annexed, marked Exhibit B, and hereby made a part of this affidavit. That the locators, after the discovery of the said lode, drove a stake on said lode on the discovery claim, erected a monument of stone around said stake, and placed thereon a written notice of location describing the claim so located and appropriated, giving the names of the locators and quantity taken by each, and after doing all the acts and performing all the labor required by the laws and regulations of said mining district and territory of , the locators of said lode caused said notice to be filed and recorded in the proper books of record in the Recorder's office in said district on the day of , 18 .

Affiant further says, that the said locators remained continuously in possession of said lode, working upon the same and within months from the date of said location had done and performed work and labor on said location in mining thereon and developing the same, more than days work, and expended on said location more than hundred dollars, and by said labor and money expended upon the said mining location and claim, had developed the same and extracted therefrom more than tons of ore.

And Affiant further says, that said locators, in all respects complied with every custom, rule, regulation, and requirement of the mining laws, and every rule and custom established and in force in said mining district, and thereby became and were owners (except as against the paramount title of the United States) and the rightful possessors of said mining claims and premises.

And this affiant further says, that said locators proved and established to the satisfaction of the Recorder of said mining district that they had fully complied with all the rules, customs, regulations, and requirements of the laws of said district, and thereupon the said Recorder issued to the locators of said lode, certificates confirming their titles and rights to said premises.

That the said lode was located and worked by the said locators as tenants in common, and they so continued in the rightful and undisputed possession thereof from the time of said location until on or about the day of , A, D. 18 , at which time the said locators and owners of said lode formed and organized under the laws of the State (or Territory) of , and incorporated under the name of the " ," and on the day of A. D. 18 , each of the locators of said lode conveyed said lode and each of their rights, titles and interest in and to said lode, to said " mining company."

On the said day of , 18 , the said company entered into and upon said lode, and was seized and possessed thereof and every part and parcel of the same, and occupied and mined thereon until the day , 18 , at which time the said mining company sold and conveyed the same to this affiant, which said several transfers and conveyances will fully appear by reference to the abstract of title and paper hereto attached, marked Exhibit D, and made a part of this affidavit.

[*In case of individual transfers.*]

And this affidavit further says, that the said , who located claim northwesterly of the said lode, and the said who located claim northwesterly thereon, was seized and in possession of said claims, and occupied and mined thereon until the day of , 18 , at which time the said and sold and conveyed the same to , and thereupon the said was seized and possessed of said mining claims and locations, and occupied and mined thereon until the day of , 18 , at which time the said sold and conveyed the same to this affiant, as will fully appear by reference to the abstract of title and paper hereto attached, marked Exhibit D, at which time this affiant hereby makes a part of this his affidavit.

Affiant further says, that he is now and has been in the occupation and possession of the said lode since the day of , 18 , and the said lode and mining claims were located, and the title thereto established, several before said (applied for) lode was located.

Affiant furthers says, that said lode, as shown by the notice and diagram posted on said claim, and the copy thereof filed in the United States Land Office at said with said application for a patent, crosses and overlaps said lode, and embraces about hundred feet in length by hundred feet in width of the said lode, the property of affiant, as fully appears by reference to the diagram or map duly certified by , United States Deputy

Surveyor, hereto attached, marked Exhibit C, and which diagram presents a correct description of the relative locations of the said (adverse) lode, and of the pretended (applied for) lode.

Affiant further says that he is informed and believes that said applicant for patent, well knew that affiant was the owner in possession and entitled to the possession of so much of said mining ground embraced within the survey and diagram of said applications, as is hereinbefore stated, and that this affiant is entitled to all the and other metal in said (adverse) lode, and all that may be contained within a space of feet on each side of said (adverse) lode.

And affiant further says, that this protest is made in entire good faith, and with the sole object of protecting the legal rights and property of this affiant in the said (adverse) lode and mining premises.

Subscribed and sworn to before me this day of , A. D. 188 .

SURVEYOR'S CERTIFICATE.

On the diagram marked Exhibit C, the Surveyor must certify in effect as follows:

I hereby certify that the above diagram correctly represents the conflict claimed to exist between the and lodes, as actually surveyed by me. And I further certify that the value of the labor and improvements on the (adverse) lode exceeds five hundred dollars, and said improvements consist of (state in full).

(Place and date.)

, *U. S. Deputy Surveyor.*

TUNNEL CLAIM—LOCATION CERTIFICATE.

Know all men by these presents, that the undersigned, citizens of the United States, have this day of , 188 , claimed by right of location, a tunnel claim, for the purpose of discovering and working veins, lodes or deposits on the line thereof [Cutting the lode, and working the lode]. Said tunnel claim is situated in the mining district, county of , State of , and the location and bounds of said tunnel are staked on the surface at the place of commencement and termination thereof, as well as along the line thereof. Said claim is more particularly described as follows: [*Describe the commencement and termination by reference to natural objects and permanent monuments, and the line by courses and distances.*]

Dated , 188 .

,
Locator.

POWER OF ATTORNEY TO LOCATE AND SELL.

Know all men by these presents, that we the undersigned [*names*] , citizens of the United States, have made, constituted and appointed A. B. [*some third person who will locate and stake*], our true and lawful attorney for us, and in our names to locate, stake and record for us each lode claim and placer mining ground in the , county, of , and having located the same, to bargain, sell, grant, release and convey the same, entire or in separate parcels, to make proper deeds, seal, acknowledge and deliver the same to such persons as our attorney may desire; hereby ratifying and confirming all lawful acts done by our said attorney by virtue hereof.

Witness our hands and seals this day of , 18 .

[*Names.*]

of , *County of* , *ss.*

On this day of , 18 , before me in and for the county and State aforesaid, appeared personally known to me as the persons whose names are subscribed to the foregoing power of attorney, and acknowledged the execution thereof as their free act and deed, for the purposes therein mentioned.

Given under my hand and seal the day and year above written.

NOTICE OF RIGHT TO WATER.

The undersigned claims the water running in this stream to the extent of inches for mining purposes, to be conveyed by (ditch or flume) from this point to the placer claim.

Dated , 18 .

,
Locator.

PRE-EMPTION OF RIGHT OF WAY FOR DITCH AND LOCATION OF WATER.

To whom these presents may concern, know ye, that I, , of the county of , in the State of , a citizen of the United States, do hereby declare and publish as a legal notice to all the world, that I claim, and have a valid right to the occupation, possession and enjoyment of all and singular, that tract or parcel of land lying and being in the county of , in the state of , for the exclusive right of way for the purpose of constructing a flume or water ditch from stream to placer claim, more particularly described as follows: Commencing (*here describe the exact route for ditch or flume.*)

I also claim, and have a valid right to the enjoyment and use of inches of water from said stream for mining purposes, to be conveyed through such flume or water ditch to said claim, together with all and singular, the hereditaments and appurtenances thereunto belonging, or in any wise appertaining.

Witness my hand and seal this day of , A. D. 18 .

[*Name.*]

Notice posted on the stream , 18 .
Ditch commenced at claim or at stream , 18 .

of , *County of* , *ss.*

On this day of , 18 , before me, a in and for the county aforesaid, in the state aforesaid, personally appeared , to me personally known to be the person who executed the foregoing written instrument, and acknowledged that he executed the same for the uses and purposes therein set forth.

Witness my hand and official seal.

MINING DEED.

THIS INDENTURE, made the day of , in the year of our Lord one thousand eight hundred and eighty, between , of the county of , and of , party of the first, and , of the county of , and of , party of the second part;

Witnesseth, That the said party of the first part, for and in consideration of the sum of dollars, lawful money of the United States of America, to him in hand paid by the said party of the second part, the receipt whereof is hereby acknowledged, hath granted, bargained, sold, remised, released, and for ever quit-claimed, and by these presents does grant, bargain, sell, remise, release, and for ever quit claim, unto the said party, of the second part, his heirs and assigns, the lode, as located, surveyed, recorded, and held by said party of the first part, situated in mining district county , together with all the dips, spurs, and angles, and also all the metals, ores, gold and silver-bearing quartz rock and earth therein, and all the rights, privileges, and franchises thereto incident, appendant and appurtenant, or therewith usually had and enjoyed: and also, all and singular the tenements, hereditaments, and appurtenances thereunto belonging, or in any wise appertaining, and the rents, issues and profits thereof; and also, all the estate, right, title, interest, property, possession, claim and demand whatsoever, as well in law as in equity, of the said party of the first part, of, in or to the said premises, and every part and parcel thereof, with the appurtenances.

To have and to hold, all and singular, the said premises, together with the appurtenances and privileges thereto incident, unto the said party of the second part, his heirs and assigns for ever. In witness whereof, the said party of the first part has hereunto set his hand and seal the day and year first above written.

SEAL.

of , *County, ss.*

I, Fitzmaurice Langton, a Notary Public in and for said county, in the state aforesaid, do hereby certify that , personally known to me to be the person whose name is subscribed to the annexed deed, appeared before me this day in person, and acknowledged that he signed, sealed and delivered the said instrument of writing as his free and voluntary act, for the uses and purposes therein set forth.

Given under my hand and official seal, this day of , A. D. 188 .

SEAL. FITZMAURICE LANGTON, *Notary Public.*

TITLE BOND.

Know all men by these presents, that I. James Bingham, party of the first part, of the County of Lake, and State of Colorado, am held and firmly bound unto George Boyd, party of the second part, of the County of Lake, and State of Colorado, in the penal sum of ten thousand dollars, lawful money of the United States, to the payment of which the party of the first part hereby binds himself, his heirs, executors and administrators. Witness his hand and seal this 20th day of July, 1880. The conditions of the foregoing obligations are such, that whereas, the above bounden party of the first part, in consideration of the sum of five dollars, in hand paid, has, on the day and year aforesaid, agreed to sell to the party of the second part the following described mining property, viz.: An undivided one-eighth interest in and to the Gilt Edge lode claim, as located, surveyed, recorded, and held, situate, lying and being in California Mining District, Lake County, Colorado, together with all and singular, the improvements, hereditaments, and appurtenances thereto belonging, or in any wise appertaining, for the sum of five thousand dollars, to be paid at the times and in the manner following, viz.: One thousand dollars on or before August 20, 1880; one thousand dollars on or before September 20, 1880; and three thousand dollars on or before October 20, 1880; which sums of money are to be paid to the party of the first part in person, or by depositing the same to his credit at the First National Bank of Philadelphia, at the times aforesaid, and time shall be of the essence of these conditions. And in case of failure of the party of the second part, or his assigns, to make either of said payments at the times mentioned, such sum or sums as may have been paid hereunder, shall be forfeited to and retained by the party of the first part, as a penalty and for liquidated damages, and notice of forfeiture is hereby expressly waived, and also all right, demand or claim for the balance or any of said sum of five thousand dollars, is hereby expressly waived by the party of the first part. The party of the first part, his heirs, executors, administrators, and assigns, shall, on the 20th day of October, 1880, or at any time before, upon payment of said sums of money hereinbefore mentioned, make, execute, and deliver to the party of the second part, or to such person or persons as he shall designate, good and sufficient deed or deeds of all of the above described property, conveying a clear and perfect title (except the fee simple title of the United States), free from all incumbrances, with a covenant, that the annual expenditure has been made thereon as required by law. Now, if the party of the second part shall fail to pay the sum or sums of money as hereinbefore provided, and if the party of the first part shall faithfully perform the covenants herein set forth, then this obligation shall be null and void; otherwise, to be and remain in full force and effect.

SEAL. JAMES BINGHAM.

— 9

State of Colorado, Lake County, ss.

Be it known, That on this 20th day of July, 1880, before me, personally came James Bingham, to me known as the person described in, and who executed the foregoing instrument in writing, and acknowledged the execution thereof to be his free act and deed, for the uses and purposes therein mentioned.

Witness my hand and official seal,

SEAL. ALVIN GARNETT, *Notary Public.*

ESCROW AGREEMENT.

The inclosed deed of the lode is hereby placed in the Bank of , *in escrow.* If A. B. shall place, or cause to be placed to the credit of C. D. and E. F., in said bank of , on or before , 188–, the full sum of dollars, then and in that case the said bank is hereby authorized to deliver the inclosed deed to A. B., or his order. In case the said A. B. shall not place, or cause to be placed, to the credit of said C. D. and E. F., in said bank, the full sum of dollars, on or before , 188–, then the said bank is hereby authorized to deliver the inclosed deed to the said C. D. and E. F., or their joint order.

(Signed) C. D.
E. F.
A. B.

——— ——— ———, 188–, (Place and date).

MINING LEASE.

This Indenture, made this day of , in the year of our Lord one thousand eight hundred and eighty , between lessor and lessee or tenant; *Witnesseth*, That the said lessor for and in consideration of the rents, royalties, covenants and agreements hereinafter reserved, and by the said lessee to be paid, kept and performed, granted, demised and let, and by these presents do grant, demise and let unto the said lessee, all the following described mine and mining property, situated in mining district, county of of , to wit: (Here description of property.) Together with the appurtenances to have and to hold unto the said lessee or tenant for the term of from the date hereof, expiring at noon on the day of , A. D. 188–, unless sooner forfeited or determined through the violation of any covenant hereinafter against the said tenant reserved.

And in consideration of the said demise, the said lessee does covenant and agree with said lessor as follows, to wit:

To enter upon said mine or premises and work the same mine fashion, in manner necessary to good and economical mining, so as to take out the greatest amount of ore possible, with due regard to the safety, development and preservation of the said premises as a workable mine.

(Here insert special covenants for dead work, etc.)

To work and mine said premises as aforesaid steadily and continuously from the date of this lease: and that any failure to work said premises with at least persons employed underground for the space of consecutive days may be considered a violation of this covenant.

To well and sufficiently timber said mine at all points where proper, in accordance with good mining; and to repair all old timbering wherever it may become necessary.

To allow said lessor and agents to enter upon and into all parts of said mine for the purpose of inspection, with use of all passages, ropes, windlass, ladder-ways, and all other means of ingress and egress for such purpose.

To not assign this lease, or any interest thereunder, and to not sublet the said premises or any part thereof, without the written assent of said lessor, and to not allow any person or persons except the said lessee and workmen to take or hold possession of said premises or any part thereof under any pretence whatever.

To occupy and hold all cross or parallel lodes, dips, spurs, feeders, crevices or mineral deposits of any kind, which may be discovered in working under this lease, or in any tunnel run to intersect said lode, or by the said lessee or any person or persons under , in any manner at any point within feet of the centre line of said lode, as the property of said lessor; with privilege to said lessee of working the same as an appurtenance of said demised premises, during the term of this lease; and to not locate or record the same, or allow the same to be located or recorded, except in the name of said lessor.

To keep at all times the drifts, shafts, tunnels, and other passages and workings of said demised premises, thoroughly drained and clear of loose rock and rubbish of all kinds.

To pay and deliver to said lessor as royalty, of all ores to be extracted from said premises during said term, of like assay to that retained by said lessee, delivered at as soon as mined, without offset, deduction, or charge whatever, except lessor's proportion for packing.

To deliver up to said lessor the said premises, with the appurtenances and all improvements in good order and condition, with all shafts and tunnels and other passages thoroughly clear of rubbish and drained, and the mine in all points ready for immediate continued working (accidents not arising from negligence alone excusing), without demand or further notice, on said day of , A. D. 188–, at noon or at any time previous, upon demand for forfeiture.

And finally, upon the violation by said lessee, or any person under , of any covenant or covenants hereinbefore reserved, the term of this lease shall, at the option of said lessor, expire, and the same and said premises with the appurtenances shall become forfeit to said lessor; and said lessor or agent may thereupon, after demand of possession in writing, enter upon said premises and dispossess all persons occupying the same, with or without force, and with or without process of law; or at the option of said lessor, the said tenant and all persons found in occupation may be proceeded against as trespassers from the beginning of said term both as to realty and the ore served therefrom; or as guilty of unlawful detainer.

Each and every clause and covenant of this Indenture shall extend to the heirs, executors, and administrators of all parties hereto; and to the assigns of said lessor: and as said lessor may elect, to the assigns of said lessee.

In witness whereof, The said parties, lessor and lessee, have hereunto set their hands and seals.

——— ———. ——— ———. SEAL.

——— ———. ——— ———. SEAL.

Prospecting Contracts.—These are quite common and should be carefully drawn. The following form will answer for a guide:

I, A. B., in consideration of the supplies, tools and general prospecting outfit furnished me by C. D., and for the sum of dollars, to be paid as follows, viz:

Have agreed and do hereby agree with the said C. D. to prospect diligently for lodes and placers in the county, (or counties) of , in the State of , and to locate and develop all discoveries, which in my best judgment, shall be worth locating, in the joint names of myself and the said C. D. in equal undivided shares. All expenses of survey and record shall be paid by the said C. D. And the said A. B. agrees to devote his entire time and attention to prospecting for, locating and developing mining claims as aforesaid.

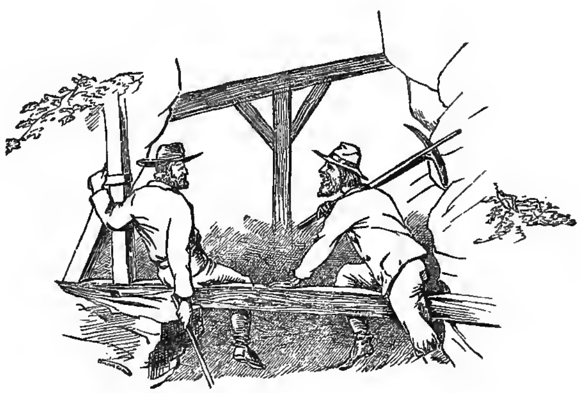
This contract shall be in force from this date until the day of , 188 , or until cancelled by the mutual consent of the parties hereto. (Signed,) A. B.

I agree to the terms above written. C. D.

Dated,

The contract should be recorded in the county, or counties, where the prospecting is to be done, for the purpose of giving notice of the interest of the party furnishing the grubstake in all claims located by the prospector. A contract to prospect for mines on joint account will be enforced; and a decree was given, directing the conveyance to C. of an interest of one-half in a mine located by S. in his own name, upon a finding that the claim was located under the terms of an existing contract that the claim should belong to S. and C. jointly.

An Important Legal Decision.—The Supreme Court of California, in banc, has decided that all mining stocks now issued and in circulation are fully paid up, no matter at what price per share the stock may have been bought. That no stock fully paid up can be assessed. That, under the law, no corporation organized or now in existence can levy any assessment or tax upon said stock; and that any assessment so levied is illegal, and hence null and void; that no stockholder under such circumstance can be divested of his or her rights in and to said stock by any such void proceedings. That partly-paid-up stock may be issued; but that such stock must bear upon its face its fully-paid-up value, and also the exact amount paid per share for said stock. That such partly-paid-up stock may be assessed—but not until 25 per cent. of the company's capital stock shall have been subscribed for; and then only that portion subscribed for can be assessed, and only 10 per cent. of its paid-up-value. This case has been all the more important because of the millions possessed by the contestants—the Santa Craz Railroad Company for and Claus, Spreckels & Co., against. It is believed that those who have paid these illegal assessments in the past can recover the amount paid, with interest. No one has lost or can lose his stock in any company organized in California by refusing to pay his assessments—but only by statute of limitations, which is three years under the present law.—*Chicago Tribune.*



PART VIII.

A GLOSSARY OF MINING TERMS—THE PROPERTIES OF METALS—WEIGHTS AND MEASURES—REFERENCE TABLES.

CALCULATIONS in Mining are the guides of every action. The Miner, the Engineer, the Owner, are slaves of calculation. To accomplish this successfully, reference tables are in constant requisition, as well as that kind of information that may be said to embody cardinal facts. We have therefore in part viii THE MINES, MINERS AND MINING INTERESTS, compiled a set of reference tables that in their liberal scope we trust, will cover every need of the miner, or his employer, or the engineer, or the owners. These are very properly prefaced with Dr. Raymond's admirable Glossary of Mining terms and expressions, a glossary that is of undoubted interest to the professional as well as the non-professional reader; opening up as it does a wide field of thought in the study of the phraseology of a great occupation. The tables are made to include a wide range of information concerning mining and its collateral interests. For the majority of them we are indebted to the "Engineers and Mechanics' Handbook," by Charles H. Haswell, M. E.

A GLOSSARY OF MINING AND METALLURGICAL TERMS.

THE absence of a convenient glossary of terms connected with mining and metallurgy has long been felt by the general public. It is to meet this want, not to furnish a technical manual for experts, that the following glossary has been prepared. In the compilation, the following general principles were adopted:—1. To include the most important technical words and phrases used by American miners and metallurgists, or occurring in English books and periodicals. 2. To exclude Spanish, French and German terms, unless they fall under the rule above given. The Spanish terms included are in use among our miners in the far West and Southwest. 3. To exclude almost all purely scientific terms, such as those which denote the operations of chemical analysis, the chemical names and symbols of elements and compounds, the species of rocks and minerals, the principles of general physics and mechanics, etc. 4. To avoid scientific and technical explanations. 5. To omit, in general, self-explanatory terms, and such as are common to all mechanical and manufacturing trades.

The grounds of these rules are evident. It was neither practicable nor necessary to give in what could be, and must be, sought in technical textbooks or general dictionaries and cyclopædias. But the glossary presents numerous exceptions to the above rules. Many geological terms, for instance, are so common among metallurgists as to render their adoption in this catalogue justifiable. The difficulty has been to "draw the line;" and this has been done, somewhat arbitrarily. An apology should be made for the obscurity of a few of the definitions. Many terms taken from English glossaries were found to be most vaguely defined; and in most cases of this kind, the definitions were improved; but there remain some which it was impossible to amend with certainty.

In many instances, the locality in which a term is believed to have originated or to be peculiarly in use, is indicated by abbreviations which will mostly explain themselves. The principal regions named are England, Scotland, Wales, France, Germany, the United States, Spain (including Mexico), Australia, Cornwall, Derbyshire, Staffordshire, Newcastle, Devonshire, Lake Superior, Pennsylvania, and the Pacific slope (including the mining districts of the Rocky Mountains). It must be understood that the naming, in this connection, of any one locality does not exclude the use of the term in other localities; and particularly that in this country the circulation both of miners and metallurgists, and of books and journals from all the world has brought into use a heterogeneous technical vocabulary. This is especially the case in the gold, silver and lead mining districts of the West, where all the names, phrases, and theories that anybody anywhere at any time has cultivated, together with a crop of indigenous, spontaneous growth, seem to flourish vigorously.

ABSTRICH, GERM. The black or greenish-brown mass (*black litharge*) appearing upon the bath of work-lead early in the cupelling-process, and gradually, as the process advances, giving way to pure litharge.

Abzug, GERM. The first scum appearing (before the *abstrich*) on the surface of molten lead.

Adit. A nearly horizontal passage from the surface, by which a mine is entered and unwatered. In the United States an adit is usually called a *tunnel*, though the latter, strictly speaking, passes entirely through a hill, and is open at both ends.

Adlings, ENG. Earnings.

Adobe, SP. Clay suitable for *adobes* or sun-dried bricks.

Adventurers, ENG. Shareholders or partners in a mining enterprise; in Cornwall, *cost-book* partners.

After-damp, ENG. The irrespirable gas, consisting of nitrogen and carbonic acid chiefly, remaining after an explosion of *fire-damp.*

Agitator, PAC. See *Settler.*

Aich's metal. See *Gun-metal.*

Air-head, or Air-heading, S. STAF. A smaller passage, driven parallel with the *gate-road.* and near its roof, to carry the ventilating current. It is connected with the *gate-road* at intervals by openings called *spouts.*

Air-reduction process. See *Roasting and Reaction process.*

Aitch-piece. See *H-piece.*

Alberti furnace. A continuously working reverberatory furnace for the roasting of quicksilver ores, with condensation of the mercury in iron-tubes and brick chambers.

Alligator. 1. See *Squeezer.* 2. A rock-breaker operating by jaws.
Alloy. A compound of two or more metals fused together.
Alluvium. The earthy deposit made by running streams, especially in times of flood.
Aludel. An earthen condenser for mercury. See *Bustamente furnace.*
Aluminium ores. *Cryolite,* a fluoride of sodium and aluminium, found in Greenland; *bauxite,* a hydrous compound of alumina, ferric oxide and silica.
Amalgamation. 1. The production of an amalgam or alloy of mercury. 2. The process in which gold and silver are extracted from pulverized ores by producing an amalgam, from which the mercury is afterwards expelled. See *Retorting.*
Amalgamator. 1. A machine for amalgamating ores. 2. The workman in charge of such a machine.
American forge. See *Catalan forge.*
Anemometer. An instrument for measuring the rapidity of an air-current.
Annealing. 1. The gradual cooling of glass or metal from a high temperature, to render it less brittle. 2. See *Malleable castings.*
Anthracite. See *Coal.*
Anticlinal. The line of a crest, above or under ground, on the two sides of which the strata dip in opposite directions. The converse of *synclinal.*
Antimony ores. Native antimony; *stibnite,* (sulphide of antimony); *valentinite* and *senarmontite* (oxides).
Apex. In the U. S. Revenue Statutes, the end or edge of a vein nearest the surface.
Apolvillados, Sp. Ores superior in quality to the *azogues.*
Appolt oven. An oven for the manufacture of coke, differing from the *Belgian* in that it is divided into vertical compartments.
Aprons. See *Copper-plates.*
Arch, Corn. 1. A portion of a lode left standing when the rest is extracted, to support the *hanging wall* or because it is too poor for profitable extraction. 2. The roof of a reverberatory furnace.
Arenaceous. Silicious or sandy (of rocks).
Arends' tap. An arrangement by which the molten lead from the crucible of a shaft-furnace is drawn through an "inverted siphon" into an exterior basin, from which it can be ladled without disturbing the furnace.
Arenillos, Sp. Refuse earth.
Argentiferous. Containing silver.
Argillaceous. Containing clay.
Arm. The inclined member or leg of a set or frame of timber.
Arrastre, Sp. Apparatus for grinding and mixing ores by means of a heavy stone dragged around upon a circular bed. The arrastre is chiefly used for ores containing free gold, and amalgamation is combined with the grinding. Sometimes incorrectly written *arraster, arrastra,* or *raster.*
Arroba, Sp. Twenty-five pound avoirdupois.
Arsenic ores. Native arsenic; *mispickel* (*arsenopyrite, arsenical pyrites,* arseno-sulphide of iron).
Ascension-theory. The theory that the matter filling fissure-veins was introduced in solution from below.
Ash-pit. The receptacle for ashes under a fire-place.
Assay. To test ores and minerals by chemical or blowpipe examination; said to be in *the dry way* when done by means of heat (as in a crucible), and in *the wet or humid way* when by means of solution and precipitation or liquid tests. An assay differs from a complete analysis in being confined to the determination of certain ingredients, the rest not being determined. Both assays and analyses may be either qualitative or quantitative; that is, they may determine the presence merely, or also the amount, of some or all of the constituents of the substance examined. The assay value of gold and silver ores is usually determined in Troy ounces (or, for gold, pennyweights) per ton (2000 pounds avoirdupois) of ore. See *Assay ton.* When reported in money value, the ounce of gold is taken at $20.6718. A ton of pure gold would be worth $602,928.51; the value of $6 per ton would be by weight one-thousandth per cent., and so on. Silver varies greatly in market value; but assayers often report their results according to the old U. S. standard, which made the ounce of pure silver worth $1.2929. The ton of silver at this rate, would be worth $37. 710.40; the value of $37 per ton would be by weight one-tenth per cent., and so on. For ordinary gold and silver ores, it is evident that the percentages would be inconveniently small as expressions of value. Assays of lead, copper, iron, etc., are reported in percentages.
Assay-ton. A weight of 29.166⅔ grams. Since one ton of 2000 pounds avoirdupois contains 29.166⅔ troy ounces, it is evident that each milligram of gold or silver obtained from one *assay-ton* of ore represents one ounce troy to the ton of 2000 pounds avoirdupois.
Assessment-work, Pac. The work done annually on a mining claim to maintain possessory title.
Astel. Overhead boarding or arching in a gallery.
Astyllen, Eng. A small dam in an adit or level, to check water.
Atierres, Sp. Refuse ores.
Attle, Corn. Refuse rock.
Auger-nose shell. See *Wimble.*
Auger-stem. The bar to which a *drilling-bit* is attached.
Auget or *Augette.* A priming tube, used in blasting.
Augustin process. The treatment of silver ores by chloridizing, roasting, lixiviation with hot brine, and precipitation with copper.
Auriferous. Containing gold.
Average produce, Corn. The quantity of pure or fine copper in one hundred parts of ore.
Average standard, Corn. The price per ton of pure or fine copper in the ore.
Aviador, Sp. A person who *habilitates* a mine; that is, who furnishes the money for working it by contract with proprietors.
Azogueria, Sp. 1. The amalgamating works. 2. The process of amalgamation.
Azogues, Sp. Common or inferior ores.

BACK, Corn. 1. With reference to an adit, drift or stope, the part of the vein between it and the next working above, or the surface. 2. See *Face.*
Back-casing, Eng. A temporary shaft-lining of bricks laid dry, and supported at intervals upon *curbs.* When the *stone-head* has been reached, the permanent masonry lining is built upon it inside of the *back-casing.*
Back-end, Newc. The part of a *judd* remaining after the *sump* has been removed.
Backing deals, Newc. Planks driven vertically behind the curbs in a shaft from one curb to another.
Back-shift. The second set of miners working in any spot each day.
Back-skin, Newc. A leather covering worn by men in wet workings.
Bait, Newc. A pitman's provisions.
Bal, Corn. A mine.
Balance-bob. A heavy lever ballasted at one end, and attached at the other to the pump-rod, the weight of which it thus helps to carry. When the shaft is deep, and the pump-rods are consequently very heavy, balance-bobs are put in at intervals of 200 or 300 feet, thus relieving the strain on the rods themselves and on the engine.
Balk, Newc. A *hitch* producing a *nip.*
Balland, Derb. Pulverulent lead ore.
Ballast-shovel. A round-mouthed shovel.
Balling. The aggregation of iron in the *puddling* or the *bloomary* process into *balls* or *loups.*
Ball-stamp, Lake Sup. A stamp for crushing rock, operated directly by steam-power, the stem of the stamp being at the same time the piston-rod of a steam cylinder.
Band, Newc. Stone interstratified with coal.
Bank. 1. (Derb. or *Benk*). The face of the coal at which miners are working. 2. An ore-deposit or coal-bed worked by surface excavations or drifts above water-level. 3. Eng. The ground at the top of a shaft. Ores are brought "to bank," *i. e.,* "to grass." See *Grass.*
Banksman, Newc. See *Lander.*
Bar. 1. A drilling or tamping-rod. 2. A vein or dyke crossing a lode. 3. A sand or rock ridge crossing the bed of a stream.
Bar-diggings, Pac. Gold-washing claims located on the bars (shallows) of a stream, and worked when the water is low, or otherwise with the aid of coffer-dams.
Barilla, Sp. Native copper disseminated in grains in copper ores.
Barmaster. Derb. A mining official who collects the dues or royalties, presides over the *barmote,* etc. (From *Germ. Bergmeister*).
Barmote, Derb. A mining court.
Barney. A small car attached to a rope and used to push cars up a slope or inclined plane.
Barranca, Sp. A ravine.
Barrel. 1. The water-cylinder of a pump. 2. A piece of small pipe inserted in the end of a cartridge to carry the *squib* to the powder. 3. A vessel used in amalgamation.
Barrel-amalgamation. The amalgamation of silver ores by revolution in wooden barrels with quicksilver, metallic wire, and water.
Barrel-work, Lake Sup. Native copper occurring in pieces of a size to be sorted out by hand in sufficient purity for smelting without mechanical concentration.
Barrier-pillars. *Pillars* of coal, larger than ordinary, left at intervals to prevent too extensive crushing when the ground comes to be *robbed.*
Barrow, Corn. 1. A heap of *attle* or rubbish; a *dump.* 2. A vehicle in which ore, coal, etc., are wheeled.
Barrow-men, Newc. See *Putters.*
Barrow-way, Newc. A *level* through which coal or ore is wheeled.
Base bullion. See *Bullion.*
Base metals. The metals not classed as *noble* or precious. See *Noble metals.*
Basic. In furnace practice, a slag in which the earthy bases are in excess of the amount required to form a neutral slag with the silica present.
Basic lining. A lining for furnaces, converters. etc., formed of non-silicious material, usually limestone, dolomite, lime, magnesia, or iron oxide.
Basic-lining process. An improvement of the *Bessemer process,* in which by the use of a basic lining in the *converter* and by the addition of basic materials during the *blow,* it is possible to eliminate phosphorus from the pig iron, and keep it out of the steel.
Basin. 1. A natural depression of strata containing a coal bed or other stratified deposit. 2. The deposit itself.
Bass or *batt.* See *Bind.*

Basset. DERB. An outcrop; the edge of a stratum.
Batch, CORE. The quantity of ore sent to the surface by a pare of men.
Batea, SP. A large wooden bowl in which gold-bearing earth or crushed ore is washed in the same way as in a *pan.*
Bath. A mass of molten material in a furnace, or of a solution in a tank.
Batt. See *Bind.*
Battery. 1. A set of *stamps* in a stamp-mill, comprising the number which fall in one *mortar,* usually five. 2. A bulkhead of timber. 3. The plank closing the bottom of a *coal-chute.*
Battery-amalgamation. Amalgamation by means of mercury placed in the mortar.
Battery-assay. See *Pulp-assay.*
Bauxite. See *Aluminium-ores.*
Beans, NEWC. Small coals.
Bean shot. Copper granulated by pouring into hot water.
Bear. 1. See *Salamander.* 2. See *Loup.*
Bearing. See *Strike.*
Bed. A seam or deposit of mineral later in origin than the rock below, and older than the rock above; that is to say, a regular member of the series of formations, and not an intrusion.
Bedded vein. Properly *bed vein* (*Lagergang* of the Germans); a lode occupying the position of a bed, that is, parallel with the stratification of the inclosing rock.
Bede. A miner's pickaxe.
Bed-rock, PAC. The solid rock underlying alluvial and other surface formations.
Bed-way. An appearance of stratification, or parallel marking, in granite.
Beehive oven. An oven for the manufacture of coke, shaped like the old-fashioned beehive.
Belgian oven. A rectangular oven with end-doors and side-flues for the manufacture of coke.
Belgian zinc-furnace. A furnace in which zinc is reduced and distilled from calcined ores in tubular retorts.
Bell and hopper. See *Cup and cone.*
Belly helve, ENG. A forge-hammer, lifted by a cam which acts about midway between the fulcrum and the head.
Bell-metal. A hard bronze, containing sometimes small proportions of iron, zinc or lead, but ordinarily consisting of 78 parts copper and 22 tin.
Bell's dephosphorizing process. The removal of phosphorus from molten pig iron in a puddling furnace, lined with iron oxide and fitted with a mechanical rabble to agitate the bath. Red-hot iron-ore is added. See *Krupp's washing process.*
Bench. 1. One of two or more divisions of a coal seam, separated by slate, etc., or simply separated by the process of cutting the coal, one bench or layer being cut before the adjacent one. 2. To cut coal in *benches.*
Benching up, NEWC. Working on the top of coal.
Bend or *Bind,* DERB. Indurated clay.
Beneficiar, SP. To benefit. To work or improve a mine; to reduce its ores; to derive profit or advantage from working it.
Beneficiation, sometimes used in English, usually means the reduction of ores.
Bessemer iron. Pig iron suitable for the Bessemer process.
Bessemer process. The process of decarburizing a bath of molten cast iron by blowing air through it, in a vessel called a *converter.*
Biche. A tool ending below in a conical cavity, for recovering broken rods from a bore-hole.
Billet. 1. Iron or steel, drawn from a pile, bloom, or ingot into a small bar for further manufacture. 2. A small bloom.
Bind, DERB. See *Bend.*
Biny, NORTH ENG. Eight hundred weight of ore.
Bing-ore, DERB. Ore in lumps.
Bing-hole, DERB. A hole or *shoot* through which ore is thrown.
Bing-tale, NORTH ENG. See *Tribute.*
Bismuth-ores. Native bismuth; *bismuth ochre* (oxide); *bismuthine* (sulphide); also, bismuthiferous cobalt, silver and copper ores.
Bit. The cutting end of a boring implement.
Bituminous coal. See *Coal.*
Black-band. An earthy carbonate of iron, accompanying coal-beds. Extensively worked as an iron ore in Great Britain, and somewhat in Ohio.
Black-copper. Impure copper from smelting, before refining.
Black damp, ENG. Carbonic acid gas.
Black ends, ENG. Refuse coke from coking-ovens.
Black flux. A mixture of charcoal and potassium carbonate.
Black jack, CORN. Zinc-blende; sometimes hornblende.
Black lead. Graphite.
Black litharge. See *Abstrich.*
Black plate. Sheet iron before tinning.
Black tin, CORN. Tin ore prepared for smelting.
Blair process. An improved form of the *Chenot process.*
Blanch. Lead ore, mixed with other minerals.
Blanched copper. An alloy of copper and arsenic.
Blanket sluices. Sluices in which coarse blankets are laid, to catch the fine but heavy particles of gold and amalgam, etc., in the slime passing over them. The blankets are removed and washed from time to time, to obtain the precious metal.
Blast. 1. The operation of *blasting,* or rending rock or earth by means of explosions. 2. The air forced into a furnace to accelerate combustion. 3. The period during which a blast furnace is *in blast,* that is in operation.
Blast furnace. A furnace, usually a shaft-furnace, into which air is forced under pressure.
Blasting-stick. A simple form of fuse.
Bleaching-clay, CORN. Kaolin, used with size, to whiten and give weight and substance to cotton goods.
Bleiberg furnace. See *Carinthian furnace.*
Blende. See *Zinc ores.*
Blick, GERM. The *brightening* or iridescence appearing on silver or gold at the end of the cupelling or refining process.
Blind level. 1. A level not yet connected with other workings. 2. A level for drainage, having a shaft at either end, and acting as an inverted siphon.
Blind-shaft. See *Winze.*
Blister-steel. See *Steel.*
Bloat. A hammer swelled at the *eye.*
Block-coal, U. S. See *Coal.*
Block-furnace. See *Bloomary.*
Block tin. Cast tin.
Bloom. 1. A large steel bar, drawn ftom an ingot for further manufacture. 2. A rough bar of iron, drawn from a Catalan or bloomary ball, for further manufacture. See *Billet.*
Bloomary. A forge for making wrought-iron, usually direct from the ore. The sides are iron plates, the *hair-plate* at the back, the *cinder plate* at the front, the *tuyere-plate* (through which the tuyere passes) at one side (its upper part being called in some bloomaries the *merrit-plate*) the *fore spar plate* opposite the *tuyere-plate* (its upper part being the *skew-plate*) and the *bottom plate* at the bottom.
Blossom. The oxidized or decomposed outcrop of a vein or coal-bed, more frequently the latter. Also called *smut* and *tailing.* See *Gossan.*
Blow. A single *heat* or operation of the Bessemer *converter.*
Blower, NEWC. 1. A strong discharge of gas from a fissure. 2. A *fan* or other apparatus for forcing air into a furnace or mine.
Blow-george. A hand-fan.
Blow-in. To put a blast furnace in operation.
Blow-out. 1. To put a blast furnace out of blast, by ceasing to charge fresh materials, and continuing the blast until the contents of the furnace have been smelted. 2. A large outcrop, beneath which the vein is smaller, is called a *blow-out.* 3. A *shot* or blast is said to *blow out* when it goes off like a gun and does not shatter the rock.
Blow-pipe. A tube through which air is forced into a flame, to direct it and increase its intensity. In the compound blowpipe, two jets of gas (one of which may be air) are united at the point of combustion.
Blue-billy, ENG. The residuum of cupreous pyrites after roasting with salt.
Blue-john, DERB. Fluorspar.
Blue lead. (Pronounced like the verb *to lead.*) The bluish auriferous gravel and cement deposit found in the ancient river-channels of California.
Blue metal. See *Metal.*
Blue peach, CORN. A slate-blue, very fine-grained schorl-rock.
Blue stone. Copper-vitriol; copper-sulphate.
Boards. The first set of excavations in *post-and-stall* work.
Boat level, WALES. A navigable *adit.*
Bob, CORN. A triangular frame, by means of which the horizontal motion imparted from an engine is transformed into a vertical motion of the pump-rods in a shaft.
Bob-station. See *Station.*
Bog-iron-ore. A loose, earthy *brown hematite,* of recent origin, formed in swampy ground.
Boiling. See *Puddling.*
Bonanza, SP. Literally, fair weather. In miners' phrase, good luck, or a body of rich ore. A mine is *in bonanza* when it is profitably producing ore.
Bone. The slaty matter intercalated in coal-seams.
Bonnet. A covering over a cage to shield it from objects falling down the shaft.
Bonney, CORN. An isolated body of ore.
Booming. The accumulation and sudden discharge of a quantity of water (in placer mining, where water is scarce.) See, also, *Hushing.*
Boot. A leather or tin joint connecting the *blast-main* with the *tuyere* or *nozzle* in a *bloomary.*
Bord, NEWC. A passage or *breast,* driven up the slope of the coal from the gangway, and hence across the *grain* of the coal.
Bord. See *Boards, Breast,* and *Post-and-stall.*
Board-and-pillar. See *Post-and-stall.*
Borer. See *Drill.*
Borrasca, SP. The converse of *bonanza.* Barren rock.
Bort. Opaque black diamond.
Bosh. 1. A trough in which bloomary tools (or, in copper-smelting, hot ingots) are cooled. 2. (Or. *Boshes.*) The portion of a shaft furnace in which it widens from above the hearth up to its maximum diameter.
Bottom-lift. The deepest lift of a mining-pump, or the lowest pump.
Bottomer, ENG. The man stationed at the bottom of a shaft in charge of the proper loading of cages, signals for hoisting, etc.

Bottoms, CORN. 1 The deepest workings. 2. In copper-smelting, the impure metallic copper, or cupriferous alloy, which separates from the *matt*, and is found below it, when there is not enough sulphur present to retain in combination all the copper.

Boulder or *Bowlder*. A fragment of rock brought by natural means from a distance (though this notion of transportation from a distance is not always, in later usage, involved) and usually large and rounded in shape. *Cobble stones* taken from river-beds are, in some American localities, called boulders.

Bonds, CORN. A tract of tin-ored ground.

Bout, DERB. A measure of lead-ore; twenty-four *dishes*.

Bowke, S. STAFF. A small wooden box in which iron-ore is hauled underground.

Bowse or *Bouze*, DERB. Lead-ore as cut from the lode.

Box-bill. A tool used in deep boring for slipping over and recovering broken rods.

Box-groove. A closed groove between two *rolls*, formed by a collar on one roll, fitting between collars on another roll.

Box-timbering. See *Plank-timbering*.

Brace, CORN. The mouth of a shaft.

Brace-head. A cross-attachment at the top of the column of rods in deep boring, by means of which the rods and bit are turned after each drop.

Brace-key. See *Bracehead*.

Braize, U. S. Charcoal-dust. See *Breeze*.

Brake-sieve. A *jigger*, operated by a hand-lever.

Brakesman. The man in charge of a winding-engine.

Brances. See *Brasses*.

Branch. CORN. A small vein departing from the main lode, and in some cases returning.

Basque. A lining for crucibles or furnaces; generally a compound of clap, etc., with charcoal-dust.

Brass. An alloy of copper and zinc.

Brasses, ENG. and WALES. Pyrites (sulphide of iron) in coal.

Brat, ENG. and WALES. A thin bed of coal mixed with pyrites or carbonate of lime.

Brattice, ENG., SCOT., and WALES. A plank lining, or a longitudinal partition of wood, brick, or even cloth, in a shaft, level, or gangway, generally to aid ventilation.

Brazil. Iron pyrites.

Breaker. See *Coal-Breaker* and *Rock-Breaker*.

Breast. 1. The *face* of a working. 2. In coal mines, the chamber driven upwards from the *gangway*, on the seam, between pillars of coal left standing for the extraction of coal. 3. That side of the *hearth* of a *shaft-furnace* which contains the *metal-notch*.

Breast-boards. Planking placed between the last set of timbers and the *face* of a *gangway* or *heading* which is in quicksand or loose ground.

Breccia. A *conglomerate* in which the fragments are angular.

Breeding-fire. See *Gob-fire*.

Breeze, ENG. Small coke. Probably connected, perhaps interchangeable, with *Braize*, and both with the FR. *Braise*.

Brettis, DERB. A *crib* of timber filed up with *slack* or waste.

Brettis way. A road in a coal-mine, supported by *brettises* built on each side after the coal has been worked out.

Bridge. See *Reverberatory furnace*.

Bridle-chains. Safety-chains to support a *cage* if the link between the cage and rope should break.

Brightening. See *Blick*.

Broaching-bit. A tool used to restore the dimensions of a bore-hole which has been contracted by the swelling of the marl or clay walls.

Brob. A peculiar spike, driven alongside the end of an abutting timber to prevent its slipping.

Broil or *Broyl*, CORN. See *Bryle*.

Broken coal, PENN. See *Coal*.

Bronze. An alloy of copper and tin.

Brood, CORN. The heavier kinds of waste in tin and copper ores.

Brown coal. See *Coal*.

Browse. Ore imperfectly smelted, mixed with cinder and clay.

Bruckner cylinder, PAC. A form of revolving roasting furnace.

Bryle, CORN. The traces of a vein, in loose matter, on or near the surface.

Bucker, DERB. A flat piece of iron with a wooden handle, used for breaking ore.

Bucket. The piston of a lifting-pump.

Bucking, DERB. See *Cobbing*. The *bucking-hammer* or *bucking-iron* is a broad-headed hammer used for this purpose; and the ore is broken on a flat piece of iron (*bucking plate*).

Buckshot cinder. Cinder from the iron blast furnace, containing grains of iron.

Buckwheat-coal, PENN. See *Coal*.

Buddle, CORN. An inclined vat or stationary or revolving platform upon which ore is concentrated by means of running water. Strictly the *buddle* is a shallow vat, not a platform or *table;* at least not in some localities. But general usage, particularly on the Pacific slope, makes no distinction.

Buggy. A small mine-wagon holding ½ ton to 1 ton of coal.

Buhrstone. A quartz rock containing cellules.

Buitron, SP. A furnace of peculiar construction, in which silver ore is reduced.

Bulkhead. 1. A tight partition or stopping in a mine for protection against water, fire, or gas. 2. The end of a flume, whence water is carried in iron pipes to hydraulic workings.

Bull. See *Clay iron*.

Bulldog. 1. A refractory material used as a furnace-lining, got by calcining *mill-cinder*, and containing silica and ferric oxide. 2. PENN. See *Buckshot-cinder*.

Bullfrog. See *Barney*.

Bullion. Uncoined gold and silver. *Base bullion* (PAC,) is pig lead containing silver and some gold, which are separated by refining.

Bull pump, CORN. A direct single-acting pump, the steam cylinder of which is placed over the top of a shaft or slope, and the piston-rod attached to the pump-rods. The steam lifts piston and pump-rods, and the weight of these makes a down-stroke.

Bull wheel. In rope-boring, a wheel on which is wound the rope for hoisting the bit, etc.

Bully. A pattern of miners' hammer, varying from "*broad-bully*" to "*narrow bully*."

Bunch of ore, CORN. An ore-body, usually a small one.

Bunding. A staging of boards on *stulls* or *stemples*, to carry *deads*. See *stull covering*.

Buntons, ENG. Battens or scantlings placed horizontally across a shaft, to which are nailed the boards forming the *cleading* or *sheathing* of a *brattice*.

Burden, CORN. 1. The tops or heads of steam work, which lie over the stream of tin. 2. The proportion of ore and flux to fuel in the charge of a blast-furnace.

Burning. See *Calcining*.

Burnt iron. 1. Iron which by long exposure to heat has suffered a change of structure and become brittle. It can be restored by careful forging at welding-heat. 2. In the *Bessemer* and *open-hearth* processes, iron which has been exposed to oxidation until all its carbon is gone, and oxide of iron has been formed in the mass.

Burr. Solid rock.

Burrow, CORN. A heap of refuse.

Buscones, SP. Searchers; explorers.

Bushel. The Imperial bushel, of 2218 cubic inches, and the Winchester bushel, of 2150 cubic inches, are divided into 4 pecks. The bushel used in measuring charcoal and coal contains 5 pecks, or 2680 cubic inches, being 20 pounds or less of charcoal, and, in various localities, 80, 76, or 72 pounds of coal.

Bustamente furnace. A cylindrical shaft-furnace for roasting quicksilver ores; divided by perforated arches into two compartments, of which the upper receives the ore and the lower the fuel. The mercury-vapors are condensed in *aludels*.

Butt, ENG. Of coal; a surface exposed at right angles to the *face*. See *End*.

Button. The globule of metal remaining on an *assay-cupel* or in a crucible, at the end of the fusion.

Butty, DERB. and STAFF. A miner by contract at so much per ton of coal or ore.

Cabbling. Breaking up pieces of flat iron to be *piled* or *fagoted*, heated and rolled.

Cable-tools. The apparatus used in drilling deep holes, such as artesian wells, with a rope instead of rods, to connect the drill with the machine on the surface.

Cache, FR. The place where provisions, ammunition, etc., are *cached* or hidden by trappers or prospectors in unsettled regions.

Cage. 1. A frame with one or more platforms for cars, used in hoisting in a vertical shaft. It is steadied by guides on the sides of the shaft. 2. A structure of elastic iron rods slipped into the bore-hole in *rod-boring* to prevent vibration of the rods. 3. The barrel or drum in a *whim* on which the rope is wound.

Cake copper. See *Tough cake*.

Caking coal. See *Coal*.

Cala, SP. A small pit or experimental hole.

Cal, CORN. Wolfram.

Calcine. To expose to heat, with or without oxidation; to *roast*. Applied to ores for the removal of water and sulphur, and the disintegration of the mass; to limestone for the expulsion of its carbonic acid; etc.

Calciner. A furnace or kiln for roasting.

Calicata, SP. A digging or trial pit.

Campaign. The period during which a furnace is continuously in operation.

Canada, SP. A ravine, or small canon.

Canch. A part of a bed of stone worked by quarrying.

Cand or *Cann*, CORN. Fluorspar.

Cank, DERB. See *Whinstone*.

Canon, SP. A valley, usually precipitous; a gorge.

Cannel coal. See *Coal*.

Cap or *Cap-rock*. Barren vein matter, or a *pinch* in a vein, supposed to overlie ore.

Capel. A composite stone of quartz, schorl, and hornblende.

Capella, SP. Cupelling furnace.

Captain, CORN. and WALES. The official in immediate charge of the work in a mine.

Carat. 1. A unit employed in weighing diamonds, and equal to 3⅙ troy grains. A *carat-grain* is one-fourth of a carat. 2. A term employed to distinguish the fineness of a gold alloy, and meaning one-twenty-fourth. Fine gold is 24–*carat* gold. Goldsmith's standard is 22 *carats* fine, *i. e.*, contains 22 parts gold, 1 copper, and 1 silver.

Carbona, CORN. An irregular deposit or impregnation of tin ore, found in connection with a tin lode.

Carbonaceous. Containing carbon not oxidized.

Carbonates. The common term in the West for ores containing a considerable proportion of carbonate of lead. They are sometimes earthy or ochreous (soft carbonates), sometimes granular and comparatively free from iron (sand carbonates), and sometimes compact (hard carbonates.) Often they are rich in silver.

Carbonization. The process of converting to carbon, by removing other ingredients, a substance containing carbon, as in the charring of wood or the natural formation of anthracite.

Carburization. The process of imparting carbon, as in making *cement steel*.

Carga, SP. A mule-load of 300 pounds avoirdupois.

Carinthian furnace. A small reverberatory with inclined hearth, in which lead ore is treated by *roasting and reaction*, wood being the usual fuel.

Car-wheel iron. See *Chill.*

Case. A small fissure, admitting water into the workings.

Case harden. To convert iron superficially into steel by partial cementation.

Casing, CORN. 1. A partition or *brattice*, made of *casing-plank*, in a shaft. 2. PAC. *Casings* are zones of material altered by vein-action, and lying between the unaltered country rock and the vein.

Cast-after-cast, CORN. The throwing up of ore from one platform to another successively. See *Shambles.*

Cast house. The building in which pigs or ingots are cast.

Casting. Pouring or drawing fused metal from a blast furnace, cupola, crucible, converter, or ladle into moulds.

Cast-iron. See *Iron.*

Cast-steel. See *Steel.*

Cata, SP. A mine denounced, but unworked.

Catalan forge. A forge with a tuyere for reducing iron ore, with charcoal, to a loup of wrought iron; a *bloomary.* See *Champlain forge.*

Cat-head. 1. A small capstan. 2. A *broad-bully* hammer. See *Bully.*

Cauf. NEWC. See *Corf.*

Caunter lode, CORN. A vein coursing at a considerable angle to neighboring veins.

Caving. The falling in of the sides or top of excavations.

Cawk. Sulphate of baryta (heavy spar).

Cazo, SP. A caldron in which amalgamation is effected by the *cazo* process, used in Mexico, and South America.

Cement, AUSTR. and PAC. Gravel firmly held in a silicious matrix, or the matrix itself.

Cementation The process of producing a chemical change in a solid substance by packing it in a powder and heating it. See *Cement-steel* and *Malleable castings.*

Cement-copper. Copper precipitated from solution.

Cement-gold. Gold precipitated in fine particles from solution.

Cement-silver. Silver precipitated from solution, usually by copper.

Cement-steel. See *Steel.*

Cendrada, SP. Ashes or smeltings found at the bottom of a furnace, and valuable for use in other smeltings.

Cerro, SP. A hill or mountain.

Chasing. Following a vein by its range or direction.

Chafery. A forge fire for *reheating.* (From the FR. *Chaufferie.*)

Chaldron. Thirty-six bushels. In Newcastle fifty-three hundredweight avoirdupois. *Chaldron-wagons*, containing this quantity, convey the coal from the pit to the place of shipment.

Chalybeate. Impregnated with iron (applied to mineral waters).

Chamber. See *Breast.*

Champion lode. The main vein as distinguished from branches.

Champlain forge or *American forge.* A forge for the direct production of wrought iron, generally used in the United States instead of the Catalan forge, from which it differs in using only finely-crushed ore and in working continuously.

Changing-house, CORN. A room where miners change and dry their underground clothing. See *Dry.*

Charbon roux, FR. Brown charcoal, produced by an incomplete carbonization of wood.

Charge. 1. The materials introduced at one time or one round into a furnace. 2. The amount of explosive used for one blast.

Charger, CORN. An auger-like implement for charging horizontal bore-holes for blasting.

Charring. The expulsion by heat of the volatile constituents of wood, etc., leaving more or less pure vegetable carbon.

Chartermaster, S. STAFF. See *Butty.*

Chats, NORTHUMB. Small pieces of stone with ore.

Cheeks. 1. The sides or walls of a vein. 2. Extensions of the sides of the *eye* of a hammer or *pick.*

Chenot process. The process of making *iron-sponge* from ore mixed with coal-dust, and heated in vertical cylindrical retorts.

Chert. Hornstone; a silicious stone often found in limestone.

Cherry coal, ENG. See *Coal.*

Chestnut coal, PENN. See *Coal.*

Chilian Mill. An improved *arrastre*, in which a heavy stone wheel is rolled around the bed.

Chill. An iron mould or portion of a mould, serving to cool rapidly, and so to harden, the surface of molten iron which comes in contact with it. Iron which can be thus hardened to a considerable depth is *chilling iron*, and is specially used for cast-iron railway car-wheels requiring hardness at the rim without loss of strength in the wheel.

Chimming, CORN. See *Tossing.*

Chimney. An ore-shoot. See *Chute.*

China clay. Kaolin.

Chisel. See *Bit.*

Chock. See *Nog.*

Choke-damp, ENG. Carbonic acid gas.

Chlorides, PAC. A common term for ores containing chloride of silver.

Chloridize. To convert into chloride. Applied to the roasting of silver ores with salt, preparatory to amalgamation.

Chlorination process. The process first introduced by Plattner, in which auriferous ores are first roasted to oxidize the base metals, then saturated with chlorine gas, and finally treated with water, which removes the soluble terchloride of gold, to be subsequently precipitated and melted into bars.

Chrome ore. Chromic iron (*chromite*, oxide of chromium and oxide of iron).

Chute. (Sometimes written *shoot.*) 1. A channel or shaft underground, or an inclined trough above ground, through which the ore falls or is "shoot" by gravity from a higher to a lower level. 2. A body of ore, usually of elongated form, extending downward within a vein (*ore-shoot*). The two forms of orthography of this word are of French and English origin respectively. Under *chute*, the original idea is that of falling; under *shoot*, that of shooting or branching. Both are appropriate to the technical significations of the word. An *ore-shoot*, for instance, may be considered as a branch of the general mass of the ore in a deposit or as a pitch or fall of ore (GERM. *Erzfall*). In England the orthography *shoot* is, I believe, exclusively employed, and this is perhaps the best, the other being unnecessarily foreign.

Cinder, ENG. Slag, particularly from iron blast furnaces.

Cinder-pig, ENG. See *Pig iron.*

Cinder plate. See *Bloomary.*

Cinder tap, *Cinder notch.* The hole through which cinder is tapped from a furnace. See *Lurmann front.*

Cinnabar. Sulphuret of mercury.

Cistern, CORN. See *Tank.*

Clack, CORN. A pump-valve.

Clack-door, CORN. An opening into the valve chamber of a pump.

Claggy, NEWC. Adhesive. When the coal is tightly joined to the roof, the mine is said to have a *claggy top.*

Claim, PAC. The portion of mining ground held under the Federal and local laws by one claimant or association, by virtue of one location and record.

Clanny lamp. The safety-lamp invented by Dr. Clanny.

Clay-iron. A tool for crowding clay into leaky bore-holes.

Cleading, ENG. See *Buntons.*

Clean-up. The operation of collecting all the valuable product of a given period or operation in a stamp mill, or in a hydraulic or placer mine.

Cleat. 1. A joint in coal or rock. 2. A strip of wood.

Cleavage. The property in a mineral, of splitting more easily and perfectly in some directions than in others. The planes of cleavage bear a relation to the crystal form of the mineral. The *cleavage* of rock-masses is more properly a jointing, unless it follows the planes of bedding.

Clinker. The product of the fusion of the earthy impurities (ash) of coal during its combustion.

Clinometer. A simple apparatus for measuring by means of a pendulum or spirit-level and circular scale, vertical angles, particularly *dips.*

Clod. Soft shale or slate, in coal mines, usually applied to a layer forming a bad roof.

Closed-top. See *Cup-and-cone.*

Closed front. An arrangement of the blast-furnace without a *fore-hearth.*

Clotting. The sintering or semi-fusion of ores during roasting.

Coal. (ENG. *Coals*). This term is now applied to *stonecoal* or *pit-coal*, that is, mineral coal, obtained by mining, as distinguished from charcoal. No scientific account of the nature and origin of coal will be given here. The three principal classes recognized by common usage are *anthracite* (hard, black, composed, when pure, almost exclusively of carbon), *bituminous* or *coking coal* (brown or black, containing hydrocarbons, and *lignite* or *brown coal* (brown or black, generally showing a woody or laminar structure, containing much water, and more recent, geologically speaking, than the other varieties). *Semi-anthracites* and *semi-bituminous coals* are gradations between *anthracite* and *bituminous*, based on the increasing percentage of volatile matters. *Hydrogenous* or *gas-coals* are bituminous coals yielding the highest percentage of volatile matters. The English classification of *bituminous coals* distinguishes *coking coal* proper (splintering when heated, but subsequently fusing into a semi-pasty mass), *cherry* or *soft coal* (igniting readily and burning rapidly without splintering or fusion), *splint*, *rough* or *hard* coal (igniting with more difficulty but burning with a clear, hot fire), and *cannel coal* (the *parrot coal* of Scotland, compact, homogeneous, conchoidal in fracture, burning with clear, bright flame). The English call *anthracite* also *stonecoal* or *culm*, and speak of a *semi-anthracite* as *steam-coal*. Any coal advantageously used for generating steam is called a *steam-coal* in the United States. The solid carbon remaining after the expulsion of volatile matters from *bituminous coal* or *lignite* is called *coke*. Commercial *coke*, however, must have a certain coherence and strength; and the coals which furnish it in this condition are called *coking coals*. A peculiar bituminous coal of Indiana and Ohio, which breaks in blocks, and is used raw without coking, to some extent, as a blast-furnace fuel, is called *block coal*. *Anthracite* is divided in the United States according to the color of the ash after burning, into *white-ash*, *red-ash* and *pink-ash coal*. It is also classified for the market according to the size of the pieces (see *Coal-breaker*), as follows: *Lump* includes the largest lumps as they come from the mine. The other sizes pass over and through sieve-meshes of the size named, the figures signifying inches, and thus indicating roughly the average limit of diameter for the pieces in each size, viz.:

Steamboat	through 7	over 4;
No. 1, *Broken* or *grate*,	through 4	over $2\frac{3}{4}$ to $2\frac{1}{2}$;
No. 2, *Egg*,	through $2\frac{3}{4}$ to $2\frac{1}{2}$	over $2\frac{1}{4}$ to 2;
No. 3, *Large stove*,	through $2\frac{1}{4}$ to 2	over $1\frac{7}{8}$ to $1\frac{1}{2}$;
No. 4, *Small stove*,	through $1\frac{7}{8}$ to $1\frac{1}{2}$	over $1\frac{1}{8}$ to 1
No. 5, *Chestnut*,	through $1\frac{1}{8}$ to 1	over $\frac{5}{8}$ to $\frac{1}{2}$;
No. 6, *Pea*,	through $\frac{7}{8}$ to $\frac{1}{2}$	over $\frac{3}{8}$ to $\frac{1}{4}$.

No. 7, *Buckwheat*, is rarely made, except when the coal is washed on the screens, and the *chestnut* and *pea* have the larger dimensions above given. It is the smallest size, and usually included in the dirt or *culm*.

Coal-breaker. A building containing the machinery for breaking coal with toothed rolls, sizing it with sieves, and cleaning it for market.

Coal-pipes. NEWC. Very thin irregular layers of coal.

Cobalt ores. *Cobalt-speiss* (*smaltine*, *chloanthite* when niccoliferous, *safflorite* when ferriferous, an arsenite of cobalt with or without nickel or iron); *cobalt glance* and *cobalt pyrites* (*smaltite* and *linnœrite*, sulphides of cobalt); *cobalt bloom* (*erythrite*, arseniate of cobalt).

Cobbing, CORN. Breaking ore to sort out its better portions. See *Spall*.

Cobble, PENN. An imperfectly puddled ball which goes to pieces in the *squeezer*.

Cobre ores. Copper ores from Cuba.

Cockte, CORN. See *Schorl*.

Cod, NEWC. The bearing of an axle.

Coffer or *Cofer*, DERB. 1. To secure a shaft from leaking by ramming in clay behind the masonry or timbering. 2. (or *Cover*) CORN. See *Mortar* (2). 3. A rectangular plank frame, used in timbering *levels*.

Coffin, CORN. 1. An old open working. 2. The mode of open working by casting up ore and waste from one platform to another, and so to the surface.

Cog. To roll or *bloom* ingots.

Cogs. See *Nogs*; only *Cogs* are not squared, but simply notched where they cross each other. The interior of a structure of this kind and the spaces between the timber are usually filled with *gob*. They are called also *cobs*, *corncobs*, etc.

Coil-drag. A tool to pick up pebbles, bits of iron, etc., from the bottom of a drill-hole.

Coke. The product remaining after the expulsion by heat of the volatile constituents of coal.

Coking coal. See *Coal*.

Coal-bed. A platform in a rolling-mill on which cold bars are stored.

Cold blast. Air forced into a furnace without being previously heated.

Cold short. Brittle when cold. Applied chiefly to iron and steel.

Collar. 1. See *Cap*. 2. The *Collar* of a shaft is the horizontal timbering around the mouth.

Colliery. A coal mine.

Collom washer. LAKE SUP. A variety of *jig*.

Color, SP. 1. Color. The shade or tint of the earth or rock which indicates ore. 2. A particle of Metallic gold found in the prospector's pan after a sample of earth or crushed rock has been "panned out." Prospectors say, *e. g.*, "The dirt gave me so many colors to the panful."

Colorados, SP. Ores impregnated with oxide of iron, and in a state of decomposition. See *Gossan*.

Col-rake. A shovel used to stir lead-ores during washing.

Comb. The place, in a fissure which has been filled by successive depositions on minerals on the walls, where the two sets of layers thus deposited approach most nearly or meet, closing the fissure and exhibiting either a drusy central cavity, or an interlocking of crystals.

Combined Carbon. That portion of the carbon in iron or steel which is not visible as graphite, and is supposed to be alloyed or chemically combined with the iron.

Compass. An instrument like the ordinary nautical or surveyor's compass, though sometimes otherwise marked, and having a *clinometer* attached. Also, *a dip-compass*, for tracing magnetic iron ore, having a needle hung to move in a vertical plane.

Concentration. The removal by mechanical means of the lighter and less valuable portions of ore.

Concentrator. An apparatus in which, by the aid of water or air and specific gravity, mechanical concentration of ores is performed.

Condensor. A vessel or chamber in which volatile products of roasting or smelting (*e. g.*, mercury or zinc vapors) are reduced to solid form by cooling, or in which the fumes of furnaces, containing mechanically suspended as well as volatile metallic matters are arrested.

Conglomerate. A rock consisting of fragments of other rocks (usally rounded) cemented together.

Consume. The chemical and mechanical loss of mercury in amalgamation.

Contact. The plane between two adjacent bodies of dissimilar rock. A *contact-vein* is a vein, and a *contact-bed* is a bed, lying, the former more or less closely, the latter absolutely, along a contact.

Continental process. See *German process*.

Converter. See *Bessemer process*.

Cope. 1. DERB. To contract, to mine lead ore by the *dish* load, or other measure. 2. The upper part of a *flask*, separable from the lower part. See *Drag*.

Coper, DERB. One who contracts to raise lead ore at a fixed rate.

Copperas. Ferrous sulphate.

Copper-ores. Native copper; red copper-ore (*cuprite*, protoxide); green and blue *malachite*) *malachite* and *azurite*, carbonates); *copper glance* (*chalcocite*, sulphide); *purple copper* (variegated or *peacock* ore, *bornite*, sulphide of copper and iron); *gray copper* (*fahl-ore*, *tetrahedrite*, sulphantimonide of copper and other metals); *yellow copper* (*copper-pyrites*, *chalcopyrite*, sulphide of copper and iron); *copper-lead ore*, (*bournonite*, sulphantimonide of lead and copper); *black copper-ore* (an earthy and variable mixture of sulphide and oxide of copper).

Copper-plates, AUSTR. and PAC. The plates of amalgamated copper over which the auriferous ore is allowed to flow from the stamp battery, and upon which the gold is caught as amalgam.

Copper-rain. Minute globules thrown up from the surface of molten copper, when it contains but little suboxide.

Copper-smoke. The gases from the calcination of sulphuretted copper-ores.

Corbond. An irregular mass or "dropper" from a lode.

Cordurie process. The refining of lead by conducting steam through it, while molten, to oxidize certain metallic impurities.

Core, CORN. A miner's underground working-time or *shift*.

Corf, *Corve*, or *Cauf* (the last incorrect). 1. NEWC. A large basket used in hoisting coal; from the GERM. *Korb*. 2. A wooden frame to carry coal. 3. A sled or low wagon for the same purpose.

Cornish pump. A pump operated by rods attached to the beam of a single-acting condensing beam-engine. The steam, pressing down the piston in the vertical steam-cylinder, lifts the pump-rods, and these subsequently descend by their own weight.

Coro-coro. A dressed product of copper-works in South America, consisting of grains of native copper and mixed with pyrite, chalco-pyrite, mispickel, and earthy minerals.

Corroding-lead. Refined lead, sufficiently pure for the corroding process, by which white lead is manufactured.

Cost-book, CORN. A book used to keep accounts of mining enterprises carried on under the *cost-book system*, peculiar to Cornwall and Devon, and differing from both partnership and incorporation. It resembles the mining partnership system of the Pacific States.

Costeaning or *Costeening*, CORN. Discovering veins by pits and open cuts, run on the surface transversely to the supposed course of the veins.

Counter. 1. A cross-vein. 2. (Or *counter-gangway*.) A gangway. driven obliquely upwards on a coal-seam from the main gangway until it cuts off the faces of the workings, and then continues parallel with the main gangway. The oblique portion is called the *run*.

Country, or *country-rock*, CORN. The rock traversed by or adjacent to an ore deposit.

Course. See *Strike*.

Course of ore. See *Chute* (2.).

Coursing. Conducting the air-current of a mine in different directions by means of doors and stoppings.

Cousin Jack. A common nickname for a Cornishman.

Covered-binding, CORN. See *Plank-timbering*.

Cow. A kind of self-acting brake for inclined planes; a trailer.

Cowl. See *Water-barrel*.

Cowper-Siemens stove. A hot blast stove of firebrick on the regenerative-principle.

Coyoting, PAC. Mining in irregular openings or burrows, comparable to the holes of *coyotes* or prairie foxes.

Crab. A machine for moving heavy weights. Specially the engines employed for lowering into place the pumps, rods, pipes, etc., of Cornish *pit-work*.

Cradle, PAC. See *Rocker*.

Cramp. A pillar of rock or mineral left for support.

Cranch. Part of a vein left by old workers.

Craze or *Creaze*, CORN. The tin-ore which collects in the middle part of the *buddle*.

Creep, NEWC. A rising of the floor of a gangway, occasioned by the weight of incumbent strata, in pillar workings. Also any slow movement of mining ground.

Cretaceous. 1. Chalky. 2. See *Geological formations*.

Crevet. A crucible.

Crevice, PAC. 1. A shallow fissure in the bed-rock under a gold placer, in which small but highly concentrated deposits of gold are found. 2. The fissure containing a vein.

Crib. 1. See *Curb*. 2. A structure composed of frames of timber laid horizontally upon one another, or of timbers built up as in the walls of a log cabin. 3. A miner's luncheon.

Cribbing. Close timbering, as the lining of a shaft, or the construction of *cribs* of timber or timber and earth or rock, to support a roof.

Cribble. A sieve.

Crop. 1. CORN. See *Crop-tin*. 2. The *basset* or *outcrop* of strata at the surface. 3. To leave coal at the bottom of a bed.

Cropping out. The rising of layers of rock to the surface. That part of a vein which appears above the surface is called the *cropping* or *outcrop*.

Crop-tin. The chief portion of tin-ore separated from waste in the principal dressing operation.

Cross-course, CORN. An intersecting (usually a barren) vein.

Cross-cut. A level driven across the course of a vein, or, in general, across the direction of the main workings (and to connect two parallel gangways), or across the "grain of coal."

Cross-heading. A heading driven across from one gangway or breast to another, usually for ventilation.

Cross-vein. An intersecting vein.

Crow or *Crow-foot*. A tool with a side-claw, for grasping and recovering broken rods in deep bore-holes.

Crucible. 1. A melting pot. 2. The lower part of a shaft furnace, in which fusion is effected and the molten bath is contained.

Crush. 1. A *squeeze*, accompanied, perhaps, with more violent motion and effects. 2. A variety of fault in coal. See *Fault* (2).

Crusher. A machine for crushing ores.

Cry of tin. The peculiar crackling noise produced in bending a piece of metallic tin.

Culm. 1. ENG. Anthracite. 2. PENN. The waste or *slack* of the Pennsylvania anthracite mines, consisting of fine coal, more or less pure, and coal-dust and dirt.

Cup-and-cone. A machine for charging a shaft-furnace, consisting of an iron hopper with a large central opening, which is closed by a *cone* or *bell* pulled up into it from below. In the annular space around this cone, the ore, fuel, etc., are placed; then the cone is lowered to drop the materials into the furnace; after which it is again raised to close the hole.

Cupellation. The treatment on a hearth or *cupel* (usually formed of bone-ash) of an alloy of lead, gold, and silver, by means of fusion and an air blast, which oxidizes the lead to litharge, and removes it in liquid form, or absorbs it in the cupel.

Cupola. A shaft-furnace with a blast, for remelting metals, preparatory to casting. Sometimes incorrectly pronounced and written *Cupalo*.

Curb. A timber frame, circular or square, wedged in a shaft to make a foundation for walling or tubbing, or to support, with or without other timbering, the walls of the shaft.

Curbing. See *Cribbing*.

Cut. 1. To intersect a vein or working. 2. To excavate coal.

DAM. 1. To keep back water in a stream or mine by means of a dam or bulkhead. 2. S. STAFF. See *Stopping* and *Bulkhead*. 3. The wall of refractory material, forming the front of the *fore-hearth* of a blast furnace. It is built on the inside of a supporting iron plate (*dam-plate*). Iron is tapped through a hole in the dam, and cinder through a notch in the top of the dam. See *Lurmann front*.

Damask. The etched or "watered" surface produced on polished (welded) steel by corrosion.

Damper. A valve in a flue or at the top of a chimney to regulate the draft.

Dam-plate. The plate upon the *dam-stone* or front stone of the bottom of a blast furnace.

Damp-sheet, S. STAFF. A large sheet, placed as a curtain or partition across a gate-road to stop and turn an air-current.

Dan, NEWC. A truck or sled used in coal mines.

Danks puddler. A revolving mechanical puddler. See *Puddling*.

Dant, NEWC. Soft, inferior coal; *mineral charcoal*.

Davy lamp. The safety lamp invented by Sir H. Davy.

Day, WALES. The surface of the ground over a mine. *Day-level*. An *adit*. *Day-water*. Water from the surface.

Dead, CORN. 1. Unventilated. 2. As to a vein or piece of ground, unproductive.

Deadened mercury. See *Floured*.

Dead-plate. Nearly horizontal iron plate, at the mouth of the furnace, under a steam-boiler, on which the bituminous coal charges are laid to be partially coked before they are pushed upon the grate where their solid carbon is consumed. The gases evolved on the *dead-plate* pass over the grate and are burned.

Dead riches. See *Base bullion*.

Dead roasting. Roasting carried to the farthest practicable degree in the expulsion of sulphur.

Deads, CORN. The waste rock, packed in excavations from which ore or coal has been extracted.

Dead work. Work that is not directly productive, though it may be necessary for exploration and future production.

Deal. Plank used in shaft and gallery construction.

Dean, CORN. The end of a level.

Debris, FR. The fragments resulting from shattering or disintegration.

Deep, CORN. The lower portion of a vein; and in the phrase *to the deep, i. e.*, downward upon the vein.

Denunciar, SP. To denounce. To give information that a mine is forfeited for being insufficiently worked, or for a violation of some condition which imposes that penalty. This term is also applied to the giving notice of a discovery, for the purpose of registry.

Deposit. The term *mineral deposit* or *ore-deposit* is arbitrarily used to designate a natural occurrence of a useful mineral or ore in extent and degree of concentration to invite exploitation.

Derrick. 1. See *Whip*. 2. The hoisting-tower over an artesian well-boring.

Descension-theory. The theory that the material in veins entered from above.

Desilverization. The process of separating silver from its alloys.

Desuing, CORN. See *Disuing*.

Desulphurization. The removal of sulphur from sulphuret ores.

Dial, CORN. See *Compass*. To *dial* a mine is to make a survey of it.

Diamond-drill. A form of rock-drill in which the work is done by abrasion instead of percussion, black diamonds (*borts*) being set in the head of the boring tool.

Diamond groove. A groove of V-section in a *roll*.

Die. A piece of hard iron, placed in a mortar to receive the blow of a stamp, or in a pan to receive the friction of the muller. Between the die and the stamp or muller the ore is crushed.

Dig. CORN. See *Gouge*.

Diggings. Applicable to all mineral deposits and mining camps, but in usage in the United States applied to placer-mining only.

Dike. A vein of igneous rock.

Dilluing or *dilleughing*, CORN. An operation performed in tin-dressing upon the slimes of a certain part of the process. It is like the operation of *panning*, only performed with a sieve having a close haircloth bottom, and in a *kieve* of water which receives the tailings of the process.

Diluvium. Sand, gravel, clay, etc., in superficial deposits. See *Drift*. According to some authors, alluvium is the effect of the ordinary, and diluvium of the extraordinary action of water. The latter term is now passing out of use as not precise, and more specific names for the different kinds of material are substituted.

Dinas brick. A refractory brick, almost entirely composed of silica from the Dinas "clay" in the Vale of Neath, England.

Dip. The inclination of a vein or stratum below the horizontal. The dip at any point is necessarily at right angles with the local *strike*, and its inclination is steeper than that of any other line drawn in the plane of the vein or stratum through that point.

Dipping-needle. See *Compass*.

Discovery, PAC. The first finding of the mineral deposit in place upon a mining claim. A *discovery* is necessary before the location can be held by a valid title. The opening in which it is made is called *discovery-shaft, discovery tunnel*, etc.

Dish, CORN. 1. The landowner's or landlord's part of the ore. 2. DERB. A measure of 14, 15 or 16 pints.

Dissuing, CORN. Cutting out the *selvage* or *gouge* of a lode, to facilitate the ore-extraction.

Distillation. Volatilization, followed by condensation to the liquid state.

District. In the States and Territories west of the Missouri, a vaguely bounded and temporary division and organization made by the inhabitants of a mining region. A district has one code of mining laws, and one recorder. Counties and county officers are gradually taking the place of these cruder arrangements.

Ditch. An artificial watercourse, flume or canal, to convey water for mining. A flume is usually of wood; a ditch, of earth.

Divining-rod or *Dowsing-rod*, CORN. A rod (most frequently of witch-hazel, and forked in shape) used, according to an old but still extant superstition, for discovering mineral veins and springs of water, and even for locating oil wells.

Doggy, S. STAFF. An underground superintendent, employed by the *butty*.

Dog-hole. A small *proving-hole* or airway, usually less than 5 feet high.

Dole. A division of a parcel of ore.

Dolly-tub, CORN. A tub in which ore is washed, being agitated by a *dolly*, or perforated board.

Dope. See *Explosives*.

Dotts or *Dott-holes*. Small openings in the vein.

Douglas process. See *Hunt and Douglas process*.

Downcast. The opening through which the ventilating air-current descends into a mine.

Downcome. The pipe through which *tunnel-head* gases from iron blast-furnaces are brought down to the hot-blast stoves and boilers, when these are below the *tunnel-head*.

Dradge, CORN. The inferior portions of ore, separated from the *prill* by cobbing.

Drag. The lower part of a *flask*. The mould having been prepared in the two parts of the flask, the *cope* is put upon the *drag* before casting. After casting, the flask is opened by removing the *cope*.

Drag-twist. A spiral hook at the end of a rod, for cleaning boreholes.

Draught, S. STAFF. The quantity of coal raised *to bank* in a given time.

Draw. To *rob* pillars or the top-coal of breasts before abandoning the ground.

Dredge. Very fine mineral matter held in suspension in water.

Dresser, S. STAFF. A large pick, with which the largest lumps of coal are prepared for loading into the *skip*.

Dressing, CORN. The picking and sorting of ores, and washing, preparatory to reduction.

Drift. 1. A horizontal passage underground. A *drift* follows the vein, or distinguished from a *cross-cut*, which intersects it, or a *level* or *gallery*, which may do either. 2. Unstratified *diluvium*.

Drill. A metallic tool for boring in hard material. The ordinary miner's drill is a bar of steel, with a chisel-shaped end, and is struck with a hammer. See *Rock-drill*, *Diamond-drill*.

Driving. Extending excavations horizontally. Distinguished from *sinking* and *raising*.

Dropper, CORN. A branch leaving the main vein on the *footwall* side.

Dross. The material skimmed from the surface of freshly melted, not perfectly pure metal.

Drowned-level. See *Blind-level*, (2).

Druggon, S. STAFF. A square iron or wooden box, used for conveying fresh water for horses, etc., in a mine.

Drum. That part of the winding machinery on which the rope or chain is coiled.

Druse. A crystallized crust lining the sides of a cavity.

Dry, CORN. See *Changing-house*.

Dry copper. See *Under-poled copper*. Also copper just ready for *poling*.

Dry Puddling. See *Puddling*.

Dry sand. Sand prepared for *moulds* by thorough drying and baking. When special cohesion is required (as for *cores*) other substances, such as flour, molasses, etc., are mixed with it.

Dualin. See *Explosives*.

Dumb-drift. An *air-way* conveying air around, not through, a ventilating furnace to the *upcast*.

Dump. 1. To unload a vehicle by tilting or otherwise, without handling or shovelling out its contents. 2. A pile of ore or rock.

Dumper. A tilting-car used on *dumps*.

Durn, CORN. A frame of timbering, like a door-frame.

Dust-plate. A vertical iron plate, supporting the *slag-runner* of an iron blast furnace.

Dutch metal. An alloy of copper and zinc, containing more copper than ordinary brass.

Duty. A measure of the effectiveness of a steam-engine, usually expressed in the number of foot-pounds (or kilogrammetres) of useful work obtained from a given quantity of fuel.

Duty-ore, CORN. The landlord's share of the ore.

Dyke. See *Dike*.

Dzhu, CORN. To cut ahead on one side of a *face*, so as to increase the efficacy of blasting on the remainder. (Doubtless the same word as *Dissue*. See *Dissuing*.) Also called *to hulk*.

EGG-coal, PENN. See *Coal*.

Egg-hole, DERB. A notch cut in the wall of a lode to hold the end of a *stempel*.

Electrum. An alloy of copper, zinc, and nickel.

Eliquation. Separating an alloy by heating it so as to melt the more fusible of its ingredients, but not the less fusible.

Elutriation. Purification by washing and pouring off the lighter matter suspended in water, leaving the heavier portions behind.

Elvan, CORN. A name given to certain broad granite veins or belts in schistose rocks.

Emery. Impure corundum.

End of coal. The direction or section at right-angles to the *face*; sometimes called the *butt*.

End-pieces, CORN. See *Wall-plates*.

English process. In copper-smelting, the process of *reduction* in a *reverberatory* furnace, after *roasting*, if necessary.

English zinc-furnace. A furnace in which zinc is reduced and distilled from *calcined* ores in *crucibles*.

Engorgement. The *clogging* of a furnace. See *Scaffold*.

Entry. An *adit*. Applied to the main *gangway* in some coal mines.

Estufa amalgamation, SP. A modification of the *patio* process, using heat.

Exploder. A cap or fulminating cartridge, placed in a charge of gunpowder or other explosive, and exploded by electricity or by a fuse. See *Explosives*.

Exploitation, FR. The productive working of a mine, as distinguished from exploration.

Explosives. The principal explosives used in mining are *gunpowder*, a compound of sulphur, charcoal, and potassium nitrate (potash saltpetre) or sodium nitrate (Chili or soda-saltpetre); *nitro-glycerin*, a liquid compound of carbon, hydrogen, nitrogen, and oxygen, produced by the action of nitric acid upon glycerin; *dynamite No.* 1, or *giant-powder*, a mixture of nitroglycerin with a dry pulverized mineral or vegetable absorbent or *dope* (commonly silicious or infusorial earth); *dynamite No.* 2, nitroglycerin mixed with saltpetre, sawdust, or coaldust, paraffin, etc., in lieu of an inexplosive *dope*; *lithofracteur*, nitroglycerin mixed with silicious earth, charcoal, sodium (and sometimes barium) nitrate and sulphur; *dualin*, nitroglycerin mixed with potassium, nitrate and fine sawdust; *rend-rock*, *Atlas*, *Hercules*, *Neptune*, *tonite*, *vigorite*, and other powers, resembling dynamite No. 2, *i. e.*, consisting of nitroglycerin with a more or less explosive *dope*; and *mica-powder*, a No. 1 *dynamite*, in which the *dope* is fine scales of mica. The *chlorate*, *picrate*, and *fulminate* explosives are not used in mining, except the fulminate of mercury, which is employed for the *caps* or *exploders*, by means of which charges of powder, dynamite, etc., are fired.

Eye. 1. The top of a shaft. 2. The opening at the end of a *tuyere*, opposite the *nozzle*. 3. The hole in a *pick* or hammer-head which receives the handle.

FACE. 1. In any adit, tunnel, or stope, the end at which work is progressing or was last done. 2. The *face of coal* is the principal cleavage-plane at right angles to the stratification. Driving *on the face* is driving against or at right angles with the face.

Fagot. See *Pile*.

Fahlband, GERM. A zone or stratum in crystalline rock, impregnated with metallic sulphides. Intersecting fissure-veins are enriched by the *fahlband*.

Famp, NEWC. Soft, tough, thin shale beds.

Fan. A revolving machine, to blow air into a mine (*pressure-fan*, *blower*), or to draw it out (*suction-fan*).

Fanega, SP. A bushel; sometimes half a mule-load.

Fang, DERB. An air-course cut in the side of a shaft or level, or constructed of wood.

Fast-end. 1. The part of the coal-bed next the rock. 2. A gangway with rock on both sides. See *Loose-end*.

Fast shot, NEWC. A charge of powder exploding without the desired effect.

Fathom, CORN. Six feet. A *fathom of mining ground* is six feet square by the whole thickness of the vein, or in Cornish phrase, *a fathom forward by a fathom vertical*.

Fauld. The *tymp-arch* or working-arch of a furnace.

Fathom-tale, CORN. See *Tut-work* (2). This name probably arises from the payment for such work by the space excavated, and not by the ore produced.

Fault. 1. A dislocation of the strata or the vein. 2. In coal-seams, sometimes applied to the coal rendered worthless by its condition in the seam (*slate-fault*, *dirt-fault*, etc.).

Feather. See *Plug and feather*.

Feathered-shot. Copper granulated by pouring into cold water.

Feathering. See *Plugging*.

Feeder. 1. A small vein joining a larger vein. 2. A spring or stream. 3. A *blower* of gas.

Feigh, NEWC. Refuse washed from lead-ore or coal.

Feldspathic. Containing feldspar as a principal ingredient.

Fell. See *Riddle*.

Ferric furnace. A high iron blast furnace, in the upper part of which crude bituminous coal is converted into coke.

Ferromanganese. An alloy of iron and manganese.

Ferruginous. Containing iron.

Fettle, *Fettling*. See *Fix*.

Fillet. The rounded corner of a *groove* in a *roll*.

Fin. The thin sheet of metal squeezed out between the collars of the *rolls* in a *roll-train*.

Fine metal. 1. See *Metal*. 2. The iron or plate-metal produced in the *refinery*.

Finery. A charcoal-hearth for the conversion of cast into malleable iron.

Fining. 1. See *Refining*. 2. The conversion of cast into malleable iron in a hearth or charcoal-fire.

Finishing-rolls. The *rolls* of a *train* which receive the bar from the *roughing-rolls*, and reduce it to its finished shape.

Fire-bars. Grate bars in a fireplace.

Fire-bricks. Refractory bricks of fire-clay or of silicious materials used to line furnaces.

Fire-bridge. The separating low wall between the fire-place and the *hearth* of a reverberatory furnace.

Fire-clay. A clay comparatively free from iron and alkalies, not easily fusible, and hence used for fire-bricks. It is often found beneath coal-beds.

Fire-damp. Light carburetted hydrogen gas. When present in common air to the extent of one-fifteenth to one-thirteenth of volume, the mixture is explosive.

Fire-setting. The softening or cracking of the working-face of a lode, to facilitate excavation, by exposing it to the action of a wood-fire built close against it. Now nearly obsolete, but much used in hard rock before the introduction of explosives.

Fire-stink, S. STAFF. The stench from decomposing iron pyrites, caused by the formation of sulphuretted hydrogen.

Fissure-vein. A fissure in the earth's crust filled with mineral.

Fix. To *fettle* or line with a *fix* or *fettling*, consisting of ores, scrap and cinder, or other suitable substances, the hearth of puddling furnace.

Flang, CORN. A two-pointed miner's pick.

Flange. Applied to a vein widening.

Flap-door, NEWC. A manhole door.

Flask. 1. The wooden or iron frame which holds the sand-mould used in a foundry. 2. An iron bottle in which quicksilver is sent to market. It contains 76½ pounds.

Flat, DERB. and N. WALES. A horizontal vein or ore-deposit auxiliary to a main vein; also any horizontal portion of a vein elsewhere not horizontal.

Flat-nose shell. A cylindrical tool with valve at bottom, for boring through soft clay.

Flat-rods. A series of horizontal or inclined connecting-rods, running upon rollers, or supported at their joints by rocking-arms, to convey motion from a steam-engine or water-wheel to pump-rods at a distance.

Flat-wall, CORN. A local term (in St. Just) for *foot-wall.*

Flintshire furnace. A *reverberatory* with a depression, *well* or *crucible* in the middle of the side of the hearth; used for the *roasting and reaction process* on lead ores.

Float-copper, LAKE SUP. Fine scales of metallic copper (especially produced by abrasion in stamping) which do not readily settle in water.

Float-gold, PAC. Fine particles of gold, which do not readily settle in water, and hence are liable to be lost in the ordinary stamp-mill process.

Float-ore. Water-worn particles of ore; fragments of vein-material found on the surface, away from the vein outcrop.

Flookan or *Flooking*, CORN. See *Fluccan.*

Floor. 1. The rock underlying a stratified or nearly horizontal deposit, corresponding to the *foot-wall* of more steeply-dipping deposits. 2. A horizontal, flat ore-body. 3. A floor, in the ordinary sense, or a plank platform underground.

Floran-tin, CORN. Tin ore scarcely visible in the stone, or stamped very small.

Flosh, CORN. A rude mortar, with a shutter instead of a screen, used under stamps.

Floss. Fluid, vitreous cinder, floating in a puddling furnace.

Floss-hole. A tap-hole.

Floured. The finely granulated condition of quicksilver, produced to a greater or less extent by its agitation during the amalgamation process.

Flowing furnace. A *reverberatory* with inclined hearth, used in Cornwall for treating roasted lead ores by the *precipitation process.*

Fluccan, CORN. Soft clayey matter in the vein; a vein or course of clay.

Flue. A passage for air, gas, or smoke.

Flue-bridge. The separating low wall between the flues and the laboratory of a reverberatory furnace.

Flue-cinder. Iron-cinder from the reheating furnace, so called because it runs out from the lower part of the flue.

Flume. A wooden conduit, bringing water to a mill or mine.

Flux. A salt or other mineral, added in smelting to assist fusion, by forming more fusible compounds.

Foal. NEWC. A young boy employed in *putting* coal.

Fodder, NORTH ENG. A unit employed in expressing weights of metallic lead, and equal to 21 hundredweight of 112 pounds avoirdupois.

Foge, CORN. A forge for smelting tin.

Fondon. A large copper vessel, in which hot amalgamation is practiced.

Foot-piece. See *Sill.*

Foot-wall, CORN. The wall under the vein.

Foot-way. The series of ladders and *sollars* by which men enter or leave a mine.

Forefield, NEWC. The face of the workings. The *forefield-end* is the end of the workings farthest advanced.

Fore-hearth. A projecting bay in the front of a blast-furnace-hearth, under the *tymp.* In *open-front* furnaces it is from the fore-hearth that cinder is tapped. See *Dam* and *Tymp.*

Forfeiture. The loss of possessory title to a mine or public lands by failure to comply with the laws prescribing the quantity of *assessment* work, or by actual abandonment.

Fore-poling. A method of securing drifts in progress through quicksand by driving ahead poles, lath, boards, slabs, etc., to prevent the inflow of the quicksand on the sides and top, the face being protected by *breast-boards.*

Forespar. See *Bloomary.*

Fore-winning. NEWC. Advanced workings.

Forge. 1. An open or semi-open *hearth* with a *tuyere.* 2. ENG. That part of an ironworks where *balls* are squeezed and hammered and then drawn out into *puddle-bars* by grooved rolls.

Forge-cinder. The slag from a forge or bloomary.

Formation. See *Geological formations.*

Fork. 1. CORN. The bottom of the *sump.* 2. DERB. A piece of wood supporting the side of an excavation in soft ground.

Forpale or *Forepale.* The driving of timbers or planks horizontally ahead at the working-face, to prevent the caving of the ground in subsequent driving.

Fossil ore. Fossiliferous red hematite.

Fother, NEWC. One-third of a chaldron.

Foundershaft. The first shaft sunk.

Fox-tail, S. WALES. The last cinder obtained in the *fining* process.

Frame, CORN. See *Tin-frame.*

Free, native, uncombined with other substances, as free gold or silver.

Free fall. An arrangement by which, in deep boring, the *bit* is allowed to fall freely to the bottom at each drop or down-stroke.

Free-milling. Applied to ores which contain free gold or silver, and can be reduced by crushing and amalgamation, without roasting or other chemical treatment.

Freiberg amalgamation. See *Barrel amalgamation.*

Fritting. The formation of a slag by heat with but incipient fusion.

Frontal hammer or *Frontal helve*, ENG. A forge-hammer lifted by a cam, acting upon a "tongue" immediately in front of the hammer-head.

Frue vanner. A variety of continuously working *percussion-table.*

Fulguration. See *Blick.*

Furgen. A round rod used for sounding a bloomary fire.

Furnace. 1. A structure in which heat is produced by the combustion of fuel. 2. A structure in which, with the aid of heat so produced, the operations of roasting, reduction, fusion, steam-generation, desiccation, etc., are carried on, or, as in some mines, the *upcast* air-current is heated, to facilitate its ascent and thus aid ventilation.

Furnace cadmium or *cadmia.* The oxide of zinc which accumulates in the chimneys of furnaces smelting zinciferous ores.

Furtherance, NEWC. An extra price paid to *hewers* when they also *put* the coal.

Fuse. A tube or casing filled with combustible material, by means of which a blast is ignited and exploded.

GAD. 1. A steel wedge. 2. A small iron punch with a wooden handle used to break up ore.

Galemador, SP. A small Mexican furnace for roasting silver ores.

Gale, ENG. (Forest of Dean). A grant of mining ground.

Galiage. Royalty.

Gallery. A level or drift.

Gallery-furnace. A retort-furnace used in the distillation of mercury.

Gallows-frame. A frame over a shaft, carrying the pulleys for the hoisting cables.

Galvanize. To coat with zinc.

Ganister. A mixture of ground quartz and fire-clay, used in lining Bessemer converters.

Gang. 1. A mine. 2. A set of miners.

Gangue. The mineral associated with the ore in a vein.

Gangway. 1. A main level, applied chiefly to coal mines. 2. NEWC. A wooden bridge.

Garland, S. STAFF. A trough or gutter round the inside of a shaft to catch the water running down the sides.

Gas-coal. See *Coal.*

Gas-furnace. A furnace employing gaseous fuel.

Gash. Applied to a vein wide above, narrow below, and terminating in depth within the formation it traverses.

Gas-producer. A furnace in which combustible gas is produced, to be used as fuel in another furnace.

Gas-well. A deep boring, from which natural gas is discharged.

Gate, Gate-way, or *Gate-road*, ENG. 1. A road or way underground for air, water or general passage; a *gangway.* 2. The aperture in a founders' mould, through which the molten iron enters.

Gear, NEWC. 1. The working tools of a miner. 2. The mechanical arrangement connecting a motor with its work.

Geode. A cavity, studded around with crystals or mineral matter, or a rounded stone containing such a cavity.

Geological formations. Groups of rocks of similar character and age are called formations. The different stratified formations have been arranged by geologists according to their apparent age or order of position stratigraphically, and the fossils they contain. While there are minor points of difference in classification, and still more in nomenclature, the general scheme is now well settled. Three tables are given on another page, the first prepared in 1878, by Prof. J. D. Dana, the second by Prof. T. Sterry Hunt, both for the United States, and the third referring to formations found in Pennsylvania only, by Professor J. P. Leslie. They are taken (Professor Hunt's, with later revision by the author), from *The Geologist's Traveling Handbook*, prepared by James Macfarlane, Ph.D. The numbers attached to the different formations in these tables will facilitate the identification of a given formation under different names. A catalogue of the formations is added to the tables, in which the predominant rocks of each are named. The eruptive rocks are not included in these tables, the determination of their age being a more difficult and doubtful matter, the discussion of which cannot be undertaken in this place. For lack of space, also, the enumeration and description of the different species of rocks and minerals must be omitted, the reader being referred for such information to works on lithology and mineralogy.

Geordie. The Miners' term for Stephenson's safety-lamp.

PROFESSOR J. D. DANA'S TABLE OF GEOLOGICAL FORMATIONS.

SYSTEMS OR AGES.	GROUPS OR PERIODS.	FORMATIONS OR EPOCHS.
Age of man.	20. Quarternary.	20. Quarternary.
Age of mammals.	19. Tertiary.	19 c. Piliocene. 19 b. Miocene. 19 a. Eocene.
Reptilian age.	18. Cretaceous.	18 c. Upper Cretaceous. 18 b. Middle Cretaceous. 18 a. Lower Cretaceous.
	17. Jurassic.	17. Jurassic.
	16. Triassic.	16. Triassic.
Carboniferous.	15. Permian.	15. Permian.
	14. Carboniferous.	14 c. Upper Coal Measures. 14 b. Lower Coal Measures. 14 a. Millstone Grit.
	13. Subcarboniferous.	13 b. Upper Subcarboniferous 13 a. Lower Subcarboniferous.
Devonian or age of fishes.	12. Catskill.	12. Catskill.
	11. Chemung.	11 b. Chemung. 11 a. Portage.
	10. Hamilton.	10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.
	9. Corniferous.	9 c. Corniferous. 9 b. Schoharie. 9 a. Cauda Galli.
Silurian or age of Invertebrates. Upper Silurian.	8. Oriskany.	8. Oriskany.
	7. Lower Heiderberg.	7. Lower Heiderberg.
	6. Salina.	6. Salina.
	5. Niagara.	5 c. Niagara. 5 b. Clinton. 5 a. Medina.
Lower Silurian.	4. Trenton.	4 c. Cincinnati. 4 b. Utica. 4 a. Trenton.
	3. Canadian.	3 c. Chazy, 3 b. Quebec. 3 a. Calciferous.
	2. Primordial on Cambrian.	2 b. Potsdam. 2 a. Acadian.
	1. Archæan.	1 b. Huronian. 1 a. Laurentian.

PROFESSOR T. STERRY HUNT'S TABLE OF GEOLOGICAL FORMATIONS.

AGES.	GROUPS.	AMERICAN FORMATIONS.
Cenozoic.	20. Quarternary.	20. Recent.
	19. Tertiary.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene
Mesozoic.	18. Cretaceous. 17. Jurassic. 16. Triassic.	18. Cretaceous. 17. New Red Sandstone. 16. New Red Sandstone.
Paleozoic.	13-15. Carboniferous.	15. Permo-Carboniferous.
	8-12. Erian or Devonian.	14. Coal Measures. 13 b. Mississippi (Carb-Limest'e). 13 a. Waverley or Bonaventure. 12. Catskill 11. Chemung and Portage, 10. Hamilton (including Genesee and Marcellus). 9. Corniferous or Upper Heiderb'g 8. Oriskany.
	5-7. Silurian.	7. Lower Heiderberg. 6. Onondaga or Salina. 5 c. Niagara (including Guelph). 5 b. Clinton. 5 a. Medina. 5 a. Oneida.
	4. Upper Cambrian, Siluro-Cambrian, Ordovician, or Ordovian.	4 c. Loraine. 4 b. Utica. 4 a. Trenton.
	3. Middle Cambrian.	3 c. Chazy. 3 b. Levis (Tremadoc and Arenig). 3 a. Calciferous.
	2. Lower Cambrian.	2 e. Potsdam. 2 d. Sillery. 2 c. Acadian (Menevian). 2 b. Taconian. 2 a. Keweenian.
Eozoic.	1. Primary or Crystalline.	1 e. Montalban. 1 d. Norian or Labrador.[1] 1 c. Huronian. 1 b. Arvonian. 1 a. Laurentian.

[1] Professor Hunt says there are many reasons for believing that the Norian may be older than the Arvonian and Huronian.

PROFESSOR J. P. LESLEY'S PROVISIONAL NOMENCLATURE OF THE SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.

	NAMES PROVISIONALLY ADOPTED.	Nos. used in first survey.
	20. Quarternary. 16. Triassic. 14 c. Upper Barren Measures. 14 c. Monongahela River Coal Series. 14 b. Lower Barren Measures. 14 b. Allegheny River Coal Series. 14 a. Pottsville Conglomerate.	 XIII. XIII. XIII. XIII. XII.
Bernician.	13 b. Manch Chunk Red Shale. (Umbral.) 13 a. Pocono Gray Sandstone. (Vespertine.)	XI. X.
Devonian.	12. Catskill Red Sandstone. (Ponent.) 11 b. Chemung. 11 a. Portage. 10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus. 9. Upper Heiderberg. 8. Oriskany.	IX. VIII. VIII. VIII. VIII. VIII. VIII. VII.
Silurian.	7. Lower Heiderberg. (Lewistown Limestone.) 5 b. Clinton. 5 a. Medina. 5 a. Oneida.	VI. V. IV. IV.
Siluro-Cambrian.	4 c. Hudson River. 4 b. Utica. 4 a. Trenton. 3 a. Calciferous. 2 b. Potsdam.	III. III. II. II. I.
	1. Azoic.	

NOTES.—In the following notes Professor Hunt's classification is sufficiently followed to show the nature of the older groups which he distinguishes.

1a. *Laurentian.* Chiefly massive gneiss, reddish or grayish, sparingly micaceous, often hornblendic Some crystalline limestone, magnetic iron, and other metallic ores.

1b. *Arvonian.* Chiefly petrosilex, often becoming quartziferous porphyry, with some quartzites and hornblendic rocks; magnetic and specular iron ore.

1c. *Norian.* Chiefly a feldspathic rock (norite), which sometimes carries garnet, epidote, etc.; also, great beds of titaniferous iron ore.

1d. *Huronian.* Chloritic schists, greenstone, (diorite or diabase). serpentine, steatite, dolomite, copper, chrome, nickel, and iron ores.

1e. *Montalban.* Fine-grained micaceous or hornblendic gneiss, crysolite rock, serpentine, mica-schist, granite.

2a. *Keweenian.* The copper-bearing series of Lake Superior, made up of sandstones and conglomerates, with much interstratified eruptive rock.

2b. *Taconian.* Granular quartzites, argillites and nacreous or hydro-micaceous schists and great masses of crystalline limestone, marbles, magnetite, siderite, and pyrite changing to limonite.

2c and d. *Acaian* (and *Sillery*). Fossiliferous sandstone and shale.
2e. *Potsdam.* Sandstone conglomerate.
3a. *Calciferous.* Sandy magnesian limestone, calcareous sandstone.
3b. *Quebec.* Sandstone, limestone conglomerate, black slate.
3c. *Chazy.* Limestone, chert.
4a. *Trenton.* Limestone, buff and blue; dolomite carrying lead ore deposits; brown-hematite beds.
4b. *Utica.* Dark carbonaceous slate; impure limestone.
4c. *Hudson River.* Slate, shale, clay, grit.
5a. *Medina.* Conglomerate; argillaceous sandstone.
5b. *Clinton.* Sandstone, shale, conglomerate, limestone, fossiliferous red hematite, or oolitic iron ore bed.
5c. *Niagara.* Clay shale; limestone.
6. *Salina.* Red shale, gypseous, shale, hydraulic lime, salt.
7. *Lower Heiderberg.* Limestone, shaly or compact, and fossiliferous.
8. *Oriskany.* Sandstone.
9. *Corniferous or Upper Heiderberg.* Principally limestone.
9a. *Cauda-galli.* Fine-grained calcareous and argillaceous, drab or brownish sandstone; peculiar fossils.
9b. *Schoharie Grit.* Fine-grained calcareous grit, similar to 9a, but with differing fossils.
9c. *Onondaga,* and 9d. *Coniferous.* Gray, blue, black limestone. At the top of 9d occur the Marcellus iron ore (carbonate.)
10a. *Marcellus.* Black or dark-brown bituminous and pyritiferous shales. In 10a, and 9d occur the petroleum deposits of Canada.
10b. *Hamilton.* Slate, shale, sandstone calcareous and argillaceous.
10b. *Tully.* Impure dark limestone.
10c. *Genesee.* Black clay slate.
11a. *Tortase.* Green and black sandy and slaty shales, sandstone, flagstone.
11b. *Chemung.* Thin-bedded greenish sandstones and flagstones, with intervening shales, and rarely beds of impure limestone.
12. *Catskill.* Red, gray sandstone, grindstone grit, greenish shale, conglomerate.
13. *Lower Subcarboniferous.* Sandstone, limestone, small local coal beds.
13b. *Upper Subcarboniferous.* Red shale, red and gray sandstone, blue limestone.
14a. *Millstone Grit.* White or yellow sandstone, and conglomerate of quartz pebbles.
14b. and 15c. *Coal Measures.* Fire-clay, shale, sandstone, conglomerate, limestone, bituminous coal, anthracite, iron ore, salt.
15. *Permian.* Limestone, sandstone, marl, shale.
16. *Triassic.* Red Sandstone, red shale, conglomerate, lignite, trap dikes, copper ore, coal.
17. *Jurassic.* Marl, limestone, probably the gold-bearing slates of California.
18. *Cretaceous.* Earthy beds of sand, marl, clay, limestone, chalk, lignite.
19. *Tertiary.* Earthy sand, clay, marl, limestone, sandstone.
20. *Quaternary.* Sand, pebbles, boulders, clay, diluvium; gravel and placer tin and gold deposits.

NOTE.—The primary and crystalline schistose rocks contain the larger number of mineral veins. The ancient magnesian limestones (probably Devonian) are characterized in many localities by deposits of argentiferous lead ore and of zinc ore.

German process. In copper smelting, the process of reduction in a *shaft-furnace*, after *roasting*, if necessary.
German Silver. A white alloy of nickel, copper, and zinc.
German steel. See *Steel.*
Gerstenhofer furnace. A *shaft furnace* filled with terraces or shelves, through which crushed ore is caused to fall, for roasting.
Gig. See *Kibble.*
Gin. See *Whim.*
Ginging, DERB. The lining of a shaft with masonry.
Giraffe. A car of peculiar construction to run on an incline.
Girdle. A thin bed of stones.
Girdle, NEWC. A thin stratum of stone.
Girth. In *square-set* timbering, a horizontal brace in the direction of the *drift.*
Glazy. See *Iron.*
Glist, CORN. Mica.
Glut, NEWC. A piece of wool, used to fill up behind *cribbing* or *tubbing.*
Goaf, ENG. An excavated space; also, the waste rock packed in old workings.
Goaves. Old workings.
Gob, S. WALES. See *Goaf.* Both terms are chiefly used in collieries, and are apparently the same word. Local usage seems to give to *goaf* rather the meaning of the space in which the roof has fallen after the *pillars* have been removed, and to *gob* that of a space packed with waste after *long-wall* extraction of the coal.
Gobbing. Packing with waste rock. See *Stowing.*
Gob-up, ENG. Of a blast furnace, to become obstructed in working by reason of a *scaffold* or a *salamander.*
Gob-fire. Fire produced by the heat of decomposing *gob.*
Goffan or *Goffen,* CORN. A long narrow surface-working.
Gold ores. Native gold; *telluric gold ore* (*sylvanite, mullerite, nagyagite,* tellurides of gold, silver, and lead); auriferous lead, zinc, and copper ores.
Good levels, CORN. Levels nearly horizontal.
Good roasting. See *Roasting.*
Gopher or *Gopher-drift.* An irregular prospecting-drift, following or seeking the ore without regard to maintenance of a regular grade or section.
Gossan or *Gozzan,* CORN. Hydrate oxide of iron, usually found at the decomposed outcrop of a mineral vein.
Gothic groove. A groove of Gothic arch section in a *roll.*
Gouge. A layer of soft material along the wall of a vein, favoring the miner, by enabling him after "gouging" it out with a pick, to attack the solid vein from the side.
Grain, ENG. Of coal, the lines of structure or parting parallel with the main gangways and hence crossing the *breasts.*
Grain-tin, CORN. 1. Crystalline tin ore. 2. Metallic tin.
Grapnel. An implement for removing the core left by an annular drill in a bore-hole, or for recovering tools, fragments, etc., fallen into the hole,
Grampus, U. S. The tongs with which *bloomary loups* and *billets* are handled.
Granzas, SP. Small pieces of ore.
Graphite. A crystalline form of carbon.
Graphitic carbon. That portion of the carbon in iron or steel which is present as graphite.
Grass, CORN. The surface over a mine. *Bringing ores to grass* is taking them out of the mine.
Grassero, SP. A slag-heap.
Grate, CORN. See *Screen* (as applied to stamps).
Grate coal, PENN. See *Coal.*
Gravel mines, U. S. An accumulation of auriferous gravel.
Grueso, SP. Lump ore. The term is in use at the quicksilver mines of California.
Green sand. Sand used for moulds without previous drying or mixture.
Gray ore, CORN. Copper-glance. See *Copper-ores.*
Gray slag. The slag from the Flintshire lead furnaces. It is rich in lead.
Griddle, CORN. A miner's sieve to separate ore from *halvans.*
Grip. A small, narrow cavity.
Grizzly, PAC. A grating to catch and throw out large stones from sluices.
Groove or *Grove.* 1. DERB. A mine; from the GERM. *Grube.* See *Roll.*
Ground, CORN. The rock in which a vein is found; also, any given portion of the mineral deposit itself.
Growan, CORN. Decomposed granite; sometimes the granite rock.
Gubbin. A kind of ironstone.
Grundy. Granulated pig iron.
Guard. A support in front of a *roll-train* to guide the bar into the groove, sometimes called a *side-guide.*
Guides. 1. The timbers at the side of a shaft to steady and guide the cage. 2. The holes in a cross-beam through which the stems of the stamps in a stamp mill rise and fall. 3. In a rolling-mill a *guide* is a wedge-shaped piece held in the *groove* of a *roll* to prevent the sticking of the bar by peeling it out of the groove. When the guide is held by a hanger or counter-weight against the under side of the roll, it is called a *hanging-guide.*
Guillotine. A machine for breaking iron with a falling weight.
Gullet. An opening in the Strata.
Gun-metal. An alloy of copper with tin or zinc, and sometimes a little iron. The common formula is nine parts copper to one tin. *Aich's metal* and some other gun-metals contain zinc and iron but no tin.
Gunnies or *Gunniss,* CORN. The vacant space left where the lode has been removed.

HACIENDA, SP. Exchequer, treasury; public revenue; capital; funds; wealth; landed estate; establishment. In mining it is usually applied to the offices, principal buildings, and works for reducing the ores.
Hack. 1. See *Pick.* 2. A sharp blade on a long handle used for cutting billets in two.
Hade, DERB. See *Underlay.*
Hahner furnace. A continuous working shaft furnace for roasting quicksilver ores. The fuel is charcoal, charged in alternate layers with the ores. The *Vall' Alta furnace* is a modification, having the iron tubes of the *Alberti.*
Hair plate. See *Bloomary.*
Half-marrow, NEWC. Young boys, of whom two do the work of one *putter.*
Halvans, CORN. Ores much mixed with impurities.
Hammer-pick. See *Poll-pick.*
Hanging-coal. A portion of the coal-seam which, by the removal of another portion, has had its natural support removed, as in *holding.*
Hanging-guide. See *Guide.*
Hanging-side, or *Hanging-wall,* or *Hanger,* CORN. The wall or side over the vein.
Hazel. Freestone.

Hard head. A residual alloy, containing much iron and arsenic, produced in the refining of tin.

Hard lead. Lead containing certain impurities, principally antimony.

Hasenclever furnace. A roasting furnace, consisting of a long inclined channel (in its first form, a succession of inclined shelves in a shaft) down which the ore slides in a thin sheet, heated from below.

Head-gear. That part of deep-boring apparatus which remains at the surface.

Headhouse. See *Gallows-frame.*

Heading. 1. The vein above a drift. See *Back.* 2. An interior level or air-way driven in a mine. 3. In *long-wall* workings, a narrow passage driven up in a gangway in starting a working in order to give a *loose end.*

Headings. In ore-dressing, the heavier portions collecting at the upper end of a buddle or sluice, as opposed to the *tailings*, which escape at the other end, and the *middlings*, which receive further treatment.

Head-piece. See *Cap.*

Headsman, NEWC. See *Putter.*

Head-stocks. See *Gallows-frame*

Head-tree, NEWC. See *Cap.*

Headway, NEWC. See *Cross-heading.* The *headways* are the second set of excavations in *post-and-stall* work.

Heap, NEWC. The refuse at the pit's mouth

Hearth. 1. The floor or *sole* of a reverberatory. 2 The *crucible* of a blast furnace.

Hearth-ends. Particles of unreduced lead ore expelled by the blast from a furnace.

Heat. One operation in a heating furnace, Bessemer *converter*, *puddling* furnace, or other furnace not operating continuously.

Heating-furnace. The furnace in which *blooms* or *piles* are heated before *hammering* or *rolling.*

Heave, CORN. A horizontal dislocation of a vein or stratum.

Helve. A *lift-hammer* for forging *blooms.*

Henderson process. The treatment of copper sulphide ores by roasting with salt, to form chlorides, which are then leached out and precipitated. Henderson originally proposed to volatilize the chlorides, and the leaching and precipitation are not original with him. *Longmaid* and many other metallurgists have proposed them in various modifications.

Hercules powder. See *Explosives.*

Hewer, NEWC. The man who *cuts* the coal.

Hitch, SCOT. and NEWC. 1. A minor dislocation of a vein or stratum not exceeding in extent the thickness of the vein or stratum. 2. A hole cut in the side rock, when this is solid enough, to hold the *cap* of a set of timbers, permitting the *leg* to be dispensed with.

High explosive. An explosive or detonating compound developing more intense and instantaneous force than gunpowder. Most high explosives in general use contain nitroglycerin. See *Explosives.*

Hog-back. 1. A sharp anticlinal, decreasing in height at both ends until it runs out. 2. A ridge produced by highly titled strata.

Hogger-pipe. The upper terminal pipe of the mining pump.

Hogger-pump. The topmost pump in a shaft.

Holing. 1. The working of a lower part of a bed of coal for bringing down the upper mass. 2. The final act of connecting two workings underground

Hollow-fire, ENG. A kind of hearth with blast, used for reheating the *stamps* produced in the South Welsh process of fining, or the bars of *blister-steel* in the manufacture of *shear-steel.*

Holloway process. The removal of sulphur from iron and copper sulphides by fusion and pneumatic treatment, analogous to the manner in which carbon, etc., are removed in the Bessemer process.

Homogeneous metal. A variety of *ingot-metal* produced by the open-hearth process. See *Steel.*

Hopper. 1. A trap at the foot of a *shoot* for regulating the contents of a wagon. 2. A place of deposit for coal or ore.

Horn. See *Spoon.*

Horse, CORN. 1. A mass of *country-rock* inclosed in an ore-deposit. 2. See *Salamander.*

Horse-back, NEWC. A portion of the roof or floor which bulges or intrudes into the coal.

Horseflesh ore, CORN. Bornite. See *Copper-ores.*

Horse-gin. Gearing for hoisting by horse-power.

Hot-bed. A platform in a rolling-mill on which rolled bars lie to cool.

Hot-blast. Air forced into a furnace after having been heated.

Hotching. NORTH ENG. See *Jigging.*

House of water, CORN. A cavity or space filled with water.

Howell furnace. A form of revolving roasting furnace.

H-piece. That part of a *plunger-lift* in which the valves or *clacks* are fixed.

Hudge. An iron bucket for hoisting ore or coal.

Hulk. See *Dzhu.*

Huel, CORN. See *Wheat.*

Hungry. A term applied to hard, barren vein-matter, such as white quartz (not discolored with iron oxide).

Hunt & Douglas process. The treatment of copper oxide (or roasted sulphide) ores by dissolving the oxides of copper in a hot solution of protochloride of iron and common salt. From the solution thus obtained, metallic iron precipitates metallic copper, at the same time regenerating the protochloride of iron for further use.

Hurdy-gurdy wheel. A water-wheel operated by the direct impact of a stream upon its radially-placed paddles.

Hushing. The discovery of veins by the accumulation and sudden discharge of water, which washes away the surface soil and lays bare the rock. See *Booming.*

Hutch. 1. SCOT. A low car, suited both to run in a level and to be hoisted on a cage. 2. CORN. A cistern or box for washing ore. See *Jig.*

Hydraulicking, PAC. Washing down a bank of earth or gravel by the use of pipes, conveying water under high pressure.

IDRIA furnace. See *Leopoldi furnace.*

Impregnation. An ore-deposit consisting of the country-rock impregnated with ore, usually without definite boundaries.

Inbye or *Inbyeside,* NEWC. Further into a mine, away from the shaft.

Incline. 1. A shaft not vertical; usually on the dip of a vein. See *Slope.* 2. A *plane*, not necessarily under ground.

Indicator. 1. An instrument for showing at any moment the position of the cage in the shaft. 2. An instrument for recording, by a diagram, upon a card the varying pressure of the steam in the cylinder of a steam engine during the stroke.

Infiltration theory. The theory that a vein was filled by the infiltration of mineral solutions.

Ingot. A cast bar or block of metal.

Injection-theory. The theory that a vein was filled first with molten mineral.

In place. Of rock, occupying, relative to surrounding masses, the position that it had when formed.

Inquartation. See *Quartation.*

Intake The passage by which the ventilating current enters a mine. See *Downcast*, which is more appropriate for a shaft; *Intake* for an adit.

Inwalls. The interior walls or lining of a *shaft-furnace.*

Irestone. Hard clay slate; hornstone; hornblende.

Irestone or *Ironstone,* CORN. Greenstone.

Iron. The principal varieties of iron are *wrought-iron* and *cast-iron* (see *Pig-iron*). *Wrought-iron,* also called *bar-iron* and *weld-iron,* is the product of the forge or the puddling furnace, *cast-iron* of the blast furnace. The former approaches pure iron; the latter is an alloy of iron and carbon. Steel except some of the so-called "low" or "mild" steels, which are more nearly wrought-iron (fused and cast) stands between them, having less carbon than cast-iron and more than wrought-iron. Some of the carbon in cast-iron is usually segregated during cooling in the form of graphite, and this determines the grade of the iron as *No. 1 foundry* (the most graphitic, coarsely crystalline, soft and black), *No. 2 foundry* (less open in grain), *gray forge* or *mill-iron* (still closer in grain, suitable for puddling), *mottled* (spotted with *white-iron*), and *white* (hard, brittle, radially crystalline, containing its carbon mostly in alloy with the iron, and showing no visible graphite). These grades are also called simply No. 1, 2, 3, etc. So-called *silver-gray, glazy,* or *carbonized iron* is usually an iron rendered brittle by excess of silicon. *Ingot iron,* see *Steel.* *Anthracite, charcoal* and *coke iron* are names given to pig-iron according to the fuel with which it is made.

Iron hat. See *Gossan.*

Iron-ores: *Magnetic* (*magnetite,* protoperoxide) *specular* (*hematite* proper, *red hematite,* anhydrous peroxide, (*brown-iron ore* (*hematite, brown hematite, limonite,* etc., hydrated peroxides), *spathic* (*siderite,* carbonate), clay ironstone (*black band,* argillaceous *siderite.*) See *Fossil ore.*

Iron-reduction process. See *Precipitation process.*

Ironstone. 1. Iron-ore. 2. See *Ironstone.*

JACKET. A covering to prevent radiation of heat, as the jacket of a steam boiler; also a casing around a furnace hearth in which water is allowed to stand or circulate to keep the walls cool.

Jackhead-pit. A small shaft sunk within a mine.

Jack-head pump. A subordinate pump in the bottom of a shaft, worked by an attachment to the main pump-rod.

Jack-roll, NEWC. See *Windlass.*

Jadding or *Judding.* See *Holing.*

Jagging. A mode of carrying ore to the reduction-works in bags on horses, mules, etc.

Jars. A part of percussion-drilling apparatus for deep holes, which is placed between the *bit* and the *rods* or *cable*, and which by producing at each up-stroke a decided jar of the *bit* jerks it up, though it may be tightly wedged in the hole.

Jig-brow. See *Jinny-road.*

Jig-chain. S. STAFF. A chain hooked to the back of a *skip* and running round a post, to prevent its too rapid descent on an inclined plane.

Jigging, CORN. Separating ores according to specific gravity with a sieve agitated up and down in water. The apparatus is called a *jig* or *jigger.*

Jinny-road. A gravity plane underground.

Joachimsthal process. The extraction of silver from sulphuretted ores by converting into chloride, leaching with sodium hyposulphite, and precipitating the silver as sulphide with sodium sulphide.

Jawl, NEWC. A noise made for a signal by hammering at the faces of two levels expected to meet.

Judge, DERB. and NEWC. A measuring-stick to measure coal work under ground.

Judd, NEWC. In *whole-working*, a portion of the coal laid-out and ready for extraction; in *pillar-working*, (*i. e.*, the drawing or extraction of pillars), the yet unremoved portion of a pillar.

Jugglers. Timbers set obliquely against pillars of coal to carry a plank partition making a triangular air-passage or man-way.

Jump. 1. PAC. To take possession of a mining claim alleged to have been forfeited or abandoned. 2. A dislocation of a vein.

Jumper, CORN. and NEWC. A drill or boring tool, consisting of a bar, which is "jumped" up and down in the bore-hole.

KANN. See *Cand.*

Kast-furnace. A small circular shaft furnace with three or four tuyeres, for lead smelting.

Keckle-meckle. The poorest kind of lead ore.

Keeve. 1. See *Cauf.* 2. A tub used in collecting grains of heavy ore or metal; a dolly tub.

Kernel roasting. See *Roasting.*

Kevil, DERB. A vein-stone consisting of a mixture of carbonate of lime and other minerals.

Kibball or *Kibble*, CORN and WALES. An iron bucket for raising ore.

Kicker. Ground left in first cutting a vein, for support of its sides.

Kieve, CORN. A tub for *tozing* tin-ore.

Killas, CORN. Clay-slate.

Kiln. A furnace for the calcination of coarsely broken ore or stone; also, an oven for drying, charring, etc.

Kind's plug. A wooden plug attached to an iron rod, used in connection with sand for recovering *tubing* from *bore-holes.*

King-pot. The large central pot or crucible in a brass-melting furnace.

King's yellow. Sulphide of arsenic.

Kirving, NEWC. The cutting made at the bottom of the coal by the *hewer.*

Kish. The blast-furnacemen's name for the graphite-segregations seen in pig-iron and in the cinder of a furnace making a very gray iron.

Kit. A wooden vessel.

Kitchen. See *Laboratory* (2).

Knits or *Knobs.* Small particles of ore.

Knobbing-fire. A *bloomary* for refining cast-iron.

Knockings. See *Riddle.*

Knox & Osborne furnace. A continuously working shaft furnace for roasting quicksilver ores, having the fireplace built in the masonry at one side. The fuel is wood.

Knots. Small particles of ore.

Krohnke process. The treatment of silver ores preparatory to amalgamation, by humid chloridization with copper dechloride.

Krupp washing Process. The removal of silicon and phosphorus from molten pig iron by running it into a *Pernot furnace*, lined with iron oxides. Iron ore may also be added, and the bath is agitated by rotation for five to eight minutes only. See *Bell's dephosphorizing process.*

LABOR, SP. Labos; work; a working. This term is applied in mining to the work which is actually going on, and to the spaces which have been dug out. It includes galleries, cavities and shafts.

Laboratory. 1. A place fitted up for chemical analysis, etc. 2. The space between the fire and flue bridges of a *reverberatory* furnace in which the work is performed; also called the *kitchen* and the *hearth.*

Ladle. A vessel into which molten metal is conveyod from the furnace or crucible, and from which it is poured into the moulds.

Lagging. Planks, slabs, or small timber placed over the caps or behind the posts of the timbering, not to carry the main weight, but to form a ceiling or a wall, preventing fragments of rock from falling through.

Lame skirting, NEWC. Widening a passage by cuttng coal from the side of it.

Lander, CORN. The man at the shaft-mouth who receives the *kibble.*

Laundry-box, NEWC. A box at the top of a set of pumps into which the water is delivered.

Lath door-set. A weak lath-frame, surrounding a main *door-frame*, the space between being for the insertion of *piles.*

Lath-frame or *crib.* A weak lath-frame, surrounding a main *crib*, the space between being for the insertion of *piles.*

Laths, CORN. The *boards* or *lagging* put behind the *durns.*

Launder, CORN. A wooden trough, gutter or sluice.

Lazadores, SP. Persons employed to collect work for a mine.

Lazyback, S. STAFF. The place at the surface where coal is stacked for sale.

Leaching. See *Lixiviation.*

Lead (pronounced like the verb *to lead*), PAC. See *Lode.*

Lead-fume. The fumes escaping from lead furnaces, and containing both volatilized and mechanically suspended metalliferous compounds.

Leader, CORN. A small vein leading to a larger one.

Lead-ores. *Galena* (*galenite*, sulphide); *antimonial lead-ore bournonite*, sulphantimonide of lead and copper); *white lead-ore* (*cerussite*, carbonate); *green lead-ore* (*pyromorphite*, the phosphate, or *mimetite* or *mimetesite*, the arseno-chloride); *lead-vitriol* (*anglesite*, sulphate); *yellow lead-ore* (*wulfenite*, molybdate); *red lead-ore* (*crocite*, chromate).

Lead-spar, CORN. Anglesite. See *Lead-ores.*

Leap, DERB. A fault. See *Jump.*

Leat, CORN. A watercourse.

Leath. Applied to the soft part of a vein.

Leavings, CORN. The ores left after the *crop* has been removed.

Ledge, SAC. See *Lode.*

Ledgerwall. See *Footwall.*

Leg. A prop of timber supporting the end of a *stull*, or the *cap* of a set of timber.

Leopoldi furnace. A furnace for roasting quicksilver ores, differing from the *Bustamente* in having a series of brick condensing chambers. Both are intermittent, *i. e.*, have to be charged and fired anew after each operation. The *California intermittent furnace* is a modification of the *Leopoldi*, having the fireplace on the side.

Level. A horizontal passage or drift into or in a mine. It is customary to work mines by levels at regular intervals in depth, numbered in their order below the adit or drainage level, if there be one.

Lewis. An iron instrument for raising heavy blocks of stone.

Ley, SP. Proportion of metal in the ore; fineness of bullion; also an alloy or base metal.

Lid. A flat piece of wood placed between the end of a *prop* or *stamper* and the rock.

Lifters, CORN. The wooden beams used as *stems* for stamps in old-fashioned stamp-mills.

Lift-hammer. See *Tilt-hammer.*

Liftingdog. A claw-hook for grasping a column of bore-rods while raising or lowering them.

Lignite. See *Coal.*

Limp. An instrument for striking the refuse in the sieves in washing ores.

Lining, NEWC. See *Dialling.*

Linnets, DERB Oxidized lead ores.

Liquation. See *Eliquation.*

Litharge. Protoxide of lead.

Lithofracteur. See *Explosives.*

Little giant. A jointed iron nozzle used in hydraulic mining.

Lixiviation. The separation of a soluble from an insoluble material by means of washing with a solvent.

Location. 1. The act of fixing the bou ndaries of a mining claim, according to law. 2. The claim itself.

Loam. An impure potter's clay, containing mica or iron ochre.

Loch, DERB. and WALES. See *Vug.*

Lock-timber. An old plan of putting in *stull-pieces* in Cornwall and Devon. The pieces were called *lock-pieces.*

Lode, CORN. Strictly a fissure in the country-rock filled with mineral; usually applied to metalliferous lodes. In general miner's usage, a *lode, vein*, or *ledge* is a tabular deposit of valuable mineral between definite boundaries. Whether it is a fissure formation or not is not always known, and does not affect the legal title under the United States federal and local statutes and customs relative to lodes. But it must not be a placer, *i. e.*, it must consist of quartz or other rock *in place*, and bearing valuable mineral.

Lodge, WALES. See *Platt.*

Log, S. STAFF. A balance-weight near the end of the hoisting-rope of a shaft to prevent its running back over the pulley.

Longmaid Process. See *Henderson process.*

Long tom, PAC. A kind of gold-washing cradle.

Long-wall. A method of coal mining by which the whole seam is taken out as the working faces progress, and the roof is allowed to fall behind the workers, except where passages must be kept open, or where the *gob* being packed in the space formerly occupied by the coal, prevents caving. According as the work of extraction begins at the boundary of the *winning*, and converges back to the shaft, or begins with the coal nearest the shaft and proceeds outward to the boundaries, it is called *long-wall retreating* or *long-wall advancing.*

Loob or loobs, CORN. The clayey or slimy portion washed out of tin-ore in *dressing.*

Loop. See *Loup.*

Loop-drag. An eye at the end of a rod through which tow is passed for cleaning bore-holes.

Loose-end. A gangway in *long-wall* working, driven so that one side is solid ground while the other opens upon old workings. See *Fast-end.*

Lorry. A hand-car used on mine tramways.

Lost level, CORN. "Level" is "lost" when a gallery has been driven with an unnecessarily great departure from the horizontal.

Loup. The pasty mass of iron produced in a *bloomary* or puddling furnace. See *Puddle-ball.*

Lowe, NEWC. A light. A "piece of lowe" is part of a candle.

Luckhart furnace. A continuously working shaft furnace for roasting quicksilver ores, having the fire-place in the shaft at the bottom, protected by a cast-iron roof. The fuel is wood.

Lum. A chimney over an upcast pit.

Lumpcoal, PENN. See *Coal.*
Lurmann front. An arrangement of water-cooled castings through which iron and cinder are tapped from the blast furnace, thus avoiding the use of a forehearth. See *Closed front.*
Lying-wall. See *Foot-wall.*

MACHINE-WHIM. A rotary steam-engine for windling.
Magistral, SP. A powder of roasted copper pyrites, used in the amalgamation of silver ores.
Main-rod. See *Pump-rod.*
Mainway. A *gangway* or principal passage.
Makings, NEWC. The small coals hewn out in *kirving.*
Malleable castings. Small iron castings made malleable by "annealing" or decarburizing by cementation in powdered hematite or other oxide of iron.
Mallet, CORN. The sledge-hammer used for striking or *beating* the *borer.*
Mandril. See *Maundril.*
Manganese-ores. Gray oxide (*pyrolusite, polianite*, anhydrous peroxide, and *manganite*, hydrated sesquioxide); *black manganese* (*hausmannite*, protoperoxide); *braunite* (anhydrous sesquioxide); *red manganese ore* (*rhodochrosite*, a carbonate, or *rhodonite*, a silicate); also, manganiferous iron ores.
Man-hole, CORN. The hole in a *sollar* through which men pass upon the ladder or from one ladder to the next.
Man-machine or *man-engine*, CORN. and DERB. A mechanical lift for lowering and raising miners in a shaft by means of a reciprocating vertical rod of heavy timber with platforms at intervals, or of two such rods, moving in opposite directions. In the former case, stationary platforms are placed in the shaft, so that the miner in descending, for instance, can step from the moving platform at the end of the down-stroke, and step back upon the next platform below at the beginning of the next down-stroke. When two rods are employed, the miner steps from the platform on one rod to that on the other.
Man-of-war, STAFF. A small pillar of coal left in a critical spot; as a principal support in thick coal workings.
Manta, SP. Blanket; sack of ore.
Mantle. The outer wall and casing of an iron *blast furnace*, above the *hearth.*
Manway. A small passage, used by workmen but not for transportation.
Maquilla, SP. A mill where ore is ground on shares.
Marl. Calcareous clay, sometimes used for the hearths of cupelling-furnaces.
Martin process. Called also the *Siemens-Martin* and the *open-hearth process.* See *Steel.*
Mass-copper, LAKE SUP. Native copper, occurring in large masses.
Massicot. See *Litharge*
Matrix. The rock of earthy material containing a mineral or metallic ore; the *gangue.*
Matt, or *Matte*, FR. A mass consisting chiefly of metallic sulphides got in the fusion of ores.
Maul, DERB. A large hammer or mallet.
Maundril, DERB and S. WALES. A prying *pick* with two prongs.
Mear. DERB. Thirty-two yards of ground measured on the vein.
Measures. Strata of coal, or the formation containing coal beds.
Meat-earth. The vegetable mould.
Meetings, NEWC. The place at middle-depth of a *shaft, slope*, or *plane*, where ascending and descending cars pass each other.
Merceal, SP. A gift. This term is applied to a grant which is made without any valuable consideration.
Merchant-iron. See *Mill.*
Merchant-train. A *train* of *rolls* for reducing iron *piles* or steel *ingots, blooms*, or *billets* to bars of the various round, square, flat or other shapes, known as merchant iron or steel.
Mercury-ores. Native mercury; *cinnabar* (sulphide).
Merrit-plate. See *Bloomary.*
Metal, SP. 1. This term is applied both to the ore and to the metal extracted from it. It is sometimes used for vein, and even for a mine itself. *Metal en piedra*, ore in the rough state. *Metal ordinario*, common ore. *Metal pepena*, selected ore. *Metal de ayuda*, ore used to assist the smelting of other ores. 2. Copper *regulus* or *matt* obtained in the *English process.* The following varieties are distinguished by appearance and by their percentage of copper) here given in approximate figures) *Coarse*, 20 to 40; *red*, 48; *blue*, 60; *sparkle*, 74; *white*, 77; *pimple*, 79. *Fine metal* includes the latter four varieties. *Hard metal* is impure copper containing a large amount of tin. 3. SCOT. All the rocks met with in mining ore. 4. *Road metal*, rock used in macadamizing roads.
Metal-notch. See *Tap-hole.*
Mica-powder. See *Explosives.*
Mill. 1. ENG. That part of an iron works where *puddle-bars* are converted into *merchant-iron, i. e.*, rolled iron ready for sale in bars, rods or sheets. See *Forge.* 2. By common usage any establishment for reducing ores by other means than smelting. More strictly, a place or a machine in which ore or rock is crushed. 3. An excavation made in the *country* rock, by a *cross-cut* from the workings on a vein, to obtain waste for *gobbing.* It is left without timber so that the roof may fall in and furnish the required rock. 4. CORN. A passage through which ore is shot underground. See *Pass* and *Shoot.*
Mill-cinder. The slag from the puddling-furnaces of a rolling-mill.
Mill-run, PAC. 1. The work of an amalgamating mill between two *clean-ups.* 2. A test of a given quantity of ore by actual treatment in a mill.
Mine. 1. In general, any excavation for minerals. More strictly, subterranean workings, as distinguished from *quarries, placer* and *hydraulic* mines, and surface or open works. The distinction between the French terms *mine* and *miniere* results entirely from the law, and depends upon the depth of the working. The former is the more general term, and, ordinarily speaking, includes the latter, which signifies shallow or surface workings. 2. In a military sense, a mine is a subterranean gallery run under an enemy's works, to be subsequently exploded.
Mine-pig, ENG. See *Pig-iron.*
Miner, PENN. The workman who *cuts* the coal, as distinguished from the *laborer* who loads the wagons, etc.
Mineral. In miners' parlance, ore.
Mineral caoutchouc. Elastic bitumen.
Mineral charcoal. A pulverulent, lustreless substance, showing distinct vegetable structure, and containing a high percentage of carbon with little hydrogen and oxygen, occurring in thin layers in bituminous coal.
Mineralized. Charged or impregnated with metalliferous mineral.
Mineral oil or *Naphtha.* A limpid or yellowish liquid, lighter than water, and consisting of hydrocarbons. *Petroleum* is heavier than naphtha, and dark greenish in color when crude. Both exude from the rocks; but naphtha can be distilled from petroleum.
Mineral pitch. Asphaltum.
Mineral right. The ownership of the minerals under a given surface, with the right to enter thereon, mine, and remove them. It may be separated from the surface ownership, but, if not so separated by distinct conveyance, the latter includes it.
Mineral-wool. See *Slag-wool.*
Mine-rent. The rent or royalty paid to the owner of a mineral right by the operator of the mine—usually dependent, above a fixed minimum, upon the quantity of product.
Mineria, SP. Mining. This term embraces the whole subject, including both mines and miners, and also the operations of working mines and of reducing their ores. It, however, is often used in a more restricted sense.
Minero, SP. Miner. This term is not limited to those who work mines, but includes their owners, and all who have the qualifications prescribed in the ordinances, and are enrolled as members of the body or craft. Many of the laborers who work in mines are not, technically speaking, miners. This term is sometimes used in the old laws for *mine.*
Miner's inch, PAC. A local unit for the measurement of water supplied to hydraulic miners. It is the amount of water flowing under a certain head through one square inch of the total section of a certain opening, for a certain number of hours daily. All these conditions vary at different localities. At Smartsville, Cal., the discharge opening is a horizontal slit, 4 inches wide, in a 2-inch plank, with the standing head of water in the feed-box 9 inches above the middle of the slit. Each square inch of this opening will discharge 1.76 cubic feet per minute. A miners' inch in use in Eldorado County, Cal., discharges 1.39 cubic feet per minute. At North Bloomfield, Cal., and other places, the discharge is 50 inches long by 2 wide (giving 100 miners' inches) through a 3-inch plank, with the water 7 inches above the centre of the opening. Each inch is 1.50 to 1.57 cubic feet per minute in practice, or 59.05 to 61.6 per cent, of the theoretical discharge. These figures are taken from the paper of A. J. Bowie, Jr., on "Hydraulic Mining in California," *Trans. Am. Inst. M. E.*, vol. vi, p. 59.
Mineta, SP. A little mine; a chamber, or cavity.
Minium. Protosesquioxide of lead.
Mispickel, GERM. Arsenical pyrites.
Mistress, NEWC. A lantern used in coal-mines.
Mobby, S. STAFF. A leathern girdle, with small chain attached, used by the boys who draw *bowkes.*
Mock-lead, CORN. Zincblende.
Moil or *Moyle*, CORN. A drill pointed like a *gad.*
Monkey-drift. A small prospecting drift.
Monitor, PAC. A kind of nozzle used in *hydraulicking.*
Monnier process. The treatment of copper sulphide ores by roasting with sodium sulphate, and subsequent lixiviation and precipitation.
Monoclinal. Applied to any limited portion of the earth's crust throughout which the strata dip in the same direction.
Montefiore furnace. A peculiar furnace in which *zinc dust* is compressed at a high temperature.
Moorestone, CORN. Loose masses of granite found on Cornish-moors.
More, CORN. A quantity of ore in a particular part of a lode, as a *more* of tin.
Mortar. 2. A heavy iron vessel, in which rock is crushed by hand with a pestle, for sampling or assaying. 2. The receptacle beneath the stamps in a stamp mill, in which the dies are placed, and into which the rock is fed to be crushed.
Mosaic gold. Disulphide of tin.

Mote. See *Squib.*
Mothergate, NEWC. The main passage in a district of working.
Mottled. See *Iron.*
Mouth. The end of a shaft or adit emerging at the surface.
Mountain limestone. The English designation of a limestone of the lower part of the carboniferous age; called also subcarboniferous limestone.
Muck-bar. Bar iron which has passed once through the *rolls.*
Mucks, S. STAFF. See *Smut.*
Muffle. A semi-cylindrical or long arched oven (usually small and made of fire-clay), heated from outside, in which substances may be exposed at high temperature to an oxidizing atmospheric current, and kept at the same time from contact with the gases from the fuel. *Cupellation* and *scorification* assays are performed in *muffles*, and on a larger scale copper ores were formerly roasted in *Muffle-furnaces.*
Muller. The stone or iron in an *arastre*, or grinding or amalgamating pan, which is dragged around on the bed to grind and mix the-bearing rock.
Mun, CORN. Any fusible metal.
Mundic, CORN. Iron pyrites. White *mundic* is *Mispickel.*

NARROW work. The driving of *gangways* or *airways;* also any *dead work.*
Nasmyth hammer. A steam-hammer, having the head attached to the piston-rod, and operated by the direct force of the steam.
Native. Occurring in nature; not artificially formed. Usually applied to the metals.
Nays, CORN. See *Nogs.*
Needle or *Nail*, CORN. A copper or copper-pointed implement, placed in a bore-hole during charging, to make, by its withdrawal, an aperture for the insertion of the *rush* or train.
Negrilo, SP. A silver ore; black sulphuret of silver.
Neptune powder. See *Explosives.*
Neutral. Of slags, neither acid nor basic; or wrought-iron, neither *red-short* or *cold-short;* of iron-ores, suitable for the production of neutral irons.
Niccoliferous or *Nickeliferous.* Containing nickel.
Nickel ores. *Copper-nickel* (*niccolite*, arsenide of nickel); *antimonial nickel* (*breithauptite*, antimonide); *white nickel* (*rammelsbergit*, biarsenide); *nickel pyrites* (*pentlandite*, sulphide of nickel and iron, *millerite*, sulphide); *nickeliferous gray antimony ullmannite*, arsenantimonide): *nickeliferous serpentine* (*refdanskite*, hydrous magnesian silicate); also, niccoliferous ores of copper, cobalt, manganese, etc.
Nicking, NEWC. The cutting made by the *hewer* at the side of the *face.* *Nickings* is the small coal produced in making the nicking.
Nicking-trunk. A tub in which metalliferous slimes are washed.
Nip, NEWC. 1. A crush of pillars or workings. 2. See *Pinch.*
Nipping-fork. A tool for supporting a column of bore-rods while raising or lowering them.
Nitroglycerin. See *Explosives.*
Nittings. The refuse of good ore.
Noble metals. The metals which have so little affinity for oxygen (*i. e.*, are so highly electronegative) that their oxides are reduced by the mere application of heat without a reagent; in other words, the metals least liable to oxidation under ordinary conditions. The list includes gold, silver, mercury, and the platinum group (including palladium, iridium, rhodium, ruthenium, and osmium). The term is of alchemistic origin.
Noddle or *Nodule.* A small rounded mass.
Noger. A *jumper* drill.
Nogs, DERB. and CORN. Square blocks or logs of wood, piled on one another to support a mine roof.
Nose. An accumulation of chilled material around the inner end of a *tuyere* in a smelting shaft furnace, protecting and prolonging the tuyere.
Nose-helve, ENG. See *Frontal hammer.*
Nuts. Small coal.

OCCLUSION. The mechanical retention of gases in the pores of solids.
Ochre. A term applied to metallic oxides occurring in an earthy, pulverulent condition, as iron ochre, molybdic ochre.
Oil-well. A dug or bored well, from which petroleum is obtained by pumping or by natural flow.
Old man. Ancient workings; *goaves.*
Old men. The persons who worked a mine at any former period of which no record remains,
Open cast, SCOT. See *Open cut.*
Open crib timbering. Shaft timbering with *cribs* alone, placed at intervals.
Open cut. A surface working, open to day-light.
Open front. The arrangement of a blast furnace with a *fore-hearth.*
Open hearth. See *Reverberatory furnace.*
Openings. The parts of coal mines between the pillars, or the pillars and ribs.
Opens. Large caverns.
Open sand castings. Castings made in moulds simply excavated in sand without *flasks.*
Open work. A quarry or *open cut.*
Operator, PENN. The person, whether proprietor or lessee, actually operating a colliery.
Ore. 1. A natural mineral compound, of the elements of which one at least is a metal. The term is applied more loosely to all metalliferous rock, though it contain the metals in a free state, as occasionally to the compounds of non-metallic substance, as *sulphur ore.* 2. CORN. Copper-ore; tin-ore being spoken of in Cornwall as *tin.*
Ore hearth. See *Scotch hearth.*
Ore washer. A machine for washing clay and earths out of earthy brown-hematite ores.
Orpiment. Sesquisulphide of arsenic.
Outbye or *Outbyeside*, NEWC. Nearer to the shaft, and hence further from the *forewinning.*
Outcrop. The portion of a vein or stratum emerging at the surface, or appearing immediately under the soil and surface-*debris.*
Outlet. The passage by which the ventilating current goes out of a mine. See *Upcast.*
Output. The product of a mine.
Oval groove. A groove of U-Section in a *roll.*
Overburden. 1. CORN. See *Burden* (1). 2. To charge in a furnace too much ore and flux in proportion to the amount of fuel. 3. The waste which overlies the good stone in a quarry.
Overman, ENG. The mining official next in rank below the *manager*, who is next below the *agent.*
Overpoled copper. Copper from which all the suboxide has been removed by *poling.*
Oxidation. A chemical union with oxygen.

PACK. A wall or pillar built of *gob* to support the roof.
Pair or *Pare*, CORN. Two or more miners working in common.
Pan. 1. See *Panning.* 2. A cylindrical vat of iron, stone, or wood, or these combined, in which ore is ground with *mullers* and amalgamated. See *Amalgamation.*
Pane. The striking-face of a hammer.
Panel. 1. A heap of dressed ore. 2. A system of coal-extraction in which the ground is laid off in separate districts or panels, pillars of extra size being left between.
Panning, AUST. and PAC. Washing earth or crushed rock in a pan, by agitation with water, to obtain the particles of greatest specific gravity which it contains (chiefly practiced for gold, also for quicksilver, diamonds, and other gems).
Parachute. 1. A kind of *safety-catch* for shaft cages. 2. In rod-boring, a *cage* with a leather cover to prevent a too rapid fall of the rods in case of accident.
Parcel. CORN. A heap of dressed ore ready for sale.
Parkes process. The desilverization of lead by treatment with zinc.
Parrot coal, SCOT. See *Coal.*
Parting. 1. A small joint in coal or rock, or a layer of rock in a coal seam. 2. The separation of two metals in an alloy, especially the separation of gold or silver by means of nitric or sulphuric acid.
Parting-sand. Fine dry sand, which is sifted over the partings in a *mould* to facilitate their separation when the *flask* is opened.
Pass, CORN. 1. An opening in a mine through which ore is shot from a higher to a lower level. See *Shoot.* 2. In rolling mills the passage of the bar between the *rolls.* When the bar passes "on the flat" it is called a *flatting-pass;* if "on the edge," an *edging-pass.*
Patent fuel, ENG. The fuel produced by the agglomeration of *coal-slack* into lumps.
Patera process. See *Joachimsthal process.*
Patio, SP. The yard where the ores are cleaned and assorted; also, the amalgamation floor, or the Spanish process itself of amalgamating silver ores on an open floor.
Pattinson process. The process in which lead containing silver is passed through a series of melting-kettles, in each of which crystals of a poorer alloy are deposited, while the fluid bath, ladled from one kettle to the next, is proportionately richer in silver. In *mechanical pattinsonation* the operation is performed in a cylindrical vessel, in which the bath is stirred mechanically, and from which, as the richer alloy crystallizes, the poorer liquid is repeatedly drained out. *Steam pattinsonation* is a variety of the *Pattinson process*, in which steam is conducted through the lead bath to assist the refining.
Pavement. The *floor* of a mine.
Pay-streak. The zone in a vein which carries the profitable or *pay* ore.
Peach, CORN. Chlorite.
Pea-coal, PENN. See *Coal.*
Percussion-table. An inclined table, agitated by a series of shocks, and operating at the same time like a *buddle*, It may be made self-discharging and continuous by substituting for the table an endless rubber cloth, slowly moving against the current of water, as in the *Frue vanner.*
Pernot furnace or *Post-Pernot furnace.* A *reverberatory* puddling or smelting furnace, having a circular, inclined, revolving hearth.
Pershbecker furnace. A continuously working shaft-furnace for

roasting quicksilver ores, having two fire-places at opposite sides. The fuel is wood.

Pertinencia, SP. The extent of a mining location in Mexico, to which a title is acquired by denunciation.

Peter or *peter out.* To fail gradually in size, quantity, or quality.

Pewter. An alloy of tin and lead. Other metals are often added, or the lead is entirely replaced with copper, zinc, antimony, etc.

Pick. A pick-axe with one or two points. The usual miners' pick has but one.

Picker or *Poker.* A hand chisel for *dzhuing*, held in one hand and struck with a hammer.

Pick-hammer. A hammer with a point, used in cobbing.

Pickling. Cleaning sheet-iron or wire by immersion in acid.

Pig. An ingot or cast bar of metal. See *Pig-iron.*

Pig-iron. Crude cast-iron from the blast furnace. When the furnace is tapped the molten iron flows down a *runner* moulded in sand, from which it enters the *sows* or lateral runners, flowing from these again into the *pig-beds*, the separate parallel moulds of which form the *pigs.* In each bed the ingots lie against the *sow* like suckling pigs, whence the two names. See *Iron. Mine-pig* is pig-iron made from ores only; *cinder-pig*, from ores with admixture of some *forge* or *mill-cinder.*

Pike. See *Pick.*

Picking. See *Cobbing.*

Pile. 1. The *fagot* or bundle of flat pieces of iron prepared to be heated to welding-heat and then rolled. 2. To make up into *piles* or *fagots.* 3. *Piles* are long thick laths, etc., answering in shafts, in loose or "quick" ground, the same purpose as *spills* in levels, *piles* being driven vertically.

Pillar-and-stall. See *Post-and-stall.*

Pilz furnace. A circular or octagonal shaft-furnace, maintaining or increasing its diameter towards the top, and having several *tuyeres;* used in smelting lead-ores

Pinch, CORN. To contract in width.

Pink ash, PENN. See *Coal.*

Pipe or *Pipe-vein*, DERB. An ore-body of elongated form.

Pipe-clay, U. S. A fine clay found in hydraulic mines.

Pipe ore. Iron ore (limonite) in vertical pillars, sometimes of conical, sometimes of hour-glass form imbedded in clay. Probably formed by the union of stalactites and stalagmites in caverns.

Piping. 1. PAC. See *Hydraulicking.* 2. The tubular depression caused by contraction during cooling, on the top of iron or steel ingots.

Pit. 1. A shaft. 2. A stack or *meiler* of wood, prepared for the manufacture of charcoal.

Pitch, CORN. 1. The limits of the set to tributers. 2. The inclination of a vein, or of the longer axis of an ore body.

Pitch-bag, CORN. A bag covered with pitch, in which powder is inclosed for charging damp holes.

Pit-coal. See *Coal.*

Pit-eye, ENG. The bottom of the shaft of a coal-mine; also the junction of a shaft and a level.

Pit-eye pillar. A barrier of coal left around a shaft to protect it from caving.

Pit-frame. The framework carrying the pit-pulley.

Pitman. 1. CORN. A man employed to examine the lifts of pumps and the drainage. 2. NEWC. A working miner.

Pitwork, CORN. The pumps and other apparatus of the engine shaft.

Place. See *In place.*

Placer, SP. A deposit of valuable mineral, found in particles in *alluvium* or *diluvium*, or beds of streams, etc. Gold, tin ore, chromic iron, iron ore, and precious stones are found in placers. By the United States Revised Statutes all deposits not classed as veins of rock in place are considered placers.

Plane. An incline, with tracks, upon which materials are raised in cars by means of a stationary engine, or are lowered by gravity.

Plank-timbering. The lining of a shaft with rectangular plank frames.

Plank-tubbing. The lining of a shaft with planks, spiked on the inside of *curbs.*

Plat. The map of a survey in horizontal projection.

Plate-metal. See *metal.*

Plate-shale. A hard argillaceous bed.

Platinum-ores. Mixtures of native platinum in grains with various other metals and minerals.

Platt, CORN. An enlargement of a level near a shaft, where ore may await hoisting, wagons pass each other, etc.

Plattner process. See *Chlorination.*

Plomo, SP. Lead. *Plomo-plata*, lead-silver.

Plug. A hammer closely resembling the *bully.*

Plumb. 1. Vertical. 2. Soft.

Plumbago. Graphite.

Plunger. The piston of a force-pump.

Plush-copper. Chalcotrichite, a fibrous red copper ore.

Pocket. 1. A small body of ore. 2. A natural underground reservoir of water. 3. A receptacle, from which coal, ore, or waste is loaded into wagons or cars.

Podar. See *Mundic.*

Pointed boxes. Boxes in the form of inverted pyramids or wedges in which ores, after crushing and sizing, are separated in a current of water.

Pole-tools. The tools used in drilling with rods. See *Cable-tools.*

Poling. Stirring a metallic bath (of copper, tin or lead) with a pole of green wood, to cause ebullition and deoxidation in the refining process.

Polings. Poles used instead of planks for *lagging.*

Poll, CORN. The lead or striking part of a miner's hammer.

Poll-pick. A *pick* with a head for breaking away hard *partings* in coal-seams or knocking down rock already seamed by *blasting.*

Polroz (pronounced *Polrose*), CORN. The pit underneath a water-wheel.

Ponsard furnace. A furnace in which the escaping combustion-gases, passing through tubular flues, heat the incoming air continuously through the flue-walls.

Poppet-heads, CORN. A timber frame over a shaft to carry the hoisting pulley.

Post. 1. A pillar of coal or ore. 2. An upright timber.

Post furnace. See *Pernot furnace.*.

Post-and-stall. A mode of working coal, in which so much is left as pillar and so much is taken away, forming *rooms* and *thirlings.* The method is called also *bord-and-pillar, pillar-and-breast*, etc.

Potstone. Compact steatite.

Potter's clay and *Pipe-clay.* Pure plastic clay, free from iron, and consequently white after burning.

Power-drill. See *Rock-drill.*

Precious metals. See *Noble metals.*

Precipitation process. The treatment of lead ores by direct fusion with metallic iron or slags or ores rich in iron; performed generally in a *shaft-furnace*, rarely in a *reverberatory.* Often combined with the *roasting and reduction process.*

Prian, CORN. Soft white clay.

Pricker. See *Needle.*

Prill, CORN. 1. The best ore after cobbing. 2. See *Button.*

Pringap. The distance between two mining possessions in Derbyshire.

Produce. 1. The marketable ores or minerals produced by mining and *dressing.* 2. CORN. The amount of fine copper in one hundred parts of ore.

Producer. See *Gas-producer.*

Prop. A timber set to carry a roof or other weight acting by compression in the direction of the axis.

Prop-crib timbering. Shaft-timbering with *cribs* kept at the proper distance apart by means of *props.*

Prospecting. Searching for new deposits; also, preliminary explorations to test the value of lodes or placers. The *prospect* is good or bad.

Proving-hole. A small *heading* driven to find and follow a coal-seam lost by a dislocation.

Pryan. Ore in small pebbles mixed with clay.

Pudding-stone. A conglomerate in which the pebbles are rounded. See *Breccia.*

Puddle-bars. See *Forge.*

Puddle-steel. *Steel*

Puddle-train. A *train* of *rolls* for reducing squeezed *puddle-balls* to *puddle* or *muck-bars.*

Puddling. I. The process of decarburizing cast iron fusion on the hearth of a reverberatory furnace, lined (*fixed* or *fettled*) with ore or other material rich in oxide of iron. The bath is stirred with a *rabble* to expose it to the action of the lining and of an air current. The escape of carbonic oxide causes it to boil, whence the early name of this method of puddling, viz., *boiling. Dry puddling* is performed on a silicious hearth, and the conversion is effected rather by the flame than by the reaction of solid or fused materials. As the amount of carbon diminishes the mass becomes fusible and begins to coagulate (*come to nature*), after which it is worked together into lumps (*puddle-balls, loups*) and removed from the furnace to be hammered (*shingled*) or *squeezed* in the *squeezer*, which presses out the *cinder*, etc., and compacts the mass at welding heat, preparatory to rolling. Silicon and phosphorus are also largely removed by puddling, passing into the cinder. Mechanical *puddlers* (in which the bath is agitated by revolution, or by mechanical *rabbles*, to save hand-labor) are employed to a limited extent. 2. The term *puddling*, now applied in metallurgy exclusively to the above process, originally referred to the *puddling* of clay or clay and charcoal upon the masonry of a furnace hearth, to form a lining. Ditches, reservoirs, etc., are *puddled* with clay to make them water-tight.

Pug-tub. See *Settler.*

Pulley-frame. *Gallows-frame.*

Pulp, PAC. Pulverized ore and water; also applied to dry-crushed ore.

Pulp-assay, PAC. The assay of samples taken from the *pulp* after or during crushing.

Pump-bob. See *Bob.*

Pump-rod. The rod or system of rods (usually heavy beams) connecting the steam-engine at the surface, or at a higher level, with the pump-piston below. See *Balance-bob.*

Pump-station. See *Station.*

Punch or *Puncheon.* See *Leg.*

Punch-prop, NEWC. A short *prop.*

Put, NEWC. To convey coal from the working *breast* to the tramway. This is usually done by young men (*putters*).

Putty-powder. Crude oxide of tin, used for giving opaque whiteness to enamels, or for grinding glass.
Putwork See *Tutwork.*
Pyrometer. An instrument for measuring high temperatures.

QUARRY. An open or "day" working, usually for the extraction of building-stone, slate or limestone.
Quartation. The separation of gold from silver by dissolving out the latter with nitric acid. It requires not less than ¾ silver in the alloy, whence the name, which is also applied to the alloying of gold with silver, if necessary, to prepare it for this method of *parting.*
Quartz. 1. Crystalline silica. 2. PAC. Any hard gold or silver ore as distinguished from gravel or earth. Hence *quartz-mining,* as distinguished from hydraulic, etc.
Quartzose. Containing quartz as a principal ingredient.
Qaere, queere, qwear, CORN. A small cavit or fissure.
Quick. 1. Applied to a productive vein as distinguished from *dead* or barren. 2. PAC. Quicksilver.
Quick ground. Ground in a loose incoherent state.
Quicksand. Sand which is or (becomes on the access of water) "quick," *i. e.* shifting, easily movable or semi-liquid.
Quick-silver ores. See *Mercury ores.*
Quintal. One hundred pounds avoirdupois.

RABBLE. An iron bar bent to a right angle at the end. See *Puddling.*
Race. A small thread of spar or ore.
Rack, CORN. A stationary *buddle.*
Raftertimbering. Timbering in which the pieces are arranged like the rafters of a house.
Rag-burning, CORN. See *Tinwitts.*
Rabbing. A rough *cobbing.*
Rail-train. A *train* of *rolls* for reducing iron *piles* or steel *ingots* or *blooms* to rails.
Raise. See *Rise.*
Rake, DERB. A fissure vein crossing the strata.
Raking-prop. An inclined *prop.*
Ramble. NEWC. A shale bed on the top of a coal seam, which falls as the coal is removed.
Rancho. SP. An estate or property; a farm (PAC. *ranch*).
Rundom. The direction of a *Rake-vein.*
Rapper. A lever or hammer at the top of a shaft or inclined plane, for signals from the bottom.
Raschette furnace. A shaft furnace used in lead, copper, and iron smelting, and having an oblong rectangular or oval horizontal section.
Reaction process. See *Roasting and reaction process.*
Realgar. Sulphide of arsenic.
Reamer. A tool for enlarging a bore-hole.
Record. To enter in the book of the proper officer (usually a district or county officer) the name, position, description, and date of a mining claim or location. See *District.*
Red-ash, PENN. See *Coal.*
Redevance, FR. A tax, duty, or rent. In mining law it means a tax or duty payable to the government or to the surface owner.
Red-lead. See *Minium.*
Red-short. Brittle at red heat. See *Cold-short.*
Reduce. 1. To deprive of oxygen. 2. In general, to treat metallurgically for the production of metal.
Reed, CORN. See *Spire.*
Reef, AUSTR. See *Lode.*
Refinery. See *Run-out fire.*
Refining. 1. The purification of crude metallic products. The refining of "base bullion" (silver-lead) produces pure lead and silver. 2. The conversion of gray into white cast iron in a *run-out fire.*
Refractory. Resisting the action of heat and chemical reagents: a quality undesirable in ores, but desirable in furnace-linings, etc.
Regenerator. A chamber filled with open-work of bricks to take up the heat of the gases of combustion from a furnace, and subsequently impart it to a current of air, the air and gas being conducted alternately through the chamber. See *Siemens furnace.*
Regule, FR. A copper *regulus* from which most of the impurities have been removed by liquidation.
Regulus. 1. The metallic mass which sinks to the bottom of a furnace or crucible, separating itself by gravity from the supernatant *slag* or *matt.* 2. An intermediate product obtained in smelting ores, especially those of copper, lead, silver and nickel, and consisting chiefly of metallic sulphides. In this sense it is synonymous with *matt,* or the GERM. *Stein. Antimony regulus* is metallic antimony.
Rend-rock. See *Explosives.*
Renk, NEWC. The average distance coal is brought by the *putters.*
Rests. The arrangement at the top and bottom of a pit for supporting the shaft-cage while changing the tubs or cars.
Retorting. Removing the mercury from an amalgam by volatilizing it in an iron retort, conducting it away, and condensing it.
Reverberatory furnace. A furnace in which ores are submitted to the action of flame, without contact with the fuel. The flame enters from the side or end, passes upward over a low wall or *bridge,* strikes the roof (*arch*) of the furnace, and is *reverberated* downward upon the charge.

Reversing rolls. See *Three-high train.*
Rib. 1. In coal mining, the solid coal on the side of the gallery or long-wall face; a pillar or barrier of coal left for support. 2. The solid ore of a vein; an elongated pillar left to support the hanging-wall, in working out a vein.
Ribbed. Containing *bone.*
Ribbon-borer. A boring-tool consisting of a twisted flat steel blade.
Rick, PENN. An open heap or pile in which coal is coked.
Riddle, CORN. and SCOT. A sieve. The large pieces of ore and rock picked out by hand are called *knockings.* The *riddlings* remain on the riddle; the *fell* goes through.
Rider. See *Horse.*
Riffle. A groove or interstice, or a cleat or block so placed as to produce the same effect, in the bottom of a sluice, to catch free gold.
Rim-rock. The bed-rock rising to form the boundary of a placer or gravel deposit.
Ring, NEWC. A gutter cut around a shaft to catch and conduct away the water.
Ringe. See *Cowl.*
Rise or *Riser,* CORN. A shaft or winze excavated upward.
Rise-heading. See *Heading in long-wall.*
Rivelaine. A pick with one or two points, formed of flat iron, used to undercut coal by scraping instead of striking.
Roasting. Calcination, usually with oxidation. *Good, dead,* or *sweet roasting* is complete roasting, *i. e.,* carried on until sulphurous and arsenious fumes cease to be given off. *Kernel-roasting* is a process of treating poor sulphuretted copper ores, by roasting in lumps, whereby copper (and nickel) are concentrated in the interior of the lumps.
Roasting and reaction process. The treatment of galena in a *reverberatory,* by first partially *roasting* at a low temperature, and then partially fusing the charge at a higher temperature, which causes a reaction between the lead-oxide formed by roasting and the remaining sulphide, producing sulphurous acid and metallic lead.
Roasting and reduction process. The treatment of lead ores by roasting to form lead-oxide, and subsequent reducing fusion in a shaft-furnace.
Rob. To extract pillars previously left for support; or, in general, to take out ore or coal from a mine with a view to immediate product, and not to subsequent working.
Rock-breaker. Usually applied to a class of machines, of which Blake's rock-breaker is the type, and in which the rock is crushed between two jaws, both movable, or one fixed and one movable. It is common to use a rock-breaker instead of hand-spalling to prepare ore for further crushing in the stamp-mill.
Rock-drill. A machine for boring in rock, either by percussion, effected by reciprocating motion, or abrasion, effected by rotary motion. Compressed air is the usual motive power, but steam also is used. The Burleigh, Haupt, Ingersoll, Wood, and other machines operate percussively; the *diamond drill* (which see) abrasively.
Rocker. A short trough in which auriferous sands are agitated by oscillation, in water, to collect their gold.
Rod-tools. See *Pole-tools.*
Rolley. A large truck carrying two *corves.*
Rolley-way. A *gangway.*
Rolling. See *Roll-train.*
Rolls. 1. Cylinders of iron or steel revolving towards each other, between which rock is made to pass, in order to crush it. 2. See *Roll-train.*
Roll-train. The set of plain or grooved rolls through which iron or steel *piles, ingots, blooms* or *billets* are passed, to be rolled into various shapes.
Rondle or *Rondelle.* The crust or scale which forms upon the surface of molten metal in cooling.
Roof. The rock overlying a bed or flat vein.
Roofing. The wedging of a loaded wagon or horse against the top of an underground passage.
Room, SCOT. See *Breast* and *Post-and-Stall.*
Rosette Copper. Disks of copper (red from the presence of sub-oxide) formed by cooling the surface of molten copper through sprinkling with water.
Rosse furnace. An American variety of hearth for the treatment of galena, differing from the *Scotch hearth* in using wood as fuel, working continuously, and having hollow walls, to heat the blast.
Roughing rolls. The *rolls* of a *train* which first receives the *pile, ingot, bloom.* or *billet,* and partially form it into the final shape.
Roughs, CORN. Coarse, poor sands, resulting from tin-dressing.
Round coal. See *Lump-coal.*
Rounder. See *Reamer.*
Row, CORN. Large, rough stones.
Royalty. The dues of the lessor or landlord of a mine, or of the owner of a patented invention.
Rozan process. An improvement of the *Pattinson process.*
Rubber. A gold-quartz amalgamator, in which the slime is rubbed against amalgamated copper surfaces.
Rullers, CORN. The workmen who wheel ore in wheelbarrows underground.
Run, CORN. 1. The natural falling or closing together of underground workings. 2. Certain accidents to the winding apparatus. 3. *By the run.* A method of paying coal miners per linear yard of breast excavated, instead of *by the wagon* of clear coal produced. 4. A long deep trough in which slimes settle. 5. See *Counter.*

Runner. The channel through which molten metal is conducted from the blast furnace or cupola to the *pig-bed, converter* or *moulds.* See *Pig-iron.*

Run-out-fire. A forge in which cast-iron is refined.

Run-steel. Malleable castings.

Rush, CORN. See *Spire.*

Rusty. Applied to coals discolored by water or exposure, as well as to quartz, etc., discolored by iron oxide.

Rusty gold, PAC. Free gold, which does not easily amalgamate, the particles being coated, as is supposed, with oxide of iron.

SADDLE. An anticlinal in a bed or flat vein.

Safety-cage. A cage with a *safety-catch.*

Safety-car. See *Barney.*

Safety-catch. An automatic device for preventing the fall of a cage in a shaft or a car in an incline, if the supporting cable breaks.

Safety-lamp. A lamp, the flame of which is so protected that it will not immediately ignite fire-damp. There are several varieties, invented by Davy, Stephenson, Clanny and others.

Salamander. A mass of solidified material in a furnace hearth; called also a *sow* and *bear.*

Saline. A salt spring or well; salt works.

Sampson-post. An upright post which supports the walking-beam, communicating motion from the engine to a deep-boring apparatus.

Sand-pump. A cylinder with a valve at the bottom, lowered into a drill-hole from time to time, to take out the accumulated slime resulting from the action of the drill on the rock. Called, also, *Shell-pump* and *Sludger.*

Scaffold. An obstruction in a *blast-furnace* above the *tuyeres* caused by an accumulation or shelf of pasty, unreduced materials, adhering to the lining.

Scal, CORN. A portion of earth or rock which separates and falls from the main body.

Scale. 1. The crust of metallic oxide formed by cooling of hot metals in air. *Hammer-scale* and *roll-scale* are the flaky oxides which fall from the *bloom, ingot,* or *bar* under hammering or rolling. 2. The incrustation caused in steam-boilers by the evaporation of water containing mineral salts. 3. A *scale of air* (NEWC.) is a small portion of air abstracted from the main current.

Scarcement. A projecting ledge of rock, left in a shaft as footing for a ladder, or to support pit-work, etc.

Scarfing. Splicing timbers, so cut that when joined the resulting piece is not thicker at the joint than elsewhere.

Schist. Crystalline rock, usually micaceous, having a slaty structure.

Schlicker, GERM. The skimmings from molten unrefined lead, containing chiefly copper, iron and zinc, with a little antimony and arsenic.

Schorl. Black tourmaline.

Scoria or *Scoriæ.* See *Slag.*

Scorification. A process employed in assaying gold and silver ores, and performed in a shallow clay vessel (*scorifier*), in which ore, lead and borax-glass are exposed to heat and oxidation in a *muffle.* The operation involves roasting, fusion and *scorification* proper, or the formation of a slag, which is not, like the litharge produced in *cupellation,* absorbed by the vessel.

Scotch hearth. A low forge or furnace of cast-iron, with one *tuyere,* in which rich galena is treated by a sort of accelerated *roasting and reaction process.*

Scouring cinder. A basic slag, which attacks the lining of a shaft-furnace.

Scovan lode, CORN. A lode having no *gossan* at or near the surface.

Scraper. A tool for cleaning bore-holes.

Screen. A sieve of wire-cloth, grate bars, or perforated sheet-iron used to sort ore and coal according to size. Stamp-mortars have screens on one or both sides, to determine the fineness of the escaping pulp.

Screw-bell. A recovering tool in deep boring, ending below in a hollow screw-threaded cone.

Scrin or *Skrin,* DERB. A small subordinate vein.

Seam. 1. A stratum or bed of coal or other mineral. 2. CORN. horse-load. 3. A *joint, cleft,* or *fissure.*

Seat, DERB. The floor of a mine.

Seed-bag. A bag filled with flaxseed and fastened around the tubing in an artesian well, so as to form, by the swelling of the flaxseed when wet, a water-tight packing, preventing percolation down the sides of the bore-hole from upper to lower strata. When the tubing is pulled up the upper fastening of the bag breaks, and it empties itself, thus presenting no resistance to the extraction of the tubing.

Segregate, PAC. To separate the undivided joint ownership of a mining claim into smaller individual "*segregated*" claims.

Segregation. A mineral deposit formed by concentration from the adjacent rock.

Selvage or *Selfedge.* A layer of clay or decomposed rock along a vein-wall. See *Gouge.*

Semi-anthracite. See *Coal.*

Semi-bituminous coal. See *Coal.*

Separator. 1. A machine for separating, with the aid of water or air, materials of different specific gravity. Strictly, a *separator* parts two or more ingredients, both valuable while a *concentrator* saves but one and rejects the rest; but the terms are often used interchangeably. 2. Any machine for separating materials, as the *magnetics separator,* for separating magnetic from its gangue.

Set or *Sett,* CORN. 1. A grant of mining ground, as the assignment of a certain part of a mine under contract or *tribute.* 2. A frame of timber for supporting excavations.

Settler. A tub or vat, in which *pulp* from the amalgamating *pan* or *battery-pulp* is allowed to settle, being stirred in water to remove the lighter portions.

Shadd, CORN. Smooth, round stones on the surface, containing tin-ore, and indicating a vein.

Shaft. 1. A pit sunk from the surface. 2. The interior of a *shaft-furnace* above the boshes.

Shaft-furnace. A high furnace, charged at the top and tapped at the bottom.

Shaft-walls. 1. The sides of a shaft. 2. NEWC. Pillars of coal left near the bottom of a pit.

Shake. 1. A cavern, usually in limestone. 2. A crack in a block of stone.

Shaking table. See *Percussion table.*

Shambles. Shelves or benches, from one to the other of which successively ore is thrown in raising it to the level above or to the surface.

Shearing. 1. The vertical side-cutting which, together with *holing* or horizontal undercutting, constitutes the attack upon a *face* of coal. 2. Cutting up steel for the crucible.

Shears, CORN. Two high timbers, standing over a shaft and united at the top to carry a pulley, for lifting or lowering timbers, pipes, etc., of greater length than the ordinary hoisting-gear can accommodate.

Sheathing. A close partition or coverings of planks.

Sheave. The groove-wheel of a pulley.

Shelf, CORN. The solid rock or *bed-rock,* especially under alluvial tin-deposits.

Shell-pump. See *Sand-pump.*

Shelly. The condition of coal which has been so much faulted and twisted that it is not massive, but easily breaks into conchoidal pieces.

Shet, S. STAFF. The broken down roof of a coal-mine.

Shift. 1. The time for a miner's work in one day. The gang of men working for that period, as the *day-shift,* the *night-shift.*

Shift-boss. The foreman in charge of a *shift* of men.

Shingling. Hammering *blooms, billets,* etc.

Shiver. 1. Shale; a hard argillaceous bed. 2. See *Sheave.*

Shoad, CORN. Ore washed or detached from the vein naturally. See *Float-ore.*

Shoading or *Shoding,* CORN. The tracking of boulders towards the vein or rock from which they have come.

Shoe. A piece of iron or steel, attached to the bottom of a *stamp* or *muller,* for grinding ore. The shoe can be replaced when worn out.

Shoot. 1. See *Chute.* 2. See *Blast.* A *Shoot* is a single operation of *blasting.*

Shooting needle. A sharp metal rod, to form a vent-hole through the tamping to a blasting-charge.

Shore-nose shell. A cylindrical tool, cut obliquely at bottom, for boring through hard clay.

Show. 1. The pale-blue, lambent flame of the top of a common candle-flame, indicating the presence of fire-damp. 2. See *Blossom.*

Shute. See *Chute.*

Sicker. See *Zighyr.*

Siddle. The inclination of a seam of coal.

Side-basset. A transverse direction to the line of dip in strata.

Side-guide. See *Guard.*

Side-laning, S. STAFF. Widening a *gate-road* (abandoned for that purpose) so as to make it part of a new *side of work.*

Side of work, S. STAFF. The series of *breasts* and *pillars* connected with a *gate-road* in a colliery.

Siemens furnace. A reverberatory furnace, heated by gas, with the aid of regenerators.

Sigger. See *Zighyr.*

Silesian zinc furnace. A furnace in which zinc is reduced and distilled from calcined ores in muffles.

Silicia. Consisting of or containing silex or quartz.

Sill. 1. A stratum. 2. A piece of wool laid across a drift to constitute a frame with the posts and to carry the track of the tram-way.

Silt. See *Alluvium.*

Silver ores. Silver-glance (*argentite,* sulphide); *horn silver, cerargyrite chloride; dark-ruby silver* (*pyrargyrite,* sulphantimonide); *light-ruby silver* (*proustite,* sulpharsenide); *brittle-silver-glance* (*stephanite,* antimonial sulphide of silver and *polybasite,* arsenical and antimonial sulphide of several metals); *white ore* (argentiferous gray copper, *tetrahedrite,* antimonial sulphide of iron, zinc, copper, lead, and silver); *stetefeldtite* and *partzite* (antimoniates); also, argentiferous lead, copper and zinc ores.

Sinker-bar. A heavy bar attached above the *jars* to *cable-drilling* tools.

Sinking-fire. A force in which wrought iron scrape or refined pig-iron is partially melted or welded together by a charcoal blast.

Siphon-tap. See *Arend's tap.*
Sit or *Sits.* A settling or falling of the top of workings. See *Thrust* and *Creep.*
Sizing. Separating ores according to size of particles, preparatory to *dressing.*
Skep or *Skip,* CORN. An iron box working between guides in which ore or rock is hoisted. It is distinguished from a *kibble,* which hangs free in the shaft.
Skew-plate. See *Bloomary.*
Skimmings or *Skimpings,* CORN. The poorest part skimmed off the *jigger.*
Skull. A crust of solidified steel lining a Bessemer ladle.
Slack. Small coal; coal dirt. See *Culm* (2).
Slag. The vitreous mass separated from the fused metals in smelting ores.
Slag-hearth. A hearth on the principle of the *Scotch-hearth* for the treatment of slags, etc., produced by lead-smelting in the *reverberatory furnace.* The English slag-hearth has one *tuyere;* the Castilian or Spanish, three.
Slag-lead. Lead obtained by a re-smelting of *gray slag.*
Slag-wool. A finely fibrous mass produced by blowing steam or air into molten slag.
Slant. A heading driven diagonally between the dip and the strike of a coal-seam; also called a *run.* See *Run* and *Counter.*
Slate. A sedimentary rock splitting into thin plates. The terms *slate, shale* and *schist* are not sharply distinguished in common use, particularly among older writers. Strictly, according to recent authors, *slate* may be crystalline; *schist* is always so; shale is always (and *slate* most frequently) non-crystalline. There is also a notion of coarser or less complete lamination attached to the term *shale,* as of a rock splitting into thicker or less perfect plates than *slate.* Both may be argillaceous, arenaceous, calcareous, silicious, etc., according to their lithological character. The terms *slaty, shaly,* and *schistose* describe their respective structures.
Sleck, NEWC. Mud deposited by water in a mine.
Sleeper. See *Sill.*
Sleeping-table, CORN. A stationary *buddle.* Now for strict distinction sometimes made between *buddle* and *table.* See *Buddle.*
Slickensides. Polished and sometimes striated surfaces on the walls of a vein, or on interior joints of the vein-material or of rock-masses. They are the result of movement.
Slide, CORN. 1. A vein of clay intersecting and dislocating a vein vertically; or the vertical dislocation itself. 2. An upright rail fixed in a shaft with corresponding grooves for steadying the cages.
Slide-joint. A connection acting in *rod-boring,* like the *jars* in *rope-boring.*
Slimes. CORN. The most finely crushed ores.
Slime-table. See *Buddle.*
Sline. Natural transverse cleavage of rock.
Slip. A vertical dislocation of the rocks.
Slipes, S. STAFF. Sledge runners, upon which a *skip* is dragged from the working breast to the tramway.
Slit. A communication between two levels.
Slitter. See *Pick.*
Sliver, ENG. A thin wooden strip, inserted into grooves in the adjacent edges of two boards of a *brattice,* to make it air-tight.
Slope. See *Incline.*
Sludge. See *Slimes.*
Sludger. See *Sand-pump.*
Sluicing. Washing auriferous earth through long boxes (*sluices*).
Slums, PAC. See *Slimes.*
Slurry, N. WALES. See *Regulus* (2).
Smalt. A blue pigment or glass, consisting of silica, potash and cobalt.
Smeddum, SCOT. The smaller particles which pass through the sieve of the *hutch.*
Smelting. Reducing ores by fusion in furnaces.
Smift. A fuse or slow match.
Smitham or *Smiddan,* DERB. Lead-ore dust.
Smut. 1. S. STAFF. Bad, soft coal, containing much earthy matter. 2. See *Blossom.*
Snoff, CORN. A short candle-end, put under a fuse to light it.
Snore-hole. The hole in the lower part of *wind-bore* of a mining pump, to admit the water.
Soapstone. Compact talc or steatite; often applied incorrectly to soft unctuous clays or marls.
Softening. Of lead, the removal of antimony and other impurities.
Solder. A metal or alloy used to unite adjacent surfaces of less fusible metals or alloys. *Soft solder* is a compound of tin and lead; *hard solder,* of copper and zinc, or tin, copper, and zinc, or tin and antimony; *gold solder,* of gold, silver and copper; *silver solder,* of silver and copper, or silver and brass; and so on.
Sole. 1. The bottom of a level. 2. The bottom of a reverberatory furnace.
Solid crib-timbering. Shaft-timbering with cribs laid solidly upon one another.
Sollar, CORN. A platform in a shaft, usually constituting a landing between two ladders.
Sough, DERB. See *Adit.*
Sow. 1. See *Salamander.* 2. See *Pig-iron.*
Spate, CORN. To fine for disobedience of orders.
Spall or *Spawl.* To break ore. *Ragging* and *cobbing* are respectively coarser and finer breaking than *spalling,* but the terms are often used interchangeably. Pieces of ore thus broken are called *spalls.*
Spar. A name given by miners to any earthy mineral having a distinct cleavable structure and some lustre; in Cornwall usually quartz.
Spears. See *Pump-rods.*
Speise or *Speiss,* GERM. Impure metallic arsenides (principally of iron), produced in copper and lead smelting. Cobalt and nickel are found concentrated in the speiss obtained from ores containing these metals.
Spel or *Spell.* A change or turn.
Spence-furnace. A long *reverberatory,* for thorough roasting.
Spend. To break ground; to continue working.
Spiegeleisen. Manganiferous white cast-iron.
Spiking-curb, ENG. A *curb* to the inside of which *plank-tubing* is spiked.
Spilling, CORN. A process of driving or sinking through very loose ground.
Spills, CORN. Long thick laths or poles driven ahead horizontally around the door-frames, in running levels in loose ground—a kind of *lagging* put in ahead of the main timbering.
Spire. The tube carrying the train to the charge in a blast-hole. Also called *reed* or *rush,* because these, as well as spires of grass, are used for the purpose.
Spitting. The violent ejection of globules by a body of molten silver, in the act of becoming solidified by cooling.
Splint coal. See *coal.*
Split. 1. To divide a ventilating current. 2. When a *parting* in a coal-seam becomes so thick that the two portions of the seam must be worked separately, each is called a *split.* See *Bench.*
Sponge. Metal in a porous form, usually obtained by reduction without fusion. See *Chenot process.*
Spoon. 1. An instrument made of an ox or buffalo horn, in which earth or *pulp* may be delicately tested by washing to detect gold, amalgam, etc. 2 (or *Spoon-end*). The edge of a coal-basin when the coal-seam *spoons, i. e.,* rises to the surface, after growing thinner as it approaches its termination.
Spout, S. STAFF. See *Air-head.*
Sprag. 1. A *prop.* 2. A short round piece of wood used to block the wheels of a car.
Spreader. A horizontal timber below the *cap* of a set, to stiffen the *legs,* and to support the *brattice* when there are two air-courses in the same gangway.
Spreaders. Pieces of timber stretched across a shaft as a temporary support of the walls.
Sprue. A piece of metal attached to a casting, occupying the *gate* or passage through which the metal was poured.
Spud. A nail, resembling a horseshoe nail, with a hole in the head, driven into mine-timbering, or into a wooden plug inserted in the rock, to mark a surveying-station.
Spur. A branch leaving a vein, but not returning to it.
Spurns, S. STAFF. Small connecting masses of coal, left for safety during the operation of cutting between the *hanging coal* and the main body.
Square sets. A kind of timbering used in large spaces.
Squat, CORN. 1. Tin-ore mixed with spar. 2. See *Bunch of ore.*
Squeeze. The settling, without breaking, of the *roof* over a considerable area of workings.
Squeezer. A machine for reducing the *puddle-ball* to a compact mass, ready for the hammer or rolls.
Squib. A slow-match or safety-fuse, used with a *barrel.*
Squirting. Forcing lead by hydraulic pressure into the form of rods or pipes.
Stack. 1. A chimney. 2. See *Shaft-furnace.*
Stall, S. STAFF. See *Room, Breast* and *Post-and-Stall.*
Stamping. Reducing to the desired fineness in a *stamp-mill.* The grain is usually not so fine as that produced by grinding in *pans.*
Stamp-mill. An apparatus (also the building containing the apparatus) in which rock is crushed by descending pestles (*stamps*), operated by water or steam-power. Amalgamation is usually combined with the crushing when gold or silver is the metal sought, but copper and tin-ores, etc., are stamped to prepare them for *dressing.*
Stamps, S. WALES. The pieces into which the rough bars *shingled* from the finery ball are broken, to be *piled* for subsequent rolling into sheet-iron.
Stamp-work, LAKE SUP. Rock containing disseminated native copper.
Stanchion. See *Leg.*
Standage, ENG. A large *sump,* or more than one, acting as a reservoir.
Stannary. A tin-mine or tin-works.
Station. 1. See *Platt.* 2. Also a similar enlargement of shaft or level to receive a balance-bob (*bob-station*), pump (*pump-station*), or tank (*tank-station*).
Steamboat-coal, PENN. See *Coal.*
Steam-coal. See *Coal.*
Steel. A compound or alloy of iron, principally with carbon, which may be cast, forged, hardened and tempered. Ordinary steel contains from 0.5 to 1.5 per cent. of carbon. More carbon makes cast-iron; less carbon, wrought-iron. But this classification is not now strictly adequate or applicable, either to the scientific or to the commercial use of the term. The so-called *mild* or *low* or *structural*

steels (low in carbon, and hence relatively soft and tough), as compared with *high* or *hard* or *tool* steels, do not always harden or temper. An international committtee appointed by the American Institute of Mining Engineers has recommended the use of the following classification:

1. That all malleable compounds of iron with its ordinary ingredients, which are aggregated from pasty masses, or from piles, or from any forms of iron not in a fluid state, and which will not sensibly harden and temper, and which generally resemble what is called "wrought-iron," shall be called *weld-iron* (GERM. *Schweisseisen;* FR., *fer soude*).

2. That such compounds, when they will from any cause harden and temper, and which resemble what is now called "puddled steel," shall be called *weld-steel* (GERM., *Schweissstahl;* FR., *acier soude*).

3. That all compounds of iron with its ordinary ingredients, which have been cast from a fluid state into malleable masses, and which will not sensibly harden by being quenched in water while at red heat, shall be called *ingot-iron* (GERM., *Flusseisen;* FR., *fer fondu*).

4. That all such compounds, when they will from any cause so harden, shall be called *ingot-steel* (GERM., *Flussstahl;* FR., *acier fondu*).

This proposed classification does not cover ordinary cast or pig iron. It is a classification of the malleable compounds only. The Institute has recommended its use in papers and discussions, except as to the term *weld*, for which a substitute was desired, and meanwhile the continuance of the old term *wrought*, though in a somewhat wider significance, was suggested. The resolution of the Institute concludes as follows: "It being understood that the *ingot-iron* and *ingot-steel* of this classification constitute, taken together, what is now commercially known as *cast-steel*, including the so-called low or soft cast-steels." *Bessemer-steel* is made by decarburizing cast iron in a *converter*. (See *Bessemer process.*) *Blister* or *cement-steel* is made by carburizing wrought iron bars by packing them in charcoal powder and heating without access of air. It is melted in crucibles to *cast-steel*, or hammered (*tilted*) to *shear-steel* (for cutlery, etc.), or rolled to *spring-steel*. *Puddled steel* is made by arresting the *puddling* process before wrought iron has been produced, and thus retaining enough carbon in the bath to constitute steel. *Natural* steel is a similar product, obtained from the refining of cast-iron. *Crucible cast-steel* is steel made by the fusion in crucibles, either of *blister-steel*, or *puddled steel*, or steel scrap, or other ingredients and fluxes which will produce the desired quality. *Cast-steel* in its widest sense, as now employed, comprises all malleable compounds produced by fusion, including therefore the *Bessemer* and *open-hearth* metal. *Open-hearth*, called also *Martin-Siemens steel*, is made in the reverberatory furnace (almost invariably a gas-furnace on the Siemens regenerative system, since an intense tenmperature is required) by the reaction, in the fused bath, of cast-iron with wrought-iron, iron-oxide, or iron ore. At a certain stage of the process a *deoxidizing* or *recarburizing* agent (*spiegeleisen, ferro-manganese*) is added. *Chrome-steel* is a crucible cast-steel in which chromium is a constituent. *Tungsten* or *Wolfram-steel* is a steel containing tungsten. *Phosphorus-steel* is a steel in which the amount of phosphorus exceeds that of carbon. *Damascus-steel* is a laminated mixture of steel and wrought iron. *India-steel* or *Wootz* is manufactured in India direct from the ore.

Stemmer, NEWC. See *Tamping-bar.*

Stemming, NEWC. The tamping put above the charge in a bore-hole.

Stempel or *Stemple*. 1. DERB. One of the cross-bars of wood placed in a mine-shaft to serve as steps. 2. A *stull-piece*. 3. A *cap*, both sides of which are *hitched* instead of being supported upon legs. See *Stull.*

Stenton, NEWC. A passage between two *winning headways*. A *stenton-wall* is the *pillar* of coal between them.

Step-grate. A grate made in steps or stairs, to promote completeness of the combustion of the coal burned upon it.

Step-vein. A vein alternately cutting through the strata of *country-rock*, and running parallel with them.

Stetefeldt furnace. A shaft-furnace for desulphurizing or chloridizing roasting, in which the pulverized charge falls freely down the shaft.

Stirrup. See *Temper-screw.*

Stock-work (GERM., *Stockwerk*). An ore deposit of such a form that it is worked in floors or stories. It may be a solid mass of ore, or a rock-mass so interpenetrated by small veins of ore that the whole must be mined together. *Stockworks* are distinguished from *tabular* or *sheet*-deposits (veins, beds), which have a small thickness in comparison with their extension in the main plane of the deposit (that is, in *strike* and *dip*).

Stone-coal. See *Coal.*

Stone-head, ENG. The solid rock first encountered in sinking a shaft.

Stoop-and-Rooms, SCOT. See *Post-and-Stall.*

Stope, CORN. To evacuate ore in a vein by driving horizontally upon it a series of working, one immediately over the other or *vice versa*. Each horizontal working is called a stope (probably a corruption of *step*), because when a number of them are in progress, each working face being a little in advance of the next above or below, the whole face under a jack assumes the shape of a flight of stairs. When the first stope is begun at the lower corner of the body of ore to be removed, and after it has advanced a convenient distance, the next is commenced above it, and so on, the process is called *over-hand* stoping. When the first stope begins at an upper corner, and the succeeding ones are below it, it is *under-hand* stoping. The term *stoping* is loosely applied to any subterranean extraction of ore except that which is incidentally performed in sinking shafts, driving levels, etc., for the purpose of opening the mine.

Stopping. 1. See *Stoping*. 2. A partition of boards, masonry, or rubbish, to stop the air-current in a mine, or force it to take a special desired direction.

Stove. The oven in which the blast of a furnace is heated.

Stove-coal, PENN. See *Coal.*

Stowbord, NEWC. A place into which rubbish is put.

Stowce. 1. A Windlass. 2. DERB. *Stowces* are wooden landmarks, placed to indicate possession of mining ground.

Stowing. A method of mining in which all the material of the vein is removed and the waste is packed into the space left by the working.

Straightening press. A power-press to straighten iron and steel bars, such as rails, shafting, etc.

Strake, CORN. An inclined *launder* for separating or *tying* ground ore in water.

Stratum. A bed or layer.

Streak. The powder of a mineral, or the mark which it makes when rubbed upon a harder surface.

Stream-tin, CORN. Tin-ore in alluvial deposits, as pebbles.

Stream work, CORN. Work on *stream-tin.*

Streamers, CORN. Searchers for *stream-tin.*

Striated. Marked with parallel grooves or *striæ.*

Strike. The direction of a horizontal line, drawn in the middle plane of a vein or stratum not horizontal.

String, CORN. A small vein.

Stringing-deals, ENG. Thin planks, nailed to the inside of the curbs in a shaft, so as to suspend each curb from those above it.

Strip. To remove from a quarry, or other open working, the overlying earth and disintegrated or barren surface rock.

Studdles, CORN. 1. Props supporting the middle of *stulls*. 2. Distance-pieces between successive frames of timbering.

Stull, CORN. A platform (*stull-covering*), laid on timbers (*stull-pieces*), braced across a working from side to side, to support workmen or to carry ore or waste.

Stulm. See *Adit*. From the GERM. *Stollen.*

Stump, PENN. A small pillar of coal, left at the foot of a *breast* to protect the *gangway.*

Stup. A pulverized mixture of clay and coke or coal. Probably from the GERM. *Gestubbe.*

Sturt. A *tribute*-bargain which turns out profitable for the miner.

Stythe, NEWC. *Choke-damp.*

Sublimation. The volatilization and condensation of a solid substance, without fusion.

Sublimation-theory. The theory that a vein was filled first with metallic vapors.

Sucker-rod. The *pump-rod* of an oil-well.

Sulphur. 1. Iron pyrites. 2. Carburetted or sulphuretted hydrogen.

Sulphurets, PAC. In miner's phrase, the undecomposed metallic ores, usually sulphides. Chiefly applied to auriferous pyrites.

Sump, CORN. (from GERM. *Sumpf.*) The space left below the lowest landing in a shaft to collect the mine-water. The lowest pump draws from it. 2. NEWC. That part of a *judd* of coal which is extracted first.

Sump-fuse. A water-proof fuse.

Swad, NEWC. A thin layer of stone or refuse coal at the bottom of the seam.

Swape. An implement for shaping the edge of a boring bit.

Swalls, Swallows or *Swallow-holes*. Surface holes caused by the subsidence of rocks; or openings into which mine-water disappears.

Swamp. A depression in a nearly horizontal bed, in which water may collect.

Swedish process. See *German process.*

Sweeping table. A stationary *buddle.*

Sweeps. The dust of the workshops of jewellers, goldsmiths, silversmiths, and assayers and refiners of gold and silver.

Sweet-roasting. See *Roasting.*

Synclinal. The axis of a depression of the strata; also the depression itself. Opposed to *anticlinal*, which is the axis of an elevation.

TACKLE, CORN The *windlass*, rope, and *kibble.*

Tacklers, DERB. Small chains put around loaded *corves.*

Tail-house, Tail-mill. The buildings in which *tailings* are treated.

Tailing. See *Blossom.*

Tailings. The lighter and sandy portions of the ore on a buddle or in a sluice. The *headings* are accumulated or discharged at the upper end, the *middlings* in the middle, while the *tailings* escape at the foot. The term *tailings* is used in a general sense for the refuse of reduction-processes other than smelting.

Tail-race. The channel in which *tailings*, suspended in water, are conducted away.

Tamp. To fill (usually with clay-tamping) the bore-hole or other opening through which an explosive charge has been introduced for blasting.

Tamping-bar. CORN.
Tank. A subterranean reservoir into which a pump delivers water for another pump to raise.
Tap-Cinder. The cinder drawn from a *puddling* furnace or *bloomary*.
Tap-hole. The opening through which the molten metal is *tapped* or drawn from a furnace.
Teem, ENG. 1. To dump. 2. To pour steel from a melting-pot.
Temper. 1. To grind and mix plastic materials, such as clay, or the ingredients of mortar. To give the metals (especially steel) the desired degree of hardness and elasticity by a process of heating and cooling, suitably regulated. A metallic compound in which these qualities can thus be produced is said *to temper*, or *to take temper*.
Tempering-bar. See *Furgen.*
Temper-screw. A screw-connection for lengthening the column of boring-rods as boring advances.
Tenant-helve, ENG. See *Frontal-hammer.*
Tepetate, SP. Waste rock and rubbish in a mine.
Tern-plate. A variety of tin-plate coated with an alloy of one-third tin, and two-thirds lead.
Test. See *Cupel.*
Test-ring. An oval iron frame for holding a test or movable cupelling-hearth.
Thermo-aqueous. Produced by, or related to, the action of heated waters.
Thill, NEWC. The floor of a coal mine.
Thirling. See *Thurling.*
Thomas and Gilchrist process. See *Basic lining process.*
Three-high train. A *roll-train* composed of three rolls, the bar, being entered on one side between the bottom and the middle rolls and on the other side between the middle and upper roll. The *passes* in both directions thus take place without reversing the movement of the rolls, as is done in so-called *reversing-rolls.*
Throw. A dislocation or fault of a vein or stratum, which has been *Thrown up* or *down* by the movement.
Throwing, S. STAFF. The operation of breaking out the *spurns*, so as to leave the *hanging coal* unsupported, except by its own cohesion.
Thrust. The breaking down or the slow descent of the roof of a *gangway*. Compare *Creep.*
Thurl, S. STAFF. To cut through from one working into another.
Thurlings. Passages cut from *room* to *room* in *post-and-stall* working.
Thurst. The ruins of the fallen roof, after *pillars* and *stalls* have been removed.
Ticketings, CORN. Meetings for the sale of ores.
Tick-hole. See *Vug.*
Tierras, SP. Fine dirt impregnated with quick-silver ore, which must be made into *adobes* before roasting.
Tiger. See *Nipping-fork.*
Tile-copper. See *Bottoms.*
Tiller. See *Brace-head.*
Tilt-hammer. A hammer for shingling or forging iron, arranged as a lever of the first or third order, and "tilted" or "tripped" by means of a cam or cog-gearing, and allowed to fall upon the billet, bloom, or bar.
Tin-frame, CORN. A *sleeping-table* used in dressing tin-ore *slimes*, and discharged by turning it upon an axis till its surface is nearly vertical, and then dashing water over it, to remove the enriched deposit. A *machine-frame* or *self-acting frame* thus discharges itself automatically at intervals; a *hand-frame* is turned for the purpose by hand.
Tin-ores. Tinstone (*cassiterite*, oxide); *tin-pyrites*, (*stannite*, sulphide of tin, copper, iron and zinc). The latter is not, so far as I am aware now actually treated for tin. Ores containing it are smelted as copper ores, and the tin is lost.
Tin-plate. Sheet-iron coated with tin.
Tin-witts, CORN. The product of the first dressing of tin-ores, containing, besides tinstone, other heavy minerals (wolfram and metallic sulphides), It must be roasted before it can be further concentrated. Its first or partial roasting is called *rag-burning.*
Tipe. To upset or "dump" a *skip.*
Toadstone. A kind of trap-rock.
Ton. For many things, such as coal and iron, the ton in use is the *long* ton of twenty hundredweight at 112 pounds avoirdupois. Allowances ("sandage," etc.), are made in weighing pig-iron and other crude metals, so that the "smelter's ton" is still greater. The Cornish mining ton is twenty-one hundredweight or 2352 pounds avoirdupois. In gold and silver mining, and throughout the Western States, the ton is the *short* ton of 2000 pounds.
Tonite. A nitrated gun-cotton, used in blasting.
Top-wall. See *Hanging-wall.*
Torta, SP. A flat heap of silver ore (*slime* or *pulp*) prepared for the *patio* process.
Tossing or *Tozing,* CORN. 1. Washing ores by violent agitation in water, their subsidence being accelerated by *packing* or striking with a hammer the *keeve* in which the operation is performed. *Chimming* is a similar process on a smaller scale. 2. Refining tin by allowing it, while molten, to fall several feet through the air.
Touchstone. A black, hard stone (basalt or jasper), on which the fineness of an alloy of gold and silver can be tested by comparing its *streak* with that of a piece of alloy (*touch-needle*) of known fineness.
Tough-cake. Refined or commercial copper.
Toughening. Refining, as of copper or gold.
Tough-pitch. See *Tough-cake.*
Towt, NEWC. A piece of old rope.
Train. See *Roll-train.*
Tram, WALES. 1. A four-wheeled truck to carry a *tub*, *corve*, or *hutch*, or to carry coal or ore on a railroad. 2. One of the rails of a *tramroad* or railroad.
Trap. In miners' parlance, any dark, igneous or apparently igneous, volcanic rock.
Trap-door. See *Weather-door.*
Trapiche, SP. A rude grinding machine, composed of two stones, of which the upper is fastened to a long pole.
Trapper. NEWC. A boy who opens and shuts the *trap-door.*
Tribute, CORN. A portion of ore given to the miner for his labor. *Tributors* are miners working under contract, to be paid by a *tribute* of ore or its equivalent price, the basis of the remuneration being the amount of clean ore contained in the crude product.
Trip-hammer. See *Tilt-hammer.*
Trogue. A wooden trough, forming a drain.
Trolly. A small four or two-wheeled truck, without a body. The two-wheeled trolly is used in a *rolling-mill* to wheel the *puddle-balls* to the *squeezer.*
Trombe or *Trompe,* FR. An apparatus for producing an air-blast by means of a falling stream of water, which mechanically carries air down with it, to be subsequently separated and compressed in a reservoir or drum below.
Trommel. A revolving sieve for *sizing* ores.
Trouble, NEWC. A dislocation of the strata.
Trow. A wooden channel for air or water.
Trumpeting, S. STAFF. A small channel cut behind the brick-work of a shaft lined with masonry.
Trunk, CORN. A long narrow box or square tube, usually of wood.
Trunking, CORN. Separating slimes by means of a *trunk.*
Tubbing. A shaft-lining of casks or cylindrical caissons, of iron or wood. See *Plank-tubbing.*
Tubing. Lining a deep bore-hole by driving down iron tubes.
Tubs, NEWC. Boxes for lowering coals. See *Trolly.*
Tuff or *Tufa.* A soft sandstone or calcareous deposit.
Tug, DERB. The iron hook of a hoisting bucket, to which the *tacklers* are attached.
Tunnel. 1. A nearly horizontal underground passage, open at both ends to *day*. 2. PAC. See *Adit.*
Tunnel-head. The top of a *shaft-furnace.*
Turbary. A peat-bog.
Turn. A pit sunk in a *drift.*
Turn-bat. A wooden stick used in turning the tongs which hold a *bloom* under the hammer.
Turning-house. The first working on a vein where it has been intersected by a *cross-cut.*
Tut-work. See *Dead-work.* In general, work paid for by the amount of excavation, not (as in *tribute*) of product.
Tuyere, Tweer, Twyer or *Twere.* A pipe inserted in the wall of a furnace, through which the blast is forced into the furnace. Usually the tuyere enters through an embrasure in the masonry (*tuyere-arch*). A *nozzle* or interior pipe is frequently inserted at the inner end of the *tuyere*. By changing the *nozzle*, the size of the opening for the blast may be thus regulated without changing the *tuyere*. The latter is either an annular hollow casting of iron (*box-tuyere*) or bronze (*bronze-tuyere*), or a coil of iron pipe. In either case, water is continually circulated through it, to protect it and the nozzle from the action of the melting materials in the furnace. *Spray-tuyeres* are open *box-tuyeres*, in which a spray of water, instead of a current, is employed. This is vaporized by the heat, and passes away as steam.
Tuyere-plate. See *Bloomary.*
Tying, CORN. See *Strake.*
Tymp. A hollow iron casting, cooled interiorly by a current of water, and placed to protect the *tymp-arch*, or arch over the *dam* in a blast furnace having a *fore-hearth*. (See *Open front.*)

UNDER-HAND. See *Slope.*
Underlayer, CORN. A vertical shaft sunk to cut a lode.
Underlie or *Underlay,* CORN. The departure of a vein or stratum from the vertical, usually measured in horizontal feet per fathom of inclined depth. Thus a *dip* of 60° is an *underlay* of three feet per fathom. The *underlay* expressed in feet per fathom is six times the natural cosine of the angle of the dip. See *Dip.*
Under-poled copper. Copper not *poled* enough to remove all sub-oxide.
Universal train. A *roll train* having adjustable horizontal and vertical rolls, so as to produce sections of various sizes.
Unwater. To drain or pump water from a mine.
Upcast. 1. A lifting of a coal seam by a dike. 2. The opening through which the ventilating current passes out of a mine. See *Downcast.*
Upraise. See *Rise.*
Ure's process. The treatment of quicksilver ores by heating in iron retorts with admixture of lime.

VALL' ALTA FURNACE. See *Hahner furnace.*
Vamping. The *debris* of a stope, which forms a hard mass under the feet of the miner.
Vanning, CORN. A method of washing ore on a shovel, analogous to *panning.* Concentrating machines are sometimes called *vanners.* See *Percussion-table.*
Vein. See *Lode.* The term *vein* is also sometimes applied to small threads, or subordinate features of a larger deposit.
Vena, SP. A small vein.
Vend, NEWC. The total sales of coal from a colliery.
Verifier. A tool used in deep boring for detaching and bringing to the surface portions of the wall of the bore-hole at any desired depth.
Vermillion. Mercury sulphide.
Vestry, NEWC. Refuse.
Veta, SP. A vein. As compared with *vena, veta* is the main vein.
Viewer. A colliery manager.
Vigorite. See *Explosives.*
Vug, vugg or *vugh.* A cavity in the rock, usually lined with a crystalline incrustation. See *Geode.*

WAD-HOOK. A tool with two spiral steel blades for removing fragments from the bottom of deep bore-holes.
Wagon. A four-wheeled vehicle used in coal mines, usually containing 75 to 100 cubic feet.
Wagon-breast. A *breast* into which wagons can be taken.
Wale, NEWC. To clean coal by picking out the refuse by hand. The boys who do this are called *Walers.*
Wall. 1. The side of a level or drift. 2. The *country-rock* bounding a vein laterally.
Wall-plates, CORN. The two side-pieces of a timber frame in a shaft, paralled to the strike of the lode when the shaft is sunk on the lode. The other two pieces are the *end-pieces.*
Washer. See *Ore-washer.*
Water-jacket. See *Jacket.*
Waste. NEWC. Old workings. The signification seems to include that of both *goaf* and *gob.*
Wastrel. A tract of waste land or any waste material.
Water-barrel or *Water-tank.* A barrel or box with a self-acting valve at the bottom, used for hoisting water in lieu of a pump.
Water-level. 1. The level at which, by natural or artificial drainage, water is removed from a mine or mineral deposit. 2. A drift at the water-level.
Water-packer. A water-tight packing of leather between the pipe and the walls of a bore-hole.
Way-shaft. See *Blind-shaft.*
Weather-door. A door in a level to regulate the ventilating current.
Weathering. Changing under the effect of continued exposure to atmospheric agencies.
Wedging-curb or *Wedging-crib,* ENG. A *curb* used to make a water-tight packing between the *tubbing* in a shaft and the rock-walls, by means of split *deals,* moss and wedges, driven in between the *curb* and the rock.
Weld. To join pieces of metal by pressure, at a temperature below that of complete fusion.
Weld-iron. Wrought-iron. See *Iron* and *Steel.*
Weld-steel. See *Steel.*
Weld. The crucible of a furnace.
Welsh process. See *English process.*
Wetherill furnace. A furnace with perforated iron bottom, under which a blast is introduced, and upon which zinc-ore (red oxide) is reduced.
Wharl or *Wharr,* NEWC. A sledge for hauling corves in low drifts.
Wheal, CORN. A mine.
Whim or *Whimsey.* A machine for hoisting by means of a vertical drum, revolved by horse or steam power.
Whin or *Whinstone,* NEWC. Basaltic rock; any hard, unstratified rock. In Scotland, greenstone.
Whip. The simplest horse-power hoisting machine, consisting of a fixed pulley and a hoisting rope passing over it, to which the animal is directly attached.
White-ash, PENN. See *Coal.*
White-damp. A poisonous gas sometimes (more rarely than fire-damp or choke-damp, etc.), encountered in coal mines. It has been supposed to contain carbonic oxide, but this is doubtful.
White furnace. See *Howell furnace.*
White-lead. Carbonate of lead.
White tin, CORN. *Metallic tin.*
Whits or *Witts,* CORN. See *Tin-witts.*
Whitwell stove. A fire-brick hot-blast stove, on the regenerative system.
Whole-working, NEWC. Working where the ground is still whole, *i. e.,* has not been penetrated as yet with breasts. Opposed to *pillar-work,* or the extraction of pillars left to support previous work.
Wild lead. Zinc-blende.
Wicket. A *breast.* See *Breast,* and *Post-and-stall.*
Wimble. A shell-auger used for boring in soft ground.
Win. To extract ore or coal.
Windbore, NEWC. The pipe at the bottom of a set of pumps.
Winch or *Windlass.* A man-power hoisting machine, consisting of a horizontal drum with crank handles.
Winding. Hoisting with a rope and drum.
Winds. See *Winze.*
Winning. 1. A new opening. 2. The portion of a coal field laid out for working.
Winning headways. NEWC. Headways driven to explore and open out the coal seam.
Winze. An interior shaft, usually connecting two levels.
Wood-tin. Tinstone of light wood-color.
Wootz. See *Steel.*
Work. Ore not yet dressed.
Working. See *Labor.* The Spanish and the English term are synonymous in meaning and alike in application. A *working* may be *shaft, quarry, level, open-cut,* or *stope,* etc.
Working-barrel, CORN. The cylinder in which a pump piston works.
Working home. Working toward the main shaft in extracting ore or coal, as in *longwall retreating.*
Working-out. Working away from the main shaft in extracting ore or coal, as in *longwall advancing.*
Work-lead. See *Base bullion.*

YELLOW-ORE. CORN. Chalcopyrite. See *Copper ores.*
Yokings. See *Stowces.*

ZAWN, CORN. A cavern.
Ziervogel process. The extraction of silver from sulphuret ores or matte by roasting in such a way as to form sulphate of silver, leaching this out with hot water, and precipitating the silver by means of metallic copper.
Zighyr, zigger, or *sicker,* CORN. To percolate, trickle or ooze, as water through a crack. From GERM., *sickern.*
Zinc-dust. Finely-divided zinc, zinc-oxide, and impurities, incidentally produced in the manufacture of *spelter.* It is sometimes used as an inferior paint (*zinc-gray*).
Zinc-gray. See *Zinc-dust.*
Zinc-ores. *Red ore* (*zincite,* oxide); *black-jack* (*zinc-blende, sphalerite,* sulphide); *zinc-spar* (*noble calamine, smithsonite,* carbonate, and *earthy calamine, hydrozincite,* hydrated carbonate); *silicious oxide* (*willemite,* anhydrous, and *calamine,* hydrated silicate).
Zinc-scum. The zinc-silver alloy skimmed from the surface of the bath in the process of desilverization of lead by zinc.
Zinc-white. Oxide of zinc.
Zones. In a shaft-furnace, the different portions (horizontal sections) are called *zones,* and characterized according to the reactions which take place in them, as the *zone of fusion* or *smelting-zone,* the *reduction-zone,* etc.

THE PROPERTIES OF METALS.

THE word Metal appears to be derived from the Greek μετ ἄλλα, *in quest of other things,* whence come μεταλλάω *to search after, to explore,* or in gold-diggers' language *to prospect,* and the corresponding substantive μέταλλον *a mine.* About fifty of the undecomposed or *elementary* substances are classed together under the head of Metals by the chemist, because they manifest certain properties when acted upon by chemical tests, without regard to those external characters which are commonly associated with the idea of a metal. Many of these are unfit to be employed in the metallic state for any of the ordinary uses of metals, because they cannot be exposed to the action of air, even for a short time, without being rusted or corroded, by combining with the oxygen of the air, to such an extent that they entirely lose their metallic characters. Among those which offer sufficient resistance to the action of air, many are excluded from useful application in their metallic state, on account of their rarity, or of the great difficulty which is experienced in extracting them from their ores. The metals which are employed for useful purposes in their pure or metallic state are—

Aluminum	Copper	Magnesium	Platinum
Antimony	Gold	Mercury	Silver
Bismuth	Iron	Nickel	Tin
Cadmium	Lead	Palladium	Zinc

On considering this list, it will be seen that several of the metals named in it are employed to produce some effect dependent upon a peculiar property of the metal, and not upon qualities which belong to it in common with the rest. Thus, mercury or quicksilver is used for amalgamating or dissolving, and also as a suitable liquid for constructing barometers and thermometers; antimony owes its usefulness to its property of hardening lead and tin when melted with them; bismuth and cadmium are employed to render lead and tin capable of being melted at lower temperatures; nickel is used to whiten copper in order to make German silver; and magnesium is valuable for its property of burning easily with production of a brilliant white light. Moreover, gold, platinum, palladium, and silver, being comparatively rare, and aluminum being obtainable by a somewhat costly process, the useful applications of these metals are limited by their high price, so that there remain only tin, lead, copper, iron and zinc to be considered as metals largely employed for useful purposes.

The qualities possessed by these metals, rendering them fit for purposes which could not be fulfilled by non-metallic substances, are lustre, or the power of reflecting light, tenacity, or resistance to any attempt to pull asunder their particles; malleability, or the capability of being hammered or rolled into thin sheets; ductility, or the property of being drawn out into wire; high specific gravity or relative weight; high conductive power for heat and electricity; and fusibility, or the property of becoming liquid when heated.

Metallic Lustre.—The power of reflecting the rays of light is possessed in a much higher degree by metals than by non-metallic substances. Although some examples of the latter class, such as iodine and plumbago, reflect much of the light which falls upon smooth surfaces of them, they have a black appearance, caused by their absorbing a large proportion of the luminous rays, which is quite different from the true metallic lustre. Iron, in the form of steel, is capable of exhibiting this lustre in very great perfection, because the hardness of steel allows its surface to be ground perfectly smooth by the application of fine particles of very hard substances, such as emery and diamond-dust, which rub off minute projections from the surface without producing scratches or indentations. A surface, so polished sends back directly to the eye of the observer almost all the light falling upon it, whilst a rough surface, being made up of a number of small surfaces, scatters the reflected rays in all directions. Tin is naturally a brilliant metal, but is not hard enough to be polished, like steel; if, however, it be dissolved in twice its weight of melted copper, an alloy of great hardness and brilliancy is formed, which is employed for the specula or mirrors of reflecting telescopes. Zinc and lead exhibit the metallic lustre in an inferior degree, and become dull when exposed to air, because the metal at the surface combines with oxygen, forming a thin film of oxide which has no metallic lustre. The natural lustre of silver is very great, and if it be hardened by admixture with a little copper, it becomes susceptible of a very high polish which is not dimmed by the action of the oxygen of air, though it is easily tarnished by sulphur existing in foul air in the form of sulphuretted hydrogen. The splendid combination of lustre and color exhibited by burnished gold is proverbial and is undiminished by the action of the atmosphere. The lustre of palladium and platinum resembles that of silver, and is not affected by oxygen or sulphur in the air. Aluminum has also a permanent lustre, though inferior to that of silver. When dissolved in nine times its weight of melted copper aluminum forms a hard yellow alloy capable of being polished to resemble gold, but becoming slowly tarnished by the action of the oxygen in air.

Tenacity.—The strength with which the metals oppose any attempt to pull asunder their particles is one of their most useful properties, and is determined by ascertaining the exact weight which must be suspended from the ends of wires or rods of equal diameter, in order to break them. The weight required to break a given metallic wire is found to vary according to the manner in which the strain is applied, the resistance of the wire being greater when the whole of the breaking weight is applied at once than when it is added gradually, probably because, in the latter case, the wire becomes stretched and weakened by each additional weight. Steel (iron combined with about $\frac{1}{100}$th part of carbon) is by far the most tenacious of metals, and lead is the least tenacious of those in ordinary use. If the weight required to pull asunder a wire of lead be taken as unity, that required by similar wires of the other metals will be found to approach nearly to the number contained in the following table:—

Relative Tenacity of the Metals.

Lead	1	Silver	12½
Tin	1⅓	Platinum	15
Zinc	2	Copper	18
Palladium	11½	Iron	27½
Gold	12	Steel	42

The tenacity of metals is very seriously affected by variations in their structure, purity and temperature. Thus, rods of metal which have been cast in a mould are generally weaker than rods of equal dimensions made by drawing the metal through the gradually diminishing holes of the wire-drawer's plate. The tenacity of iron rods which have been rolled until they have acquired a fibrous structure, is much higher than that of rods which are crystalline in texture, the metal tending to break asunder where the smooth surfaces of the separate crystals are in contact with each other. The tenacity of metal when hot is, as might be anticipated, less than its tenacity when cold; and if the metal be made red-hot and allowed to cool slowly, it will generally be found to have diminished in tenacity, probably because a high temperature tends to encourage the formation of a crystalline structure. The effect of the presence of impurities upon the tenacity of metals will be more appropriately studied elsewhere, but it may be stated generally that chemical purity is not of necessity accompanied by the highest degree of tenacity. Thus, the small proportion of carbon present in steel is seen in the above table to have greatly increased in tenacity of the iron, and pure zinc has a much lower tenacity than the ordinary zinc of commerce.

Malleability.—The facility with which a mass of metal can be hammered or rolled into a thin sheet without being torn, must depend partly upon its softness, and partly upon its tenacity. If it depended upon softness alone, lead should be the most malleable of ordinary metals; but, although it is easy to hammer a mass of lead into a flat plate, or to squeeze it between rollers, any attempt to reduce it to an extremely thin sheet fails from its want of tenacity, which causes it to be worn into holes by percussion or friction. On the other hand, if malleability were entirely regulated by tenacity, iron would occupy the first place, whereas, on account of its hardness, it is the least malleable of metals in ordinary use; whilst gold, occupying an intermediate position with respect to tenacity, is the most malleable, which appears surprising to those who are only acquainted with gold in its ordininary forms of coin and ornament, in which it is hardened and rendered much less malleable by the presence of copper and silver. During the rolling or lamination of metals their particles are obviously squeezed into unnatural positions; it becomes necessary, therefore, in order to avoid breaking, to enable the particles to resume their former relative situations; this is effected by heating the metallic sheet after every two or three rollings, and allowing it to cool slowly, a process of annealing similar to that by which glass vessels are rendered less brittle. In the following table the ordinary metals are arranged in the order of malleability:

Table of Malleability.

1. Gold.	4. Tin.	7. Zinc.
2. Silver.	5. Platinum.	8. Iron.
3. Copper.	6. Lead.	

Ductility.—The ease with which a metal can be elongated into a wire, by being drawn through the gradually diminishing holes of the wire-drawer's plate, will be greater in proportion to the softness of the metal; but the thinness of the wire to which it can be reduced is regulated by the tenacity of the metal, which enables it to resist, without breaking, the force required to draw it through the holes. and it is found that their tenacity has more influence upon the ductility of metals than upon their malleability, for the particles of a weak metal, like tin, may cohere under the hammer, although they would be easily torn apart by the direct pull necessary in wire-drawing. Gold, silver, and platinum, which occupy an intermediate position with respect to tenacity, are the most ductile of the metals, whilst tin and lead, which are lowest in tenacity, are the least ductile, though their softness gives them a higher place in the order of malleability.

Table of Ductility.

1. Gold.	5. Copper.	8. Zinc.
2. Silver.	6. Palladium.	9. Tin.
3. Platinum.	7. Aluminum.	10. Lead.
4. Iron.		

The metals require annealing during the process of wire-drawing, as in that of lamination, and for a similar reason.

Specific Gravity.—The relative weights of equal bulks of the metals exercise considerable influence upon their useful applications. The relative weight of gold being very high it is well adapted for a circulating medium, a large value being compressed into a portable form. On the other hand, iron would be employed with far less advantage in building if its relative weight did not happen to be low, whilst aluminum, being the lightest of metals in ordinary use, is particularly well adapted for the production of small weights, as fractions of a grain, which shall yet be large enough to handle; such weights being nearly nine times as large when made of aluminum as they are when platinum is employed, as was the case before the introduction of aluminum. The specific gravities, or comparative weights of equal bulks of the metals, are generally expressed by numbers which show that each metal is so many times as heavy as an equal bulk of pure distilled water at the ordinary temperature (60° F.); thus zinc is a little more than seven times as heavy as an equal bulk of water, so that its specific gravity is expressed by 7 and a fraction. The first column of numbers in the following table gives the specific gravities of the metals in round numbers, which can be easily retained in the memory, and are sufficiently exact for ordinary purposes, the more accurate numbers usually employed in scientific works being given in the next column:—

Table of Specific Gravities of the Metals.

Platinum	$21\frac{1}{2}$	21.53	Nickel	$8\frac{4}{5}$	8.82
Gold	$19\frac{1}{3}$	19.34	Iron	$7\frac{4}{5}$	7.84
Mercury	$13\frac{3}{5}$	13.59	Tin	$7\frac{1}{3}$	7.29
Palladium	$11\frac{4}{5}$	11.8	Zinc	$7\frac{1}{7}$	7.14
Lead	$11\frac{1}{3}$	11.36	Antimony	$6\frac{2}{3}$	6.71
Silver	$10\frac{1}{2}$	10.53	Aluminum	$2\frac{2}{3}$	2.67
Bismuth	$9\frac{4}{5}$	9.79	Magnesium	$1\frac{3}{4}$	1.74
Copper	9	8.95			

Conducting Power of Metals for Heat.—The sensation of cold when the hand is placed upon a piece of metal of the ordinary temperature of the air shows us that metals are better conductors of heat than non-metallic bodies, for the particles of metal which are warmed by contact with the hand give up the acquired heat to the neighboring particles, and being thus cooled to nearly their former temperature, are able to abstract a fresh supply of heat from the hand; whereas, when the hand is placed upon wood, or other inferior conductors of heat, the particles in contact with it are warmed by the removal of a trifling amount of heat from the hand, and are not soon cooled again by parting with their heat to the particles adjoining. In consequence of the rapidity with which heat applied to one portion of a mass of metal is communicated to the whole of the particles composing it, metals may be suddenly heated or cooled with much less risk of causing them to crack or fly than is the case with non-metallic substances. When an earthenware pipkin or a glass bottle is placed upon the fire, the outside immediately becomes much hotter than the inside, and being expanded by the heat, tears apart the particles of the inside of the vessel and produces a crack, but in the case of a metallic vessel the heat is rapidly transmitted, and all parts of the vessel are expanded almost simultaneously. The much greater rapidity with which water can be heated in metallic vessels is another useful result of the superior conducting power of the metals. In the following table the metals are arranged in the order of their conducting power, the first being the best conductor:—

Table of Conducting Power for Heat

1. Silver.	5 Zinc.	9. Lead.
2. Gold.	6. Iron.	10. Antimony.
3. Copper.	7. Tin.	11. Bismuth.
4. Aluminum,	8. Platinum.	

Conducting Power of Metals for Electricity.—The conducting power of electricity, of metals, refers to the facility with which an electric disturbance excited in portion of a mass of metal is transmitted to the other particles composing the mass. Thus, a very slight electric disturbance at one end of a copper wire is sufficient to produce movement in a telegraph needle at the other extremity, whilst a much greater amount of disturbance, or, in other words, a more powerful current, is required if an iron wire of the same length and thickness be employed. Only one non-metallic substance—carbon, in some of its varieties—at all approaches to the metals in the power of conducting electricity. Those metals which are the best conductors of heat are also the best conductors of electricity, and in both cases the conducting power is seriously impaired by the presence in the metal even of small quantities of other metals, or of non-metallic bodies, as well as by an increase of temperature in the metal. When heated to the boiling point of water, the metals have only about three-fourths of the conducting power which they exhibit at the freezing point. The following table shows the relative conducting power of the most important metals in a pure state at 32° F., the conducting power of silver, which is higher than that of any other metals, being taken as 1000:—

Table of Conducting Power for Electricity.

Silver = 1000

Copper	999	Nickel	131
Gold	779	Tin	123
Zinc	290	Lead	83
Palladium	184	Antimony	46
Platinum	180		
Iron	168	Bismuth	12

Fusibility.—Although the property of becoming liquid at high temperatures is not confined to the metals, it must be mentioned among the properties which conduce to their utility, for it enables the founder to produce a large number of objects of a given pattern with little expenditure of time and labor, and offers to the worker in metals a ready method of soldering together, in a durable manner, the separate pieces of his work. Tin and lead, being the most fusible of ordinary metals, are the constituents of solder, whilst iron (wrought iron), as the least fusible of the common metals, is used for firebars, melting-pots and similar purposes.

Table of Fusibility.

Tin	melts at	442° F.	Silver	melts at	1800° F.
Cadmium	"	442	Copper	"	1990
Bismuth	"	507	Gold	"	2000
Lead	"	617	Cast Iron		2780
Zinc	"	773	Steel	"	4000
Antimony	"	1150	Wrought Iron	"	above 4000 *

Platinum melts only in the oxy-hydrogen blowpipe flame.

In practical work the temperature is commonly inferred from the appearance of the fire; thus, the red heat of an ordinary domestic fire is roughly valued at 1000° F., so that tin, lead, and zinc can be very easily melted in a crucible or ladle placed in such a fire; but aluminum, silver, copper, and gold, require a bright red (cherry red) or furnace heat to melt them: cast iron requires a very bright red heat, only attainable in a furnace with a very good draft; and for melting steel, a furnace of special construction (wind furnace) is employed. Wrought iron can be fused only at a white heat, producible by a blast of air in a forge, and platinum melts at a greenish white heat in the flame of hydrogen supplied with pure oxygen. The production of a temperature adequate to the fusion of steel and wrought iron in large quantities has been much facilitated by the introduction of Siemens' regenerative furnace, in which the waste heat of the fire, instead of escaping up the chimney into the air, is accumulated into masses of fire-brick, and restored again to the furnace.

Compiled from "Metals, their properties and treatment, by C. L. Bloxam."

TABLES OF REFERENCE FOR THE MINER, ENGINEER, AND MINE-OWNER.

HEREWITH we introduce a number of tables, collated facts, dimensions, gauges, standard measurements, and other tabulated data, that doubtless will often be of service to our reader.

* Estimates of temperature above the fusing point of zinc cannot be regarded as exact, on account of the difficulty of ascertaining them.

CHRONOLOGICAL ERAS AND CYCLES FOR 1882.

The year 1882, *or the* 107*th year of the Independence of the United States of America, corresponds to*

The year 7390-91 of the Byzantine Era;
" 6595 of the Julian Period;
" 5642-43 of the Jewish Era;
" 2658 of the Olympiads, or the second year of the 665th Olympiad, commencing in July, 1881, the era of the Olympiads being placed at 775.5 years before Christ, or near the beginning of July of the 3938th year of the Julian Period;
" 2635 since the foundation of Rome, according to Varro;
" 2194 of the Grecian Era, or the Era of Seleucidæ;
" 1601 of the Era of Diocletian.

The year 1299 of the Mohammedan Era, or the Era of the Hegira, begins on the 7th of February, 1882.

The first day of January of the year 1882 was the 2,408,447th day since the commencement of the Julian Period.

Dominical Letter	A	Lunar Cycle or Golden Number . .	2
Epact	11	Solar Cycle	15

Chronology.

B. C.

4004. Creation of the World (according to Julius Africanus. Sept. 1st, 5508; Samaritan Pentateuch, 4700; Septuagint 5872; Josephus, 4658; Hales, 5411).
2348. Deluge (according to Hales, 3154).
2203. Chinese Monarchy.
2090. First Egyptian Pyramid.
1180. Troy destroyed.
1111. Mariner's Compass discovered.
753. Foundation of Rome.
676. Money coined at Rome.
605. Geometry, Maps, etc., first introduced.
289. First Sun-dial.
219. Hannibal crossed the Alps.
219. Land Surveying first introduced.
155. Time first measured by water.
51. Cæsar invaded Britain.

A. D.

214. Grist Mills introduced.
667. Glass discovered.
991. Arabic Minerals introduced.
1066. Battle of Hastings.
1180. Mariner's Compass introduced in Europe.
1383. Cannon introduced.
1492. America discovered.
1627. Barometer and Thermometer invented.
1752. New Style, introduced into Britain; Sept. 3 reckoned Sept. 14.
1769. James Watt—First design and patent of a steam-engine having a separate vessel of condensation.
1789. French Revolution.

A. D.

1772. Oliver Evans—Designed the non-condensing engine, 1792. Applied for a patent for it 1801. Constructed and operated it.
1790. Water lines first introduced in the models of vessels in the U. S., by Orlando Merrill, of Newburyport, Mass.
1797. John Fitch—Propelled a yawl boat by the application of steam to side wheels, and also to a screw propellor, upon the Collect pond, New York.
1807. Robert Fulton—First passenger Steam-boat.
1827. First Rail Road in the U. S., from Quincy to Neponset, Mass.

UNITED STATES MEASURES AND WEIGHTS.

According to Act of 1866.

Measures of Length.

Denominations and Values.		*Equivalents in use.*
Myriameter	10 000 meters.	6.2137 *miles.*
Kilometer	1 000 meters.	.62137 *mile*, or 3280 *feet* and 10 *ins.*
Hectometer . . .	100 meters.	328 *feet* and 1 *inch.*
Dekameter	10 meters.	393.7 *inches.*
Meter	1 meter.	39.37 *inches.*
Decimeter	$\frac{1}{10}$th of a meter.	3.937 *inches.*
Centimeter	$\frac{1}{100}$th of a meter.	.3937 *inch.*
Millimeter	$\frac{1}{1000}$th of a meter.	.0394 *inch.*

Measures of Surface.

Denominations and Values.		*Equivalents in use.*
Hectare.	10 000 square meters.	2.471 *acres.*
Are.	100 square meters.	119.6 *square yards.*
Centare	1 square meter.	1550 *square inches.*

Measures of Volume.

Denominations and Values.			*Equivalents in use.*	
Names.	No. of Liters.	Cubic Measure.	Dry Measure.	Liquid or Wine Measure.
Kiloliter or Stere	1000	1 cubic meter	1.308 *cubic yards.*	264.17 *gallons.*
Hectoliter .	100	$\frac{1}{10}$ cubic meter	2 *bush* and 3.35 *pecks.*	26.417 *gallons.*
Dekaliter. .	10	10 cubic decimeters	9.08 *quarts.*	2.6417 *gallons.*
Liter. . . .	1	1 cubic decimeter	.908 *quart.*	1.0567 *quarts.*
Deciliter . .	$\frac{1}{10}$	$\frac{1}{10}$ cubic decimeters	6.1022 *cubic inches.*	.845 *gill.*
Centiliter .	$\frac{1}{100}$	10 cub. centimeter	.6102 *cubic inch.*	.338 *fluid oz.*
Milliliter .	$\frac{1}{1000}$	1 cub. centimeter	.061 *cubic inch.*	.27 *fluid drm.*

Weights.

Denominations and Values.			*Equivalents in use.*
Names.	Number of Grams	Weight of Volume of Water at its Maximum Density	Avoirdupois Weight.
Millier or Tonneau.	1 000 000	1 cubic meter.	2204.6 *pounds.*
Quintal.	100 000	1 hectoliter.	220.46 *pounds.*
Myriagram	10 000	10 liters.	22.046 *pounds.*
Kilogram or Kilo .	1 000	1 liter.	2.2046 *pounds.*
Hectogram	100	1 deciliter.	3.5274 *ounces.*
Dekagram	10	10 cubic centimeters.	.3527 *ounce.*
Gram.	1	1 cubic centimeter.	15.432 *grains.*
Decigram.	$\frac{1}{10}$	$\frac{1}{10}$th of a cubic centimeter.	1.5432 *grains.*
Centigram	$\frac{1}{100}$	10 cubic millimeters.	.1543 *grain.*
Milligram	$\frac{1}{1000}$	1 cubic millimeter.	.0154 *grain.*

For Measuring Surfaces the square Deckametre is used under the term of ARE; the Hectare, or 100 ares, is equal to about 2 acres.

The Unit of Capacity is the cubic Decimetre or LITRE, and the series of measures is formed in the same way as in the table of lengths.

The cubic Metre is the unit of measure for solid bodies, and is termed STERE.

The Unit of Weight is the GRAMME, which is the weight of one cubic centimetre of pure water weighed in a vacum at the temperature of 4° Centigrade, or 39°.2 Fahrenheit, which is about its temperature of maximum density.

In practice, the term cubic Centimetre, abbreviated C. C., is used instead of Millilitre, and cubic Metre instead of Kilolitre.

EQUIVALENTS OF OLD AND NEW U. S. MEASURES.

Length.

	Meters.
1 Inch =	.02540005
1 Foot =	.3048006
1 Yard =	.9144018
1 Chain =	20.1168396
1 Furlong =	201.168396
1 Mile =	1609.347168

Surface.

	Square Meters.
1 Inch =	.000645161
1 Foot =	.092903184
1 Yard =	.836128658
1 Rod =	25.292891844
1 Rood =	1011.71567376
1 Acre =	4046.86269504

Volume.

	Liters.
1 Fluid Drachm =	.0036967
1 Fluid Ounce =	.0295739
1 Fluid Pound =	.35488656
1 Gill =	.1182955
1 Wine Pint =	.4731821
1 Dry Quart =	1.1012344
1 Wine Quart =	.9463642
1 Wine Gallon =	3.7854579

Weight.

	Grams.
1 Grain =	.0648004
1 Scruple =	1.296008
1 Dwt. =	1.5552096
1 Drachm =	3.888024
1 Ounce (Troy) =	31.104192
1 Ounce =	28.350175
1 Pound =	453.6028
1 Ton =	1016070.272

NOTE.—A square Meter is 1549.9969 square inches, but by Act of Congress it is declared to be 1550 square inches; hence the Liter (cubic decimeter)=61.02377-953 cubic inches. In the Act of Congress, a Liter is declared to be 61.022 cubic inches, which is erroneous, as here shown, by the .001+ of an inch.

According to Previous and Existing Laws.

MEASURES OF LENGTH.

The Standard of measure is a brass rod, which at the temperature of 32°, is the standard yard.

Lineal.

		Inches.	*Feet.*	*Yards.*	*Rods.*	*Furl.*
12 inches	= 1 foot.					
3 feet	= 1 yard.	36=	3.			
5.5 yards	= 1 rod.	198=	16.5=	5.5.		
40 rods	= 1 furlong.	7920=	660 =	220 =	40.	
8 furlongs	= 1 mile.	63360=	5280 =	1760 =	320=	8.

The inch is sometimes divided into 3 *barley corns*, or 12 *lines.*

A hair's breadth is the .02083 (48th part of an inch.)

1 yard is . . . . .000568 of a mile.
1 inch is . . . . .0000158 of a mile.

Gunter's Chain.

7.92 inches=1 link.
100 links =1 chain, 4 rods, or 22 yards.
80 chains =1 mile.

Ropes and Cables.

6 feet=1 fathom. | 120 fathoms=1 cable's length.

Geographical and Nautical.

1 degree of a great circle of the earth= 69.77 Statute miles.
1 mile =2046.58 yards.

MEASURE OF TIME.

	″	′	°
60 seconds = 1 minute			
60 minutes= 1 degree.	3600=	60.	
360 degrees = 1 circle.	1296000=	21600=	360

Sidereal day=23 h., 56 m., 4.092 sec., in solar or mean time.
Solar day, mean=24 h., 3 m., 56.555 sec.. in sidereal time.
Sidereal year, or revolution of the earth, 365.25635 solar days.
Solar, Equinoctial, or Calendar year, 365.24224 solar days.
1 day=.002739 of a year. | 1 minute=.000694 of a day.
30°=1 sign.

MEASURES OF SURFACE.

144 square inches =1 square foot.
9 square feet =1 square yard.
100 square feet =1 square (*Architect's Measure*).

Land.

		Yards.	*Rods.*	*Roods.*
30.25 square yards	= 1 square rod.	1210		
40 square rods	= 1 square rood.			
4 square roods / 10 square chains	= 1 acre.	4840 =	160.	
640 acres	= 1 square mile.	3097600 =	102400 =	2560.

208.710326 feet, 60.570109 yards, or 220 by 198 feet square=1 acre.

Paper.

24 sheets=1 quire. | 20 quires=1 ream.

Drawing Paper.

Cap	13 ×16 inches.	Columbia	23× 33.75 inches.
Demy	15.5 ×18.5 "	Atlas	26× 33 "
Medium	18 ×22 "	Theorem	28× 34 "
Royal	19 ×24 "	Double Elephant . .	26× 40 "
Super-Royal	19 ×27 "	Antiquarian . .	31× 52 "
Imperial	21.25×29 "	Emperor	40× 60 "
Elephant	22.25×27.75 "	Uncle Sam	48×120 "

Peerless . . . . 18×52 inches.

Tracing Paper.

Double Crown	20×30 inches.	Grand Royal	18×24 inches.
Double D. Crown . . .	30×40 "	Grand Aigle	27×40 "
Double D. D. Crown . .	40×60 "	Vellum Writing .	18 to 28 inches wide.

Miscellaneous.

1 sheet = 4 pages.	1 duodecimo =24 pages.
1 quarto = 8 "	1 eighteenmo =36 "
1 octavo =16 "	1 bundle =2 reams.

Roll of Parchment=60 sheets.

Dimensions of Drawings for Patents.

United States, 8.5×12 inches.

MEASURES OF VOLUME.

The Standard gallon measures 231 cubic inches, and contains 8.3388822 avoirdupois pounds, or 58373 troy grains of distilled water, at the temperature of its maximum density 39°.83, the barometer at 30 inches. The Standard bushel is the *Winchester*, which contains 2150.42 cubic inches, or 77.627413 lbs. avoirdupois of distilled water at its maximum density. Its dimensions are 18.5 inches diameter inside, 19.5 inches outside, and 8 inches deep; and when heaped, the cone must not be less than 6 inches high, equal 2747.715 cubic inches for a true cone.

Liquid.

		Gills. Pints.
4 gills	=1 pint.	8.
2 pints	=1 quart.	32 = 8.
4 quarts	=1 gallon.	

Dry.

		Pints. Quarts. Gallons.
2 pints	=1 quart.	8.
4 quarts	=1 gallon.	16 = 8.
2 gallons	=1 peck.	64 = 32 = 6.
4 pecks	=1 bushel.	

Cubic.

		Inches.
1728 cubic inches	=1 foot.	46656.
27 cubic feet	=1 yard.	

NOTE.—A cubic foot contains 2200 cylindrical inches, 3300 spherical inches, or 6600 conical inches.

Fluid.

		Minims. Drachms. Ounces.
60 minims	=1 drachm.	480.
6 drachms	=1 ounce.	7680 = 128.
16 ounces	=1 pint.	61240 = 1024 = 128.
8 pints	=1 gallon.	

Miscellaneous.

1 cubic foot . . . . 7.4805 gallons.
1 bushel . . . . 9.30918 gallons.
1 chaldron=36 bushels, or . . . . . 57.244 cubic feet.
1 cord of wood . . . . 128 cubic feet.
1 perch of stone . . . . 24.75 cubic feet.

1 quarter =8 bushels.	1 load hay or straw=36 trusses.
1 sack flour=5 bushels.	1 M quills =1200 quills.

MEASURES OF WEIGHT.

The Standard avoirdupois pound is the weight of 27.7015 cubic inches of distilled water weighed in air, at 39°.83, the barometer at 30 inches.

A cubic inch of such water weighs 252.6937 grains.

Avoirdupois.

		Drachms. Ounces. Pounds.
16 drachms	=1 ounce.	256.
16 ounces	=1 pound.	28672 = 1792.
112 pounds	=1 cwt.	573440 = 35840 = 2240.
20 cwt.	=1 ton.	

1 pound=14 oz. 11 dwts. 16 grs. troy, or 7000 grains.
1 ounce=18 dwts 5.5 grains troy, or 437.5 grains.

Troy.

		Grains. Dwt.
24 grains	=1 dwt.	480.
20 dwt.	=1 ounce.	5760 = 240.
12 ounces	=1 pound.	

7000 troy grains = 1 lb. avoirdupois.
437.5 troy grains = 1 oz. "
175 troy pounds =144 lbs. "
175 troy ounces =192 oz. "
1 troy pound = .822857 lb.
1 avoirdupois pound= 1.215278 lbs. troy.

Apothecaries.

		Grains. Scruples. Drachms.
20 grains	=1 scruple	60.
3 scruples	=1 drachm.	480 = 24.
8 drachms	=1 ounce.	5760 = 288 = 96.
12 ounces	=1 pound.	

45 drops =1 tea spoonful or a fluid drachm.
2 table spoonful=1 ounce.
The pound, ounce, and grain are the same as in Troy Weight.

Miscellaneous.

Coal and Wood per cubic feet.

	lbs.		*lbs.*
Anthracite, ordinary	50 to 55	Charcoal, hard-wood	18.5
Bituminous, ordinary . . .	45 to 55	Charcoal, pine-wood	18
Cumberland	53	Pine, Virginia	21
Cannel	50.3	Pine, Southern	25.5
1 ton Welsh coal .	=43 cubic feet.	1 ton Newcastle coal .	=45 cubic feet.

1 ton Scotch Coal . . . =43 cubic feet.

Lead.

1 fodder=8 pigs. Roll sheet lead=6.5 to 7.5 feet in width and from 30 to 35 feet in length.

MEASURES OF VALUE.

10 mills=1 cent.	10 dimes =1 dollar.
10 cents=1 dime.	10 dollars=1 eagle.

Standard of gold and silver 900 parts of pure metal and 100 of alloy in 1000 parts of coin.

Fineness expresses quantity of pure metal in 1000 parts.

Remedy of the Mint is allowance for deviation from exact standard fineness and weight of coins.

Nickel cent (old) contained 88 parts of copper and 12 of nickel.

The bronze cent contains 95 parts of copper and 5 of tin and zinc.

Pure gold, 23.22 grains=$1.00. Hence the value of an ounce is $20 67.183+.

Standard gold, $18 60.465+ per ounce.

GEOGRAPHICAL MEASURES AND DISTANCES.

To Reduce Longitude into Time.

RULE.—Multiply the degrees, minutes, and seconds by 4, and the product is the time.

To Reduce Time into Longitude.

RULE.—Reduce the hours to minutes and seconds, divide by 4, and the quotient is the longitude.

Or, multiply them by 15.

Table of Departures for a Distance run of 1 Mile.

Course.	*Departure.*	*Course.*	*Departure.*	*Course.*	*Departure.*
3.5 points.	.773	4.5 points.	.634	5.5 points.	.471
4. "	.707	5. "	.556	6. "	.383

Thus if a vessel holds a course of 4 points, that is, without leeway, for the distance of 1 mile, she will make .707 of a mile to windward.

Or, a vessel sailing E. N. E. upon a course of six points for 10 miles, will make 38 3 miles (100×383) longitude.

Table showing the Degrees, Minutes, and Seconds of each Point on the Mariner's Compass with the Meridian.

North.	South.	Points.	° ′ ″	Sin. A.*	Cos. A.*	Tan. A.*
		.25	2 48 45	.0489	.9988	.0491
N	S.	.5	5 37 30	.098	.9952	.0985
		.75	8 26 15	.1467	.9891	.1484
		1.	11 15	.195	.9808	.1989
N. by E . .	S. E. by E. .	1.25	14 3 45	.2429	.97	.2504
N. by W . .	S. by W. . .	1.5	16 52 30	.2903	.9569	.3034
		1.75	19 41 15	.3368	.9415	.3578
		2.	22 30	.3827	.9239	.4142
N. N. E. . .	S. S. E. . .	2.25	25 18 45	.4275	.90	.4729
N. N. W. . .	S. S. W. . .	2.5	28 7 30	.4714	.8819	.5345
		2.75	30 56 15	.5141	.8577	.5994
		3.	33 45	.5556	.8315	.6682
N. E. by N. .	S. E. by S. .	3.25	36 33 45	-5957	.8032	.7416
N. W. by N.	S. W. by S. .	3.5	39 22 30	.6344	.773	.8207
		3.75	42 11 15	.6715	.7409	.9063
		4.	45	.7071	.7071	1.
N. E. . .	S. E.	4.25	47 48 45	.7404	.6715	1.103
N. W.	S. W. . . .	4.5	50 37 30	.773	.6344	1 218
		4.75	53 26 15	.8032	.5957	1.348
		5.	56 15	.8315	.5556	1.497
N. E. by E.	S. E. by E. .	5.25	59 3 45	.8577	.5141	1.668
N. W. by W.	S. W. by W.	5.5	61 52 30	.8819	.4714	1.871
		5.75	64 41 15	.904	.4275	2.114
		6.	67 30	.9239	.3827	2.414
E. N. E. . .	E. S. E. . .	6.25	70 18 45	.9415	.3368	2.795
W. N. W. .	W. S. W. . .	6.5	73 7 30	.9569	.2903	3.296
		6.75	75 56 15	.97	.2429	3.941
		7.	78 45	.9808	.195	5.027
E. by N. . .	E. by S. . .	7.25	81 33 45	.9891	.1467	6.741
W. by N. .	W. by S. . .	7.5	84 22 30	.9952	.098	10.153
		7.75	87 11 15	.9988	.0489	20.556
East or West	East or West	8.	90	1.	.0000	8.

* A, representing course of points from the meridian.

Table of the Visible Distance of Objects in Statute Miles.

Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.
*.582	1.	11	4.36	30	7.18	150	16.05
1	1.31	12	4.54	35	7.78	200	18.54
2	1.85	13	4.71	40	8.3	300	22.7
3	2.27	14	4.9	45	8.8	400	26 2
4	2.62	15	5.07	50	9.37	500	29.3
5	2.93	16	5.24	55	9.72	1000	41.45
6	3.21	17	5.4	60	10.14	2000	58.61
7	3.47	18	5.56	70	10.97	3000	71.79
8	3.7	19	5.72	80	11.72	4000	82.9
9	3.93	20	5.86	90	12.43	5000	92.68
10	4.15	25	6.55	100	13.1	1 mile.	95.23

* For a Statute mile the curvature=6.99 inches.

The difference in two levels is as the square of their distance. The difference in two distances is as the square root of their heights.

Table of the Visible Distance of Objects in Geographical or Nautical Miles.

Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.	Height in Feet.	Distance in Miles.
* .663	1.	11	4.08	30	6.74	150	15.07
1.	1.23	12	4.28	35	7.28	200	17.4
2.	1.74	13	4.43	40	7.78	300	21.32
3.	2.13	14	4.6	45	8.25	400	24.64
4.	2.46	15	4.77	50	8.7	500	27.52
5.	2.75	16	4.92	55	9.13	1000	38.92
6.	3.01	17	5.07	60	9.53	2000	55.04
7.	3.25	18	5.22	70	10.29	3000	67.41
8.	3.48	19	5.36	80	11.01	4000	77.84
9.	3.69	20	5.5	90	11.68	5000	87.03
10.	3.89	25	6.15	100	12.31	1 mile.	89.43

* For a Geographical or Nautical mile, the curvature=7.962 inches.

Measurement of Heights with a Sextant.

Multiplier	Angle.	Multiplier	Angle.	Multiplier	Angle.	Multiplier	Angle.
	° ′		° ′		° ′		° ′
1.	45 0	3.	71 34	5.	78 41	8.	82 52
1.6	56 18	3.5	74 4	5.6	79 42	9.	83 40
2.	63 26	4.	75 58	6.	80 32	10.	84 17
2.5	68 11	4.5	77 29	7.	81 52		

OPERATION.—Set sextant to any angle in table, and height will equal distance multiplied by number opposite to it.

Reduction of Base Line to Level of Sea.

$\frac{l\,h}{20\,890\,000}$ —l= L. *l representing length of line, and h height of base line above level of sea, both in feet;* C *correction to be subtracted from l, and* L *reduced line in feet.*

Elements of Figure of the Earth.

(*Capt. A. K. Clarke*, 1866.)

	Feet.	Miles.
Major semi-axis of equator (longitude 15° 34′ E.)	20 926 350	3 963. 324
Minor " " " (" 105° 34′ E.)	20 919 972	3 962. 115
Polar "	20 853 429	3 949. 513
Equatorial semi-axis	20 926 062	3 963. 269
Circumference, mean		24 898. 562
Diameter, mean		7 925. 440

MISCELLANEOUS NOTES.

Natural Power.

Sun.—Power or work performed by Sun's evaporation is estimated at 90 000-000 000 horse-power.

Niagara.—Volume of water discharged over the Falls is estimated at 33 000 000 tons per hour; the fall of Niagara River from Lake Erie at Buffalo to face of Falls 65 feet, to foot of Falls 230, to Lake Ontario 330.

Heat of the Sun.

Sir Isaac Newton	3 138 740°	Soret	10 443 323°
Capt. John Ericsson	4 909 860°	Waterston	16 000 000°

Sundry others ranging from 2520° to 183 600°.

Frigorific Mixture.

Lowest temperature yet produced. Faraday obtained —160° by evaporation of a mixture of solid carbonic acid and sulphuric ether.

Light.

Light.—Sun's rays have a velocity of 185 000 miles per second, equal to 7.5 times around the earth.

Mirage.

A mirage is that condition of the atmosphere when air near to surface of earth becomes so highly heated, as upon a sandy plain, that its density within a defined distance from it increases upward. A ray directed obliquely downwards will be rendered by refraction more and more nearly horizontal, gradually increasing as it advances, until its direction is so great as to produce a total reflection; and the reflected ray then, by successive refractions, is gradually elevated until it meets the eye of an observer.

Looming is inverted mirage, frequently seen over calm water, and is the effect of lower or surface stratum of air being colder than that above it.

Colors for Drawing.

MATERIAL.	COLOR.	MATERIAL.	COLOR.
Brass	Gamboge	Granite	Indian ink, light.
Brick	Carmine.	Lead	Indian ink and Prussian blue.
Cast Iron	Neutral tint.	Steel	Light blue and lake.
Clay	Burned umber.	Water	Cobalt or verdigris
Earth	Burned umber, light.	Woods	Bur'd sienna, deep and light for dark and light wood
Concrete	Sepia with dark spots		
Copper	Lake and burned sienna	Wro't Iron	Prussian blue, light.

Tenacity of Iron Bolts in Wood.

Diameter 1.25 ins. and 12 ins. in length: required for Hemlock 8 tons and for Pine 6 tons to withdraw them.

Retaining Walls of Iron Piles.

Piles.—7 feet from centres, 18 ins. in width, and 2 ins. in thickness, strengthened with 2 *ribs* 8 ins. in depth

Plates.—7 feet in length by 5 feet in width and 1 in. in thickness, with 1 diagonal feather 1 by 6 ins.

Tie-rods 2 ins. in diameter.

Interception of Light by Glass.

Polished plate .25 in. thick, 13 per cent.; rough cast, 30; polished plate, rolled, 4 flutes per inch, 63; and sheet glass, 32 or 22.

Adhesion of Glue.

From 500 to 700 lbs. per sq. inch on wood.

Cost of Dredging

Actual cost if on an extended work, inclusive of delivery of dredging into or on a vessel at side of dredger. (*Trautwine*).

Labor at $1 per day and Repairs of Plant included.

Depth in Feet.	Cents per Cub. Yard	Depth in Feet.	Cents per Cub Yard	Depth in Feet.	Cents per Cub. Yard	Depth in Feet.	Cents per Cub. Yard.
10	6	20	8	25	10	35	18
15	7	22	9	30	13	40	25

Discharge of Scows or Camels.—Towing .25 mile 4 cents per cube yard, .5 mile 6 cents, .75 mile 8 cents, and 1 mile 10 cents.

Tide Table for the Coast of the United States.

Showing Time of High-water at the Full and Change of the Moon, termed the Establishment of the Port, being the Mean Interval between Time of Moon's Transit and Time of High-water. [By Prof. A. D. BACHE, U. S. Coast Survey.

Places and Time.		Rise and Fall. Spring.	Neap.
COAST FROM PORTLAND TO NEW YORK.	h. m.	Feet.	Feet
Portland . . . . Me.	11 25	9.9	7.6
Portsmouth . . N. H.	11 23	9.9	7.2
Newburyport . Mass.	11 22	9.1	6.6
Salem . . . . "	11 13	10.6	7.3
Boston Light . "	11 12	10.9	8.1
Boston.† . . . "	11 27	10.3	8 5
Nantucket . . "	12 24	3.6	2 6
Edgartown . . "	12 16	2.5	1.6
Holmes's Hole. "	11 43	1.8	1 3
Tarpaulin Cove "	8 4	2.8	1.8
Wood's Hole, n. side.	7 59	4.7	3 1
Wood's Hole, s. side.	8 34	2.0	1.2
Bird Isl. Light, Mass	7 69	6.3	3.5
New Bedford Entrance (Dumpling Rock) . .	7 57	4.6	2.8
Newport. . . . R. I.	7 45	4.6	3.1
Point Judith . "	7 32	3.7	2.6
Montauk Point N. Y.	8 20	2.4	1.8
Sandy Hook . . N. J.	7 29	6.6	4 0
New York‡ . . N. Y.	8 13	6.4	3.4
LONG ISLAND SOUND.			
Watch Hill . . R. I.	9 9	3.1	2 4
Stonington . . . Ct.	9 7	3.2	2.2
Little Gull Isl. N. Y.	9 38	2 9	2.3
New London . . . Ct.	9 28	3.1	2.1
New Haven . . . "	11 16	6.2	5.2
Bridgeport . . . "	11 11	8.0	4.7
Oyster Bay . . N. Y.	11 7	9.2	5.4
Sand's Point . . "	11 13	8.9	6.4
New Rochelle . "	11 22	8.6	6.6
Throg's Neck . "	11 20	9.2	6.1
COAST OF NEW JERSEY			
Cold Spg. Inlet, N. J.	7 32	5.4	3 6
Cape May Landing "	8 19	6.0	4.3
DELAWARE BAY AND RIVER			
Delaware Br'kwater.	8 0	4.5	3 0
Higbee's (Cape May)	8 33	6 2	3.9
Egg Isl'd Light, N. J.	9 4	7.0	6.1
Mahon's River . Del.	9 52	6 9	6.0
Newcastle "	11 53	6.9	6.6
Philadelphia . . Pa.	13 44	6.8	5.1

Places and Time.		Rise and Fall. Spring.	Neap.
CHESAPEAKE BAY AND RIVERS	h. m.	Feet.	Feet.
Old Pt. Comfort§. Va.	8 17	3.0	2.0
Point Lookout . Md.	12 58	1.9	0.7
Annapolis . . "	17 4	1.0	0.8
Bodkin Light . . "	18 8	1.3	0 8
Baltimore . . . . "	18 59	1.5	0.9
James R. (City Pt) Va	14 37	3.0	2.5
Richmond . "	16 58	3.4	2.3
COASTS OF N. AND S. CAROLINA, GEORGIA AND FLORIDA.			
Hatteras Inlet . N. C.	7 4	2.2	1.8
Beaufort . . . "	7 26	3 3	2.2
Smithv. (C. Fear) "	7 19	5.5	3.8
Charleston, (C. H. Wharf)‖ . . S C.	7 26	6 0	4.1
Fort Pulaski . . Ga.	7 20	8.0	5.9
Savannah (Dry Dock Wharf) Ga	8 13	7.6	5.5
St Augustine . . Fla.	8 21	4.9	3 6
Cape Florida . . "	8 84	1 8	1.2
Sand Key . "	8 40	2.0	0.6
Key West . . . "	9 22	1.6	1.0
Tampa Bay . . "	11 21	1.8	1.0
Cedar Keys (Dépôt Keys) . . . Fla	13 15	3.2	1.8
WESTERN COAST.			
San Diego . . . Cal.	9 38	5.0	2.3
San Pedro . . . "	9 39	4 7	2.2
Cuyler's Harbor . "	9 25	5.1	2 8
San Luis Obispo . "	10 8	4.8	2 4
Monterey . . . "	10 22	4.3	2.5
South Farallone "	10 37	4.4	2.8
San Francisco . . "	12 0	4.3	2.8
Mare Island (San Francisco Bay) .	13 40	5.2	4.1
Benicia . . . . . Cal	11 10	5.1	3.7
Ravenswood . . "	12 36	7 3	4 9
Bodega . . . . . "	11 17	4.7	2.7
Humboldt Bay . "	12 2	6.5	3.5
Astoria . . . . , Or.	12 42	7.4	4.6
Neeah Harb'r. Wash	12 23	7.4	4.8
Port Townshend "	3 49	6.5	4 0
Semi ah-moo Bay "	4 50	6.6	4.8

NOTE.—The mean interval has been increased 12 hours 26 minutes (half a mean lunar day) for some of the ports in Delaware River and Chesapeake Bay, so as to give the succession of times from the mouth, hence 12 hours 26 minutes is to be subtracted from the establishments which are greater than that time, in order to give the interval required.

Bench Marks referred to in preceding Table.

† BOSTON.—The top of the wall or quay, at the entrance to the dry-dock in the Charlestown navy-yard, 14.76 feet above mean low-water.

‡ NEW YORK.—The lower edge of a straight line, cut in a stone wall, at the head of the wooden wharf on Governor's Island, 14.56 feet above mean low-water.

§ OLD POINT COMFORT, VA.—A line cut in the wall of the light-house, one foot from the ground, on the southwest side, 11 feet above mean low-water.

‖ CHARLESTON, S C.—The outer and lower edge of embrasure of gun No. 3, at Castle Pinckney, 10.13 feet above mean low-water.

Establishment of the Port for several Places not included in the preceding Table.

Place.	Time	Rise and Fall.	Place.	Time	Rise and Fall.
	H. M.	Ft.		H. M.	Ft.
Albany . . . . . . N. Y.	3 30	1	Cape Henry . . . . . Va.	7 51	6
Amboy . . . . . . N. J.	8 15	5	Eastport . . . . . . Me.	11 30	15
Bay of Fundy . . . . N. S	12	60	Egg Harbor . . . . . N. J.	9 34	6
Blue Hill Bay	11	12	Halifax . . . . N. S.	7 30	9
Campo Bello . . . . . Me	11	25	Hell Gate . . . . . . N. Y	9 35	6
Cape Ann . . . . . . "	11 30	11	Kingston . . . . . . Jam.	2 30	2
Cape Cod . . . . . . Mass.	11 30	6	Providence . . . . . . R. I.	8 25	6
Cape Hatteras . . . N. C.	9 1	6	St. Johns . . . . N. S.	12	30

Rise and Fall of Tides at several Places in the Gulf of Mexico.

Places.	Mean.	Spring.	Neap.	Places.	Mean.	Spring.	Neap.
	Ft.	Ft.	Ft.		Ft	Ft.	Ft.
St. George's Island . Fla.	1.1	1.8	.6	Isle Dernière . . . . La.	1.4	1.2	.7
Pensacola . . . . . . "	1.0	1 5	.4	Entrance to Lake Calcasieu . . . . La.	1.5	1.1	6
Fort Morgan (Mobile Bay) . . . . Ala.	1 0	1.5	.4	Galveston . . . . Texas.	1 1	1.6	.8
Cat Island . . . . Miss.	1.3	1.9	.6	Aransas Pass . . "	1.1	1.8	.6
Southwest Pass . . . La.	1.1	1.4	.5	Brazos Santiago . . "	.9	1.2	5

Earth Digging.

Number of Cubic Feet of Various Earths in a Ton.

Loose Earth 24	Clay 18.6	Clay with Gravel . . 14 4
Coarse Sand 18.6	Earth with Gravel . 17.8	Common Soil . . . 15.7

The volume of Earth and Sand in bank exceeds that in embankment in the following proportions:

Sand . . . . ½ | Clay . . . . ⅓ | Gravel . . . . $\frac{1}{12}$

and the volume of Rock in embankment quarried in large fragments exceeds that in bank fully one half.

MINING AND BLASTING.

MINING.

In ordinary Soil, $\frac{l^3}{10}$ *= charge of powder in pounds, l representing half the depth of the line of least resistance.*

In Masonry, $l^3 \times C$ *= charge in pounds; C representing a coefficient depending upon the structure.*

In a plane Wall, C=.15, in one with counterforts=2, and under a foundation when it is supported upon two sides=.4 to .6.

BLASTING.

In small blasts 1 lb. of powder will loosen about 4½ tons.

In large blasts 1 lb. of powder will loosen about 2¾ tons.

50 or 60 lbs. of powder, inclosed in a resisting bag, hung or propped up against a grate or barrier, will demolish any ordinary construction.

One man can bore, with a bit 1 inch in diameter, from 50 to 100 ins. per day of 10 hours in granite, or 300 to 400 ins. per day in limestone.

Two strikers and a holder can bore with a bit 2 inches in diameter 10 feet in a day in rock of medium hardness.

Rock Blasting.

The proper charge of powder for a blast is determined by dividing the cube of the line of least resistance in feet by 32. Thus, a line of 4 feet will require $4^3 \div 32 = \frac{64}{32} = 2$ *lbs.*; or, for every ton of rock to be removed there is required ½ lb. of powder.

A hole 1 inch in diameter will contain 5 oz. in each foot of its depth.

Comparison of Tonnages under Old and New Laws.

Description of Vessel.	Old Law.	New Law. Flush Deck.	New Law. Houses, etc.	New Law. Total.	Diff. +or— of old Meas't.
	Tons	Tons.	Tons.	Tons.	Per Ct.
Full-built Ship . . 187 ×42 ×20.7 ft.	1353	1518	107	1625	20 +
Clipper . . . . . 220.5×42.5×17.7 "	1768	1280	45	1325	25 —
Half Clipper . . . 213 ×42.5×28 "	1831	1687	100	1787	2½—
P. R. Sea Steamer . . . 337 ×41.3×26.1 "	2803	2554	355	2909	4 +
S. W. " " . . . 280·6×46 ×32.8 "	2818	2419	225	2644	6 —
S. W. River Steamboat . 329.9×35.4×10.4 "	1185	675	590	1265	7 +
S. W. " " . 393 ×51 ×10.2 "	2118	1383	1262	2645	20 +
P. R. Steam-tug . . . . 81.6×17.4× 7.8 "	102	55.4	-	55.4	46 —
Coast'g Schooner . 127 ×31 ×10.6 "	363	256	93	349	4 —
Yacht . . . . . . 72 ×20 × 7.6 "	96	42	3	45	53 —
Fishing Smack . . 36.6×13.6× 3.3 "	12.2	-	-	7.6	40 —
Canal-boat . . . . 94.6×16.6× 8 "	118	109	-	109.	7½—

Weight of Round Rolled Iron.

From $\frac{1}{16}$ Inch to 12 Inches in Diameter.

ONE FOOT IN LENGTH.

Diam.	Weight.	Diameter.	Weight.	Diameter.	Weight.	Diam.	Weight.
Ins.	Lbs.	Ins.	Lbs.	Ins.	Lbs.	Ins.	Lbs.
.$\frac{1}{16}$	.01	.¼	13.44	.⅝	56.788	.½	149.328
.⅛	.041	.⅜	14.975	.¾	59.9	.¾	159.456
.$\frac{3}{16}$	.093	.½	16.588	.⅞	63.094	8.	169.856
.¼	.165	.⅝	18 293	5.	66.35	.¼	180.696
.⅜	.373	.¾	20.076	.⅛	69.731	.½	191.808
.½	.663	⅞	21.944	.¼	73.172	.¾	203.26
.⅝	1.043	3.	23.888	.⅜	76.7	9.	216.04
.¾	1.493	.⅛	25.926	.½	80.304	.¼	227.152
.⅞	2.032	.¼	28.04	.⅝	84.001	.½	239.6
1.	2.654	.⅜	30.24	.¾	87.776	.¾	252.376
.⅛	3.359	.½	32.512	.⅞	91.634	10.	265.4
.¼	4.147	.⅝	34.886	6.	95.552	.¼	278.924
.⅜	5.019	.¾	37.332	.¼	103.704	.½	292.688
.½	5.972	.⅞	39.864	.⅜	107.86	.¾	306.8
.⅝	7.01	4.	42.464	.½	112.16	11.	321.216
.¾	8.128	.⅛	45.174	.⅝	116.484	.¼	336.004
.⅞	9.333	.¼	47.952	.¾	120.96	.½	351.104
2.	10.616	.⅜	50.815	7.	130.048	.¾	366.536
.⅛	11.988	.½	53.76	.¼	139.544	12.	382.208

Weight of Flat Rolled Iron.

From ½×⅛ Inch to 6¾×6 Inches.

ONE FOOT IN LENGTH.

Thickn.	Weight.
Ins.	Lbs.
.½	
.⅛	.211
.¼	.422
.⅜	.634
.⅝	
.⅛	.264
.¼	.528
.⅜	.792
.½	1.056
.¾	
.⅛	.316
.¼	.633
.⅜	.95

Thickn.	Weight.
Ins.	Lbs.
.½	1.265
.⅝	1.584
.⅞	
.⅛	.369
.¼	.783
.⅜	1.108
.½	1.477
.⅝	1.846
.¾	2.217
1.	
.⅛	.422
.¼	.845
.⅜	1.267

Thickn.	Weight.
Ins.	Lbs.
.½	1.69
.⅝	2.112
.¾	2.534
.⅞	2.956
1.⅛	
.⅛	.475
.¼	.95
.⅜	1.425
.½	1.901
.⅝	2.376
.¾	2.85
.⅞	3.326
1.	3.802

Thickn.	Weight.
Ins.	Lbs.
1.¼	
.⅛	.528
.¼	1.050
.⅜	1.584
.½	2.112
1.¼	
.⅝	2.64
.¾	3.168
.⅞	3.696
1.	4.224
1.⅛	4.752
1.⅜	
.⅛	.58

Table—(*Continued.*)

Thickn.	Weight.
Ins.	Lbs.
.¼	1.161
.⅜	1.742
.½	2.352
.⅝	2.904
.¾	3.484
.⅞	4.065
1.	4.646
1.⅛	5.227
1.¼	5.808
1.⅜	6.389
1.½	
.⅛	.633
.¼	1.266
.⅜	1.9
1.½	
.½	2.535
.⅝	3.168
.¾	4.802
.⅞	4.435
1.	6.069
1.⅛	5.703
1.¼	6.337
1.⅜	6.97
1.⅝	
.⅛	.686
.¼	1.372
.⅜	2.059
.½	2.746
.⅝	3.432
.¾	4.119
.⅞	4.805
1.	5.492
1.⅛	6.178
1.¼	6.864
1.⅜	7.551
1.½	8.237
1.¾	
.⅛	.739
.¼	1.479
.⅜	2.218
.½	2.957
.⅝	3.696
.¾	4.435
.⅞	5.178
1.	5.914
1.⅛	6.653
1.¼	7.393
1.⅜	8.132
1.½	8.871
1.⅝	9.61
1.⅞	
.⅛	.792
.¼	1.584
.⅜	2.376
.½	3 168
.⅝	3.96
.¾	4.752
.⅞	5.544
1.	6.336
1.⅛	7.129
1.¼	7.921
1.⅜	8.713
1.½	9.505
1.⅝	10.297
1.¾	11.089
2.	
.⅛	.845
.¼	1.689
.⅜	2.534
.½	3.379
.⅝	4.224
.¾	5.069
.⅞	5.914
1.	6.758
1.⅛	7.604
1.¼	8.448
1.⅜	9.294
1.½	10.138
1.⅝	10.983
1.¾	11.828
1.⅞	12.673
2.⅛	
.⅛	.898
.¼	1.795
.⅜	2.693
.½	3.591
.⅝	4.488
.¾	5.386
.⅞	6.283
2.⅛	
1.	7.181
1.⅛	8.079
1.¼	8.977
1.⅜	9.874
1.½	10.772
1.⅝	11.67
1.¾	12.567
1.⅞	13.465
2.	14.362
2.¼	
.⅛	.95
.¼	1.9
.⅜	2.851
.½	3.802

Thickn.	Weight.
Ins.	Lbs.
.⅝	4.752
.¾	5.703
.⅞	6.653
1.	7.604
1.⅛	8.554
1.¼	9.505
1.⅜	10.455
1.½	11.406
1.⅝	12.356
1.¾	13.307
1.⅞	14.257
2.	15.208
2.⅛	16.158
2.⅜	
.⅛	1.003
.¼	2.006
.⅜	3.009
.½	4.013
.⅝	5.016
.¾	6.019
.⅞	7.022
1.	8.025
1.⅛	9.028
1.¼	10.032
1.⅜	11.035
1.½	12.038
1.⅝	13.042
1.¾	14.045
1.⅞	15.048
2.	16.051
2.⅛	17.054
2.¼	18.057
2.½	
.⅛	1.056
.¼	2.112
.⅜	3.168
.½	4.224
.⅝	5.28
2.½	
.¾	6.336
.⅞	7.392
1.	8.448
1.⅛	9.504
1.¼	10.56
1.⅜	11.616
1.½	12.672
1.⅝	13.728
1.¾	14.784
1.⅞	15.84
2.	16.896
2.⅛	17.952
2.¼	19.008
2.⅜	20.064
2.⅝	
.⅛	1.109
.¼	2.218
.⅜	3.327
.½	4.436
.⅝	6 545
.¾	6.654
.⅞	7.763
1.	8.872
1.⅛	9.981
1.¼	11.09
1.⅜	12.199
1.½	13.398
1.⅝	14.417
1.¾	15.526
1.⅞	16.635
2.	17.744
2.⅛	18.853
2.¼	19.962
2.⅜	21.071
2.½	22.18
2.¾	
.⅛	1.162
.¼	2.323
.⅜	3.485
.½	4.647
.⅝	5.808
.¾	6.97
.⅞	8.132
1.	9.294
1.⅛	10.455
1.¼	11.617
1.⅜	12.779
1.½	13.94
1.⅝	15.102
1.¾	16.264
1.⅞	17.425
2.	18.587
2.⅛	19.749
2.¾	
2.¼	20.91
2.⅜	22.072
2.½	23.234
2.⅝	24.395
2.⅞	
.⅛	1.215
.¼	2.429
.⅜	3.644
.½	4.858
.⅝	0.072
.¾	7.287
.⅞	8.502

Thickn.	Weight.
Ins.	Lbs.
1.	9.716
1.⅛	10.931
1.¼	12.145
1.⅜	13.36
1.½	14.574
1.⅝	15.789
1.¾	17.003
1.⅞	18.218
2.	19.432
2.⅛	20.647
2.¼	21.861
2.⅜	23.076
2.½	24.29
2.⅝	25 505
2.¾	26.719
3.	
.⅛	1.267
.¼	2.535
.⅜	3.802
.½	5.069
.⅝	6.337
.¾	7.604
.⅞	8.871
1.	10.138
1.⅛	11.406
1.¼	12.673
1.⅜	13.94
1.½	15.208
1.⅝	16.475
1.¾	17.742
1.⅞	19.01
2.	20.277
2.¼	22.811
2.½	25.346
2.¾	27.881
3.¼	
.⅛	1.373
.¼	2.746
.⅜	4.119
.½	5.492
3.¼	
.⅝	6.865
.¾	8.237
.⅞	9.61
1.	10.983
1.⅛	12.358
1.¼	13.73
1.⅜	15.102
1.½	16.475
1.⅝	17.848
1.¾	19.221
1.⅞	20.694
2.	21.967
2.¼	24.712
2.½	27.458
2.¾	30.204
3.	32.95
3.½	
.⅛	1.479
.¼	2.957
.⅜	4.436
.½	5.914
.⅝	7.393
.¾	8.871
.⅞	10.35
1.	11.828
1.⅛	13.307
1.¼	14.785
1.⅜	16.264
1.½	17.742
1.⅝	19.221
1.¾	20.699
1.⅞	22.178
2.	23.656
2.¼	26.613
2.½	29.57
2.¾	32.527
3.	39.485
3.¼	38.441
3.¾	
.⅛	1.584
.¼	3.168
.⅜	4.752
.½	6.336
.⅝	7.921
.¾	9.505
.⅞	11.089
1.	12.673
1.⅛	14.257
1.¼	15.841
1.⅜	17.425
1.½	19.009
1.⅝	20.594
3.¾	
1.¾	22.178
1 ⅞	23.762
2.	25.346
2.¼	28.514
2.½	31.682
2.¾	34.851
3.	38.019
3.¼	41.187
3.½	44.355
4.	
.⅛	1.69

Thickn.	Weight.
Ins.	Lbs.
.¼	3.38
.½	6.759
.¾	10.138
1.	13.518
1.¼	16.897
1.½	20.277
1.¾	23.656
2.	27.036
2.¼	30.415
2.½	33.795
2.¾	37.174
3.	40.554
3.¼	43.933
3.½	47.313
3.¾	50.692
4.¼	
.⅛	1.795
.¼	3.591
.½	7.181
.¾	10.772
1.	14.364
1.¼	17.953
1.½	21.544
1.¾	25.135
2.	28.725
2.¼	32.316
2.½	35.907
2.¾	39.497
3.	43.088
3.¼	46.679
3.½	50.269
3.¾	53.86
4.	57.45
4.½	
.¼	3.802
.½	7.604
.¾	11.406
1.	15 208
1.¼	19.01
1.½	22.812
1.¾	26.614
4.½	
2.	30.415
2.¼	34.217
2.½	38.019
2.¾	41.82
3.	45.623
3.¼	49.425
3.½	53.226
3.¾	57.028
4.	60.83
4.¼	64.632
4.¾	
.¼	4.013
.½	8.026
.¾	12.036
1.	16.052
1.¼	20.066
1.½	24.079
1.¾	28.092
2.	32.105
2.¼	36.118
2.½	40.131
2.¾	44.144
3.	48.157
3.¼	52.17
3.½	56.184
8.¾	60.197
4.	64.21
4.¼	68.223
4.½	72.235
5.	
.¼	4.224
.½	8.449
.¾	12.673
1.	16.897
1.¼	21.122
1.½	25.346
1.¾	29.57
2.	33.795
2.¼	38 019
2.½	42.243
2.¾	46.468
3.	50.692
3.¼	54.916
3.½	59.14
3.¾	63.365
4.	67.589
4.¼	71.813
4.½	76 038
4.¾	80.262
5.¼	
.¼	4.438
5.¼	
.½	8.871
.¾	13.307
1.	17.742
1.¼	22·178
1.½	26.613
1.¾	31.049
2.	35.484
2.¼	39.92
2.½	44 355
2.¾	48.791

Table—*Continued.*

Thickn.	Weight.	Thickn.	Weight.	Thickn.	Weight.	Thickn.	Weight.
Ins.	Lbs.	Ins.	Lbs.	Ins.	Lbs.	Ins.	Lbs.
3.	53.226	1.½	27.881	5.¼	97.582	3.¼	63.154
3.¼	57.662	1.¾	32.527	5.¾		3.½	68.012
3.½	62.097	2.	37.174	.½	9.716	5.¾	
3.¾	66.533	2.¼	41.821	.¾	14.574	3.¾	72.87
4.	70.968	2.½	46.468	1.	19.432	4.	77.728
4.¼	75.404	2.¾	51.114	1.¼	24.29	4.¼	82.585
4.½	79.839	3.	55.761	1.½	29.148	5.¾	
4.¾	84.275	3.¼	60.408	1.¾	34.006	4.½	87 443
6.	88.71	3.½	65.055	2.	38.864	4.¾	92.301
5.½		3.¾	69.701	2.¼	43.722	5.	97.159
.¼	4.647	4.	74 348	2.½	48.58	5.¾	
.½	9.294	4.¼	78.995	2.¾	53.437	5.¼	102.017
.¾	13.94	4.½	83.642	5.¾		5.½	106.876
1.	18.587	4.¾	88.288	3.	58.296	6.	116.592
1.¼	23.234	6.	92.935				

Examples.—What is the weight of a bar of iron 5¼ ins. in breadth by ¾ in. in thickness?

In column 7, page 756, find 5.¼; and below it, in column 5.¾; and opposite to that is 13.307, which is 13 lbs. and .307 of a pound.

For parts of a pound and of a foot, operate according to the rule laid down for table, page 756.

Weight and Volume of Cast Iron and Lead Balls.

From 1 to 20 Inches in Diameter.

Diam.	Volume.	Cast Iron.	Lead.	Diam.	Volume.	Cast Iron.	Lead.
Ins.	Cubic In.	Lbs.	Lbs.	Ins.	Cubic In.	Lbs.	Lbs.
1.	.5235	.1365	.2147	8.½	321 555	83.8396	131.883
1.½	1.7671	.4607	.7248	9.	381.7034	99.5103	156.553
2.	4.1887	1.092	1.718	9.½	448.9204	117.0338	184.121
2.½	8.1812	2.1328	3.3554	10.	523.5987	136 5025	214.749
3.	14.1371	3.855	5.7982	11.	696 9098	181.7648	285.832
3.½	22.4492	5.8525	9.2073	12.	904.7784	235.8763	371.096
4.	33.5103	8.7361	13.744	13.	1150.346	299.623	471.806
4.½	47.7129	12.4387	19.569	14.	1436.754	374.5629	589.273
5.	65.4498	17.0628	26 843	15.	1767.145	460.6959	724.781
5.½	87.1137	22.7206	35.729	16.	2144.66	559.1142	879.616
6.	113.0973	29.4845	46.385	17.	2572.44	670.7166	1055.066
6.½	143.7932	37.4528	58.976	18.	3053.627	796.0825	1252 422
7.	179.5943	46.8203	73.659	19.	3591.363	936.2708	1472.97
7.½	220.8932	57.587	90.598	20.	4188.79	1092.02	1717.995
8.	268.0825	69.8892	109.952				

Weight of Cast Iron Pipes of Different Thicknesses.

From 1 Inch to 36 Inches in Diameter.

ONE FOOT IN LENGTH.

Diam.	Thickn.	Weight.	Diam.	Thickn.	Weight.	Diam.	Thickn.	Weight.
Ins.	Ins.	Lbs.	Ins.	Ins.	Lbs.	Ins.	Ins.	Lbs.
1.	.¼	3 06	6.	.¾	49.6	11.½	.½	58.82
	.⅜	5.05		.⅞	58.96		.⅝	74.28
1.¼	.¼	3.67	6.½	.½	34.32		.¾	90.06
	.⅜	6.		.⅝	43.68		.⅞	106.14
1.½	.⅜	6.89		.¾	53.3		1.	122.62
	.½	9.8		.⅞	63.18	12.	.½	61.26
1.¾	.⅜	7.8	7.	.½	36.66		.⅝	77.36
	.½	11.04		.⅝	46.8		.¾	93.7
2.	.⅜	8.74		.¾	56.96		.⅞	110.48
	.½	12.23		.⅞	67.6		1.	127.42
2.¼	.⅜	9.65		1.	78.39	12.½	.½	63.7
	.½	13.48	7.½	.½	39.22		.⅝	80.4
2.½	.⅜	10.57		.⅝	49.92		.¾	97.4
	.½	14.66		.¾	60.48		.⅞	114.72
	.⅝	19.05		.⅞	71.76		1.	132.35
2.¾	.⅜	11.54		1.	83.28	13.	.½	66.14
	.½	15.91	8.	.½	41.64		.⅝	83.48
	.⅝	20.59		.⅝	52.68		.¾	101.08
3.	.⅜	12.28		.¾	64.27		.⅞	118.97
	.½	17.15		.⅞	76.12		1.	137.28
	.⅝	22.15		1.	88.2	13.½	.½	68.364
	.¾	27.56	8.½	.½	44.11		.⅝	86.55
3.¼	.½	18.4		.⅝	56.16		.¾	104.76
	.⅝	23.72		.¾	68.		.⅞	123.3
	.¾	29.64		.⅞	80.5		1.	142.16
3.½	.½	19.66		1.	93.28	14.	.½	71.7
	.⅝	25.27	9.	.½	46.5		.⅝	89.61
	.¾	31.2		.⅝	58.92		.¾	108.46
3.¾	.½	20.9		.¾	71.7		.⅞	127.6
	.⅝	26.83		.⅞	84.7		1.	147.03
	.¾	33.07		1.	97.98	14.½	.½	73.72
4.	.½	22.05	9.½	.½	48.98		.⅝	92.66
	.⅝	28.28		.⅝	62.02		.¾	112.1
	.¾	34.94		.¾	75.32		.⅞	131.86
4.¼	.½	23.35		.⅞	86.98		1.	151.92
	.⅝	29.85		1.	102.9	15.	.½	75.96
	.¾	36.73	10.	.½	51.46		.⅝	95.72
4.½	.½	24.49		.⅝	65.08		.¾	115.78
	.⅝	31.4		.¾	78.99		.⅞	136.15
	.¾	38.58		.⅞	93.24		1.	156.82
4.¾	.½	25.7		1.	108.84	15.½	.½	78.4
	.⅝	32.91	10.½	.½	53.86		.⅝	98.78
	.¾	40.43		.⅝	68.14		.¾	119.48
5.	.½	26.94		.¾	82.68		.⅞	140.4
	.⅝	34.34		.⅞	97.44		1.	161.82
	.¾	42.28		1.	112.68	16.	.½	80.87
5.½	.½	29.4	11.	.½	56.34		.⅝	101.82
	.⅝	37.44		.⅝	71.19		.¾	123.14
	.¾	45.94		.¾	86.4		.⅞	144.76
6.	.½	31.82		.⅞	101.83		1.	166.6
	.⅝	40.56		1.	117.6	16.½	.½	83.3

Table.—(*Continued.*)

Diam.	Thick.	Weight	Diam.	Thickn.	Weight.	Diam.	Thickn	Weight.
Ins.	*Ins.*	*Lbs.*	*Ins.*	*Ins.*	*Lbs.*	*Ins.*	*Ins.*	*Lbs.*
16.½	.⅝	104.82	22.	.⅝	138.6	30.	1.	303.86
	.¾	126.79		.¾	167.24		1.⅛	343.2
	.⅞	149.02		.⅞	196.46	31.	.¾	233.4
	1.	171.6		1.	225.38		.⅞	273.4
17.	.½	85·73	23.	.⅝	144.77		1.	313.68
	.⅝	107.96		.¾	174.62		1.⅛	354.24
	.¾	130.46		.⅞	204.78	32.	.¾	240.76
	.⅞	153.3		1.	235.28		.⅞	281.94
	1.	176.58	24.	.⅝	150.85		1.	323.49
17.½	.½	88.23		.¾	181.92		1.⅛	365.29
	.⅝	111.06		.⅞	213.28	33.	.¾	248.1
	.¾	134.16		1.	245.08		.⅞	290.5
	.⅞	157.59	25.	.⅝	156.97		1.	333.24
	1.	181.33		.¾	189.28		1.⅛	376.26
18.	.⅝	114.1		.⅞	221.94		1.¼	420.77
	.¾	137.84		1.	254.86	34.	.¾	255.45
	.⅞	161.9	26.	.¾	196.62		.⅞	298.88
	1.	186.24		.⅞	230.56		1.	342.88
19.	.⅝	120.24		1.	264 66		1.⅛	387.13
	.¾	145.2	27.	.¾	204.04		1.¼	431.76
	.⅞	170.47		.⅞	239.06	36.	.¾	262.7
	1.	195.92		1.	274.56		.⅞	307.62
20.	.⅝	126.33	28.	.¾	211.32		1.	352.86
	.¾	152.53		.⅞	247.62		1.⅛	398.1
	.⅞	178.02		1.	284.28		1.¼	443.96
	1.	205.8	29.	.¾	218.7	36.	.¾	270.18
21.	.⅝	132.5		.⅞	256.2		.⅞	316.38
	.¾	159.84		1.	294.02		1.	362.86
	.⅞	187.6	30.	.¾	226.2		1.⅛	409.34
	1.	215.52		.⅞	264.79		1.¼	456.46

Note.—These Weights do not include any allowance for spigot and faucet ends.

CAST IRON.

To Compute the weight of a Cast Iron Bar or Rod.

Find the weight of a wrought iron bar or rod of the same dimensions in the preceding tables or by computation, and from the weight deduct the $\frac{2}{27}$th part; or,

As .1000 : .9257 : : the weight of a wrought bar or rod : to the weight required. Thus, what is the weight of a piece of cast iron 4 × 3.¾ × 12 inches?

In table, page 756, the weight of a piece of wrought iron of these dimensions is 50,692 lbs.

Then 1000 : .9257 : : 50,692 : 46.93 *lbs.*

To Compute the Weight of a piece of Cast or Wrought Iron of any Dimension or Form.

By the rules given in Mensuration of Solids (page 759), ascertain the number of cubic inches in the piece, then multiply by the weight of a cubic inch, and the product will give the weight in pounds.

Weights of Wrought Iron, Steel, Copper and Brass Plates.

SOFT ROLLED.

Thickness determined by American Gauge.

No. of Gauge	Thickness of each number.	*PLATES—per square foot.* Wrought Iron.	Steel.	Copper.	Brass.
	Inch.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
0000	.46	18.4575	18.7036	20.838	19.688
000	.40964	16.4368	16.6559	18.5567	17.5326
00	.3648	14.6376	14.8328	16.5254	15.6134
0	.32486	13.0351	13.2088	14.7162	13.904
1	.2893	11.6082	11.7629	13.1053	12.382
2	.25763	10.3374	10.4752	11.6706	11.0266
3	.22942	9.2055	9.3283	10.3927	9.8192
4	.20431	8.1979	8.3073	9.2552	8.7445
5	.18194	7.3004	7.3977	8.2419	7.787
6	.16202	6.5011	6.5878	7.3395	6.9345
7	.14428	5.7892	5.8664	6.5359	6.1752
8	.12849	5.1557	5.2244	5.8206	5.4994
9	.11443	4.5915	4.6527	5.1837	4.8976
10	.10189	4.0884	4.1428	4.6156	4.3609
11	.090742	3.641	3.6896	4.1106	3.8838
12	.080808	3.2424	3.2856	3.6606	3.4586
13	.071961	2.8874	2.9259	3.2598	3.0799
14	.064084	2.5714	2.6057	2.903	2.7428
15	.057068	2.2899	2.3204	2.5852	2.4425
16	.05082	2.0392	2.0664	2.3021	2.1751
17	.045257	1.8159	1.8402	2.0501	1.937
18	.040303	1.6172	1.6387	1.8257	1.725
19	.03589	1.44	1.4593	1.6258	1.5361
20	.031961	1.2824	1.2995	1.4478	1.3679
21	.028462	1.142	1.1573	1.2893	1.2182
22	.025347	1.017	1.0306	1.1482	1.0849
23	.022571	.9057	.9177	1.0225	.96604
24	.0201	.8065	.8173	.91053	.86028
25	.0179	.7182	.7278	.81087	.76612
26	.01594	.6396	.6481	.72208	.68223
27	.014195	.5696	.5772	.64303	.60756
28	.012641	.5072	.514	.57264	.54103
29	.011257	.4517	.4577	.50994	.4818
30	.010025	.4023	.4076	.45413	.42907
31	.008928	.3582	.363	.40444	.38212
32	.00795	.319	.3232	.36014	.34026
33	.00708	.2841	.2879	.32072	.30302
34	.006304	.2529	.2563	.28557	.26981
35	.005614	.2253	.2283	.25431	.24028
36	.005	.2006	.2033	.2265	.214
37	.004453	.1787	.181	.20172	.19059
38	.003965	.1591	.1612	.17961	.1697
39	.003531	.1417	.1436	.15995	15113
40	.003144	.1261	.1278	.14242	13456
Specific Gravities . . .		7.704	7.806	8.698	8.218
Weights of a Cubic Ft.		481.25	487.75	543.6	513.6
" " " In.		.2787	.2823	.3148	.2972

Elementary Bodies, with their Symbols and Equivalents.

Body.	Sym.	Equ.	Body.	Sym.	Equ.	Body	Sym.	Equ.
Aluminium	Al	13.7	Hydrogen .	H	1.	Potassium .	K	39.2
Antimony .	Sb	64.6	Iodide . . .	I	126.5	Rhodium .	R	52.2
Arsenic . .	As	37.7	Iridium . .	Ir	98.5	Ruthenium	Ru	52.1
Barium .	Ba	68.6	Iron	Fe	28.	Selenium . .	Se	40.
Bismuth .	Bi	71.5	Lantanium .	Ln	48.	Silicon . . .	Si	22.
Boron . . .	B	11.	Lead	Pb	103.7	Silver . . .	Ag	108.3
Bromine .	Br	78.4	Lithium . .	L	7.	Sodium . .	Na	23.6
Cadmium .	Cd	55.8	Magnesium	Mg	12.7	Strontium .	Sr	43.8
Calcium .	Ca	20.5	Manganese	Mn	26.	Sulphur . .	S	16.1
Carbon . .	C	6.1	Mercury . .	Hg	200.	Tellurium .	Te	64.2
Cerium . .	Ce	46.	Molybdenum	Mo	47.9	Terbium .	Tb	—
Chlorine .	Cl	35.5	Nickel . . .	Ni	29.5	Thorium . .	Th	60.
Chromium	Cr	26.2	Niobium . .	Nr	—	Tin	Sn	58.9
Cobalt . .	Co	29.5	Nitrogen . .	N	14.2	Titanium .	Ti	24.5
Columbium	Ta	184.8	Norium . .	No	—	Tungsten .	W	92.
Copper . .	Cu	31.7	Osmium . .	Os	99.7	Uranium . .	U	60.
Didymium	D	48.	Oxygen . .	O	8	Vanadium .	V	68.5
Erbium . .	E	—	Palladium .	Pd	53.3	Yttrium . . .	Y	32.
Fluorine .	F	18.7	Pelopium .	Pe	—	Zinc	Zn	32.3
Glucinum .	G	6.9	Phosphorus	P	15.9	Zirconium .	Zr	34.
Gold . . .	Au	196.6	Platinum . .	Pt	98.8			

SHEET LEAD.

Sheet Lead is designated by the weight of a square foot of it, and it usually ranges from $2\frac{1}{2}$ to 10 lbs. per square foot.

Weight of a Square Foot of Cast and Wrought Iron, Copper, Lead, Brass and Zinc.

From $\frac{1}{16}$ to 1 Inch in Thickness.

Thick.	Cast Iron.	Wr't Iron.	Copper.	Lead.	Brass.	Zinc.
Inch.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
$\frac{1}{16}$	2.346	2.517	2.89	3.691	2.675	2.34
$\frac{1}{8}$	4.693	6.035	5.781	7.382	5.35	4.68
.	7.039	7.552	8.672	11.074	8.025	7.02
$\frac{1}{4}$	9.386	10.07	11.562	14.765	10.7	9.36
.	11.733	12.588	14.453	18.456	13.375	11.7
$\frac{3}{8}$	14.079	15.106	17.344	22.148	16.05	14.04
.	16.426	17.623	20.234	25.839	18.725	16.34
$\frac{1}{2}$	18.773	20.141	23.125	29.53	21.4	18.72
.	21.119	22.659	26.016	33.222	24.075	
$\frac{5}{8}$	23.466	25.176	28.906	36.913	26.75	
.	25.812	27.694	31.797	40.604	29.425	
$\frac{3}{4}$	28.159	30.211	34.688	44.296	32.1	
.	30.505	32.729	37.578	47.987		
$\frac{7}{8}$	32.852	35.247	40.469	51.678		
.	35.199	37.764	43.359	55.37		
1.	37.545	40.282	46.25	59.061		

NOTE.—The Wrought Iron is that of hard rolled Pennsylvania plates, and the Copper that of hard rolled plates from the works of Messrs. Phelps, Dodge & Co., Conn.

To Ascertain the Weight of Wrought Iron, Copper or Brass Tubes and Pipes per Lineal Foot.

From $\frac{1}{2}$ an inch in internal diameter to 6 inches.

Diam.	Area of Pl	Diam.	Area of Pl.	Diam.	Area of Pl.	Diam.	Area of Pl.
Ins.	Sq. Ft.	Ins.	Sq. Ft.	Ins	Sq. Ft.	Ins.	Sq. Ft.
$\frac{1}{2}$	.1309	$1\frac{5}{16}$	.3436	$2\frac{3}{4}$	.7199	$4\frac{1}{2}$	1.1781
$\frac{9}{16}$	.1473	$1\frac{3}{8}$	.36	$2\frac{7}{8}$	.7526	$4\frac{5}{8}$	1.2108
$\frac{5}{8}$	.1636	$1\frac{7}{16}$	.3764	3	.7854	$4\frac{3}{4}$	1.2435
$\frac{11}{16}$	.18	$1\frac{1}{2}$	.3927	$3\frac{1}{8}$	.8181	$4\frac{7}{8}$	1.2763
$\frac{3}{4}$	.1964	$1\frac{5}{8}$	.4254	$3\frac{1}{4}$	.8508	5	1.309
$\frac{13}{16}$	.2127	$1\frac{3}{4}$	.4581	$3\frac{3}{8}$	.8836	$5\frac{1}{8}$	1.3417
$\frac{7}{8}$	.2291	$1\frac{7}{8}$	.4909	$3\frac{1}{2}$	.9163	$5\frac{1}{4}$	1.3744
$\frac{15}{16}$	.2454	2	.5236	$3\frac{5}{8}$	.949	$6\frac{3}{8}$	1.4072
1	.2618	$2\frac{1}{8}$	.5543	$3\frac{3}{4}$	.9818	$6\frac{1}{2}$	1.4399
$1\frac{1}{16}$	.2782	$2\frac{1}{4}$	.587	4	1.0472	$6\frac{5}{8}$	1.4726
$1\frac{1}{8}$	.2945	$2\frac{3}{8}$	.6198	$4\frac{1}{8}$	1.0799	$6\frac{3}{4}$	1.5053
$1\frac{3}{16}$	.3105	$2\frac{1}{2}$	.6545	$4\frac{1}{4}$	1.1126	$5\frac{7}{8}$	1.5381
$1\frac{1}{4}$	.3272	$2\frac{5}{8}$	.6872	$4\frac{3}{8}$	1.1454	6	1.5708

Application of the Table.

When the Thickness of the Metal is given in the Divisions of an Inch.

To the internal diameter of the tube or pipe add the thickness of the metal; take the area of a plate in square feet, from the table for a diameter equal to the sum of the diameter and thickness of the tube or pipe, and multiply it by the weight of a square foot of the metal for the given thickness (see tables, page 757), and again by its length in feet.

When the Thickness of the Metal is given in Numbers of a Wire Gauge.

To the internal diameter of the tube or pipe add the thickness of the number from table, page 757; multiply the sum by 3.1416, divide the product by 12, and the quotient will give the area of the plate in square feet. Then proceed as before given.

ROPES, HAWSERS AND CABLES.

Ropes of hemp fibres are laid with three or four strands of twisted fibres, and run up to a circumference of 12 inches.

Hawsers are laid with three strands of rope, or with four rope strands.

Cables are laid with three strands of rope only.

Tarred ropes, hawsers, etc., have 25 *per centum* less strength than white ropes; this is in consequence of the injury the fibres receive from the high temperature of the tar $=290^{\circ}$.

Tarred hemp and Manilla ropes are of about equal strength. Manilla ropes have from 25 to 30 *per centum* less strength than white ropes.

Hawsers and cables, from having a less proportionate number of fibres and from the increased irregularity of the resistance of the fibres, have less strength than ropes, the difference varying from 35 to 45 *per centum*, being greatest with the least circumference.

Ropes of four strands up to 8 inches are fully 16 *per centum* stronger than those having but three strands.

Hawsers and cables of three strands up to 12 inches are fully 10 *per centum* stronger than those having four strands.

The absorption of tar in weight by the several ropes is as follows:

Bolt rope . . . . . 18 *per centum.*	Cables . . . . 21 *per centum.*
Shrouding . . 15 to 18 "	Spun yarn . . 25 to 30 "

White ropes are more durable than tarred.

The greater the degree of twisting given to the fibres of a rope, etc., the less its strength, as the exterior alone resists the greater portion of the strain.

To Compute the Strain that can be borne with safety by new Ropes, Hawsers, and Cables.

Deduced from the experiments of the Russian Government upon the relative strength of different Circumferences of Ropes, Hawsers, etc.

The U. S. Navy test is 4200 lbs. for a White rope of three strands of best Riga hemp, of $1\frac{3}{4}$ inches in circumference (=17000 lbs. per square inch), but in the following table 14000 lbs. is taken as the unit of strain that can be borne with safety.

RULE.—Square the circumference of the rope, hawser, etc., and multiply it by the following units for ordinary ropes, etc.

Table showing the Units for computing the safe strain that may be borne by Ropes, Hawsers, and Cables.

Description.	Ropes.				Hawsers.		Cables.	
	White.		Tarred.		White	Tar'd	White	Tar'd
	3 str'ds	4 str'ds	3 str'ds	4 str'ds	3 str'ds	3 str'ds	3 str'ds	3 str'ds
Inches Circumference.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
White rope, 2.5 to 6 ins.	1140	1330	. . .	. . .	600	. .	. . .	. .
" " 6 " 8 "	1090	1260	. . .	. . .	570	. .	510	. .
" " 8 " 12 "	1045	880	. . .	. . .	530	. .	530	. .
" " 12 " 18 "	. . .	. . .	. . .	. . .	550	. .	550	. .
" " 18 " 26 "	. . .	. . .	. . .	. . .	. . .	. .	560	. .
Tarred " 2.5 " 5 "	. . .	. . .	855	1001	. . .	460	. . .	. .
" " 6 " 8 "	. . .	. . .	825	940	. . .	480	. . .	. .
" " 8 " 12 "	. . .	. . .	780	820	. . .	505	. . .	505
" " 12 " 18 "	. . .	. . .	. . .	. . .	. . .	. .	. . .	525
" " 18 " 26 "	. . .	. . .	. . .	. . .	. . .	. .	. . .	550
Manila " 2.5 " 6 "	810	950	. . .	. . .	440	. .	. . .	. .
" " 6 " 12 "	760	835	. . .	. . .	465	. .	510	. .
" " 12 " 18 "	. . .	. . .	. . .	. . .	. . .	. .	535	. .
" " 18 " 26 "	. . .	. . .	. . .	. . .	. . .	. .	560	. .

When it is required to ascertain the weight or strain that can be borne by ropes, etc., in general use. The above Units should be reduced *one-third*, in order to meet the reduction of their strength by chafing and exposure to the weather.

Ex. 2. What is the weight that can be borne by a tarred hawser 10 inches in circumference, in *general use?*

$$10^2\times\left(505-\frac{505}{3}\right)=100\times336.7=33667 \ lbs.$$

To Compute the Circumference of a Rope, Hawser, or Cable for a Given Strain.

RULE.—Divide the strain in pounds by the appropriate units in the above table and the square root of the product will give the circumference of the rope, etc., in inches.

EXAMPLE.—The stress to be borne in safety is 165550 lbs.; what should be the circumference of a tarred cable to withstand it?

$165552\div550=301$, and $\div301=17.35$, say $17\frac{3}{8}$ *ins.*

Ex. 2. What should be the circumference of a Manila cable to withstand a strain, in general use, of 149336 lbs.?

Assuming the circumference to exceed 18 ins., the unit=560.

$$149336\div\left(560-\frac{560}{3}\right)=149336\div373.34=400, \text{ and}\div400=20 \ ins.$$

WIRE ROPE.

Wire rope of the same strength as new *Hemp rope* will run on the same-sized sheaves, but the greater the diameter of the sheaves, the longer it will wear. Short bends should be avoided, and the wear increases with the speed. It is better to increase load rather than speed. The adhesion is the same as that of hemp rope.

Wire rope should not be coiled, or uncoiled like hemp rope, but should be wound upon a reel.

When substituting wire rope for hemp rope, it is well to allow for the former the same weight per foot which experience has approved of for the latter. As a general rule one wire rope will outlast three hemp ropes. To guard against rust, stationary rope should be oiled once a year with linseed-oil, or kept well painted or tarred. Running rope, while in use, requires no protection.

Where great pliability is required, the centre or core of wire rope is made of hemp, and small-sized rope is generally made with hemp centres.

Running rope is made of fine wire, and standing rope of coarse wire.

Wire rope made from charcoal made iron is fully one-fourth stronger than the ordinary rope.

The standing rigging of a vessel when composed of wire rope is one-fourth less in weight than when of hemp.

Results of an Experiment with Galvanized Wire.

A strand of 2-inch wire rope broke with a strain of 13564 lbs., and a piece of a like rope, when galvanized, withstood a strain of 14796 lbs. before breaking.

Proof and Breaking Strain of Chain Cables.

Diameter of Chain.	Proved.	Breaking Strain	Diameter of Chain.	Proved.	Breaking Strain
Ins.	*Lbs.*	*Lbs.*	*Ins.*	*Lbs.*	*Lbs.*
$\frac{7}{8}$	10750	33500	$1\frac{5}{8}$	56675	113350
1	21700	43400	$1\frac{3}{4}$	65750	131500
$1\frac{1}{8}$	27500	55000	$1\frac{7}{8}$	75650	151300
$1\frac{1}{4}$	33300	66600	2	86100	172200
$1\frac{3}{8}$	40450	80900	$2\frac{1}{8}$	97376	194750
$1\frac{1}{2}$	48150	96300	$2\frac{1}{4}$	109090	218180

The proof of British Navy Chain is $\frac{2}{3}$ the breaking strain.

Table of the Relative Dimensions of Wire Rope (Coarse and Fine Laid), and of Ropes, Hawsers, and Cables, with their Breaking Strain.

R–J. A. Roebling. N–Newall & Co. AG–Admiralty, and Garnock, Bibby & Co.

(COARSE LAID.)

Trade Number.	Manufacture.	Diameter.	Circumference.	Weight per foot.	Breaking Weight of Strain.	Proof Weight of Strain.	Circumference of equal resistance for General Use. Tarred. Ropes. Three Strands.	Ropes. Four Strands.	Haw's. Three Strands.	Cables. Three Strands.
No.		Ins.	Irs.	Lbs.	Lbs.	Lbs.	Ins.	Ins.	Ins.	Ins.
27	R	.25	.78	—	1120	—	1¼	—	—	—
26	R	.26	.88	—	1620	—	1½	—	—	—
25	R	.3	.94	—	2060	—	1¾	—	—	—
—	N	.32	1.	.16	4480	—	2 7/16	2¼	3 5/16	—
24	R	.35	1.11	—	2760	—	—	—	—	—
—	N	.36	1.⅛	.19	5018	—	2 9/16	2⅜	3½	—
23	R	.39	1.23	—	3300	—	—	—	—	—
—	N	.4	1.¼	.21	5600	—	2 11/16	2½	3 11/16	—
22	R	.41	1.31	—	4260	—	—	—	—	—
—	N	.44	1.⅜	.23	6182	—	2⅞	2⅝	3⅞	—
—	N	.48	1.½	.25	6720	—	3	2¾	4 1/16	—
—	AG	—	1.½	.34	6720	5040	3	2¾	4 1/16	—
21	R	.49	1.53	—	5660	—	—	—	—	—
20	R	.52	1.⅝	—	8180	—	—	—	—	—
—	N	.52	1.⅝	.34	8960	—	3 7/16	3⅛	4 13/16	—
—	N	.56	1.¾	.42	11200	—	3 3/16	3½	5 3/16	—
—	AG	—	1.¾	.42	11200	7280	3 13/16	3½	5 3/16	—
—	N	.64	2.	.58	15680	—	4 9/16	4 3/16	6	—
19	R	.6	1.9	—	11600	—	—	—	5¼	—
18	R	.68	2.⅛	—	15200	—	—	—	—	—
—	AG	—	2.	.58	15680	9632	4 9/16	4 3/16	6	—
—	N	.72	2.¼	.75	20160	—	5⅛	4¾	6⅞	—
—	AG	—	2.¼	.75	—	11870	5⅛	4¾	6⅞	—
17	R	.75	2.4	—	17600	—	—	—	—	—
—	AG	—	2.½	.92	19400	14124	5¾	5⅜	7 9/16	—
—	N	.8	2.½	.92	24640	—	5¾	5⅜	7 9/16	—
—	N	.88	2.¾	1.08	29120	—	6¼	5⅞	8¼	8¼
—	AG	—	2.¾	1.08	—	16464	6¼	5⅞	8¼	8¼
16	R	.875	2.68	—	24600	—	—	—	—	—
—	N	.95	3.	1.25	33600	—	6¾	6⅛	8⅝	8⅝
15	R	1.	2.98	—	32000	—	—	—	—	—
—	AG	—	3.	1.25	—	19152	6⅝	6⅝	8⅝	8⅝
—	AG	—	3.¼	1.42	—	23744	7¼	6¾	9 3/16	9 3/16
—	N	1.03	3.¼	1.42	38080	—	7¼	6¾	9 3/16	9 3/16
14	R	1.⅛	3.¼	—	40000	—	—	—	—	—
—	AG	—	3.½	1:67	40880	26208	7 13/16	7 5/16	10	10
—	N	1.11	3.½	1.66	44800	—	7 13/16	7 5/16	10	10
13	R	1.¼	3.⅝	—	50000	—	—	—	—	—
—	AG	—	3.¾	2.	—	30240	8 13/16	8½	10 15/16	10 15/16
—	N	1.19	3.¾	2.	53760	—	8 13/16	8½	10 15/16	10 13/16
12	R	1.⅜	4.	—	60000	—	—	—	—	—
—	AG	—	4.	2.33	—	34272	9½	9¼	11 13/16	11 13/16
—	N	1 27	4.	2.34	62720	—	9½	9¼	11 13/16	11 13/16
11	R	1.4	4.45	—	72000	—	—	—	—	—
—	AG	—	4.¼	2.67	—	38752	9⅞	9 9/16	12¼	12⅛
—	N	1.35	4.¼	2.5	67200	—	9⅞	9 9/16	12¼	12¼
—	N	1.43	4.⅜	2.66	71680	—	10⅛	9⅞	—	12 7/16
—	AG	—	4.½	3.	—	42232	10 7/16	10 13/16	—	12¾
—	N	1.51	4.⅝	3.	80640	—	10¾	10½	—	13⅛
—	AG	—	4.¾	3.33	—	48944	11	10¾	—	13½
—	AG	—	5.	3.66	—	54656	—	11⅞	11 9/16	—
—	N	1.59	5.	3.66	98560	—	—	11⅞	11 9/16	—
—	AG	—	5 ¼	4.	108400	63392	—	12½	12¼	—
—	N	1.75	5.½	4.41	118720	—	—	—	—	—
—	AG	—	5.½	4.33	—	72240	—	—	—	—
—	—	—	5.¾	—	130530	—	—	—	—	—
—	N	1.91	6.	5.25	141120	—	—	—	—	—
—	AG	—	6.	5.	—	80640	—	—	—	—
—	—	—	6.½	—	165555	—	—	—	—	—
—	—	—	7.	—	192080	—	—	—	—	—
—	—	—	7.½	—	215048	—	—	—	—	—
—	—	—	8.	—	256880	—	—	—	—	—
FINE LAID.										
10¾	R	.5	1.37	—	7500	—	—	3⅛	2⅞	—
10	R	.9/16	1.68	—	9680	—	—	3 9/16	3¼	4⅞
10	R	.⅝	2.12	—	11600	—	—	3 15/16	3⅝	5¼
10	R	.¾	2.45	—	17280	—	—	4 13/16	4⅜	6⅜
9	R	.⅞	2.56	—	22800	—	—	5½	5	7¼
8	R	1.	2.98	—	32800	—	—	7¼	6¼	8¾
7	R	1.⅛	3.36	—	40400	—	—	8 3/16	7	9½
6	R	1.¼	3.91	—	54400	—	—	8 13/16	8 1/16	11
5	R	1.½	4.5	—	70000	—	—	10	9¾	12½
4	R	1.⅝	4.9	—	87200	—	—	11 3/16	10 15/16	—
3	R	1.¾	5.44	—	108000	—	—	12½	12⅛	—
2	R	1.⅞	8.2	—	130000	—	—	—	—	—
1	R	2.¼	6.62	—	148000	—	—	—	—	—

In the above table the determination of the circumference of the rope. etc., is based upon the Breaking Weight or Tensile resistance of the wire being reduced by one-fourth, and the *units* or the ultimate resistance of the rope, etc., are reduced one-third.

In the U. S. Navy the relative dimensions of Hemp Cable and of Wire Rope are as follows:

Circumference in inches.

Hemp	3,	4,	5,	5½,	6,	6¾,	7¼,	8,	9,	10,	10½,	11,	12
Wire	1⅝,	2⅛,	2¾,	3,	3¼,	3⅝,	4,	4⅜,	4⅞,	5½,	5¾,	6,	6½

Note.—The difference between the dimensions of the wire rope here given and in the preceding table, of one-fourth in area, is in consequence of the high estimate of strength given to the hemp rope made in the U. S. Service.

The circumferences given are for Tarred ropes, etc., alone; if, therefore, the circumferences for White and Manila ropes are required, proceed as follows:

To Compute the Circumference of a White or Manila Rope, Hawser, or Cable, compared with one of Tarred Hemp.

Rule.—Multiply the square of the circumference of the given rope by the unit for the circumference, from the table, see below, divide the product by the unit for the circumference of the rope etc., required, and the square root of the product will give the circumference required.

Note.—If the circumference is required for a rope in general use, reduce the units in the table one-third.

Illustration.—Required the circumference for a white rope and a Manila hawser, for general use—equivalent to a tarred rope of three strands, and 9½ inches in circumference.

Units of tarred rope of 9½ ins.= 780—⅓=520.
Units of white rope of about 9½ ins.=1045—⅓=697.
Units of Manila hawser of about 9½ ins.= 760—⅓=507.

Then $9.5^2 \times 520 = 46030$, which $\div 697 = 67.33$, and $\div 67.33 = 8.2$, say 8¼ *ins.* for the white rope.

Again, $9.5^2 \times 520 = 46930$, which $\div 507 = 92.56$, and $\div 92.56 = 9.62$, say 9⅝ *ins.* for the Manila hawser.

To Compute the Weight of Ropes, Hawsers, and Cables.

Rule.—Square the circumference, and multiply it by the appropriate unit in the following table, and the product will give the weight per foot in pounds:

	Ropes.	Hawsers.	Cables.
3-strand Hemp	.032	.031	.031
3-strand tarred Hemp	.042	.041	.041
3-strand Manila	.032	.031	.031
4-strand Hemp	.033	. .	. .
4-strand tarred Hemp	.048	. .	. .
4-strand Manila	.035	.034	.034

The units for Thread Ropes is the same as that for Ropes of like material.

SOLIDS.

Rule.—Divide the specific gravity of the substance by 16, and the quotient will give the weight of a cubic foot of it in pounds.

Substances.	Specific Gravity	Weight of a Cub. In.
METALS.		
Aluminum	2560	.0926
Antimony	6712	.2428
Arsenic	5763	.2084
Barium	470	.017
Bismuth	9823	.3553
Brass, copper 84 / " tin 16	8832	.3194
" copper 67 / " zinc 33	7820	.2828
" plate	8380	.3031
" wire	8214	.2972
Bronze, gun metal	8700	.3147
Boron	2000	.0723
Bromine	3000	.1085
Cadmium	8650	.3129
Calcium	1580	.057
Chromium	5900	.2134
Cinnabar	8098	.2929
Cobalt	8600	.3111
Columbium	6000	.217
Gold, pure, cast	19258	.6965
" hammered	19361	.7003
" 22 carats fine	17486	.6325
" 20 " "	15709	.5682
Copper, cast	8788	.3179
" plates	8698	3146
" wire	8880	.3212
Iridium	18680	.6756
" hammered	23000	.8319
Iron, cast	7207	.2607
" " gun metal	7308	.264
" hot blast	7065	.2555
" cold "	7218	.2611
" wrought bars	7788	.2817
" " wire	7774	.2811
" rolled plates	7704	.2787
Lead, cast	11352	.4106
" rolled	11388	.4119
Lithium	590	.0213
Manganese	8000	.2894
Magnesium	11750	.0633
Mercury—40°	15632	.5661
" +32°	13598	.4918
" 60°	13580	.4912
" 212°	13370	.4836
Molybdenum	8600	.3111
Nickel	8800	.3183
" cast	8279	.2994
Osmium	10000	.3613
Palladium	11350	.4105
Platinum, hammered	20337	.7356
" native	16000	.5787
" rolled	22069	.7982
Potassium, 59°	865	.0313
Red Lead	8940	.324
Rhodium	10650	.3852
Ruthenium	8600	.3111

Substances.	Specific Gravity	Weight of a Cub. In.
METALS.		
Selenium	4500	.1627
Silicium		
Silver, pure, cast	10474	.3788
" " hammered	10511	.3802
Sodium	970	.0351
Steel, plates	7806	.2823
" soft	7833	.2833
" tempered & hardened	7818	.2828
" wire	7847	.2838
Strontium	2540	.0918
Tin, Cornish, hammered	7390	.2673
" " pure	7291	.2637
Tellurium	6110	.221
Thalium	11850	.4286
Titanium	5300	.1917
Tungsten	17000	.6149
Uranium	18330	.6629
Wolfram	7119	.2575
Zinc, cast	6861	.2482
" rolled	7191	.26
WOODS.		CUB. FT.
Carbon	3500	218.75
STONES, EARTHS, ETC.		
Clay	1930	120.625
" with gravel	2480	155.
Coal, Anthracite	1436	89.75
	1640	102.5
" Borneo	1290	80.625
" Cannel	1238	77.375
	1318	82.375
" Caking	1277	79.812
" Cherry	1276	79.75
" Chili	1290	80.625
" Derbyshire	1292	80.75
" Lancaster	1273	79.562
" Maryland	1355	84.687
" Newcastle	1270	79.375
" Rive de Gier	1300	81.25
" Scotch	1259	78.687
	1300	81.25
" Splint	1302	81.375
" Wales, mean	1315	82.187
Coke	1000	62.5
" Nat'l, Va.	746	46.64
Earth,* com. soil	2194	137.125
" loose	1500	93.75
" moist sand	2050	128.125
" mould, fresh	2050	128.125
" rammed	1600	100.
" rough sand	1920	120.
" with gravel	2020	126.25
Granite, Egyptian red	2654	165.875
" Patapsco	2640	165.
" Quincy	2652	165.75
" Scotch	2625	164.062
" Susquehanua	2704	169.

* Specific grav. of the earth is variously estimated at from 5450 to 5600.

Table—(*Continued.*)

Substances.	Specific Gravity	Weight of a Cub. Ft.	Substances.	Specific Gravity	Weight of a Cub. Ft.
STONES, EARTHS, ETC.					
Gravel, common . .	1749	109.312	Sand, silicious . . .	1701	106.33
Gypsum, opaque . .	2168	135.5	Shale	2600	162.5
Hone, white, razor .	2876	179.75	Slate	2900	181.22
Hornblende	3540	221.25		2672	167.
Lime, hydraulic . .	2745	171.562	Slate purple	2784	174.
" quick	804	50.25	Spar, calcareous . .	2735	170.937
Limestone, green .	3180	198.75	" Feld, blue . .	2693	168.312
" white .	3156	197.25	" " green .	2704	169.
Marl, mean	1750	109.375	" Fluor	3400	215.5
Mica	2800	175.	Stalactite	2415	150.937
Mud	1630	101.875	Sulphur, native . .	2033	127.062
Phosphorus	1770	110.625	Talc, mean	2500	156.25
Plumbago	2100	131.25	Talc, black	2900	181.25
Quartz	2660	166.25	Trap	2720	170.
Red-lead	8940	558.75			
Rock, crystal . . .	2735	170.937			
Salt, common . . .	2130	133.125	MISCELLANEOUS.		
Saltpetre	2090	130.625			
Sand, coarse	1800	112.5	Asphaltum . . .	905	56.562
" common . . .	1670	104.375		1650	103.125
" damp & loose	1392	87.	Atmospheric Air .	001205	07.629
" dried & loose	1560	97.5	Gunpowder, loose .	900	66.25
" dry	1420	88.75	" shaken	1000	62.5
" mortar, Fort			" * solid	1550	96.875
Richmond . . .	1659	103.66		1800	112.5
Sand, mortar, Brook-			Horn	1689	105.562
lyn	1716	107.25	Ice, at 32°	920	57.5

Compression of the following fluids under a pressure of 15 lbs. per square inch:

Alcohol	.0000216	Mercury	.00000265
Ether	.00006158	Water	.00004663

Elastic Fluids.

1* *Cubic Foot of Atmospheric Air weighs 527.04 Troy Grains.*

Its assumed Gravity of 1 is the Unit for Elastic Fluids.

Atmospheric air, 34° . . .	1.	Sulphuretted hydrogen . .	1.77
Ammonia	.589	Sulphurous acid	2.21
Azote	.976	Steam,* 212°	.4883
Carbolic acid	1.52	Smoke, of bituminous coal.	.102
" oxyd	.972	" coke	.105
Carbureted hydrogen . . .	.559	" wood	.09
Chlorine	2.47	Vapor of alcohol	1.613
Chloro-carbonic	3.389	" bisulphuret of car-	
Cyanogen	1.815	bon	2.64
Gas, coal	.4	Vapor of bromine	5.1
	.752	" chloric ether . . .	3.44
Hydrogen	.07	" ether	2.586
Hydrochloric acid	1.278	" hydrochloric ether	2.255
Hydrocyanic "	.942	" iodine	8.675
Muriatic acid	1.247	" nitric acid	3.75
Nitrogen	.972	" spirits of turpen-	
Nitric oxyd	1.094	tine	4.763
Nitrous acid	2.638	Vapor of sulphuric acid . .	2 7
" oxyd	1.527	" " ether .	2.586
Oxygen	1.102	" sulphur	2.214
Phosphureted hydrogen . .	1.77	" water	.623

* Equal to .07529143 lbs. avoirdupois.

Weights and Volumes of Various Substances in Ordinary Use.

Substances.	Cubic Foot.	Cubic Inch.	Substances.	Cubic Foot.	Cubic Feet in a Ton.
METALS.	Lbs.	Lbs.			
Brass {copper 67. / zinc 33.}	488.75	.2829	Walnut, black, dry	31.25	71.68
			Willow	36.562	61.265
" gun metal .	543.76	.3147	" dry	30.375	73.744
" sheets . . .	513.8	.297	MISCELLANEOUS.		
" wire	524.18	.3033			
Copper, cast	547.25	.3179	Air	.075291	
" plates . . .	543.625	.3187	Basalt, mean . . .	175.	12.8
Iron, cast	450.437	.2607	Brick, fire	137.562	16.284
" gun metal . .	466.5	.27	" mean	102.	21.961
" heavy forging	479.5	.2775	Coal, anthracite .	89.75	24.958
" plates	481.5	.2787		102.5	21.854
" wrought bars.	486.75	.2816	" bitumin., mean	80.	28.
Lead, cast	709.5	.4108	" Cannel	94.875	23.609
" rolled	711.75	.4119	" Cumberland .	84.687	26.451
Mercury, 60°. . .	848.7487	.491174	" Welsh, mean .	81.25	27.669
Steel, plates	487.75	.2823	Coke	62.5	35.84
" soft	489.562	.2833	Earth, clay	120.625	18.569
Tin	455.687	.2637	" common soil	137.125	16.335
Zinc, cast	428.812	.2482	" " gravel	109.312	20.49
" rolled	449.437	.2601	" dry, sand . .	120.	18.667
			" loose	93.75	23.893
WOODS.		Cub. Ft. in a ton.	" moist, sand.	128.125	17.482
			" mold	128.125	17.482
Oak, Canadian . . .	54.5	41.101	" mud	101.875	21.987
" English . . .	58.25	38.455	" with gravel.	128.25	17.742
" live, seasoned	66.75	33.558	Granite, Quincy . .	165.75	13.514
" white dry . .	53.76	41.674	" Susqu'h'na	169.	13.254
" " upland.	42.937	52.169	Limestone	197.25	11.355
Pine, pitch	41.25	54.303	Marble, mean . . .	167.875	13.343
" red	36.875	60.745	Mortar, dry, mean	97.98	22.862
" white	34.625	64.693	Water, fresh	62.5	35.84
" well seasoned	29.562	75.773	" salt	64.125	34.931
Pine, yellow	33.812	86.248	Steam	.036747	
Spruce	31.25	71.68			

* Weight of a cubic foot, 257.353 Troy grains.

WAGES TABLE.

Salaries and Wages by the Year, Month, Week or Day, showing what any sum from $20 to $1600 per annum, is per Month, Week or Day.

Per Year.	Per Month.	Per Week.	Per Day.	Per Year.	Per Month.	Per Week.	Per Day.
$	$ c.	$ c.	$ c.	$	$ c.	$ c.	$ c.
20 is	1.67	.38	.05	280 is	23 33	5.37	.77
25	2.08	.48	.07	285	23.75	5.47	.78
30	2.50	.58	.08	290	24.17	5.56	.79
35	2.92	.67	.10	295	24.58	5.66	.81
40	3.33	.77	.11	300	25.00	5.75	.82
45	3.75	.86	.12	310	25.83	6.95	.85
50	4.17	.96	.14	320	26.67	6.14	.88
55	4.58	1.06	.15	325	27.08	6.23	.89
60	5.00	1.15	.16	330	27.50	6.33	.90
65	5.42	1 25	.18	340	28.33	6.52	.93
70	5.83	1.34	.19	350	29.17	6.71	.96
75	6.25	1.44	.21	360	30.00	6.90	.99
80	6.67	1.53	.22	370	30.83	7.10	1.01
85	7.08	1.63	.23	375	31.25	7.19	1.03
90	7.50	1.73	.25	380	31.67	7.29	1.04
95	7 92	1.82	.26	390	32.50	7.48	1.07
100	8.33	1.92	.27	400	33.33	7.67	1.10
105	8.75	2 01	.29	425	35.42	8.16	1.16
110	9.17	2.11	.30	450	37.50	8.63	1.23
115	9.58	2.21	.32	475	39.58	9.11	1.30
120	10.00	2.30	.33	500	41.67	9.59	1.37
125	10.42	2.40	.34	525	43.75	10.07	1.44
130	10.83	2.49	.36	550	45.83	10.55	1.51
135	11.25	2.59	.37	575	47.92	11.03	1.58
140	11.67	2.69	.38	600	50.00	11.51	1.64
145	12.08	2.78	.40	625	52 08	11.99	1.71
150	12.50	2.88	.41	650	54.17	12.47	1.78
155	12.92	2.97	.42	675	56.25	12.95	1.85
160	13.33	3.07	.44	700	58.33	13.42	1.92
165	13.75	3.16	.45	725	60.42	13.90	1.99
170	14.17	3.26	.47	750	62.50	14.38	2.05
175	14.58	3.36	.48	775	64.58	14.86	2.12
180	15.00	3 45	.49	800	66.67	15.34	2.19
185	15.42	3.55	.51	825	68.75	15.82	2.28
190	15.83	3.64	.52	850	70.83	16.30	2.33
195	16.25	3.74	.53	875	72.92	16.78	2.40
200	16.57	3.84	.55	900	75.00	17.26	2.47
205	17.08	3.93	.56	925	77.08	17.74	2.53
210	17.50	4.03	.58	950	79.17	18.22	2.60
215	17.92	4.12	.59	975	81.25	18.70	2.67
220	18.33	4.22	.60	1000	83.33	19.18	2.74
225	18.75	4.31	.62	1050	87.50	20.14	2.88
230	19.17	4.41	.63	1100	91.67	21.10	3.01
235	19.58	4.51	.64	1150	95.83	22.08	3.15
240	20.00	4.60	.66	1200	100.00	23.01	3.29
245	20.42	4.70	.67	1250	104.17	23.29	3.42
250	20.83	4.79	.69	1300	108.33	24.93	3.56
255	21.25	4.89	.70	1350	112.50	25.89	3.70
260	21.67	4.99	.71	1400	116.67	26.85	3.84
265	22.08	5.08	.73	1450	120.84	27.80	3.98
270	22.50	5.18	.74	1500	125.00	28.77	4.11
275	22.92	5.27	.75	1600	133.34	30.68	4.38

Wages Table, calculated on a scale of Ten Hours labor per day. The Time, in Hours and Days is noted in the left hand column, and the Amount of Wages under the respective headings as noted below.

Wages	$1.00	$1.50	$2.00	$2.50	$3.00	$3.50	$4.00	$4.50	$5.00	$5.50	$6.00
Hours. ½	.1	.1¼	.1⅔	.2	.2½	.3	.3½	.2¾	.4½	.41[illegible]	.5
1	.1⅔	.2½	.3⅓	.4⅓	.5	.6	.6⅔	.7½	.8⅓	.9⅙	.10
2	.3⅓	.5	.6⅔	.8⅓	.10	.11⅔	.13⅓	.15	.16⅔	.18⅓	.20
3	.5	.7½	.10	.12½	.15	,17½	.20	.22½	.25	.27½	.30
4	.6⅔	.10	.13½	.16⅔	.20	.23⅓	.26⅔	.30	.33⅓	.36⅔	.40
5	8.⅓	.12½	.16⅔	.21	.25	.29⅙	.33⅓	.37½	.41⅔	.46	.50
6	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60
7	.11⅔	.17½	.23⅓	.29½	.35	.41	.46⅔	.52½	.58⅓	.64⅙	.70
8	.13⅓	.20	.26⅔	.33⅓	.40	.46⅔	.53⅓	.60	.66⅔	.73⅓	80.
9	.15	.22½	.30	.37½	.45	.52½	.60	.67½	.75	.82½	.90
Days 1	.16⅔	.25	.33⅓	.41⅔	.50	.58⅓	.62⅔	.75	.83⅓	.91⅔	1.00
2	.33⅓	.50	.66⅔	.83⅓	1.00	1.16⅔	1.33⅓	1.50	1.66⅔	1.83⅓	2.00
3	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.60	2.75	3.00
4	.66⅔	1.00	1.33⅓	1.66⅔	2.00	2.33⅓	2.66⅔	3.00	3.31⅓	3.66⅔	4.00
5	.83⅓	1.25	1.66⅔	20.8⅓	2.50	2.91⅔	3.31⅓	3.75	4.16⅔	4.58⅓	5.00
6	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00

Wages	$6.50	$7.00	$7.50	$8.00	$.900	$10.00	$11.00	$12.00	$13.00	$14.00	$15.00
Hours. ½	5½	.8	.6¼	.6⅔	.7½	.8⅓	9.	.10	.11	.12	.12½
1	.11	.11⅔	12.½	.13⅓	.15	.16⅔	.18⅓	.20	.22	.23½	.25
2	.21⅔	.23⅓	.25	.26⅔	.30	.33⅓	.36⅔	.40	.43⅓	.46⅔	.50
3	.32½	.35	.37½	.40	.45	.50	.55	.60	.65	.70	.75
4	.43⅓	.46⅔	50	.53⅓	.60	.66⅔	.73⅓	.80	.86⅔	.93⅓	1.00
5	.54⅓	.58⅓	.62½	.66⅔	.75	.83⅓	.91⅔	1.00	1.08⅓	1.16⅔	1.25
6	.65	.70	.75	.80	.90	1.00	1.10	1.20	1.30	1.40	1.50
7	.76	.81⅔	.87½	.93⅓	1.05	1.16⅔	1.28⅓	1.40	1.52	1.63⅓	1.75
8	.86⅔	.93⅓	1.00	1.06⅔	1.20	1.33⅓	1.46⅔	1.60	1.73⅓	1.86⅔	2.00
9	.97½	1.05	1.12½	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25
Days 1	1.08⅓	1.16⅔	1.25	1.33⅓	1.50	1.66⅔	1.83⅓	2.00	2.17	2.33⅓	2.50
2	2.16⅔	2.33⅓	2.50	2.66⅔	3.00	3.33⅓	3.66⅔	4.00	4.34	4.66⅔	5.00
3	3.25	3.50	3.75	4.00	4.50	5.00	5.50	6.00	6.51	6.99⅔	7.50
4	4.33⅓	4.66⅔	5.09	5.33⅓	6.00	6.66⅔	7.33⅓	8.00	8.68	8.33	10.00
5	5.41⅔	5.83⅓	6.25	6.66⅔	7.00	8.33⅓	9.16⅔	10.00	10.85	11.66⅓	12.50
6	6.50	7.00	7.50	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00

If the desired number of days or amount of wages is not in the table double or treble any suitable number of days or amount of money as the case may be, until you obtain the desired number of days and the wages to correspond.

HYDRAULIC MINING.

Fifth Roots.—The following table of numbers and roots will cover all problems that come to the miner in hydraulic mining. The numbers are printed in heavy type and the roots in light. If the exact number is not found, take the roots of the number nearest to it:

No.	*Root.*	*No.*	*Root.*	*No.*	*Root.*
7.59	1.5	**5032.84**	5.5	**59049.**	9.
32.	2,	**7776.**	6.0	**77378.**	9.5
97.65	2.5	**11603.**	6.	**100000.**	10.
243.	3.	**16807.**	6.5	**136638.**	10.5
525.21	3.5	**23730.**	7.	**161051.**	11.
1024.	4.	**32768.**	7.5	**201035.**	11 5
1845.28	4.5	**44370.**	8.	**248832.**	12.
3125.	5.		8 5		

Velocities and Discharges.

Head in feet per 100 *feet.*	*Head in ft. per mile.*	*Velocity in feet per second.*	*Discharge in cu. ft. per second.*	*Discharge in cu. ft. per 24 hours.*
.0019	.1	.208	.1633	14,114
.0038	.2	.293	.2301	19,880
.0057	.3	.359	.2819	24,360
.0076	.4	.415	.3267	28,229
.0095	.5	.464	.3638	31,435
.0114	.6	.508	.3989	34,464
.0132	.7	.549	.4311	37,427
.0161	.8	.685	.4602	39,760
.0170	.9	.623	.4901	42,343
.0189	1.1	.656	.5144	44,431
.0237	1.25	.735	.5753	49,701
.0284	1.50	.805	.6322	54,604
.0331	1.75	.871	.6832	59 011
.0379	2.	.928	.7276	62,870
.0426	2.25	.984	.7696	66,484
.0473	2.50	1.040	.8168	70,672
.0521	2.75	1.080	.8482	73,284
.0568	3.00	1.130	.8914	76,982
.0758	4.	1.310	1.028	88,862
.0947	6.	1.47	1.150	99,403
.1136	6.	1.61	1.264	109,209
.1325	7.	1.74	1.366	118,022
.1514	8.	1.86	1.455	125,740
.1703	9.	1.96	1.539	132,969
.1894	10.	2.08	1.633	141,145
.2273	12.	2.27	1.782	153,964
.2652	14.	2.45	1.924	186,233
.3030	16.	2.62	2.057	177,724
.3409	18.	2.78	2.183	188,611
.3788	20.	2.93	2 301	198,806
.4735	25.	3 28	2.572	222,156
.5682	30.	3.59	2.819	243.604
.6629	35.	3.88	3.047	263,260
.7576	40.	4.15	3.267	282,288
.8523	45.	4.40	3.451	298,209
.9470	50.	4.64	3.638	314,352
1.1360	60.	5.08	3.989	344,649
1.3260	70.	6.49	4.311	372,470
1.5150	80.	5.85	4 602	397,613
1.7040	90.	6.23	4.900	423,435
1.8940	100.	6.56	5.144	444,312
2.0830	110.	6.87	5.395	466,128
2.2720	120.	7.18	5.639	487,209
2.4620	130.	7.47	5.866	506,822
2.8410	150.	8.05	6.322	646,048
3.0300	160.	8.30	6.534	564,576
3.2190	170.	8.55	6.715	680,176
3.4080	180.	8.80	6.903	696,418
3.5960	190.	9.04	7.100	613,440
3.7880	200.	9.28	7.276	628,704
4.2610	225.	9.84	7.696	664,848
4.7350	250.	10.40	8.168	705,728
5.2080	275.	10.8	8.482	732,844
5.6820	300.	11.3	8.914	769,824
6.6290	350.	12.3	9.621	831,168
7.6760	400.	13.1	10.280	888,624
8.5320	450.	13.9	10.910	943,056
9.4700	500.	14.7	11.50	994,032
10.4100	550.	15.4	12.09	1,044,576
11.3600	600.	16.1	12.64	1,092,096
12.3000	650.	16.9	13.11	1,132,704
13.2500	700.	17.4	13.66	1,180,224
14.2000	750.	18.	14.13	1,220,832
15.1600	800.	18.6	14.55	1,257,408
16.0900	850.	19.1	15.00	1,296,000
17.0400	900.	19.6	15.39	1,329,698
17.9900	950.	20.3	15.94	1,377,216
18.9400	1000.	20.8	16.33	1,411,456
22.7300	1200.	12.8	17.82	1,539,648
26.5200	1400.	24.5	19.24	1 662,336
30.3000	1600.	26.2	20.57	1,777,248
37.8700	2000.	29.3	23.01	1,988,064

In the Scour of water-course Beds.

¼ ft. per second will scour fine clay.
½ " " " " sand.
¾ " " " coarse sand.
1 " " " fine gravel.
2 ft. per second will scour round shingle 1 in. diam.
3 ft. " " angular stone, size of an egg.
3 ft. " " conglomerate.

Value of Gold according to fineness.—Pure gold, 1000 fine, is worth \$20.67 per oz.; gold 500 fine, is worth \$10.33; 600 fine, \$12.40; 700 fine, \$14.49; 800 fine, \$16.53; 900 fine, \$18.60. At the mint in San Francisco, the charge for melting, assaying and refining is 14 cents per oz. The charge for coining is ½ per cent. No deposits are received at the mint in less sums than \$100. The value of a ton of pure gold is \$602,799.21. The value of a ton of silver is \$37,704.84. The weight of \$1,000,000 in gold coin is 3,685.8 lbs. avoirdupois. The weight of \$1,000,000 in silver coin is 58,929.9 lbs. avoirdupois. For other facts relating to the weight of the precious metals consult pp. 762.

Phillips gives the following rule for ascertaining the amount of gold in a lump of auriferous quartz:

"The specific gravity of the gold—19,000.

"The specific gravity of the quartz—2,600.

"These numbers are given here merely for convenience in explaining the rule; they do not accurately represent the specific gravities of all quartz and quartz gold. (The quartz gold of California has not, on an average, a specific gravity of more than 18,600.)

"1. Ascertain the specific gravity of the lump. Suppose it to be 8,067.

"2. Deduct the specific gravity of the lump from the specific gravity of the gold; the difference is the ratio of the quartz by volume: 19,000—8,067 = 10,933.

"3. Deduct the specific gravity of the quartz from the specific gravity of the lump; the difference is the ratio of the gold by volume: 8,067—2,600 = 5,467.

"4. Add these ratios together, and proceed by the rule of proportion. The product is the percentage of gold by bulk: 10,933+5,467=16,400. Then as 16,400 is to 5,467, so is 100 to 33,35.

"5. Multiply the percentage of gold by bulk by its specific gravity. The product is the ratio of the gold in the lump by weight: 33,35×19,00=643,65.

"6. Multiply the percentage of quartz by bulk (which must be 66,65 since that of the gold is 33,35) by its specific gravity. The product is the ratio of the quartz in the lump by weight: 66,65×2,60=173,29.

"7. To find the percentage, add these two ratios together, and proceed by the rule of proportion: 633,65+173,29=806,94. Then, as 806,94 is to 633,65, so is 100 to 78,63. Hence, a lump of auriferous quartz, having a specific gravity of 8,067, contains 78,73 per cent. of gold, by weight.

The weight and volume of Anthracite Coal.

Color of ash.	Name of coal.	Cubic feet to 2000 lbs.	Cubic feet to 2240 lbs.
White	Honey Brook	34·5	38·6
White	Hazleton	34·8	38·9
White	Sugar Loaf	34·8	38·9
White	Old Company's	34·8	38·9
White	Spring Mountain	34·8	38·9
White	Greenwood	34·8	38·9
Pink	Cross Creek	35·1	39·2
Pink	Council Bridge	35·1	39·2
Pink	Buck Mountain	35·1	39·2
White	Locust Mountain	35·5	39·6
White	Mahanoy	35·5	39·6
Gray and red	Shamokin	36·9	41·0
Red	Lorberry	37·3	41·4

The following figures, from another source, may be of interest in this connection:

ANTHRACITE.

Peach Mountain	41·06	Lackawanna	45·08
Forest Improvement	41·07	Lehigh Co.'s	40·05
Beaver Meadow, No. 5	39·08	Beaver Meadow, No. 3	40·07

BITUMINOUS.

Cumberland maximum	42·3	Pittsburg, Pa	47·08
" minimum	41·2	Sydney, Cape Breton	47·02
Duffruyn, Welsh	42·99	Clover Hill, Va	49·02
Cannal, Lancashire	46·37	Cannelton, Indiana	47·00
Blossburg, Pa	42·2	Scotch	43·08
Hartley, Newcastle	44·00	Richmond, Va. (Middleton)	41·04
Pictou, Nova Scotia	45·00		

COKE.

Natural of Virginia	48·03	Charcoal	104
Pittsburg	70·09		

COST OF MINING.

Wages paid in Colorado and Nova Scotia.

	Leadville.	Nova Scotia.
	Per day.	*Per day.*
Mining foreman	\$4 50	\$2 00
Mill foreman	\$3 50 to 5 00	\$1 50 to 2 00
Amalgamators	3 50	1 50
Engineers	4 00	1 25 to 1 50
Tenders and firemen	3 00	1 00
Miners	3 00	1 25 to 1 40
Mill feeders	3 50	1 25 to 1 50
Blacksmiths and carpenters	3 00	1 25 to 1 50
Barrowman and woodmen	2 50	80 to 1 00
Drivers	2 18	50 to 74
Horses' feed	75	50
Wood (per cord)	4 80	1 50 to 2 00

Lineal Expansion of Metals.

Produced by raising their temperature from 32° to 212° Fahrenheit.

Zinc	1 part in 322	Gold	1 part in 682
Platinum	" 351	Bismuth	" 717
Tin (pure)	" 403	Iron	" 812
Tin (impure)	" 500	Antimony	" 923
Silver	" 624	Palladium	" 1000
Copper	" 581	Platinum	" 1100
Brass	" 584	Flint glass	" 1248
Falmouth tin	" 462	Soft rolled iron	" 819
English brass rod	" 528	Prism of cast iron	" 901
Brass wire	" 517	Reflector metal	" 517
Blistered steel	" 870	Refined silver	" 528

Mining Machinery (Molesworth).

Speed of crushing rolls at periphery	60 ft. per minute.
Diameter of " " "	24 to 30 ins.
Breadth of " " "	12 to 15 ins.
Roller shaft	6 ins. square.
Tumbling shaft	4½ "
Sifting screen shaft	1¾ ins. diameter.
Rolls crushed together with a force of	60 tons.
Weight of stamped heads, from	1½ to 5 cwt.
Lift of ditto	9 to 12 ins.
Number of lifts per minute	45 to 60.
Exposed area of cast gratings about	9 × 10 ins.
Number of holes to the inch for tin	140.
Area of stamper bottom, generally	6 × 10 ins.
Pumps for deep mines, usually	8 to 10 ft. stroke.
Each lift	from 150 to 200 ft.

Horse power of pumping engines:—

Q = quantity of water raised per minute, cubic feet.
H = height in feet.
Actual horse power = ·0021 H. Q.

Table showing the quantity of Gold to the ton of Ore, corresponding to the weights in Grains contained from 400 Grains of Mineral.

If 400 grains of Ore give Fine Gold.	One ton of Ore will yield.			If 400 grains of Ore give Fine Gold.	One ton of Ore will yield.		
Grains.	Ozs.	Dwts.	Grs.	Grains.	Ozs.	Dwts.	Grs.
.001	0	1	15	.200	16	6	16
.002	0	3	6	.300	24	10	0
.003	0	4	21	.400	32	13	8
.004	0	6	12	.500	40	16	16
.005	0	8	4	.600	49	0	0
.006	0	9	19	.700	57	3	8
.007	0	11	10	.800	65	6	16
.008	0	13	1	.900	73	10	0
.009	0	14	16	1.000	81	13	8
.010	0	16	8	2.000	163	16	16
.020	1	12	16	3.000	245	0	0
.030	2	9	0	4.000	326	13	8
.040	3	5	8	5.000	408	6	16
.050	4	1	16	6.000	490	0	0
.060	4	18	0	7.000	570	13	8
.070	5	14	8	8.000	653	6	16
.080	6	10	16	9.000	735	0	0
.090	7	7	0	10.000	816	13	8
.100	8	3	8	20.000	1633	6	16

Mr. Black, of San Francisco, estimates that in mining operations the average cost of handling a cubic yard of auriferous gravel with the pan is $20; with the rocker, $5; with the long tom, $1; and with the hydraulic process, 20c.

Stowage of Coals.—The following information will be valuable to many coal dealers and consumers who may be in doubt as to the capacity of their coal bins. A box 4 feet long, 3 ft. 5 in. wide, and 2 ft. 8 ins. deep, has a capacity of 36½ cubic feet, and will contain 2000 lbs. or one ton of Beaver Meadow or Lehigh (American) coal. The spaces occupied by one ton of the undermentioned English coals, economic weight are:—Haswell's Wallsend, 45·25 cubic feet. North Percy, Hartley (Newcastle) 46·93 cubic feet. Balcarras Arley (Lancashire) 44·35 cubic feet. Cannel (Wigan, Lancashire) 46·37 cubic feet. Duffryn (Welsh) 42·09 cubic feet. Pontypool (Welsh) 40·22 cubic feet. Hence, a shed 16 feet high, 20 feet broad, and 30 feet long, will hold over 212 tons of Haswell's Wallsend (Newcastle) coals, about 207 tons of Cannel, and 228 of Duffryn. The *average* space occupied by one ton of Newcastle coal, economic weight, is 44 cubic feet, that of one ton of Lancashire coal, 44½ cubic feet, and that of 1 ton of Welsh coal, 41 cubic feet. Therefore a shed of the above dimensions, would, on the average, hold 217 tons of Newcastle coal, 216 of Lancashire, and 234 of Welsh. From the above data, any intending purchaser can easily calculate the capacity of his coal bins, sheds, &c., and in many cases secure a good bargain by laying in a large stock when coals are cheap.

Explosive force of various substances used for Fire Arms, Artillery, Blasting, &c.

	Heat.	Volume of Gas.	Estimate Explosive Force.
Blasting Powder	509	0.173 liter.	88
Artillery "	608	0.225 "	137
Sporting "	641	0.216 "	139
Powder, Nitrate of Soda for its base	764	0.248 "	190
Powder, Chlorate of Potash for its base	972	0.318 "	309
Gun Cotton	590	0.801 "	472
Picric Acid	687	0.780 "	536
Picrate Potash	578	0.585 "	680
Gun Cotton mixed with Chl. Potash	1420	0.484 "	680
Picric Acid " " "	1424	0.408 "	582
Picrate " " "	1422	0.337 "	478
Nitro-Glycerin	4320	0.710 "	939

The above instructive table is by the celebrated M. Berthelot, who further describes nitro-glycerin as "really the ideal of portable force. It burns completely without residue; in fact, gives an excess of oxygen; it develops twice as much heat as powder, three and a half times more gas, and has seven times the explosive force, weight for weight, and, taken volume for volume, it possesses twelve times more energy." From the extreme danger of the work, none but competent chemists should attempt to manufacture it.

Effects of heat on various bodies:

Fine Gold melts	2590°	Heat, cherry red	1500°
" Silver "	1250	" bright "	1860
Copper melts	2548	" red visible by day	1077
Wrought Iron melts	3980	" white	2900
Cast " "	3479	Mercury boils	662
Bright red " in the dark	752	" volatilizes	680
Red hot " in twilight	884	Platinum melts	3080
Glass melts	2377	Zinc melts	740
Common fire	790	Highest natural temperature (Egypt),	117
Brass melts	1900	Greatest natural cold (below zero)	56
Air furnace	3300	" artificial " "	106
Antimony melts	951	Heat of human blood	98
Bismuth "	476	Snow and Salt, equal parts	0
Cadmium	600	Ice melts	32
Steel	2500	Water in *vacuo* boils	98
Lead	504	Furnace under steam boiler	1100
Tin	421		

Shrinkage of Castings.

Iron, small cylind's=1-16th in. per ft	Ditto, in length . . ⅛ in 16 ins.
" Pipes . . . . =⅛ " " ft.	Brass, thin . . . . = ⅙ in 9 "
" Girders, beams, etc. . . . . . . =⅛ in. in 15 ins.	Brass, thick . . . ⅛ in 10 "
" Large cylinders, the contraction of diameter at top . . . . =1-16th per foot.	Zinc . . . . . . =5-16ths in a foot.
Ditto at bottom . . =1-12th per foot.	Lead . . . . . = 5-16ths " "
	Copper . . . . . = 3-16ths " "
	Bismuth . . . . = 5-32nds " "

Green sand iron castings are 6 per cent. stronger than dry, and 30 per cent. stronger than chilled, but when the castings are chilled and annealed, a gain of 115 per cent. is attained over those made in green sand. Chilling the under side of cast iron very materially increases its strength.

Alloys and their Melting Heats.

No.	Tin	Lead	Bismuth	Fahr.	Modes of Applying Heat
No. 1	1 Tin	25 Lead		258 Fahr.	
2	1 "	10 "		541 "	
3	1 "	5 "		511 "	
4	1 "	3 "		482 "	
5	1 "	2 "		441 "	
6	1 "	1 "		370 "	
7	1½ "	1 "		334 "	
8	2 "	1 "		340 "	
9	3 "	1 "		356 "	
10	4 "	1 "		365 "	a. Naked fire.
11	5 "	1 "		378 "	b. Hollow furnace or muffle.
12	6 "	1 "		381 "	c. Immersion in melted solder.
13	4 Tin	4 Lead	1 Bismuth	320 Fahr,	d. Melted solder or metal poured on.
14	3 "	3 "	1 "	310 "	e. Heated iron, not tin'd,
15	2 "	2 "	1 "	292 "	f. Heated Copper tool, tinned.
16	1 "	1 "	1 "	254 "	g. Blow Pipe flame.
17	2 "	1 "	2 "	236 "	h. Flame alone, generally alcohol.
18	3 "	5 "	2 "	202 "	i. Stream of heated air.

Fluxes.

A. Borax.
B. Sal-am. or mur. of amm.
C. Muriate or chlor. of zinc.
D. Common resin.
E. Venice turpentine.
F. Tallow.
G. Gallipoli oil, or common sweet oil.

WEIGHTS AND MEASURES OF COAL.

In the United States, by the tariff act of 1872, coal is computed at 28 bushels per ton of 2340 pounds, 80 pounds to the bushel. In Pennsylvania 2000 pounds is a ton. In most of the States coal is sold at 2000 pounds to the ton.

In Great Britain a ton is 2240 pounds.
In France 1000 kilogrammes make a ton of 2204.86 pounds.
In Belgium the French ton is the standard.
In Austria 18.14 centuers of 123½ pounds make a ton.
In Spain 14.45 quintals of 155 pounds make a ton.
In Russia 62.22 hords of 36 pounds make a ton.

The following gives the number of cubic feet in a loose ton of coal of the districts named:

BITUMINOUS.	*Cubic feet.*
Cumberland, maximum	42.3
" maximum	41.2
Duffruyn, (Welsh)	42.99
Cannel, Lancashire	46.47
Blossburgh, Pennsylvania	42.2
Hartley, Newcastle	44.
Pictou, Nova Scotia	45.
Pittsburg, Pennsylvania	47.08
Sydney, Cape Breton	47.02
Clover Hill, Virginia	49.02
Cannelton, Indiana	47.
Scotch	43.08
Richmond, Virginia, (Midlothian)	41.04
ANTHRACITE.	
Peach Mountain	41.06
Forest Improvement	41.07
Beaver Meadow, No. 5	39.08
Lackawanna	45.08
Lehigh Company's	40.05
Beaver Meadow, No. 3	40.07
COKE.	
Natural of Virginia	48.03
Pittsburg	70.09
Charcoal	104.

Volume of gas obtained from a ton of the following well-known coals, etc.:

	Cubic feet.
Boghead Cannel	13,334
Wigan Cannel	15.426
Cannel	15,000
Cape Breton	9,500
English *mean*	11,000
Newcastle	10,000
Kilkenny	12,590
Oil of Grease	23,000
Pictou and Sydney	8,000
Pine Wood	11,800
Pittsburgh Coal	9,520

ALLOYS.—The substances produced by the intimate intermixture of metals are sometimes of the nature of distinct chemical compounds, their formation being accompanied by considerable heat-development and their composition being expressible by definite formulæ. In most cases, however, they partake more of the nature of simple mixtures, or of homogeneous solutions converted into the solid state without the separation of particles, differing from one another in physical and chemical nature, of sufficient magnitude to be discernible by a microscope. Nevertheless the formation of these bodies in almost every instance is fairly included in the term "chemical action," according to the usual definition that "chemical action takes place when the properties of the resultant substances are different from those of the original bodies;" for, save in comparatively few instances, the physical and often the chemical properties of an alloy are different from the arithmetical average of those of its components. Thus, according to Matthiessen, all metals excepting zinc, lead, tin, and cadmium, yield alloys, the physical properties of which are not in the proportions calculable from those of the constituents. The physical properties of specific gravity, specific heat, and expansibility are never greatly different in alloys (no matter what the constituents) from those calculable from the constitution; but the properties of fusibility, crystalline form, conductivity for heat, electricity, and sound, elasticity, tenacity, &c., are invariably considerably different from those calculable from the composition (save only alloys containing no constituents other than zinc, tin, lead, or cadmium). The following tables give a general idea of the average composition of many of the more important alloys in common use for various purposes.

	Coinage Alloys.					*Solders.*	
	Standard Gold.		*Standard Silver.*		*Bronze.*	*For Gold*	*For Silver.*
	English.	*French.*	*English.*	*French.*			
Gold	91·667	90	—	—	—	60	—
Silver	8 333	10	92·5	90	—	25	67
Copper			7·5	10	95	15	22
Tin	—	—	—	—	4	—	—
Zinc	—	—	—	—	1	—	11
	100·000	100	100·0	100	100	100	100

Copper Alloys.

(I.) *Brass and Allied Alloys.*

	Tombak.	*Casting Brass.*	*Dutch Metal (or-molu.)*	*Brass for lathe-work.*	*Fine Brass.*	*Munt's Metal.*	*Spelter Solder.*	*Aich's Gun-metal and Gedge's metal*
Copper	80—95	65—72	70—85	60—70	65	60	50	60—62
Zinc	5—20	35—28	15—25	28—38	35	39	50	36—38
Lead	—	—	0—3	2	—	1	—	—
Tin	—	—	0—3	—	—	—	—	—
Iron	—	—	—	—	—	—	—	2

(II.) *Bronzes and Allied Alloys.*

	Gun-metal.	*Bell-metal.*	*Speculum metal.*	*Antique Bronzes.*	*Medal Bronze.*	*Casting Bronze.*
Copper	85—92	65—80	60	70—95	·93	82—83
Tin	8—15	20—35	30	8—15	7	1—3
Antimony	—	0—2	—	—	—	—
Arsenic	—	—	10	—	—	—
Lead	—	—	—	0—1	—	trace—3
Zinc	—	—	—	0—15	—	17—18

(III.) *Copper, Nickel, Zinc Alloys, &c.*

	German Silver (yellowish).	*Chinese Pakfong.*	*White Nickel Silver.*	*German Silver for Casting.*	*Aluminium Bronze.*
Copper	50—60	40	50	49	90—95
Zinc	25—30	25	25	24	—
Nickel	15—20	32	25	24	—
Iron	—	3	—	—	—
Lead	—	—	—	3	—
Aluminium	—	—	—	—	5—10

Lead and Tin Alloy.

	Solders.				*Pewter.*		*Britannia Metal.*	*Queen's Metal.*	*Type Metal.*	*Fusible Metal.*	*Shot.*
	Hard.	*Ordinary.*	*Soft.*	*Pewterer's.*	*Common.*	*Finest.*					
Lead	67	50	33	50	20	—	—	8	75—85	25	98
Tin	33	50	67	25	80	90	88—92	76	0—5	25	—
Antimony	—	—	—	—	—	7	8—12	8	12—25	—	—
Bismuth	—	—	—	25	—	2	—	8	—	50	—
Copper	—	—	—	—	—	2	—	—	—	—	—
Arsenic	—	—	—	—	—	—	—	—	—	—	2

In many instances the precise combination of metals employed for any particular purpose is regarded as a valuable trade secret by the manufacturer, so that the product preferred by one is not necessarily identical with that used by another. Thus, the character of the alloys pewter, Britannia metal, and the like, vary with the manufacturer, and the purpose for which the alloy is intended, &c.; the pewter for tankards (hard pewter) and that employed for covering over public-house bars, &c. (counter metal,) are generally prepared by adding to the tin which forms the basis different amounts of other metals (lead, antimony, bismuth) constituting what is termed "temper." Similarly very different "tempers" are employed to add to tin to form "Britannia metal," "Queen's metal," &c., by different manufacturers; whilst the exact composition of bell-metal is subject to considerable variations according to the size of the bell, &c.

In the practical manufacture of alloys, as a general rule, the materials are melted, (either separately or together), well incorporated, and then cast into ingots or such other form as may be required; some few alloys, however, are prepared in other ways; for example, brass may be obtained by heating copper-plates with a mixture of calamine and small coal, which gives off zinc in the form of vapor; this zinc is absorbed by the copper and retained by it much as a sheet of gold heated over mercury absorbs the mercurial vapor and becomes whitened in consequence. Certain alloys are obtained directly from complex ores, *e.g., spiegeleisen.* The standard alloys used for coinage are prepared by incorporating together the right quantities of the ingredients and casting into bars which are rolled into ribbons of the requisite thickness for the kind of coin required, the degree of thickness being judged by punching out discs or "blanks" and weighing them. When the sheet has been rolled to the requisite extent blanks are punched out by machinery, and are then (after undergoing softening, annealing, and other processes) stamped in the coining press, and passed through a machine which weighs and sorts the coins into those of the just weight (or rather which fall within a slight difference from the true weight, termed the "remedy"), those which are too light and those which are too heavy. These incorrect pieces are melted up again and the metal employed a second time. Great care must be taken in the selection of the copper used for alloying with the gold or silver, and also purity of the precious metal employed is essential, as minute quantities of foreign metals in the coinage-alloy impair its softness, and either prevent it from rolling or taking the impression from the dies, or render it brittle.

The verification of the correctness of the mixture of metals employed (*assaying*) is a most important part of minting operations. In the case of gold coins the process employed depends on the circumstances that whilst neither gold nor silver will oxidize in hot air, other metals, especially in presence of a certain quantity of lead, will do so, so that a separation of precious and common metals may be thus effected with due precautions; also that from an alloy of gold and silver containing not less than two or three parts of silver to one of gold hot nitric acid will dissolve out the silver, leaving behind the whole of the gold (*Quartation*). The metal to be assayed is accurately weighed, pure silver to the extent of two or three times its weight added, and the whole rolled up in a piece of pure sheet lead weighing from six to ten times the amount of gold present (the quantity of lead varying with the amount of foreign alloy). The whole is then heated in a "cupel" (made of bone-ash compressed in a mould) placed in a "muffle," by a furnace. The fused mass oxidises on the surface, the lead, whilst oxidising, causing copper and other base metals present to oxidise too; the fused oxides are absorbed by the porous cupel and finally a button of pure gold and silver is left. This is rolled out into a ribbon, annealed, twisted up into a "cornet" and acted on by hot nitric acid, whereby the silver is dissolved out and the pure gold left. After annealing, the residual gold cornet is weighed, and thus the weight of gold present known. If silver be also present, another portion is cupelled with lead without the addition of pure silver; the difference between the weight of the button thus obtained and the pure gold previously found representing the silver present. Silver alloys may be similarly cupelled with lead; or may be dissolved in nitric acid, and the silver estimated by precipitation with a soluble chloride, the silver chloride thrown down being collected and weighed, or else the bulk of a chloride solution of known strength required to completely precipitate the silver being noted.

Certain of the metals and alloys commonly used for household and other purposes, give rise, by their corrosion, to poisonous substances; and in consequence the contact of articles made of such materials with alimentary products not unfrequently gives rise to illness, and sometimes produces fatal results. Lead, copper, and zinc are the metals most injurious in this respect, especially the first. When most kinds of drinking-water are allowed to stand in leaden pipes or cisterns a certain amount of the noxious metal is taken into solution, or becomes suspended in the water; wherefore, whenever water is drawn from a housepipe for drinking purposes the portion which first runs out should be rejected as being liable to contain lead from the pipe; whilst no water from lead cisterns should ever be used for culinary or potable purposes. Tinned meats, fruits, and the like, are apt to contain lead from the presence of that metal in the impure tin used in making the tinplate canisters, or from that in the soldering junctions. Beer, &c., that has stood in the tubes of a beer-engine all night is apt to contain lead, and cases of lead-poisoning are on record from the continued use of the ale first drawn in the morning. Similarly soda-water, and aërated waters generally, as well as artificially prepared sparkling wines, (more commonly met with than is supposed), are apt to contain lead from the aërating apparatus, whilst pickles, &c., sometimes contain it from the pewter capsule of the bottles in which they are sold. Brass and copper stew-pans occasionally become verdigrised, whilst preserved peas, pickles, and the like, are often purposely treated with copper compounds to improve the color. For the same reason many cooks habitually boil greens for the table with a rusty pennypiece or brass or copper bolt, etc. Acid or saccharine liquids sometimes act on galvanized iron vessels, taking up zinc therefrom. In order to diminish some of these risks, tubes are now manufactured for water supply, beer-engines, and the like, in which the outside portion of the pipe is composed of lead, but the internal lining is of pure block tin, so that liquids passing through such pipes cannot take up lead unless the tin lining be first eaten through, which is unlikely in most cases, from the less tendency to oxidise and rust exhibited by tin. Even tin, however, is not always free from objection on the score of corrosion under certain circumstances, and consequent impregnation of food with deleterious metallic compounds; the author has recently met with instances of this action in the case of preserved fruits, etc., put up in ordinary tinned canisters; an unpleasant metallic taste was noticeable, and on analysis considerable amounts of *tin* were detected in solution in the juice, besides iron from the underlaying metal of the tinplate; in one case, violent colic and diarrhœa lasting for several hours, was produced in the persons partaking of the preserved fruits; this corrosive action on tin has only been noticed as yet in the case of very *acid* fruits, etc., such as apples and rhubarb.

COMPOSITION OF BRONZE FOR MACHINERY.

Below will be found the composition of alloys approved of and used by prominent French mechanics in government and railway work.

FRENCH MARINE.	*Copper.*	*Tin.*	*Zinc.*
Tough bronze for rods, valves, etc.,	88	12	2
Very tough bronze for eccentric straps, etc	90	10	2
Bronze for plummer blocks	86	14	2
Hard bronze	84	16	2
Very hard bronze for steam brass-cocks	82	18	2
Bell bronze	78	22	0
Anti-friction bronze, with 8 parts antimony	4	96	0
FRENCH RAILROADS.			
Car pillows	82	18	2
Locomotive and tender oil boxes	84	16	2
" slide valves	82	18	2
Cocks	88	12	2

The bronze composed of eighty-six copper, fourteen tin, and two zinc, is least porous, and therefore is most suitable when pressure is to be resisted.

—*Compiled from "Metals and their Chief Industrial Applications, by C. R. A. Wright, D. Sc."*

VALUE OF BARS.

Large bullion scales, and troy weights, are not always at hand; yet it is often desirable to know the value of a bar before sending it from the works, and as good counter scales, with avoirdupois weights, are generally accessible, the following facts may be found useful.

The assay value of one avoirdupois pound of pure silver is $18.85; that of one avoirdupois ounce is $1.17. The pound of pure gold is worth $301.44, and the ounce $18.84. Hence it is easy to calculate the value of a bar of which the fineness is known, and which has been weighed on common counter scales to the nearest quarter ounce. For example, a silver bar is .969 fine, and weighs 82 lbs. 3¼ ounces.

Then : $18.85 × .969 = $18.26 × 82 = $1,497.32
and 1.17 × .969 = 1.13 × 3¼ = 3.67

Making the value of the bar $1,500.99

Each 1-1000th of silver in a bar is worth 1.885 cents, and each 1-1000th of gold 30.14 cents per avoirdupois pound; therefore, if in the above example the bar contained also a little gold, say .003, and perfect accuracy is not required, it would be sufficient to add to the value 3 times 30.14 cents for each pound weight, or in all $74.14. Again, a gold bar is .969 fine and weighs 7 lbs. 13½ ounces, or 125½ ounces; then 18.84×.969 =18.26×125½=$2,291.63. Or, the value of a gold bar may be calculated as though it were silver, and the result multiplied by 16.

The commercial or market value is different from the assay value. The discount on silver varies from 10 per cent. to 15 per cent. of the assay value, to which is added ½ of 1 per cent. for mintage, or assayer's fee. Gold bars free from base metal are subject to a discount or a premium, equal to 1.10 of one per cent. for every 10 "points," or thousandths, above or below the quoted par fineness; discount if above, premium if below. The apparent anomaly is due to the fact that, if there is no base metal in the bar, all that is not gold is silver, whence, at par fineness, there is just enough of silver in the bar to pay parting charges, etc., while in a finer bar those charges must be met by a discount on the value of the gold. Conversely, a bar which is below par fineness commands a premium for the extra silver it contains. On account of this arrangement, bars which are more than half gold are stamped with the gold value only, unless they contain much base metal, when both gold and silver value is stamped on them. These facts we take from Aaron's "Leaching of Gold and Silver Ores," for sale by Dewey & Co.

Mixed bars, in which the gold forms a large part of the value, but less than half the weight, are called "dore" bars, and are stamped with the value of both the gold and the silver.

ATMOSPHERIC AIR.

The volume of carbonic acid gas given off daily by human respiration averages 4.08 per cent. of the air respired.

In twenty-four hours a man gives off 10.7 cubic feet of carbonic acid gas, and receives from the atmosphere the same volume of oxygen.

An ordinary sized candle consumes as much oxygen, during combustion, as the respiration of a man.

The volume of pure air required for the respiration of a man in twenty-four hours is 266 cubic feet.

A miner's lamp will not burn in an atmosphere containing 3 per cent. of carbonic acid gas. The miner himself will live for several hours after his lamp becomes extinguished.

One cubic foot of air at the surface of the earth, with the barometer at 30 degrees and the thermometer at 34 degrees, weighs 527.04 grains, and is 829.43 times lighter than water.

The mean weight of a column of air a foot square, at the level of the sea, is 2120.14 pounds, and is equal to the support of 33.95 feet of water.

Thirteen thousand eight hundred and seventeen feet of air weigh a pound avoirdupois.

Air contains 21 parts of oxygen and 79 parts of nitrogen by volume, and in 1000 parts there are 4.9 parts of carbonic acid gas.

The rate of expansion of air and all elastic fluids for all temperatures is uniform. From 32 degrees to 212 degrees they expand from 1000 to 1376, equal to $\frac{1}{478}$ for each degree of their bulk for every degree of heat applied.

CARBONIC ACID GAS.

The difference in constitution and temperament of individuals makes it impossible that any exact rule should be laid down as to the precise quantity of carbonic acid which may be present in the air without injury to respiration, but it may be safely asserted that it is not advisable to breathe for any length of time in air containing more than ($\frac{1}{1000}$) one-tenth of one per cent. of its volume of carbonic acid.

There appears to be no immediate danger, however, until the carbonic acid amounts to one-two-hundredths, or five-tenths of one per cent., when most persons are attacked by languor and headache, attending the action of this gas A larger proportion of carbonic produces insensibility, and air containing one-hundredth of its volume of carbonic causes suffocation.

WATER.

Water contains 88.9 parts of oxygen and 11.1 parts of hydrogen, by weight, and 1 part of oxygen and 2 parts of hydrogen, by measure.

One cubic inch of distilled water at its maximum density of 39.83 degrees, and the barometer at 30 inches weighs 252.6839 grains. A cubic foot weighs 62.37925 pounds avoirdupois. For facility of computation a cubic foot of water is taken at 62½ pounds. The standard gallon of water, contains 231 cubic inches and weighs 8.3388822 pounds avoirdupois. The British imperial gallon measures 277.274 cubic inches and weighs 10 pounds.

35.84 cubic feet of water weigh a ton.

39.13 cubic feet of ice weigh a ton.

34.83 cubic feet of sea water weigh a ton.

COMBUSTION OF COAL.

The constituents of coal are carbon, hydrogen, azote and oxygen.

The volatile products of the combustion of coal are hydrogen and carbon, the union of which relating to combustion in a furnace are carbureted hydrogen and bi-carbureted hydrogen or olefiant gas, which upon combining with atmospheric air becomes carbonic acid or carbonic oxide, steam and uncombined nitrogen.

Carbonic oxide is the result of imperfect combustion, and carbonic acid of perfect combustion. The perfect combustion of carbon evolves heat as 15 to 4.55 compared with the imperfect of it, as when carbonic oxide is produced 1 pound of carbon combines with 2.66 pounds of oxygen, and produces 3.66 pounds of carbonic acid.

Weight of a cubic foot of Coal after it has been mined and broken up.

Anthracite, (Peach Mountain)	53.79 pounds.
Semi-bituminous, (Frostburgh)	53 "
" " (Blossburgh)	53 "
Bituminous, (Newcastle)	50.82 "
" (Pictou)	49.25 "
" (Pittsburgh)	46.81 "
Cannel, (Wigan)	48.03 "

The average weight of a cubic foot of solid coal is 83 pounds. It contains 1728 cubic inches. One cubic yard of solid coal (27 cubic feet) weighs 2240 pounds—1 ton—and contains 46656 cubic inches.

A bushel of loose coal, of 80 pounds, contains 2688 cubic inches. A bushel of 75 pounds contains 2520 cubic inches.

METRICAL ABBREVIATIONS.

It may interest our readers to know that the following abbreviations for metrical units have recently been decreed by the Spanish Government for Spain and its colonies:

Kilometer	km.	Cubic decimeter	dm³.
Meter	m.	Cubic centimeter	cm³.
Decimeter	dm.	Cubic millimeter	mm³
Centimeter	cm.	Hectoliter	hl.
Millimeter	mm	Decaliter	dal.
1-1000 millimeter	m.	Liter	l.
Square kilometer	km².	Deciliter	dl.
Hectare	ha.	Centiliter	cl.
Are	a.	Ton	t.
Square meter	m²	Metrical cwt	q.
Square decimeter	dm².	Kilogram	kg.
Square centimeter	cm².	Gram	g.
Square millimeter	mm².	Decigram	dg.
{Stere	S.	Centigram	cg.
{Cubic meter	m³.	Milligram	mg.

RECKONING QUANTITY OF COAL IN PLACE.

A summary way of reckoning the quantity of available coal in a given area of a seam is to take an acre of coal one inch thick to contain 100 tons; this leaves a sufficient margin for faults and loss in working.

Example: A seam of coal 24 inches thick will yield 2,400 tons per acre. But to ascertain the exact quantity of coal under a given area—presuming the seam to be lying of regular thickness and quality throughout—the first thing necessary is to obtain the specific gravity; then, as this represents the weight of a cubic foot in ounces, it is a simple matter of calculation to obtain the gross weight.

The exact weight of coal seams can be got from the table below:

Specific gravity.	*Weight in the natural bed, per acre, pe inch thick, in tons.*	*Weight of a cubic foot in the broken state. in lbs.*	
		Large coal.	*Small coal.*
1.10	111.411	43.62	37 12
1.15	116.475	44.56	38.81
1.20	121.540	46.50	40.50
1.25	126.604	48.43	42.18
1.30	131.668	50.37	43.87
1.35	136.732	52.31	45.56
1.40	142.796	54.25	47.25
1.45	146.860	56.18	48.93
1.50	151.925	58.12	50.62

If the figures in the second column be multiplied by the number of inches any coal seam is in thickness, the result will be the contents in tons per acre.

The weight of coal in its broken state, that is, as it comes to the surface in tubs or otherwise, will depend on its mechanical structure; it has here been computed to weigh in proportion to the solid coal as 62 is to 100, and the weight of the small as 54 is to 100.

RULES FOR THE PREPARATION OF ALLOYS OF A GIVEN FINENESS.

Manufacturers of silverware may obtain an alloy of silver of any desired fineness in melting fine silver with silver of an inferior quality by observing the following rules:[1]

Obtain the difference between the two higher finenesses and divide by the difference between the two lower; the quotient indicates the number of ounces of the silver to be raised in fineness, which are required to be added to one ounce of fine silver.

Example.—Required to raise a quantity of silver of the fineness of $\frac{867}{1000}$ to $\frac{900}{1000}$ by the mixture with it of fine silver at $\frac{999}{1000}$.

Difference between the two higher finenesses $\frac{99}{1000}$. Difference between two lower finenesses $\frac{33}{1000}$. 99÷33=3. From this it appears that one ounce of fine silver at $\frac{999}{1000}$ will raise the fineness of three ounces of silver at $\frac{867}{1000}$, so that the compound will consist of four ounces at $\frac{900}{1000}$.

MODE OF VALUATION.

According to law, the standard gold of the United States consists in 1000 parts by weight, of 900 of pure gold and 100 of an alloy composed of copper and silver.

[1] This and the following rules are extracted by special permission from the "Bullion dealers' Guide," by George W. Edelman, which contains many valuable tables useful to dealers in the precious metals.

Three hundred and eighty-seven ounces of pure gold are worth $8,000, and 99 ounces of pure silver are worth $128. These relations furnish the following proportions, from which are readily derived the subjoined rules:

For Gold.—As 1000 : $\frac{8000}{387}$, or as 99,000 : 128 : : the given weight multiplied by its particular fineness in thousandths: the value of said weight.

For Silver.—As 1000 : $\frac{128}{99}$, or as 387 : 8 : : the given weight multiplied by its particular fineness in thousandths : the value of said weight.

RULES.

To find the value in the United States money of any number of troy ounces of gold or silver, the weight and fineness being given:

For Gold.—Multiply the given weight by the fineness and by 8, and divide the product by 387.

For Silver.—Multiply the given weight by the fineness and by 128, and divide the product by 99,000.

SHORT METHODS OF CALCULATION.

FOR GOLD.—1. *To Convert Weight into Value.*—Multiply the weight by double the fineness, add to the product $\frac{1}{30}$ thereof, plus $\frac{1}{129}$ of the $\frac{1}{30}$ the answer will be in cents.

Example.—What is the value of 1,258 ounces at 774 thousandths?

	1258 × 1548 =	19473.81
	$\frac{1}{30}$	649.128
	$\frac{1}{129}$	5.032
Answer:		$20,128.00

By this rule the value of one ounce of gold, of any fineness, may be readily determined.

Example.—What is the value of 1 ounce at 658½ thousandths?

	658½ × 2 =	1317.
	$\frac{1}{30}$	43 9
	$\frac{1}{129}$	.34
Answer:		$13.6124

The division by 129 being somewhat difficult, it will be found sufficiently accurate, in most cases, to divide by 130.

2. *To Convert Value into Standard Weight.*—Divide the value in dollars by 20, this quotient by 20, and the second quotient by 2, add the three quotients together; the answer will be in standard ounces.

Example.—What is the weight in standard ounces of $154,686 56?

	20)	154686.56
	20)	7734.328
	2)	386.7164
		193.3582
Answer:		8314.4026 ounces.

FOR SILVER.—1. *To Convert Weight into Dollar Value.*—Add to the weight in standard ounces $\frac{1}{11}$ thereof, plus the $\frac{8}{10}$ of the $\frac{1}{11}$; the answer will be in dollars.

Example.—What is the value of 1268.30 standard ounces?

		1268.30
	$\frac{1}{11}$	115.30
	$\frac{8}{10}$ of $\frac{1}{11}$	92.24
Answer:		1475.84

2. *To Convert Dollar Value into Standard Ounces.*—Subtract from the value $\frac{1}{8}$ thereof, plus $\frac{1}{8}$ of this quotient; the answer will be in standard ounces.

Example.—What is the weight of $1475 84?

		$1475.84
	$\frac{1}{8}$	184.48
	$\frac{1}{8}$	23 06
		207.54
Answer:		1268.30 standard ounces.

MINERS' INCHES FOR VARIOUS HORSE POWERS.

Since the measure of a large quantity of water is most apparent to the mind from a consideration of the size of the opening which is required for its passage at a certain fixed velocity, the miners' inch forms a good standard of measurement. Four miners' inches will permit the passage of sufficient water in one minute to give an effect, with a fall of 100 feet, of one-horse power, at a percentage of 80. The scale has been constructed upon this standard by the "Union Iron Works" of San Francisco. (See next page.)

The diagonal lines in the left-hand section represent heads of water from 4 feet to 500 feet. The column at the bottom shows the number of miners' inches to one-horse power for the various heads. To find how many inches are required for one-horse power at any head, the horizontal line occurring at the intersection of the line on the right with the margin, is followed to the diagonal marked 500 HP. The perpendicular line at this intersection is followed to the column of miners' inches, where the amount is indicated. Thus, with ten feet head, the horizontal line at the intersection with the margin is followed to the line marked 500 HP. Here a vertical line intersects, which, on being followed to the column of miners' inches, indicates 40 inches to one-horse power.

The remaining portion of the scale is simply a scale of multiplication. The diagonals represent horse powers from 10 to 500. The perpendicular lines represent miners' inches to one-horse power, and are numbered from one up to ten. By following the line of inches to the line of the horse power, and then taking the horizontal line to the margin at the right, the number of miners' inches for the horse power are found indicated in the margin. Thus, four inches followed to 300-horse power, and then carried to the margin at the right, indicate 1,200 inches. The result may also be found by one operation. Suppose that there is required the number of miners' inches necessary to 200-horse power at a head of six feet. The horizontal line followed from the intersection of the six-feet line on the left margin, to the line 500 HP., gives the vertical line of 64; this line carried to the line of 200 HP., gives the horizontal line of 1,280; but, since the line of 64 has 10 times the value at the end from which we have worked that it has at the other end, the horizontal line will in this case have a value 10 times as great as the margin indicates. This will make the result 12,800 inches for 200-horse power at six feet head.

—*Mining and Scientific Press*

A MINER'S INCH OF WATER.

There is no legal or other authoritative determination of the quantity of water meant by a miner's inch; neither is there any uniform method of ascertaining it; and even if there were, unless the method employed makes allowances for the influences of latitude, altitude, and temperature, the result could not be exact. The following are some of the various determinations of a miner's inch, which have fallen under our observation. The gallons mentioned are Winchester gallons, and the pounds avoirdupois. In the California State legislature of 1866–'67, a bill was introduced which defined a miner's inch to be $2\frac{1}{3}$ cubic feet, or $7\frac{4}{10}\frac{054}{000}$ gallons, or $145\frac{86}{100}$[1] pounds of water per minute. (Mineral Resources 1868, p. 184.) If 2.3333 cubic feet=7.4054 gallons, then 1 cubic foot=3,17374 gallons: and if 7.4054 gallons=145.86 pounds, then 1 gallon=19.6964 pounds. It also follows that 1 cubic foot=62.51125 pounds. The equivalents of 1 cubic foot assumed in this bill are, therefore, as follows: One cubic foot=3.17374 gallons=62.51125 pounds. These equivalents are wrong. One gallon=231 cubic inches. (Kelley's Cambist. II, 235.) Therefore, 1.728 cubic inches, or 1 cubic foot=7.48052 gallons. One gallon of water weighs 8.3388 pounds; therefore, 7.48052 gallons or 1 cubic foot, weighs 62.37856 pounds. The true equivalents of 1 cubic foot are, therefore, as follows: One cubic foot= 7.48052 gallons=62.37856 pounds. The assumed and the true equivalents are nearly alike with respect to the relation between cubic feet and pounds; but they differ very widely with respect to the relations between gallons and feet and gallons and pounds. In reducing the terms mentioned in this bill to the number of gallons which would be supplied by a miner's inch in twenty-four hours, it becomes necessary to choose between the feet, gallons, and pounds which it erroneously assumes to be equivalents. Taking the feet as the basis of calculation, a miner's inch, according to this bill, would supply 25,134.48 gallons in twenty-four hours.

1 This quantity of water—145.86 pounds per minute, herein erroneously assumed to be equal to 7.4054 gallons per minute—is the determination of a machinist's inch, not a miner's inch.

2. The above bill was referred to a committee on mines, which reported a substitute defining a miner's inch as that quantity of water which would pass through an orifice one inch square, through plank one inch thick with a pressure of seven inches, measured from the centre of the orifice to the surface of the water; provided the water has no other motion than that caused by its flow through such orifice. This determination of the miner's inch is unspecific. Both the original bill and substitute were indefinitely postponed. (Mineral Resources, 1868, p. 184.)

3. At Smartsville, California, a miner's inch is calculated to discharge 2.534.4 cubic feet in twenty-four hours, or 1.76 cubic feet per minute. (Pacific Rural Press, Nov. 17, 1877.) Hence, 2,534.4×7.48052=18,958.53 gallons in twenty-four hours.

At the Parke Canal (Eureka ditch), Placerville, California, a miner's inch is reckoned at 1.39 cubic feet per minute. (*Ibid.*) Hence, 1,329×7·48052×1,140=14,972.68 gallons in twenty-four hours.

5. At the South Yuba Canal, Nevada City, California, a miner's inch is that quantity of water which will pass through a 2-inch hole in a 1½ inch plank with 6 inches pressure. (*Ibid.*) This is unspecific.

6. The miner's inch used at the North Bloomfield, Milton, and La Grange placer mines, California, was practically measured at Columbia, a place whose altitude above the sea was assumed at 2,900 feet. The aperture employed measured 20 by 2 inches, and was made through a 3-inch plank. The last or outer inch of the aperture was chamfered at the bottom, so as to form a sort of lip, out of which the water flowed. The pressure was that of 7 inches of water, measuring from the center of the discharge. The result was, in effect, that 1 inch actually discharged 1.5744 cubic feet per minute, or 2,267.135 cubic feet per day of twenty-four hours, and that this result bore a ratio of 61.6 per cent. to the theoretic discharge of a miner's inch, assumed in the arithmetical formula employed at the mines mentioned. (*Ibid.*) Hence, 2,627.136×7.48052=16,959.36 gallons in twenty-four hours.

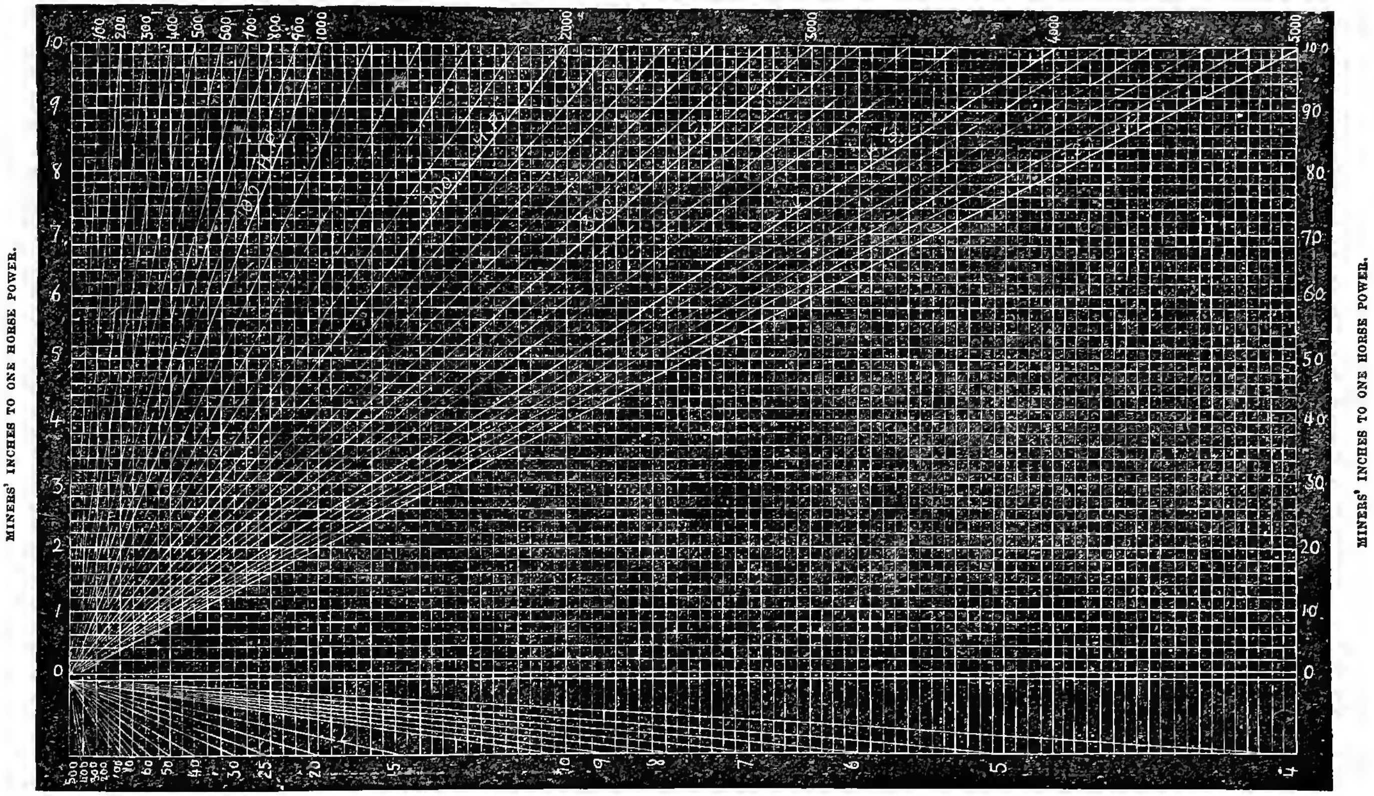
7. Mr. Culver, of San Francisco, says that a miner's inch is the quantity of water that will flow through a 1-inch aperture in a 2-inch plank, the water having a 6-inch head. This quantity, he says is 17,032 gallons in twenty-four hours.

8. Mr. James A. Gibson, an attorney of San Bernardino, California, who has made some researches, says, on the subject, that a miner's inch is that quantity of water that will flow through an aperture with a free discharge and constant pressure of 6 inches above the top of the opening. This determination is unspecific. He then goes on to say that an aperture 12½×15¾ will discharge 200 inches of water. This is erroneous, for 12½×15¾=196,875, and not 200. Finally, he says that a miner's inch will discharge 2,250 cubic feet, or 17,000 gallons, or 130,500 pounds of water in twenty-four hours. These equivalents are not precise. For 2,250×7,48052=16,831.17, and not 17,000. And 2,250×62.37856=140,361.76, and not 130,500. And 8.3388×17,000=141,759.6, and not 130,500. And 16,831.17×8.3388=140,351.76, and not 130,500. But the number of gallons flowing in twenty-four hours is specifically stated, and this is the determination which is now being sought.

9. According to "Mineral Resources, 1871, page 447," a miner's inch equals 17,033.46 gallons in twenty-four hours. Neither of these determinations can be regarded as entirely satisfactory. No. 1 is evidently a theoretical calculation; Nos. 3 and 4 are not sufficiently specific; No. 6 is objectionable on account of the aperture employed having been chamfered; Nos. 7 and 8 are not sufficiently specific; No. 9 is believed to be correct for the altitude where it was taken; but this is not positively specified, the determination must be regarded as defective in this respect. Perhaps the most practical, because the nearest even figure is 17,000 gallons in twenty-four hours, and, in the absence of any legal determination, this may be regarded as the correct equivalent of a miner's inch of water.

From the Mining Record.

MINERS' INCHES TO VARIOUS HORSE POWERS.



HEADS IN FEET.

Mean Relative Evaporating Power of different Fuels and Total Heat of Combustion.

Fuel.	Water Evaporated from 212°.	Evaporated Power.	Total heat in Thermal Units.
	Lbs.		
Anthracite coal.	9.5	1.	15 225
Bituminous coal.	8.75	.92	14 700
Bituminous coal, caking. . .	. . .	.	15 837
Bituminous coal, canned. . . .	. .	.	15 080
Coke, natural	9.	.95	13 620
Coke, artificial	8.5	.89	12 760
Pine wood.	4.35	.45	7 215
Peat	5.5	.58	9 650
Patent fuel, Warlilch's *maximum*	10.36	1.09	.
Patent fuel, Bell's *minimum* . .	8.53	.89	. . .

Relative Values of different Fuels.

Description of Coal, etc.	Pounds of Steam raised from Water at 212° Fahr. by 1 lb. of Fuel.	Relative Evaporative Power for equal Weights of Coal.	Relative Evaporative Power for equal Bulks of Coal.	Relative Rapidities of Ignition.	Relative Freedom from Waste.	Relative Completeness of Combustion.	Relative Weights.
Anthracites.							
Peach Mouotain, Pa. .	10.7	1.	1.	.505	.633	.725	.945
Beaver Meadow, No. 5 .	9.88	.923	.982	.207	.748	.6	1.
Bituminous.							
Newcastle.	8.66	.809	.776	.595	.887	.346	.904
Picton (Cunard's) . .	8.48	.792	.738	.588	.418	1.	.876
Liverpool	7.84	.733	.663	.581	1.	.333	.852
Cannelton, Ind . . .	7.34	.686	.613	1.	.984	.578	.848
Scotch	6.95	.649	.625	.521	.499	.649	.969
Pine wood, dry	4.69	436	.175	. . .	16.417	. . .	. . .

Destructive Distillation of various Coals.

Coal.	Coke.	Tar.	Water.	Ammonia.	Carbonic Acid.	Sulph. Hydrogen.	Olefiant Gas and Hydro-carbon.	Other Gases Inflammable
Anthracite	92.9	. . .	2.87	.2	.06	.04	. . .	3.93
Oldcastle Fiery Vein. . .	79.8	5.86	3.39	.35	.44	.12	.27	9.77
Binea Coal . . .	88.1	2.08	3.58	.08	1.68	.09	.31	4.08
Llaogennach	83.69	1.22	4.07	.08	3.21	.02	.43	7.28

Miscellaneous.

One pound of anthracite coal in a cupola furnace will melt from 5 to 10 lbs. of cast iron; 8 bushels of bituminous coal in an air furnace will melt 1 ton of cast iron.

Small coal produces about ¾ the effect of large coal of the same description.

Experiments by Messrs. Stevens at Bordentown, N. J., gave the following results:

Under a pressure of 30 *lbs.*, 1 lb. pine wood evaporated 3.5 to 4.75 lbs. water, 1 lb. Lehigh coal, 7.25 to 8.75 lbs.

Bituminous coal is 13 per cent. more effective than coke for equal weights; and in England the effects are alike for equal costs.

Radiation from Fuel.—The proportion which the heat radiated from incandescent fuel bears to the total heat of combustion is,

From Wood. . . . . .29 | From Charcoal and Peat 5

The least consumption of coal yet attained is 1½ lbs. per indicated horse-power. It usually varies in different engines from 2 to 8 lbs.

The bulk of pine wood is about 5⅓ times as great as its equivalent bulk of bituminous coal.

CALENDAR, 1882-3.

1882.	Su	Mo	Tu.	We.	Th.	Fri.	Sat.
JULY.							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30	31					
AUG...			1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		
SEPT..						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
OCT...	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				
NOV...				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30		
DEC...						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31						

1883.	Su.	Mo.	Tu.	We	Th.	Fri.	Sat.
JAN...		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31			
FEB...					1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28			
MAR..					1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
APR...	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30					
MAY..			1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		
JUNE.						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30

PART IX.

THE ROMANCE OF MINING—MINE ACCIDENTS—MINE SUPERSTITIONS—THE MINING REGIONS—THE PRACTICAL PART OF MINING.

COLORADO and the mining States to many an Eastern man who obtains his impression from nowhere particularly, are not much more than a succession of huge, deserted brickyards. The very name of the State conjures up forsaken mining camps, ragged ravines, and barren mountains, rocks, plains and precipices that go to make up a very uninviting view, and yet if you question him as to the source of his impressions he can give none. But ignorance of the west is very common in the East where much more is known concerning the summits of the Alps, the shady sides of the Pyrenees, the fjiords of Norway than the glorious and surprisingly wonderful scenery of the Western States. Partly for this reason we have inserted in various places in this volume illustrations of Western scenery, of which the frontispiece is an admirable example, and open PART IX of the MINES, MINERS, AND MINING INTERESTS OF THE UNITED STATES, with a number of illustrations of a magnificent region. In this Part we have also brought together something of the more picturesque, less prosaic side of the mining industry, something about the superstitions, the weird ideas, the bravery, the kaleidoscopic life of the mining classes. To this much of a scientific nature has been added, and some papers that have not found a place in this volume until now. A series of articles upon the practical side of mining are included. They were prepared for this volume by Mr. Alfred Balch, of New York. Some of the articles in this Part are rendered more valuable by a free use of the engraver's art, the illustrations aiding materially the force of the text.

THE PHYSICAL GEOLOGY OF THE GRAND CANYON DISTRICT.

THE Grand Canyon District is a part of the Plateau Province, and to this province as a whole we may now devote our attention. As already indicated, it lies between the Park and Basin Provinces, and its topography differs in the extreme from those found on either side of it. It is the land of tables and terraces, of buttes and mesas, of cliffs and canyons. Standing upon any elevated spot where the radius of vision reaches out fifty or a hundred miles, the observer beholds a strange spectacle. The most conspicuous objects are the lofty and brilliantly colored cliffs. They stretch their tortuous courses across the land in all directions, yet not without system; here throwing out a great promontory, there receding in a deep bay, and continuing on and on until they sink below the horizon or swing behind some loftier mass or fade out in the distant haze. Each cliff marks the boundary of a geographical terrace and marks also the termination of some geological series of strata, the edges of which are exposed like courses of masonry in the scrap-walls of the palisades. In the distance may be seen the spectacle of cliff rising above and beyond cliff, like a colossal stairway leading from the torrid plains below to the domain of the clouds above. Very wonderful at times is the sculpture of these majestic walls. There is an architectural style about it which must be seen to be appreciated. The resemblances to architecture are not fanciful or metaphorical, but are real and vivid; so much so that the unaccustomed tourist often feels a vague skepticism whether these are truly the works of the blind forces of nature or of some intelligence akin to the human, but far mightier; and even the experienced explorer is sometimes brought to a sudden halt and filled with amazement by the apparition of forms as definite and eloquent as those of art. Each geological formation exhibits in its cliffs a distinct style of architecture which is not reproduced among the cliffs of other formations, and these several styles differ as much as those which are cultivated by different races of men. The character which appeals most strongly to the eye is the coloring. The gentle tints of an eastern landscape, the pale blue of distant mountains, the green of vernal or summer vegetation, the subdued colors of hillside and meadow, are wholly wanting here, and in their place we behold belts of brilliant red, yellow, and white, which are intensified rather than alleviated by alternating belts of gray. Like the architecture, the colors are characteristic of the geological formations, each series having its own group and range of colors. They culminate in intensity in the Permian and Lower Trias, where dark, brownish red alternate with bands of chocolate-purple, and lavender, so deep, rich, and resplendent that a painter would need to be a bold man to venture to portray them as they are.

The Plateau country is also the land of canyons, in the strictest meaning of the term. Gorges, ravines, canyads are found and are more or less impressive in every high region; and in the vernacular of the West all such features are termed canyons, indiscriminately. But those long, narrow, profound trenches in the rocks, with inaccessible walls, to which the early Spaniards gave the name of *cajon* or *canyon*, are seldom found outside the plateaus. There they are innumerable and the almost universal form of drainage channels. Large areas of the Plateau country are so minutely dissected by them that they are almost inaccessible, and some limited though considerable tracts seem wholly so. Almost everywhere the drainage channels are cut from 500 to 3,000 feet below the general platform of the immediate country. They are abundantly ramified and every branch is a canyon. The explorer upon the mesas above must take heed to his course in such a place, for once caught in the labyrinth of interlacing side gorges, he must possess rare craft and self-control to extricate himself. All these drainage channels lead down to one great trunk channel cleft through the heart of the Plateau Province for eight hundred miles—*the chasm of the Colorado*, and the canyons of its principal fork, the Green River. By far the greater part of these tributaries are dry during most of the year, and carry water only at the melting of the snow and during the brief periods of autumnal and vernal rains. A very few hold small, perennial streams, coming from the highlands around the borders of the province, and swelling to mad torrents in times of spasmodic floods. The region is for the most part a desert of the barrenest kind. At levels below 7,000 feet the heat is intense and the air is dry in the extreme. The vegetation is very scanty, and even the ubiquitous sage (*Artemisia tridentata*) is sparse and stunted. Here and there the cedar

WESTERN SCENERY.—SIDE CANYON.

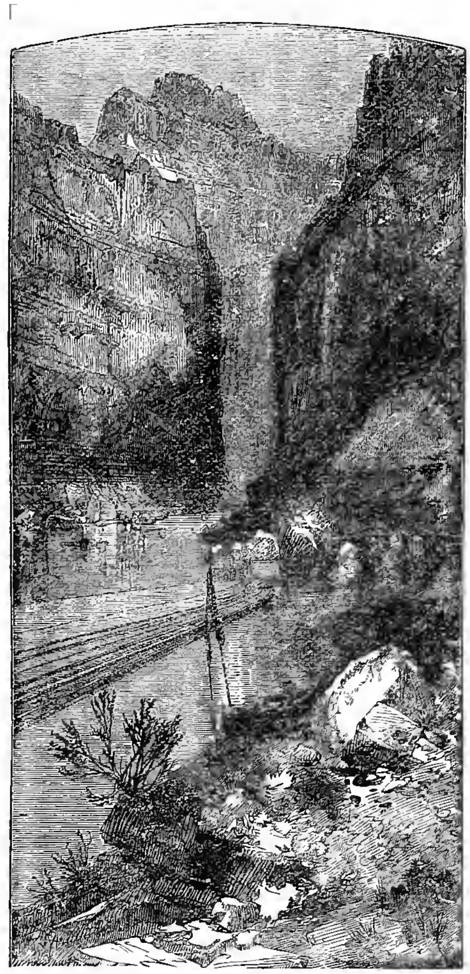
(*Juniperus occidentalis*) is seen, the hardiest of arborescent plants, but it is dwarfed and sickly and seeks the shadiest nooks. At higher levels the vegetation becomes more abundant and varied. Above 8,000 feet the plateaus are forest-clad and the ground is carpeted with rank grass and an exuberant growth of beautiful summer flowers. The summers there are cool and moist; the winters severe and attended with heavy snow-fall.

The Plateau Province is naturally divided into two portions, a northern and a southern. The dividing barrier is the Uinta range. This fine mountain platform is in one respect, an anomaly among the western ranges. It is the only important one which trends east and west. Starting from the eastern flank of the Wasatch, the Uintas project eastward more than 150 miles, and nearly join perpendicularly the Park ranges of Colorado. Of the two portions into which the Plateau Province is thus divided, the southern is much the larger. Both have in common the plateau features; their topographies, climates, and physical features in general, are of similar types, and their geological features and history appear to be closely related. But each has also its peculiarities. The northern portion is an interesting and already celebrated field for the study of the Cretaceous strata and the Tertiary lacustrine beds. The subjects which it presents to the geologist are most notably those which are embraced under the department of stratigraphy—the study of the succession of strata and co-related succession of organic life. Otherwise the region is tame, monotonous, and unattractive. The southern portion, while presenting an abundance of material for stratigraphical study, and in this respect fully rivaling, and perhaps surpassing, the northern portion, also abounds in the grandest and most fascinating themes for the student of physical geology. In respect to scenery, the northern portion is almost trivial, while the southern is the sublimest on the continent. With the former we shall have little to do; it is the latter which claims here our exclusive attention. The southern part of the Plateau Province may be regarded as a vast basin everywhere bounded by highlands, except at the southwest, where it opens wide and passes suddenly into a region having all the characteristics of the Great Basin of Nevada. The northern half of its eastern rim consists of the Park ranges of Colorado. Its northern rim lies upon the slopes of the Uintas. At the point where the Uintas join the Wasatch, the boundary turns sharply to the south, and for 200 miles the High Plateaus of Utah constitute the elevated western margin of the Province. It is from the summits of the High Plateaus that we gain our first comprehensive view of those grand facts which are the principal subjects of this discourse. But let me first ask the reader to endeavor to frame some conception, however crude, of three lines, each 200 miles long, placed in the positions of three sides of a square; the fourth side being, for the moment neglected. Upon the eastern side conceive the Park ranges of Colorado; upon the northern, the Uintas; and upon the western side the southern portion of the Wasatch and the High Plateaus of Utah; and all these highlands having altitudes ranging from 9,000 to 12,000 feet above the sea, while the included area varies from 5,000 to 7,000 feet high. The space thus partially bounded may represent the northern part of the southern Plateau Province. Along the line required for the fourth and south side of the complete square there is no boundary. The topography continues on beyond it to the southward, and also widens out both west and east and overspreads an additional area more than twice as great as that already defined. From the eastern crests of the High Plateaus we may obtain an instructive overlook of the northern portion of the southern Plateau country. The easiest line of approach is from Salt Lake City. Proceeding south from that town along the western base of the Wasatch, we reach the southern end of that fine range about 90 miles from Salt Lake. The last mountain pile is Mount Nebo, and skirting around its southern flank we soon perceive to the southeastward a long and very lofty ridge 20 to 30 miles distant. This is the Wasatch Plateau, the northernmost member of the group of High Plateaus. It has nothing in common with the Wasatch Mountain range, being wholly disconnected from it and standing with a wide interval *en echelon* to the southeastward of it. The Wasatch Plateau presents a long straight, horizontal summit projected against the sky without peaks or domes, resembling somewhat the ridges of Pennsylvania and Virginia, but on a grander scale. We perceive along its entire western front a rapid slope, descending to the bottom of the San Pete Valley at its foot. It is not deeply incised with ravines and amphitheaters, nor notched with profound transverse gorges, as are ordinary mountain ranges, but shows a slightly diversified slope in every part. As we draw nearer we begin to see the attitudes of the strata composing its mass, or, as the geologists say, its "structure." The strata are inclined at the same angle as the slope of its flank. In the valley below, the beds are horizontal; as they approach the base of the plateau they flex upward and ascend the slope; as they reach the summit they flex back to horizontality. If we ascend the plateau and ride eastward a very few miles, there suddenly breaks upon the view a vast and impressive panorama. From an altitude of more than 11,000 feet the eye can sweep a semicircle with a radius of more than 70 miles and reach far out into the heart of the Plateau country. We stand upon strata of Lower Tertiary age, and beneath our feet is a precipice leaping down across the level edges of the beds upon a terrace 1,200 feet below. The cliff on which we stand stretches far northward into the hazy distance, gradually swinging eastward and then southward through a course of more than a hundred miles, and vanishing below the horizon. It describes, as we well know, a rude semicircle, around a center about 40 miles east of our standpoint. At the foot of this cliff is a terrace of greatly varying width, rarely less than 5 miles, consisting of Upper Cretaceous beds nearly but not quite horizontal. They incline upwards towards the east at angles rarely so great as 3°, and are soon cut off by a second cliff plunging down 1,800 feet upon Middle Cretaceous beds. This second cliff describes a semicircle like the first, but smaller and concentric with it. From its foot the strata still rise gently towards the east, through a distance of about 10 miles, and are cut off as before by a third series of cliffs concentric with the first and second. For the fourth and fifth time this process is repeated. In the center of these girdling walls is an elliptical area about 40 miles long and 12 to 20 miles broad, completely surrounded by mural escarpments more than a thousand feet high. This central spot is called the SAN RAFAEL SWELL, and it is full of interest and suggestion to the geologist. From its central point the strata dip away in all directions, the inclinations, however, being always very small.

* * * * * * * * * *

Throughout the great Carboniferous age the entire area of the Plateau Province was submerged beneath the ocean. Deposition of strata went on continuously. The thickness of the strata accumulated in that age appears to have varied greatly, and the deposits were laid down unconformably over the surface of a country which had been ravaged by a great erosion. Such exposures of the Carboniferous as now exist, however, exhibit for the most part a remarkable evenness of stratification. In the interior spaces of the province the beds are either horizontal, or if disturbed, give full evidence that the disturbances took place long after their deposition. The close of this age evidently left a subaqueous surface, which was exceedingly flat, and, except around the borders of the province, quite free, so far as we now know, from any appreciable inequalities. The thickness of the Carboniferous system is from 4,500 to 5,000 feet in the interior of the province, but around its borders, and in the Uinta Mountains, it is sometimes found in far greater volume. Its strata consist of impure limestones, occasionally of enormous thickness in the individual beds, and alternating with fine-grained homogeneous sandstones. Extensive beds of gypsum also occur. After the Carboniferous came the Permian age, in which were laid down from 800 to 1,500 feet of sandy shales. The stratification was wonderfully even and everywhere horizontal. The Permian beds are often ripple-marked and betray many evidences that they accumulated in shallow waters. Among these evidences are the appearance at several horizons of indications that for a time the sea-bottom was laid bare by the recession of the waters, or by the elevation of the platform itself; for we may discern evidences of slight erosion at the contacts of the beds. But the horizontality of the beds appears never to have been notably disturbed. The same state of affairs continued through the Trias. There, too, we find evidence of alternations of emergence and submergence in the shape of slight unconformities by erosion, and in the occurrence of extensive remains of silicified forests. The Triassic series is composed almost wholly of sandstones, the only calcareous matter being thin seams of gypsum. The sandstone beds are very numerous and often shaly. They are usually of no great thickness individually, but there is one very notable member of which we shall see more when we come to view the Vermilion Cliffs.

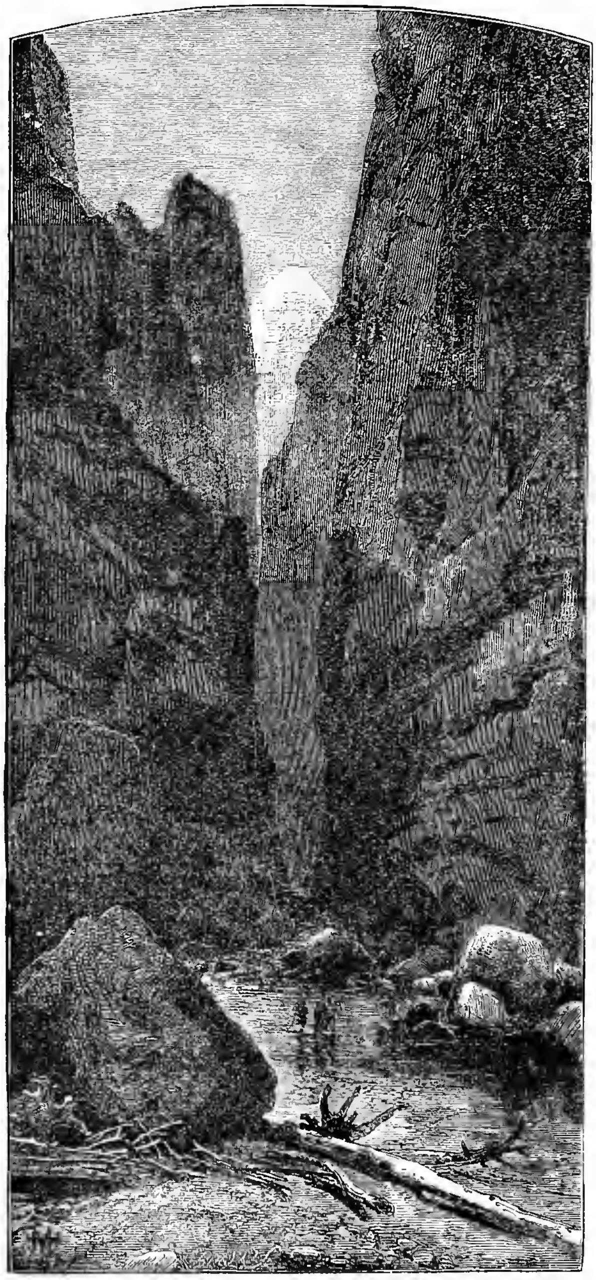
Directly upon the Trias rests the Jurassic. A wonderful bed of sand-stone 800 to 1,200 feet thick, and very white and sugary in color represents the principal part of this series. It is a very notable formation because of its remarkable homogeneity, the persistent way in which it preserves its lithological characters through great distances, and the absence of divisional planes of stratification—the mass being solid from top to bottom. But most striking of all its wonderful cross-bedding, far surpassing in beauty, extent, and systematic character, any similar phenomenon elsewhere with which I am acquainted. The summit of the Jurassic suddenly changes to calcareous and sandy shales, abounding in fossils. This series, as well as the Trias, appears to have been laid down horizontally in shallow waters. Next comes the Cretaceous system—a mass of yellow sandstones with clayey and marly shales, aggregating from 4,000 to 5,000 feet thick. In this series we find abundance of plant remains, many beds of good coal,



WESTERN SCENERY.—MARBLE CANYON.—COLORADO RIVER.

and much carbonaceous shale. The conditions during the Cretaceous appear to have been quite similar to those which prevailed in the Appalachian region during the Carboniferous. Perhaps the conditions which attended and rendered possible the accumulation of coal are not sufficiently well understood to enable us to say confidently just what they were, but there seems to be a general agreement that they have involved a flat, low, moist country lying almost exactly at mean sea-level, and subject to alternate emergence and submergence. No other supposition seems to meet the requirements of the case, or to be capable of explaining how a mass of strata could be so accumulated, consisting of alternations of thin seams of coal and carbonaceous shale with layers of sand-stone containing marine fossils. We have now the following remarkable state of affairs. From the close of the Carboniferous to the close of the Cretaceous there is strong evidence that the surface of deposition was always very near to sea-level, sometimes a few feet above it, but for the most part a little below it. And yet in the interval about 9,000 feet of strata accumulated with remarkable uniformity over the entire province, and always in a horizontal position. From this it necessarily follows that the mass of material thus deposited sank or "subsided" at a rate which, in the long run, was exactly or sensibly equal to the rate of deposition. At the close of the Cretaceous we find evidence that the long calm which had characterized the action of the physical processes was invaded. Some extensive disturbances took place, resulting at some places in the dislocation and flexing of the strata, and the elevation of some portions of the region to considerable altitudes. Erosion at once attacked the uplifted portions, and around the borders of the province we find numerous localities, usually not very extensive, which were greatly devastated. At some of these places the entire local Cretaceous series was denuded, and even a portion of the Jurassic and across the beveled edges of the flexed Cretaceous strata. But even these localities were again submerged, as the presence of the Tertiary fully attests. These disturbances were not general—did not extend to the entire province, but appear to have occurred around, or a little within, its marginal portions. The last period of deposition was marked by the accumulation of the Eocene beds, which form such a striking feature in the stratigraphy of the peripheral parts of the Plateau country. Around the southern flanks of the Uintas their aggregate thickness exceeds 5,000 feet, but southward the upper members disappear, and 80 miles north of the Grand Canyon only about 1,000 to 1,200 feet, representing the lowest portion of the series, make their appearance. It is highly probable that the middle and upper portions of the Eocene were never deposited there. But the lowest beds, most probably, once covered the entire province, while the middle and late Eocene were confined to its more northerly portions. The lowest members were deposited in brackish water, as their fossils amply attest; but in the succeeding beds the fossil forms are entirely those which live in fresh water. From that epoch to the present time there has been no recurrence of marine conditions. We now reach a turning point in the history of this region. That long continuance of marine conditions lasting from the beginning of Carboniferous time to the close of the Cretaceous came gradually to an end. The waters became brackish and then fresh. During the prevalence of the marine condition it seems to be a necessary conclusion that the waters which covered it had abundant access to the ocean. Whether its waters were wide open to the ocean, like the Gulf of Mexico or Hudson's Bay, or whether they formed a broad expanse, with a comparatively narrow outlet, like the Mediterranean, we do not know, and it would be useless to conjecture at present. At all events the communication was sufficiently free to maintain a degree of saltness suitable to the existence of molluscan forms of the ordinary marine types. When the waters became brackish, we infer that the straits became greatly narrowed; when they became quite fresh, we infer that the access of the ocean to the area was wholly cut off, and that the water brought by the rivers and rains merely outflowed, and the region became an inland lake of vast proportions. For the deposition still went on. Through Eocene time from 1,000 to 5,000 feet of lacustrine beds, containing an abundance of fresh-water fossils, were deposited. Among them are also found layers of coal and carbonaceous shales, and sandstones thickly imprinted with the traces of arboreal vegetation. But at length the deposition of lacustrine strata ceased; not, however, at one and the same time in all parts of the province. The evidence indicates that in the southern and southwestern portions it stopped after about one-fourth or one-third of the Eocene horizons had been laid down. In the central portions it appears to have ceased after about one-half to two-thirds of those horizons had been deposited. In the northern portions, in the vicinity of the Uintas, the entire system of Eocene strata is found in immense volume. These facts lead us to infer that the great Eocene lake, soon after its waters became quite fresh, began to shrink its area, and that its bottom became through a slow progression dry land. The southern and southwestern portions were the first to emerge; then the middle portions; the lake gradually retracting its boundary to the northward, until in the latter part of the Eocene it occupied a greatly diminished area in the vicinity of the San Rafael country and the southern base of the Uinta Mountains. At the close of the Eocene this remnant of the lake also disappeared.

We now reach another turning point in the history of the region. Hitherto and for an immense stretch of geological time it had been an area of deposition and of subsidence. It now became an area of elevation and denudation, and these processes have been in operation ever since. In the periods of deposition and subsidence, from the Carboniferous to the Eocene, both inclusive, the thickness of the strata



Western Scenery.—The Parunumcap.—Colorado River.

accumulated varied from 14,000 to 20,000 feet, and the subsidence of the base of the Carboniferous was of nearly equal extent. In the periods of elevation and denudation these vast masses of strata rose bodily up again; the amount of elevation varying according to locality from 6,000 to 18,000 feet. The havoc wrought by erosion has been, as already shown, stupendous; the thickness of strata removed exceeding 10,000 feet in some considerable areas, and averaging probably 5,500 to 6,000 feet over the entire province. The points which it is desirable to notice here concerning the progress of the Tertiary and Quaternary erosion of the province, are few and of the broadest nature. In truth it is necessary to speak very guardedly. For while the most general features of the work have left well-marked traces which can be interpreted, yet when we come to details the vast erosion has swept away so much of its mass that a large portion of the evidence of the details has vanished with the rocks. There is reason to believe that the greater part of the denudation was accomplished in Miocene time. This was a period of slow but continuous uplifting, reaching a great amount in the aggregate, and it was most probably also a period of rapid erosion. The uplifting, however, was unequal in the different parts of the province. The comparatively even floor of the old lake was deformed by broad swells and plateaus rising above the surrounding country. As we shall see hereafter, the action of the denuding agents is much more vigorous and efficient upon the higher than the lower parts of a region; and consequently these upswellings at once became the objects of special attention from the destroying forces and were wasted more rapidly than the lower regions around them. Here were formed centers or short limited axes, from which erosion proceeded radially outwards, and the strata rising gently towards them from all directions were beveled off. Thus were formed those areas of maximum erosion, already spoken of, and of which the San Rafael Swell is the most perfect and simplest type.

The Toroweap and Uinkaret.—The first stage of the journey from Kanab to Pipe Spring is an easy one. It leads southward to a gap cut through the low Permian terrace, and out into the open desert beyond. The road, well travelled and easy, then turns westward, and at length reaches the spring twenty miles from Kanab. Pipe Spring is situated at the foot of the southernmost promontory of the Vermillion Cliffs, and is famous throughout Southern Utah as a watering place. Its flow is copious, and its water is the purest and best throughout that desolate region. Ten years ago the desert spaces outspreading to the southward were covered with abundant grasses, affording rich pasturage to horses and cattle. To-day hardly a blade of grass is to be found within ten miles of the spring, unless upon the crags and mesas of the Vermillion Cliffs, behind it. The horses and cattle have disappeared, and the bones of many of the latter are bleached upon the plains in front of it. The cause of the failure of pasturage is twofold. There is little doubt that during the last ten or twelve years the climate of the surrounding country has grown more arid. The occasional summer showers which kept the grass alive, seldom come now, and through the long summer and autumn droughts the grasses perished even to their roots before they had time to seed. All of them belong to varieties which reproduce from seed, and whose roots live but three or four years. Even if there had been no drought, the feeding of cattle would have impoverished and perhaps wholly destroyed the grass by cropping it clean before the seeds were mature, as has been the case very generally throughout Utah and Nevada. Northeastward, the Vermillion Cliffs extend in endless perspective towards Kanab, and beyond the Paria. Northwestward, with growing magnitude, they extend towards the Virgen, ever forming a mighty background to the picture. To the southward stretches the desert, blank, lifeless, and as expressionless as the sea. For five or six miles south of the Pine Spring promontory there is a gentle descending slope, and thence onward the surface feebly ascends through a distance of thirty miles to the brink of the Grand Canyon. Thus the range of vision is wide, for we overlook a gentle depression of great extent. Though the general impression made is that of a smooth or slightly modulated country, yet we command a far greater expanse than would be possible among the prairies. To the southeastward the Kaibab looms up, seemingly at no great distance, and to the southwestward the flat roof of Mount Trumbull is more than a blue cloud in the horizon. Towards this latter mountain we take a straight course. The first few miles lie across drifting sands bare of all vegetation. The air is like a furnace, but so long as the water holds out the heat is not enervating, and brings no lassitude. Everything is calm and still, except here and there a hot whirling blast which sends up a tall, slender column of dust diffusing itself in the air. At a slow pace the sand hills at length are passed, and we enter upon a hard, firm soil, over which we move more rapidly. Just here, and for three or four miles in either direction, the Permian terrace has been obliterated. It has been bevelled off by erosion and buried beneath the wash brought down from the foot of the Vermilion Cliffs to the northward. But seven miles from Pipe Spring, the Permian terrace springs up out of the earth, scarped by its characteristic cliff. Stretching northwestward, it increases in altitude, becoming at last eight hundred to one thousand feet high. At its summit is seen the Shinarump conglomerate, of a pale brown color, and beneath are the gorgeous hues of the shales. Nothing can surpass the dense, rich, and almost cloying splendor of the red-brown seen in these shales. They suggest the color of old mahogany, but are much more luminous and quite uniform. Under them are belts of chocolate, slate, lavender, pale Indian red, and white. Very wonderful, too, is the evenness of the bedding, which is brought out in great clearness and sharpness by the etching of minute layers of clays, holding selenite. Between the shales and overhanging conglomerate, careful scrutiny enables us to detect an unconformity by erosion without any unconformity of dip. As stated in a preceding chapter, Mr. Wolcott fixed provisionally the separating horizon between the Permian and Trias at this unconformable contact.

Along the route the vegetation is scanty indeed. Several forms of cactus are seen looking very diseased and mangy, and remnants of low desert shrubs browsed to death by cattle. Yet strangely enough there is one plant and one alone that seems to flourish. It is the common sunflower (*Helianthus lenticularis*), found anywhere from Maine to Arizona, and seeming indifferent to the vicissitudes of climate. About 18 miles from Pipe Spring the trail leads gently down into a broad shallow valley known as the Wild Band Pockets. The drainage from the fronts of the Permian cliffs now far to the northward here collects into a gulch, which gradually deepens and becomes a tributary of Kanab Canyon. In every stream-bed may be found many depressions which would hold water even though the sources of supply were cut off. This is as true of wet-weather channels as of perennial streams. After the infrequent showers, and after the surface waters have ceased to run, the beds of the stream will still retain pools of water, provided the bottom of it is of a consistency which will prevent it from filtering away. To these pools the people of the west have given the name of "water-pockets." They are very common in the stream-beds which bear away the wash from the Permian and lower Triassic shales. These shales yield a very fine impervious clay, which forms an excellent "puddling" for water holes and basins. The Wild Band Pockets have received their name from the fact that they are the resort of bands of wild horses that roam over these deserts, far from human haunts, ranging from spring to spring, which they visit by stealth only at night, and never so long as they can find chance water in these and other pockets. Beyond the Wild Band Valley there is a slight ascent to a rocky platform, consisting of the summit beds of the Carboniferous. In the course of 20 miles we have crossed the entire Permian series, which now lies to the north of us. A few stunted cedars, most of which are dead or dying of drought, are scattered over this platform and give us until nightfall some slight shelter from the sun. It is as good a camping place as we are likely to find, and if we are fortunate enough to reach it after a copious shower, the hollows and basins in the flat rocks may contain a scanty supply of clear rain-water. It is a good locality, also from which we may overlook the outspreading desert, which is not without charms, however repulsive in most respects.

To the northward rises the low escarpment of the Permian, forming a color picture which is somewhat indistinct through distance, but weird because of its strange colors and still stranger forms. Beyond and in the far distance rise the towering fronts of the Vermillion Cliffs, ablaze with red light from the sinking sun. To the eastward they stretch into illimitable distance, growing paler but more refined in color until the last visible promontory seems to merge its purple into the azure of the evening sky. Across the whole eastern quarter of the horizon stretches the long level summit of the Kaibab as straight and unbroken as the rim of the ocean. To the southwestward rises the basaltic plateau of Mount Trumbull, now presenting itself with somewhat imposing proportions. Around it a great multitude of basaltic cinder cones toss up their ominous black waves almost as high as Trumbull itself. Their tumultuous profiles and gloomy shades form a strong contrast with the rectilinear outlines and vivid colors of the region roundabout. At dawn we move onward, reaching soon the summit of a hill which descends two or three hundred feet to a broad flat depression called the Wonsits Plain. It is a smooth and very barren expanse, dotted with a few moldering buttes of Upper Carboniferous rocks, now wasting to their foundations. The plain is about seven miles in width, and on the further side rises a low mesa of great extent capped with basalt. It is the Minkaret. Beyond the nearer throng of basaltic cones Mount Trumbull rises with a striking aspect dominating strongly the entire western landscape. The smaller cones are now seen to be very numerous, all of them are apparently perfect in form, as if time had wrought no great ravage among them. The *lapilli* and *peperino* with which they are covered, have become dull red by the oxidation of the iron, and this peculiar color is easily recognized though the cones are far away. Just before reaching the basaltic mesa we must make our choice between two routes to the Toroweap, one direct, and the other very circuitous. No spring is to be found until we reach the further side of Mount Trumbull, but we know of a large water-pocket on this side, which has never been known to dry up. The spring water is sure to be good, but the water in the pocket will depend for its quality upon the length of time which has passed since the last heavy rain. Let us here choose the shorter one, and go to the water-pocket.

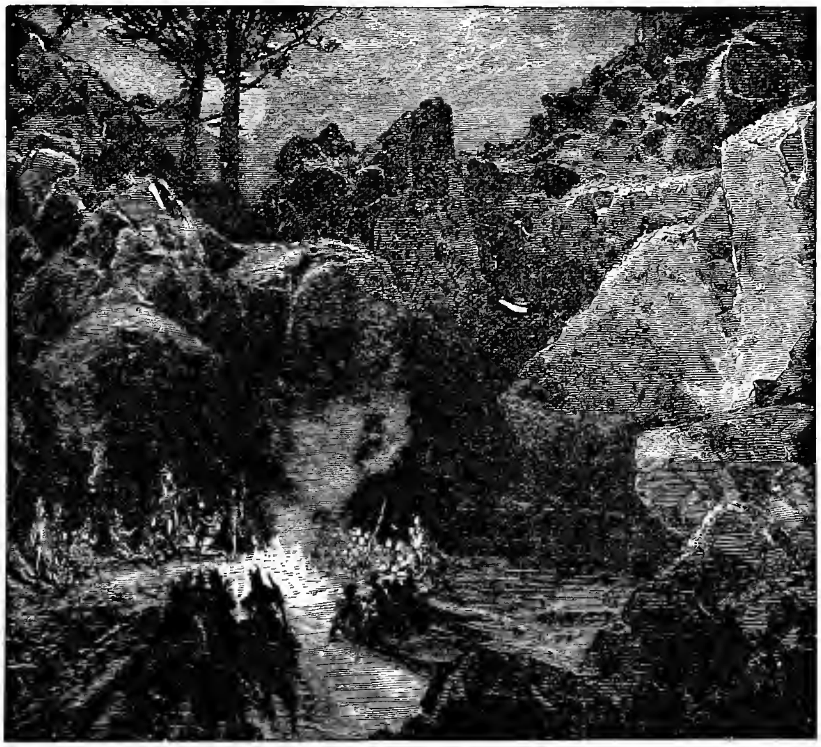
Ascending the mesa which rises abruptly about 200 feet above the Wonsits Plain, we find ourselves at once upon the basalt. The ground is paved with cinders and fragments half buried in soil, the debris of decaying lava sheets. These sheets are rarely of any great thickness, seldom exceeding 30 or 40 feet, and often much less, and none of the individual eruptions of lava seem to have covered any very great expanse. Probably the area covered by the largest would be less than a square mile. They show no perceptible differences in composition or texture, and all are basalts of the most typical variety—very black and ferruginous in the unwithered specimens and speckled with abundant olivine. At the time of eruption they appear to have been in a state of perfect liquidity; spreading out very thin and flowing rapidly and with ease. In none of them has erosion wrought much havoc, though here and there some local destruction has been effected, most conspicuously upon the edges of the principal mesa where the sheets have been undermined and their fragments scattered upon the plain below. The cones, which stand thick around us, are still in good preservation. They are of ordinary composition—mere piles of cinders thrown out of central vents and dropping around it. The fume and froth of the lava surfaces, the spongy inflated blocks, the lapilli and peperino, are not greatly changed, though all of them here show the oxidation of the iron. We wonder what their age may be; what time has elapsed since they vomited fire and steam. But there is no clew—no natural record by which such events can be calendared. Historically they have doubtless stood in perfect repose for very many centuries. Not a trace of activity of any kind is visible, and they are as perfectly quiescent as the dead volcanoes of the Auvergne or of Scotland. Geologically, they are extremely recent; yet even here where historic antiquity merges into geologic recency the one gives us no measure of the other. Following a course which winds among the silent cones and over rough, flat surfaces of lava beds half buried in drifting sands, we at length reach the border of a slight depression, into which we descend. It is hardly noteworthy as a valley just here, and might be confounded with any one of the innumerable shallow-water courses which occur round about; only when we look beyond we see it growing broader and much deeper. It is the head of the Toroweap. Upon its smooth bottom is a soft clayey soil, in which desert shrubs and stunted sage-brush grow in some abundance. Here and there a cedar, dwarfed indeed, but yet alive, displays a welcome green, and upon the valley slopes are a few sprays of grass. The valley bottom descends at a noticeable rate to the southward, and as we put the miles behind us we find the banks on either side rising in height, becoming steeper, and at last displaying rocky ledges. In the course of six or seven miles the left side has become a wall 700 feet high, while the other side, somewhat lower, is much broken and craggy. Huge piles of basalt lie upon the mesa beyond, sheet upon sheet, culminating in a cluster of large cones. At length the course of the valley slightly deflects to the left, and as we clear a shoulder of the eastern wall, which has hitherto masked its continuation, a grand vista breaks upon the sight. The valley stretches away to the southward, ever expanding in width; the walls on either side increase in altitude, and assume profiles of wonderful grace and nobility. Far in the distance they betoken a majesty and grandeur quite unlike anything hitherto seen. With vast proportions are combined simplicity, symmetry, and grace, and an architectural effect as precise and definite as any to be found in the terraces. And yet these walls differ in style from the Trias and Jura as much as the Trias and Jura differ from each other. In the background the vista terminates at a mighty palisade, stretching directly across the axis of vision. Though more than 20 miles distant it reveals to us suggestions of grandeur which awaken feelings of awe. We know instinctively that it is a portion of the wall of the Grand Cañon. The western side of the valley is here broken down into a long slope descending from the cones clustered around the base of Mount Trumbull, and covered with broad flows of basalt. Turning out of the valley we ascend the lava bed, which has a very moderate slope, and about a mile from the valley we find the Witches' Water Pocket. In every desert the watering places are memorable, and this one is no exception. It is a weird spot. Around it are the desolate Phlegræan fields, where jagged masses of black lava still protrude through rusty, decaying cinders. Patches of soil, thin and coarse, sustain groves of cedar and piñon. Beyond and above are groups of cones, looking as if they might at any day break forth in renewed eruption, and over all rises the tabular mass of Mount Trumbull. Upon its summit are seen the yellow pines (*P. ponderosa*), betokening a cooler and a moister clime. The pool itself might well be deemed the abode of witches. A channel half-a-dozen yards deep and twice as wide, has been scoured in the basalt by spasmodic streams, which run during the vernal rains. Such a stream cascading into it has worn out of the solid lava a pool twenty feet long, nearly as wide, and five or six feet deep. Every flood fills it with water, which is good enough when recent, but horrible when old. Here, then, we camp for the night.

Filling the kegs at daylight we descend again into the Toroweap and move southward. Our attention is strongly attracted by the wall upon the eastern side. Steadily it increases its mass and proportions. Soon it becomes evident that its profile is remarkably constant. We did not notice this at first, for we saw in the upper valley only the summit of the palisade; but as the valley cuts deeper in the earth the plan and system begin to unfold. At the summit is a vertical ledge, next beneath a long Mansard slope, then a broad plinth, and last, and greater than all, a long, sweeping curve, descending gracefully to the plain below. Just opposite to us the pediments seem half buried, or rather half risen out of the valley alluvium. But beyond they rise higher and higher until in the far distance the profile is complete. In this escarpment are excavated alcoves with openings a mile wide. As soon as we reach the first one new features appear. The upper ledge suddenly breaks out into a wealth of pinnacles and statues standing in thick ranks. They must be from 100 to 250 feet high, but now the height of the wall is more than a thousand feet, and they do not seem colossal. Indeed, they look like a mere band of intricate fretwork—a line of balustrade on the summit of a noble façade. Between the alcoves the projecting pediments present gable-ends towards the valley plain. Yet whithersoever the curtain wall extends the same profile greets the eyes. The architect has adhered to his design as consistently and persistently as the builders of the Thebaid or of the Acropolis. As we pass alcove after alcove, and pediment after pediment, they grow loftier, wider and deeper, and their decoration becomes more ornate. At length we pass one which is vast indeed. It is recessed back from the main front three-fourths of a mile, and shows three sides of an oblong room with walls 1,800 feet in height. The fourth side is obliterated and the space opens into the broad valley. Wonderfully rich and profuse are the pinnacles and statues along the upper friezes. The fancy is kindled as the eye wanders through the enclosure.

We look across the valley, which is here three miles in width, and behold the other wall, which presents an aspect wholly different, but quite as interesting. The western wall of the Toroweap, is here lower than the eastern, but still is more than a thousand feet high. The geologist soon surmises that along the valley bottom runs a fault which drops the country on the west several hundred feet, and the conjecture soon becomes certainty. Above and beyond the western escarpment is the platform of the Unikaret Plateau. Upon its summit is a throng of large basaltic cones in perfect preservation. Streams of lava larger than any hitherto seen have poured from their vents, flooding many a square mile of mesa land, and in the wide alcoves they have reached the brink of the wall and cascaded over it. Still pouring down the long taluses they have reached the valley bottom below and spread out in wide fields, disappearing underneath the clayey alluvium, which has buried much of their lower portions. The appearance of these old lava cascades, a mile or more wide, a thousand feet high, and black as Erebus, is striking in the extreme. There are five of these basaltic cataracts, each consisting of many individual *coulées*. Between them the bold pediments of brightly-colored Carboniferous strata jut out into the valley.

At length we approach the lower end of the Toroweap. The scenery here becomes colossal. Its magnitude is by no means its most impressive feature, but precision of the forms. The dominant idea ever before the mind is the architecture displayed in the profiles. It is hard to realize that this is the work of the blind forces of nature. We feel like mere insects crawling along the street of a city flanked with immense temples, or as Lemuel Gulliver might have felt in revisiting the capital of Brobdignag, and finding it deserted. At the foot of the valley the western wall is nearly 1,500 feet high, the eastern about 2,000, and the interval separating them is about three miles. Suddenly they turn at right angles to right and left, and become the upper wall of the Grand Canyon of the Colorado. The Toroweap now opens into the main passage way of the great chasm. The view however, is much obstructed.

At the foot of the eastern gable is a medley of rocky ledges of red sandstone, while around the base of the western gable are large masses of basalt reaching more than half-way across the valley. In front rises a crater, which is about 600 feet high, seemingly a mere knoll in the midst of this colossal scenery. Beyond it, and five miles distant, rises the palisade which forms the southern upper wall of the chasm, stretching athwart the line of vision interminably in either direction. Its altitude is apparently the same as that of the palisade above us, and its profile is also identical. Climbing among the rocky ledges which lie at the base of the escarpment, we at length obtain a standpoint which enables us to gain a preliminary view of the mighty avenue. To the eastward it stretches in vanishing perspective forty miles or more. Between symmetric walls 2,000 feet high and five miles apart is a plain, which in comparison with its limiting cliffs might be regarded as smooth, but which in reality is diversified by rocky hummocks and basins, and by hillocks where patches of soil give life to scattered cedars and pinons. Of the inner chasm nothing as yet is to be seen. Moving outward into this platform we find its service to be mostly bare rock, with broad shallow basins etched in them, which hold water after showers. There are thousands of these pools, and when the showers have passed they gleam and glitter in the sun like innumerable mirrors. As we move outward towards the centre of the grand avenue the immensity and beautiful proportions of the walls develop. The vista towards the east lengthens out and vanishes against the blue ramp of the Kaibab, which lies as a cloud upon the horizon. To the west the view is less symmetric and regular, and the eye wanders vaguely among cliffs and buttes of stupendous magnitude, displaying everywhere the profile with which we have become of late familiar. Much of the distance towards the west is obstructed by the crater, but the portions in view bewilder us by the great number of objects presented, and oppress us by their magnitudes. At a distance of about two miles from the base of the northern wall we come suddenly upon the inner chasm. We are not conscious of its proximity until we are within a few yards of it. In less than a minute after we have recognized the crest of the farther wall of this



WESTERN SCENERY.—ELFIN WATER POCKET.—CANYONS OF THE COLORADO.

abyss we crane over its terrible brink and gaze upon the waters of the river full 3,000 feet below.

The scene before us is a type of the Grand Canyon throughout those portions which extend through the Kanab, Uinkaret, and Sheavwits Plateaus. The plan and section here presented are quite simple. They consist of a broad upper chasm from five to six miles in width with walls varying in altitude but little from 2,000 feet. Between these escarpments is a rocky plain, rough indeed, but in the overpowering presence of such walls seeming relatively smooth and uniform. In this floor is cut the inner chasm 3,000 feet deep and from 3,500 to 4,000 feet wide from crest to crest. The strata in which the chasm is excavated are all of Carboniferous age except three or four hundred feet at the bottom of the gorge. The strata beneath the Carboniferous are at present believed to be Lower Silurian, and their contact with the Carboniferous is unconformable, both by dip and by erosion. In the upper part of the palisades which form the wall of the upper chasm we find at the summit two series of limestones. The upper contains an abundance of siliceous matter, one portion of which is intimately disseminated through the mass while another portion is aggregated into myriads of cherty nodules varying from two to ten inches in diameter. The lower one is a purer lime stone with few nodules. The cherty members form a nearly vertical band at the summit of the wall; the purer members form a Mansard slope beneath, covered with talus. The total thickness of the limestones is about 700 to 750 feet, Beneath them come sandstones a little more than 250 feet thick, which form everywhere a vertical plinth or frieze. They are very adamantine in texture, and one of the members, about 160 feet thick, is in every exposure seen to be uniformly cross-bedded. Under the cross-bedded sandstone is a mass of thinly bedded and almost shaly sandstones, having an aggregate thickness very closely approximating to 1,000 feet. They are of an intensely brilliant red color, but are in greatest part, covered with a heavy talus of imperishable cherty nodules, fragments of the cross-bedded sandstones, and spalls of limestone shot down from above. The color of these is pale gray, with occasionally a yellowish or creamy tinge. The brilliant red sandstones form the long curved slope which descends from the plinth of cross-bedded sandstones to the plain below.

The walls of the inner gorge have at the summit about 325 feet of hard sandstone of a brown-red color. Beneath the sandstone are about 1,800 feet of impure limestone in layers of the most massive description. Very few such ponderous beds of limestone are found in any part of the world. The color is deep red with a purplish tone, but the brilliancy of the coloring is notably weakened by weathering. Still lower are red-brown sandstones again having a dark and strong shade and lying in very massive beds. The strata forming the walls of the outer chasm from the summit to the plain below are designated the Aubrey group, and this is again subdivided at the base of the cross-bedded plinth into Upper and Lower Aubrey groups. The two subdivisions are believed to be the equivalents, in age, of the Coal Measures of Pennsylvania and England. The strata disclosed in the inner gorge correspond in age to the Lower Carboniferous of those countries, and are here termed the Red Wall group. Some uncertainty exists regarding the beds which lie at the base of the conformable series deep down in the chasm, but they are regarded at present as being just what they seem and just what they would naturally be inferred to be—a part of the Carboniferous system. Of the strata at the bottom of the canyon, we shall have more to say hereafter. They are regarded at present as being of Lower Silurian or Primordial age.

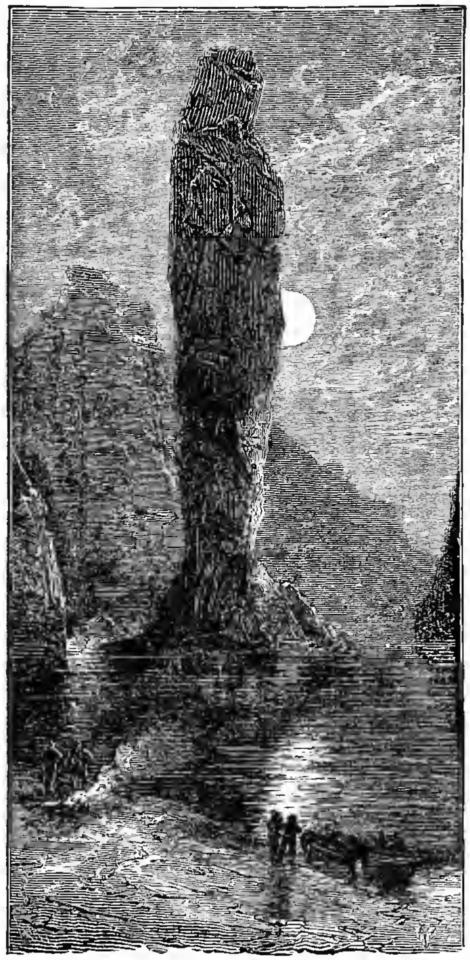
The observer who, unfamiliar with plateau scenery, stands for the first time upon the brink of the inner gorge, is almost sure to view his surroundings with commingled feelings of disappointment and perplexity. The fame of the chasm of the Colorado is great; but so indefinite and meager have been the descriptions of it that the imagination is left to its own devices in framing a mental conception of it. And such subjective pictures are of course wide of the truth. When he first visits it the preconceived notion is at once dissipated and the mind is slow to receive a new one. The creations of his own fancy no doubt are clothed with a vague grandeur and beauty, but not with the grendeur and beauty of nature. When the reality is before him the impression bears some analogy to that produced upon the visitor who for the first time enters St. Peter's Church at Rome. He expected to be profoundly awe-struck by the unexampled dimensions, and to feel exalted by the beauty of its proportions and decoration. He forgets that the human mind itself is of small capacity and receives its impressions slowly, by labored processes of comparison. So, too, at the brink of the chasm, there comes at first a feeling of disappointment; it does not seem so grand as we expected. At length we strive to make comparisons. The river is clearly defined below, but it looks about large enough to turn a village grist-mill: yet we know it is a stream three or four hundred feet wide. Its surface looks as motionless as a lake seen from a distant mountain-top. We know it is a rushing torrent. The ear is strained to hear the roar of its waters, and catches it faintly at intervals as the eddying breezes waft it upwards; but the sound seems exhausted by the distance. We perceive dimly a mottling of light and shadow upon the surface of the stream, and the flecks move with a barely perceptible cloud-like motion. They are the fields of white foam lashed up at the foot of some cataract and sailing swiftly onward.

Perhaps the first notion of the reality is gained when we look across the abyss to the opposite crest-line. It seems as if a strong, nervous arm could hurl a stone against the opposing wall-face; but in a moment we catch a sight of vegetation growing upon the very brink. There are trees in scattered groves which might at first have been mistaken for sage or desert furze. Here at length we have a stadium or standard of comparison which serves for the mind much the same purpose as a man standing at the base of one of the sequoias of the Mariposa grove. And now the real magnitudes begin to unfold themselves, and as the attention is held firmly the mind grows restive under the increasing burden. Every time the eye ranges up or down its face it seems more distant and more vast. At length we recoil, overburdened with the perceptions already attained and yet half-vexed at the inadequacy of our faculties to comprehend more. The magnitude of the chasm, however, is by no means the most impressive element of its character; nor is the inner gorge the most impressive of its constituent parts. The thoughtful mind is far more deeply moved by the splendor and grace of Nature's architecture. Forms so new to the culture of civilized races and so strongly contrasted with those which have been the ideals of thirty generations of white men which cannot indeed be appreciated after the study of a single hour or day. The first conception of them may not be a pleasing one. They may seem merely abnormal, curious, and even grotesque. But he who fancies that Nature has exhausted her wealth of beauty in other lands strangely underestimates her versatility and power. In this far-off desert are forms which surprise us by their unaccustomed character. We find at first no place for them in the range of our conventional notions. But as they become familiar we find them appealing to the æsthetic sense as powerfully as any scenery that ever invited the pencil of Claude or of Turner.

The inner gorge, as we sit upon its brink, is indeed a mighty spectacle; but as we withdraw a little, it fades out of view, and, strangely enough, the sublimity of the scene is not very greatly impaired. It is, after all, a mere detail, and the outer chasm is the all-engrossing feature. On either side its palisades stretch away to the horizon. Their fronts wander in and out, here throwing out a gable, there receding into a chamber, or gaping widely to admit the entrance of a lateral chasm. The profile is ever the same. It has nothing in common with the formless, chaotic crags, which are only big and rough, but is definite, graceful, architectural and systematic. The width of the space inclosed between the upper walls is one of the most essential elements of the grandeur. It varies from five to six miles. If it were narrower the effect would be impaired; nor could it be much wider without diluting and weakening the general effect. This proportion seems quite just. It is a common notion that the distinctive and overruling feature of the great chasm is its narrowness relatively to its depth. No greater mistake could be made. Our highest conceptions of grandeur are most fully realized when we can see the greatest mass. We must have amplitude in all of the three dimensions, distance, breadth and depth, and that spectacle is in point of magnitude the grandest which has the three dimensions so proportioned and combined as to make the most of them. Another common and mistaken idea is that the chasm is pervaded by a deep, solemn gloom. The truth is almost the reverse. In the depths of the inner gorge there is a suggestion of gloom, but even in the narrower portions there is seldom less than sixty degrees of sky from crest to crest, and a hundred and sixty along the track of the river. In the outer chasm the scene is unusually bright. The upper half of the palisades have a pale, ashy or pearl-gray color, which is very lustrous, and this sometimes gives place to a creamy or Naples yellow tint in the frieze of cross-bedded sandstone. The Lower Aubrey sandstones are bright red, but they are in great part masked by the talus shot down from the pale gray limestones above, and peep out in lustrous spots where the curtain of the talus is drawn aside. There is nothing gloomy about such colors. Under a burning sun that is rarely clouded they have a brilliancy seldom seen in any rocks, and only surpassed by the sugary whiteness of the Jurassic sandstone or the brilliant red of the Vermillion Cliffs.

Directly in the southward prolongation of the axis of the Toroweap Valley there stands a basaltic cinder-cone immediately upon the brink of the inner gorge. Its altitude above the surrounding plain is 580 feet. The summit is readily gained, and it is an admirable stand-point from which the entire panorama may be viewed. We named it Vulcan's Throne. To the eastward about forty miles of the main chasm are well in view. The altitude of the cone, though small in comparison with surrounding objects, is sufficient to bring into view about twelve miles of the opening of the inner gorge, while in the foreground its depths are seen. To the westward the scenery is much more broken and diversified. The chasm is seen through the entire stretch in the Uinkaret Plateau and reaching a few miles into the Sheavwitts. But about twenty miles westward it makes a southward turn and disappears. From the north the Toroweap Valley descends from near Mount Trumbull. It is cut down only to the base of the upper cañon wall and opens into the main chasm on the level of the plain above the inner gorge. There is reason to believe that at some prior epoch it was cut a few hundred feet deeper than its present floor, and was subsequently built up by many floods of basalt coming from the cones on the Uinkaret and by considerable quantities of alluvium washed from its cliffs and overlooking mesas. On the south side of the Grand Cañon is a valley quite the counterpart of the Toroweap. It enters the main chasm directly opposite the Toroweap, so that the two form the arms of a transept, the main chasm being regarded as the nave. Vulcan's Throne is situated almost exactly at the intersection of the axes of the nave and transept.

It would be difficult to find anywhere else in the world a spot yielding so much subject-matter for the contemplation of the geologist; certainly there is none situated in the midst of such dramatic and inspiring surroundings. The chasm itself, with its marvelous story of erosion, and the two lateral valleys adding their quotas of information are grand subjects indeed; but other themes are disclosed which are scarcely less surprising and suggestive. The cone stands immediately upon the line of a large fault. And never was a fault and its consequences more clearly displayed. The Toroweap fault is one of six which at wide intervals traverse the Grand Cañon district from north to south with a rude approximation to parallelism. It is the smallest of the six. Twenty miles north of the chasm no trace of it is visible. Its beginning there is small, but as it approaches the chasm it increases in the amount of displacement; and at the crossing of the river the shear or "throw" is between 600 and 700 feet. In the wall-face of the inner gorge it is disclosed as clearly as a draughtsman could delineate it on paper. The masses of horizontal limestones and sandstones, displaying their fretted edges and lines of bedding, advance from the eastward in the face of the wall until they reach the vertical fault plane. Then they "break joints" and drop at once six or seven hundred feet, and continue westward as before, but at a lower level. The whole topography goes with it. Looking beyond to the upper wall of the outer chasm the "jog" where the break occurs is plainly seen. The whole platform of the country is dropped to the westward. The plain between the upper palisades descends by a single step from east to west across the fault by an amount equal to the displacement, and the inner gorge and the whole chasm becomes by so much reduced in depth. Excepting the dislocation itself, the faulting does not appear to have been accompanied by any injury to the strata. Not a trace of shattering, crumbling, or mashing of the beds is discernible. All looks as clean and sharp as if it had been cut with a thin saw and the smooth faces pressed neatly together. But the only attainable view of it is from the distance of a mile. Yet miles here are less than furlongs in other countries, and all details as well as broader features are upon the Brobdignagian scale. What a nearer view might disclose



Western Scenery.—Island Monument in the Glen Canyon.—Colorado River.

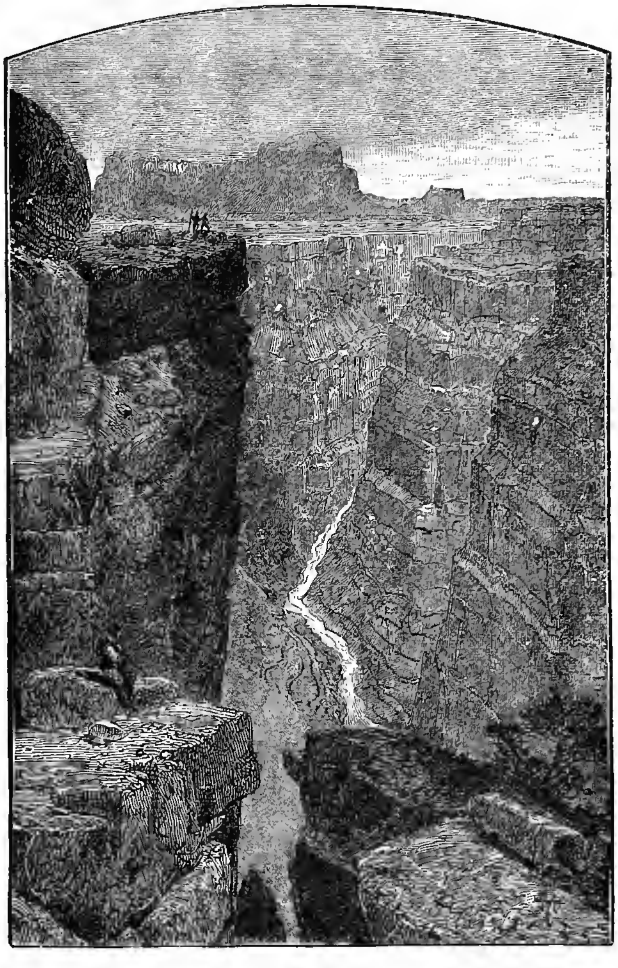
is of course impossible to conjecture. The plane of the fault is about vertical, though there seems to be a slight inclination to the east, which may be apparent only and a result of perspective. After a careful study of the surroundings of the fault, it becomes apparent that it is of recent occurrence in comparison with other events which have been in progress here. The tenor of all evidence bearing upon the subject goes to show that these faults were not suddenly produced by violent convulsions, but gradually developed through long stretches of time, and inch by inch or foot by foot. The Toroweap fault gives no evidence of being exceptional in this respect. Its recency is disclosed by many facts. It is seen that the amount of erosion in the face of the transverse "cliff of displacement" produced by the faulting is very small. This cliff has not receded from the fault plane to any considerable extent. Yet the giant palisades which wall the outer chasm have receded from the median line of the cañon more than two miles since the corrosion of the river laid bare the edges of their strata. It seems very plain that the outer chasm had been formed and attained very nearly its present condition before the fault started. But there is still more conclusive evidence of recency. At the foot of the southern palisade and at the jaws of the lateral valley are several basaltic craters. They look like mere bee-hives under the eves of such an escarpment, though in truth they are four or five hundred feet high. From their vent streams of basalt are seen flowing down into the lateral valley across the fault plane, and clear to the brink of the inner abyss. The fault shears the lava floods as nearly as it does the Red Wall limestone. Many other facts might be cited to the same purport, but this one is so conclusive that nothing further is necessary. We shall find similar evidences of recency when we come to the study of the great Hurricane fault.

Another subject which will awaken the enthusiasm of the geologist who visits this unique spot is the volcanic phenomena. Turning to the northwestward he beholds the heights of the Uinkaret. Upon its broad expanse stand many basaltic craters in perfect preservation. We know of about a hundred and fifty distinct cones in this plateau, included in the space which lies between the Grand Canyon and a limit forty miles north of it. But it is in the vicinity of the chasm that they cluster most thickly together and present the largest proportions. This part of the Uinkaret is thickly covered with basalt, above which rises the tumultuous throng of craters. Very many wide and deep floods of basalt have poured over the edge of the plateau into the lower Toroweap Valley and upon the great esplanade of the canyon, 1,500 to 1,800 feet below, and, spreading out into wide fields, have reached the brink of the inner gorge. Pouring over its brink, the fiery cascades have shot down into the abyss and pursued their way many miles along the bed of the river. At one epoch they had built up the bed of the Colorado about 400 feet, but the river has scoured out its channel again and swept them all away, regaining its old level, and is now cutting the sandstones below. The spectacle of the lava floods descending from the Uinkaret, as seen from Vulcan's Throne, is most imposing. It tells the story so plainly that a child could read and understand it. Compared with many classic volcanic regions the volcanism of the Uinkaret is a small affair. In those classic regions the mind does not come into direct contact with the enormity of the facts by a single glance of the eye. But here, if kind Asmodeus were to lift the basaltic roof of the plateau, we should see no more than we do now. The boldness of the picture is much increased by the pediments of Carboniferous strata projecting from the body of the plateau, showing the brilliant colors of the strata and their sharply-defined architecture, with the dark masses of basalt wrapping around them. Hard by, and almost within hail, is a superb gable projecting between two broad floods of lava, and so beautifully proportioned and richly colored that we cannot help wishing to transport it by magic to some more habitable region. The Toroweap Valley has a significance to the geologist which might not be at once apparent to the tourist. Even the geologist would be slow to discern it unless familiar with cognate facts displayed in the country at large bordering the Grand Cañon. In the effort to interpret its meaning it becomes necessary to take a hasty view of one or two broad facts relating to the lateral drainage of the chasm. Upon the north side, in all the distance between the head of the Marble and the foot of the Grand Canyons, there is but one side canyon, carrying drainage from distant regions. This single exception is Kanab Canyon. In this respect the Colorado is much like the lower courses of the Nile; and the cause is plainly the same. The region is too arid to sustain any living streams or even to keep open the conduits which in former periods might have sustained them. Yet upon the assumption that at some former period the climate was much more humid all analogy compels us to believe that the Colorado once received many tributaries which are now extinct, and upon examination we find good evidence that this was really the case. The Toroweap Valley is the modified channel of an ancient river. On the west side of the Uinkaret is another. A third is seen upon the south side of the Colorado, directly opposite the Toroweap; and a few others may easily be designated. It appears that all these rivers dried up before the inner gorge was excavated. For if they had continued to carry water we may be sure that they would have cut their chasms as deep as the Grand Canyon itself—just as the Little Colorado, Kanab Creek, and Cataract Creek have done. For we have only to look at the great multitude of lateral chasms of the upper courses of the Colorado and of its forks, the Grand and Green, to be deeply impressed with the fact that so long as a tributary river carries, we will not say a living stream, but even occasional floods, its channel will be scoured down to the same level as the trunk river itself. It is apparent, then, that the Toroweap dried up before the cutting of the inner gorge of the Grand Cañon began, and hence we infer that the arid climate which caused it to dry up existed before the beginning of the inner gorge.

By the application of other homologous facts, and by the same method of reasoning, we infer that the outer chasm has also been excavated during the prevalence of an arid climate. The platform of country adjoining the canyon is at present devoid of lateral chasms, yet traces are often found of ancient channels which became dry at about the time the excavation of the outer canyon began, or very soon thereafter. They are cut to comparatively slight depths—from one hundred to three or four hundred feet. That they are not of recent origin is proved by the fact that they often have slopes away from the river, though it is clear that they formerly sloped towards it. In truth, the entire chasm betrays everywhere the continued action of an arid climate through the entire period of its formation. This arid period is limited, approximately, to Pliocence and Quaternary time. The general tenor of the facts is to the effect that the Miocene was a humid period and the Pliocene a dry one throughout the greater part of the West. This is one of the reasons which lead us to the very probable conclusion that the age of the Grand Canyon is not older than the beginning of Pliocene time. We might also draw a similar inference from a consideration of the enormous erosion which took place here before the excavation of the chasm was begun. The denudation of the Mesozoic system was an incomparably greater work, and yet that denudation could not have begun until the last strata (the Lower Eocene) was deposited. If these inferences are well founded, we may assign the greater part of Eocene and the whole of Miocene time for the principal denudation of the Mesozoic, and the Pliocene and Quaternary for the excavation of the entire canyon. The proportion thus suggested between the portions of the work done and the divisions of time required to accomplish them seems very fair and reasonable. But the strongest evidence of all it would be almost impossible to recite here in detail. In general terms, it may be characterized as that internal evidence which appears when a vast array of facts, at first disjointed and without obvious relation, are subsequently grouped aright into a coherent system. Each constituent fact is then seen to admit of one intelligible interpretation and no other; and each subsidiary proposition has an overwhelming justification and an evidence of verity far stronger than any which could be summoned if we endeavored to prove it independently.

Another question which the geologist asks here is, how happens it that the outer chasm is so broad while the inner one is so narrow? The outer chasm is five to six miles wide and 2,000 feet deep; the inner is about 3,500 feet wide and 3,000 feet deep. The disparity is great. We have seen enough to say at once that the widening of the outer chasm was effected by the recession of its cliffs. If the corrosion of the canyon went steadily onward without a halt or respite this disparity demands some explanation. Although we should expect less recession in the cliffs of the inner gorge than in those of the outer, we should not expect it to be so much less if the only variable concerned was length of time. We might explain it by assuming the rocks of the inner gorge to be much more obdurate than those above. This is true in part, but still the difference in this respect is insufficient. A much more satisfactory explanation is found in the supposition that the broad esplanade of the canyon between the upper palisades was an ancient base-level of erosion. We might imagine that when the Colorado had cut its channel down to that level, it had reached the limiting depth of corrosion for the time being. Then for a long period the palisades on either sides wasted and receded from the river. At last another epoch of upheaval set in; the entire platform of the district was lifted several thousand feet; the power of the river to corrode was restored; and with comparative rapidity it sank the inner gorge. This becomes more than a mere guess when we take account of its relation to the general category of facts. Thus the great faults attest the fact that such an upheaval did occur; that it occurred, too, just at the time supposed; and that in amount it was quite equal and probably not more than equal to the amount required. Other evidence might also be produced, but they are too intricate to be discussed here. We leave the Toroweap Valley and the Grand Canyon, regretting that all its wonderful and instructive subjects should receive such brief notice. Retracing our steps up the Toroweap for a distance of about six miles, we at length select one of the great lava streams on the western side. Although quite steep, we may ascend it with the animals and packs without serious difficulty. At the end of an arduous climb upon the rugged slope, we find ourselves upon the platform of the Uinkaret. Around us are the old cinder-cones, most of which are of considerable dimensions. All of them have given vent to floods of basalt, which have spread out thinly over extensive surfaces, but as the number of superposed sheets is considerable in this part of the plateau, the aggregate thickness, though somewhat roughly inferred, must be three or four hundred feet, and occasionally much more. There is not much to add to this description. The lava is apparently all of one kind, but some of it much older than other portions. In truth, it soon becomes apparent that the period of volcanic activity was a long one. A few miles from the point where we attained the summit of the plateau and in a northwest direction from it, we come upon the termination of a lava stream which has the appearance of being extremely recent. It looks as fresh as the emanations from Vesuvius or Ætna which have outflowed within the last fifty years. Its surface is intensely black, and only here and there can we perceive that weathering has even impaired its freshness. Two miles away is seen the cone from which it emanated. The last eruptions from it have almost destroyed it, and melted down a greater part of its mass. Skirting the edge of this lava-sheet, we find at the eastern base of Mount Logan a small spring, named the Oak Spring. It is a central point, from which the southern part of the plateau may be visited. There is another very small spring high up on the southwestern side of Mount Trumbull, and its waters have been brought down by a wooden pipe to the plain below, to supply the wants of a saw-mill. A third and much larger spring is found on the western side of the Uinkaret. These are the only available sources of supply, and each may be used as occasion requires for the examination of different parts of the plateau.

The Kaibab.—It is difficult to say precisely wherein the charm of the sylvan scenery of the Kaibab consists. We, who through successive summers have wandered through its forests and parks, have come to regard it as the most enchanting region it has ever been our privilege to visit. Surely there is no lack of beautiful or grand forest scenery in America, and it is a matter of taste what species of trees are the most pleasing. Probably few people would select the conifers and poplars as the highest types of arboreal beauty. I suspect that the charm consists in influences far more subtle than these outward forms. The delicious climate, neither cold nor hot, neither wet nor excessively dry, but always exhilarating, is a fundamental condition by virtue of which the body and mind are brought into the most susceptible mood. The ease with which we move from place to place, the absence of all anxiety or care for the three great requisities of camp life, fuel, water, and grass, are accessory conditions. The contrast of the desert with its fatigue, its numberless discomforts and privations, is still another. But the scenery is also very beautiful in itself. The trees are large and noble in aspect and stand widely apart, except in the highest parts of the plateau where the spruces predominate. Instead of dense thickets where we are shut in by impenetrable foliage, we can look far beyond and see the tree trunks vanishing away like an infinite colonnade. The ground is unobstructed and inviting. There is a constant succession of parks and glades—dreamy avenues of grass and flowers winding between sylvan walls, or spreading out in broad open meadows. From June until September there is a display of wild flowers which is quite beyond description. The valley sides and platforms above are resplendent with dense masses of scarlet, white, purple, and yellow. It is noteworthy that while the trees exhibit but few species, the humbler plants present a very great number, both of species and genera. In the upper regions of the High Plateaus, Mr. Lester F. Ward collected in a single season more than 600 species of plants, and the Kaibab, though offering a much smaller range of altitude and climate, would doubtless yield as rich a flora in proportion to the diversity of its conditions.



Western Scenery.—A View of the Grand Canyon.

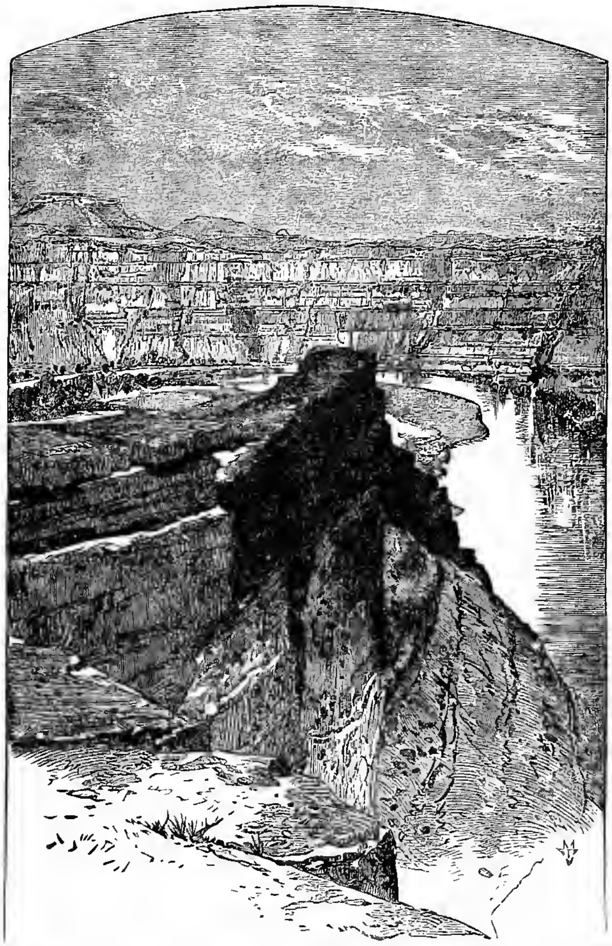
At a distance of about eight miles from its mouth, the ravine we have chosen has become very shallow, with gently sloping sides. At length we leave it and ascend its right bank to the upper platform. The way here is as pleasant as before, for it is beneath the pines standing at intervals varying from 50 to 100 feet, and upon a soil that is smooth, firm, and free from undergrowth. All is open, and we may look far into the depths of the forest on either hand. We now perceive that the surface of the plateau undulates with rolling hills and gently depressed vales. These valleys are the ramifications of the drainage channels. They are innumerable and cover the entire surface of the plateau. The main channels all deepen as they approach the edges of the plateau and often attain considerable depth, becoming at the same time precipitous. The deepest are those which emerge near the elbow of Stewart's Canyon and north of that point. These attain depths exceeding a thousand feet. The ravines which descend towards the eastern flank of the plateau terminate in a different manner. In the interior parts of the plateau these drainage valleys are all shallow, rarely exceeding 300 or 400 feet in depth, and seldom abrupt. After two or three miles upon the summit, the trail descends into another valley, whose course we follow upward for about seven miles. At the distance of about twenty miles from Stewart's Canyon, we find that we have gained about 1,200 feet of altitude, and that the vegetation has changed its aspect somewhat. The pines, though still abundant, are now in minority, and the spruces and aspens greatly predominate. The spruces form dense thickets on either hand, which nothing but the direst necessity would ever induce us to enter. Of this genus there are several species, varying much in habit. The great firs (*Abies grandis*, *A. Engelmanni*) are exceedingly beautiful on account of their sumptuous foliage. But the most common species is a smaller one (*A. subalpina*), with a tall and straight trunk, its branches spreading only five or six feet. These trees cluster so thickly together that a passage through them is extremely difficult and sometimes impossible. But we are not constrained to attempt it, for they seldom grow in the valley bottoms. Again we leave the ravine, and winding about among the hills, passing from glade to glade, we at length find ourselves upon the summit of a long slope, which descends rapidly into a great park, the largest on the Kaibab. It has received the name of

De Motte Park.—Its length is about ten miles, its average width is about two miles. It is a depressed area in the heart of the plateau, and is on every side girt about by more elevated ground rising by strong slopes 300 or 400 feet above its floor. The borders and heights above are densely forest-clad, but not a tree stands within the park itself. Descending into its basin and proceeding southward about two and a half miles, we reach a little spring where we make camp. The distance from the Big Spring to Stewart's Canyon is about twenty-six miles by trail. De Motte Park is eminently adapted to be the base of operations in a campaign of geological investigation upon the southern part of the Kaibab. It is a central locality from which we may radiate in any direction to the bounds of the plateau. Here the great bulk of the supplies may be deposited, and from the supply-camp we may make journeys with light packs for one, two or three days, as it may suit our convenience, and to it we may return to fit out for another short trip. The circumstances which make the park so advantageous in this respect are worth reciting. Notwithstanding the open character of the forest there are two difficulties in the way of travel on the Kaibab. The first has already been mentioned, scarcity of water. We know of about a dozen small springs, some of them conveniently located for the purposes of the explorer, others not. There is, however, another source of water supply which will be described presently. The second difficulty is the danger of getting lost and bewildered in the forest. This may seem to be a singular source of danger for an explorer, who of all men is bound to know his exact whereabouts at every step. But if he were to visit the Kaibab with that easy confidence and without a guide he would probably learn a severe lesson in less than a fortnight. The young Mormon herders who range over this region, and who follow a trail with the keen instincts of Indians, and with more than an Indian's intelligence, dread the mazes of the forest until they come to know them. Even the Indians who live and hunt there during the summer and autumn have sad tales about comrades lost when the snows came early and buried the trails so that they could not be followed. The bewildering character arises from the monotony of the scenery. There are hundreds of hills and gulches, but they all look alike. There are no landmarks except trees, which are worse than none at all. If you enter a ravine for the second time at a point other than that at which you first entered it you would probably fail to recognize it. As with the faces of the Chinese, no conscientious white man would be willing to swear that he had ever seen any particular one before. Yet the riddle of the Kaibab is soon solved, and once read, all danger is over. If the traveler is lost there is an infallible clue. He must go at once to De Motte Park. But how shall he find the way? If he has reason to suppose that he is within a dozen miles of it he has only to enter a main ravine and follow it to its head. This, however, does not apply to the portions of the plateau which lie more than five miles north of the park. The way may be long, but it is easy and sure. A few ravines fade out before reaching the near neighborhood of the park. In that event take the nearest one on the right or left. All of them head upon the summit which looks down into the park. It is necessary, however, to keep to the *main* ravine and avoid its minor tributaries, and there is a criterion by which it may be distinguished. At the confluence of a lateral ravine the grade of the main ravine is always the less of the two.

Although this may seem to be nothing more than a trivial bit of woodcraft, it really illustrates an important fact—the drainage system of a large portion of the Kaibab. The study of this drainage system will shed some light upon the geological history not only of the plateau itself, but of the region adjoining, and of the Grand Canyon. The thought which must be predominant in the mind of one who for the first time enters the Kaibab is of the Grand Canyon. The fame of its grandeur is world-wide, and the desire to see it as it is grows stronger the nearer he approaches to it. This longing must be at least tempered if not wholly satisfied before the mind is in the humor to contemplate anything else. Our first expedition, then, shall be to the brink of the great abyss. As the sun is rising and before his beams have penetrated to the bottom of the park we are on the way. On either hand is the forest, covering the slopes and the heights above, but ending suddenly at the foot of every incline. Before us to the southward stretches the open field with hardly an undulation. Six or seven miles away we can see the sylvan walls approach each other, leaving a narrow gateway between the tall spruces where the surface of the ground for a moment is sharply projected against the sky. The scene is, on the whole, a very attractive one. There is a great wealth of vegetation, somber indeed, and monotonous, but the darkness of the tone is suggestive of depth and richness of color. The only alleviating contrast is between the smooth expanse of the park and the myriads of sharp spikes which terminate the tree tops. The spirit of the scene is a calm, serene, and gentle one, touched with a tinge of solemnity and melancholy. About a mile from camp we came upon an object worthy of attention. It is rather a deep depression in the earth about 200 feet across and very nearly circular. Within it is a large pool of water. Its depth below the valley floor may be about 40 feet, and the depth of the water 5 or 6 feet in the middle. It is a fair specimen of a frequent occurrence upon the Kaibab. I have never seen them elsewhere, and the explanation is difficult. The interest lies in the mystery of their origin. In every day's ride we usually find three or four of them and sometimes more. Some of them contain water, but the majority do not. Some hold water throughout the year, some only in the early summer or until autumn. They vary in size and depth very considerably. Some are as narrow as 20 feet; some are 300 to 400 feet across. The depths vary from a yard or two to a hundred feet. The form is crater-like—always approximately circular. They do not appear to occur under any special set of conditions. They are found as often upon the platforms as in the valleys, and are not uncommon upon the slopes of the ravines. In a few instances traces may be seen of rain gullies or washes leading into them, but not often, and none have ever been noted leading out of them. Whatever running water may enter them sinks within their basins; but it is certain that many of them rarely receive any running water. In the cases of those which do the wonder is that they do not soon fill up with sand and silt, for the water generated by heavy rain storms or by melting snows, when sufficient in volume to run in a stream, is always thick with mud. The scarcity of running water on the Kaibab has been mentioned. Yet the precipitation is comparatively great and the evaporation small. It is apparent that all the water which falls upon its vast expanse, with the exception of a slight percentage evaporated, must sink into the earth, where it is doubtless gathered in subterranean drainage channels which open in the profound depths of the great amphitheaters of the Grand Canyon. In those depths are large creeks of perennial water issuing from the openings of those underground passages. This implies a system of subterranean rivulets, but it is not more wonderful than the endless caverns in the limestones of Kentucky and Indiana, and it is probably not upon so large a scale nor so greatly ramified. It also argues a high degree of permeability both in the upper strata and in the overmantling soil. The water sifts through them as easily as through sand, and rarely gathers into streams even in the most copious showers or most rapid melting of the snow. Whether these "lagoons" and "sink-holes," as we termed them, are the openings of pipes leading down into the subterranean rivers and kept open by a gradual solution of the limestone, it is difficult to say. There are some difficulties in the way of this theory.

Moving rapidly southward, at length we reach the Sylvan Gate at the lower end. Passing through we immediately find ourselves at the head of a second park very similar to De Motte's, but smaller, having a length of nearly three miles. It is named Little De Motte Park, and the Sylvan Gate occupies a divide between the two. It contains a large lagoon holding stagnant water. There is a chain of these parks reaching from the northern end of De Motte's southward, a distance of 25 miles, separated only by necks of forest. Our aspens, the golden shafts of sunlight shot through their foliage, the velvet sward—surely this is the home of the woodland nymphs, and at every turn of the way we can fancy we are about to see them flying at our approach, or peeping at us from the flowery banks.

By half-past ten the spring is reached. Next the Big Spring, in Stewart's Canyon, it is the largest on the summit of the plateau. Here, too, is the only semblance of running water, for the stream flows a little more than half a mile before it sinks. The water is cold and delicious. It has a faint whitish cast like that which would be produced by putting a drop or two of milk into a bucket of pure water. I presume it is caused by a fine precipitate of lime. We called it the "Milk Spring." Pausing here for a hasty lunch, and to fill the kegs (for to-night we may make a "dry" camp), we push on. We climb out of the ravine, and in fact we only came here to obtain water, as it is the



WESTERN SCENERY.—SUMNER'S AMPHITHEATRE.—COLORADO RIVER.

first objective point is a spring situated in one of the large ravines which head in the heights overlooking these two parks. Without some foreknowledge of the way to reach it, or without a guide, it would be impossible to find it, and the same is true of any other spring on the summit, but with this foreknowledge we seek the southwestern border of Little De Motte and enter the timber. During half an hour there is a miserable struggle with fallen trees and thick set branches of spruce and aspen, but at length the heights are gained, and we descend into a shallow ravine where the way is once more open. The winding glade with smooth bottom richly carpeted with long green grass, aglow with myriads of beautiful blossoms is before us, and the tall trees are on either hand. Soon it leads into a larger one, and this into another, until at last the main ravine is reached. Very sweet and touching now are the influences of nature. The balmy air, the dark and somber spruces, the pale green

only place near to the point of destination at which water can be procured. The route now becomes more rugged, leading across ravines and over intervening ridges, crossing the grain of the country, so to speak. But it is not difficult, for the pines have taken place of the spruces, and where the pines predominate the forest is very open. For eight miles from the Milk Spring we continue to cross hills and valleys, then follow a low swale shaded by giant pines with trunks three to four feet in thickness. The banks are a parterre of flowers. On yonder hillside, beneath one of these kingly trees, is a spot which seems to glow with an unwonted wealth of floral beauty. It is scarcely a hundred yards distant; let us pluck a boquet from it. We ride up the slope. The earth suddenly sinks at our feet to illimitable depths. In an instant, in the twinkling of an eye, the awful scene is before us.

—Taken from an article by Clarence E. Dutton, Report of U. S. Geological Survey.

THE ROMANCE OF MINING.

WHAT romance can there be connected with such an occupation as that of mining? Is the doing of the hardest work romantic? Can poetry be associated with deep pits and long underground galleries in which the never ending rows of timbers look like processions of ghosts and the masses of fungus remind you of strange monsters without form, yet of most fantastic shape, as seen in the dim light of the lamps which gleam like stars in the heads of the miners? The answer is yes. Are we not to find romance associated with the occupation of the Dwarfs and the drolls; poetry in the ground sacred to the Pixies? Mining is full of romance, of quaint superstitions, of dazzling tales which would not disgrace eastern imaginations; of poetry which comes down to us from the dead and gone races who centuries ago worked the metals under the frozen hills with their pine tree coronets in the far north; of strange Indian legends which as we hear them told remind us of the time when the dazzling Emperors of the South, the mighty Montezumas, watched the hecatombs of victims slain on the Obsidian altars of the dead war god; of the wonderful stories which were first told in the mines of sunny Spain and carried thence by the stern *conquistodares* to the land they made their own, reappearing to-day in quaint form and quainter language at the campfire of the lusty prospectors. In modern days too mining has shown its romantic side in the changes of fortune which have marked the careers of those who followed it, changes whcih are only paralleled in the oriental tales of *Genii*. Sudden wealth and equally sudden poverty, long years of patient waiting to be followed by affluence, hard and exhausting toil resulting in the finding of a placer or a pocket out of which the gold is taken in such quantities as to turn the brain of the discoverer. Can romance and poetry be denied to a form of work in which heroism of the grandest has been shown again and again? The very strangeness of the life of these human moles which we call miners, has brought about phases of human nature as strange as the life itself; and as the lonely miner toils under-ground by the light of his flickering lamp, his imagination has peopled the dark places in the mine with spirits of potent power; of a kindliness in the nature of some only equalled by the fell cruelty of the others. How often have poets sung and great musicians wedded to deathless music the *Niebelungen Leid?* How often have they told the story of the capture of Lohi, of the Dwarf King Andvari and Marr's first possession of the wonderful treasure when Lohi gave it to Huidman as a ransom for the three from Asgard, how Seigfried captured it and compelled Andvari the dwarf to pound it, how after Seigfried married Brumhild, Haco killed him for the treasure and how Haco hid the glittering hoard, refusing his life in exchange for the secret. The great German epic turns about a treasure of the mines. From the southland come the stories of the Moorish kings of Spain and the wonderful treasures procured and kept for them by the mighty power of the magicians; of the deep and hidden caves founded by *genii* and only to be opened by strange spells, in which the gold and the jewels were placed. Every race upon the earth has had its wonderful legends about mining, some as simple as the fairy tales for children; some as complex as the most involved drama in which human passions have played their parts.

The Madre D'Oro.—There has always been a strange fascination to the minds of men about the sudden acquisition of wealth. About the idea of gold so secured there has always been that mental glitter which has attracted the poet and the romancer. To the men who search for gold, whose lives are devoted to the discovery of the precious metals, there is a double measure of this fascination. The modest and least imaginative of them can picture to himself a ledge which is not solid gold shall at least contain nuggets and veins of the virgin metal bright with its yellow gleam. And so there is no story in the west half as often told as that of the *Madre D'Oro*, the "Mother of gold," the Treasure House destined by nature for her fortunate child. The story comes to us from the Aztecs, they in turn may have heard it from the Toltecs who preceded them. When the Great Empire of the Montezumas fell under the stern assaults of Don Herman Cortez and the army of heroes which he led; and when the last of the Montezumas who placed on his head the imperial plumes, the unfortunate Guatimozin died, the Indians adopted a belief similar in many respects to that which was so common among the English about the return, some day, of the fabled Arthur. Under the grinding tyranny of the *Anquistadores* this belief was the sole hope left among the unfortunates who lived and died under the lash. When Montezuma returned, he would, so the legend ran, lift the race from slavery, drive out the hated Spaniards, rear once more the altars to the war God on top of the *teocallis* and resume his ancient state and power. Until that time came, the Aztecs who were left must endure as best as they might the evil days which had fallen upon them. And so they lived and died, nursing the vain hope that some day better times would come when the long delayed vengeance would be fully satisfied. But they realized that when Montezuma returned he would need in order to resume his power, stores of gold, and so they told to each other with bated breath the story of the wonderful valley, where, under the guardianship of the faithful tribe, descended from the remnant of the priests who united with their devotion to their terrible Deity almost as sincere a worship for the House of Montezuma, the treasures destined by the Gods to furnish forth the rehabilitated glories of the kingdom lying waiting for the coming. Although, as is Indian nature, the Aztecs were to the last degree reticent, such a story as this was too wonderful not to be told again. Perhaps more Aztec maidens whispered the legend she had heard from the grandsires of her race to the ears of her Spanish lover. Perhaps some poor slave tortured to death let fall the story to delay for a time the intolerable torment. It matters not how the tale came to be told. In time the Mexicans heard it and in retelling gave it possibly, still further wonderment as it passed through brains colored by the vivid imagination of the Spanish nature. And so it came to us, as wonderful a story as was ever told to men; one rivaling the wildest legends of the East. Somewhere in Southeastern Arizona or in Northern Mexico, so runs the tale to-day, there is a small valley. It is always described as being about five miles long and two wide, and walled in by towering mountains. It was formed originally by water, being simply the widening out of a Canyon, through which at the lower end is the only entrance to it. Its sides are airy, are from three to five —thin sand—feet high, and they go down there from the top. While they have been fashioned into strange shapes during the long ages that have passed since the water began its work, they are always said to be so precipitous as to prevent anyone climbing down. The upper part of the Canyon, that above the valley, is simply impassible for men owing to a tremendous precipice, over which the ancient river once ran and down which the stream now falls in an exquisitely beautiful water fall. The Canyon below the valley, however, may be passed through the entrance cave. When the river was cutting it, it encountered a deposit of hard stone, under which it slowly worked its way through a softer bed and gradually hollowed this out, until, in time, it cut a long tunnel, like a cavern. Through this is the entrance to the valley. But not only is the exact location of the valley not known but the entrance to the cave is carefully hidden by the efforts of men. The Indians, who guard the treasure for the coming of Montezuma, live near the entrance, and they have carefully concealed all the approaches to it, and are, if it be necessary, prepared to give up their lives in its defence. It is said that even among them the entrance to the cavern is only known to the three most aged men, and is never communicated except when, on the death of one, it is necessary to give the knowledge into the keeping of another. When this occurs, the tribe know, for the first time, that the man who has gone was one of the guardians of the secret. The communication of the knowledge to another is done after many ceremonies and in a way which absolutely prevents all knowledge on the part of the tribe as to who is chosen. The women and children and such of the men who are not old enough to belong to the medicine lodge, or what is apparently —supposing this story, as told, to be true—a kind of order of priesthood in the medicine lodge, prepare enough food to maintain them for ten days. They start in the direction of the setting sun and travel five days. On the morning of the sixth they turn and travel back. The day after they leave, each of the members of this order of priesthood, taking with him enough food to last seven days, leaves the *rancheria* or village, and goes alone to some designated spot within half-a-day's trip. Here he stays for the seven days, at the end of which time he comes back. Among these men, who are always old, there are two, known only to each other, who possess the secret. They set forth like the others, but they alone have the right to leave the places to which they go on the morning of the third day. Together they journey to one of the spots where the priests have gone, and greeting the man they find there by some form of words, said to be a remnant of the old Aztec language, bid him rise and follow them. They take him to the long cavern and through it to the valley, they show him the ledge which they have guarded in the past and which he must guard in the future, they reveal to him the knowledge which they have of Montezuma, they tell him of the signs which will point to the coming again of the Imperial race. Slowly and carefully they show him the method by which the place is found. They exact from him oaths of the most solemn sort that as he has received the secret so alone he will impart it, unless the fulness of time should come and Montezuma return. They give him the signs by which Montezuma will be known; the form of words which Montezuma will use when he asks the faithful guardians of the secret for his own. They indulge in a sacrificial banquet, in which it is said, the flesh of the man who has just died forms the sacrament, on which the living swear that as he kept the secret entrusted to him, so they will keep it until the end. Returning to the *rancheria*, and effacing with infinite pains the marks of their feet after they leave the cavern, each of the three goes to his appointed place to return with all the others on the seventh day. No one knows who has been selected to carry on the trust, except the three to whom it is confided. On the tenth day the young men, women and children return to find the members of the priesthood quietly awaiting them. They know that during their absence some one of the old men who sit there so calmly and quietly, has seen the valley and the ledge but they know no more.

The valley is as I have said, described as being about five miles long and two wide. Surrounded on all sides by towering and precipitous cliffs, grim in their stern and rugged shapes, the valley itself is a paradise. Watered by the stream which flows through it, its soil is covered with flowers and beautiful trees, through the branches of which flit the bright-hued birds of the South land. Brilliant insects dart here and there through the delicious air; the only reptiles seen are the gold snakes with their glittering greenish-yellow scales. Perfectly harmless, they but serve to give added beauty to the scene. Stretching across the valley from one side to the other lies the great ledge, like a golden zone; its masses of virgin metal gleaming and glistening in the sunlight. It is said to be five feet, ten feet, fifty feet, a hundred feet wide. The gold lies in it in great veins and nuggets, embedded in clear quartz, the sharp angles of which glitter in the sunlight like gigantic diamonds.

Across the ledge the stream flows, and forms a little waterfall, below which the nuggets of gold can be seen in the water and out. Growing beside the ledge, just by the fall, is an exquisite tree at the base of which lies a great gold snake, ever watching with unmoving eyes the treasures of Montezuma. It is the war-god in person who guards the place. Gold in the ledge, gold in the scales of the snakes, gold in the stream, gold in the colors of the insects, and birds, gold across the valley, gold down the valley; gold, gold, gold, gold, is the refrain of the golden story. The fearful precipices which surround the place, the strange ceremonies and horrid banquets which have served to keep the secret safe, the tribe of Aztecs, living only to preserve for their mysterious ruler this treasure-house of nature, have all aided in giving to the story its strange interest. Small wonder is it that the pulse should quicken and the eye grow bright, as you hear the tale from the lips of men who more than half believe it. The lonely desert surrounding you, with the tall *cacti* looking like ghosts in the half-moonlight; the long-drawn melancholy of the cayote's howl, the prospector's fire of greasewood, the men with their rough clothing and quaint language, all vanish as you listen, and in imagination you are transported to the wonderful valley, in which is the "*Madre D' Oro*, the "Mother of Gold." Nor are they content to tell the story as an Indian legend. They cite instances of white men who have seen the place, who have descended into the valley in some way and returned with all the gold they could carry. The location of the spot is always in a dangerous Indian country; I have been told twice that it was in the Chicahua Mountains. It is always said to have been found purely by accident, by men who were either hunting or prospecting for ledges; about the only two occupations which will make unscientific men climb high mountains. It can only be seen from the upper end and after the morning mists in the valley have cleared away. Then as one stands on the rugged peaks and looks down he sees the great ledge spanning the valley below him, the virgin metal glittering in the sunlight, and he knows that he has before him the place of which he has heard so much and dreamed so often.

Is there any truth in the story? I cannot tell. The Indians believe it implicitly, as anyone who contrives to get on sufficiently intimate terms with them to be trusted can, if he takes enough trouble, find out. The Mexicans are far more communicative than the Indians, and will tell the tale on the slighest provocation, appealing to all saints in the calendar to convince you of its truth. Many of the old projectors believe it absolutely and a number of them have gone upon the search themselves or have known men who had done so. The treasures of the western half of this continent are not more than suspected as yet, and it may be that there will be discovered in time ledges of far greater value, especially in free gold, than any yet found. Who can tell what will be developed in the future. In the mean time the story is one worth preserving, if for nothing else, for the wealth of barbaric magnificence which it contains.

The dangers of mining are great under the most scientific methods known; judge what they must have been in the days when men carried out the ore in leather buckets on their backs by ascending steep ladders. Wherever there is danger superstition steps in to account for it, and it is small wonder that the acts of the demons and evil spirits with which the imaginations of the miners has peopled the mines should have about them a horror all their own. One of the most common "bogies" or devils supposed to haunt the mines is the "step devil," "Sauch," or "the Ladder Dwarf," for he is called by all these names. He is described as a hunch-backed dwarf with a short body, large head and enormously long and powerful arms. In fact a gorilla is as good a comparison as could be made of this particular spirit. His favorite trick is climbing the ladders by means of which the miners leave the mine, by raising himself with his long arms and as he passes the rungs, kicking them out one by one. He is supposed to always do this just before an accident of some kind in the mine. This superstition may be found in the far south as well as in the north. In Mexican mines in the old days, the descent and ascent of the shaft was made by the aid of tree trunks, having notches cut in them, in which the piens or laborers rested the great toe as they stepped from one to the other. "Sauch" in the southern legends became a demon having on each great toe an enormous nail or claw by the aid of which he would gouge out these places where the feet of the ascending miners rested. In both these stories it will be noticed that the demon is described as being possessed of a kind of refined cruelty, for he leaves the ladders or the tree trunks after having destroyed their usefulness, to tantalize the unfortunate men who are imprisoned in the mine. A superstition which is common, is that about the "gold snake." This species of serpent is perfectly harmless, and is rather handsome, being green in color with a sort of golden hue or irridescence in the scales. It is believed that wherever a gold snake makes his lair there is a ledge containing the precious metal, and there are many Mexicans who will locate a claim at once if they find a gold snake. I saw an instance of this in Arizona where a gold snake was found and a claim located. Not only was this done but a fine mustang was actually given for a share in it by a Mexican who was as credulous as the original locator. My own curiosity was sufficiently excited to make me prospect in the most careful manner for a ledge in the place and its vicinity, in order to find out if there were any truth in the theory, but I must say that I could not find one. There may, of course, be this much at the bottom of this widely-spread belief, the gold snake is found in a country where ledges of precious metals are also found, and it is no very extraordinary step for the imagination of the credulous to take, that of believing that the gold snake indicates the gold. The name of the reptile too, may have something to do with the theory. One of the most common beliefs of miners is that before an accident happens, the rats, of which there are generally large numbers in the workings, will leave the mine. This belief is so universal that I should hesitate before pronouncing it to be absurd, as certainly one is tempted to do on first hearing of it. I have had miners give me many instances in which they said it had occurred, and I had then no reason to doubt the truthfulness of what they said nor have I now. As will probably occur to the reader, this belief is one which is directly akin to that of sailors about rats leaving "a sinking ship." A similar story is told about the cockroaches which swarm the mines. They are said to crawl out of the shaft before accidents take place and to be particularly anxious to leave before an earthquake. Animals often seem to have some mysterious instinct by the aid of which they can reason or feel that something is going to take place, when as yet the signs are not perceptible to man. I know for a fact that in the desert horses will find water when there is nothing to guide a man in the search. Of course they may do this by the power of smell just as dogs follow "scent," and it would be ridiculous to suppose that they smell an earthquake. Still, before one of these convulsions of nature, animals are exceedingly uneasy, and it may be that they have some instinct or perception which we have not. I have certainly seen enough of this to make me slow in disbelieving the miners' stories about the rats in a mine.

The Divining Rod.—One of the most common and most curious superstitions among miners is the belief in the Divining rod. If any class are distinguished above their fellows by this, it is that which comes from Cornwall. The broad statement about the Divining rod may be said to be as follows: You take a forked twig of witch hazel, mountain ash, mountain cherry or alder and place one of the forked ends in each hand. The twig must be shaped like the letter Y. The end placed in one of the hands is laid across the palm which is turned up, the fingers are shut down over it and the thumb bent over the ends of the fingers. The hands are then held in front of the body, the elbows being bent at a right angle. Between the hands holding the forked ends of the twig, the single end rises straight up so that the twig looks like a Y upside down, thus ⅄. Now the theory is that when a person walks over a ledge or deposit of any mineral, or over a spring of water, this upper stem of the twig will of its own volition turn down in spite of all that the person holding it can do to restrain it. This may be said to be the divining rod in its simplest form, and its use depends upon the existence of some mysterious force or attraction exerted upon it by the neighborhood of the metal, or the water. The Cornish miner who almost always uses the witch hazel twig does not hesitate to tell you that persons having the "gift," as some mysterious power inherent in certain individuals which permit of this equally mysterious force being exerted on the rod, is called, are able to find deposits of ore by its aid without the slightest difficulty. And what is more, he firmly and honestly believes what he says. There is a class of men however, who with the acquisition of some knowledge have acquired a certain amount of distrust in the simple rod, or perhaps I should say, in the proposition that a body of metal can by any occult power affect a twig. It may be too that they feel a certain degree of shame in confessing their belief in such a bald superstition as is that of the rod, in its simplest form. These men, then, having a desire to give some excuse for the faith that is in them have invented the rod complex. The virtues of the rod complex are supposed to rest upon what they call the affinity of metals. This is a belief that every metal may be said to have some one other among the metals for which it has a strong affinity or liking which it will manifest whenever and wherever you give it an opportunity. It is of course easy to see that this idea is based upon a misconception of the laws of chemical affinity. Having this idea they make rods which are suitable for, or which it is supposed will work in particular metals. I knew a very clever man who had been bitten by this theory and he told me how he had constructed his rod. Knowing that gold has a strong chemical affinity for tellurium, he procured a bar of the latter metal and lashed it between the ends of two pieces of whalebone. Taking the other ends of the whalebones, one in each hand and holding them in the manner described, he walked over a ledge in which he knew there was gold. Sure enough the rod turned down, without, he said, and I did not disbelieve him, any conscious effort on his part. He made a number of similar experiments which resulted in the same way. In some of these he did not know until afterwards that there was any gold present. I prepared two specimens of gravel, one with and one without gold and he tried the rod upon each. The rod bent in the former and failed to move in the latter, and my friend was triumphant as might naturally have been expected. He accounted for the movement of the rod by saying that he supposed there was some inhuman form of electricity akin to that which attracts iron to a magnet. I suggested to him that if this was the case and if gold was attracted by or would attract tellurium, it was perfectly evident that it would do so under any and all circumstances. To this he agreed. I then suggested the following experiment. We placed the bar of tellurium in one pan of an assayer's scales, accurately balancing it with common sand. Placing the scales in a large bell receiver we exhausted the air as far as possible and introduced two ounces of fine gold under the pan having in it the tellurium bar. It is perhaps scarcely necessary to say the index of the scales did not move. Somewhat chagrined by the result my friend suggested that it might be that the human body supplied a form of electricity necessary to the experiment. I then took a common wooden rolling pin and bored eight holes in it in which I inserted pegs six inches long. Weighing out seven portions of sand, each of which balanced the tellurium bar, we bound these to the ends of seven of the pegs, binding the tellurium bar to the end of the eighth. The apparatus looked something like a wheel from which the felloe and tire have been removed; and by holding the handles the whole thing could be spun around with the greatest ease. But, and in this lay the value of the test, by no possible means could the person holding the handles cause the pegs to move. Placing the tellurium peg on top, as the stem of the Y shaped rod had been, we, or rather he, tried it on rock containing gold, or pure gold, gold in alloy and finally upon three ledges on which the rod had worked perfectly. Upon none of these did the machine turn. We then substituted for the tellurium some mercury with the same result. Being then as anxious to prove the rod theory a failure as he had formerly been to convince me it was a success, my friend went to several "rod makers" in the place and procured from them their rods which had been used many times and always with success. Removing the mysterious charms which were supposed to attract or to be attracted by the gold, he placed them in turn upon the apparatus, but the thing would not turn. There was in the neighborhood a man whose rods were celebrated as being always reliable and who was himself believed to have the "gift" to an extraordinary degree. By telling him that the rolling pin was a German rod which I had brought from Heidelberg, we persuaded him to use it over a ledge in which we all three knew there was gold, but even in his hands the rolling pin refused to move. In this case the eighth peg had on it a charm taken from a rod manufactured and often used by the man himself; who by the by pronounced the German rod to be useless, and taking one of his own showed us how it would turn down whenever he crossed the ledge—which in fact, it did. We then took the original whalebone rod a small bag of sand having been fastened to the tip, and gave it to the man with the "gift." Of course he supposed that the bag contained one of the charms. In his hands the rod so prepared turned down every time he crossed the ledge, although feebly. He told me that the charm in the bag was not a good one, but that if he had the rod made by him and lent to us he could make it work. This rod was the one from which we had taken the charm, then attached to the rolling pin. When this had been done however, a bag of sand had been substituted for it. Giving him the rod, we found that it worked perfectly, whirling around in his hands the moment he placed his foot upon the ledge. The result of these experiments was satisfactory as far as they went.

There was one more however, which I was anxious to try and the next day we invited the man with the "gift" to come over to my friend's place. In the meantime we took the charm from the rolling pin and replaced it upon his rod. When he came I broached the theory that the cause of the rods working was the weight on the tip, and that the charms had nothing to do with it. This the man with the "gift" strongly combated. I suggested that we should try it, and, he agreeing, I removed the charm from his rod and substituted a bag of sand of the same weight. The rod was then in precisely the same condition as it had been the day before when, it had worked perfectly, the difference in the experiment being that he was then aware of the change, whereas, the day before he had been ignorant of it. We adjourned to the same ledge, and the rod in his hands refused to work. Now it must be remembered that in none of these experiments was there any conscious fraud on the part of the operator—except indeed, on my part, when I told the man with the "gift" that the rolling pin was a rod from Heidelberg. If I ever was convinced of anything, I was that the man was sincere in his belief in the virtues of the rods as prepared by him. A single experiment on his part convinced me of this. He and I were together hunting specimens from a placer-claim, and he was exceedingly anxious that I should find gold in the dirt. I had tried some five or six specimens without success, and he went down the stream to find a spot from which we could take dirt that would show color. In hunting for a place, he used the rod. Now his one desire then was, that I should find gold, and, he believed that the rod would show him where to tell me to take a specimen.

It is a fact that the divining rod will turn down when the person who carries it crosses a spot where he believes there is a ledge. I have seen this, not only in the case of the rod complex, but when the simple witch-hazel rods have been used by the Cornish miners. Nor have I had any reason to doubt the perfect honesty of those using them. They believed that the rods worked of themselves, and were perfectly unconscious of doing anything to make them turn. The reason why they turn, or at least my own theory upon the subject, I may illustrate by citing an experiment which I tried. Weighting a rod with two pounds of lead, I got the gentleman who constructed the rod, with the tellurium bar attached, to hold it in the prescribed manner. In performing the experiment, I told him to rest his elbows upon a table. This I did because, under such circumstances, he would be able to resist the strain upon the muscles for the longest time. I also told him to hold the rod tight. At the end of three and a half minutes his hands began to tremble, and at the end of five the rod turned slowly down. He said that his hands were so tired he was unable to hold it up any longer. I tried the same experiment myself and found that he had accurately described the feeling in the hands. It was, to use a slang expression, as if they had "lost their grip." I found, too, that there was a feeling of soreness along the inner side of the forearm, and that the nerves at the wrists were quite painful. Now all those who had used the rods, believing in them, had spoken of a tingling sensation in the arms after the trials, and this they ascribed to the currents of electricity which they believed to be excited by the experiments. In the experiment just cited the weight of the rod was enormously increased, for as a rule the charms weigh about an ounce and a half—the average of nineteen charms weighed by me was 4,665 centigrams—and the effect, therefore, upon the muscles of those making the experiment was proportionately increased. The fact that we knew the experiment to be one which was simply a test; that is, the fact that we did not believe there was any power besides that of gravity acting upon the rod, caused us to resist the action longer and to strain the muscles more. But the experiment proved to me that with a light rod and a desire to yield to any attraction at once, the natural feeling of fatigue might be easily mistaken for such attraction, especially when combined with a full belief in the power exerted upon the rod by the deposits. All believers in the rods tell you that they must be held in the hands with the palms turned up and the thumb side of the hand outward. I am not enough of an anatomist to know whether this produces any unusual strain upon the muscles, but I found that by taking the heavily weighted rod in the reverse way; that is, with the backs of the hands up and the thumbs towards each other, both my co-experimenter and I could keep the stem upright for a much greater length of time; and I, therefore, concluded that the prescribed position for the hands during the trials is one which causes the muscles to be exceedingly sensitive to fatigue. I merely give this as a theory of my own, adopted as the result of the experiments cited and not as a fact. About the causes of the movement of the rod in cases where the experimenters are honest, I have not, however, the slightest doubt; and speaking of the honesty of those using the rods, I must mention one fact, I found that it was impossible to mistake the movement of the rod by any voluntary action of the muscles. The rods, as held by those using them, will often twist in the hands; the whalebone becoming bent or the twig twisted to that extent that the bark is sometimes broken. This cannot be imitated voluntarily, and the fact of this twisting is appealed to by those who use the rods to show two things; first, that they are holding them tightly, and second, that there is some external force being exerted upon them. It would, certainly, seem that the force of gravity as exerted upon the stem of a small shaped twig, would not be sufficient to cause it to twist in this way; at least, I took one the same size and shape as that which had turned on a gold ledge, and nailed it to two sticks within six inches of the ground, and it did not move, then I transposed the sticks to a pile of exceedingly rich gold-ore and the rod remained upright as before. I do not know if it be possible, anatomically speaking, for the muscles of the hand and fingers to twist the rod in the hand, but this is apparently what is done. It is certain that in one of the experiments, that in which the man "with the gift" had the rod prepared with the bag of sand in his hands, he supposing that the charm was still on the rod, the whalebone bent in the manner described. There is another explanation of this twisting which is possibly the correct one. In the forked ends of the twig or the pieces of whalebone, there is a considerable amount of spring, and it may be that this is unconsciously taken advantage of to cause the stem to turn. I have devoted a considerable amount of space to this discussion of the divining rod for the simple reason that it is not only one of the most widely spread beliefs among miners, but because I have found instances where money has been spent as a result of its use. Men have bought charms on ledges solely upon the mystic information conveyed by twigs or the rods complex, and as I cannot help feeling that this is a great piece of folly on their part, I am anxious, if possible, to aid in stopping it. I have, therefore, given my own experiments at length, not that they possess any great amount of intrinsic value, but because they served to convince me that there was nothing in the theory and nothing to be derived from the use of the rods; and I hope that my readers before giving their support to the practice, before, if I may be permitted the expression, allowing themselves to be "rod-bitten," will test for themselves in some such way as I have tested. To me, the theory that chemical affinity can be correlative with anything like magnetic attraction, is one which I have never seen supported by any test that would stand examination.

The Whims of Fortune.—Mining owes a great share of the romance which attaches itself to it to the sudden changes of fortune which it brings about. This is particuarly true of mining for gold and silver. The prospectors, or that class of men who spend their lives looking for deposits of the precious metals, are poor to-day and rich to-morrow. The history of the West is full of these sudden changes, and in nothing is this better shown than in the fact that there is a common phrase or form of words used to describe such a change. They say, "So and so has made a strike." As it takes many instances of a certain defined alteration in a man's life to introduce into the language a phrase expressive of such alteration, we may reason not unfairly from the phrase to that which has caused it. As we find that "making a strike" is one of the most common group of words used, we may conclude that the doing so has been a common thing. And as a matter of fact this is true. Were the histories of the men who have risen to the possession of great wealth upon the Pacific Coast written, it would be found that many of them if not the majority have acquired their money as a result of "making strikes" in mining. From the case of the pocket prospector whose credit has declined to that point that he is unable to obtain a side of bacon, a bag of flour and a bag of beans, and who, finding a pocket, takes from one to twenty thousand dollars in a day or two, and spends it gloriously in a spree which lasts anywhere from one month to twelve, to that of the man who buys stock in a mine which is supposed to be worthless and wakes up some morning to find that he is worth millions as the result of his purchase, all "make a strike." The Bonanza Firm are instances of this, perhaps as good as could be selected. Years ago Messrs. Flood and O'Brien were the proprietors of a saloon on Washington street, in San Francisco; Mr. Fair was a miner, and Mr. Mackay a timber-man in the Mexican mine. They made money in the Hale and Norcross, and put that money where it would do the most good, in developing the Consolidated Virginia and California. After driving the drift 1200 feet they "made a strike"—they struck the Big Bonanza, and fortune was the result. It is this chance of making large amounts of money very suddenly which gives its fascination to mining, to prospecting and to investments in mines.

I remember the story of a friend of mine who went to New Mexico. A Fellow of the Royal Chemical Society, he had drifted into journalism in San Francisco, and his ability and talents had raised him to a high place in his adopted profession. He was engaged to go to a town in New Mexico and there edit a paper to be started by a man who believed that there was money in the venture. Two weeks after their arrival in the place the owner of the paper died and his companion, finding that the paper project was at an end, was obliged to cast about for something to do. Having a little money, enough to purchase an outfit, he joined himself to two others, and started on a prospecting expedition. Striking into a new district, they found ledges and located five claims. Clubbing their funds together, they sent the ex-journalist to San Francisco, where he soon succeeded in selling the property for $21,0000; his share, of course, being $7,000. Not a bad stake for a man who two months before had found himself all but penniless in a frontier town. And mining history in the west is full of such instances.

Here is another case I remember, which has about it all the elements of romance. A young engineer, by the name of Jackson—all the names given are fictitious—who had had some experience in mining, fell in love with the daughter of a prominent merchant in San Francisco named Smith. Young Jackson found that Miss Helen Smith returned his affection with, so to speak, legal interest, and he applied to Smith, *père*, for permission to marry his daughter, Smith, *père*, being of the truculent order of sires, and knowing that Jackson had nothing but his profession as an engineer to depend on, rejected the suit with much contumely for the suitor. A consultation between the lovers revealed the fact that Miss Helen said enough for him to wait, and after many vows, Jackson left to seek his fortune. Two years passed but he was not heard from, and during which time there were many applications made by unexceptionable men for Miss Helen's hand, and a very pretty hand it was, too. She rejected each and all, preferring to wait as she had promised, and being fully convinced that in time her lover would return. At the end of the two years, or, to be exact, at the end of two years and three months, Jackson came back. He told his story to sympathizing ears, how he had gone prospecting and had worked without success until his money was exhausted; how he had then labored as a miner until he saved enough to buy provisions for another trip; how he had gone on that trip and failed again; how he had once more gone to work and got another "grub stake" saved up; how he had joined a party and traveled into Idaho; how they had found a ledge of rich ore and opened it; how the ledge widened as it went down, and proved to be exceedingly valuable, and how he was in San Francisco as a representative of the party for the purpose of interesting capital in the mine. What girl could listen unmoved to such a story, especially when told by the lips of her lover, to whom she had been true during the weary months, and who she found was true to her; certainly not Miss Helen. As Jackson's prospects were as yet somewhat misty, they agreed that they would wait a little longer before trying to obtain the consent of Smith, *père*. It was not long, however. Jackson's specimens were sufficiently good to induce men with money to look into the matter, the mine was found upon examination to be all that was claimed for it, and $80,000 was paid for sixty per cent. of the claim. The capitalists who had bought in were sufficiently well pleased with the young fellow who had brought the mine to their notice, to think he would make a good superintendent, and they offered him the place with $20,000, ten per cent. of the stock in the mine, and the position of superintendent. Jackson once more went to Smith, *père*. The old man had found out by this time, that if his daughter did not marry the man of her choice she would not marry anyone, and I suppose that he was pleased with the way in which his would-be son-in-law had shown what there was in him. Besides, it must be conceded that the prospects of the young couple were infinitely better than they had been before. And so the consent was given, and the wedding took place, all parties appearing to forget the unpleasant interview of two and a half years back. What story of the olden days when knights went forth in full armor to win for their ladies fair castle and broad possessions is more romantic than this of young Jackson? What Knight battled more strongly with axe and lance than did Jackson with pick and drill? And what "fair ladye" was more true to her absent knight during the long, weary days, than was the charming girl, whose personality I have hidden under the somewhat unpoetical name of Smith? This story, as I have told it, is literally and exactly true, and is not, as might be possibly imagined, an extract from an unpublished novel.

In speaking of the romance of mining, an article would be incomplete were that strange institution or custom of "partnerships" in the west unmentioned. "Pards," as they are ordinarily called, are men, who from mutual liking when thrown together, form the closest kind of friendships. In a mode of life which is full of strange vicissitudes, men get to know each other as they never can under other circumstances, and it may well be said that their affection for each other passes that of brothers. A man not only backs up his "pard" on every and all occasions, but any other line of conduct on his part would excite no small degree of surprise among his acquaintances. Instances of heroism which seem almost sublime, have been common enough, and some of them have been wedded to verse which will live as a record of what a man can do for his friend. The remark, "He was my pard," is a key to the origin of many a deed which kindles the eye and makes the blood run faster of those who hear the story told. Self-sacrifice of a kind which is sublime, and love almost surpassing that of a mother for her child, have glorified and ennobled "pardnership;" though the word be uncouth, it describes a very beautiful thing. I cannot close my brief allusion to it better than by quoting the poem which commemorates what one "pard" did for his friend.

IN THE TUNNEL.

Here in this tunnel
He was my pardner,
That same Tom Flynn,
  Working together
  In wind and weather,
Day out and in.

Didn't know Flynn?
  Well, That is queer;
Why, it's a sin
To think of Tom Flynn,—
  Tom with his cheer,
  Tom without fear—
Stranger, look 'yar!

Thar in the drift,
Back to the wall
He held the timbers
  Ready to fall;
  Then, in the darkness,
I heard him call:

"Run for your life, Jake!
Run for your wife's sake!
Don't wait for me."
  And that was all.

Heard in the din,
Heard of Tom Flynn,—
Flynn of Virgin'.

—*Alfred Balch.*

DOWN IN A UTAH MINE.

"BEEN *down a mine!* What on earth did you do that for?" said the elder Sheridan to the younger.

"Oh, just to say that I *had* done it," was the reply.

"To *say* that you had done it! Good gracious! Couldn't you have *said* that *without going down a mine?*"

No, Mr. Sheridan, you could not; at least not in these latter days. Too many people do it now for the impostor to remain undiscovered. Take my own case, for instance. I have often read descriptions of mine descents and thought I knew how it happened and how ore was got out. But no one ever told me that you had to go paddling about in water half the time, or that mines were excavated *upwards.* Now, then, if I had tried to pretend that I had been down a mine I should have been promptly found out, by my ignorance of the two first facts that strike one. Again, it is very simple work imagining the descent of a "shaft" in a "cage." But unfortunately a "cage" is only a platform to stand on without either sides or top, and not, therefore, such a cage as one would buy to keep a bird in, or as would keep a bird in if one *did* buy it. Nor without actually experiencing it could anybody guess that the first sensation of whizzing down a pipe, say 800 feet, is that of seeming to lose all your specific gravity, and that the next (after you had partially collected your faculties) is that you are stationary yourself, but that the timbers that line the shaft are all flying upwards past you like sparks up a chimney. Mines, of course, differ from one another just as the men who go down them do, but as far as I am concerned all "mines" are puddly places, and the sensations of descent are ridiculous—for I have only been down one in my life. The mine to which I refer, then, is the "Ontario," in Utah, which may be said, in the preposterous vernacular of the West, to be a "terrible fine" mine, or, in other words, a —— "big thing," that is to say a "daisy." As for daisies, anything that greatly takes the fancy or evokes especial admiration is called a daisy. Thus I heard a very much respected Mormon Bishop, who is also a director of a railway, described by an enthusiastic admirer as "*a daisy!*"

Finding myself in Park "City" one evening—it is a mining camp dependent chiefly upon the Ontario—I took a walk up the street with a friend. Every other house appeared to be a saloon, with a doctor's residence sandwiched in between —a significantly convenient arrangment perhaps in the days when there was no "Protective Committee" in Park City, but—so I am told—without much practical benefit to the public in these quiet days, when law-abiding citizens do their own hanging, without troubling the county sheriff, who lives somewhere on the other side of a distance. The result of this is that bad characters do not stay long enough in Park City now to get up free fights and make work for the doctors. The Protective Committee invites them to "get" as soon as they arrive, and, to do them credit, they "get."

However, as I was saying, I took a walk with a friend along the street and presently became aware above me, high upon the hillside, of a great collection of buildings, with countless windows (I mean that I did not try to count them) lit up and looking exactly like some night scene in a melodrama. These were the mills of the Ontario, which work night and day and seven days to the week, a perpetual flame like that of the Zoroastrians and as carefully kept alive by stalwart stokers as ever was Vestal altar-fire by the girl-priestesses of Rome. It was a picturesque sight, with the huge hills loomin up black behind and their few pine-trees showing out dimly against the darkening sky. Next morning I went up to the mine—and down it. Having costumed myself in garments that made getting dirty a perfect luxury, I was taken to the "shaft." Now, I had expected to see an unfathomably black hole in the ground with a rope dangling down it, but instead of that I found myself in a spacious boarded shed, with a huge wheel standing at one end and a couple of iron uprights with a crossbar standing up from the floor at the other. Round the wheel was coiled an enormous length of a six-inch steel-wire band, and the disengaged end of the band, after passing over a beam, was fastened to the crossbar above mentioned. On the bridge of the wheel stood an engineer, the Rhadamanthus, arbiter of fates, who is perpetually unwinding victims down from stage to stage of the Inferno and winding up the redeemed from limbo to limbo. Having propitiated him by an affectation of intelligence as to the machinery he controlled, we took our places under the crossbar, between the stanchions, and suddenly the floor—as innocent-looking and upright-minded a bit of boarded floor as you could wish to stand on—gave way beneath us, and down we shot *apud inferos,* like the devils in "Der Freischütz." We had our lamps in our hand and they gave just light enough for me to see the dripping wooden walls of the shaft flashing past, and then I felt myself becoming lighter and lighter—a mere butterfly—imponderable. But it doesn't take many seconds to fall down 800 feet, and long before I had expected it I found we were "at the bottom."

Our explorations then began; and very queer it all was, with the perpetual gushing of springs from the rock and the bubble and splash of the waters as they ran along on either side the narrow tunnels, the meeting at corners with little cars being pushed along by men who looked, as they bent low to their work, like those load-rolling beetles that naturalists tell us of; the machinery for pumping, so massive that it seemed much more likely that it was found where it stood, the vestiges of a long-past subterranean civilization, than that it had been brought down there by the men of these degenerate days; the sudden endings of the tunnels that the miners were driving along the vein, with a man at each ending, his back bent to fit into the curve which he had made in the rock, and reminding one of the frogs that science tells us are found at times fitted into holes in the middle of stones; the climbing up hen-roost ladders from tunnel to tunnel, from one darkness into another; the waiting at different spots till "that charge had been blasted," and the dull, deadened roar of the explosion had died away; the watching the solitary miners at their work pecking and thumping at the discolored strips of dark rock that looked to the uninitiated only like water-stained, mildewy accidents in the general structure, but which in reality was silver, and yielding, it might be, $1,600 to the ton. "This is all very rich ore," said my guide, kicking a heap that I was standing on. I got off it at once, reverentially. But reverence for the Mother of the Dollar gradually dies out, for everything about you, above you, beneath you, is silver or silverish—dreadful rubbish to look at, it is true, but the spirit of the great metal in it all none the less; that fairy Argentine who builds palaces for men and gives them if they choose, all the pleasures of the world and the leisure wherein to enjoy them. And there they stood, these latter-day Cyclops, working away like the gnomes of the Hartz Mountains or the entombed artificers of the Bear Kings of Dardistan, with their lanterns glowing at the end of the tunnels like Kanthi gem which Shesh, the fabled snake-god, has provided for his gloomy empire of mines under the Nagas hills. Unless crystals glittered on every side as if they were jewels, and the water dripping down the sides glistened as if it was silver, but the pretty hypocrisy was of no avail. For though the ore itself was dingy and ugly and uninviting, the ruthless pick pursued it deeper and deeper into its retreat, and only struck the harder the darker and uglier it got. It reminded me, watching the miner at his work, of the fairy story where the prince in disguise has to kill the lady of his love in order to release her from the enchantments which have transformed her, and how the wicked witch makes her take shape after shape to escape the resolute blows of the desperate lover. But at last his work is accomplished and the ugly thing stands before him in all the radiant beauty of her true nature. And it is a long process and a costly one before the lumps of heavy dirt which the miner pecks out of the inside of the hill are transformed into those hundredweight blocks of silver bullion which the train from Park City carries every morning of the year into Salt Lake City. From first to last it is pretty much as follows. Remember I am not writing for those who live inside mines; very much on the contrary. I am writing for those who have never been down a mine in their lives, but who may care to read an unscientific description of "mining," and the Ontario mine in particular.

In 1872 a couple of men made a hole in the ground, and finding silver ore in it offered the hole for sale at thirty thousand dollars. A clever man, R. C. Chambers by name, happened to come along, and liking the look of the hole, joined a friend in the purchase of it. The original diggers thus pocketed thirty thousand dollars for a few days' work, and no doubt thought they had done a good thing. But alas! That hole in the ground which they were so glad to get rid of ten years ago now yields *every day* a larger sum in dollars than they sold it for! The new owners of the hole, which they christened "The Ontario Mine," were soon at work, but instead of following them through the different stages of development, it is enough to describe what that hole looks like and produces to-day.

A shaft, then, has been sunk plumb down into the mountain for 900 feet, and from this shaft, at every 100 feet as you go down, you find a horizontal tunnel running off through the mountain. If you stop in your descent at any one of these tunnels and walk along it—water rushing along over your feet and the vaulted rock dripping overhead—you will find that a line of rails has been laid down along it and that the sides and roofs are strongly supported by timbers of great thickness. These timbers are necessary to prevent, in the first place, the rock above from crushing down through the roof of the tunnel, and in the next, from squeezing in its sides, for the rock every now and then swells and the sides of the tunnels bulge in. The rails are, of course, for the cars which the miners fill with ore and which are then pushed along to the "stage;" the miner signals by a bell which communicates with the engineer at the big wheel in the shed I have already spoken of, and there being a regular code of signals, the engineer knows at once where the loaded car is waiting, and how far therefore he is to let the cage down. Up goes the car with its load into the day-light, and then its troubles begin. But meanwhile let us stay a few minutes more in the mine. Walking along any one of the main horizontal tunnels, we come at intervals to a ladder, and going up one of them we find that a stope, or smaller gallery, is being run parallel with the tunnel in which we are walking, and of course, as it follows the same direction of the ore, immediately over that tunnel, so that the roof of the tunnel is the floor of the stope. The stopes are just wide enough for a man to work in easily and are as high as he can reach easily with his pickaxe, about seven feet. If you walk along one of these stopes you come to another ladder and find it leads to another stope above, and going up this you find just the same again, until you become aware that the whole mountain above you is pierced throughout the length of the ore vein by a series of seven-foot galleries lying exactly parallel one above the other, and separated only by a sufficient thickness of pine timber to make a solid floor for each. But at every hundred feet, as I have said, there comes a main tunnel, down to which all the produce of the minor galleries above it is shot down by "shoots," loaded into cars and pushed along to the shaft. But silver ore is not the only thing that the company gets out of its mine, for unfortunately the mountain in which the Ontario is located is full of springs, and the miner's pick is perpetually, therefore, letting the water break into the tunnels, and in such volume too that I am informed it costs as much to rid the works of the water as to get out the silver! Streams gurgle along all the tunnels, and here and there ponderous bulkheads have been put up to keep the water and the loosened rock from falling in. Pumps of tremendous power are at work at several levels, throwing the water up towards the surface—one of these at the 800-foot level throwing 1,500 gallons a minute up the 500-foot level.

Following a car-load of ore we find it, having reached the surface, being loaded into wagons in which it is carried down the hill to the mills, weighed, and then shot down into a gigantic bin—in which, by the way, the company always keep a reserve of ore sufficient to keep the mills in full work for two years. From this hour life becomes a burden to the ore, for it is hustled about from machine to machine without the least regard to its feelings. No sooner is it out of the wagon than a brutal crusher begins smashing it up into small fragments, the result of this meanness being that the ore is able to tumble through a screen into cars that are waiting for it down below. These rush up-stairs with it again and pour it into hoppers, which, being in the conspiracy too, begin at once to spill it into gigantic drying cylinders that are perpetually revolving over a terrific furnace fire, and the ore, now dust, comes streaming out as dry as dry can be, is caught in cars and wheeled off to batteries where forty stampers, stamping like one, pound and smash it as if they took a positive delight in it. There is an *intelligent*, deliberate determination about this fearful stamping which makes one feel almost afraid of the machinery. Some pieces, however, actually manage to escape sufficient mashing up and slip away with the rest down into a "screw conveyer," but the poor wretches are soon found out, for the fiendish screw conveyer empties itself on to a screen, through which all the pulverized ore goes shivering down, but the guilty lumps still remaining are carried back by another ruthless machine to those detestable stamps again. They cannot dodge them. For these machines are all in the plot together. Or rather, they are the honest workmen of good masters, and they are determined that the work shall be thoroughly done, and that not a single lump of ore shall be allowed to skulk. So without any one to look after them these cylinders and stampers, hoppers and dryers, elevators and screens go on with their work all day, all night, relentless in their duty and pitiless to the ore. Let a lump dodge them as it may it gets no good by it, for the one hands it over to the other, just as constables hand over a thief they have caught, and it goes its rounds till the end eventually overtakes it, and it falls through the screen in a fine dust. For its sins it is now called "pulp," and starts off on a second tour of suffering—for these Inquisitors of iron and steel, these blind, brutal Cyclops-machines, have only just begun, as it were, their fun with their victim. Its tortures are now to be of a more searching and refined description. As it falls through the screen another screw-conveyer catches sight of it and hurries it along a revolving tube into which salt is being perpetually fed from a bin overhead—this salt allow me to say for the benefit of those as ignorant as myself, is "necessary as a chloridizer"—and thus mixed up with the stranger, falls into the power of a hydraulic elevator, which carries it up forty feet to the top of a roasting furnace and deliberately spills the mixture into it. Looking into the solid flame I appreciated for the first time in my life the courage of Shadrach, Meshach and Abednego. They were young men of great nerve. There is no doubt of that whatever in my mind.

The mixture which fell in at the top bluish-gray comes out at the bottom yellowish-brown—I only wonder at its coming out at all—and is raked into heaps that have a wicked, lurid color and give out such fierce short flames of brilliant tints and fierce short blasts of a poisonous gas that I could not help thinkiog of the place where bad men go to, and wondering if Satan could not get a hint or two for improving damnation by a visit to the Ontario roasting-furnace. The men who stir these heaps use rakes with prodigious handles and wear wet sponges over their mouths and noses, and as I watched them I remembered Dante's devils who keep on prodding up the damned and raking them about over the flames. But the ore submits without any howling or gnashing of teeth, and is dragged off dumb and soused into great churns, kept at a boiling heat, in which quicksilver is already lying waiting, and the ore and the quicksilver are then churned up together by revolving wheels inside the pans till the contents look like huge caldrons of bubbling chocolate. After some hours they are drained off into settlers and cold water is let in upon the mess, and lo! silver as bright as the quicksilver with which it is mixed comes dropping out through the spout at the bottom into the canvas bags. Much of the quicksilver drips through the canvas back into the pans, and the residue silver, mixed with quicksilver, makes a cold, heavy, white paste called an "amalgam," which is carried off into jars to the retorts. Into these it is thrown, and while lying there the quicksilver goes on dripping away from the silver and after a time the fires are lighted and the retort sealed up. The intense heat that is obtained volatalizes the quicksilver, but this mercurial vapor is caught as it is escaping at the top of the retort, again condensed into its solid form and again used to mix with fresh silver ore. Its old companion, the silver, goes on melting inside the retort all the time, till at last when the fires are allowed to cool down it is found in irregular lumps of a pink-looking substance. These lumps are then taken to the crucibles and passing from them, molten and refined, fall into moulds, each holding about a hundred weight of bullion. And all this bother and fuss, reader, to obtain these eight or ten blocks of metal! True, but then that metal *is silver*, and with one single day's produce from the Ontario Mine in the bank to his credit a man might live like a gentleman in London all the days of his life, like a nobleman in Paris or like a prince in Vienna!

—*N. Y. World.*

SOCIAL LIFE IN THE MINES AND THE SURROUNDING INFLUENCES.

JUSTIN, who wrote during the third century of our era, obtaining his materials from a still earlier historian, informs us that the Lydians were habituated to indolence, gaming, and licentiousness. The Lydians were the inhabitants of the earliest gold-mining country of whose industry we have any account, and although Justin's opinion does not wholly warrant the conclusion that they derived the character he has given them from the influenee of the mines, what we know of the population of other great mining countries leads us to believe that this was the fact. Notwithstanding the immense lapse of time since the earlier Argonautic expeditions, and the scantiness of any literature relating to them, it is not difficult to discern a common character in the populations of all the ancient mining countries of importance, Lydia, Greece, Italy, and Spain. Nor can the glamour which heroic history has thrown over their actions conceal from us the fact that this character belonged also to the Spanish and Portuguese gold-seekers in America.

Nevertheless, until we come to California and Australia, the social influences of the mines cannot be traced with that certainty which would warrant any practical use of the inferences they afford. Here the view is a clear one. Here for the first time in history the mines were worked by free men. Here there was neither slavery, nor serfdom, nor peonage. The character of the miners did not come from the conditions of their service, as it might have done in all previous cases. In this case it can only be attributed to the nature of the industry; and hence from the light obtained in this nearest view of the influence of mining we are enabled to go back some thousands of years in history, and determine the social influences of the mines in the most remote times.

Years have rolled over the graves that stud the gold-fields of California and Australia; the histories, even the names of the dead are forgotten, and the circumstances of disease, destitution and violence through which they passed from life have fallen into oblivion. The best, often the only accounts of these scenes are contained in the newspapers of the day; but as these are not accessible to the general reader, it has been deemed more desirable, though it greatly restricts the range of observation, to cite only such particulars as lie within general reach. In conformity with this plan the following details relating to early mining on the Pacific coast have been taken from volumes usually to be found in public libraries.

Gold was discovered in California, January 19th, 1848. Although the discoverers, Marshall and Sutter, tried to conceal their good fortune (it eventually ruined both of them) the news leaked out; and in the course of a few months the diggings around their now historic mill were occupied by at least 4,000 men of whom a moiety were Indians, some partly domesticated, and the others wild. As to the white miners, it will be profitable to consider their characters more in detail; first, because it is a necessary and common one to all first-comers in placer mines; second, because, although it becomes effaced in time, it nevertheless lasts long enough to impress itself upon the earlier institutions of placer-mining countries when they come to be settled. Placer mines when first discovered, and while the gold is easily found, commonly afford a profitable refuge to a class of men who cannot thrive elsewhere, to adventurers, outcast, fugitives from justice, bullies, and felons. In their train follows a class of law and ordinance-breakers of the softer sex. However rapidly new additions to the community may improve its character, the influence of the first arrivals is bound to be felt for a long time. They are the older and the richer. The laws already established were framed in accordance with their habits, the customs already in vogue were moulded by their necessities, and their social peculiarities are perpetuated for generations. In other communities vice is lost in a mass of healthy surroundings; in the early days of a placer-mining country there is so little sound environment that vice is paramount, and gives law and custom to the future community. It is evident that placers rich enough to invite miners are to be found in old or well-settled countries. The soil of these countries has been completely turned over by the plough, and if there was ever gold enough in it to be worth searching for, it has long since been extracted. Gold placers are therefore only found in new and unexplored countries, beyond the pale of civilization, beyond the domain of the agricultural pioneer, beyond even the outposts of the trader. Such countries are destitute of the means of subsistence to bodies of men in permanent settlements. There is no other protection for property and life than such as may arise out of the forbearance and justice of the assembled adventurers. There is no assistance to be obtained in case of sickness or accident; there are no women; there are no children. To such a country, until it becomes better settled, few prudent persons would seriously think of emigrating. It follows as a necessary consequence that, at the outset, placer mines are occupied chiefly by the reckless and the desperate, few others being willing to encounter their dangers, inclemencies, and deprivations. This, as we shall find from the evidences open to us, often that of the men themselves, was the character of the Argonauts of California. It was likewise that of the first settlers in the gold-fields of Australia. The first-comers at Sutter's mill were from the surrounding country, from Southern California, and from the Sandwich Islands. "The miners were by no means exclusively Americans. They consisted of every kindred and class. There were already some Indians, Mexicans from Sonora, Kanakas from the Sandwich Islands, settlers from Oregon, mixed with the usual dash of Spanish, British, German, and French adventurers, that had for a long time existed in California. Later months were to bring other Mexicans, Chinese, Peruvians, and Chilians, and all these before the great impending immigration of Americans and Europeans."

So much for the origin of the Californian Argonauts; as to their moral character we have it here painted by companions and lookers on. "Among the people engaged in the mines there are many runaway sailors, deserters from the army, trappers, and mountaineers, who are naturally idle, dissipated, and dissolute; in short, taken in the aggregate, the miners are the worst kind of labouring population.

"The miners who survive and return home may carry gold with them, but their morals and manners will have been ruined. The risk is too great for the reward." . . . "I can think of but few men whom I would advise to come to California." "The mines had no sooner been discovered than crime commenced to increase." "Thefts, robberies, murder, and other outrages of the most desperate and criminal nature were taking place (in San Francisco) and there were no proper officials to take cognizance of them and bring the offenders to justice. Every man was intent on merely making money, and provided an outrage did not in a direct manner personally or pecuniarily affect himself, he was content to shut his eyes to the ultimate consequences."

"Ever since the first great immigration many of the inhabitants carried some weapon of defense secretly about them. During the disturbed times in the early part of 1851, when nobody was safe from the assaults of desperadoes, even in the public street or in his own dwelling, the practice of wearing deadly weapons became still more common.

"These were often used, though not so much against the robber and assassin as upon the old friend and acquaintance, or the stranger, when drink and scandal, time and circumstance had converted them into supposed enemies.

"The number of duels and especially of sudden personal affrays was fearfully great. The general population of San Francisco, with shame it must be confessed, in those days as is still (1855) the case, to a considerable extent drank largely of intoxicating liquors. Some scenes of a most savage and atrocious description, ending occasionally in death, took place between parties who were reputed to be of the first class of citizens. Among the lower American orders, and in all classes of foreigners, down to the vilest Greasers, the same violent spirit of personal revenge and deadly outrage was common.

"On the slightest occasion, at a look or touch, an oath, a single word of offense, the bowie-knife leaped from its sheath, and the loaded revolver from the breast-pocket or secret case, and death or severe wounds quickly closed the scene. The spectators often shared in the same wild feelings and did not always seek to interfere. The law was powerless to prevent such conflicts. Men thought as little of their blood and lives as of their money; and to gratify high swelling passions would madly waste them all alike."

Of course there were exceptions to this general character, and these exceptions increased in number every year; but that these descriptions of society during the first few years of the placer settlements of California were truthful cannot be doubted. The better class of Californians, both native and settlers, stayed at home, stood by their fields and flocks, and thereby reaped surer and greater gains in the end.[1]

According to Mr. Newmarch the character of the first gold settlements in Australia was much superior to those of California. "In Victoria," says Mr. Newmarch, "as in New South Wales, there were, long prior to the events of 1850, all the rudiments of an orderly and growing state. There was a powerful central authority, equal laws, perfect individual liberty, a population including wholesome proportions of the sexes, solid and respectable banking institutions, regular and frequent communicatioos with the mother country, and a fair command of the species of capital necessary for the development of a new region."

This is strange language to hold in respect of a land which was settled only sixty years before by 650 men and 200 women belonging to a class of infamous criminals, whose former Governor was a despot armed with absolute power over the lives of the convicts, where famine was frequent, murder committed at any time for a few days' rations, and rum was money.

If true, it can only be so in respect of the towns, and merely goes to show that in the course of sixty years assisted by a continual leavening of better colonists, even a convict settlement can be turned to some good account. That it is a correct description of the placer mining population of Australia is denied. When the gold diggings were discovered they were occupied by 9,000 ticket-of-leave men. "The records of crime show that the terrible outrages against life and property which were committed daily, both in town and country, were almost exclusively the work of convicts." And it may be added that there is not a sinister lineament upon the social features of early California which is not traced in darker lines upon those of Australia.

Society near the Gold Mines.—The following extracts will serve to illustrate the condition of society in the vicinity of newly discovered mines, the character of miners, the hardships and risks of mining, the cost of living near the mines, and the wear and tear of life.

"Kanakas, or Sandwich Islanders, the worst of laborers, are now employed constantly about town in storing and landing merchandise, at *four shillings an hour* each; and the most indifferent laborers are hired by the week together at six or eight dollars a day. Mechanics obtain, when employed by the day, £1 12s. or £2 per day, and by the month about £1 4s. . . . . Washing £1 12s. per dozen. . . Waiters at the hotel £240 to £300 per year; head waiter, £340. . . . For some time last summer (August and July) the officers at Monterey were entirely without servants, and the Governor (Col. Mason) actually took his turn in cooking for the mess. . . . Whole cargoes of goods are sold at an average of 150 per cent. clear profit, and ready pay in gold dust. . . . In a few months real estate that cost me less than £160, I suppose I could now sell for £1,600 or perhaps £2,000. . . . Something should be done here at once for the establishment of peace and good order in the country. All law, both civil and military, is at an end. Among the mines, and indeed most parts of the country out of the villages, no authority but that of the strongest exists, and outrages of the most disgraceful nature are constantly occurring and the offenders go unpunished."

Notwithstanding hardships and deprivations, many of the miners were unsuccessful even so early as 1849. San José was crowded with these men recruiting their purses by highway robbery, and seeking to drown remorse in drinking and gambling.

In 1849 and 1850 "the canopy of heaven was the only tent spread over the slumbering heads of thousands. Some sheltered by canvas, had sheetless, nay blanketless beds, some no beds at all."

At San José, in 1850, flour, £10 a barrel; boots, £6 8s. a pair; eggs, 2s. each; onions, 1s. to 2s. each.

At San José, 1850: "Crimes were numerous. It was not safe to travel at night without being armed. The country was so sparsely settled that it was difficult to catch criminals. Every few days some one was murdered in the valley."

San Francisco, August, 1849: "Many who went to the mines returned unsuccessful, and report that the exertion of getting gold is too great."

San Francisco, 1849: "Potatoes, 1s. 6d. a pound."

Sacramento, October 13, 1849: "A meeting is called today for the relief of those on their way overland; they are said to be dying by hundreds from thirst and hunger upon the great desert."

"Hundreds were coming in daily from over the mountains—sick, destitute, and almost starved. They met here with harpies to prey upon them, and they were often compelled to sell their teams for food enough to last them down to Sacramento city."

"Quinine was in great demand at 4s. a grain. For a shave at a barber's, 4s."

"You have heard of the Battle of Life—it is a reality here; the fallen are trampled into the mud and left to the tender mercies of the earth and sky. No longer ago than last night, I saw a man lying on the wet ground, unknown, unconscious, uncared for, and dying. To-day, some one with more humanity than the rest, will have a hole dug for him; some one else will furnish an old blanket; he will be rolled up and buried, and his friends at home, who may be as anxious about him as mine are about me, will never know his fate. Money, money, is the all-absorbing object."

"There is no government, no law. Whatever depravity there is in a man's heart now shows itself without fear and without restraint."

"A young man died in the street to-day. No one knew him. In his pocket was an ounce of gold, a note-book, and a Bible, the latter of the smallest size, with gilt edges and tucks. In one place was a beautiful card, on which was written in a lady's hand, 'Remember your friend and——.' In another was a card, worked with worsted and mounted with silk ribbon, and the legend 'A sister's prayers go with you.' Disappointment, drinking, gambling, and destitution was the story."

"A pine-board building, 'no better than a barn,' 55 by 35 feet and 1½ stories high, the interior partitioned with muslin, cost £3,000; it rented for £300 a month, or £3,600 a year. Wages of a cook, £50 a month."

"Butter, 6s. per pound; fare from Sacramento to San Francisco, £8."

Sacramento, January, 1850: "The people at home can have no conception of the amount of suffering in the vicinity of this city. Hundreds are encamped in tents through the rains and storms, scantily supplied with food and covering. *Many were driven from the mines for want of food,* and are

[1] When gold was discovered in 1848, one Louis Peralta, an old Spanish soldier and adventurer, upwards of one hundred years of age, said to his sons, who had attained the age of threescore: "You had better not go after it, but let the Americans go; you can go to your ranch and raise grain, and that will be your best gold-field, because we all must eat while we live." Hall's "Hist. of San José," ed. San Francisco, p. 191, Bancroft, 1871. (San José was then the capital of the State.)

begging for employment, asking only subsistence. Yesterday there were 25 deaths. The sickness does not arise from the severity of the climate, which is no colder (now) than November at home, but from a complication of causes. The intermittents of the autumn are aggravated by overwork, scanty and bad food, disappointment, and homesickness. Men in the ravings of delirium call upon friends who are far off, and, dying, mutter the names of their loved ones; men wasting away with chronic disease lose their manhood and weep often, like children, to see their mothers once more." During the river flood of 1850, Dr. Stillman wrote that some men who had been taken into the hospital were "dying on the floor; others, dead, are sewed up in blankets and sunk in the water in a room on the first floor."

"Gold washing is very hard work." . . . "I have been to the mines, was sick, made nothing, and returned."

May 5, 1850: "My friend, Hiram Bingham, goes home by the next steamer. He was a member of our company. He has been leading the nomadic life of a miner, and has picked up about $2,000, which he will carry home. That seems small compensation for all the dangers and hardships passed through and the time spent; yet it is better than the average."

Speaking of an intelligent miner who, after years of blighted hopes and unrequited toil, was preparing to return home to his family, and died before he could do so, Dr. Stillman says: "I went to see his corpse, and, as I gazed upon him alone, I thought it was the saddest case I had ever known. No one of that fond family was here—no hand of affection to put back the locks that fell over that broad forehead."

It is stated that so late as 1850, members of the legislature were paid in State scrip. January, 1851: "Crime continues to be rife in San José and vicinity. Scarcely a day passes without bringing something new to light."

1852: The history of the first few years of this decade is blotted with crime throughout the State; and San José has not been fortunate enough to be excepted from the catalogue of criminal localities. Murder, highway robbery, and stealing were the *avocations* followed by no small number. The law permitted punishment by death, in the discretion of a jury, upon conviction of *grand larceny*.

January 30, 1852: Theodore Basquez was executed for stealing a horse.

November 18, 1852: Ramon Romero was executed for grand larceny. A license for gambling cost £100 a month for each table.

Miners, poor and broken in health, were continually entering the city for relief and medical attendance.

"No city on this continent has equalled San Francisco in the prevalence of gambling, intemperance, licentiousness, and kindred evils. A decided improvement in public morals is said to have been made during the last year; but whoever, even now, takes a stroll through its streets, by night or by day, will be convinced that the unenviable reputation it has acquired is well deserved."

"Among the miners, except for the protection of life and property, the code of morals is generally a dead letter."

According to the Federal Census of California for 1850 the number of females to males at the ages of 20 to 40 is represented by the frightful proportion of 4 to 100. "Here then was a population composed almost wholly of male adults at those ages—20 to 40—when the energies and passions are most active, and almost wholly unrestrained by any of the duties claimed by infancy and old age, or by the respect due to the presence of women."

"Success in mining for gold in California is subject to many contingencies, and mining, as a business, should be classed with very hazardous pursuits. A good prospect does not insure a good mine. Gold may be found there to a large amount, but it may also happen that after the miner, relying on the evidence given by his prospect, has toiled for months, and expended a large sum of money in making the necessary preparations to work his mine, he is doomed at last to irremediable disappointment, and perhaps is made penniless."

"At Grass Valley and Nevada, the country around which has thus far been regarded, as the most fruitful in gold, and where quartz-mining especially has been prosecuted more extensively than in any other section of California, several quartz mills are now useless, the mines having failed for a long time to yield a paying supply of gold. One of these mills at Nevada cost £2,000, and several others £600 to £1,000. All these quartz mines opened richly, and for many months were very productive; but at length the supply decreased, until the product did not pay the expense of mining. . . . The same may be said of other parts of the gold region. Scarcely a district can be mentioned, where mines have been opened to any considerable extent, in which miners have not been ruined by the erection of expensive mills, canals, flumes, or other fixtures for mining, in leads and places which promised well at first, but which too soon, disappointed their expectations."

Diet and Privation among Miners.—Without assenting to all of the inductions presented by Mr. Buckle in his "History of Civilization," that one may be safely accepted which asserts that the nature of the occupations in which a community may be engaged, and the diet and other physical circumstances to which it is exposed, have much to do with the character of the institutions whose establishment may follow. Of this rule we shall find that mining communities offer a peculiar and further exemplification. The labor of the Californian placers was intense and unremitting. The glare of gold was constantly in the men's eyes, blinding them to the frightful bodily and mental risks they ran, and to the many forms of death that lurked behind them. They worked all day and often at night, exposed at times to the scorching rays of a mid-day sun, and at others to the destructive chills of damp nights. Stimulants and medicines, purchased at extravagant prices, were employed to ward off disease and death; while shelter, repose, and moderate labor, the only true palliatives for the ills that beset them, were shunned, because they interfered with gold-getting. "The day was intensely hot, yet about 200 men were at work in the full glare of the sun, washing for gold—some with tin-pans, some with close woven Indian baskets, but the greater part had a rude machine known as the cradle." . . . . "Recently there has been a reaction, which brings many back from the mines and an active immigration is flowing from abroad. Sickness has broken out among the miners, and many have returned prostrated with fevers while others have come back to avoid being so . . Flour and pork vary in the mines from £8 to £40 per barrel . . . . I saw a box of Seidlitz-powders, worth 2*s.* in San Francisco, sold in the mines for £4 16*s.* grain gold; and was credibly informed that brandy had been sold at £9 12*s.* per bottle . . . I was in the mines about the 1st of July. At that time the weather was insufferably hot. I think it by far the most oppressive climate I was ever in. It is much more uncomfortable than the climate of Brazil at the warmest season of the year, and everything was literally parched-up, after a drought which had been continued for near three months, and which had five months to run to the rainy season. The sea breezes which extend up the valley of the Sacramento never pass the Sierra Nevada, and seldom penetrate even the lateral valleys and ravines of those mountains; and there was not a breath of air moving among the mines. The sun was blazing down with more than tropical fervor, while his rays were reflected in ten thousand directions from the sides of the hills until the atmosphere glowed and glimmered like the air in a furnace. I then foresaw (what has since happened) that there would be much sickness among the miners. These people had deserted their reglar occupation, and a complete change of life and unnatural climate could not fail to act unfavorably upon their hea.th. Their diet was bad, their labors were severe, and they were exposed completely without shelter, in the daytime to a burning sun, and at night to the chilly atmosphere of the mountains. Many of them worked with their feet in the water and inflamed their blood in a feverish state by a free use of ardent spirits. The natural consequences followed. Many are now sick with bilious and intermittent fevers, dysenteries, camp-fevers, &c." "All live in tents, in bush arbors, or in the open air."

"During the year commencing July 1st, 1848, there will be £1,100,000 removed from the mines . . . . It is sufficiently obvious that the country will be prematurely filled by a restless, excitable, adventurous, and reckless population, and that extended agricultural or mechanical improvements are at an end for some years to come. Gambling and all sorts of thoughtless profusion begin to prevail. The present excitement will attract vast numbers of the idle, vicious and dissolute. Refugees from justice from the United States as well as other countries will flock to California among the better disposed population, and will find shelter among the almost inaccessible fastnesses of the mountains where such mines of wealth are now opened. These regions are of vast extent and are remote from the regular settlements, and from the operations of the laws. In the solitary recesses of the Sierra Nevada are little clusters of men, with nothing but the trees for their covering, and no protection but their own vigilance and strength. Many of these people are known to possess very large amounts of gold (sometimes as much as £4,000) wrapped in their blankets, where there is no eye to see and no agent to pursue the guilty. Is it strange when the temptation is so great, that the robber and assassin should be abroad among the mountains? Many robberies and some murders are known already to have occurred; but little attention is excited by these events where all are in the eager pursuit of wealth. No one can conjecture the extent of these outrages; for living witnesses are not at hand, and dead men tell no tales. . . . . "Besides living like wild animals, they slept on the bare damp ground exposed to the dews of heaven and the violence of man, a sickly nervous sleep that brought little rest. Some reposed in arbors composed of tree branches; a few in canvas tents. The sold their gold at 16*s.* an ounce, and brought bread and potatoes at from 1*s.* to 4*s.* per pound and meat at double these prices. Besides these articles, few others were to be had at any rate. They lived in fear of each other, buried their gold in secret holes, and robbed and assassinated one another right and left. Most of them succumbed to violence or fever; a few got away with sums which as a rule almost without exception, they soon lost in gambling or debauchery; not one of them acquired a permanent fortune."

"In May, 1849, 20,000 men broke camp on the Missouri river to march to the land of gold." "We had provisions for a year; as there was then no stock in the mines." "In the midst of our rejoicings (upon reaching the new placers) we ran out of provisions and had to live for days on grass and acorns, picked from the holes in trees where they had been placed by woodpeckers." "It was customary to sell the gold (dust) at 16*s.* per ounce, which was intrinsically worth over £3 4*s.*" "California gold averaged 89·58 per cent. pure." "No man would give another a hand's turn for less than £1; while a day's constant labor of the commonest kind, if it could have been procured at all, would cost from £4 to £6 at least."

"In San Francisco in 1849, 4*s.* was paid for a pill, and the same sum for an egg; £20 for a pair of boots, and twice that sum for a decent suit of clothes; a single rough brick cost fivepence, and a plank some twenty feet long was cheap at £2. At one period of that wondrous year, common iron tacks of the smallest size sold for their weight in gold; and for a long period were in request at from £1 to £2 an ounce. . . . In June, 1849, prices were: eggs, 4*s.*, 8*s.*, and even 12*s.* each; sugar, tea, and coffee each 16*s.* per pound; laudanum, 4*s.* per drop, £8 per dose; pills, £2 per dose; spirits, £2 to £8 per quart; wines, £2 to £8 per bottle . . . As for beef, little of it was to be had, and then only jerked, at correspondingly high prices."

Similar details are narrated of Australia during the first few years that followed the discovery of the placer mines in that country.

"In the spring of 1854 there was discovered in Australia one of the richest placers or gold beds, even of that auriferous country. The spot was a deep ravine formed by the Buckland river, enclosed by steep mountain sides, which excluded every breath of wind. It was autumn in Australia, though spring here (in England). The air in the ravine was stagnant, and the scorching sun made it intensely hot during the day; while at night the temperature fell to a piercing cold, so that the sojourners in the ravine were alternately in an oven and an ice-house. Moreover, as the gold beds lay in the channel of the river, the miners worked up to their waists in water.

"To this gold field of surpassing richness hundreds of adventurers flocked in feverish haste; but disease, like the fabled dragons and griffins of old, kept horrid sentry over the buried treasures. A peculiar fever of the typhoid character was the natural denizen of the spot; besides which the gold-seekers suffered severely from eye-blight, owing to the concentrated blaze of the sunshine reflected from the steep sides of the ravine; and they were at all times grievously tormented by clouds of flies. Bad diet and want of vegetables aggravated the diseases natural to the place and to the kind of work. In the strangely interesting accounts which then reached us, we read of onions selling at six shillings a pound; and cabbages, which we buy here for a penny, were so precious that they were cut up and sold by weight, from half-a-crown to four shillings the pound being readily paid for them. Physic, or what passed for it, rose in price in a still more startling manner; Holloway's pills selling at a shilling each or a guinea per box. It was a valley of death! . . . . Constitutions that had borne the hardships of other fields broke down here, wrote an eye-witness of the scene, and hundreds have perished, dying unattended and unknown. The little levels between the stream and the base of the mountain-wall, for ten miles along the valley, are so thickly studded with graves, *that the river appears to run through a churchyard.*

"One new-comer, wiser than the rest, having counted eleven corpses carried past his tent during the dinner hour of his first working day, and thinking that even gold may be purchased too dearly, left the place instantly. Many abandoned it after a somewhat longer trial; but the greater number, fascinated by the unusual richness of the gold-beds, remained, in defiance of disease, and took their chance, with what result the numerous graves of the valley testify to this day."

The low price of gold dust in coin, so peculiar a feature of early California experience, is noticeable in that of Australia. An ounce troy of fine gold was and is still coined by the British Government into 1019·45 pence, or 84·9541 shillings, which is the mint price in London. In 1851 the Australian miners were obliged to sell their dust at probably not over one-half its value. In 1852 they sold it at prices varying from 58 to 68 shillings per ounce; in 1853 from 70 to 76 shillings, and in the three following years from 75 to 77 shillings. These low prices of gold dust were due to the scarcity of coins, particularly the minor ones. The writer has now in his possession some rude lumps of silver stamped with crosses, which passed in the early days of California for 25 cents each, their value in bullion not exceeding 10 cents. He has also been credibly informed by more than one of the original "pioneers," that at one time gold dust was exchanged by the miners for silver dollars, weight for weight. The insecurity of property at the mines is another noticeable feature of early Californian life.

"The miner having obtained the gold, is next chiefly concerned for its safety. He is far up in the mountains and forests, surrounded by roving robbers and thievish lurking Indians, and in his frail shanty, constructed of boards or cloth, has no stone vaults or iron safe in which to secure his treasure. It is too heavy to be carried about his person; and if he secretes it in some hollow tree or peculiar rock, or secret cave or crevice, the hiding-place may be discovered by the marauders, who may chance to discover his visits to the spot. Under these circumstances he resorts to various expedients to secure his gold. Perhaps he digs a small pit under the stones on which he builds his fire, or under the bunk on which he sleeps."

"When these things (the high prices of labor, food, medicines, etc.,) and the risks of sickness, the discomforts of living, and the unusual and severe kind of labor, are all balanced against the average gains, it may appear that after all the miners (were they ever so fortunate) were only enough paid."

"The expenses, the time spent in traveling and prospecting, and lack of all the luxuries and many of the comforts of life, made many of us think it was cheaper to get gold in any other way than by digging for it in the placers. We abandoned the mines. Our bright dreams of becoming millionaires by washing the sands of the Sierra Nevada were all dissipated."

"September, 1849. A short experience of the mines had satisfied most of the citizens of San Francisco that, in vulgar parlance, all was not gold that glittered.

"With a few the dream had been realized; and although in the aggregate vast sums of gold have been obtained, yet a large proportion of the miners have learned the, to them, sad lesson, that man, in any country, to be truly happy, must earn his living by the sweat of his brow. Through much exposure and suffering, wearied and heart-broken, the poor miner has not unfrequently turned from the scene of his brilliant hopes to spend his last hours among his early friends—a sadder but a wiser man."

"One . . . employed nearly one hundred and fifty Indians to dig gold for him: at one time he had nearly £400,000 buried in the ground. But like all other miners, he lost it all."

—Compiled from "The History of the Precious Metals," by Alexander Delmar.

THE WRECK WROUGHT BY MINING.

"MOIL not too much underground, for the hope of mines is very uncertain," said one of the wisest of men, in whose time mining meant chiefly for gold and silver. Few, perhaps, who have read this opinion are aware how shrewd a one it is, and even men who have been the witnesses and subjects of the uncertainty of mining, have shut their eyes to the plain evidence before them, and retained faith in a metaphysical doctrine which has no foundation in fact. One writer, originally a Californian miner, advances as a reason for his faith in the generally accepted theory of value, the inconceivability of the continuance of mining were it not profitable.

The same may be said of the purchase of lottery tickets. This occupation has been systematically pursued ever since the Lotto was established at Florence in 1530. In England lotteries were brought from Holland in the XIth Elizabeth. According to Raynal two American companies were favored with the first lottery that ever was drawn in her dominions. Lotteries as a regular source of government revenue were established in England about 1620, and for nearly two centuries contributed to swell the revenues of the crown. They can be traced back to the mode of distributing, and the practice of purchasing the ancient Roman *congiari*, and may even have had an earlier and more distinct origin. From 1816 to 1828 the French government derived from lotteries an annual income of 14,000,000 francs. At the present day, in spite of prohibition, and penal laws, and of increased intelligence and morality, lottery tickets are sold in every large city in the United States. The "business" is as permanent and well-established as any other. A person of the shallowest intelligence may easily become convinced of the fact that on the average the purchaser must lose, and the seller gain, in a lottery: and yet this institution continues. In the city of New York nearly all, if not quite all, of the adult negro population (who number many thousands), besides a very large number of whites of the lower orders, are systematic lottery gamblers, purchasing their tickets every day, and generally both morning and afternoon; there being four lotteries daily in certain of the Western and Southern States, whose drawings are sent to the metropolis by telegraph. Such of the better classes as purchase lottery tickets—and many of these are stockbrokers and jobbers who are capable of calculating the chances of the game with great exactness—deal in the tickets of the Havana lottery, whose drawings are sent by the Cuba cable and published in the New York newspapers. Some of the "Exchange" offices in Wall Street are engaged in selling lottery tickets, the display of coins in the window being merely a blind. The sale of cigars and other articles are used as blinds in the commercial portions of the city. In the dwelling portions a shop or booth with the word "Exchange" in the window, or merely a shabby curtain, or a screen inside the door, denotes the lottery office. There are stated to be upwards of a thousand such places in New York. They are scarcely less numerous as proportioned to population in other American cities. In New Orleans the tickets are openly displayed (or were a few years ago when the writer visited that city) in the cigar and other shop windows. The sums of money invested from time to time in this manner, where it may be assuredly known beforehand that the whole number of purchasers, or the average purchaser *must* lose, probably amounts to more than the entire product of the gold and silver-mines of the United States. Yet "the business has been maintained" in this country, not like the gold production, during a brief twenty-five years, but during two hundred years, for we hear of its being denounced in Boston so early as 1699.

If it be asked why a practice so evidently unprofitable as lottery gambling is continued in the face both of prudence and interdiction, the answer is that although evidently unprofitable it is not generally speaking obviously so. The mass of those who gamble are incapable of justly estimating the chances of the game, or are destitute of that force of character which is necessary to enable them to eschew so hazardous a pursuit. It is the same with free mining for the precious metals. Apart from the free pioneer, apart from the hired miner who mechanically works with pick and shovel for a day's pay, and would work as steadily in a coal mine or on a farm, and apart from those stipendiaries connected with mines, such as superintendents, officials, &c., these classes together comprising but a small portion of those who have contributed to stock the world with gold and silver, the miners, that is to say the mine hunter, the mine promoter, and the mining speculator, is essentially a gambler.[1] If husbandmen invariably obtained three bad harvests before one good one, they might nevertheless sow the fourth time, because one good harvest might cover even this great deficiency. But it certainly would not cover any more; and an invariable succession of four bad harvests before one good one would put an end to agriculture. Not so with mining for the precious metals. Were ninety-nine-hundredths instead of four-fifths (which is the fact) of all mining adventures unprofitable, still would there be found a class of men willing to hazard the hundredth one in the hope that that one *might* prove profitable.

The uncertainty and uncertain profits of free mining extend the calculation of its cost over long periods of time, and many countries; until it eludes the grasp of the mass of men. This cost is not obvious; it has never been demonstrated by evidence. It is, at the most, suspected by a few persons who have enjoyed unusual opportunities for observation and reflection upon the subject.

Another reason why men continue to pursue gold and silver mining is closely allied to the one above given. That one was its unproved character of unprofitableness: the present one is its uncertainty, and occasional vast profits which liken it to a lottery. One may have reason to doubt that in the long run gold and silver mining is unprofitable, but he has none to doubt that it is risky. And just as there are multitudes of persons who, knowing beforehand the unprofitableness of systematically purchasing lottery tickets, nevertheless continue to do so all their lives, so are there multitudes with even more excuse for their rashness, who are always ready to follow the fascinating pursuit of gold and silver mining.

The secret of this fascination is in the gambling nature of the industry. Every step in mining, from discovery to production, is attended with risks of the most violent character, which are wholly impossible to foresee. One has only to examine the fluctuations in the prices of mining stocks in the San Francisco or Sydney markets to be convinced of this fact. These prices are not quoted, as were

[1] J. R. MacCulloch, in the "Encylopædia Britannica," article "Money:"

"Frequently indeed, the production of the precious metals partakes very largely of the nature of a gambling speculation. . . . Ulloa says that in Peru an individual who embarked in a mining speculation used to be considered as a *ruined man*, or as having adventured *in a lottery*, in which, though there are many great prizes, the blanks had a decided preponderance; and, according to Humboldt, the same thing was experienced in Mexico, the search after mines, and the working of them, being there looked upon as a sort of *gambling adventure*, in which many are ruined, while only a few obtain great wealth."

The facts quoted by MacCulloch will be found in Adam Smith's "Wealth of Nations," book i. chap. xi. part ii. In view of the vast influence which Dr. Smith's Work has exercised upon the welfare of mankind, it is to be profoundly regretted that in this important respect the suggestions contained in the materials before him were turned to such poor account as is to be found in his doctrine of value.

those of railway stocks in New York during the war, in a credit money whose mass was more than once suddenly augmented, but in gold coin, the fluctuations in the value of which at the present time are not nearly so great. The general rule of experience that miners, mine discoverers and mine explorers, rarely or never retain the wealth which exceptional good fortune sometimes bestows upon them, is not without its significance in this connection. These men were successful because they were gamblers, and the habit of gambling, which once acquired is difficult to throw off, is the cause of their so commonly losing what they have gained.

It might be urged still further that although the class of individuals engaged in mining for the precious metals may commonly fail to perceive its unprofitable nature; that although perceiving it they may still be led to pursue the industry on account of its promises of vast wealth to the successful; yet that the rest of society can hardly be supposed to share their imperfect observation or judgment. Conceding that precise data are wanting, and that the historical evidence as yet not segregated from the mass of other events was tediously diffuse and difficult to sift, yet a truth so important must, despite these obstacles, have floated in some shape or another to the surface, and made some mark upon the legislation, the government, or at least the philosophy of the times. We shall have reason in another part of this work to fully verify this suspicion. It is no new discovery that mining for the precious metals is both pecuniarily and in other respects an unprofitable industry. The ancients seem to have been very well aware of it, and at many periods and in many countries its pursuit has been entirely forbidden. As to the absence of any modern recognition of gold and silver mining, we Europeans of this brilliant and eventful century are too apt to forget our very recent emergence from the ignorance, the violence, and the servile condition of the mediæval ages. It is scarcely a century since the occurrence of the American and French revolutions, and, speaking as Europeans, not a century since the enfranchisement of our industrial classes from serfdom. We have scarcely yet become accustomed to the word Liberty, or to know its deep significance; yet here we find ourselves wondering why we have not already penetrated the inmost arcana of a polity to which only the light of a long-continued civilization had led the ancient world. Although neither the unprofitableness nor the gambling character and the immoral tendency of gold and silver mining have as yet found specific recognition in modern legislation, there is not wanting a significance in the absence of popular regret with which many of the European and American States have parted (perhaps forever) with their stocks of the precious metals.

In many of these countries systems of money composed of government numeraries have supplanted the use of gold and silver coins, although in none of them have the latter as yet been prohibited. These coins therefore remain legal tender, generally, as before, and thus offer that same immediate market for the sale of these metals, which has always formed the principal incentive to their reckless production. Any commercial conclusions concerning the cost of the precious metals which are derivable from the course of recent national legislation on the subject are therefore premature. We can gain no light even from the aggregate wisdom of society, until the experience which must furnish its basis has become more matured.

Between ancient and modern legislation there intervenes not the legislation, but rather the government of mediæval countries. As it is from these countries and this period that much of our stock of the precious metals is derived, it remains for us to inquire why society, during the entire period from the subversion of European liberty by the Roman conquerors to its general restoration after the French Revolution, failed to discern the unprofitable character, and to avoid the unprofitable pursuit, of mining. The answer to this question comes in a word. Society was not free, and whether it perceived the unprofitableness of mining or not, it was powerless to avoid its pursuit. The condition of all Europe and America except that of the ruling classes, was one of servility. Under the military power and the form of feudal obligations men were forced into the mines until they perished in them. Political economy had nothing to do with this period; commercial calculations were impossible and futile. It was an era of force, in which on the one side were ranged a few nobles clad in armor, girt with steel swords, and protected by castles, ramparts, and ditches; and on the other a multitude of unarmed and half-naked peasants, incapable of resistance.

Mining as a Promoter of Crime.—Only those who have lived in gold and silver mining countries can fully understand the powerful influence which this hazardous industry exercises upon the moral welfare of the surrounding community. The almost universal passion for gambling which it excites and encourages; the extraordinary freaks of fortune which it gives rise to, where sometimes, and in the course of a few months, the most indigent and illiterate of the community are lifted into opulence and power, while the well-to-do and intelligent are reduced to unexpected poverty and obscurity; the licentiousness of the *nouveau riche*, and the grief and despair of the unlucky and disappointed—all these are social features peculiar to mining countries, whose broad and deep marks to be appreciated must be seen with the observer's own eyes. A continuous residence of more than two years in California has satisfied the writer that, at least in San Francisco, which contains one-third of the entire population of the State, there are few persons of an adult age who are not at some time or other directly interested in the mines; and this is probably also largely the case throughout the State generally, and also throughout Nevada and the remaining portions of the North Pacific slope. The miners themselves, who, now that the placers are exhausted, are, for the most part, workingmen upon daily wages, are probably the least interested of any class in the vicissitudes of the mines. But down to the very boot-blacks and servant-girls there are few others of whom the same can be said. When a new ore discovery is made, or is expected to be made—and this occurs not unfrequently—every kind of productive labor is abandoned for the superior attraction of the Stock Exchange and the broker's office. At these centres of activity can be seen any day thousands of men and women, the latter chiefly of the poorer classes, tradeswomen and domestic servants, waiting for that turn of the wheel of fortune which shall bring them opulence and ease. Little hoards are withdrawn from savings banks and other receptacles, and eagerly exchanged for shares in looked-for bonanzas, and when the prices of the latter advance so as to place them beyond the reach of the purchaser with limited means, the shares of other properties, often so obviously worthless as to be openly and generally alluded to as "wild-cats," are purchased with the same eagerness, and paid for in coin wrung from the sweat of labor and subservience.

Upon the passion thus roused and the credulity which it fosters, there are not wanting classes to prey and thrive. False or exaggerated reports of ore discoveries, delusive tricks and plants in and about the mines, stock deals and jobs concocted to deceive investors, wash-sales and bull-and bear movements on the stock-market, the employment of stool-pigeons, point-givers, and cappers—in short all the devices known to the jockey and the blackleg are brought into active play. The common result is loss and despair to the deluded investor and fortune to the conspirator; and yet the few prizes snatched from the fire are so fascinating, that no degree of general loss appears to be sufficient to deter new aspirants for fortune. There is scarcely a class of the community which does not play some part in this drama. The conservative merchant or banker who lends money upon this or that mining stock, or withdraws the often designedly accorded credit; the influential leader of fashion who confidentially imparts the exclusive intelligence concerning some mine to his or her circle of dearest friends, which, in most cases is certain ruin to them; the fiduciary who borrows from his trust-fund merely for a few days, until he can realize the enormous profit promised by an impending rise in stocks and pay back the dishonestly abstracted money; the clerk who is tempted to seek fortune through the humbler medium of his master's till; the poor shop-girl whose virtue falls an easy prey to the powerful allurements of wealth and who is then employed as the medium for trapping other victims—all these and many other classes are lost in the dangerous and demoralizing pursuit of sudden wealth from the mines.

At the present writing there are four exchanges in San

Francisco, all of them devoted exclusively to mining stocks. So small a quantity as five shares of stock is commonly dealt in, and cases are known where a single share, nay one-half of a share was bought and sold. The prices of the stocks have ranged from several hundred dollars down to two cents a share, so that the smallest speculator can be accommodated. So universal has stock gambling become in California, that mining stocks take the place of the weather in other countries, and have become the commonest theme of conversation, alike in the politest circles and the obscurest retreats. Indeed, one can learn after a brief residence on the coast, and merely by observing the faces and demeanor of those who throng the neighborhood of the exchanges, whether the "market" is up or down. That in a community thus engaged and constituted—and the same may be said of the mine-owning towns of Mexico and Australia—insanity and crime should prevail to an unusual extent is only what would naturally be expected. The intellect is not proof against the sudden changes of fortune induced by the hazard of gold and silver mines, and the sudden and tremendous fluctuations in their value; nor are the passions subject to the same control that distinguish them in communities occupied in safer and more sober pursuits. The evidences of these aberrations of mind, this violence of emotion which distinguishes mining countries, are to be found in every direction. It will suffice for the purposes of this work if two of the principal ones are selected for illustration. These are insanity and suicides.

In arranging the evidence of insanity it is primarily necessary to distinguish between this mental derangement and idiocy, the former being "the product of society and of moral and intellectual causes," and the latter "a state depending on soil and material influences." Next, an allowance must be made for the number of insane in private families or at large, and not confined in the asylums. According to the voluminous, though far from critical report of Dr. Wilkins to the Governor of California, France is the only country whose statistics, as quoted, distinguish the insane and idiotic severally, in asylums and at home. The year selected for illustration, 1861, happens to be that one when the official figures were, for the first time, substantially correct. Of this we are assured by the "Statistique de la France" [par Maurice Block, Paris, 1875, volume i, p. 308], the same work on a previous page giving the number of insane under treatment in France at various recent periods as follows:—

Year.	*In Asylum.*	*At Home.*	*Together.*	*Population of France.*	*Insane to Population, 1 in*
1851	21 353	24,433	45,786	35,783,170	781
1856	25,485	34,004	59,499	36,139,364	607
1861	30,239	53,160	83,399	36,717,254	440

The increase of insanity apparently shown here is due for the most part to the increased completeness of the returns, evidenced by the augumenting proportion of insane treated at home. This, at the latest date, was 175 to 100 in asylums. The statistics of insanity in the United States are obtained for the Federal census from the reports of the asylums. They are somewhat defective as to numbers in private asylums, and do not make any allowance for the numbers treated at home. With an estimate of the latter based on the proportions exhibited in France, the statistics of the United States are as follows:

Year.	*Whites in Asylums.*	*Estimated at Home.*	*Together.*	*White Population.*	*Insane to Population, 1 in*
1850	14,257	24,950	39,207	19,553,068	498
1860	23,593	41,288	64,881	27,461,813	423
1870	35,610	62,318	97,928	33,589,377	343

The estimates in the second, third, and fourth columns for 1860 include free colored persons who are not distinguished from the whites in the census compendium of that year. The proportion of free coloured is little more than 1½ per cent. All of the above numbers include California. The black, formerly the slave population of the United States, is omitted, because, while idiocy is quite common with this race, insanity is rare, and their incorporation into the table would render it misleading. Here, again, the numbers and proportions exhibit increase since 1850, and show that in the United States generally, insanity is half again as prevalent at the present time as it was twenty or more years ago. Let us now see how their case stands in California, considered by itself. In that State there are no private asylums. The official returns of insane at Stockton and Napa include a few idiots—according to the Federal census of 1870, only 14 per cent. of the whole number—and to that extent the comparison which will presently be made is vitiated, certainly for one year, and probably, to more or less than this extent, for all years:

At close of official year.	*In asylums at Stockton and Napa.*	*Estimated at home. Proportion as in France.*	*Together.*	*Population of State.*	*Insane to population, 1 in*
1850	22	38	60	165,000	2.750
1860	417	730	1,147	379,994	331
1866	693	1.213	1.906	476,409	250
1867	769	1.346	2,115	600,039	236
1868	853	1.493	2,346	618,000	221
1869	920	1.610	2,530	638,000	213
1870	1.047	1.832	2,879	660,247	195
1871	1,090	1.908	2,998	682,400	194
1872	1,123	1,966	3,088	605,700	196
1873	1,156	2.023	3,179	630,000	198
1874	1,224	2.142	3,366	655,200	195
1875	1,302	2.279	3,581	681,400	190
1876	1,422	2.489	3,911	708,700	181
1877	1,590	2.783	4,373	737,000	168

The numbers include white and other races; but as the latter form only a small portion (ten per cent., mainly Chinese) of the whole population of the State, it has not been deemed worth while to exhibit their statistics of insanity separately. The proportion of Chinese insane is less than five per cent. of the whole number. The uncertain factor in this table is the proportion of insane not in the two asylums at Stockton and Napa. The proportion estimated is derived from the statistics of France, where wealth being less equally distributed, and the police more scrutinizing, it is to be presumed that this proportion, great as it is, is less than in California. As these statistics do not show the number of new persons afflicted each year, but only show the whole number remaining afflicted at the close thereof, and as the populations of France, the United States and California respectively, are of different ages, there is other room for errors when the table is used for the purpose of international comparisons. But these uncertainties and discrepancies are not important in the present connection. Unmodified by these considerations, it appears that among the white race in France insanity is the condition of 1 in 440 of the population; in the United States, generally, 1 in 343; in California, by itself, 1 in 168. In other words, insanity appears to be twice as rife in California as in the United States, and more than twice and a-half as rife as in France. The number of new commitments for insanity each year since 1866 may serve, in some measure, to indicate the causes of this extraordinary and sorrowful exhibit:

Fiscal year ended June 30.	*Commitments to Stockton and Napa Asylums.*	*Population of the State.*	*Annual commitments to population, 1 in*
1866	279	476,409	1,707
1867	313	500 039	1,597
1868	387	518,000	1,328
1869	482	538,000	1,116
1870	562	560.247	997
1871	523	582,400	1,112
1872	506	605,700	1,197
1873	401	630,000	1,177
1874	524	655,200	1,250
1875	615	681,400	1,108
1876	735	708,700	964
1877	652	737,000	1,130

From 1848 to 1865, inclusive, a period of eighteen years, the whole number of commitments to the State Asylums for the insane was 3,169, or an average of 176 per annum, while from 1866 to 1877, inclusive, a period of twelve years, the commitments have been 5,979, or an average of 498 per annum. The former may be regarded as the area of the placers, when few besides those who worked in or about the mines were subject to their vicissitudes, and when death soon closed the career of the unfortunate adventurer, and shielded him from the milder visitation of insanity. The latter is the area of the vein-mines, of mining incorporations, and of gambling made easy by mining shares and stock markets. It is not difficult to infer that these causes have had much to do with the great increase of insanity shown by the statistics adduced; an inference that becomes greatly strengthened upon turning to the statistics of suicide in San Francisco. These statistics, it must be remarked, are very defective. Until lately, no attempt had been made at the coroner's office to construct tables of suicides comparing one year with another; and nothing beyond the most indifferent effort was made to ascertain their causes. Much improvement in these respects has lately taken place, but still many suicides are not reported. These consists mainly of persons who drowned themselves in the bay, and whose bodies are not recovered and brought under the notice of the coroner; and of Chinese, the deaths of whom in San Francisco from whatever causes, are reported as due to "unknown" causes.[1] Another class of omissions is of persons belonging to the city who may have committed suicide beyond its corporate limits. In such cases the coroner of the city has no supervision and makes no mention of them. Some of these, not all, are included in the reports of the health officer. From the records of these two officials, and, when they disagree, choosing the higher number as the more nearly correct, we have the following comparative results:

Reported Numbers of Suicides in San Francisco.

Year.[2]	*Suicides.*	*Year.*[1]	*Suicides.*	*Year.*[1]	*Suicides.*
1860	31	1867	29	1873	38
1861	30[2]	1868	22	1874	61
1862	13[3]	1869	39	1875	64
1863	18	1870	47	1876	70
1864	20	1871	51	1877	76
1865	17	1872	37	1878	103
1866	24				

Any comparison of these numbers with the reputed population of the city in any other years but those in which a census was taken, is considered hazardous on account of the tendency to exaggerate the number of inhabitants, which is common to the growing cities of the United States, and appears in all the publications relating to them except the census itself. The only years of the series above shown in which a census was taken in San Francisco were 1860 and 1870, when the population was respectively 56,802 and 149,-473. The least objectionable means of determining the relation of the number of suicides in San Francisco to that in other cities is to compare both of them with the whole number of deaths in each place. Without burdening this work with details which would probably weary the reader, it is deemed sufficient to say that, determined in this way, suicides are more than twice as common in San Francisco as in New York, and more than three times as common as in Philadelphia. It is the present writer's belief, that as compared with population—could the latter be satisfactorily determined as to San Francisco—the result would appear still more unfavorable. It is also to be remembered that this result is only given with reference to the numbers of the reported, not the true numbers of suicides in San Francisco. Giving due weight to this consideration, it will probably be not far from correct to regard the proportion of suicides in San Francisco either to all deaths or to population as fully three times as great as in New York where suicide is a much more common occurence than elsewhere in the United States.

All inquiry into the probable causes of such an extraordinary preponderance of suicides is bound to be beset with obstacles. When the predisposing, nay, even the immediate, causes of self-destruction defy, as we know they commonly do, the scrutiny of a legal inquest, there would seem to be little hope of determining them from that more general sort of evidence which is to be found in other ways; and but for a personal knowledge of the habits of life common to several mining countries, the present writer would hesitate to indicate them. In his report for the fiscal year ended June 30, 1878, the coroner of San Francisco reports thirty-five cases as caused by pecuniary, and seven by unknown motives. Three of the former he directly traced to stock gambling. Intemperance, insanity, and unsound mind cover twenty-one more cases. All of these cases and many other attributed to various causes, may have been, and probably were due to gambling in the mines, or the absence from home and friends which forms another condition peculiar to mining countries. This probability is greatly strengthened by the causes of the suicides, covering a portion of the same period. which were reported by the daily press. During the calendar year ended December 31, 1877, the following suicides with their supposed causes were reported in the "San Francisco Chronicle."

Assigned or supposed causes of suicide.	*M les.*	*Females*	*Total.*
Losses in mining stocks and other pecuniary .	20	2	22
Insanity, cause not stated.	5	0	5
Intemperance, cause not stated.	12	0	12
Incurable disease.	7	0	7
Love	4	3	7
Ill treatment.	0	2	2
Religion.	1	0	1
Remorse for murder.	1	0	1
Unknown or not stated. . . .	24	3	27
	74	10	84

Among the conditions that influence suicide there are none, except mine gambling and the separation from home and familiar faces, which is peculiar to mining communities, and especially those of recent growth, in which San Francisco does not enjoy advantages which should exempt it from this crime. The city is exceptionally healthy, it is purified by sea winds that blow every day; its foundations are laid in clean dry sand, it is hilly, it has a good drainage, and is washed by a vast bay on the one side and the ocean on the other. The climate is dry, temperate, and steady. Food of every description is plentiful and cheap; all the other necessaries of life are to be obtained upon the same terms as in other cities throughout the United States; while labour is usually in demand and commands a higher price than elsewhere. Hence, in looking for the cause of this great and peculiar mortality, the inquirer is led at once to the subject of the mines. Before the civil war the number of suicides committed annually in San Francisco was about thirty. During the war—and this period also agrees with the opening and developement of the great Comstock mines—when great profits, rising prices, and abundance of employment for the industrial classes preserved them from those temptations to self-destruction which find their origin in pecuniary difficulties, the annual average fell to seventeen. When the war closed and the Comstock mines came to be incorporated into stock companies, suicides resumed their former frequency, and during the four years ending with 1869 the annual average became again, as before, thirty. The ensuing four years witnessed the opening of the great Crown Point and Belcher Bonanza, and the first series of gigantic stock speculations and jobberies which distinguish the annals of the coast. During this period the average annual number of suicides rose to forty-three. In 1874, while the Crown Point and Belcher Bonanza was still yielding at the rate of £3,600,000 a year, the Big Bonanza was struck in the consolidated Virginia and California mines, and this added some £1,000,000 to the year's product of the precious metals, and proportionately increased the pre-existing mining excitement and the practice of jobbery. From this time forward until 1877 the Big Bonanza continued to increase its product, to augment the predominant mania of the coast, and to afford additional support to the resources and devices of jobbers. In the last-named year the fact was unexpectedly disclosed that this great ore body had passed its point of highest production. Then followed a tremendous collapse in all gold and silver mining shares, numerous bankruptcies, a fall in real estate, rents, commodities, and wages, popular tumults, and numerous misdemeanors and crimes; among the latter an unusual number of suicides. Taking together the five years ended June 30, 1878, the number of suicides reported to have been committed in San Francisco reached the unprece-

[1] Report of the coroner for 1878, p. 5. The Chinese in San Francisco number about one-tenth of the population and although they nearly all consist of adult males in the prime of life, while the whites consist of both sexes and all ages, the whole number of Chinese deaths is in about the same proportion.

[2] Ended June 30. [2] Estimated.

[3] Estimated from returns of nine months. The returns for the year 1867, 1868, 1872, 1874, 1875, 1876 and 1877 are from the Health Board returns, the others from the Coroner's. The latter's summary report for 1878 gives, on p. 124, the following number for each year commencing with 1863, viz., 17, 20, 16, 20, 28, 20, 43, 44, 44, 45, 37, 59, 60, 56, 75 and 103. Total reported in sixteen years, 687. Chinamen are not included in any of these numbers except where, very rarely, a Chinaman is specifically reported to have died from self-destruction. Inquests are not held upon the bodies of Chinamen dying from unknown causes.

dented annual average of seventy-five. It is difficult to believe that these occurrences were not connected. This conviction is strengthened, not only by the statistics of commitments for insanity hereinbefore given, but also by the statistics of death by violence, of crime, immorality, and disorder of every sort; by the accounts of the savings banks, by the returns of bankruptcies, and by the prevalence of indigence and suffering among those classes of the community who did not profit by these speculations, or succumb to the blow which they inflicted on the losers.

—*From " The History of Precious Metals by Alexander Delmar."*

CURIOSITIES OF METALS.

MR. J. VAN CLEVE PHILLIPS recently sent the following curious communication to the *London Mining Journal*:

In reading Fourier's Philosophy in a new book by Van Buren Denslow, called "Modern Thinkers," and having read Erasmus Darwin's "Love of the Plants" (Dublin, 1795: grandfather of the present Darwin), I find my idea of sex in mineral veins fortified. My study of the Mississippi lead field was from 1844 to 1853, and of the Missouri lead fields from 1855 to 1880:—1. The lead fields are basins of limestone, these being from 100 yards to 5 miles wide, and vein system duplicated in each basin. 2. All the discoveries of ores in the upper Mississippi and Missouri lead fields may be located geographically in the basin where they occur, and stratigraphically in the rock and family of veins to which they belong. The lead ores mined in these fields have yielded to date $150,000,000 worth of lead, all of which has been taken from the small basins or along the edges of the larger ones, and is from the edge of the vein system, and will not include over 1-20th per cent. of the ores contained in the basins, as shown in my unpublished geographical surveys of the upper and lower Mississippi lead fields. It will be seen from this that the existence of lead and zinc is now known which will supply the people of the center of the continent with these metals when it shall have a population of 300 to the square mile, as England has to-day.

My first attention to the physical outline of crystallization of lead ore was in 1848, while superintending a lead furnace in Wisconsin. The teams were bringing in ores from 20 different lead discoveries, having north and south veins, east and west veins, and stratified veins from the rock and clay. The east and west veins had regular cubes, the north and south veins had the edges of the cubes truncated, and the horizontal veins had the solid angles of the tubes cut off or truncated. The ores from the clay were amorphous, and this form of crystallization was duplicated in each lead basin. This went to establish the fact that the lead producing and crystalline action had been directly connected with the vein system in all parts of the lead basin; that the same force which had been exerted to fill the vein system in one basin of limestone had duplicated that system in the adjacent basins, and the physical outline of the ore was an index of its geographical and stratigraphical position in the basin. Afterwards I was led to the conclusion that the north and south veins were the positive or male veins, and the east and west the negative or female veins. The north and south veins were few in number, the east and west veins many, and the north and south veins always pointed towards the basins of the east and west veins. This law is noticed in the animal and vegetable kingdoms, in the sheep and goat families, and in the cherry and apple trees, the males being in the minority. In applying this law to iron ores we suppose the magnetic ores are the positive or male ores, other varieties the negative or female ores. In the silver fields the Comstock, being a north and south vein, would be a positive or male vein, and the east and west veins of New Mexico and old Mexico the negative or female veins.

The great vein known as the San Pietro, in the town of Hidalgo del Parral, is an east and west vein; also the largest and richest mine worked at the old Spanish mining town of Inde in the State of Durango, Mexico, and known as the Del Aqua (water mine), is an east and west vein. I am not sufficiently acquainted with the courses of the veins in the mountain States to apply this law of sex to the vein system of the numerous silver and gold-bearing fields, yet I have identified it in the vein system of the upper and lower lead fields of the basin of the Mississippi, and feel assured that it can be applied to all the families of veins which, as a rule, are aggregated around a central knob or Boofa, which forms the water-shed of individual families of veins, and which families as aggregated form the great stellar silver belt from Montana south through New and Old Mexico, and that by close observation the explorer and miner may profit by its application.

This *Communique* drew forth the following confirmatory letter from Mr. James Williams, who wrote as follows:

"The subject is not by any means a new one, as it is an idea that has occupied my attention for the last thirty years, and I am fully satisfied, and have been for many years past, that we cannot apply the word sex to mineral veins, as on close inspection I have found that the north and south vein (and which Mr. J. Van Cleve Phillips, New York, would term a male, and non-productive) by a secondary influence has become the bearing or productive vein.

A short account of my investigation of mineral veins and what led to it may not be out of place. Standing on an old mine burrow and elevated, on looking southeast and northwest, I was somewhat surprised at beholding a number of mines in that direction, as our Cornish mines, with but few exceptions, are east and west, and the above was a few degrees south of east and north of west. Where I stood I could take in a distance of from four to five miles, and the number of mines (about six), and on visiting the mines separately, I found that each had been made productive on the east and west vein, except the last. All the former veins had been made productive by the caunter running in the direction named above, and non-productive until forming a junction with the east and west vein, but the last to the south of east was in the direction of and with the Nine-o'clock vein, and up to this point might be called the male or non-bearing vein. But at this point it changed its character, and became the female or bearing vein, in consequence of being disturbed by an elvan course as a secondary element, and was very productive for a short distance, and was called Wheal Chance in South Crenver, where thousands of pounds were recklessly wasted looking over a second Wheal Chance, but not finding a secondary element or elvan course, their money was spent in vain. The next we shall hear of this caunter carrying its head, and pursuing its course, so to speak, east and by south, will be in Polcrebo mine, to the east and south of South Crenver, now commenced to be worked by Mr. Battye, Secretary, Great Winchester street, London, which I have considered for years to be a valuable piece of ground, second to none. As I prefer giving a reason for the faith that is in me, please permit me to do so in this instance, as it is of the utmost importance. This caunter or Nine-o'clock vein, after being traced a few miles through highly mineralized ground, with varied but beneficial results, we now have in Polcrebo mine; to the west and north it will intersect a northeast and west vein, then three veins east and west, parallel to each other, and underlying to form a junction in depth, and which is about the center of the sett. It passes on, and in the south part of the sett it will again form a junction with three other east and west parallel lodes, about thirty feet apart at surface, and coming together in depth. One of those (the south one) was made productive by a cross course as a secondary element. When this vein was first discovered close to the cross-course, and only twenty-eight fathoms from surface, it was in September, 1872, worth more than £84 per ton. The best work made, 7 cwts. 13 qrs. of tin to 20 cwts. of the vein (tin book now before me—amount £209 10s. 6d.); yet this sett was condemned by all the old-fashioned miners. It is quite time a new state of things should take place, so that we could with a greater amount of certainty find our mineral deposits. I have used every effort to form an Inductive Scientific Mineralogical Institution, visited London in 1879, was three times to the Marlborough House to endeavor to see the Prince of Wales and Duke of Cornwall, being extensively interested in mining property in the county, and, as I then stated, I now again affirm that the Prince of Wales' income may be increased 50 per cent.; also all the mineral land proprietors in proportion.

It is only three years since I made the attempt to see and interest the Prince of Wales with my theory. However, I am not out of heart or discouraged, as I read that Mr. Samuel Morse, the inventor of the electric telegraph, presented himself at the White House Congress in America in 1837, where he was laughed at and jeered by those who should have assisted him, and did assist him after wasting six years of precious and valuable time. I suppose I must not hope to be more fortunate than was Mr. Morse with his valuable invention.

Color Relations of Metals.—In a paper on the color relations of copper, nickel, cobalt, iron, manganese and chromium, lately read before the Chemical Society, Mr. T. Bayley records some remarkable relations between solutions of these metals.

"It appears that iron, cobalt and copper form a natural color group, for, if solutions of their sulphates are mixed together in the proportions of 20 parts of copper, 7 of iron and 6 of cobalt, the resulting liquid is free from color, but is gray and partially opaque. It follows from this that a mixture of any two of these elements is complementary to the third if the above proportions are maintained. Thus a solution of cobalt (pink) is complementary to a mixture of iron and copper (bluish green); a solution of iron (yellow) to a mixture of copper and cobalt (violet), and a solution of copper (blue) to a mixture of iron and cobalt (red) red. But, as Mr. Bayley shows, a solution of copper is exactly complementary to the red reflection from copper, and a polished plate of this metal viewed through a solution of copper salt of a certain thickness is silver white. As a further consequence, it follows that a mixture of iron (7 parts) and cobalt (6 parts) is identical in color with a plate of copper. The resemblance is so striking that a silver platinum vessel covered to the proper depth with such a solution is indistinguishable from copper.

There is a curious fact regarding nickel also worthy of attention. This metal forms solutions which can be exactly simulated by a mixture of iron and copper solutions; but this mixture contains more iron than that which is complementary to cobalt. Nickel solutions are almost complementary to cobalt solutions, but they transmit an excess of yellow light. Now, the atomic weight of nickel is very nearly the mean of the atomic weight of iron and copper, but it is a little lower—that is, nearer to iron. There is thus a perfect analogy between the atomic weights and the color properties in this case. This analogy is even more general, for Mr. Bayley states that in the case of iron, cobalt and copper, the mean wave length of the light absorbed is proportional to the atomic weight. The specific chromatic power increases with the affinity of the metal for oxygen. Chromium forms three kinds of salts—pink salts, identical in color with the cobalt salts; blue salts, identical in color with copper salts; and green salts, complementary to the red salts. Manganese, in like manner, forms more than one kind of salt. The red salts of manganese are identical in color with the cobalt salts and with the red chromium salts. The salts of chromium and manganese, according to the author, are with difficulty attainable in a state of purity. He thinks these properties of the metals lead up to some very interesting considerations."—*Chemical Review.*

Of the Forms of Minerals.—The researches of Graham and others have shown that inorganic matter may exist in two perfectly distinct conditions, known respectively as crystalloid and colloid. The same portion of matter may be at one time crystalloid and another colloid, the difference being one of condition not of composition. Thus rock-crystal consists of crystalloid silica, but if a fragment be powdered, fused with carbonate of soda, dissolved in water, and precipitated by hydrochloric acid, the precipitated silica will now be in the colloid state. When in solution, crystalloids differ from colloids in some very important particulars, and on passing into the solid form the differences are still more evident.

Colloid minerals are few in number. They are totally devoid of cleavage or distinct internal structure, but they usually break with a very perfect conchoidal fracture. They occasionally, but not often, occur in what are called imitative forms, but are usually amorphous or without definite external forms. As examples of true colloid minerals, we may mention opal and obsidian.

Crystalloid minerals are very numerous, they include, indeed, the great majority of mineral species. They may be either crystallized, crystalline, or crypto-crystalline.

Crystallized minerals are those which occur in definite geometrical forms. Ordinary rock-crystal is a perfect example of crystallized mineral.

Crystalline minerals are such as have the peculiar internal structure observed in those which are crystallized. They consist, indeed, of a multitude of crystals confusedly crowded together, so that the external geometrical form is lost or disguised. The cavities or "vughs" of such aggregates, however, often display distinct crystals. The kind of quartz known as cross-course spar affords a good example of a crystallized mineral.

Crypto-crystalline minerals are those in which the crystalline structure is so minute that it is not ordinarily observable, but it may be detected in suitably prepared specimens when examined under the microscope. Chalcedony and agate are good examples of crypto-crystalline minerals.

Many crystalline and crypto-crystalline, and some amorphous minerals, occur in what are known as imitative forms. The chief of these are the following:

Globular. This form is often seen in wavellite, prehnite, and other minerals. On breaking a globular mineral, it is almost always seen to be composed of a multitude of indistinct crystals radiating from the center, and sometimes the outside of the sphere is roughened by the projecting points of these crystals. Occasionally the true crystal form of these terminations may be observed, but usually they are indistinct.

Reniform (kidney-shaped). This form is not unfrequently met with in nodules of iron pyrites, or other minerals which occur imbedded in clay or mud. Some kinds of red and brown hematite are called kidney iron from their occurrence in this form.

Botryoidal (grape-like). This form is often seen in that kind of chalcopyrites known as blistered copper ore.

Mammillary. This form is often seen in malachite and blistered copper ore.

Corralloidal. This structure is observable in chalcedony and argonite, especially in specimens from Styria. It sometimes occurs in connection with earthy deposits of iron ore, when it is called flos-ferri, or the flower of iron.

Cone in cone. This structure is often met with in iron ores from the coal measures. It consists of a series of fibrous concentric conical masses, the points of the cones meeting together, or sometimes interlaced.

Stalactitic (icicle shaped). Chalcedony, calcite, and barytes often occur in this form. Sometimes the stalactites are hollow, sometimes solid; but in stalactites of calcite and barytes, a cross-section almost always reveals a structure consisting of fibres radiating from the center, and the same thing is visible in properly prepared slices of chalcedony, when examined under the microscope.

It is probable that most, if not all, of the above-described imitative forms are the result of deposition from solution, at any rate this is known to be the case in some instances. Thus, stalactites of calcite, or carbonate of lime, may be seen in process of formation in caverns in most limestone districts, and they are very frequently formed under bridges or tunnels which have been built with lime mortar. The process of formation is as follows: Rain water containing carbonic acid in solution in filtering through limestone, mortar, or other material containing carbonate of lime dissolves a part of it. On becoming again exposed to the air drop by drop, part of the carbonic acid is given off, part of the water evaporates, and part of the carbonate of lime is deposited. A stalactite once formed, the water naturally descends to its lower end before falling off, and it is there that the greatest amount of carbonate of lime will be deposited, and in this direction its growth will be most rapid, although a small quantity of solid matter will continue to be deposited on the sides of the stalactite, so producing the concentric structure shown in the vertical section of a stalactite, or in the cross-section. The radial structure appears to be of later origin; it is really due to an incipient crystallization set up within the mass. The water dropping from the stalactite will still contain some carbonate of lime in solution. This will be deposited on the ground beneath, when the conditions are favorable, forming what is known as stalagmite. A cross-section of stalagmite, however, will differ from that of a stalactite, owing to the tendency which the drops of water have to spread themselves out. If the supply of water be abundant, a sheet of stalagmite will be formed if only a little falls, a pillar of stalagmite will gradually rise towards the stalactite above; but in all cases the separate layers will be of about equal thickness throughout. The crystalline structure sometimes observable in the imitative forms already described, is probably the result of a secondary action of the crystallizing forces, following the actual formation of the solid mineral. There are, however, other imitative forms which are merely irregular crystals or crystalline aggregates, and in the formation of which the crystallizing forces appear to have been concerned from the first. These are the so-called capillary and wiry forms observable in native silver, the mossy and leafy forms seen in native copper, the dendritic markings of oxide of manganese, the reticulate groupings characteristic of mountain leather, and the stellate groups of crystals often met with in stilbite and other minerals.—*Mining and Scientific Press.*

ACCIDENTS IN THE COMSTOCK MINES AND THEIR RELATION TO DEEP MINING.

EARLY in the month of August, 1877, a miner in Gold Hill, Nevada, made the unlucky remark that, according to his observation, that month was usually quite free from accidents in the mines. Never was presage wider from the truth. When the month closed twelve mishaps had occurred, killing six and wounding nine persons, and for the rest of that year the Comstock mining communities were kept in a ferment by the frequent occurrence of appalling disasters. There was a real tidal wave of calamity sweeping over the mines, which was never known before on the Comstock. This paper deals with the accidents that occurred between July, 1877, and May, 1879. The number in this period of twenty-two months is 101, killing immediately 53 persons and wounding 70 others. This list is incomplete in every way. All accidents which did not injure persons are omitted, and there were several which were of a threatening kind but fortunately did no damage to human beings. Probably others have been overlooked which did not belong to the category included in the lists. Finally, no effort has been made to ascertain how many of the wounded died of their wounds, and the number of fatal casualties includes only those who died so soon after their injury that their death became a part of the current records of the accident. Many of these accidents belong to the usual classes of mishaps in mines and will receive no extended discussion. Others are worth examination from their connection with labor in hot mines, deep mining, and other causes intimately dependent on the local conditions of the Comstock. They may all be classified under eight general heads: 1. Falls of rock, timber, etc.; 2. Tramming; 3. Effects of heat; 4. Falls of men; 5. Explosions; 6. Hoisting apparatus; 7. Overwinding; 8. Miscellaneous. The distribution among these groups in each year is shown in following summary:

	1877. 6 mos.	1878.	1879. 4 mos.
(1.) Casualties due to falls of rock, ice, timber, etc.			
Number of occurrences	8	7	8
Casualties, fatal	2	4	3
Casualties, not fatal	7	4	5
Proportion fatal, 36 per cent.			
(2.) Casualties in tramming.			
Number of occurrences	4	3	
Casualties, fatal	1	0	
Casualties, not fatal	4	3	
Proportion fatal, 12½ per cent.			
(3.) Casualties due to heat.			
Scalding:			
Number of occurrences	1	2	
Casualties, fatal	1	1	
Casualties, not fatal		1	
Proportion fatal, 33 per cent.			
Overheating:			
Number of occurrences	1	8	
Casualties, fatal	1	7	
Casualties, not fatal		3	
Proportion fatal, 73 per cent.			
(4.) Casualties due to falls of men.			
Number of occurrences	7	7	2
Casualties, fatal	2	6	
Casualties, not fatal	5	1	
Proportion fatal, 62½ per cent.			
(5.) Casualties due to explosions.			
Number of occurrences	5	6	3
Casualties, fatal	3	2	5
Casualties, not fatal	5	6	
Proportion fatal, 71 per cent.			
(6.) Casualties in hoisting,			
Number of occurrences	4	6	1
Casualties, fatal	2	3	1
Casualties, not fatal	2	6	
Proportion fatal, 43 per cent.			
(7.) Casualties by overwinding.			
Number of occurrences	1	2	
Casualties, fatal	1	2	
Casualties, not fatal	1	1	
Proportion fatal, 60 per cent.			
(8.) Casualties due to miscellaneous causes			
Number of occurrences	7	8	
Casualties, fatal	1	3	
Casualties, not fatal	10	6	
Proportion fatal, 20 per cent.			
Total occurrences	38	49	14
Total fatal casualties	14	28	11
Total casualties, not fatal	34	31	5
Grand total for 22 months:			
Occurrences	101		
Total casualties	53		
Casualties, not fatal	70		
Proportion fatal, 43 per cent.			

This list is not offered as a summary of accidents in the Comstock mines, but merely as an index to the causes which operate there to endanger life. Many of these are common to all mining operations, but others are quite peculiar and deserve discussion, for it is supposed that they are likely to increase in force with the deepening of the mines.

(3.) In the third class, or those casualties which are due to the high temperature of the mines and the rock in which they are opened, we have some of the most singular occurrences known in mining. The injuries by scalding were occasioned entirely by falling into the hot mine waters. Their temperature varies with the locality, but the maximum is 156° F., and usually it is considerably below this. This temperature seems to be sufficient to produce serious effects. One miner, who had slipped into the Julia water, sinking nearly to his knees, got out so quickly that the water did not have time to enter his shoes, and yet his legs were scalded so severely that the skin came off. The same mine was flooded early in 1880 with water which was reported to have a temperature of 158° F., and a miner who in a fit of absent-mindedness stepped into it, immersing himself to the chin, was fatally injured. The water is hot and gaseous, and the unfortunate man who falls in it sinks deeply and probably finds it difficult to regain the surface.

But it is in the effects of work in hot air upon the human frame that the most remarkable casulties are witnessed, and this class is purposely put first among those which are to be discussed, because it seems probable that a considerable proportion of all kinds of accidents in these mines are directly due to the heat. The proportion of fatal casulties is larger in this class than in any other, being seventy-three per cent., and from the peculiar mental effects of the heat it is obvious that it may be and probably is the initiating cause of many mishaps which would, under other circumstances, be ascribed to culpable blundering. On the 1900 level of the Gould and Curry mine a drift was run to the southward from the shaft, following the line of the black dike and lying quite near it. As a rule the drifts at this depth have not been above 108° or 110°, and many have been less hot, but this drift has several times been reported to show a temperature of 123°, 126° and 128° F. Thomas Brown, a miner working in this place fainted, and when taken to the surface and revived was found to have completely lost his memory. He could not tell his name or where he lived, and had to be dressed and taken home by his friends. The paper which records the occurrence says: "This sudden loss of memory from overheating is quite common in the mines, but the effect soon disappears and the men are themselves again. This fact furnishes an explanation of how men who are considered experienced miners walk off into fatal winzes and chutes, seemingly with deliberate intention."

A frequent accident in these mines is fainting in the shaft while the cage is rising to the surface. The faintness is always felt immediately upon reaching the cooler air a hundred or a hundred and fifty feet from the surface, where there is usually a side draft through some adit. This casulty is so common that a man who has been working in a hot drift is not allowed to go up alone. Long habitude to the heat is no safeguard against this danger, and serious accidents have occurred in this way. The faintness is commonly preceded by nausea, but insensibility follows quite suddenly. Among the minor casualties is included one which is said to have happened to Mr. Sutro. Being in the Sutro tunnel before it made connection with the savage mine, and in an air temperature of 110° F., he went to the air pipe to cool off, and staid there so long that the miners told him to get away from the pipe and let them have air. He did not move, and the account says they tried to stir him up with the handles of their shovels, but he had lost all volition and could not budge. Finally he was put on a car and taken out. These are the minor effects of the heat. Its graver results are well shown in the following cases of insanity and death: The first of these, is described by the Virginia *Evening Chronicle* as follows: "At half past nine o'clock Monday morning, March 11th, 1878, a man died at the Caledonia mine in Gold Hill, under peculiar circumstances. The man had been idle for six months, and was working his first shift in that time, he having gone down this morning at seven o'clock. He was put to work as carman on the 1400 level. At the hour stated he rushed into the station at the 1400 level and told the station-tender that the wheels of his car were smashed all to pieces. The station-tender walked back with him to the car, when it was fonnd all right. The station-tender thereupon saw that something was wrong with the man, and took him to the cooling-off place. There he soon began talking wildly and behaving boisterously, and giving other indications of mental aberration. It was therefore thought best to bring him to the surface. He was firmly lashed to the cage and hoisted up, but on reaching the surface he fainted away and died in a few minutes." The heat on the 1400 level of the Caledonia is not very great, being about 90° F., and this man's sudden decease may have been due to other causes.

Of the other fatal casualties one was from cramps, which the account attributes to the heat, but which may have been the result of drinking ice-water, and another was from a cold taken while cooling off after being partially overcome by the heat. It is to the drinking of ice-water and the comfort of a strong draft that the men resort for recovery from the exhaustion caused by the heat, and though these methods, so contrary to the ordinary rules of hygiene, are put in use several thousand times a day, and usually with impunity, these two instances are proof that they may be dangerous. The miners consider the draft of cool air safer than drinking copiously of ice-water.

The next case illustrates the violent effects which excessive heat may have upon a person not accustomed to it: "On Friday, October 11, 1878, John McCauley went to work for the first time in the Imperial mine. He was cautioned against overexerting himself in the extreme heat of the lower levels. He replied that he thought he was strong enough to stand anything, and paid no attention to the advice. At half-past two in the afternoon he was brought to the surface in an unconscious state and died the next morning at half-past ten o'clock." Two other cases very similar to this have occurred in the Imperial within a few years. This mine is excavated in one of the hot spots of the Comstock. The hot drift on the 1900 level of the Gould and Curry is the scene of the most serious of these casualties due to heat. Five men were sent there in June, 1878, to load a donkey pump on a car. This work was so exhausting that when the pump caught on a plank they were not able to move it. They seem to have been in a state of mental confusion, but felt that they could not remain longer. Starting up a winze which connects with the 1700 level one man fell on the way, and the others were afraid to stop to help him, but pressed on, reaching the 1700 in half an hour from the time they left it. They were very confused and nearly speechless, and hardly realized what had occurred. Three men went down to the rescue, and found the fallen man still alive. Clearing the pump they got into the car and signalled to hoist, but on the way up the winze the man they had gone to rescue reeled and fell off. The car was stopped at once, but he was jammed between it and the brattice so fast that the others left him and went for help. They all gave out, two half way up, and the other just as he reached the 1700 level, where a friendly hand pulled him up. A new rescue party went down and found two men dead, and the third died soon after. The shift boss reports that "the accident was due solely to the heat, as the air is good enough and pure enough, barring the heat." The winze was not an abandoned one, but in daily use. A heavy volume of steam is reported to rise through it from the 1900 level, the temperature of which, at the time of this accident, is given at 128° F. It may be from the detailed account, that the death of the man is possibly attributable to the fact that when the miner fell off the car the latter was stopped in a place that was hotter than the rest of the winze. It is to be regretted that no adequate studies have been made upon the precise physiological phenomena presented by death under these circumstances. The legal requirements are satisfied when it is proved that the casualty was due to "heat," but if the theory of heat production in these rocks is correct, and currents of hot gas rich in carbonic acid are pouring through narrow belts of shattered rock, the death of men who are stopped in one of these belts may have a more complex cause.

(4.) The most appalling accident which can occur in mining work, the falling of men down a deep shaft, repeats itself in the Comstock mines with a frequency unknown elsewhere. Sixteen occurrences of this kind took place in twenty-two months, and ten of the casualties were fatal. There were seven falls in the shaft, six in winzes and one in a chute, and three in the floors. One of these deaths was traceable to the effects of foul air, the lights having gone out and the party being on the cage in retreat from the drift. These dreadful accidents being more common on the Comstock than in any other mines, it is important to ascertain whether this frequency is attributable to the heat. In some cases we may answer in the affirmative. When a timberman repairing the upcast shaft of an unusually hot mine falls to the bottom we may fairly conclude that the tendency of blood to the head which the lifting of a heavy weight occasions may have been increased to momentary stupefaction by the heat, steam, and gases of the shaft. But though my own impression before examining this subject was that the heat was largely accountable for these mishaps, one is forced by study of the casualties in this record to admit that this is not the most frequent cause of them. If the Comstock miner is more liable than his fellows to this form of accident it is because he is more often called to work in the shafts after they have been completed. The Comstock shafts are all sunk in the hanging wall, and the vast excavations which have been made in most of the mines make the settling of this wall inevitable. But besides that the Comstock rocks are forever moving, swelling, and forcing the shafts out of line. No shaft there is in perfectly good condition. Some stand remarkably well, and keep in working order for years, while others require frequent repairs; but from the day they are completed their deterioration is steady, until a general overhauling is necessary. They are timbered in a manner which allows remarkable variation from their original alignment without loss of local support to the ground, and this timber is rapidly and conveniently readjusted when pushed too far out of line. The work of repair is necessarily dangerous and more hazardous in a hot steaming upcast shaft than in a cool one, and it is to the frequency with which the Comstock miner is called upon to perform this work that the number of falls in the shaft is to be attributed. It is also undeniable that the unfavorable heat conditions may contribute essentially to the result, but of the two causes I consider that frequent opportunity is the greater. But the falling of timbermen is not the only mode in which this accident occurs. Another is the product of pure forgetfulness. A man working near the shaft will sometimes step off upon vacancy and meet his death. The movement is made quietly, not in the heat of action but after the completion of some task, and above ground such actions are attributed to "absent-mindedness." This state of inactive perception is exceptionally frequent among Comstock miners, and it stands in such strong contrast to the habits of forethoughtfulness to which they train themselves that we must attribute it to the effect of physical exertion in hot air.

Another class of falls in the shaft are partly due to the high professional spirit and sense of individual responsibility which makes the Western miner one of the most trustworthy of his class. This mode of occurrence, which is unexpectedly frequent, is the pushing of a car into a shaft where there is no cage. This is sometimes due to pure absentmindedness, and sometimes to an interruption of the routine work by a cage going up empty, with a message, with tools, or with a passenger. It is said to be a fact that when a carman has pushed his car to the open shaft and has suddenly awakened to the dreadful situation, he never fails to sacrifice his own life in efforts, however hopeless, to stop it. Whenever a car thunders down the shaft there is always a man with it, and whenever the circumstances have come under observation it has been evident that the loss of a life was not due to stupefaction, but to a dogged determination to stake everything on the hope of preventing a possible calamity to men below. The spirit is well illustrated by the act of a man who fell down a shaft at Bodie, and used his last breath in calling out "Look out below!" Though this casualty appears so frightful to these who witness it, it is probably as painless as other modes of certain instantaneous death. It is said that the unfortunate men always lose their shoes in their fall, and also that they invariably reach the bottom sooner than the car, if one falls with the man.

(5). The history of blast accidents in the Comstock mines enforces the truth that the nitroglycerine explosives do not enjoy the immunity from ignition by friction which has been asserted for them so confidently. We have to admit that a box of cartridges can be thrown off a house with safety, for that has been frequently done, but inclosed in a drill-hole they have been fired repeatedly by friction, jarring, or a blow. Out of fourteen accidents five occurred from the explosion of unsuspected cartridges by one of these causes. Two cases of wounding are peculiar from the fact that the exploding cartridges had been in the rock a long time. Each of them lay, not in the header, but in the floor of a drift or chamber, and the accident occurred when orders were given to level up the floor. The explosions were in different mines, and one of the miners was using a pick, the other a gad. Neither was killed. Two men were wounded by the explosion of a cartridge which they were drilling out for repriming. Three accidents occurred from the explosion of old cartridges left in the header, the presence of which was not suspected, and which were fired, not by direct impact of the tool, but by the jar or the crowding in of the rock upon the cartridge, owing to the starting of a new drill hole near by. Two of these were caused by machine drills, and one by hand drilling. It is supposed that in some cases at least the exploding cartridge was not a complete one but merely a fragment—the upper portion having done its work. This seems probable, for instance, in the cases of the two men who were injured while leveling off the floor, for it is hardly conceivable that a full cartridge could blow up the floor beneath a man's feet and leave him alive. One of the explosions took place under peculiar circumstances which exhibit very well the sensitiveness of nitro-glycerine to the conditions in which it is placed. A hole having missed fire the next shift opened and recharged it. After lighting the fuse the men waited the usual time, and one of them then went to the face and found the cartridge was "boiling," making what the miners call a "stinker." It was concluded to drown the hole out, and a man took up water from the wet floor in his shovel and threw it on the boiling cartridge. While stooping for another shovelful the half-burnt charge exploded. The superintendent, Mr. Forman, who was present, attributes the explosion to the confinement of gas by the water, and the suggestion is a sensible one.

(6.) Hoisting on the Comstock has peculiar dangers from the movement of ground in the shafts already spoken of. It is often impossible to keep the guides in anything approaching a straight line. The shove is not only considerable, but it is frequently confined to short reaches in the shaft, and this displacement of line is the cause of frequent dangers and sometimes of serious casualties. The cage sways from side to side with motion sufficient to make it absolutely necessary to hold firmly to a rod placed in the top for that purpose. Among the casualties of 1877 was one caused by the violent surging of the cage in the Consolidated Virginia shaft, by which a miner was thrown off his balance, one foot going over the side. He escaped with a sprained ankle. Sticking of the cage during its descent, and its subsequent fall with a jerk, is one of the most frequent causes of these accidents, and the cage sometimes also gives a sudden bound when rising.

(7.) Though overwinding is neither the most frequent source of casualties nor the most fatal in its results, it has aroused more attention than any other. In twenty-two months, cages containing men were twice "run into the sheaves," as the local expression is, and there are on record notes of four others, where no men were hoisted, but one of which proved injurious to persons. Two of the fatal cases occurred at the same mine within five and a half months, and the other, which was caused by overwinding a heavy bailing-tank, followed soon after. These, and the running of several empty or ore-laden cages into the sheaves, made a great excitement, and the Society of Engineers tried to prove that the men at the engines were overworked. They formerly worked twelve hours at many shafts, and on solicitation were reduced to eight hours at some. The pay for twelve hours' work was usually \$6, and for eight hours \$4.50 or \$5. One result of the excitement occasioned by these dreadful casualties was the introduction of several safety devices. Nothing new was presented, there being detaching devices which depended on safety-catches for supporting the cage when connection with the cable was severed, others with special chairs to detain the cage, and one with a rope wound on a false reel to support the cable and carry it quietly to the hoisting drum or reel. In addition the usual appliances for throttling the exhaust from the cylinders of the hoisting engine, shutting off steam gradually and putting on the brake, have been re-invented. The gallows frames at most of the old shafts are thirty-five feet high, and with a "double-decker" cage that takes up twelve or fourteen feet of this space, it is evident the engineer has but a small margin for safety. The new shafts have frames forty-five feet high. The tendency on the Comstock is to employ unbalanced reels and with these, mere bleeding of the steam pipe should be sufficient to prevent serious injury. With balanced reels it would be absolutely necessary to put on the brake also.

(8.) One of the accidents classed among the miscellaneous causes is worthy of attention. Several years ago an electric signaling apparatus was introduced into the Savage mine, but abandoned on account of the uncertainty of its signals, which would sometimes sound without human aid. In 1877 a new apparatus was put in with improvements which it was thought would prevent this disadvantage, but after working well for some time it failed one morning, and caused a fatal casualty by ringing only three bells when ten were intended. Whether the signal-man was at fault is doubtful, but it is a fact that the apparatus had worked badly that morning, and before the accident a man had been stationed to signal with the bell-rope in case the battery did not work. There is little confidence in the electric mode of signaling. A small wire hand-rope is used, and on the whole is safe and convenient. In looking over this list of casualties it is evident that the accidents which possess most interest are those which have near or remote connection with the heat of the mines, for the latter are sinking with great rapidity, and becoming hotter each year. It is difficult to deny that the greater depth increases the chances of accident in mines which, in addition to the ordinary liabilities of mining work, have the insidious and ever-present effects of hot air, water, and rock upon the physical and mental condition of the men. Out of 101 accidents twelve were directly caused by the heat or hot water. Undoubtedly the falls of men down a shaft have been caused sometimes by sudden exhaustion, due to the heat and steam in upcast shafts, but on looking over the accounts of the accidents of this kind which are included in the above list none of them show a connection with this cause. The casualties positively traceable to the heat are therefore twelve per cent. of the whole. Probably the heat increases the bad effects of powder fumes and natural gases, and by making repairs to the shafts more frequently necessary it adds indirectly to the occasions when disasters may occur. Some allowance should be made for a less active mental condition, a dulling of the faculties, and a certain recklessness to which the heat sometimes goads the men. On the other hand the heat makes them more cautious except when under momentary impulses, and there are no American miners more careful of themselves than in these mines. On the whole the good and bad effects of the heat seem to nearly balance each other, and an allowance of five per cent. for the casualties indirectly caused by the high heat would be fairly sufficient. The specific cases I presented do not warrant even that allowance. The accidents recorded here relate to a time when the number of miners at work in the district was from three thousand to thirty-five hundred, including top men and underground men. Most of them worked eight hours, but some of those on top had twelve-hour shifts, and probably there was a constant force of nine hundred or one thousand men below. It is not possible to make a comparison between these casualties and the amount of ore raised, as the practice is in statistics of coal mines, for the reason that only two out of about forty mines were producing much ore throughout the period covered by the list. The comparison can be made for those two, the Consolidated Virginia and California, and is as follows for the year 1878:

		Proportion to tons ore.
Number of accidents.	10,	1 to 25,771
Fatal casualties,	5,	1 to 51,542
Casualties not fatal,	8,	1 to 32,214
Tons of ore extracted, 257,718.		

Of the casualties included in the list for twenty-two months there were in these two mines twenty-five accidents, twelve fatal, and eighteen not fatal casualties, or twenty-five, twenty-two and a half, and twenty-six per cent. of the whole.

From all these facts it may be concluded that increasing heat will not debar the Comstock mines from continuing to the greatest depths which are considered practicable in the existing adjustment of mining appliances to the market value of mining products. It is true that an air temperature of 108° F. is common at the 2000 feet level, while 110° and 112° are not infrequently observed, and that a drift which showed a temperature of 123°, 126° and 128° F., according to different reports, has proved to be the most deadly on the lode. It is also true that the temperature of the rock is increasing, and with it that of the air, and at some depth, for the calculation of which there are absolutely no data, the temperature of this drift may be expected to prevail throughout the lode unless the present conditions change. But this being an *air* temperature it is always possible to mitigate it by artificial means. It is already observable that drifts 1800 feet below the surface may show a much higher heat than others 400 feet below them. High temperature is largely a matter of locality and temporary conditions, and by various expedients it may be confined to its localities, or combated in other ways. Deep mining, by extending the line of work through the moving hanging wall, and compelling increased repairs to shafts, will perhaps tend to heighten the already great frequency of falls of men. In addition to heat, the peculiar mode of timbering in square setts, the almost exclusive use of nitro-glycerine powders, the necessity of frequent repairs to shaft timbers, the incessant movement of the rocks through which the shafts are sunk, making accidents in hoisting more than ordinarily frequent, and the necessity of transporting large quantities of rock through narrow gangways entirely by human labor, are the conditions in which mining on the Comstock may be said to suffer rather more than the usual liability to danger. Two of these causes, both connected with the movement of the ground, may be expected to increase with depth. Together with the heat they comprise forty per cent. of the whole number of accidents, and we may therefore sum up our conclusions by saying that the conditions of deep mining will increase forty per cent. of the causes which lead to casualties and will leave sixty per cent. unaffected. What the amount of this increase will be cannot be foretold, and indeed, cannot be estimated until an ore body has been found and worked at great depth. The year 1879, which was preeminently one of deep sinking on the Comstock, has been remarkably free from casualties.

The above is taken from a paper by Professor John G. Church, M. E., published in the Transactions of the American Institute of Mining Engineers. To it we append the following from the *Mining and Scientific Press:*

On Wednesday, the 31st May, 1882, the main pump column in the Alta mine on the Comstock was broken. Men were at work making the necessary repairs, when, at 11 o'clock, the bulkhead recently placed in the main east drift on the 2150 level gave way. This bulkhead was constructed of plank and timbers, and was placed in a part of the drift where the rock was hard and perfectly solid. It would seem that it at first gave way at one end, as the first rush of water was not very alarming, though it was thought best for all to get off the level. Three or four men who were near the shaft went up, and Richard Bennett, the shift boss, at once started out into the main west drift to notify the men at work at that point of the danger. About the time he started on his errand it would seem that the whole bulkhead went down, and there was a tremendous rush of water. This drift is 1400 feet long, and the last seen of Bennett was when he started in on his errand of mercy. At the face of the drift six miners were at work, whose names are as follows: P. Denney, Malachi Curran, T. McDonald, John Black, John Mulligan and Morris Conners. This drift was run with a raise of about one foot in each hundred, therefore, at the face it would be 14 feet higher than the floor of the station at the shaft. This circumstance gave some hope of being able to save the seven men who were imprisoned. Every possible effort was made to keep the pump going at best speed, but there were over 2,500 feet of drifts in the level to be emptied. It was found that the men were tapping on the compressed air pipe as a signal of their existence. A boat for navigating the drift was made, but it was too high. Another boat made of canvas and used for gunning purposes was lowered into the mine. All the time the bailing tanks and pumps were kept at work all day Thursday and Friday. During this time the excitement was, of course, intense. Two men, George Gornest and Anthony Smith tried to penetrate the drift, but had to return. At 4 o'clock on Friday morning the water was so far lowered that it was thought the boats could venture in. William Bennett, a nephew of Richard Bennett, the shift boss, and Denis Callahan took the canvas hunting boat belonging to Fred. Ritter, the gunsmith, and the flat wooden boat constructed at the mine, and ventured into the drift. They had placed in the boats ice, water and some refreshments, and hoped to be able to force their way into the end of the drift. They pulled out into the drift and that was the last seen of them alive. It appears that they started off without the knowledge of Superintendent Boyle or John Husking the foreman, who had not intended that the venture should be made at that time. It would seem that the two men were very anxious to reach their friends, and supposed the air was no worse at any point ahead than near the mouth of the drift. Both these men died. We condense from the Virginia *Enterprise* an account of the incidents: "In the afternoon, about 3 o'clock, when the water in the mouth of the drift had been reduced to about three feet, John Van Dusen entered the drift. He had on him an apparatus invented and constructed by Andrew Peasley, of this city. This armor consisted of a mask for the face from which there was a rubber breathing tube passing into a tin box strapped on the man's back, which box was filled with fragments of ice and perforated with holes to allow of air passing in through the pounded ice. Wearing this armor, Van Dusen struck boldly into the drift. He was gone about half an hour, when those at the station heard a call for help. Men went in the diretion of the cry, and, when out about 100 feet from the shaft, found Van Dusen in an exhausted and fainting condition. As soon as Van Dusen was able to converse he said that he had found the seven men originally imprisoned in the drift alive and all right. He said they were in the cooling-off house, about 100 feet from the face of the drift. With picks or bars they had broken the pipe carrying compressed air and had then so bent it as to carry the end into the cooling-house. In this house, when they were first imprisoned, they had nearly a barrel of ice water. When this was exhausted they poured into the barrel hot water from the drift. Then they twisted the end of the compressed air pipe down into the water in the barrel, and allowed it to exhaust there. This rendered the water quite cool and drinkable. They had a light in the cooling-house, but nothing to eat. The great heat rendered them weak and feverish. Mr. Van Dusen told the men he would inform their friends that they were all right, and assured them that they and a host of brave men were outside doing all that could be done by human beings for their rescue. As his ice was fast melting away, Mr. Van Dusen could not remain long with the men, besides he was anxious to get out and give notice of their being alive and of their situation. It was owing to the consumption of the ice in the box at his back that Mr. Van Dusen came near losing his life. There being but a few lumps rolling about, much hot and foul air entered his armor, whereas had there been the proper quantity all the air entering the mask must first have been cooled and purified by coming in contact with the fragments among which it passed.

That evening, about seven o'clock, six men entered the drift and, at the risk of their lives, pushed their way through to the cooling-house. They carried with them some milk punch and some ice. They found the men about as described; indeed, the six men were in a worse state when they reached the cooling station than were those they found in it. However, they recovered on reaching the fresh air sent in by the compressor. The men in the cooling station tried to persuade the new arrivals to remain and take their chances with them instead of venturing back. This, however, they dared not do, as it would have left their friends on the outside in doubt as to their fate, and would have caused great uneasiness. Though the six men had seen the bodies of Bennett and Callahan, while on their way in, they thought it best to say nothing about their having lost their lives. Work was then pushed on with great vigor on the air pipe, and at length a current from the blower was sent through its whole length. This gradually forced out the belt of foul air. The men about the mine became so exhausted by about nine o'clock last night, that they sent up from the mine to superintendent McKenzie, of the Sierra Nevada, to send down a fresh force from his mine. Meantime the air had so far improved that the imprisoned men could be visited. By the advice of the physicians they were given stimulants and refreshments, and kept in the cooling house to get some strength before an attempt was made to bring them out. The men told the visitors that they had at no time been much alarmed for their ultimate safety. They said that before the accident happened they had frequently talked about what they would do in case of the bulkhead giving way, and had concluded it would be best to remain in the upper end of the drift and wait for the water to be pumped out. When the men were all safely out of the drift, the Alta whistle began a prolonged scream, and this was taken up all along the lode. It was kept up for about five minutes, just as in case of fire in the early days, and for a time the whole country was made to howl. The only drawback to the general joy was the sad fate of the two brave men, William Bennett and Denis Callahan. It is saddest of all, to find how unnecessary was the noble attempt and the willing sacrifice they made. It is said that the scenes that occurred at the shaft when the men were brought up and restored to their wives, children, relatives and friends were such as no pen could describe. Among all the spectators present there was the wildest excitement. In this city, when the whistles sounded the signal that the men were at last saved, after their imprisonment of some seventy hours, people rushed out into the streets and shook hands right and left, and were so full of joy that they could hardly speak.

DEEP WORKINGS.

A ROYAL Parliamentary Commission of Great Britain recently made extended inquiry as to the possible depth at which coal can be worked, and the evidence thus collected bearing upon this important subject, is in substance as follows: The possible depth from which coal can be worked, does not appear to be limited to any consideration of a mechanical nature. The cost of the steam power required for hoisting coal from an unusual depth, will not be sufficiently large to be regarded as an obstacle to deep working, and the expense per yard of sinking does not greatly increase with increase of depth. The introduction of steel wire ropes, tapering downwards, renders it practicable to draw coal from extreme depth without overstraining the rope by its own weight, and it is also quite practicable to draw in successive stages by engines placed in the shaft. As regards pumping, it seems to be an established fact, so far at least as experience has yet gone, that water is seldom if ever met with in large quantities at great depths in British coal fields. As a rule, deep mines appear to be not more liable to inflammable gas than shallow mines, so that no impediment to deep working is to be apprehended in regard to increased liability to explosion.

The increase of temperature which accompanies increase of depth is the only cause which it is necessary to consider as limiting the depth at which it may be practicable to work coal. In this country the temperature of the earth is constant at a depth of about fifty feet, and at that depth the temperature is 50° Fahr. The rate of increase of the temperature of the strata in the coal districts of England is, in general, about 1° Fahr. for every sixty feet of depth. In some instances the increase is very irregular, being probably affected by local conditions, such as percolation of warm or cold water, and varying conductive power of the rocks penetrated. These cases, however, are exceptional, and throw no doubt upon the general conclusion that the rate of increase amounts, as a rule, to about 1° Fahr. to every sixty feet. As the present inquiry applies only to English coal-fields, it is immaterial to inquire whether the same rule holds good for other places. It may, however, be observed in passing, that whenever Artesian wells have been sunk in this or other countries, the rate of increase is in close harmony with that observed in English coal mines; but, on the other hand, by observations made in Belgian coal mines, the rate of increase appears to be less than in English colliers, though it is quite possible that this apparent difference may have arisen from the thermometer having been applied in a manner which would not correctly indicate the temperature of the strata. In the metalliferous mines of Cornwall, the deviations from the scale of 1° Fahr. for every sixty feet are very great, but it is probable that the disturbing causes of variable conduction and percolation of heated water exists to a much greater extent in the geological formations containing metalliferous veins than in the sedimentary rocks embracing the coal measures. The deepest colliery in England is at Rosebridge near Wigan, where the shaft has already attained a depth of two thousand three hundred and seventy six feet, and is still being sunk to a greater depth. The temperatures of the rock, as observed in this shaft, are in general agreement with the ordinary rate of increase to a depth of one thousand eight hundred feet. After that the increase becomes considerably more rapid, but it would be rash to conclude from this single example that the increase would in all cases be accelerated when that depth was exceeded. At the lowest point of this shaft the temperature of the earth, as indicated by a thermometer placed in a bore hole a yard in depth, is 92° Fahr.

According to the evidence of Mr. Elliott, and his assistant, Mr. Wilmer, the temperature of the strata in horizontal coal workings accords with the rise and fall of the surface above; but there is reason to believe that this rule will only apply to gradual variations of surface, and not to abrupt prominences in the nature of peaks, since in the Mont Cenis tunnel the temperature of the rock is very much less than would be due to the depth measured from the top of the mountain. It may, however, be assumed, that under the ordinary configuration of the surface in British coal-fields the increase of temperature will have reference to the depth from the surface of the ground, and not from the level of the sea. High temperature of the strata operates as an impediment to deep working by heating the air circulating through the passages of the mine. When cool air enters a heated mine, it absorbs heat from the surfaces of the passages through which it flows, and the rate of this absorption somewhat exceeds the ratio of the difference between the temperature of the air and that of the surrounding surface with which it is in contact. By the absorption which thus takes place the air is heated, and this heating process is most rapid at first when the difference of temperature is greatest, and gradually diminishes as the length of the passage is extended, never ceasing until complete assimilation of temperature is effected. The progress towards assimilation of temperature is much more rapid when the air comes in contact with the working face of the coal, which from being newly exposed is more highly heated than the surfaces of the permanent air courses. The rapidity, however, with which the air takes up heat from the working face depends, in a great degree, upon the system of working. In the cellular system, called "Pillar and Stall," the air seems to acquire almost immediately the full temperature of the coal, but under the "Long Wall" system there are instances of the air retaining a considerable inferiority of temperature after sweeping past the working face. The great outlay of capital involved in sinking pits to coal lying at extreme depths would render it necessary to work a large area of coal from each sinking, and this would involve air courses of great length. It thus becomes necessary to consider the question of ventilation under the double aspect of great depth from the surface, and great length of air passages.

At present, the ventilation of coal mines is almost always effected by means of a furnace applied at the foot of an upcast shaft, in which an ascending current is produced by rarefaction, as in an ordinary chimney. Ventilating fans and other mechanical contrivances propelled by steam engines have of late been partially introduced, and are found to be advantageous in reducing the consumption of fuel necessary to circulate a given volume of air. This superiority, however, will diminish as the depth of mines is increased, because the deeper the mine the more powerful is the suction in the upcast shaft. But whatever method be used for producing the current, it would require an extravagant increase of power to accelerate the velocity of the air in any considerable degree, because the resistance of the air increases in ratio somewhat exceeding that of the cube of the velocity. Thus if the volume of air were doubled by doubling the velocity of the current, more than eight times the present power would be needed. The longer air courses incident to deep mining also involve an extension of frictional surface, and this would further add to the difficulty of increasing the ventilation by acceleration of current. In short, the only way in which the volume of air would be very materially increased would be by enlarging the sectional area of the shafts and air courses.

The more general introduction of coal-cutting machines, worked by compressed air conveyed into the mine by pipes, would have some effect in lowering temperature, and would at the same time supersede the labor of hewing, which, from its arduous nature, is that form of labor against which high temperature chiefly militates. Mr. Lindsay Wood states in his evidence that the air discharged from the pneumatic coal-cutting machine is reduced by expansion in the act of escaping to a temperature of 7° Fahr. below freezing, and that the air from one machine is sufficient to lower the temperature of the whole body of air flowing past a working face by 1° Fahr. He thinks that as many as seven of these machines might be employed at one working face; but it does not follow that the collective action of these seven machines would reduce the temperature sevenfold, because the principle of accelerated absorption by reduction of temperature again intervenes, and would in a great measure defeat the cooling action of the machines. Moreover, if jointly with the use of these machines, reduction of temperature were to be attempted by increasing the volume of air in circulation, the diluting effect of the cold air from the machines would be reduced in proportion as the volume of circulating air was increased. It remains to be considered whether it be practicable to reduce the temperature of the air by surrounding the air courses with an intercepting air space, or with a layer of non-conducting material. Upon this point it may be observed that the air courses in a mine are already naturally encased in a partially cooled envelope of imperfectly conducting material. The coal itself is a very imperfect conductor, and every suggestion for jacketing the air courses, either with a surrounding air space or with solid material, must be regarded as an expedient for giving further effect to a retarding action already in operation. It is doubtful whether any increase of retardation could by these means be effected at all commensurate with the cost and difficulty attending their adoption. The evidence of Mr. Elliott, and of most of the other witnesses, is adverse to the feasibility of thus stemming back the heat, and it appears that no such method has yet been put in practice. The question of the maximum temperature of air which is compatible with the healthful exercise of human labor is one of the most difficult questions which the committee have had to investigate. Evidence has been given of extraordinary temperatures endured in the stoke holes of steamers, and in the places where glass blowers work. In some of these cases labor has been carried on without serious detriment to health where the thermometer has indicated 180° Fahr. In these instances, however, the thermometer is chiefly acted upon by radiant heat, and therefore does not truly indicate the actual temperature of the air. In an experiment made at Elswick by Sir W. Armstrong, it was found that a thermometer suspended in a stoke hole at a distance of four feet from the front plates of the boilers indicated a temperature of 105° Fahr., while another thermometer, at a distance of only three inches from the former, but carefully screened from the radiant heat, stood at 78° It is important, also, to observe that the men who work in stoke holes and glass houses have ready access to the external air, and avail themselves of numerous intervals in their labor to cool themselves. One of the medical witnesses, who had spent a great part of his life in tropical climates, states that he had experienced a temperature of one hundred and twenty-five degrees Fahrenheit in the shade, and that this great heat was rendered quite endurable by the dryness of the atmosphere; on the other hand, he had felt a damp atmosphere almost intolerable at the comparatively low temperature of eighty-six degrees. The committee had information of mining work being executed in a Cornish mine, where the air was heated by a hot spring to a temperature which was said to amount to one hundred and seventeen degrees, and was also by the same cause saturated with moisture. They therefore, deputed Doctor John Burdon Sanderson to visit this mine, and investigate the facts of the case. He found the highest temperature to exist at the extremity of an excavation, forming a sort of cul de sac, where a stream of water entered at a temperature of a hundred and fourteen and one-half degrees. At the distance of one yard from the end of this cul de sac, the thermometer indicated a temperature of a hundred and three degrees, but at a distance of only ten feet there was access to air, where the thermometer stood at eighty-one degrees. According to other evidence the temperature of the air occasionally reached one hundred and twenty-three degrees. The miners remained in the workings six hours out of the twenty-four. Four men were employed at a time, of whom two were always at rest in the cool air, and the other two were *not* always at work; the time occupied in resting being considerably more than that occupied in working. Thus the total duration of each man's work was less than three hours in the twenty-four. No miner remained more than fifteen minutes in the heat at one time. Doctor Sanderson described the condition of each miner on retreating into the cool air to be one of complete exhaustion, but by allowing cool water to pour over his body the distress and exhaustion quickly passed off: and he concluded that the occupation in question was not necessarily inconsistent with the enjoyment of vigorous health; but he found that there were many men who, after trying to work, were compelled to desist on account of the distress and exhaustion which were produced. In Doctor Sanderson's opinion, the immunity from injury to health, which most men employed in these hot workings appear to enjoy, is attributable to the shortness of the period during which they are exposed to the high temperature, and to the readiness with which they can escape to a well ventilated cooling place the moment they are incapacitated for further exertion by disorder of the circulation and increase of the temperature of the body.

Doctor Sanderson also states it to be his decided opinion that labor is not practicable in moist air of a temperature equal to that of the blood, namely ninety-eight degrees, excepting for very short intervals; and this conclusion is in harmony with the other medical evidence. The evidence having shown that the question of the maximum temperature under which work could be carried on in a coal mine hinges in a great measure on the hygrometric condition of the air, the Committee proceeded to inquire what was the state of the air in regard to moisture in coal mines. The observations which they collected on this point show that the air at the working faces of the coal was always humid, and often saturated with moisture. In general, however, the deepest collieries appear to be the dryest, although there does not appear to be any ratio between depth and dryness. The depth at which the temperature of the earth would amount to blood heat, or ninety-eight degrees, is about three thousand feet. Under the long-wall system of working, a difference of about seven degrees appears to exist between the temperature of the air and that of the strata at the working faces; and this difference represents a further depth of four hundred and twenty feet; so that the depth at which the temperature of the air would, under present conditions, become equal to the heat of the blood, would be about three thousand four hundred and twenty feet. Beyond this point the considerations affecting increase of depth and temperature become so speculative, that the Committee felt it necessary to leave the question in uncertainty: but, looking to possible expedients which the future may elicit for reducing the temperature, they considered it might fairly be assumed that a depth of at least four thousand feet might be reached.

The Temperature of the Soil.—The temperature of the ground surface is almost entirely dependent on the heat of the sun, and is therefore always greater in the daytime than at night. Considering all the circumstances which affect the temperature of the ground, there must be included the kind of exposure of the surface, the nature of the soil, the permeability of the ground by rain and the presence of underground springs, the sun's declination, the elevation above the sea, and the amount of cloud and sunshine. The temperature of the soil is observed at the Royal Botanic Gardens, London, three times daily, at depths of 3 inches, 6 inches, 12 inches, 24 inches and 48 inches. The underground thermometers used are considered better than any previously made. A series of observations made with unfailing regularity, extending over six years, have been discussed by G. J. Symons, F.R.S., with some interesting results. The mean temperature of the air at 4 feet above soil, and that of the surface of the lake, which covers more than an acre of ground have also been deduced for the same period. The lowest mean monthly temperature under the various relations to the surface of the earth are:

	At 9 a m.	*At 3 p.m.*	*At 9 p.m.*
	Deg.	*Deg.*	*Deg.*
Air at 4 feet	38.9	42.1	40 0
Surface of lake	39 7	40.7	40.2
3 in. below grass	37.3	39.1	37.9
6 in. below grass	38.1	39.0	38.8
12 in. below grass	38.1	38.3	38.3
24 in. below grass	39.5	39.4	39.4
48 in. below grass	41.6	41.6	41.6

For the highest mean monthly temperatures we have the following results:

	At 9 a.m.	*At 3 p.m.*	*At 9 p.m.*
	Deg.	*Deg.*	*Deg.*
Air at 4 feet above the soil	64.8	71.3	62.0
Surface of lake	66.3	70.1	68.4
3 in. below grass	64.9	75.0	67.2
6 in. below grass	63.4	70.4	68.3
12 in. below grass	63.6	64.8	65.9
24 in. below grass	62.1	62.0	61.9
48 in. below grass	60.5	60.5	60.5

These maxima temperatures occur in July, except those at 2 ft. and 4 ft. which fall in August. At this the hottest portion of the year the temperature of the air is on the whole slightly below that of the water, but it has a greater diurnal range. The temperature of the soil is greater than that of the air only at the surface; it decreases with the depth, and at 2 feet the diurnal range ceases. The results of the earth temperature observations made at the Royal Observatory during the years 1847 and 1873 are given in the "Greenwich Meteorological Reductions." Referred to noon as the time observation the lowest mean monthly temperature of the series are for the

Air	38.4°	in January.
At 1 inch below soil	40.9°	in January.
At 38.4 inches below soil	41.7°	in February.
At 76.8 inches below soil	44.8°	in March.
At 153.6 inches below soil	46.4°	in April.
At 307.2 inches below soil	48.9°	in June.

Similarly the highest mean monthly temperatures are:

In air	62.5°	in July.
At 1 inch below soil	65.4°	in July.
At 38.4 inches below soil	62.5°	in August.
At 76.8 inches below soil	59.6°	in August.
At 153.6 inches below soil	55.8°	in September.
At 307.2 inches below soil	52.2°	in November.

It thus appears that whereas the coldest temperature of the air is in January, the wave of cold (if it may be so called) travels slowly downward and does not reach 25 feet until June, and that whereas the hottest temperature of the air is in July, the wave of heat travels slowly downward, and does not reach 25 feet until November. At that depth the temperature decreases until June, then increases until November, whereas the thermometer bulb, covered by only 1 inch of soil, reaches its lowest and highest limits about the same time as the thermometer in air, shaded, and 4 feet above the ground. The retardation of cooling and of heating is greater the deeper the soil, though the yearly range decreases as the depth increases, down to the stratum of invariable temperature. The non-periodic fluctuations of cold and of heat which affect the air are not felt beneath the surface of the ground. Recent advices bring information concerning the temperature of the mines in the Ashton District, England. In Ashton Moss Colliery the temperature was observed at the depth of 930 yards, and was found to be 85.3°, the thermometer being inserted in a hole 2 inches in diameter and 3½ feet deep, drilled for the purpose in hard blue shale. A slow action thermometer was inserted after ten or fifteen minutes, and was allowed to remain for six hours. Assuming 49° as the surface temperature, it will be observed that we have here an increase of 36.3° for 2790 feet which is at the rate of 1° in 76.9 feet. In reference to an apprehension which was expressed that the heat of drilling did not have sufficient time to escape, it is stated that on several occasions further observations were made in the same hole, and similar results were obtained. Experiments were also conducted at Bredbury Colliery, Cheshire County, at a depth of 1020 feet, and the temperature observed was 62°. Assuming (as above) 49° as the surface temperature, we have here an increase of 13° in 1020 feet, which is at the rate of 1° in 78.5 feet. The distance from Ashton Moss Colliery is three or four miles, and the two shafts are sunk through the same coal measures, one being near the outcrop. Making no assumption as to the surface temperature, but comparing the two observations with each other, we have an increase of 23.3° in 1770 feet, which is at the rate of 1° in 76.0 feet. The consistency of these results is eminently satisfactory. Experiments at Nook Pit, belonging to the Broadoak Colliery Company, at a depth of 1050 feet, gave a temperature of 62½° F., showing an increase of 13½°, or 1° for 79 feet. The great quantity of water which is found in some parts of the rock overlying the coal measures is, perhaps, an important factor in the rate of temperatures, which, as shown by the observations, is remarkably slow.

The Physical Limits of Deep Mining.—The *Iron Age* condenses from his English exchauges the following on this subject:

"Much thought and time has been spent on the subject of the probable duration of coal fields, and various papers relating particularly to the coal fields of Great Britain have been read before the British Association. The great point, as a matter of course, is the depth at which the mines can be safely worked, this depth having been limited by the Royal Commission of 1876 to 4000 feet. It is admitted on all hands that the crust of the earth increases in temperature as we descend from the surface, and with respect to the heated walls of the rock in mines and the ventilating current the Commission remarks that when cool air enters a heated mine it absorbs heat from the surface of the passages through which it flows, and the rate of this absorption somewhat exceeds the ratio of the difference between the temperature of the air and that of the surrounding surface with which it is in contact. It is evident, therefore, that when this absorption takes place the air is heated, the process being most rapid at first, when the difference of temperature is greatest, and gradually diminishes as the length of the passage is extended, never ending until complete assimilation of the temperature is effected. But the progress toward assimilation is most when the air comes in contact with the working face, which, from being newly exposed, is more highly heated than the surface of the permanent air courses. In coal mines the rapidity with which the air takes up the heat depends in a great degree on the system of working. In the "pillar and stall" system the air appears to acquire almost immediately the full temperature of the coal, but under the long wall system there are instances of the air retaining a considerable inferiority of temperature after sweeping past the working face. Under the long-wall system of working a difference of 7 degrees appears to exist between the temperature of the air and that of the working face, which represents a greater depth which could be sunk.

But we are told that there is an element which has not been taken into consideration which raises the temperature in deep mines, that is the increased density of the air, the effect of which is greatest when the air is stagnant, but when there is a rapid circulation of the air current it will be only small. The observations made some years since in Cornwall, as well as at the Dukinfield and Rose Bridge collieries, differing as they do considerably, have been looked upon as sufficiently reliable, but different results appear to have been obtained during the present year. In Cornwall, Mr. Fox arrived at the conclusion that the increase of temperature progresses in a diminishing ratio, so that if such were correct it would go to prove, as we approach the source of heat, the heat itself decreased. At the Tresavean Mine the mean temperature at a depth of 1740 feet was 87·9 degrees. The series of observations made at Dukinfield gives an increase of 1 degree for every 80 feet, which is a less rapid increase than that shown as the result of the observations made at other places. At the Rose Bridge Colliery, Wigan, the deepest now in actual work, but not the deepest shaft, although 815 yards deep, there was an increase of 1 degree for every 54·3 feet. The difference has been accounted for, at least to some extent, as owing to the difference in the strata of the two places. At Rose Bridge, the beds are nearly horizontal, and at Dukinfield they are inclined at an angle varying from 30 to 35 degrees, rising and cropping out to the eastward, and strata, such as alternating sandstones, shales, clays, &c., with different conducting powers, offer more resistance to the transmission of heat in a direction across than parallel to their planes of bedding, so that every sudden change of material is equal to an increase of resistance, but deep-seated horizontal strata, like that at Rose Bridge, offer a succession of resisting surfaces to the upward passage of internal heat.

Some of the more recent observations, however, are worthy of every consideration, such as those brought forward at York by Professor Everitt. The observations had been made at three places—at the East Manchester coal field, the Talargoch Lead Mines, Flintshire, North Wales, and at the Radstock Collieries, in the neighborhood of Bath. The Manchester observations were made in three pits of great depth, and the results were as follows: Depth 2790 feet, temperature 85.3 degrees; depth 1020, temperature 62 degrees; depth 1050 temperature, 62½ degrees. Taking the surface temperature to be 49 degrees, the increases were 36.3 degrees in 2790 feet, or 1 degree in 76.9 feet; 13 degrees in 1020 feet, or 1 degree in 75.8 feet; and 13½ degrees in 1050 feet, or 1 degree in 79 feet. In Flintshire, with a surface temperature of 48 degrees, an increase of 14 degrees was shown at 660 feet, or 1 degree in 47 feet; while the three pit observations made in the neighborhood of Bath, brought out the following results: At the depth of 560 feet an increase of 11.7 feet, or 1 degree in 48 feet; 810 feet 13 degrees, or 1¼ degrees in 62 feet; and 1000 feet 13 degrees or 1 degree in 77 feet. From the figures given it will be seen that the observations made at different places vary a great deal, and the cause of this opens out a wide field for the consideration of those who have studied the probable limit to which mining operations can be carried on, and the depth to which it will be safe to sink shafts.

Deep Coal Mining in Wales.—Regarding the great depths from which coal is now won in South Wales, some interesting particulars on the subject of deep mining, in connection with the Harris Navigation pits, situated near Quaker's Yard, Glamorganshire, the deepest in the district, have recently appeared, in a report by Messrs. Thomas Forster Brown and George Frederick Adams, members of the Institution of Civil Engineers, who are professionally connected with the operations.

"The depth of the lowest seam at present sunk to was 760 yards; the pits were each 17 feet in diameter inside the walling. In addition to the depth, a special feature was the thickness of hard and heavily-watered rock penetrated. Guide-ropes, upon the following principle, were used in sinking, and the value of this system was shown in the saving of over two minutes in steadying the bowk at the bottom of the pit; at depths of 475 and 530 yards, the total time occupied in clearance at the latter depth being three minutes and twenty-six seconds. The method of dealing with the various feeders of water during sinking was described: One of the pits was drained by a hole bored by the diamond machine, which was put down, at a depth of 175 yards from the surface, for a farther depth of 860 feet. Where the strata were conformable, and cut up by faults which intersected all the measures, considerable objection existed to metal tubbing, even for comparatively shallow depths; for the water could rarely be prevented from forcing its way through fissures into the underlying strata. Moreover, provision had to be made for the probable working of the Brithdir seam, a very watery measure, lying at a depth of 250 yards. On account of these and other circumstances, it was ultimately decided to provide for the permanent pumping of all the feeders, and a powerful 100-inch Cornish pumping-engine was erected. The parallel motion for the main pump-rods was obtained by a gudgeon, attached to the top rods, carrying two slide-blocks, which worked in cast-iron guides 13 feet long and 27 inches wide. This gudgeon was attached to the beam by two hammered iron radius-rods, 43 feet long 10 inches wide, and tapering from three inches thick at the top and bottom to 1½ inches at the middle. The space between the rods was filled with pitch-pine 12 inches thick at the top and bottom and 18 inches wide in the middle. Five lifts, three of which were 26 inches in diameter, and the others 22 inches and 21½ inches, were worked by the Cornish engine. The total feeders amounted to 440 gallons, of which 298 were pumped from a depth of 467 yards. The rods were double, of pitch-pine, 16 inches square. To economize space in the pit, the lifts were fixed in one perpendicular line; to effect this, the rods directly above the plunger and the rods below were connected by side-rods and distance-pieces; the horizontal connecting pipe of the H-piece being cast semi-circular, to allow the rods to pass down in a straight line. The total weight of rods, etc., amounted to 181½ tons, that of the water being 133 tons; 35 tons of the difference were counterbalanced by a balance-beam in the pit, leaving 13½ tons to overcome friction.

"A large diamond boring-machine was used for a portion of the sinking. The apparatus weighed ten tons, and consisted of four beams or transoms fixed to a center piece. On the transoms were placed the drills—ten in number—which could be moved to any part of, or inclined to any angle parallel with, the face of the transoms, and each drill could be started or stopped singly. In making the first trials, from thirty to forty short holes at varying angles, and from three feet to five feet in depth, were bored, the operation requiring from twelve to fourteen hours. Nearly one half of this time was occupied in jacking the machine for the various positions required to bore the sumping-holes, bench-holes to sump, and finally the cropping-holes. Long holes from 15 to 20 feet in depth were subsequently tried, and blasted in sections; but having to be bored vertically, so as not to pass out of the line of the shaft, they had not always the most effectual lifting power. Better progress was made with single drills; but the cost of diamonds became too great for the frequent holes and changes, and the contracting company completed its contract by means of a percussive drill, designed by Colonel Beaumont. 'Ingersoll' drills were afterward used. These had a diameter of 3¼ inches, and a stroke of 4½ inches, and gave excellent results, the only difficulty experienced being in the wear and tear of the tappets, which, when they broke, generally caused damage in the cylinder.

"In hard and wet rock, dynamite was found to be a much more effective explosive than gunpowder, requiring about half the number of holes, and saving tamping. In shale, without water, powder was more effective, dynamite being more rapid in its action. In sinking through three yards of dry Pennant rock, the cost of powder and dynamite was, respectively, £12 1s. 3d., £10 1s. 8d.

"Under the circumstances which attended the sinking in hard and wet rocks, three yards were considered good progress by hand, and four and a half yards by machine, per week; but the authors were of the opinion that this rate ought to be improved upon with further experience. They had also arrived at the conclusion that the cost of sinking by machine was less than by hand labor. The average rate of sinking, including walling, but exclusive of stoppages, was 3.77 yards per week, there being nearly an equal percentage of hard rock and shale. The actual sinking occupied about one-half of the total time, and walling 12 per cent. The south pit which was the deeper of the two, was begun in February, 1873, and finished in February, 1879."

Messrs. Brown and Adams, in referring to the question of ventilation, allude to a furnace as being probably the most effective means at great depths; but on leaving this question for future consideration, they had meantime erected a Schiele fan fourteen feet three inches in diameter, and capable of producing a current of about 250,000 cubic feet per minute. This had been done after a series of experiments in various districts. They further urge objections to the positive type ventilators, namely, that in the event of obstructions occurring in the air-ways, undue pressure might be applied to separation-doors, air-crossings, etc., besides which they caused a vibratory motion, were costly to erect, and the working parts were in some cases liable to get out of repair. Of the closed fans, which it was stated gave slightly better results than open fans, the Guibal and Schiele were the best. The winding engine in course of construction is designed to raise 2000 tons of coal in ten hours of constant drawing; the weight, exclusive of the rope, being 10½ tons, and the velocity of the ascending cage from 40 to 45 feet per second. The scroll-drum, with a smaller diameter of 18 feet, rising by fourteen coils to 32 feet, was considered the best method of counterbalancing the rope. The cylinders were 4 feet 6 inches in diameter, with seven-foot stroke; they were inverted and placed on cast-iron supports, the drum being fixed below on masonry pillars. The valves were double beat; and for the steam valves, Barclay's simple trip expansion gear was used. The rope was a parallel flat rope of the best selected steel, and consisted of 114 No. 11 gauge wires. The calculated breaking strain was 104 tons, and the factor of safety was nine. The pit-frame is described as constructed entirely of wrought-iron; arrangements being also introduced for loading and unloading a single-decked cage by gravitation of tubs. The empty trains were hoisted about six feet, and made to run down an inclined way to the cage, being stopped and relieved by a system of catches, the cage being so arranged that on landing on the slips the bottom was inclined. In the above deep mining, at the Harris Navigation pits, the deepest in the district, the shaft-pillar is described as having an area of 400 yards square.

THE VENTILATION AND LIGHTING OF UNDERGROUND WORKINGS.

NATURE of Air.—No miner can be too much impressed with a sense of the great importance of good ventilation. The air we breathe consists mainly of two gases called by chemists "oxygen" and "nitrogen." These are mingled together in the proportion of about one part oxygen to four parts nitrogen. It is the oxygen which is really necessary for the support of life, while the office of the nitrogen is to dilute it and to increase its volume. The air being taken into the lungs in the act of breathing, the oxygen combines with some spent carbon from the blood, and is thereby converted into "carbonic acid," or, as it is sometimes called, "carbonic anhydride." Carbonic acid is injurious when breathed, even if it is mixed with a large volume of pure air, and it should therefore be removed as fast as it is formed. When men work in the open air the carbonic acid formed is speedily dispersed, and as the supply of pure air is abundant no ill effect follows. But it is otherwise in rooms, and especially in mines; here the air soon becomes quite unfit for use if it be not constantly renewed, hence the necessity for ventilation. The impurities imparted to the air by breathing are much increased in mines by the constant use of candles or lamps, rendered necessary by the absence of daylight, and by the explosion of powder or other agents used for blasting. In some iron mines carbonic acid is given off in large quantities by the ore as it is broken, and in many metal mines, where iron pyrites is abundant, the air is speedily deprived of its oxygen and rendered unfit for use, and incapable of sustaining life by the oxidation of the pyrites which is continually going on. In coal mines inflammable gases called "fire-damp" are often given off in great abundance, but such gases are very seldom met with in metal mining, except in coal districts. The miner has always a good test at hand for the fitness of the air he is breathing. If his candle burns brightly and well the air is fit to breathe, but if he has great difficulty in keeping it alight when the air is still, or if the flame becomes larger and of a pale blue color, and flickers greatly or goes out, the air which does not properly support combustion will not support life, and some artificial means of ventilation becomes necessary, or the miner's health will give way. This test is much more reliable than the common mode of judging by the rapidity of the current at any given point, as it may be applied in the working "ends" or "faces" themselves where the air is often stagnant, notwithstanding that there is a good current in some of the drifts.

Ventilation may be either natural or artificial. In coal mines it is almost always artificial, in metal mines it is in a majority of instances natural. Sometimes, however, the naturally produced current of air is improved and guided by air stoppings, doors, or other means as may be found necessary, and in some few instances an entirely artificial mode has to be adopted, especially while sinking shafts or driving long levels. Unless the shaft be very deep, a simple division of thin wood or painted canvas, dividing the shaft from top to bottom into two, will often be found sufficient. The men working in the shaft on one side of the parting will raise the temperature somewhat, when it will be converted into an upcast, while the cool air will descend on the other side or downcast to supply its place.

Air Sollars.—A natural current may often be produced in a long level by means of an "air sollar." To form an air sollar the floor of the level carrying the tram road is laid about 6 inches above the actual bottom of the level, and is supported by cross-sleepers resting upon blocks of wood or stones, or the floor in the centre of the level may be excavated somewhat deeper than the sides. Planks are laid over the sleepers just mentioned to form a kind of deck, and the whole is rendered air-tight by plastering with mud. This will divide the tunnel into two very unequal portions. Through the lower division or air sollar, a current of cool and therefore heavy air will pass into the end, and this will be farther cooled if there be water issuing from the lode at any points. The air heated by the breathing of the men, the heat of the candles, etc., will pass out through the level itself, and so a constant current will be kept up. The "level" should be kept as truly level or "dead" as possible for several reasons, two of which may be mentioned here: 1st, if there be water flowing out through the level, and the fall be considerable, the rapidity of the current of water will, to some extent check the ingoing current of air; 2nd, if the level rise rapidly, the floor of the end will soon be at a higher actual level than the "back" of the entrance, when the heated air will actually have to *descend* in order to make its escape, although the natural tendency of heated air is always to *ascend*.

Should it be necessary to to do more than divide the shaft, or air-sollar the levels, the mode known as pipe and cap head, which is similar to that which is so commonly used on board ship, may be resorted to. This is effected as follows: A pipe of thin metal or 1, wood is made of about 1 square foot area or less, to which is fitted a revolving cap-head *a*, fig. 1. The lower end of the pipe is carried down to the bottom of the shaft, and the open mouth *b* is turned towards the wind. A current of fresh air is thus forced down to the bottom of the shaft where the men are at work, and thus displaces the foul air, forcing it up the shaft. In Cornwall, for temporary purposes, the writer has seen a zinc rain-water pipe so arranged with a miner's jacket extending by wires at the top for a "cap-head" or "sail." A similar arrangement may be adopted for ventilating a level, the pipe being carried into the end, but sharp angles in the pipe should be avoided as much as possible. It is plain, however, that this mode of ventilation can only be adopted when the wind is blowing, but in time of calm, underground ventilation is most of all wanted. To meet this difficulty a small fan may be placed in the upper end of the pipe, worked by hand, a water-wheel, or a steam engine, and arranged either to force pure air into the workings, or still better, to draw the impure air out, leaving the pure air to find its way down the shaft. In many cases a jet of high pressure steam from a boiler may be discharged into the upper end of this pipe, when an outward current will be at once set up.

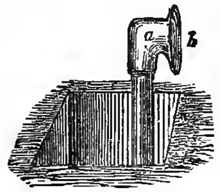


FIG. 1.

In many cases a jet of high pressure steam from a boiler may be discharged into the upper end of the pipe, when an outward current will be at once set up.

The Water Trompe.—Where there is a supply of water at surface, and an adit level to carry away the waste, the water "trunk," or "trompe," may be used for ventilation with much advantage. If there be no adit, and the spent water would have to be pumped up again after its use, it may be better to apply the power directly to produce a current of air by means of a fan or air pump, unless there be a surplus of pumping power. Figs. 2, 3 show two forms of the water trompe. In fig. 2 the water from the launder *a* falls upon the series of iron bars *b*, and down the pipe *c* into the cistern *d*. The stream of water being broken by the bars, a quantity of air is entangled and carried down with it, and this escapes at the trunk or exit pipe *e*. The water overflows the cistern *d* and is pumped up again, or passes away by an adit level. In fig. 2, the water enters the hopper by

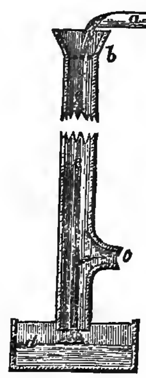


FIG. 2.

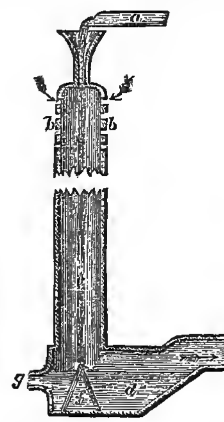


FIG. 3.

the launder *a*, passes down the pipe *c*, and falls upon the dash-block *f*, placed in the cistern *d*, the overflow of which is at *g*. Air is drawn into the pipe *c* through the holes *b*, and makes its exit as before at *e*. By lengthening the exit pipe so as to reach into the "end" of a level, these modes may be made available for ventilating very long drifts. In all cases the exit pipe should be large, as it is quantity rather than a rapid current which is wanted, and sharp angles should be avoided as much as possible, since the air current receives a serious check at every sudden change of direction.

Natural Ventilation.—In working lodes to a moderate depth, the difference of level of the "braces" of the different shafts, due to the irregularities of the surface, is often sufficient to determine the direction of the current of air, and to produce a good natural ventilation, although it is sometimes necessary to use air partings or stop doors to aid this. Thus, if in a mine, situated as in fig. 4, there be two shafts,

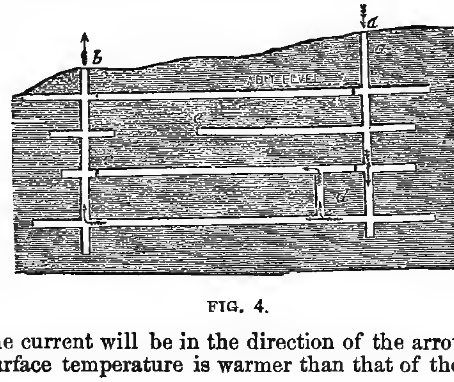


FIG. 4.

a b, the current will be in the direction of the arrows when the surface temperature is warmer than that of the bottom of the mine, and it will be reversed when the surface temperature is lower. Whenever the surface temperature is the same as that of the bottom of the mine, the ventilation will be likely to suffer; but this state of things will not last many hours at any one time, since the temperature of the bottom of the mine will be constant, that of the surface rapidly variable. It may be necessary to place regulating doors at *b b* and *c c*, *b b* being shut when *c c* are opened, and *vice versâ*. At *d* the current will be divided as shown. The level at *e* will be very badly ventilated unless a current of air can be sent along it by means of an air-sollar, or in some similar manner. Sometimes a chimney is built over one shaft to increase the natural inequality of level, and to assist in the determination of the current. This should be of large area, as if small, a sufficient quantity of air will not pass. In very deep mines the difference to be obtained by means of a high chimney is very slight as compared with the whole depth of the shaft, but the naturally high bottom temperature of such mines greatly assists their ventilation by means of natural currents.

Heat of Deep Mines.—The rate of increase of temperature in deep mines varies much in different localities. In some places it has been found as much as 1° F. for each 45 feet in depth, in others little more than half this rate. After about the first 10 fathoms the variations of surface temperature have no effect on that of the mine below, which, in the absence of chemical changes or of hot springs, is always almost exactly the same. One exception, however, must be noted. In deep workings, when they are first opened, the temperature is often much higher than in the same situations after several months' working. Thus, at the Clifford Amalgamated Copper Mines, in Gwennap, the air in the 220 fathom level was 100° F. in 1863; but in July, 1864, it had sunk to 83°. In the 230 fathom level then just opened the temperature at the same date, July, 1864, was 104° F. At the Duckinfield Colliery, in Durham, the temperature was found to increase from a depth of 20 feet down to 358½ fathoms, at an average rate of 1° F. for each 88 feet in depth. At the Rose Bridge Colliery, near Wigan, from a depth of 80½ fathoms to 403 fathoms, the average increase was at the rate of 1° in each 67 feet. This latter is one of the deepest mines yet worked. Perhaps the greatest depth yet attained is at *Viviers Reunis*, near Gilly, in Belgium, where the shaft itself reaches a depth of 3411 feet, or nearly 570 fathoms, and the bottom of a *trial-staple* was found by Mr. W. W. Smyth, in 1871, to be 3489 feet, or 581⅚ fathoms.

Furnaces, air pumps, or powerful steam jets are seldom required in the ventilation of metal mines, unless they are situated in coal districts, or worked in connection with coal mines. The construction and mode of working will be fully described in the elementary treatise on "Coal Mining," forming part of this theory.

Lighting of Workings.—In the metal mines of Cornwall, South Wales, and the north of England, the usual mode of lighting the mines while at work underground is by means of tallow candles. Each man carries a tallow candle in his hand while walking along the levels, using a lump of clay as a convenient holder. The same lump of clay serves to fix the candle to his hat, while he is ascending or descending the shaft, and to attach it to a rock in a convenient position when the place of work is at length reached. The candles used in Cornwall have large wicks, so that a sudden current of air may not too readily extinguish them; and there are from twelve to sixteen to the pound. In the north of England the candles used go from twenty to thirty to the pound; and formerly much thinner candles than these were used, but such very small candles are now seldom seen.

Lamps.—In some of the mines of the north of England, South Wales, and Scotland, and in Saxony and other parts of Germany, small metal lamps are used, in which colza, rape, or other oil is burnt. These lamps are made with a small hook or attachment to the miner's hat, and a spike which may be placed in a joint of the rock when the place of work is reached. The light given by such lamps is not equal to that of good candles, and this is probably the reason why they have not found favor in Cornwall; but the cost does not exceed from ¾d. to 1d. per shift or core of eight hours, which is about one-half the cost of candles. Within the last few years lamps for burning paraffin and petroleum oils underground have been devised. The author has not seen any of them; but they are well spoken of, as they give a good light at little cost. Hitherto, however, they have not been made to burn without much more smell than either oil lamps or candles.

Coal gas was first utilized in Cornwall, by Murdoch, in or about 1792, when he lit up his workshops at Redruth with gas. He had previously been in the habit of carrying a bladder full under his arm, which supplied a lighted jet in his night journey across the moors of Cornwall, to the great alarm of the country folk. Two miles at least have been lighted with gas at different periods in Cornwall, but at present no gas is used for this purpose in the county. At Tresavean Mine, early in the present century, gas was used for lighting the shafts and some of the principal workings. The latest instance, however, was at Balleswidden, about the year 1866, when gas was carried down the shaft and into the levels and pitches where the men were at work, as far as the 120 fathom level. Where four men were at work one gas jet was found to give sufficient light for all, with less smoke and unpleasant smell than candles. The cost was officially reported to be only one-third that of candles; but for some reason or other the apparatus was ultimately removed. Coal gas is extensively used for lighting mines of all kinds in the north of England. Sometimes it is made at the surface, stored in a gasometer, and sent down by means of a fan blower, steam jet, turbine, or a water trompe. A current having a force equal to a pressure of ten or twelve inches of water is found sufficient to carry the gas down to a depth of 150 to 200 fathoms, and to maintain sufficient pressure at the burners. In mines where furnaces are used for ventilation the retorts are sometimes placed over the furnace, and the gas is purified and stored underground. In the United States a kind of gas is produced for mining and other purposes by forcing common air through benzoline. This gas is slightly heavier than air, so that no difficulty is experienced in conveying it underground, as is sometimes the case with coal gas. The first cost of the apparatus is much less than that necessary for the production of coal gas, the complete arrangement for 100 lights only costing from £60 to £100. The forcing apparatus is a kind of clockwork, which is wound up each morning by one man in less than an hour, and the light is said to be quite equal to coal gas, or even superior to it. The cost for each light is about ½d. per hour. This would be too costly a light to supply to each pair of men; but not too costly for lighting of shafts and main roads, or levels, or other fixed positions, where a constant light is needed. This mode of gas lighting is now to be seen in the International Exhibition at South Kensington (July 1874). It seems to be admirably adapted for mining purposes.

—*From "Principles of Metal Mining."*

MINING VENTILATION.

UNDER this heading we gather a few of the more recent notes upon this subject, more as a synopsis of progress than an attempt to cover the subject of Mechanical Ventilation of Mines.

At the closing meeting of the session in connection with the Manchester Geological Society, held at Wigan, on June 30th, the whole of the programme was devoted to subjects specially interesting to mining engineers, of whom there was a large number present. Amongst other subjects was a paper by Mr. Charles Cookson on the relative efficiency and useful effect of centrifugal fans for mine ventilation. The great majority of mining engineers, he said, had become convinced on the ground of safety and efficiency, that mechanical was greatly superior to furnace ventilation, and the point now chiefly at issue was the relative superiority of the various systems of mechanical ventilators. These might be divided into two classes; the first consisting of the Waddle, the Guibal, and the Schiele, which were centrifugal ventilators; and the second consisting of those machines which were known as varying capacity ventilators. The latter class, however, in his opinion, were not at all suited for the enormous volumes of air which were required at the present day for the ventilation of coal mines, and very few comparatively were at work in this country, whilst on the Continent, where all types of mechanical ventilators had been more fully tried than here, the centrifugal fan was being put up practically to the exclusion of all others. It was therefore only necessary to consider the relative merits of this class of ventilators. In the absence of any fair means of comparison obtainable with present experiment as to the useful effects and results, he had turned his attention to one or two other points, which, in his opinion, were quite as important as the question of the percentage of steam utilized. The work of a fan was primarily, to produce a ventilating current in the mine, and they could calculate what ventilating pressure could be produced by a fan running at any speed. Since the quantity of air in a mine depended upon the ventilating pressure or water-gauge that a fan could produce, the question as to which type of fan was able to produce the greatest water-gauge was one of great importance, as it might be said that the fan which at a certain speed could produce the greatest water-gauge was the most efficient ventilator. As a basis on which to test this class of ventilator, they might consider that in all centrifugal fans the air traveled the fan at the speed at which the tips of the fan were traveling. In open running fans the work which was stored up in the air when traveling was nearly all lost, and if they could utilize any of this stored up work by lessening the velocity of the air before discharging it into the atmosphere, they would increase the useful effect of the fan. If all this stored up work could be utilized, and the fan caused no friction to the air in passing through it, they would arrive at what a perfect fan could produce. In order to get a fair average of results, he had worked out the percentage of efficiency in this respect of some six Guibals, three Waddles and five Schieles, of whose working he had particulars, and averaging the results he had found that they gave the following comparison:—

Guibals	64.5	of efficiency with regard to water-gauge produced.
Waddles	44.78	
Schiele	34.45	

Taking this as a fair basis for calculation, they could find out approximately what each of the three types of fan would do at the same or different speeds, and taking 9,000 feet per minute of periphery speed as being about the limit of safe working speed of fans of such dimensions as would pass large volumes of air, they found that at this same speed they would give the following results:—

	Water-gauge.	*Air per minute.*
Guibals,	6.61 inches.	200,000 cubic feet.
Waddles,	4.59 inches.	166,780 cubic feet.
Schiele,	3.53 inches.	146,160 cubic feet.

This showed that if the fans were all working under similar conditions and at the same speed of periphery, the Waddle would give 16.6 per cent., and the Schiele 26.9 per cent. less air than the Guibal, or putting it in another form, they found that to produce the same amount of air the Waddle would have to run at 20 per cent. and the Schiele at 36.6 per cent. greater speed than the Guibal, so that whatever the result as to the useful effect calculations, they might say that as a matter of efficiency with regard to the speed of the fan the Guibal was the most efficient. In the course of a disscussion on the paper, Mr. Wm. Bryham, a well-known mining engineer in the Wigan district, said that although he was prepared to admit that the time was coming when mechanical ventilation would be more applied than it had been before, he scarcely thought that the time had yet come when it could be said that under some conditions it was altogether superior to furnace ventilation. Mr. Cookson replied that no doubt at certain depths furnace ventilation was found to be more econonical than mechanical ventilation, but another point to be considered was the question of safety.

—*Iron.*

On March 22d, 1882, the second of a series of lectures which have been specially arranged for the purpose of affording information to the men employed at the pits in the district on mining matters, was delivered at Dukinfield, England, the lecturer being Mr. C. M. Percy, of the Wigan Mining School, who selected as his subject, "How we Ventilate our Mines by Machinery." Mr. Percy, in the course of his lecture, said there was a great deal that a mechanical engineer might do and ought to do at collieries. Winding was now made expeditious enough, but was the reverse of economical. Pumping would in the future be carried on with appliances, perhaps not cheaper in themselves, but less expensive in working. Hauling was even yet in a somewhat crude state of development, and afforded great scope in the way of improvements, which might be carried into effect by energetic engineers and enterprising colliery proprietors. Coal-getting was carried on, under existing arrangements, in what might almost be termed a barbarous fashion; the danger with explosives was very great, and the work with the very handy but, at the same time, obsolete tool, the pick, was frightful. For every ton of round coal got, in many districts, nearly a ton of slack was made, and this state of things certainly would not and could not continue. And when the coal was brought to bank, not much improvement ás a rule was to be found. The coals were hauled from the tips into the shoots, and in a rough and ready manner found their way into the wagon, insufficiently screened and insufficiently freed from dirt; while in the wagon the round coal was trampled into slack to the loss of the proprietor and the annoyance of the customers. In ventilation, the mechanical engineer had, during the last thirty years, done a great deal, and, on the whole, had done it well; and it was with reference to this that he wished speeially to speak. Fortunately for his hearers, he had no strikingly novel ideas of his own in this matter. He had no bias of his own against the furnace or the mechanical system of ventilation, nor had he any special leaning to one particular fan as compared with another. He believed, however, that in mining operations what could be done by machinery was better so done than in any other way; but he did not believe that any one system of mechanical ventilation possessed all the merits; he believed that in nearly all the systems there were some special good points, while in general the advantages were pretty nearly equal. He should try and discuss them candidly and steer clear of anything like unfair criticism. So far as simply producing a current was concerned, nothing could surpass the excellence of the furnace, and especially for deep mines, because the efficiency of the furnace increased with the depth. But with the furnace there was the danger of setting something on fire in the vicinity or in the shaft, and there were the inconveniences and the injurious influence upon winding ropes, conductors, etc., by having the products of combustion from the furnace passing out at the upcast shaft. No doubt, except for shallow pits, the mechanical system of ventilation was more expensive, but with really good appliances worked with condensing engines, mechanical ventilation, even for deep mines, would come very nearly to the furnace. Mechanical ventilation might either act to compress the air or to exhaust it, and in several respects forcing in air was more effective than sucking it out. But the inconvenience of efficiently closing in the top of a downcast for forcing arrangements has led to the almost universal adoption of exhausting appliances placed at the top of the upcast shaft. Mechanical ventilation might be divided into three classes: first pumps, with clacks such as Strewe's; secondly, revolving wheels sweeping out a fixed quantity of air every revolution, such as Leviselle's, Cooke's, and, perhaps, there might be included Root's; and thirdly, fans working on the centrifugal principle, including the Nasmyth, Brunton, Biram, Ramwell, Guibal, Waddle, and Schiele. Mr. Percy then proceeded to describe the principle of these various ventilators and the engines for driving them, and made special reference to the three last-named fans as those most generally used. The Guibal and the Waddle were made any size up to 50 feet diameter, and worked slowly, the engine being converted directly. The Schiele was a small fan, rarely exceeding 15 or 16 feet diameter, and worked quickly, power being communicated from a large pulley on the engine-shaft by means of a strap to a small pulley on the fan-shaft. All these fans had in practice given excellent results. Mr. Percy expressed no strong preference for either large or small fans, but said his opinion was, that the blades should be inclined backward and curved backward, and that the fan should either discharge freely all around the circumference, or have a complete spiral casing opening out into an enlarging chimney. Reference was then made to several methods by which the upcast or fan-shaft could be used for winding, to allow convenience for loading and unloading the cages without allowing a rush of air into the fan-drift. The lecturer next dealt with the manner of ascertaining the actual power of the fan-engine and of the fan itself, so as to decide accurately the percentage of useful effect obtained. The whole of the matters discussed, including the fans, the percentage of leakage at the surface, and the useful effect, were illustrated by diagrams; and in conclusion, Mr. Percy observed that no doubt among those whom he was addressing there would be some anxious to obtain knowledge which would enable them to raise themselves in the social scale, and that was a laudable ambition. But they could not all rise to distinction and prominence, and what he wished to impress upon them was to get as much knowledge in connection with their occupation as they could. If, then, increasing knowledge led to advancement, well and good; but even if not, their better knowledge would be to them all the same, their labor would be sweeter, and their lives pleasanter, from knowing something of appliances which made mining safer and more efficient.

Mechanical Ventilation and Drainage in Indiana Mines.—Mr. Thomas Wilson, Jr., Mine Inspector of Indiana, has printed the following in his second annual report, recently issued: By mechanical ventilation, I mean the use of machinery to compel the movement of a column of air through the workings of a coal mine. This is done by various means. The present mode with the majority of opertors is the common furnace. A furnace does very well if it is rightly constructed. I would advocate the fan for cheapness and durability. The Champion exhaust-fan is the best. It requires less power to suck or draw a current of air than it does to push or force it. The difficulty of pushing or forcing a current of air through long and rough passages is a great drawback, and both theory and practice are against it. Whether the ordinary blowing-fan or blowing-cylinder is used, the difficulty is the same. But when the same power is reversed and the fan or cylinder is made to draw or suck the air instead of pushing or forcing it, the effect is reversed and the natural or atmospheric pressure becomes an active agent instead of a repelling force. Instead of increasing the density and consequent friction of the air, it decreases them and proportionately decreases the amount of power required to produce a given current. For these reasons, the improved exhaust-fan is the most perfect, safe and economical, and far superior to the furnace method. There is a number of common blowing-fans in use in the State, some of which are doing good service, one at Mr. S. W. Phelps' No. 3 mine on Coal Creek, Fountain County; one at the Buckeye shaft, in Clay County; and another at Watson's South shaft, in Clay County. These were doing excellent service. There was a perfect hurricane of air passing through their mines the whole time. These fans can be erected at a very reasonable cost. It will not exceed $250, including pipes to convey steam from the boiler unless the fan is situated an unreasonable distance from the boiler. After one of these fans is put in operation, the cost to run and keep it in repair is comparatively nothing. But this is not the case with the furnace. It costs nearly as much to erect a furnace in the first place, and then there must be added the cost of keeping it up afterward. In the first place, it will require one ton of coal per day, and it will take a man constantly to attend to it, at a cost of at least $1.25 per day, to produce say 20,000 cubic feet of air per minute, and some of our mines require a great deal more than this to comply with the law. This will amount to quite an expense at the end of the year. Besides, where furnaces are used, the hoisting shaft is always the downcast for the air; and where shafts drip water, there is always a great deal of trouble and annoyance with shafts freezing up in cold weather. It is also very disagreeable for the cager. But this is not the case with fans; the hoisting shafts are always the upcast, and it is always warm and pleasant in the winter season. Besides, the frost air is always distributed among the mines before it becomes charged with foul gases of the mine. I am opposed to furnaces on account of the expense of keeping them in operation. As much air can be produced with a furnace as with a fan, if the furnace is made large enough. The best ventilated mine in the State of Indiana is the Sulphur Spring mine, near Washington, Indiana. There are 29,250 cubic feet of air per minute circulating through the entire mine. They were working a force of 155 men and boys. The air was sufficient for 292 persons, allowing 100 cubic feet of air per minute for every person employed. This current of air was produced with a furnace of 34 cubic feet of heating space. It will cost to build a furnace of this size $130 in the first place, and it requires one ton of coal per day, and the constant attendance of a man to keep up this current of air. This mine is opened on the double-entry system. Every air-course and entry in this mine has a sectional area of 42 cubic feet of space for the passage of air. This is the most extensive mine in the State. The air-current in this mine from where it first enters the mine at the downcast shaft traverses the main entries and air-courses, and runs a distance of four and three-quarter miles to where it enters the furnace and upcast shaft. Among the different modes of ventilation, the difference in cost is greatly in favor of the fans. There have been about fourteen fans erected during the year for ventilating purposes, and I hope to see during the present year all the furnaces done away with for ventilation purposes.

At the present writing, February 20th, 1882, the larger portion of the Sulphur Spring mine is entirely submerged, the water standing in some places to a depth of eight feet. This has been caused by the heavy rains that have been falling for the last eight or ten days. There are at present about 200 persons lying idle on account of it. There is more water handled at this mine than at any four other mines in the State. The water is hoisted here with large boxes. There is one six-inch discharge-pump, but at the present time it is entirely submerged. The capacity for handling water here is 840 gallons per minute. At this rate, it is supposed that it will take about two weeks to drain the mine and put it in a working order. The territory in this mine comprises about 200 acres, and the seam of coal lies so close to the surface that when a pillar is taken out the upper strata is so rotten that it falls through to the surface, and all the water that falls on this ground goes into the mine, and has to be either pumped or drawn out in boxes. This is a great drawback in working the surface veins unless they are worked with drift openings. Coal can be produced cheaper from a vein that lies from two to three hundred feet below the surface than it can from a vein that is between forty and sixty feet. Of course, the first cost is greater with a deep shaft than it is with a shallow one, but you are never troubled with surface water. This is a very important item in operating a mine. I could point out instances where the expense of handling the water and cutting drains in the mine is more than the cost of getting out the coal.

Measuring the Air of Mines.—From the Seventh Report of Andrew Roy, Inspector of Mines in Ohio, we glean the following on this subject: The instruments used for measuring the currents of air in mines in this State are generally anemometers, or air-meters. Beram's 4-inch anemometer, reading to 100 feet, is the favorite. There are some 6-inch instruments of this manufacture, and one or two 12-inch ones in use. The large ones are most costly and more cumbersome to carry around than those of the 4-inch size. Castello's 2-inch air-meter is also used, but Beram's is preferred. The manner of measuring the air is very simple, as the anemometer self-registers the speed of the current. A point is selected in the air-course where the whole column passes, and the instrument is held in the current. The vanes are so constructed that they revolve by the current of air impinging upon them, the speed of the current being indicated by the index-hand or pointer of the dial-plate, which reads to single feet; one revolution of the pointer recording one hundred feet. The anemometer is usually held in the current just one minute, and the speed with which the air travels is noted. The sectional area of the air-way is then ascertained, which multiplied by the number of feet at which the wind is flowing, gives the amount of cubic feet of air. An allowance has to be made for the friction of the anemometer, which is equivalent to 17 feet for 50 feet per minute, and 8 feet for 200 cubic feet per minute. When the speed of the current, as indicated by the anemometer, exceeds 200 feet per minute, the friction, owing to the construction of the instrument, is very little, being only 3 feet for 300, 2 feet for 400 and nothing for 500.

The speed of the current in a good-sized air-course, in the best ventilated mines in the State seldom exceeds 500 feet; in the worst mines there is sometimes so little current moving, that the vanes of the anemometer refuse to revolve, even on the main air-courses. Three hundred feet per minute, which is nearly equal to five miles per hour, is a sufficiently vigorous current for any coal mine in this State. Moving through an air-course of thirty-six feet of sectional area, this rate of speed would produce 11,700 cubic feet per minute, an amount capable of supplying 117 workmen, if properly distributed, with an abundance of fresh and wholesome air. Nearly all the reports sent to this office since the mining law required the bosses to measure the air of mines, give different results at the intake and outlet. For example one boss reports 10,700 cubic feet as entering the mine, and 11,525 as being discharged. Sometimes the results show a larger current at the intake than at the upcast. The facts show that these measurements were honestly, though mistakingly taken, the cause of the varying results being due to the want of care or opportunity in selecting the places of measurement. To measure the current accurately, a straight passage in the entry should be selected, for on a curve the current is stronger on one side than the other, as in seen in a current of water moving along the bend of a river. In selecting a wide place in the air-gallery, also just beyond a narrow point, to make a measurement, the result will show a larger current than really exists, because the air forms a *cul de sac* at the pillar sides, just as water does on being discharged from a pipe of lesser diameter into one of greater diameter. Another reason why a larger current is sometimes shown at the upcast than at the intake, is due to the measurement at the upcast being taken near the mouth of the ventilating furnace where the air has become expanded by heat. In this latter case there is, in reality, a larger volume discharged than enters the mine. The galleries of mines are generally ragged, wider at the top than at the bottom, and in the low veins, where the roof is shot down, the height is irregular, so that accurate measurements cannot be taken; but accurate measurements are not required, the point being to possess a current at least equal in volume to the requirements of law. There are two other methods which are sometimes used in measuring the air of mines. One is by flashing a small quantity of powder in the air-way, and noting with a watch the speed at which the smoke travels along the gallery. The other method is by carrying a lighted lamp or candle in the moving current of air, and maintaining the light in an exactly upright position, noting the time required to pass from one place to another. Both methods are on the same principle. The experiments can only be made along an even part of the air-gallery. A distance of from 100 to 200 feet is generally selected. The cubic area of the chosen part of the air-way is ascertained in feet, which, multiplied by sixty, the number of seconds in a minute, and divided by the number of seconds of time required by the flashed gunpowder, or person traversing the measured distance, gives the amount of cubic feet of air per minute.

Compressed Air in Mines.—Mr. M. G. Johnson, of the Kingswood Collieries, Bristol, writes thus under this topic: Among the collieries visited by Mr. Cossham were included Ryhope and Shireoaks, and at each of these collieries compressed air is being used with excellent results. The same may be said of all the places I visited in South Wales —in one colliery no less than 40 horses have been dispensed with through the application of this power. Great credit is due to Sir George Elliot for the persistant efforts he has made and the money he has spent in order to bring as near perfection as possible the methods for obtaining this power. In the Powell's Duffryn Collieries, in South Wales, the proprietors are so convinced of the benefits to be derived from its use that they are dispensing altogether with animal power, and substituting air engines for their underground haulage; and the testimony of these collieries (Mr. Wakinson, manager, and Mr. Snape, engineer) was to the effect that after ten years' experience in the use of compressed air they are fully convinced that there is no power equal to it for winning coal back to the shaft where steam cannot be conveniently employed and where the coal lies to the dip. At New Tredegar Collieries, belonging to the same firm, this motor is, I am told, extensively employed. They have no coal works but what lie below 1,500 yards to the dip, and from that distance down to 2,000 yards, the lowest point reached at that time (two years ago), they were hauling 800 tons per day.

When the Mont Cenis Tunnel had to be driven, the engineers, Messrs. Sommellier and Grattoni, at once recognized this power, and availed themselves of it, and but for this I have no doubt the completion of that grand engineering feat would have been retarded for at least five years. It not only served as the power for driving their rock drills, but it cleared away the smoke after blasting almost immediately, and enabled the men to resume work at the face of the heading without any unneessary loss of time, and to get the debris at once cleared away. Every miner knows that the hanging of the smoke in the ordinary method very often keeps him away from the place of his work quite one-fifth of his time, so that this power not only permits much more work to be done, but admits of its being done in a healthy atmosphere instead of in a vitiated one. At Mont Cenis Tunnel, too, they got this power very cheaply at merely the cost of the machinery, a mountain stream running down near the mouth of the tunnel was utilized, and supplied the power for compressing the air. Mr. Derilley has published an elaborate and most valuable report on the work done at this tunnel, and much information is given therein respecting their method of compressing the air. Mr. Taylor, of Ryhope Colliery, in a paper read before the North of England Institute of Engineers some few years ago, enumerates some of the advantages resulting from the use of this power:—1. It is obviously of great importance to have a large power which can be applied to any purpose, and at any moment, to any part of the mine. 2. Possessing this power is a mere question of detail to use means for working the coal and bringing it to the point from which it is to be led by the air engine, thus dispensing in a great measure with manual labor, both as regards hewing and putting the coals. 3. Compressed air at 40 lbs. pressure has been successfully tried at Ryhope for airing a stone drift, and he sums up the results as follows: 1. Economy as regards its application to any part of the mine. 2. Additional safety to mine, inasmuch as there is more direct commuication with the control over all parts. 3. Having a power so easy of application to any part of the mine, its use for all purposes where labor is concerned must necessarily follow.

M. Trasenter, Professor of Mining at the University of Liege, considers that great advantages must ensue from the use of this power for driving engines at high speed in the galleries or working places underground, through the freedom from heating and condensation, slight friction in the pipes, and the ventilation in the works; but while enumerating its advantages we must not fail to look fairly in the face of what are considered to be the drawbacks to its general adoption. Mr. Trasenter says compressed air necessitates costly works, and if used without expansion leads to a great loss of power owing to the necessity for conducting the air at the required pressure. In calculating the ratio of the energy expended in compressing the air to the useful work theoretically given out, Mr. Trasenter has laid down a simple and interesting formula. The work given out soon reaches a limit which cannot be exceeded, whatever may be the pressure of the air or the energy expended. The maximium of work given out (increasing the compression indefinitely, and without taking into consideration the elevation of temperature due to this compression) cannot exceed the energy given out by the volume of air caused by the piston of the blowing cylinder working with an effective pressure of one atmosphere, and he demonstrates the law, and goes on to say that the power which a cubic meter of air, compressed to a million atmospheres, is capable of yielding, without taking the rise of temperature into consideration, can never become double that which the same quantity of air, compressed to two atmospheres is capable of yielding. Air compressed to four atmospheres will give out a power proportional to $1-\frac{1}{4}$, or $\frac{3}{4}$, whereas to obtain a power equal to 1 a compression infinitely great is necessary. He gives a formula which expresses the ratio of the work done to the power expended. This power is not a new discovery; Hero, of Alexandria, was in some measure acquainted with it, as well as with the knowledge of steam as a motive power. Hero's tutor, Clestibuis, is said to have discovered that air was compressible, and the pupil is credited with having written a book on pneumatics, showing that when air was compressed it decreased in volume, and expanded itself again when the pressure was removed. Experiments proving its "ponderability" were made in the 17th century by Galileo and Torricelli; about the same time, too, Guericke invented the air pump. Its chemical properties, however, did not engage much attention until another century had elapsed, when Black, Priestly, Lavoisier, and others took up the subject, and great discoveries resulted from their labors. Papin, about the beginning of last century, had an idea of working an engine with air, generated by a water-wheel and compressing pump at a distance, but it was not brought into practice; and just 100 years before the Mont Cenis Tunnel was commenced one Isaac Wilkinson obtained a patent for a machine for compressing air very similar to the one employed at those works. It is generally known that when air or other elastic fluid is compressed, there is generated an amount of heat which is the exact equivalent of the force employed in the compression. It may not be out of place here to give an extract from Professor Tyndall's valuable work, "Heat a Mode of Motion." He says:

"Whenever friction is overcome (by compression or otherwise) heat is produced, and the heat produced is the exact measure of the force expended in overcoming the friction. The heat is simply the primitive force in another form, and if we wish to avoid this conversion we must abolish the friction. We put oil upon the surface of a bone, we grease a saw, and are careful to lubricate the axles of our railway carriages. What is the real meaning of these acts? Let us obtain general notions first, and aim at strict accuracy afterward. It is the object of a railway engine driver to urge his train from one place to another; he wishes to employ the force of his steam; it is not his object or interest to allow any portion of that force to be converted into another form of force which would not promote the attainment of his object; he does not want his axles heated, and hence he avoids as much as possible expending his power in heating them—in fact, he obtained his power from heat, and it is not his object to reconvert by friction the force thus obtained into its primitive form. For every degree of temperature generated in his axles a definite amount would be withdrawn from the urging force of his engine. There is no absolute loss. Could we gather up all the heat generated by the friction, and could we apply it mechanically, we should by it be able to impart to the train the precise amount of speed which it had lost by the friction. Thus every one of those railway porters whom you see moving about with his can of yellow grease, and opening the little boxes which surround the carriage axles, is without knowing it, illustrating a principle which forms the solder of nature; he is unconsciously affirming both the convertibility and indestructibility of force. All the force of our locomotives is derived from heat. When a station is approached—say at the rate of thirty miles an hour—a break is applied and smoke and sparks issue from the wheels on which it presses. The train is brought to rest. How? Simply by converting the entire moving force which it possessed at the moment the brake was applied into heat."

The heat in actual practice is to a very considerable extent lost by radiation from the receiver and pipes in use; and, further, when this compressed air has fallen to the temperature it possessed prior to its being compressed, it has lost in cooling an exact equivalent to the power expended in compressing it. Where, then, is the power to perform work? This remains in the stored-up air in the reservoir, where it is held under considerable pressure, and when allowed to expand in the working-cylinder its temperature then falls below that of the atmosphere, and thus develops the work demanded from it. In accomplishing this, however, there is a loss of about thirty to forty per cent. in consequence of the temperature of expansion not being depressed in an equal proportion to the increase obtained during its compression; and hence, when the air has done its work in the cylinder, and issues forth from the exhaust passage, it is exceedingly cold, being about 28½ degrees Fahrenheit, or 3½ degrees below freezing point. This intense cold formed for a considerable time very serious objections to its practical use as an engine motor, through the formation of ice at the exhaust. Various methods have been resorted to to remedy this defect, but this is effectually accomplished by casting the cylinder so as to have the exhaust openings connected with the exhaust port vertically, and open across the cylinder, so as to discharge the air downward as well as upward, and admit of a bar being passed through, if necessary, to chip off the ice. It would appear from the foregoing that the higher the air was pressed the greater would be the loss in the economic result; but in this there is a great difference of opinion, one party going in for slow speed and low pressures, not above three atmospheres, and another for high speed and high pressures. It is a very common expression and true, that circumstances alter cases, and so, in my opinion, it is in this, the "battle of pressures."

I do not wish to be dogmatic in this matter. Douglas Jerrold once said that dogmatism was grown-up puppyism; and I know, too, there is a proverb which says that a certain class of people, the opposite to wise, rush in where angels fear to tread. Where the work, however, to be accomplished is of a temporary nature, such as tunneling, deep well sinking, or boring, high speeds and high pressures may be adopted with advantage, as they admit of smaller machines being used to do the desired amount of work; but where the power is required for the running of a colliery to extend over 20, 30 or 40 years, and the air to be carried to long distances for hauling, pumping, rock drilling, and coal cutting purposes, then I say put down a good compressing plant, with moderate speed, ordinary pressure of (say) three atmospheres, and plenty of margin. This is my view of the matter, and must be taken for what it is worth. An athlete, in running a hundred yards race, starts away at a very different speed to what the one does who is in for a mile race; it is the old fable of the hare and the tortoise.

Looking at the matter in this light, the Kingswood Coal and Iron Company ordered a pair of air compressers from Messrs. J. Fowler & Co., of Leeds, of the following dimensions: The steam cylinder is 36 in. in diameter, the air cylinders being 40 in. diameter, with a 5-foot stroke. The air cylinders are immediately behind the steam cylinder, and fixed to the same bed plate; the piston is continuous, but so arranged that no part of the rod that works in the steam cylinder shall enter the air cylinders or even the stuffing box. The air cylinders are cast with square ends and flanges to attach flat plates vertically at the sides, thus forming a tank or receptacle for a complete jacketing of cold water, the object of the cold water being to keep the temperature of the air as low as possible during compression, the top left open to allow of evaporation and radiation. The supply of cold water is kept up by a pipe at the under side, getting its supply from a reservoir at a higher level than the tops of the cylinders, and the heated water is passed off at an overflow pipe at the top, the inlet and outlet being regulated by taps. The air is forced into a receiver, which is nothing more than an ordinary egg-end boiler, 25 ft. long and 5 ft. in diameter, fitted with stop valve and safety valves, the latter weighted to 45 lbs. per square inch. Steam is supplied at 40 lbs. per square inch, and the pressure of air stands at 45 lbs. per square inch; the steam is cut off at ¾ in. of the stroke; the fly wheel is 21 ft. diameter, and weighs about 24 tons. From the receiver toward the shaft an old boiler tube, 28 ft. long, 2 ft. 10 in. diameter, is utilized, and from this cast iron pipes 8 in. diameter are carried down the shaft for 225 yards; at this depth, and in an opening in the side of the shaft, a pumping engine is fixed and driven by the compressed air. This engine consists of a pair of air cylinders, 10 in. diameter and 2 ft. stroke, which drives a pair of rams 6 in. diameter, geared 5 to 1, with air pressure of 40 lbs., and delivers 160 gallons of water per minute 700 ft. high. The out and out dimensions of this pump are 15 ft. long, 7 ft. 6 in. wide, and 6 ft. 3 in. high. These compressors and pump, made by Messrs. Fowler & Co., of Leeds, have given the most unqualified satisfaction. The air pressure at this point, more than 250 yards from compressors, stands at 2 lbs. higher than it does in the receiver at surface, and my experience is that the pressure increases 1 lb. for every 100 yards of depth. We have tested this by changing gauges; the same has also been observed by Mr. Snape, engineer, and Sir George Elliot, who has had more than 11 years' experience with compressing machinery. I do not intend here to account for this, but merely state the fact. We have 7 in. pipes continued for the remaining 270 yards down to the bottom of the shaft, and for the present have a dead flange screwed on the end of the pipes, but we have already two pairs of hauling engines in order, and hope to have them at work in a few months—one pair for level haulage, the other for dip haulage. I anticipate, therefore, when we come to put the pressure gauge on at the pit bottom, that the pressure there will register about 5 lbs. higher than at the surface receiver.

ELECTRICITY IN MINING WORK.

AT the February (1882) meeting of the American Institute of Mining Engineers held at Washington, Mr. N. S. Keith of New York read a paper on "Electrical Apparatus and Processes for the Mining and Metallurgical Engineer," from which we take the following:

No oue of the live subjects of the day to which the attention of the mining engineer and metallurgist should be turned is of greater practical interest to him than electricity, in its applications to various mechanical, chemical and metallurgical operations. The object of this paper is to call the attention of my fellow-members and associates of the Institute to the various new, as well as comparatively old, developments in the science and art of electricity, which seem to furnish or promise to furnish, results of advantage. Too many of the comparatively old applications have been neglected by the mining engineer, which, if he had given them a place among his appliances, would have assisted him greatly. The telegraph may be noticed as one. Its use is, however, confined to a person having skill in the manipulations of the key, the reading of the alphabet and familiarity with the sounder. One of the simpler forms—the call bell —without necessity of special education, has a range of application far greater as to distance and convenience than the old wire pull, or the hoarse voice of the windlass man or the bucket dumper. A few Laclanche cells two or more electric bells and a mile or more of wire, judiciously placed, will put the superintendent, at his office, in communication with the foreman of his mills and mines, so that, by the aid of a code of signals, great advantages may be gained without necessitating knowledge of the Morse alphabet, nor the mechanical voice of the sounder. The recent telephone furnishes a means of communication between the often widely separated places of duty which will save many a step, and much loss of time and wear of horse and body. It can be used by any one who can speak. I would speak of appliances in the art of electricity which enable the engineer to accomplish more in an easy manner than he otherwise can do. The preceding remarks are introductory to a description of new applications of electricity, which the miner and metallurgist will find, before long, so essential to his profession that their theory and practice will be taught at the school the same as metallurgy, mineralogy and chemistry now are. That which we may call this *new* electricity is due to the practical development of the theory of the conservation of energy, and the consequent production of mechanism for the generation of currents of electricity of any desired quantity and intensity. So new is this electricity in fact, that even the recent graduate of the mining schools knows little or nothing of its modes of production or of its applications, actually, in practical operation or projection.

I will speak of the new applications which are consequent upon the extensive production of machinery for the generation of electricity. First comes that which appeals so sensibly to the eye—light. It has been fully determined that there is no light, except daylight, as cheap as that produced by the voltaic arc; none so pure in color, none so bright. Many are in use in our rolling-mills, machine shops, hydraulic mines, surface works and other places. The miner needs the electric light in his shaft-house, his stamp-mill and his furnace. If he has no engine at the shaft-house, the one at his stamp-mill or furnace can be used to run an electric generator which will send the electricity through the wire conductors, so that not only his shaft-houses can be illuminated, but also his mill or furnace, and even the road between, much cheaper than he can produce one-tenth of the light by the use of candles or kerosene, with much greater safety. It is doubtful, however, if the voltaic arc light will be of any great practical utility in narrow veins of mines, because the light produced is too great in quantity—and therefore too costly—more than is needed, by far in narrow space; nor in headings or stopes, as it requires in such places too frequent moving. The work at the new railroad tunnel through Bergen Hill, at Weehawken, is lighted by eleven arc lights placed upon the circuit from one electric machine. This circuit is two and a half miles long. The conductors are of well-insulated copper-wire, carried along the ground upon poles down and up the several shafts and into the various headings, all with great success and economy, especially as the men can do more and better work in the good light. In lighting the banks at hydraulic mines, in iron ore pits, in open cuts of railroad work; in fact, in all large spaces in which night-work is carried on, this light has no equal.

Take, now, some of the applications of electricity which can be used by the miner and metallurgist, if he has at his main engine or water-wheel a suitable generator of electricity. He may be sinking a shaft at the top of a mountain, where it would be impracticable to place or operate a steam-engine. But if he places there an electric motor, and connects it with his generator by conducting wires, he will have power at his command at the shaft which, by the mere turning of a switch-handle, will work his whin or windlass, and hoist his ore or rock, or work his pump. I have an instance at hand where electricity is now used in mining, in the Loire Valley, in France, for the transmission of power, at the works of the Compagnie de la Ferroniere. One Gramme machine is employed as a generator of electricity, and another as a motor attached to a drum which stands at the head of an inclined plane 110 m. long, with a grade of 4 cm. per m. The generator is 1200 m. from the motor. The load raised is about 800 kg. (1760 lbs.) and the ascent is made in one and a half minutes. The work goes on with great regularity. The starting and stopping can be done as gently as desired. By means of a galvanometer in the circuit one can tell at any moment what is being done at the incline, whether the work is being stopped, whether the wagons are coming up filled or not, etc. The work is about two-thirds horse power. By means of this current he can ignite his blasts. He can work his electric drills, which are said to be economical in comparison with the steam drill. He can stop or start the drill at will, and have all the advantages of mechanical movements, without the constant personal attention of an engineer at the shaft. He can light all his works from a central station at the mill or other place where he has available power. He can have wires branched to his laboratory, where the electric current will aid him in his analysis and tests. There he can melt his gold, silver and samples. He can heat, boil, cupel, roast, and perform all the operations of the laboratory which require heat, power or the determination of chemical affinity. Think of melting metals by the fall of water! The suggestion of it even not so many years ago, would have secured our excommunication. The iron and steel manufacturer can find the imperceptible flaws in his bars, and determine the amount of carbon in his steel by this agent.

It would take too long, and far exceed the proposed limits of this paper, for me to enter into the particular modes and apparatus for carrying on the various operations which I have enumerated, but I will briefly describe a few practical operations which can be carried out on a large scale. For quite a number of years in the neighborhood of Swansea, in Wales, a method of refining copper and separating such gold, silver and other metals which the impure copper may contain, has been in practical operation on a large scale. Plates of "black copper" are made the anode in an electrolytic bath, consisting of a solution of sulphate of copper. Other thin plates of pure copper are made the cathode in the bath. By the electrolytic action of the current, produced by an electro-generator, copper alone is dissolved from the black copper and it is deposited in a pure state upon the cathode. The impurities of the black copper sink to the bottom of the vat, and are removed from time to time and treated for their contents of gold and silver. The cathodes, as soon as they have reached the desired weight, are removed, and the copper thereon is melted and cast into pigs for the market. This process has been found more economical than any other for accomplishing the same result. An analogous process is the one invented by me for the refining and desilverizing of base bullion. The bullion, in plates, is placed in a solution of acetate of soda and sulphate of lead, and is so connected with the source of electricity as to be an anode, while plates of other metal are cathode. Lead is dissolved and deposited electrolytically, and the deposit is practically pure.

I have invented an improvement on this process, which consists in taking the skimmings of zinc, lead and silver which come from the kettles in the process of desilverization by means of zinc, and putting them in bags as an anode, dissolving both the lead and zinc electrolytically, and depositing them together as an alloy, or mixture, upon the cathode plates. The contents of gold, silver, &c., are retained in the bags, and are smelted for their aggregation. The combination of pure lead and zinc is removed from the cathode and added to the next or some other succeeding lot of base bullion put into the kettles for desilverization, and in that manner the process continues. In place of treating the whole mass of bullion by electrolysis, I get in the first place, by the zinc desilverization, say 80 per cent. of the base bullion as market lead, and, say 22 per cent. of a rich lead and zinc which goes to electrolytic treatment. By adding then the pure lead and zinc to the succeeding lot of bullion I effect the desilverization, and remove from it as market lead an amount approximately the quantity of lead which is in the bullion placed in the kettle.

The process which has within a year or two been reintroduced by Siemens for melting steel by electricity, can be applied to melting the metals and materials. The apparatus for this operation is comparatively simple. Take a black-lead crucible of suitable size and put it in another suitably larger, and in the space between the walls of the two pack some good non-conducting material, like asbestos. Introduce through a hole in the bottom of this combination a carbon rod, like one used in the electric arc light, and lute around it well with a paste of clay and graphite, so that it forms a conductor to the interior of the inner crucible. Next provide a cover with a hole in the center, of a size to freely admit another carbon rod. Now place above the crucible the mechanism of an electric lamp, so that the carbon carried by its movable rod can enter the crucible through the hole in the cover. Place in the crucible an amount of steel or other metal; put on the cover and pass through the hole in it the carbon rod, and connect it with the movable carbon carrier of the lamp; connect the body of the lamp with the positive pole of the current generator, and then connect the carbon which passes through the bottom of the crucible with the negative pole. Immediately the upper carbon will be automatically withdrawn slightly from contact with the metal in the crucible and form a voltaic arc at that place, with its accompaniment of heat. Fusion goes on rapidly, so that some pounds of steel can be fused in twenty minutes. The lamp mechanism serves to keep the carbon rod at its proper separation from the metal. Siemens says that there is no other equally economical mode of fusing small amounts of steel, because there is none which so concentrates the heat upon the material which it is desirable to fuse. In fact, the fusion takes place before the outer crucible is raised any considerable degree in temperature.

The latest development in electricity is in the so-called storage of it. By the term, "storage of electricity," I desire not to be understood literally, no more than I would be so understood in speaking of the store of heat in coal. It is merely a convenient term, which simply avoids giving, as it were, a chapter in physics, and may be readily understood as such. The first storage of electricity, other than in its so-called static condition, was effected by Planté in his well known secondary battery. In his case, as in all arrangements for storage, energy is absorbed in the decomposition of water by electricity, which is again given up as a current of electricity when the proper circuit is furnished; or, better said, when the proper association of materials is made. The value of this arrangement of Planté, and the scope of application of its modifications, has not been recognized until recently. There is nothing to be gained by expending zinc and acid for the production of electricity to effect chemical decomposition, for the sake of the subsequent reverse action as electric current, for the battery can be used directly whenever such current is desired. But the recent mechanical means of generating electricity has so cheapened its production that it is now sometimes desirable to store up the electricity produced, as it were, in some portable form, so that it may be utilized in the place otherwise practically inaccessible for its direct production and use. Therefore some physicists have been directing their attention to the means of storing the electrical energy, with a view to its use at other times and places when and where the use of either batteries or mechanical generators of electricity would be impracticable or too costly. The line of development which has received the greatest attention is the one of which Planté's secondary battery is the type. Faure's arrangement is the most prominent. The capacity of both depends upon the porosity of the surfaces of two lead plates, one in connection with the positive and the other with the negative pole of a source of electricity. Planté's cell acquired its limited capacity by result of repeated oxidations and reductions, effected electrolytically, of the surfaces of the lead while in a bath of acidulated water. Faure increased this capacity by applying a coating of oxide of lead directly to the lead plates so that the increase on a given surface, in comparison with Planté's, is in the proportion of 2000 to 75. The operation of charging and discharging these cells is as follows: A source of electricity, having an electro-motive force somewhat in excess of two volts, is connected, as before stated, with two lead plates in a bath of water acidulated by sulphuric acid, and the current is allowed to flow in them for a time limited by the current and capacity. The result is that the coating on one plate is peroxidized, and the other has its coating of oxide reduced to metallic lead. If the source of electricity be disconnected, and the wires which are attached to the lead plates be kept separate, the charge will be only very slowly discharged. But if the wires be connected, either directly or through any conducting substance, an electric current will flow in the reverse direction to that which was passed through the arrangement from the source of electricity, until the original condition of oxide on both plates is resumed. The action of the current through the plates is first to decompose the water of the solution in which the plates are immersed; the oxygen goes to the positive plate and is absorbed in peroxidation, while the hydrogen goes to the negative plate, and acts there as a reducing agent, making metallic lead from the oxide. The reverse action takes place when the wires are connected. So it will be seen that the original electric current determined a chemical affinity, which, when circumstances allow, reasserts itself with the development of a current of electricity. Following this theory, I have invented a storage battery, which, as in the case of the one just named, is based on an old apparatus, well known, and up to the present time of very little practical utility. The details I am not now prepared to give, pending applications for patents in this and foreign countries, but will say that its capacity for storage of electricity exceeds ten times that of Faure of equal size and weight. Sir William Thompson found 1,000,000 foot-pounds of electrical energy stored in a box weighing, with its contents, 180 pounds, made by Faure in Paris, which he set free by use in Scotland. The decomposition of only one pound of water by electricity absorbs about 5,300,000 pounds of energy, which can be drawn at will from the storage battery through an electric motor. This equals 2⅔ horse-power for an hour. The waste of power in the process of storing is not yet well determined; but the economic results seem promising. If it be so proved, the applications of "bottled electricity" will be many.

Transmission of Power by Electricity in Mining.—The first instance on record of the application of electricity for the transmission of power is reported from France. M. Mathet has submitted the details to the Société de l'Industrie Minerale. The St. Claude shaft at Blanzy was sunk to the depth of 500 meters (1640 feet), for the purpose of searching for a faulted portion of the coal seams, and a heading was run from it across the strata. When this heading had reached a length of 400 meters (1,312 feet), the ventilation became so poor that the temperature at the face rose to 95° F., and the miners could work only for a few hours. After some ineffectual attempts to improve the ventilation by simple means, it was decided to put in a fan 2.63 feet in diameter, and run it by power transmitted by electricity. An 8 to 10 horse-power portable engine was put up above ground, and, with a Gramme dynamo-electric machine, was run at a speed of 1,200 revolutions per minute. The electric current thus generated was conducted by a cable consisting of seven 0.044-inch copper wires, to a second Gramme machine coupled directly with the fan, and placed in the heading near the shaft. Running at 700 to 800, it required 2½ horse-power, the useful effect being at least 50 per cent. The temperature at the face was only lowered 5 degrees, but the men could work in eight-hour shifts. The return current was conducted from the underground machine by an iron wire cable. The cost of the whole plant is stated to have been only one-third of what a machine for delivering compressed air to the heading would have required.

Lighting Mines by Electricity.—In Europe they are doing a good deal more experimenting in the matter of developing the possibilities of the electric light than we are in this country, yet we are by no means idle here. It may interest our inventors as well as the mining community to know that a prize of $2,500 has been offered to the person who produces the best system of lighting mines by electricity. This offer comes from Mr. Ellis Lever, of Manchester, a gentleman who has shown a great and practical desire to improve the position of the working miners of Great Britain, and give them the greatest possible amount of safety whilst following their employment. Such an offer cannot fail to find a good many competitors at the present time, when so much attention is being devoted to electricity for almost every purpose in which coal and gas have hitherto been the principal agents.

Aside from this premium, of course it is well understood that a great reward awaits the inventor of a miner's electric lamp, because so very many would be used. The London *Mining Journal* relates that already lamps have been tested in some mines where a good deal of gas is given off, and that with a fair amount of success for what may be termed first attempts. In such an application of electricity it is necessary that the light should be entirely cut off from all communication with the air surrounding the lamp, and for this purpose the Swan system has been found effective, for by it a number of the lamps can be placed singly in a circuit. The light from an electric lamp in a mine has been found to be equal to from 12 to 15 candles. The lights proceed from the incandescence of a fine fibre of carbon, the combustion of which is prevented by its being inclosed in an exhausted glass bulb. The lamps were inclosed in lanterns which enabled the fragile glass bulbs to be carried about without liability to accident. At one place where the lamp alluded to was tried it was particularly admired by the workmen for its brilliancy in whatever position it was placed, and requiring scarcely any attention whatever. The electricity was supplied by the current of an ordinary Gramme machine, driven by a portable engine placed near the top of the upcast shaft; but there is an easier method, no doubt, for it can be stored up and taken down in a mine and the lamp replenished as required. Seeing that the lamps at present in use not only give a very dim and dismal light, but have been credited with well nigh having been the cause of many of the fatal explosions which have taken place at different times, there is every likelihood that they will be replaced by those lighted by electricity, and that before long, and for this purpose the inducement held out by Mr. Ellis Lever cannot fail to be taken advantage of by those specialists who are now engaged in electrical investigation.

The Application of Electricity to the Prevention of Fire-Damp Explosions.—M. Léon Somzée, a Belgian engineer, has published a treatise on the prevention of fire-damp explosions which deserves careful attention. He says in substance: It is advisable to organize in every mine a special service charged with supervising and keeping a check upon the ventilation, and directing it, if occasion should require. It is indispensable that those set over this service should be constantly, instantaneously, and correctly informed as to the composition of the air in the mine at different points to be determined by practice, especially when lights are used and blasting is carried on, whatever be the variations of pressure and temperature. It is necessary that precise indications be obtained of even very minute quantities of dangerous gases; for it has been observed in England that a proportion of one and even one-twentieth per cent. is sufficient to render explosive the mixture of air and gas where there is coal-dust in suspension. In such a case we would go further and advance the opinion that a trace even of fire-damp is sufficient to bring about an explosion, having, as gas engineer, seen explosions occur in air containing dust of great fineness—explosions which were erroneously attributed to the presence of lighting-gas alone. It is desirable that every working place be put into communication with a central point of observation, either underground or on the surface, and be connected with the mechanism of the ventilator; that an alarm, in communication with the fire-damp, give notice of its presence through the engine-man or manager, by means of a mechanical action set up by the gas itself; and that the miners be also supplied with a warning appliance which shall force them to take precautions, or better still take the precautions independently of their will; to particularize that the presence of fire-damp in the mine in a state of danger be signaled by bells, not only to the miner, but throughout the colliery and on the surface, in the offices, and to the men tending both the ventilator and the winding-engines. Lastly, that measures be taken to regulate the ventilation instantaneously, and also to direct its effect wherever required, through a special ventilating gauge, receiving their orders from far or near by means of electro-motors.

Short of suppressing the cause which produces fire-damp, one of the most efficacious means for warding off mine accidents consists in preventing the mixture of air and gas from attaining the proportion which renders it explosive. In order to do this, it is necessary to be warned of the presence or slow invasion of this dangerous gas in the atmosphere of the mine; that is to say, to have precise indications of slight quantities of fire damp in the air. Various attempts have been made in this direction, but without success, on account either of the imperfect nature of the appliances or of their not being used properly. The best indication of fire-damp at present known is the safety-lamp; but unfortunately, when the state of the flame makes known the presence of this gas, its proportion is already so high in the air that the moment is not far distant when it may become explosive, owing to the presence of coal-dust. This fact alone would imply the necessity of seeking a practical indicator which shall permit of detecting slight traces of fire-damp in the air of the mine; and sensitiveness in revealing the presence of this gas ought to be the first condition in such an appliance. This is the problem which M. Somzée set himself to solve; and his studies ultimately resulted in two classes of instruments, one indicating and the other giving warning of minute quantities of fire-damp, or of carbonic acid. The first permits of ascertaining the precise quantity, even to the slightest trace, of deleterious or explosive gases entering into the composition of the air, and independently of the variations of the barometer and thermometer. It is based upon the principle of the difference of power possessed by gases of absorbing radiant heat, and is set up at any point in the mine, even in the most remote corners. As the safety-lamp is now generally used in collieries, M. Somzée has utilized it for furnishing the calls and indications necessary for keeping a check upon the ventilation. The modification consists only in the addition of a metal ring or band, expanding by heat and capable of closing an electric circuit for causing bells to ring; while there is nothing to destroy the elements of safety. In the portable miners' lamps, a small bell is contained in the case; but the fixed lamps are placed in electrical communication with bells in the office of the ventilation officer. The essential advantage of these warning lamps is, that they reveal fire-damp before the flame of the safety-lamp—even the Davy—makes known the ingress of this gas into the air. The elongation of the flame of the lamp, caused by the presence of fire-damp, is one of the principal properties the effects of which are turned to account in the construction of the apparatus. It affords certain variations of temperature at a given point in the lamp, where the increased heat, due to the gas, sets up a mechanical action which is practically utilized.

Another warning instrument of great sensitiveness, and working automatically whatever be the pressure and temperature of the atmosphere, is based upon the mechanical power of an osmotic current to give an alarm by bells placed in an electric circuit. It may be placed at different points of the advanced workings, and gives warnings to the ventilation officer of ten per cent. of injurious or dangerous gas at the place of observation, carried along by the air-current. In view of the future use of the electric light in collieries, M. Somzée also proposes, as warning instruments, and as means of preventing the mixture of air and gas from attaining dangerous proportions, electro-chemical appliances, based upon the reactions between different substances under the influence of the electric light, for giving calls from all the stations of observation. These lamps would not be for the general use of the miners, but would rather be stationary, or used only by inspectors and foremen. A last class of warning instruments consists in transforming the safety-lamp into a "singing-lamp" by the excitation of a sonorous tube placed over the flame. One tube only may be used; or two or more may give out different notes and come into operation one after the other, as the danger increases. One or the other of these instruments would be placed in well-determined and suitable positions in the workings, each station bearing a letter or number, while in a special office on the surface would be electric bells, with indicators, bearing corresponding letters or numbers, and surmounting a general plan of the colliery, showing the stations, with their letters or numbers, and also all the air-doors for directing the ventilation. Each warning appliance would be in electrical communication with its bells, and the air-doors would be furnished with contacts and connected by wires with the ventilation office, so that the employé might know that his instructions had been followed, and that all was in order for insuring a proper distribution of air. With such an arrangement, a glance at the indicator and at the plan would be sufficient to obtain cognizance of any danger, of its imminence, and the direction from which it threatens. At the same time, the bells in the safety-lamps would warn the miners to put out their lights and retire to a place of safety; or the lamps might be made to extinguish themselves before the critical moment arrives, and before extension takes place in the ordinary safety-lamp.

ACCIDENTS IN MINES.

THOUGH mining is always considered a hazardous work, the general public, and only too often also those engaged in it, have very erroneous ideas concerning the causes of the greatest mortality, and the many circumstances which affect the safety of miners. Accurate statistics, of course, furnish the best guide for an inquiry on the nature of accidents in mines, and furnish some indications as to the character of the measures to be taken to avoid their frequent occurrence. Still, they often furnish only a general result, without allowing precise assignment of the effect of many contributing causes. It is natural to suppose that accidents of one class will be more numerous and more fatal in periods of stagnation of the business; while others will rapidly increase when the state of the markets urges proprietors and managers to strain the capacity of their plant and their force to reap the benefits of round profits. High prices for timber may cause undue economy in protecting miners against falls, or lead to recklessness in robbing the supports in abandoned workings. When a mine is busy, little defects in hoisting arrangements or track will be ignored, and repairs will be left for the dull season. These are causes which often affect the mortality of large districts, and which statistics fail to reveal. Still, with such reservations, accident statistics furnish valuable hints, and certainly are instrumental in dispelling wrong impressions. They are valuable to mine proprietors and managers, both as placing the risks of their business in their true light before the public and as furnishing them a guide as to what dangers they must avoid. Unfortunately, such statistics are collected with care in a few countries only, the returns made by the Prussian government officials being the most elaborate, closely followed by those gathered by the English mine inspectors. In our own country, we possess no data relating to our metalliferous mines, the only figures approaching a high standard of value being those reported annually by the coal-mine inspectors of Pennsylvania.

As the most complete, we may present the statistics of accidents in Prussian mines first They are particularly valuable as showing how different is the proportion of fatal accidents in coal, lignite, and metalliferous mines. We have omitted the list of miscellaneous mines, including salt, slate, limestone, etc.

Fatal Accidents in Prussian Mines.

Year.	Coal.			Lignite.		
	Total number of men.	*Total ac-ciden al deaths.*	*Accidents per 1000 men.*	*Total number of men.*	*Total accidental deaths.*	*Deaths per 1000 men.*
1880	156,125	503	3.222	19,767	42	2.125
1879	149,552	444	2.668	18,627	40	2.147
1878	146,319	401	2.741	18,302	38	2.076
1877	147,024	406	2.761	18,827	33	1.753
1876	159,660	451	2.824	19,322	48	2.484
1875	160,462	454	2.829	18,448	43	2.331
1874	161,993	484	2.988	18,597	38	2.043
1873	159,562	450	2.820	18,068	50	2.767
1872	139,858	383	2.739	17,447	53	3.038
1871	131,337	403	3.075	16,863	65	3.855
1870	107,703	339	3.148	14,780	41	2.774

Year.	Metalliferous.			All Mines.		
	Totol number of miners.	*Total ac-cidental deaths.*	*Deaths per 1000 men.*	*Total number of miners.*	*Total ac-cidental deaths.*	*Deaths per 1000 men.*
1880	67,174	97	1.444	250,294	650	2.597
1879	69,166	82	1,363	235,617	575	2.440
1878	59,848	92	1.537	232,064	542	2.336
1877	59,758	76	1.339	231,117	534	2.310
1876	53,657	61	1.696	240,865	600	2.491
1875	52,773	79	1.499	239,722	587	2.449
1874	55,468	60	1.082	243.155	591	2.431
1873	62,266	68	1.574	247,594	620	2.504
1872	63,493	110	1.732	227,520	564	2.479
1871	58,766	81	1.378	213,156	562	2.632
1870	55,044	79	1.435	133,532	469	2.555

These tables clearly illustrate the greater danger to life of working in coal mines, the average mortality per 1000 men employed, for the period of 1867 to 1880, having been 2·939, against 2·475 in lignite mines, and 1·430 in metalliferous mines. It is the custom to compute also the number of tons of mineral raised per accidental death; the average having been for a period of ten years in Prussia, 77,156 tons for coal, 197,810 tons for lignite, and 44,219 tons for ore. These figures, however, have no value for purposes of comparison, because the quantity raised per miner varies within very wide limits, according to the nature of the deposits, their location, etc. From the detailed statement of the causes of accident given by the Prussian officials, we compile the following table. The figures for the year 1880 show how the various classes of miners were affected. Where the number of accidents is small, of course one single catastrophe may alter the figures very materially. The averages for ten years of all the disasters are added, and they furnish a much better basis for deductions of a general nature. The figures are accidents per 1000 men employed.

Nature of Accidents in Prussian Mines.

Nature of Accident.	1880.			*Average of 1871 to 1880.*
	Coal.	*Lignite.*	*Metallif-erous.*	
Blasting	0.083	...	0.178	0.123
Falls of rock	1.204	0.162	0.566	0 957
On underground inclined planes	0.345	1.052	0.089	0.241
Ascending and descending	0.077	...	0.030	0.114
By falling in shafts	0.135	0.253	0.164	0.208
Miscellaneous in shafts	0.083	0.200	0.045	0.140
Transporting rock in tunnels and galleries	0.090	...	0.045	0.168
Fire-damp explosions	0.576	...	...	0.186
Bad ventilation	0.231	...	0.030	0.076
By machinery	0.077	0.051	0.060	0.068
Water	...	0.253	...	0.030
Above ground	0.256	0.101	0.104	0.174
Not above numerated	0.065	0.051	0.134	0.080
Total	3.222	2.125	1.444	2.465

This table strikingly shows that in all classes of mines, collieries not excluded, falls of rock are the most disastrous source of accident, and that in coal mines they far outnumber the explosions, which are popularly looked upon as such a terror to the miner, while in fact they inflict much greater loss, comparatively speaking, upon the operators. This class of accidents is, of course, more than any other, subject to sudden variations, as the following figures of the deaths in Prussia per 1,000 employés will show:

1880	0.359	1875	0.117
1879	0.221	1874	0.144
1878	0.194	1873	0.166
1877	0.095	1872	0 149
1876	0.112	1871	0.282

An interesting set of figures is given as bearing on the comparative danger of ascending and descending into mines by shafts, by ladder, man-engine, or cage. They cover an average of ten years:

	Ladders.	*Man-engine.*	*Cage.*
Men mining	739,424	71,910	640,710
Number killed	75	41	74
Number killed per 1000	0.101	0.570	0.115

This proves that hoisting the men out of the mines is nearly as safe as the use of ladders, while man-engines are the most dangerous. This, of course, refers to well equipped hoisting-works, carefully watched, which, so far as safety is concerned, compare as favorably with many of the buckets hanging from a rope in our Western camps as a flight of marble stairs to a Mexican notched stick of timber. With that thoroughness which is characteristic of the work of German officials, the mine inspectors of Prussia gather annually a series of statistics which we believe are unique, and the importance of which is not less than the data gathered on accidents terminating fatally. The following figures give the number of accidents in Prussia in 1880 resulting in injury involving a suspension of work of one month or more:

Injuries in Prussian Mines in 1881.

Nature of Accident.	*Per 1000 men employed.*			*Total Average.*
	Coal.	*Lignite.*	*Metalliferous.*	
Blasting	1.839	...	0.521	0.671
Fall of rock	5.637	1.265	1.786	4.111
In underground inclined planes	0.711	0.051	0.119	0.479
Ascending and descending	0.160	0.051	0.149	0.144
Falling in shafts	0.077	0.152	0.830	0.084
Other accidents in shafts	0.198	0.202	0.223	0.200
Transporting rock in tunnels and galleries	0.211	0.708	0.486	0.486
Fire damp explosions	0.717	0.050	0.445	0 445
By machinery	0 243	0.405	0.228	0.228
Above ground	1.057	0.556	0.907	0.907
Not above specified	1.165	0.506	0.927	0.927
Total	12.932	3.946	4.615	9.701

Here, too, the overwhelming preponderance of accidents by falls of rock is fully illustrated, and it may be of interest to note that of the 1029 men thus injured, 108 were totally incapacitated for work, while 921 were able to return after a suspension ranging from one to six months. Taking all the accidents together, 2428 men, out of 250,294 employed, were injured so gravely that they could not go to work in less than a month, and of this number, 211 were made invalids for life.

The statistics collected by the mine inspectors of Great Britain since the year 1851 are somewhat different in form, and some data are added which fully confirm conclusions which it would be natural to draw from the occurrence of certain classes of accidents. The British mine inspectors are careful to enumerate both the number of accidents and of deaths. As might be expected, these figures show that, while the number of fire-damp explosions is small, they usually cause many deaths, while the other accidents show a much lower mortality. Beyond this fact, the figures relating to the number of accidents, and not to the number of deaths, show little that is not better studied from the tables giving the latter.

Comparison of Fatal Accidents and Deaths in English Coal Mines.

Accidents and Deaths.		*Fire-damp.*	*Roof falling.*	*Shaft.*	*Miscellaneous Underground.*	*Miscellaneous Surface.*	*Total.*
Average for ten years ending 1860.	Accidents.	82.0	361.1	183.7	100.3	46.8	773.9
	Deaths	244.1	376.7	211.9	118.6	50.5	1,001.8
Average for ten years ending 1870.	Accidents.	56.5	403.1	133.3	156.1	73.8	822.8
	Deaths	226.7	416.3	150.5	191.6	77.5	1,062.6
Average for ten years ending 1880.	Accidents.	42.4	436.7	120.8	175.5	87.2	862.6
	Deaths	268.6	450.8	135.5	190.2	89.8	1,134.9

The British mine inspectors calculate the ratio of persons employed to each death, a method which does not so strikingly show the variations, because it must be remembered that greater safety is indicated by higher figures, while the ratio of deaths per 1000 persons employed indicates at a glance an improvement or a decline. The following are the figures for the mines classed under the coal mine act, including some fire-clay, ironstone, and shale mines:

Accidents in English Coal Mines.

Ratio of persons employed to each death.

Year.	*Fire damp Explosions*	*Fall of roof*	*Shaft.*	*Miscellaneous under ground.*	*Miscellaneous surface.*	*Total.*
1851–1860	1,008	653	1,161	2,074	4,872	245
1861–1870	1,408	766	2,121	1,666	4,119	300
1871	1.378	852	3,015	2,107	5,151	345
1872	2,914	916	2,697	1,926	5,360	394
1873	5,122	1,043	2,995	2,317	5,955	479
1874	3.245	1,304	3,498	2,517	4 943	510
1875	1,860	1,167	3,115	2,360	5,467	430
1876	5,416	1,145	3,988	3,453	4,635	551
1877	1,433	1,103	3,832	2,643	5,014	409
1878	811	1,013	4,282	2,952	5,527	336
1879	2,591	1,110	3,973	2,772	6,715	490
1880	971	1,049	5,329	2,724	5,510	368
1881	4,271	1,101	4,504	2,607	5,630	519
Ratio of deaths per 1000 persons employed.						
1851–1860	0.992	1.441	0.861	0.482	0.205	4.072
1861–1870	0.710	1.304	0.471	0.660	0.211	3 328
1871–1880	0.557	0.933	0.281	0.394	0.109	2.353

The upper table well illustrates the fluctuations which accidents in mines, and notably those due to fire-damp explosions, are subject to. The lower sets of figures will probably best show at a glance what the result of thirty years of steady improvement in methods of mining, in machinery, in appliances, and in administration, have done in British coal mines, in the face of the fact that underground workings have grown enormously in extent, that shafts are deeper, less numerous, and are, therefore, the scene of wonderful activity. The averages of long periods only can efface fluctuations, which are only too natural, and present the general result so clearly proved in these figures.

The accident statistics for the mines classed under the British Metalliferous Mines Regulation Act unfortunately do not cover so long a period, having been gathered with accuracy only since 1874. Still, as the main cause of great fluctuations, fire-damp explosions, are absent, the briefer period may be accepted as showing the course of events fairly:

Deaths caused by Accident.

Year.	*Falls of ground.*	*In shafts.*	*Miscellaneous underground.*	*On surface.*	*Total.*	*Persons employed.*		*Rate of deaths per 1000 men employed.*
						Per fatal accident.	*Per life lost.*	
1874	40	34	15	14	103	599	547	1.827
1875	32	35	33	19	119	528	488	2.049
1876	25	16	23	6	70	871	821	1 217
1877	41	21	24	11	97	659	501	1.690
1878	27	19	23	8	77	695	668	1.496
1879	24	16	16	8	64	771	735	1.3[illegible]0
1880	31	21	19	13	84	645	630	1.589
1881	36	22	32	9	99	646	555	1.802
Average	32	23	23.1	11	89.1	661	611	1.636

In Great Britain, too, the danger to life is less in metalliferous mines than in coal mines, and in both, falls of ground are the most prolific source of accidents. On the whole, the elaborate statistics quoted are encouraging, especially when it is considered that many circumstances influence progress adversely. A good deal of the improvement is probably due also to the higher grade of intelligence among the miners, although it is probably in the direction of greater care on their part that the chances of further improvement must principally rest.

—*Engineering and Mining Journal.*

FIRES IN MINES; THEIR CAUSES AND THE MEANS OF EXTINGUISHING THEM.

FIRES in mines are so serious in their consequences and of such frequent occurrence, that their causes and the means of extinguishing them are certainly questions of the greatest interest to a large part of the engineering profession. We have already in this country many mines which have been burning for years, and though our hard anthracite is so difficult to ignite that for a quarter of a century after it was first discovered it was not known how to burn it except with the aid of an artificial blast, yet most of the fires which have occurred underground have been in anthracite mines, and in the coal itself. The injury which these fires have caused to properties in various parts of the anthracite regions, and the cost of extinguishing them, would amount to many millions of dollars, and they have also occasioned the loss of many valuable lives. It is not surprising, therefore, that the subject has already attracted much attention, and the exercise of great ingenuity; and the present communication is made less with the expectation of announcing anything new, than with the object of putting upon record the present state of our knowledge upon this subject, or, in other words, of indicating how defective are the present means of combating underground conflagrations.

Causes of Mine Fires.—Even upon the surface, fire is a terrible foe to contend with, and there is probably no other which inspires such thorough and well-founded alarm. With what feelings, then, must we look upon this destructive element, when its field is in the narrow galleries of a mine where the poisonous products of combustion, spreading in every direction, protect, in the most effectual manner, the fire itself from the attacks of extinguishers, while, if the face of attack be ventilated so as to enable them to approach the seat of the fire, the air current simply increases the extent and violence of the conflagration. Fires underground originate in as various ways as those on the surface, and it is scarcely necessary to say that, except in the rare cases where they are the result of design, they are invariably classed as "accidents," and most generally as "unavoidable accidents." In reality, by an intelligent understanding of their causes and with due precautions, they can almost always be prevented. Ignorance and carelessness are their chief causes, and they are generally "unavoidable accidents" only in so far as ignorance is an accident, or carelessness unavoidable. Moreover, what, according to the light we possess to-day, may be styled an "accident," will, it is to be hoped, be rendered avoidable as the increase of our knowledge gives us a better insight into causes now hidden. I will mention some of the more common immediate causes of mine fires, and then speak of the means adopted to prevent fires, and those employed to extinguish them when they have occurred.

It is now happily a rare thing that a mine is ignited through malice or design. The most ignorant and vicious of those who work about them understand too well the enormous injury that is occasioned, to all who live in the district, by a mine fire to indulge in it as a measure of revenge for real or imaginary personal injury. It is not the owner of the mine who is the only, or in most cases, the principal loser. The efforts made to extinguish it are very frequently, we may say generally, accompanied by the loss of the lives of some of those engaged in the work; and during its continuance, which, in many cases, extends through many years, the regular work of the mine is suspended, and the workmen with those dependent, directly or indirectly, on their labor for the means of living are the chief sufferers. Still, rare cases do occur where a vicious individual is so blinded by what he considers injustice or oppression as to overlook the injury he brings upon innocent parties, and to seek revenge in this manner. In the so-called "good old days," before the rights of our neighbor were as well defined or as much respected as they are to-day, fires from this cause were not unfrequent; but as the mines were usually small, the extent of the injury done was limited. An example of one of these ancient fires, and, we believe, the only one, in Belgium, which continues burning from the olden time to the present day, is that in the vein known as the *Grande Masse de Falizolle.* This bed, Ponson tells us, was worked in a piratical way, above water-level, in a hill near Falizolle, between Namur and Charleroi, by the inhabitants of the neighboring country. The quarrels that even in those early days sometimes existed between neighbors were not forgotten when they went below ground, so when the drifts in which they worked happened to meet it was made the occasion for a regular battle, and those that heaven helped with a favorable wind were not slow in taking advantage of the blessing to smoke out their neighbors by burning pieces of old leather on a fire built in some *safe* place in the galleries. On one occasion, about the year 1822, while indulging in this harmless, but effective, method of disposing of their enemies, the coal in the mine became ignited, and has since continued to burn, excluding both sides of the fight from the benefits of free coal. Many attempts have been made to extinguish this fire, but owing to the position of the bed, near the surface and above water-level, it has been found impossible to control it.

In this country, in the anthracite regions particularly, many fires whose origin is unknown, have been attributed to design. In the majority of cases the cause was probably carelessness, though in some rare instances the malice of men on strike, who have had, or thought they had, some grievance, has doubtless been the origin. Among the mines that have been on fire for a great many years may be mentioned the Summit Hill Mine, near Mauch Chunk, the Greenwood Company's Mine, near Tamaqua, and some others in Schuylkill, Carbon, and neighboring counties of Pennsylvania. Some of these fires have now been burning upwards of twenty years. The causes of most of these are shrouded in mystery, but they are probably due to carelessness or spontaneous combustion. Carelessness is by far the most frequent cause of mine fires. A workman will leave his candle, or lamp, attached to a piece of timber in such a manner as to finally ignite it, as was the case in the great fire in the Yellow Jacket Mine of the Comstock Lode, in 1875. A fire basket will sometimes be hung so near the coal or timber as to set it on fire. Smoking in the stables underground has occasionally been the cause of conflagrations by the fire from a pipe falling among the straw and litter. It was from a lamp igniting a bundle of straw in the shaft that the West Pittston disaster occurred, by which 20 persons lost their lives. In a word, carelessness acts through about the same channels below ground that it follows above, though the field for its operation is more restricted in the mines and its effects are more disastrous. If a miner, going into a portion of the mine in which fire-damp has accumulated, with a safety lamp in his hand and *an open light on his hat,* as has been done on many occasions that are well authenticated, the resulting explosion and fire can scarcely be considered as accidental, any more than can the equally well-authenticated case of a man blowing himself up by firing the open keg of powder, from which he was filling a cartridge, by the burning oil dropping into it from the open lamp on his hat. Incredible as these cases of carelessness may seem, they are by no means isolated occurrences, but we have heard, from the very best authority, of several instances of each.

Ignorance is a scarcely less frequent cause of fires in mines than carelessness; indeed, it is difficult to say just where the one ceases and the other begins. It is frequently not altogether carelessness that causes the fire when a miner hangs his lamp so near the coal that it finally ignites it; he may not know that the heat of the lamp, not in itself sufficient to ignite the coal, may liberate and ignite the highly inflammable gases, and thus communicate the fire to the solid coal. Nor is it always carelessness that causes a fire by throwing away among the "gob" the oil-saturated cloth, or the cotton "waste" that has dropped from the oil-box of a mine wagon. He who threw it away among the fine coal may have been ignorant of the fact that the heating which comes from the decomposition of iron pyrites, and from the slow combustion of carbon in a comminuted state, though it may be insufficient to ignite coal alone, may be quite sufficient to ignite the oil-saturated "waste," already heated by the oxidation of the oil. There are few of the mine superintendents, not to mention the miners, who have any knowledge of the very important influence which coal-dust has upon the explosiveness of mixtures of fire-damp and air, or of the causes of spontaneous combustion of coal and wood; and while exercising the utmost care required, as they believe, they may, in ignorance, be doing or leaving undone, things which result in a fire—a fire that is then said to be "purely accidental," and which it was "impossible to foresee or prevent."

Nearly every fire that occurs in a mine is said to be an "unavoidable accident," and so far as an accident is "an event that takes place without one's foresight or expectation; an event which proceeds from an unknown cause," most fires may be so designated; but the ignorance which makes them, in this sense, "accidents," is not unavoidable, and should not exist. I have frequently seen the fire-pot, or grate, that stands near the foot of almost every shaft in the anthracite coal regions in winter, placed so close to the solid "rib" of coal, as to heat it far beyond a safe temperature; and before leaving the mine, at the close of the day, coal would be piled upon it, in order to have it burning well in the morning. A change in the direction of the wind, or in the temperature at the surface, is sufficient to increase the draught, and fan up the fire to a furnace-heat; is it surprising, then, that several fires in our mines have been traced to this cause?

Underground boilers are a cause of mine fires still more fruitful than that just mentioned. The number and extent of the conflagrations due to this kind of "accident," in Pennsylvania, are enormous. In the immediate vicinity of Wilkes-Barre, Pa., alone, they have cost the companies millions of dollars. One would suppose that the enormous losses inflicted by such fires would have absolutely prohibited the use of the boilers or furnaces in coal mines, yet there are many of our mines still ventilated by furnaces, and not a few that have boilers underground. The fire in the Avondale Colliery, in which one hundred and ten persons lost their lives, was occasioned by a ventilating furnace. Wood was used in lighting up the fire, and the sparks from this were carried up into the wood-bratticed upcast shaft, igniting it and the "breaker" building which stood over the shaft. As the mine had but this one outlet, the one hundred and eight persons at work in it (and two volunteers, who subsequently entered it), were suffocated before they could be rescued. In this, as in nearly every case, the furnace was thought to be "perfectly safe;" it was at some distance from the shaft, and had been in use for some time without "accident" of this kind. The mine did not produce fire-damp, and, consequently, one source of danger was eliminated. In fiery mines when the air for the furnace is taken from the return air courses, there is introduced a source of accident of a very serious character. It is probable that even when the return air is not, in itself, explosive, it may become so by the presence of a very small quantity of coal-dust; and it is well known that, even without the presence of fire-damp, the finely comminuted carbon, whether soot or coal-dust, is very easily ignited, and this has, probably, been the cause of more than one of the mysterious fires that have occurred in our anthracite mines. Such a case was that known as the Empire Mine fire (Lehigh and Wilkes-Barre Coal Company), near Wilkes-Barre, Pa. The fire originated in an abandoned chamber, from which the coal had been taken, and which was made to serve as a flue for the smoke from a set of underground boilers. It is supposed that the soot collected in this large chamber, and became ignited from a spark, or that pieces of wood, dried to tinder, caught fire in the same way; in either event, the furnace was considered "perfectly safe," and yet it resulted in a fire that cost more than half a million dollars to extinguish. The great difficulty experienced in igniting anthracite coal, when it is desired to burn it, is relied on too implicitly as a safeguard against fire; and this misplaced confidence leads to the introduction of risks that would never be admitted in a bituminous coal-mine. I have frequently seen both ventilating and boiler furnaces separated from the solid coal by but a thin brick wall, and a few inches of space. The boilers which are always of the plain cylinder type, fired externally, are usually covered with a thin bed of sand, and a crack in the brickwork, or a hole through which the sand can run, may allow the fire free escape to the solid rib, or to the roof, that in some instances is a carbonaceous shell.

When the roof is not very solid it is frequently supported, over the boilers, on heavy timbers; and it is not unusual to find a mass of timber, that the heat has made as inflammable as tinder, supporting the roof only a few feet above the boilers. A single spark may ignite the mass, and the matter of surprise is, not how the fires originate in such mines, but how these so often or so long escape being burnt up. The fire which has now been burning in the Baltimore Mine, near Wilkes-Barre, for two years, and the efforts to extinguish which are said to have cost already nearly three-quarters of a million of dollars, was caused from underground boilers. These were, as usual, "perfectly safe," but the blast of air occasioned by a heavy fall of the roof in the vicinity, forced the fire from under the boilers and ignited some timber under the fall. As the cave extended over several acres of ground, and as the vein was above water-level and near the surface, to which the rock broke through, there was no means of getting at the fire, or of extinguishing it with water. That part of the mine had to be walled off by brick or earth walls, and, doubtless, the fire will continue in the portion "caved in" for many years to come. Underground boilers and ventilating furnaces have probably occasioned more fires than any other cause, at least this is the case in the anthracite mines of Pennsylvania.

Explosions of Fire-damp.—Not many years ago, while the Pennsylvania mines were worked along the outcrops of the coal-beds, it was commonly stated that anthracite did not yield this dangerous gas, but the mines were carried below water-level to a constantly increasing depth, but that some of the most fiery mines in the world are in this hard coal. The hardness of the coal is so great as to require the use of explosives to break it down, and it is not an uncommon thing for a vein to yield fire-damp in such enormous quantity as to ignite at every shot in headings driven out into the solid. At the Prospect shaft, near Wilkes-Barre—probably the most fiery mine in the coal field—the make of gas has been so rapid that with a current of air from 20,000 to 30,000 cubic feet per minute, passing through the gangway (12 feet wide by 7 feet high), it was impossible to proceed more than ten feet beyond the cross-heading connecting the gangway and parallel airway, without putting in bratticing to carry the air up to the face—or with such bratticing (dividing the gangway into two parts, each 6 feet by 7 feet), the velocity of air current being from 500 to 600 feet per minute—the gas would ignite at the face when the distance from the face of the gangway to the bratticing was more than fifteen feet. With such a prodigious discharge of carburetted hydrogen almost every blast would ignite it, and if the promptest measures were not taken, the coal was quickly aflame. The heat of the burning gas always tends to draw still more gas from the coal, and the longer the fire continues the more fiercely it burns and the more difficult it becomes to extinguish it. A number of fires have occurred in this and other collieries in the same field from this cause, and that notwithstanding all the efforts that it was thought possible to make to extinguish the fire. With a sudden fall of the barometer, or the striking of an unusually strong blower, the fire would gain the mastery, and several of the mines have had to be filled with water to extinguish the conflagration. There is still another and more mysterious cause of fires in mines, viz., spontaneous combustion. As this important cause of fires is but imperfectly understood by those in charge of our coal-mines, and as it is a matter whose interest and practical application are not confined to fires in mines, I shall enter with some detail into the subject. It may be remarked, at the outset, that what is known as "weather waste," is but a mild form of spontaneous combustion; we may, therefore, treat this part of our subject under the title of

Spontaneous Combustion and Weather Waste of Coal.[1]—Coal is a very complex substance, and though one with which we have long been very familiar, and which we make use of by oxidizing (burning), the subject of the exact conditions under which its oxidation takes place has received but little attention, and is, even yet, but imperfectly understood. We all know that at a high, but variable, temperature, the carbon of coal combines with the oxygen of the air, and forms carbonic oxide, or carbonic acid, as the case may be; but there are few who know at what temperature this absorption of oxygen commences, or what conditions facilitate it at a low temperature.

We are principally indebted to Professor E. Richters, of the Mining School at Wallenburg, for knowledge, so far as it goes, of this interesting and important subject. He has determined that at the ordinary temperature coal left in contact with oxygen, either pure or mixed with nitrogen, as in atmospheric air, absorbs oxygen, of which one portion combines with carbon and hydrogen, forming carbonic acid and water respectively, while another portion enters into an unknown state of combination with the coal, and proportionately increases its weight. Berthelot[2] has succeeded in demonstrating the fact that coal can be hydrogenized also, at a temperature not exceeding 527° Fahr. In absorbing hydrogen, in the experiments of M. Berthelot, as much as two-thirds of the coal was converted into liquid hydrocarbons of the petroleum class. On the other hand, we know that all coals, when freshly mined, give off a very noticeable amount of a hydrocarbon gas. In some mines, even in the hard anthracites of Pennsylvania, the escape of occluded gas is so energetic as to make a hissing or singing sound, that is easily recognized. This discharge of gas continues for a very considerable time, probably several weeks in some cases, after the coal is removed from the mine. In proof of this we have the record of a great number of explosions on vessels loaded with coal, and even with anthracite, days, and sometimes weeks after it was mined. It has also been ascertained that all coal, or at least all bituminous coal, and above all those soft varieties that are rich in volatile matter and poor in fixed carbon, lose a large part of their volatile constituents by exposure to the action of the atmosphere, especially when the coal is in a finely comminuted state, and is exposed to a high temperature and moisture. The gas thus evolved varies, both in quantity and in composition, according to the nature of the different coals; it contains carbonic acid, oxygen, nitrogen, marsh gas, ethyl hydride (C_2H_6), gases absorbable by sulphuric acid, and sometimes a small amount of carbonic oxide. By far the most abundant of these gases is free nitrogen, and as this has never been certainly proved to result from any natural process of decay, it is probably derived from the atmosphere.

This view seems to be confirmed by Richter's investigations on the weathering of coal, from which he concluded that more oxygen is absorbed from the atmosphere in weathering, than suffices to oxodize that portion of the carbon which is evolved in the state of carbonic acid. A portion of the balance, probably, combines with the hydrogen to form water, and another portion enters into an unknown state of combination with the organic substance of the coal, and still another portion is consumed in oxidizing the iron pyrites which are almost always found in coal. M. Marsilly (see *l'Eclairage du gas* de R. d'Harcourt) found that the long flaming coals, free from fire-damp, of the Grand Hornu, Belgium, when heated to 350° Cent. (662° Fahr.) evolve nitrogen to the extent of 31.83 to 44.27 cubic inches per lb. of coal, and one kilog. (2.2 lbs.) of *fat fiery caking coal* at the temperatures indicated gave off the following quantities of gas:

Degrees Cent.	*Degrees Fahr.*	*Litres*	*Cubic inches*	*Gas.*
70 to 150	158 to 302	0.46	28.07	Uninflammable gas.
150 to 180	302 to 356	0.2	12 21	Gas yielding a blue flame.
180 to 250	366 to 482	0.9	54.93	" a long illuminating flame.
250 to 300	482 to 572	0.51	31.12	" a longer and brighter flame.
300 to 325	572 to 617	0.5	30.51	" a still longer and brighter flame.
325 to 350	617 to 662	.0.23	14.04	" a very long and brilliant flame.

Marsilly concludes that coal impregnated with fire-damp gives off from 1 to 2 per cent. of uncombined hydrocarbons, below 626° Fahr., and the coal then completely loses its caking properties. These are the coals which deteriorate when exposed to the air in heaps. The long flaming dry coals, at 527° Fahr., evolve but little nitrogen, a circumstance which distinguishes them from the fiery coals. Heated from 572 to 1013° Fahr. (545° C.), they do not give off gas, and are not much affected by exposure to the air. Freshly mined coal is acted on most energetically by the oxygen of the air, and though, according to Richters, coal never entirely loses its power of absorbing oxygen, that power constantly diminishes by exposure to the air. According to the same authority, when coal is heated from 180° C. to 200° C., it at first gains in weight, more oxygen being absorbed than the weight of carbonic acid and water evolved; but on continuing this temperature, after a time both the weight and chemical composition of the coal will remain constant,(?) and the relation in weight which then obtains between its hydrogen and oxygen is that in water, from which it is inferred that the oxygen which combines with the carbon is evolved again as carbonic acid, and that, consequently, with the disappearance of the disposable hydrogen, the permanent absorption of oxygen should cease. It has also been found that the quantity of oxygen absorbed by different coals, under the same conditions, is proportionate to the quantity of water they absorb, which last does not appear to depend on the physical structure of the coal, compact bright coals sometimes absorbing from two to three times as much water as very loose, soft, and tender schistose coals; but coal from the same seam over a wide area absorbed the same proportion of water. This characteristic may prove to be of such general application as to afford valuable assistance in the identification of coal-beds where the measures are disturbed by faults, etc. Richters also found that coal absorbs three times as much carbonic acid as oxygen in a given time, and under the same conditions; and even coal that has been weathered till it will scarcely take up any oxygen will quickly absorb its own volume of carbonic acid. Numerous experiments seem to prove that sunlight always lessens or retards the absorption of oxygen by coal; a fact that may, in part, explain the generally admitted phenomenon of coal or wood not burning so well in the sunlight as in the shade. That some coals are capable of spontaneous ignition when allowed to accumulate in the form of dust or slack, and, sometimes when subjected to heavy pressure in the pillars of coal-mines, is a well-known fact; but to what this property is due has always been an open question, though it has usually been attributed to the decomposition of iron pyrites in the coal and shales accompanying the coal. The atmospheric oxidation of iron pyrites, by which the sulphurets are changed into sulphates, is a comparatively slow process; and, though undoubtedly capable of developing a large amount of heat in a confined area, it does not account for the majority of well-substantiated instances of spontaneous ignition of coal, both in the mines, on board ship, and in stock-yards. Richters has shown conclusively that the coals most liable to spontaneous ignition are not those which contain the largest percentage of iron pyrites, but that this property is principally due to the atmospheric oxidation of the organic substance of the coal. The following table gives his classification of eleven varieties of coal, according to the degree of their self-inflammability:

Table of Coals arranged according to Degrees of Self-Inflammability.

Degree of Self inflammability.		*Iron Pyrites. Per cent*	*Water Per ct.*	*Character of the Coal.*
CLASS I.—Difficulty self-inflammable. . .	1	1.13	2.54	Easily friable.
	2	1.10 to 3.04	2.75	Very compact.
	3	1 54	3.90	Very compact.
CLASS II.—Of medium self-inflammability. .	4	1.20	4.53	Firm, schistose, bright.
	5	1.08	4.55	Hard, but very brittle.
	6	1.15	4.75	Moderately tender.
CLASS III.—Readily self-inflammable. .	7	1.12	4.85	Outwardly very like No. 1.
	8	1.00	9.01	Modera'ly tender, schistose
	9	0.83	5.30	Moderately soft, schistose.
	10	1.35	4.85	Moderately soft, schistose.
	11	0.84	5.52	Not stated. Yielded only 2.5 per ct. of ash. From the same pit as No. 10, but from a different seam, are markable for its greater self-inflammability

[1] Many of the data relating to this subject will be found in the last edition of Percy's Metallurgy, 1875.

[2] Ann. Chim. Phys., 1870, and Bulletin Soc. Chim.

From the above-mentioned facts, which express the results of the latest and most reliable observations and direct experiments, somewhat contradictory as some of them seem to be, we may deduce many valuable practical lessons. Many varieties of coal deteriorate to a great extent when exposed to the air, and this deterioration is greatly favored by high temperature, and, in coals which contain sulphurets of iron, by moisture; in coals free from iron pyrites, this oxidation seems to be even more energetic when dry than when wet. It is always greatly increased in all kinds of coal by increase of temperature, and is more energetic when the coal is in dust or slack. This deterioration of coal has been aptly termed "weather waste." It is, as we have seen, not dependent solely on the physical character of the coal, though the harder the coal the less it is injured, and, in some cases that have come to my own knowledge, an exposure of eight or ten years of certain Lehigh anthracites had not affected the quality to any extent that could be appreciated in its subsequent use in blast-furnaces. In the case of coking and gas coals, however, the depreciation in the heating power, and in the coking and gas producing properties is very great; indeed, a very moderate exposure to the air, in heaps, at a high temperature and when moist (for these coals, for the most part, contain more or less iron pyrites) frequently entirely unfits them for use. A recent example suggests itself, in which a large amount—several thousand tons—of Albertite (a rich gas-producing mineral quite free from sulphur) was piled on dock in Boston. So rapid was the absorption of oxygen by this so-called coal that it heated and actually fused, running together round the edges of the pile, and finally even ignited. Its value as a gas coal was almost entirely destroyed.

The spontaneous ignition of coal is, doubtless, greatly facilitated by, though not altogether due to, the presence of iron pyrites; for the oxidation of the iron pyrites is attended with considerable development of heat, and by swelling, it splits up the coal, and renders it more pervious to oxygen. The real cause of spontaneous ignition is probably the oxidation of the organic substance of the coal; it is, in fact, a very energetic example of weather waste, and the precautions to take in each case are the same. In mines the crushing of the pillars, where they are left too small, and their gradual spalling off, from the oxidation of the coal and pyrites in the coal, cause an accumulation of fine coal around the pillars; this and the fine coal thrown back into the "gob" along with the shales (which contain most of the iron pyrites) and other rubbish, form exceedingly favorable conditions for spontaneous combustion. There is usually enough oxygen in the air of the goaves to support this slow combustion, while the velocity of the air current is not sufficient to carry off the heat, and thus prevent the weather waste from developing into spontaneous ignition of the coal. Spontaneous combustion is by no means confined to coal, but pieces of wood imbedded in the coal-dirt, rags or cotton waste saturated with vegetable or animal oils, are very subject to it; in fact this is the cause of a great number of fires on the surface as well as in the mines. As an instance of the facility with which cotton, saturated with oil, will ignite, I may mention a curious case that came under my observation some years ago. Two or three men were severely burned by an explosion of a powder-mill at Wilkes-Barre, Pa., and the remedy applied by the kind-hearted neighbors was to envelop the patient in cotton padding, saturated with linseed oil. They were greatly astonished to find that the heat of the body, after a time, ignited the cotton and oil, and the victim of well-meaning ignorance was with difficulty saved from cremation. Many of the unaccountable fires in the mines, both in anthracite and bituminous coal, are undoubtedly due to spontaneous combustion, either of the coal itself, in some of the bituminous coals, or, more frequently, from the more energetic spontaneous combustion of oiled "waste" or other easily inflammable substance. The fire that has now been burning since August, 1871, in the No. 6 tunnel, Summit Hill mines (Lehigh Coal and Navigation Company), is supposed to have been caused by spontaneous combustion, originating in the gob or rubbish in some abandoned works where the ventilation was very slack. It is exceedingly doubtful if our hard Pennsylvania anthracite will ignite spontaneously, even when they contain considerable quantities of iron pyrites, but it is an incontestable fact that piles of culm or coal-dirt, on the surface, in many parts of the anthracite regions, have ignited spontaneously. I attribute the ignition to the presence of the more inflammable rags or cotton-waste saturated with oil, or simply to oil saturating the fine coal, as can readily be conceived may occur in almost every pile of coal-dirt around a colliery. Many of you have, doubtless, frequently noticed the heating of culm-banks, but it is rarely that one actually ignites, which tends to prove that the anthracite coal itself, even in the form of dust, will not ignite spontaneously, but that the accidental presence of a more inflammable substance may readily cause a fire. Soot from anthracite coal, or indeed from any kind of coal, is less inflammable than ordinary lampblack, which ignites with such facility that even a few drops of water, oil, or other moisture falling in it, is liable to cause its ignition by the rapidity with which it absorbs oxygen, as several fires in lampblack factories in different parts of the country have proved. It is well known, also, that powdered charcoal will absorb oxygen from damp air so quickly as to ignite spontaneously; is it possible, therefore, to overestimate the danger of using chambers in the coal flues for underground furnaces? If it be necessary, which is rarely if ever the case, to have boiler or ventilating furnaces in a coal-mine, it is no more than ordinary prudence to line the flues with brick throughout, and take even greater precautions than would be taken in houses on the surface.

Means Adopted for Preventing Mine Fires.—Having thus reviewed the principal immediate causes of mine fires, it remains for me to mention the means adopted to prevent these causes from producing their natural effects, and finally to investigate the means of extinguishing fires when they do occur. The mere mention of the causes of mine fires suggests, in most cases, the preventives to apply. Where the cause is carelessness there must be strict and judicious rules and careful inspection, this will prevent many of these and other accidents that make the miner's calling a somewhat dangerous one. Ignorance of the nature and full bearing of the immediate causes we have just mentioned is the ultimate cause of most "accidents." Carelessness is usually, though not always, the result of ignorance of the results that may spring from the careless act. For example, it is too often either not known, or if known, not fully appreciated, that though the wood over the boilers is not at first easily ignited, and the new setting of the boilers allows no undue escape of heat and sparks, yet the wood in time becomes like tinder, and the walls supporting the boilers are liable to crack, and the accummulation over the boilers of coal-dust, and possibly light wood-fibres, from the timber supporting the roof, create a constantly increasing danger. The fire that results from these favorable conditions can scarcely with propriety be called accidental, though that term may satisfy the unquestioned faith of that patient and exemplary class, the stockholders of the mining company.

In fiery mines the practice of shot-firing is the cause of many explosions and fires. In anthracite coal it would seem at present as if the use of some explosive were absolutely essential for the economical getting of the coal, yet substitutes for explosives have been proposed and are actually in use for many purposes, but no effort seems to have been made by the owners of fiery anthracite mines to investigate or test such substitutes, or to encourage the invention of others. They seem to rest satisfied with taking the precautions which experience has shown to be sufficient, in most cases to control and extinguish fire when once ignited, but which experience has also fully demonstrated to be unequal to some emergencies, or to be subject themselves to unavoidable accidents. Of course it is in but comparatively rare cases that underground boilers, or ventilating furnaces, or powder shots result in fires, but the enormous loss incident to a mine fire makes the risk from these rare cases much too great to be undertaken by prudent managers; and so far at least as underground boilers and ventilating furnaces are concerned they are quite unnecessary risks. Steam can be carried to considerable distances (say 1500 to 2000 feet) through properly protected pipes, without any very great loss of condensation. Boilers on the surface are much more enconomical in installation, and in running expenses, as generally to compensate for this loss of steam; and where steam cannot be used—and in most cases where it can—compressed air forms a perfectly safe and equally efficient means of transmitting power. Compressed air is not an economical motor as compared with the direct use of steam, but it is a safe and convenient one for mine use, and after its use in the underground engines it serves for ventilation, while the exhaust steam is exceedingly injurious to the timber, and in some cases, to the roof-rock of the mine. Wire ropes can also be employed to advantage in some cases for the transmission of power in mines. Mechanical ventilators have been shown to be almost always more economical, and in every case more efficient, reliable, and safer than furnaces for mine ventilation. There is consequently no necessity for incurring these risks of enormously costly conflagrations. As already stated, the danger from spontaneous combustion of the coal in mines may be overcome either by a ventilation so active as to keep the temperature of all parts of the mine so low as to prevent ignition of the coal, or it may be prevented by an almost opposite course, viz., by cutting off altogether the ventilation of abandoned workings so that, from the absence of oxygen, no combustion can take place. In mines where the coal is subject to spontaneous combustion, both plans are adopted, with more or less success. If it were possible to keep the abandoned works always open, to prevent falls or crushing of pillars, or accumulations of fine coal in places where but little air can reach them, probably thorough ventilation would insure safety; but as these conditions cannot be secured, it has been found safer to prevent altogether the access of air to the parts of the mine where conditions favorable to spontaneous combustion exist. The method of walling off the goaves or old workings is objectionable in many respects. If the mine produces fire-damp, the walling off merely creates a magazine of a most dangerous explosive gas in the mine. If a fall of roof occur in the goaves, it may force this gas out into the working parts of the mine, and cause explosions; or, in many ways, a small but sufficient quantity of air may be admitted to the walled-off space to sustain in the most effective manner the slow combustion which it is desired to prevent. In the south of France, where the beds are very large, and the coal subject to spontaneous ignition, the system of mining known as by "remblais," where the space from which the coal is taken is filled with waste material, and the roof is allowed to settle down on this packing has been found to be the only really effective preventive of fires from spontaneous combustion. The packing effectually excludes air, and consequently no combustion can take place. No other system of mining than that of taking out all the coal, and either allowing the roof to fall as the work proceeds, or of filling the space from which the coal has been taken, is adapted to working in coals of this character. In chamber and pillar work, the crushing of the pillars, which cannot be prevented, is a constant source of danger, for it presents the most favorable condition possible for the spontaneous ignition of the coal.

The most efficient preventive of fire in mines, from whatever cause they may come, is to be found in education—in increased knowledge of the causes of fires and a better appreciation of the working of these causes. Our mine managers should be obliged to pass strict examinations, and no one should be allowed to undertake the responsible duties of this place without a certificate of competency, given by a qualified board of examiners. Nor is it sufficient that the managers alone should be better educated; the miners themselves should be taught the causes and preventives of the dangers they meet with in their work. Special, free, instruction upon these points might be furnished at every colliery, and this could doubtless be accomplished by encouraging the giving of public lectures, by practical miners and engineers, on subjects of interest to the miners, and by the giving of small prizes to those who pass the best examinations on subjects of daily practical application in their calling. I am well aware of the difficulty of exciting any interest among the majority of our miners in anything that is not actually their "bread and butter." They care little for the dangers they encounter, and do not appreciate the importance of knowing more than how to swing a pick or use a drill, and but little of these accomplishments. Nevertheless, I believe that the leaven of a small percentage who would profit by such instruction would finally leaven the whole mass, and the practical results of the increase in knowledge would be apparent in greater care and better mining, even by those who had not taken any part or interest in the lectures. Greater knowledge always makes better workers, and the mine-owners would find in this a good return for the small expense incurred. No startling results are expected from this suggested plan. A pretty intimate acquaintance with our mining classes, long ago dissipated the expectation of bringing about a millennium in the mining regions by means of education and instruction such as we have here suggested, but I nevertheless believe the modest results anticipated would abundantly justify the trial of some such plan as this.

Means adopted for Extinguishing Fires.—With all the precautions that the present condition of our knowledge suggests, fires will sometimes occur, and as there is, unfortunately, no prospect of the immediate application of all the preventives that we do know, fires in mines will continue to be common accidents. We will now review the more important means proposed for extinguishing them.

When blowers of fire-damp ignite in a mine they can sometimes be beaten out with wet clothes. In some instances the sudden vibration of the air, caused by the discharge of a small cannon, has been found quite effective. This remedy is applicable only when the fire has not had time to ignite the coal, and when the discharge of explosive gas is limited to the confined space on fire. When the burning gas cannot be beaten out by means of wet clothes, carbonic acid applied by portable fire-extinguishers, such as the Babcock, the Connolly, and others, can be used with advantage, as has been done in Pennsylvania during the past few years. The carbonic acid, in addition to excluding oxygen from the fire, tends in expanding rapidly, to cool down the inflammable gas to a point below the temperature of ignition; the force with which it is thrown against the burning gas also exerts a powerful extinguishing influence. The portability of the extinguishers, which are easily carried like a knapsack on the back, enables the workmen to take advantage of every current of air, and to apply the extinguisher wherever it will prove most effective. When once the fire has obtained such headway as to make it impossible to approach it close enough to allow the carbonic acid gas being thrown directly on the fire, recourse must be had to water, which under a heavy head or pressure can be thrown to a much greater distance than the extinguishing gas. Moreover, the carbonic acid would quickly make the air of a narrow heading irrespirable if the ventilation were not active; and if active the fire would extend too rapidly. This objection does not obtain against the use of water; it can be thrown from a considerable distance and with great effect. A single example will suffice. The Propect shaft, near Wilkes-Barre, Pa., already mentioned in this paper as an exceedingly fiery mine, is also a very dry one, scarcely any water being made, though the depth is 600 feet, and the gangways run out very near, if not quite, under the Susquehanna River. In order to combat successfully the fires that occur there so frequently from the ignition of fire damp by shot firing, the general manager, Mr. Frederic Mercur, an engineer of great experience and ability, had a pipe laid along each gangway (when the work was confined to driving gangways and their parallel airways), and strong rubber hose attached to the end, and at other points along the line of the pipe. The shaft-end of this 2½ inch pipe connected with a column-pipe, leading down the shaft from a reservoir on the surface. This gave somewhat more than 600 feet of head, or 260 lbs. per square inch pressure on water leaving the hose, a force sufficent to throw it with great force to a considerable distance. When the gas became ignited the water was immediately turned on (everything being kept constantly ready for such emergencies), and a few minutes usually sufficed to extinguish a fire that with less experienced men would have been considered ample cause for the abandonment of the works.

The skill which men engaged in this work of fighting fire acquire with experience, is not the least important element in the success which has generally attended Mr. Mercur's management of this trying colliery. But even experience and ability have at times been foiled by unexpected events, such as the breaking of the the pipe leading down the shaft, and other less important mishaps, which caused the few minutes delay that were all-sufficient to give the fire an irresistible and unconquerable force. In consequence the mine, though a new one, and not yet worked upon a large scale, has twice had to be drowned out to extinguish fires occasioned in this manner. The Pine Ridge shaft (400 feet deep), also near Wilkes-Barre, is scarcely less fiery than the Prospect, and as it makes a large amount of water, it was found sufficient to tap the base of the column-pipe from the pumps, and to lead the water, as in the other cases, along the gangways in iron pipes, with attachments for rubber hose at intervals in those parts of the mine where fires were likely to occur. When a fire has fully ignited the coal and obtained such headway that it is impossible to overcome it promptly by these means, a systematic method of attack is adopted. The fire must be confined by temporary bratticing or walls, so as to exclude air: the points of attack are approached in regular siege manner, a temporary bratticed approach being kept open and ventilated with a special fan; from this heading the men direct streams of water on the fire, and as they partly extinguish it, the loose coal is removed, and aceess given to portions still burning. The work is exceedingly arduous and dangerous, and the least interruption in it allows the fire to recover the ground that may have been gained from it. A better example of fighting the fire in this manner can scarcely be cited than that of the Empire Mine fire near Wilkes-Barre, Pa., which was fully described in the report, for 1874, of the very efficient State mine inspector for the district, Mr. T. M. Williams. In the same report is an account of the old Baltimore Mine fire, and the one in the Prospect shaft, to which reference has already been made.

In the case of the Empire fire, water was thrown upon it from no less than six underground pumps, and worked upon by a force of five or six hundred men, directed by the greatest experience and energy, for four or five months, yet one accident or another always prevented the final extinguishment of the fire. It may, therefore, be assumed as proven that when a fire gets beyond a certain stage, in most cases, it cannot be extinguished by throwing water upon it. The difficulties can be understood by a reference to the mode of fighting a conflagration in an anthracite mine. Let us imagine a fire in the chambers in a large anthracite vein, the pillows of coal all aglow and burning fiercely. When a stream of water is played on this incandescent mass a portion of the water is decomposed into hydrogen and oxygen, and probably this latter and a portion of the oxygen of the air form with the coal CO. This hydrogen and carbonic oxide burn again on the admission of air, making explosions sometimes of considerable violence. The pillars "spall off," and the pieces accumulate around their base in a mass of burning coal, so deep as to be impenetrable by the water, and therefore impossible to extinguish, so long as it gets the very small quantity of oxygen requisite to maintain slow combustion. The roof-rock breaks down also under the action of water and heat, and covers still further the burning pillars of coal, till finally the fire is under an immense covering of broken coal and rock. In this manner the men will sometimes be quite above the coal-seam, standing on the pile of waste coal and rock that has accumulated from such falls. It is then impossible to reach the seat of the fire except by laboriously attacking by regular approaches on the foot-wall, and carrying away the entire mass of rubbish as it is cooled by the stream of water. Since the fire generally occurs in "old workings," the pillars are not much more than sufficient to support the roof, and in most cases timber props have also to bear a portion of the superincumbent load. As the wooden props quickly burn out, the strain on the pillars is increased, and the spalling off, produced by both the heat and the water, soon brings them to the limit below which they will no longer support the roof, and a general crush occurs. After this there is no possibility of overcoming the fire in this manner, and the attempt is abandoned. If the fire has not obtained much headway, and other conditions are favorable, it is possible to extinguish it by this direct application of water, but the cases are not rare where the almost superhuman exertions of experienced men have failed. There remain but two remedies, either to close the entire mine, or to wall off the district on fire.

This latter course is usually adopted as soon as the fire has gained such headway as to satisfy those in charge that its extinction, by throwing water on it in the manner described, will be either impossible or too expensive, if successful. The simplest method is to fill the mine with water, either by allowing this to accumulate, if the mine be a wet one, or more commonly by pumping or turning some natural water-course into the shaft. Of course, there can be no doubt as to the result of this method. Wherever the water goes it extinguishes the fire. But it may happen that this is in portions of the mine above the foot of the shaft, where the water cannot reach, because the air cannot escape. In this case the fire may long continue to burn, deriving its oxygen from the air compressed in the "rise workings," and when the mine is pumped out, and fresh air admitted, the conflagration may break out again. Where the fire has occurred from spontaneous combustion, the admission of water sometimes aggravates the trouble, for, though it extinguishes the fire wherever it goes, it leaves in the wet coal-dust a condition of things very favorable to spontaneous ignition, and it not unfrequently happens that, on pumping the water out, fires occur at points where they did not previously exist. From these and other considerations, it would seem that, in coals subject to spontaneous combustion, drowning out is not a safe or desirable manner of extinguishing a fire, but, in nearly all cases where it can be applied, it is the cheapest and most effective means yet adopted. Where mines are extensive, or where there is a necessity for working the portion not on fire, or where the nature of the roof is such that the admission of water would cause it to fall, as is the case with many shales, it is evident drowning out is not a method that can be adopted. The system in most general use for extinguishing fires in large mines consists in walling off the portion on fire, trusting to the exclusion of air to secure its gradual extinction The products of combustion (carbonic acid gas and nitrogen), are most effectual extinguishers, and all that is necessary is to confine them, or, in other words, to exclude the oxygen, when in time the fire must inevitably go out. The time necessary to effect this object depends on the intensity of the conflagration, and the extent of the area inclosed. A mass of coal in full combustion requires a long time to cool below the temperature of ignition, and, even when the fire is actually extinguished, the admission of a little fresh air on the still hot coal is often sufficient to bring about spontaneous ignition. The time must be given for the combustible material, wood or coal, to cool off, before the fenced-off portion of the mine can be opened, and this delay is one of the chief objections to this remedy. To hasten the cooling, and also to hasten the expulsion of the air from the inclosed space, steam, carbonic acid, and the mixture of carbonic acid and nitrogen, known as "choke-damp," have been injected, with greater or less success. The *rôle* of steam appears to be principally as a cooler, and it is probably the most efficient agent that can readily be applied for that purpose, except, indeed, carbonic acid gas were allowed to expand from a state of very high compression (such as liquid CO_2) into the space to be cooled. At the Empire Mine, already referred to, after all efforts to extinguish the fire, by the direct application of water, had failed, a large part of the mine was walled off, and steam, from some sixty boilers, was forced in during many months. When examined some time after closing the mine, the fire was found completely extinguished in those parts where it burned most fiercely when inclosed, but it was thought that it still burned in the higher "rise workings," where the carbonic acid and nitrogen had not had time to accumulate. There was no question but that the steam had acted advantageously, but it is by no means certain that carbonic acid, allowed to expand from a liquid state into the space inclosed, would not have been quite as efficient, and economical as the steam.

Where carbonic acid has been tried, as has been done in a number of cases in different countries, in Europe, and in some mines in the country, it must be confessed the results have not been very satisfactory, but this is probably due principally to the defective manner in which it was applied, and particularly to the shortness of the time allowed for the cooling of the heated coal. The district on fire should be hermetically closed. If the gas can run out, as it will like water, from the lowest part of the mine, it will of course be inefficacious. In mines it is very difficult to make perfectly tight stoppings, and where the cover rock is broken up to the surface, air obtains entrance, and carbonic acid exit, through innumerable, unnoticed fissures. Moreover, where the fire exists under an accumulation of fine coal and rock, the carbonic acid really does not come in contact with the fire, so that its failure in many cases was probably due to causes which would have prevented the success of other methods; indeed, it has generally been tried only after the failure of everything else. The carbonic acid is usually generated by the action of sulphuric or muriatic acid on marble-dust or limestone, and is somewhat expensive where such large quantities are required. Mr. George Thompson, in a paper read before the British Iron and Steel Institute, gave an interesting account of the extinction of a fire in the Wynnastay Colliery, Ruabon, Wales, by the use of carbonic acid gas. The following is the description of the apparatus employed for the production of the carbonic acid gas:

"Two strong wooden boxes, 6 feet square by 2 feet deep, were provided, and lined with sheet-lead to resist the action of the acid. Pipes with taps were fixed into the upper side of the box, and manlids were provided, the latter for charging the box with limestone, the former for introducing the acid. Pipes with plugs were also fixed into the bottom of the box for the purpose of discharging the residuum, chloride of calcium, after the decomposition of each charge. Two cast-iron pipes, with separate valves, and also a valve common to both, were connected to the box to convey away the gas as it was produced. Small pipes, provided with taps, were inserted for allowing the air to escape, and also for attaching a mercury gauge during the operation to indicate the pressure of the gas. Whilst one box was giving off gas, the other was being charged, so that a continuous flow was kept up.

"The charge used was about 4½ cwt. of limestone, broken very small, and the 'manlid' being fastened down, the hydrochloric acid was poured in, and the mercury gauge was watched so as to keep the pressure tolerably equable, usually about 3 inches of mercury. We found, generally, that 120 gallons of the acid, of 1.12 strength, decomposed the charge of limestone, which, by calculation, gave us about 12.0 cubic yards of gas. The gauge indicated when the charge was exhausted, and then the valves, etc., were shut, and the residuum withdrawn, and thus the operation was repeated alternately as long as needful. Altogether we put down about 6000 cubic yards of carbonic acid gas, and we believe that it had a very important effect. The gas collected from all the pipes through the different stoppings from time to time would not support combustion, and the temperature within the stoppings continued very moderate. It may be interesting to state here that, in analyzing the gases within the stoppings, we found that a mixture of 5 per cent. of carbonic acid, with 25 per cent. of atmospheric air, and 70 per cent. of carburetted hydrogen, extinguished flame instantaneously. On adding more air to the mixtnre, and applying a match, it would not explode, but when pure oxygen was added, and a match was applied, the mixture exploded gently. Further, when this gas was deprived of the carbonic acid by means of caustic soda, and a match applied, it would burn when issuing into the open air."

Carbonic acid or choke-damp may also be produced by passing air through a bed of incandescent coal, mixed with limestone, of such a depth that the oxygen of the air will all be converted into carbonic acid, and not into carbonic oxide. The depth of the bed of coal to effect this purpose will be about 14 or 15 inches, and the greater the proportion of carbonic acid the better. If too little air is admitted, the gas formed may be in large part CO, but even a very small percentage of CO^2 will render this incombustible, mixed as it is with a large proportion of inert nitrogen. The application is quite similar to that of carbonic acid made from limestone and acid, with the additional drawback that it usually enters the mine hot, and therefore effects nothing as a cooling agent. To sum up, the records of a great number of fires, and of more or less successful efforts to extinguish them, seem to justify the conclusions that the use of the portable extinguishers is sometimes advantageous in extinguishing mine fires before they have attained much headway, that water under a heavy pressure is a much more efficient agent, and with energy and experience on the part of those using it, can be relied on to conquer, in most cases, when applied promptly and continuously. When the fire has gained such headway that it cannot be extinguished in this way, the burning district should at once be walled off, and the admission of air excluded. Carbonic acid or steam, or both, may then be blown into the enclosed space with advantage, steam being the most efficient cooling agent, and carbonic acid the best extinguisher. Neither the one nor the other can effect the extinguishment, except the admission of air be carefully avoided. When a mine is small, and the nature of the roof such as will not be much injured by water, and that the coal is not subject to spontaneous combustion, the quickest, cheapest, and most reliable method is to fill the mine with water and pump it out again. On account of the numerous modifying conditions which must be taken into account in each special case, it would be simply absurd to prescribe any one method as applicable in all. The best means to employ to extinguish a mine fire can only be determined after the most careful examination and study of the local conditions, and the object of the present paper has been simply to point out the means that have been adopted, with more or less success, in cases where the conditions have been those common in mining regions. It is safe to say that none of the chemical nostrums that are proposed from time to time by persons not familiar with mines are of any practical value whatever.

—*A paper by Richard P. Rothwell, M. E., Transactions American Institute Mining Engineers.*

MINING ACCIDENTS.

SOME notes on these matters are added here, compiled from the latest files of the mining press.

Coal Mine Explosions and their Prevention.—The calamities in coal mines, due to explosions of fire-damp, which have been observed to increase annually with the increasing output and the greater depths to which the pits are being sunk, form a subject deserving the greatest attention of colliery owners and others connected with the coal industry. Commendable interest has been displayed in France in connection with this subject, and in 1878 a commission was appointed to inquire into the causes of explosions in coal mines, and to suggest means of preventing or of modifying the effects of these disastrous occurrences. It appears that no efforts have been spared in collecting all available information bearing upon the subject. New inventions have been examined and subjected to careful consideration; the methods adopted in the principal mines of several foreign countries have been carefully studied, and numerous experiments have been conducted with a view of determining the direct and indirect causes of accumulations of fire-damp and their ignition. It would be too sanguine to expect the absolute prevention of coal mine explosions, but it is to be hoped that the exhaustive labors of the several members of the commission will result at least in a diminution of the danger which the miner now encounters. According to the results obtained, the idea that some mines contain specially bad gas is to be dismissed. Fire-damp will explode much less easily in a part of a mine where, from one cause or another, the air contains a large proportion of carbonic acid, or less than the normal quantity of oxygen, than elsewhere, and what is usually known as "bad air," due to inefficient ventilation, would therefore appear to prevent explosions to some extent. Another curious series of observations relates to the toxical properties of the gas and its products. If the proportion of fire-damp is below 9.5 per cent., carbonic acid and water are produced; if it is over 12 per cent., carbonic oxide is formed, and the presence of the latter is probably not without influence in increasing the number of deaths. As, however, it is very rarely that the atmosphere of a mine will contain so large a proportion of fire-damp, even at the moment of an explosion, as the latter percentage, it is argued that should carbonic oxide be found in poisonous quantities after an explosion, it will probably be due to the partial combustion of coal dust. Experiments have also been made to show that the temperature at which the explosive mixtures in mines are ignited is tolerably precise. The temperature at which mixtures of air and fire-damp take fire is 740° C. Such mixtures, however, differ from mixtures of other combustible gases in this important particular—that the ignition does not take place at the instant the general mass, or any part of it is raised to such a temperature. In order that explosions of fire-damp may occur, the gas must be submitted to the high temperature for several seconds. The delay in the explosion diminishes in proportion as the temperature is increased. A jet of fire-damp was discharged against an inverted iron crucible heated to redness. Under these circumstances, the explosive mixture remained only for an instant in contact with the red-hot iron and no explosion took place. When, however, the jet was directed to the interior of the crucible, the gas was held for some time in contact with the heated surface, and ignition ensued after a longer or shorter interval according to the degree to which the iron was heated. The bearing of this observation upon coal-mine explosions is obvious. When the wire gauze of a safety-lamp is heated to redness in consequence of the combustion of fire-damp in the interior of the lamp, an explosion is not always caused, since the surrounding gas does not remain long enough in contact with the heated metal; if, however, for any reason the contact of the external gas is prolonged, an explosion will result. The speed with which explosions are propagated is another interesting point worthy of notice. The commission point out that, according to some experiments by MM. Schloesing and Demondesir, not generally known, the rate of transmission is extremely variable according to the conditions of ignition. Thus an explosive mixture was placed in a long tube, closed at one end only. When the heat was applied to the open end the flame could be seen to traverse slowly without detonation; if, on the contrary, the heat was applied at the closed end a violent explosion ensued, and the flame traversed the tube at a rate estimated at 328 feet per second. With certain mixtures of oxygen and hydrogen it is estimated that the speed was increased to 5248 feet per second. From these experiments it is inferred that in a relatively still atmosphere the propagation will be slower and less violent than in agitated atmospheres; or again, supposing that a gallery had only one entrance and was charged with an explosive mixture, then if the mixture were inflamed by a pit-man entering the gallery, the combustion would be propagated slowly and without noise, while if ignition were caused by a pit-man working at the far end of the gallery, the combustion would be sudden, and be accompanied by a loud noise and violent mechanical effects.

The diffusion of fire-damp through the atmosphere of a mine takes place very slowly, but when once mixed the two will not voluntarily separate, after the manner of oil and water. The commission attach little or no practical importance to the influence of changes of barometric pressure in causing a disengagement of fire-damp, although it is admitted that sudden and considerable variations of pressure may have some influence, especially when the galleries communicate with old works by comparatively narrow orifices. The wind pressure on mouths of pits during storms has also been considered as exerting little influence in producing explosions. In regard to coal-dust, it is stated that though in itself it can never be the cause of other than slight and local explosions, it may greatly extend the fatal consequences of explosions resulting from fire-damp. In connection with this subject, the question relating to the safe lighting of coal mines is forcibly brought forward—a question which has already engaged the attention of English engineers to a considerable extent. The advantages of the incandescent lamps of Swan, Maxim and Edison are recognized by the commission, who, however, do not recommend their adoption, on account of the high tension of the electric currents employed, the latter being considered dangerous in fiery mines. Safety-lamps will therefore still continue to be used, and it appears that the Muessler lamp is specially recommended. The present system of lighting, however, notwithstanding the numerous improvements which have been made in the course of years, is still far from perfect, and the problem of producing a safety-lamp efficient in every respect is therefore still unsolved.

Mining Explosions and Mining Warnings.—The meteorologist who is at the trouble of giving warnings in the daily and other papers showing atmospherical changes that may affect mining operations, calls our attention to the result of last year's explosions, and we certainly agree with him that the small loss of life last year is matter for congratulation, considering the number of persons who were convicted of offenses, some of which were calculated to lead to serious consequences. The warnings appeared to be based on the action of the barometer. High barometric pressure, we are told, accompanied 22 of the occurrences, and low pressure 15. This, to some extent, would go to prove what we have often pointed out, that the barometer was not a reliable instrument as regards sudden changes of the atmosphere likely to influence gases in mines; that is, to indicate them before they really take place, and not coincident with them. Of the three heaviest explosions last year those at Whitfield and Lilydale took place at the time of highest barometer, and that at the Abram colliery with a low barometer. As to atmospheric pressure in connection with the explosions of last year, they go to support the theory that the most dangerous time is when the barometer is high. And we are told by Mr. Thompson, of Manchester, as the result of an extended period of observation as to explosions, that "the gas in the pits spoke out loud and clear long before any change could be discerned in the mercurial barometer." A careful collation of these atmospherical changes is by no means satisfactory as to their probable cause. The Government Inspector for Derbyshire, Mr. Evans, gives 16 non-fatal explosions in his district in 1880; and with respect to them he says: "It is curious to note that eight of them occurred whilst the barometer was rising, four whilst it was steady, and four when it was falling." Mr. Dobson, a high authority, considers that an altogether erroneous value was attached to a low barometer, for the explosion might be deferred until the storm had entirely passed away, and the mercury had regained the height and stability peculiar to settled weather. On the other hand, we have the views of Messrs. Scott and Galloway, from observations made extending over a period of four years, and they found that during that time 54 per cent. of the explosions occurred from a fall of barometer, 1 per cent. from a rise of thermometer and 27 per cent. from causes associated with atmospherical influence. The barometer has been looked upon as an instrument for indicating the changing conditions of the atmosphere, and indicating approaching liability to explosions in coal mines. But many of our ablest mining engineers do not consider it to be reliable, for changes take place before they are recorded. One of these gentlemen informs us that it has been found that in whatever degree the mercurial column may move, before that movement is perceptible the gas will have made its movement to the equivalent of such movement, and that instead of being an indicator of what is taking place in a mine as regards the exudation of gas, the barometer was only an indicator of what had taken place before its movements are perceptible.

But pressure is, of course, the great element for consideration. Gas exists in coal under considerable pressure, and no sooner is the mineral cut into than it liberates a considerable quantity of the gas, whether the barometer is high or low; but if there could be brought to bear on the face of the coal pressure equal to the gas escaping from it, there would be no escape at all. It has been held that the aqueous vapor in a mine, small though it may be, and consisting of two atoms of hydrogen and one of oxygen, may play an important part in forming the materials necessary for an explosion. When the air at a low temperature is taken into a mine, the aqueous vapor seizes with avidity the coal and goaves, until in a very short time, the mixture may be at an explosive point. To bring the gas up to an explosive point, there is another important element contributing to it in an atmosphere of low temperature—that is, when temperature is low, the aqueous vapor occupies a much less space and the atoms of oxygen are much nearer together, so that, space for space, under such conditions a less amount of gas will bring the mixture to an explosive point. So it is that in winter there is a keener gas, with a top on the flame, that will fire before it is half the length it will show in warmer seasons. Operatives vary a good deal as to the indications shown by the barometer being as quick as could be desired, but it is known that when coal falls or is cut into the gas is liberated, no matter what the state of the barometer may be. But, as a rule, as soon as there is a movement in the barometer, high or low, then the pressure on the space or pores through which the gas escapes is either less or greater, so that the quantity of gas will be determined by the variation. It has generally been considered that explosions took place with a falling barometer, but now it has been ascertained that many of these fatalities have taken place when the barometer was rising. With such interesting data as have been presented to us, in addition to our previous knowledge with respect to atmospheric influences in connection with explosions in mines, there is no doubt that the question of high pressure will receive more attention on the part of meteorologists in connection with its influence upon the existence of gas in mines. It would not, under any circumstances, be desirable to do away with the barometer at our mines, but at the same time, too much reliance should not be placed upon it, but all known precautions taken to prevent accumulation of gas. This can be most effectually done by sweeping all the working places with copious supplies of fresh air, and so long as this is done, there can be no accumulation of gas, and consequently no explosive mixtures. A mine manager should have no reason for consulting the barometer or thermometer, for it is his duty, strictly laid down by act of Parliament, to provide sufficient ventilation to dilute and render harmless all gases throughout a mine, and so long as he does that he need have no fear of an explosion.—*London Mining Journal.*

MECHANICAL APPLIANCES FOR MINE ACCIDENTS.

IN considering the general character of the special mechanical appliances best adapted to the purpose, the following requirements must be steadily kept in view: (*a*) Ease of transport; (*b*) adaptability to various situations; (*c*) rapidity of erection; (*d*) duplication and interchangeability of parts; (*e*) non-liability to derangement; (*f*) facility for repair.

The machinery and apparatus which it is most desirable to provide is principally: (1) Water-raising apparatus, for dealing with large quantities of water in a short time. (2) Portable boilers with fittings and steam pipes complete for promptly and efficiently supplying with steam at high pressure the pumping and other machinery; the boilers to be capable of being readily coupled together by interchangeable pipes, and to be prepared for transit by railway and over rough mining roads. (3) Air-compressing apparatus, for keeping back rising water, and enabling the mine to be entered before ventilation has been restored. (4) Air locks, with provision for quickly fixing them in the headings. (5) Ventilating apparatus, for promptly restoring ventilation after an explosion. (6) Temporary winding apparatus, for quickly replacing the winding gear over a pit when destroyed by an explosion, or to establish additional means of communication with the mine. (7) Diving apparatus, generally adapted for penetrating long levels under water. (8) Temporary workshop, fitted with complete sets of the tools likely to be needed. Through the kind assistance of several makers of the different kinds of machinery referred to, the writers are enabled to present descriptions and drawings of a few of the mechanical appliances which appear suitable for meeting the necessities of mine accidents.

It is well at the outset to note that such apparatus must not be judged by the ordinary rules of durability and economy in working, as the great object to obtain is handiness, portability, ease in putting together, and the greatest effect in the shortest time. It has to be noted that in colliery districts the source of power—coal—is readily obtainable, and the chief point to be considered is how to extract and apply that power with the greatest rapidity and efficiency; hence it appears that classes of water-raising apparatus which are not in favor where permanent and steady work are required, may be most suitable for the purpose under consideration.

The Pulsometer.—The Pulsometer (American), for example, has the advantage of needing only a steam pipe and delivery pipe; it may be lowered into water, and occupies but a small space, and when being lowered requires only the addition of extra steam and delivery pipes at the top of the shaft. When depth is great several of these pumps can be placed in succession. The pulsometer, is an instrument for applying the pressure of the steam directly upon the water to be lifted, the only working parts being the valves, and a small ball to direct the steam into the chambers alternately. The ball is self-acting, being drawn over by the increased velocity of the steam at the moment of the formation of the vacuum. An air-vessel to reduce the shock completes the apparatus, Fig. 1.

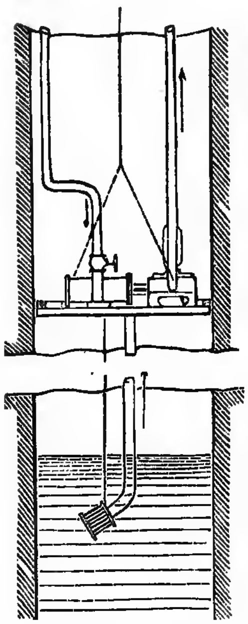
The Steam Ejector.—The ejector, another form of instrument for raising water by the direct application of steam without the intervention of moving parts, can be used; and in Fig. 2 is shown an arrangement suggested for the purpose by those familiar with its use. Fig. 3 shows an enlarged view of the ejector, which operates in the same way as the well known injector, forcing the water up the column A by the effect produced by the superior velocity of the steam jet B. It has no working parts, but is simply provided with means of adjustment. With some forms of the ejector the height of the delivery is limited only by the steam pressure obtainable. The enlarged view Fig. 4, shows such an instrument, and Fig. 5 shows its application when lifting to a great height.

Direct-Acting Steam Pump.—Some of the smaller forms of direct-acting steam pumps are capable of application on emergency, as shown in Fig. 6, where one is suspended from the surface. The same pump is shown in Fig. 7, fixed in a heading to force the water to the top of the shaft, steam being supplied from the surface. Other pumps can also be used in a similar manner.

The Centrifugal Pump.—The centrifugal pump is principally available where the height of the lift is small, but would be useful where the water could be got rid of by pumping from a lower level of the mine to another level at no great height above it, as shown in Fig. 8.

The Water-Spear Pump.—A form of pump which appears to be peculiarly well adapted for the purpose in view is shown in Fig. 9, where, instead of using wooden spears working within the pump to transmit the power of the engine, it is proposed by the designer to apply what may be termed a water spear by means of a pipe independent of the pump, and to attach the working parts of the pumps to a capstan engine by a wire rope in such a manner that the rope remains attached whilst the pump is at work, and is always in readiness to hoist the working parts to the surface, where they could be replaced by a duplicate set in a few minutes. The power is intended to be supplied from the surface by a forcing engine, the simplest form of which is indicated in Fig. 10, and all the operations could be carried on from the surface, thus enabling the pumps to be worked in any situation under water. In this way would be obviated the difficulties and delays occasioned by changing buckets and valves through door-pieces, and by drawing spears, as often found necessary in the ordinary system of pump-work, especially where dirty water has to be lifted. The mode of working may be thus described—on the surface, near the pit, would be placed a forcing engine capable of supplying all the power required for pumping; this engine could be of the form shown, in cases where time was of every consequence, or, if circumstances permitted, some other form of portable engine in which advantage could be taken of expansion. A capstan engine would also be needed for lifting and lowering the pipes, and for changing the working parts of the pumps as occasion required. The hydraulic pump would be lowered into the pit, and pipes added as frequently as required, both to the large delivery pump-trees and to the hydraulic forcing pipe. If needed, the pumps could be lowered at once to the bottom of the shaft. Where the water has to be followed where it is lowered, telescopic pipes at the surface could be used, of sufficient length to allow the pump to descend 30 feet or 40 feet without change. Such a pumping plant is calculated to work with but few interruptions, and the whole of the operations could be performed on the surface with facility and despatch, and without the use of steam in the pumping shaft.

Double Acting Hydraulic Pump.—In Fig. 11 is shown a double-acting hydraulic engine on the same principle, designed for use underground where power is available either from the column of the main pumps or from a forcing engine. The engine is shown in a horizontal position;



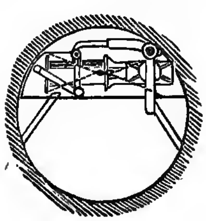


FIG. 6.

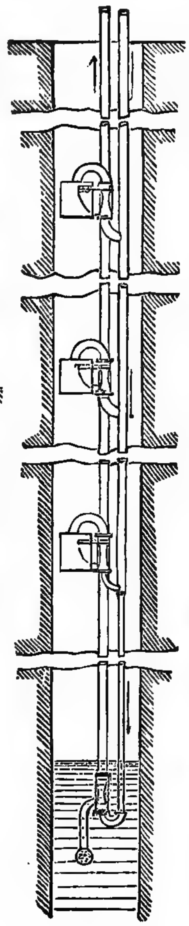


FIG. 2.

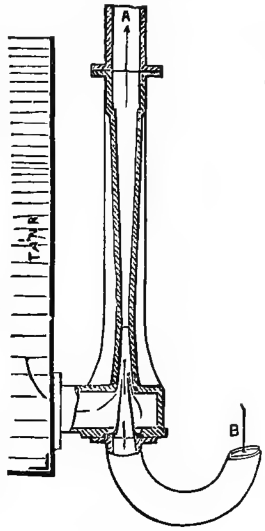


FIG. 3.

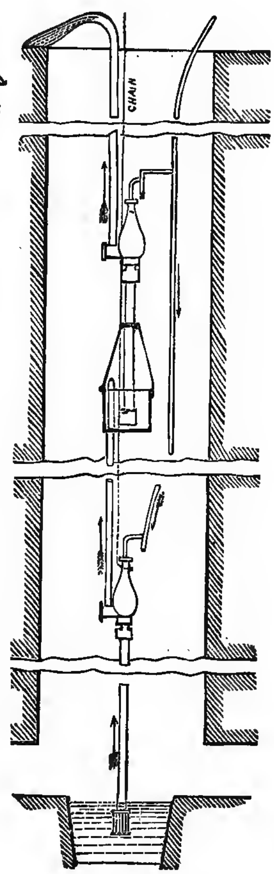
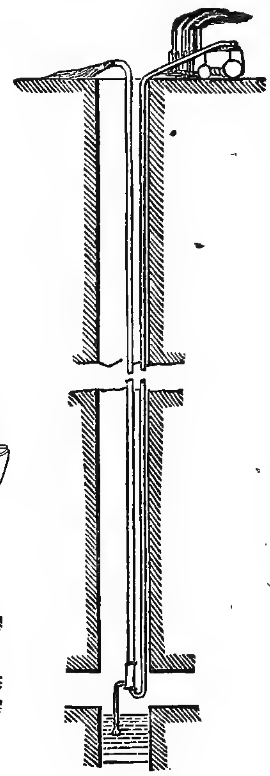


FIG. 1.



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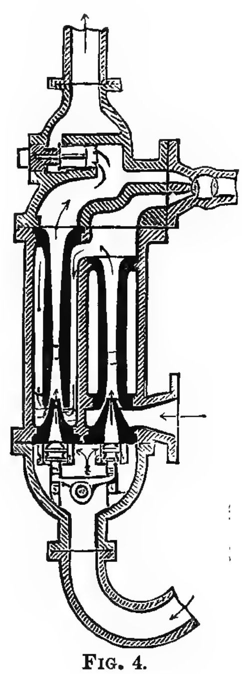


FIG. 4.

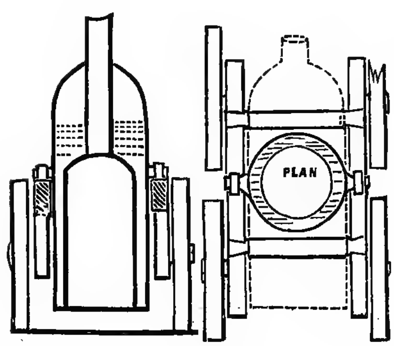


FIG. 12.

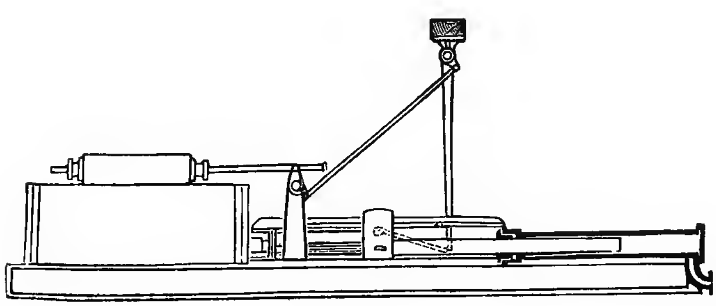


FIG. 10.

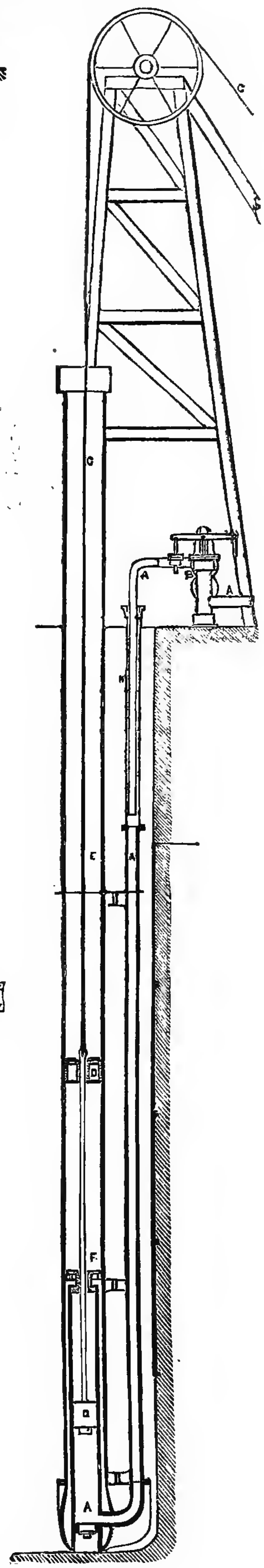


FIG. 9.

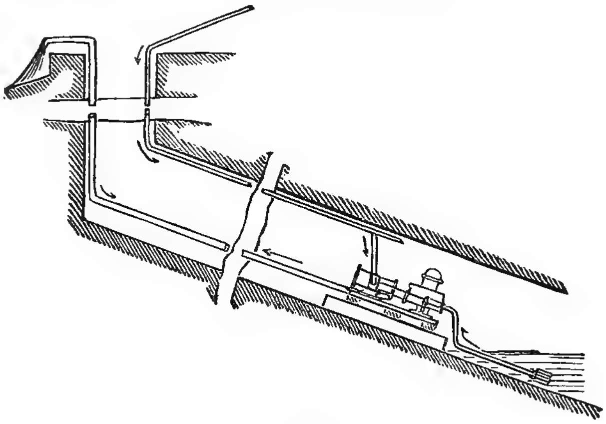


FIG. 7.

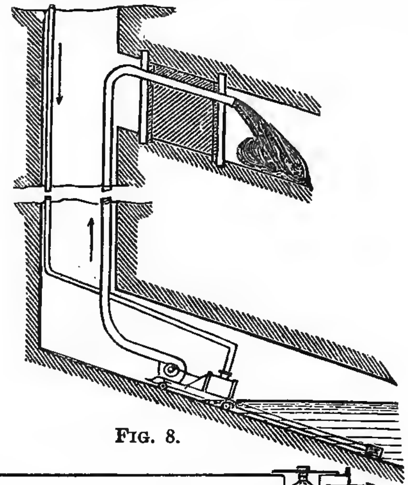


FIG. 8.

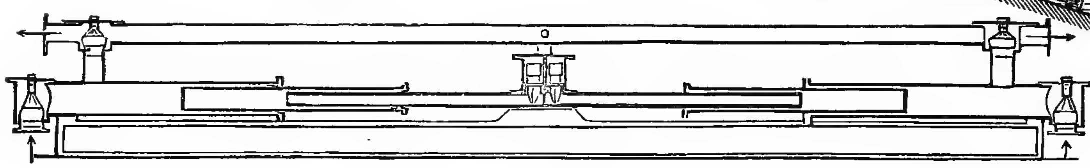


FIG. 11.

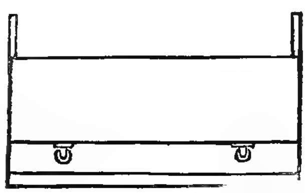
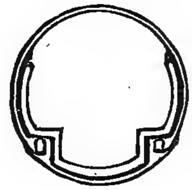


FIG. 14.



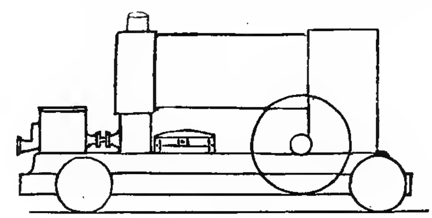


FIG. 13.

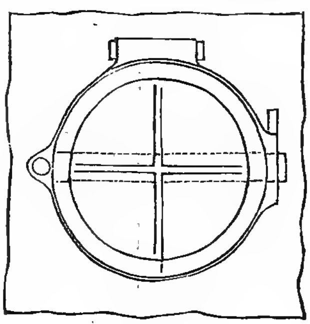


FIG. 16.

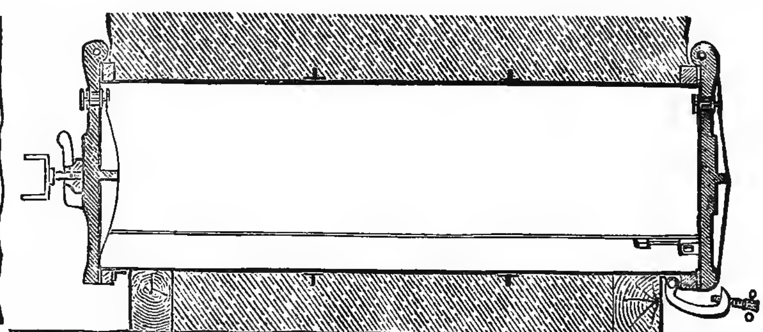


FIG. 15.

but for draining "dip" and distant workings it may be mounted on wheels, and made to follow the water as it is lowered, or in its compactest form it may be slung upright for use in a vertical shaft. This pump differs from that shown in Figs. 9 and 10, in being double instead of single-acting, and in the valves being worked by means of water pressure, in one central valve box; and it is perhaps more suitable for working under very heavy pressures.

Mounted High Pressure Boiler.—For the working of these and similar instruments to their better advantage, a greater pressure of steam is needed than is usually found at collieries; and, morever, it is probable that the local boilers will be engaged in other work, so that special portable boilers will be required, those forms being selected which do the most rather than the best duty. In Fig. 12 is shown a vertical boiler with internal fire-box, intended to be worked at a pressure of 150 lb. per square inch. The boiler is mounted on wheels, and is provided with trunnions to enable it to be laid horizontally when traveling by railway. Another figure was given, representing a portable boiler on the locomotive principle to sustain a pressure of 150 lb. to 200 lb. per square inch, and provided with wheels for traveling on roads, and also capable of being carried by railway without being dismounted.

Combined Engine, Boiler, and Air Compresser.—Whatever form of boiler is adopted, it is desirable that it be made of steel plates, with the object of attaining the greatest strength with the least weight; the boilers to be so fitted as to work seperately or in groups. A portable air compressor, with engine and boiler attached, is shown in Fig. 13; and in Figs. 14 and 15 were indicated other well known forms of air compressors, with engines combined such as those already referred to, but without attached boilers; a form of pump capable also of being used as an air compressor, and the same with arrangement of three combined, may be used where great pressure is needed. Air cylinders or other apparatus for enabling explorers to enter mines foul with choke damp should form part of the appliance provided.

Air Lock for Mines.—An air lock is shown in Fig. 16. The lock is of small size to facilitate fixing, and must be securely built into the heading in which it is to be used the materials for so doing should be kept with the apparatus, together with air proof sheeting in the event of the dam being porous. The boring apparatus, so ingeniously devised by Mr. Riches for use at the Tynewydd Colliery accident and described by him in a paper read at the last meeting of the Institution, would also be useful with certain modifications to enable it to meet a variety of circumstances.

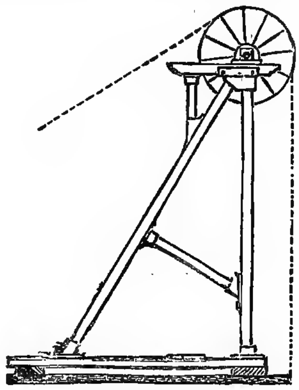


FIG. 17.

Portable Winding Gear for Mines.—As the winding gear and head frames are often injured, or are too much employed to be spared for special use, portable winding gear and engines will often be needed; a portable frame so made as to be rapidly put together is delineated in Fig. 17. It is essential that the whole of the apparatus should be so arranged as to be easily carried on railway trucks, a convenient form of which for the purpose is shown in Fig. 18. Although the machinery and apparatus indicated in the drawings are for the most part doubtless well known to every mechanical engineer, illustrations have been given to make the references to them more clear. It is necessary now to consider how the special appliances are to be provided and made available for the use of the mining community. It is not to be supposed that all that has been suggested can be accomplished without great consideration and much further information than could be obtained merely for the purpose of this paper, as to the special conditions of each mine, the needs of each past emergency, and the appliances that would have been best calculated to provide for them. The information so collected would lead to the designing of apparatus better adapted to the particular purposes in view than any now existing, nearly all of which has been constructed for working under other than the very exceptional conditions that obtain in the case of mine accidents.

It is hoped that these suggestions may lead to the organi-

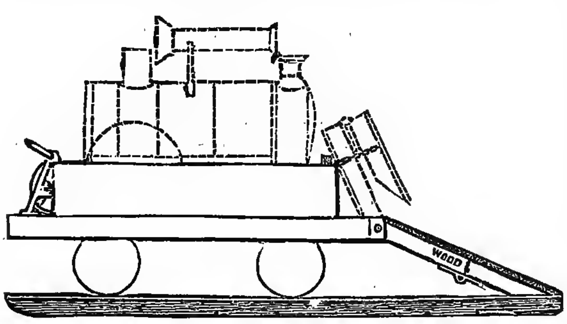


FIG. 18.

zation of an association of mine owners for mutual protection against the calamitous results of mine accidents, by establishing a central depot, with, perhaps, a branch in each mining center, containing a complete collection of the requisite special machinery and appliances, ready for use at a moment's notice. The cost of providing and maintaining the establishment would be met by a general subscription by those to be benefited; but the establishment should be made to a considerable extent self-supporting, by suitable charges for the use of the apparatus. In connection with these depots, competent men should be provided for fixing and working the apparatus; a few to be permanently engaged, while the others pursue their ordinary work, attending at intervals for training, and being "at call" at other times when needed. Had such an establishment been in existence, no doubt many valuable lives might have been saved, and much pecuniary loss spared to those engaged in mining operations; and though it is not suggested that accidents of the distressing character of those that have so recently occurred could have been averted, their sad consequences might possibly have been lessened, had appliances of the kind referred to in this paper been available. But while it falls within the province of the mechanical engineer to point out the appliances best adapted to meet the necessities of the various classes of mine accidents, it must rest with the mine owners themselves to carry the suggestion into execution.

—*A paper by Charles Hawksley and Edward B. Marten, Transactions Institution of Mechanical Engineers.*

PROSPECTING AS A PROFESSION.

THE majority of the prospectors or men who make the finding of mines the profession or business of their lives are those who have learnt what they know of mining and ores in the mines themselves. The causes which lead to their adoption of the business may be, individually speaking, many, but the primary cause affecting all alike is the fact that there are valuable properties in the shape of ledges carrying metal, waiting for the men who can find them, and that everything necessary to give a title to them is the discovery and compliance with certain simple forms. This done the prospector owns the ledge, and can sell it, develop it, or give it away, as his circumstances guided by his feelings, may dictate. As these ledges may be of a value ranging between nothing and many thousands of dollars, it follows that the hunt for them possesses all of the attributes of chance which make gambling so attractive. The prospector may discover and locate a property which will make him independently rich, or he may waste his time and money for months and years. As in other kinds of business, so in mining, one generally hears of the successes rather than the failures, for if you are talking to a successful man he likes to "brag," while to the unsuccessful man failure is not a congenial topic of conversation. It follows that among mining men prospecting is generally spoken of in connection with the strikes which have been made by the prospectors, and the months or years of weary waiting are as a rule passed over in polite silence, or spoken of merely to enhance by contrast the subsequent brilliancy of the fortune made. If one were to talk to mining men, especially in the new camps which are generally composed of prospectors, he would be apt to imagine from the stories he would hear that everything necessary to discover and locate a mine was to walk out of the camp and stake out the ground. As a matter of fact the successful prospector brings to his aid a training which is peculiar in many respects, and he possesses an amount of patience besides which that of Job was an airy figment of the imagination. I am of course excepting cases of the discovery of a mine by the purest accident, as when the *ranchers* built a wall for a *corral* out of pieces of rock taken from a ledge, and was told by the first miner that saw it that it contained rich ore or that other case of a man building the fire-place out of ore containing horn silver and finding the buttons in the ashes. But for the man who undertakes prospecting as a business he means to stick to, until he has found a mine which will make his fortune, there is hard work in plenty, and he will find that unless that hard work be done "according unto knowledge" his expenditure of time will not give him any great return. The prospector requires knowledge, and plenty of it, and he requires strength as well; the one that his strength may be profitably expended, and the other that he may be enabled to stand the terrible strain which the life he leads brings upon him.

As I have said prospecting is a business into which men generally "drift" by pure force of circumstances. Miners working in the mines go from one camp to another as a result of the stories told about rich strikes or because they hear that there is a big demand for labor. Arriving in the new camp they generally go to work at first for other men, but as time goes on and they hear the stories of those who have made rich discoveries they are tempted to see what they can do. They will take a "week off," and prospect in a desultory way in the immediate vicinity of the camp. Sometimes they find a ledge which has pay ore in it, and if they should do so they, as a rule, join the prospecting league. It is rarely the case that they receive much money at first, but it does not take many hundreds of dollars to confirm the prospector in his choice of a business. There is a fascination about going out and discovering a ledge which is valuable, that makes any kind of regular work extremely distasteful to a man. If a man follow prospecting for a year he is rarely willing to give up the business for any other, for the simple reason that all other forms of occupation seem to the last degree tame to him. As a rule prospectors do not accumulate very much money although they often make large sums. This is owing to two facts, first the nature or character of the prospector and second the kind of life he is obliged to lead. The rewards of the work being to the last degree uncertain, a man must possess, before going into it, that kind of disposition which will permit him to sacrifice the certain for the uncertain. He must be willing to take risks, to "chance it" in his luck. In other words he must have the gambling instinct largely developed. While the rewards are brilliant the prospector cannot shut his eyes to the fact that the toil may be long, and he can see in the case of others if not in his own that circumstances are apt to make that toil very wearisome. For "he who runs away may read" the statement written in the fashion of these men's lives that prospectors except after a sale have little or no money. As a rule they get nearly everything on credit as long as that credit lasts and hang around a camp before taking the plunge again, as long as it is possible for them to do so. Prospectors then must be willing to face poverty for a time in the chance of some day washing a "pile," because there is generally work to be had at wages or on contract if they are only willing to take it. Men with the kind of disposition which makes this life possible are men with but litle thought for the morrow. When they get money, as they often do, it comes in large lumps and they spend it lavishly. They generally pay all of their bills the first thing, not only because they are, as a class, a very honest set, but because they are wise enough to know that by doing this they make their credit good. Then with what is left they go on a spree, generally making their way to San Francisco or some other large place where with money in their pockets they proceed to "have a high old time." The money flows like water through their fingers, and at the end of one month or six, as the case may be, they make their way back to the camp with a large stock of stories of a somewhat dubious character as the result of their fun. The prospector "in luck" as seen in the streets of San Francisco is a man of mark. He generally goes to some tailor as soon as he arrives and purchases an outfit of clothes, which providing they be of a certain conventional cut can not be too gorgeous in color. He always, for example buys a sack coat, as he does not like the tails of a frock flapping around his legs. I remember one of them, a man named Reilley, who was one of the best prospectors I ever saw and deserved all his luck, of which he had plenty. Reilley as soon as he got to the city used to buy a suit which was gorgeous in the extreme. A tweed sack coat, a purple velvet waistcoat with brass buttons and a pair of those wonderful plaid trowsers which take two men to show the pattern, were always purchased first. A lot of white shirts with frills, a large soft felt hat and a pair of heavy boots in the tops of which the trowsers were generally tucked, completed the costume. In honor of his native land, I suppose, Reilley would always buy some enormous pin to stick in his shirt front, the color of the stone being green. A gold watch was attached to one of those immense cable chains made of large pieces of quartz showing pure gold, and this as it crossed the purple waistcoat had an effect which was to the last degree magnificent. He always bought two rings, one a diamond and the other the largest seal ring he could find. As he rarely wore any collar and never wore a cravat the effect of all this was startling. In the camps Reilley wore a full beard, but this he had cut when he arrived in the city, leaving a moustache and imperial, the former always being waxed ferociously. I can in my mind's eye, see him now; dressed in his wonderful costume, his great watch chain crossing his waist and having hanging to the end a pick about two inches long made of gold, his diamond rings flashing in the sunlight, his awe-inspiring green pin, his round good-natured face tanned to the color of leather by the fierce sun of the desert, his merry blue eyes looking at me over his altogether ferocious moustache! Truly he was a wonderful fellow to look at. While he was in the city he spent his money in the wildest way, literally throwing it in every direction. This kind of life would last as long as the money did, and then the pin would go, and then the seal ring. When he was reduced to the watch and diamond, Reilley would sell them both, generally realizing about five hundred dollars. He would then pay for his passage to the mining camp, buy an order on Wells & Fargo for two hundred, and have one last spree on what was left. This concluded he would pack up and start, and when he reached the camp would cash his order and once more go out to prospect for ledges. Having told about the somewhat ridiculous side of his character it is but fair that I should say more. This I do the more willingly because Reilley was not only a typical prospector but he was one of the pleasantest men I ever met. He was a thorough master of his business; keen-headed, manly, truthful, except perhaps in the matter of the value of the ore in ledges he had found which seemed somehow to increase every time he mentioned them; hospitable to the last degree, for whether it was champagne or water, game in a French restaurant or beans in the desert, you were always welcome to one-half of what Reilley had; and in short, "square" with him as with the great majority of the class to which he belonged, money was only good for the fun which could be got out of it. The reaction from the toil of finding the ledges showed itself in the kind of life he led when he reached the city.

And this brings me to the second reason why prospectors generally spend their money as fast as they get it. The work of prospecting is extremely hard and the privations of the life can scarcely be exaggerated. Not only is the existance a most lonely one, for the prospector goes upon his long trips with no other companions than his horse or his *burro* or jackass, but the labor of finding a ledge is very exhausting and the food is somewhat primitive. Sleeping out at night wrapped in his blankets, often cold, and often hungry, is it any wonder that when a prospector does make a strike by selling one of his properties he should plunge into the other extreme? But for the men who can resist the temptation to indulge in these wild sprees, prospecting offers a business which will probably result in the acquisition of a fortune. Given the necessary knowledge to engage in it and a determination to save money, the prospector, if he have very ordinary luck in time, "makes a pile." The education necessary is emphatically a practical one, and the best prospectors are those men who have learnt their business in the mines themselves. As they rarely carry with them more than the simplest materials for assaying or testing ores, they are obliged to have a sufficient amount of knowledge to recognize ores and to estimate their values the moment they see them. A curious instance of this fact was told to me once by a prospector who had been among the first to go to Virginia City, then called, Washoe. At that time gold was the only metal sought for and the prospectors had learned to distinguish gold-bearing quartz as soon as they saw it but they knew nothing at all about silver. "We didn't s'pose that black stuff wer' worth anything," said he, alluding to the silver ore; "an' we used to throw it away till one day 'long come a chap an' he says as how, says he, that ar black stuff were silver. Lordy, you oughter hev seen the boys' eyes bulge! Arter that we staked (located) black stuff whenever we seen it." It would be somewhat difficult to find the prospector of to-day who would not recognize and locate the "black stuff" as soon as he saw it. Of all the branches of knowledge necessary for the successful prospecting this of the ores is the most important. Not alone are there many kinds differing in appearance as radically as do the coal and granite, but the ores in one district differ from those in another in their importance and value. The prospector must not only know ores generally but he must know those of the district in which he is. It follows therefore that before a prospector can hope to engage in his work with any degree of success he must spend some time examining the district; that is, of course, if the district be developed. If there are mines opened in it, it will pay him well to examine them, not alone their ores but their walls as well. For the prospector must, if he would be successful, know as much about the barren *strata* next to the ledges as he does about the ledges themselves.

While it is generally the case that prospectors drift into the business from that of practical mining, urged to this change of occupation by a natural bent or a chance circumstance, it is certainly true that prospecting as a business offers inducements to any man who has the requisite knowledge. The number of ledges in the west which are valuable is unknown, but there can be no question that there are thousands upon thousands of them only waiting to be located and opened to yield up the treasures of gold and silver which they hold. This being the case it follows that there are many chances of making money waiting for the men who choose to look for them; and the experience of the great majority of the prospectors who have gone into the business is that it pays. Even those who have nothing now have had large sums which they have spent foolishly. If a man makes up his mind that he will adopt prospecting as the business of his life he may be reasonably certain, providing he will determine that when he gets money he will save it and invest it wisely, that he will be rich before he dies. He must however be the kind of man who can stick to a thing when he once gets hold of it, who can wait and wait patiently, who can live on hard fare with hope to season it, and who can control himself when he finds that he has suddenly made a large sum. If such a man becomes a prospector and lives to an average age, he will be wealthy before he dies. The training necessary for the business is varied, but as a foundation there can be nothing better than the ordinary course in a school of mines. This will teach a young man something of geology and mineralogy, and will make him familiar with the principles upon which the discovery of metals in the ores and the reduction of those ores depend. But the course is only a foundation for subsequent knowledge to be acquired in the mines. In the school the student learns the theoretical part of the work. He is taught, it is true, practical assaying, but when he finds himself in the mountains this is of little use to him for the simple reason that he has no tools or materials to assay with. I have often wondered why the mining schools do not make their instruction in the use of the blow-pipe more thorough than it is. In the hands of a man who knows how to use it properly, the blowpipe becomes a whole laboratory in itself, and when taken in connection with a few fluxes, will enable him to determine the character of any piece of ore he gets hold of. Not only can he perform qualitative analysis with it but he can do quantitative as well. Having passed through the mining school, the young man who wishes to be a prospector is ready to go into the mines. He will find it of almost primary importance that he work as a miner, learning by that greatest of all teachers, experience, how to handle a pick. His work as a prospector will necessitate the use of this and of powder as well, and he must learn practically how to put in and fire "a shot" or cartridge of blasting powder. Work around and about the concentrator will teach him to distinguish ore from gang the moment he sees it, and the picking over of the ore which has to be done to a greater or less extent will give him knowledge and experience of the utmost value. Although the prospector is not necessarily a miner he should know enough about mining to be able to open his ledge when he finds one and develop the property to some extent. It will pay him therefore to understand this being a mine, and he must learn the amount of carpentering necessary in making a hand winch. Time spent in a blacksmith shop learning to sharpen tools and to temper them when sharpened is time well spent, as he will find when he gets into the field. From other prospectors he can learn the uses of horn and iron spoons in the testing of ores and the

Mining Life.—A Prospector on Foot.

From "La Vie Souterraine," by L. Simonin.

numberless dodges and make-shifts by which these men make one thing take the place of another in such work. He will be surprised to find how many of the operations of a laboratory can be done in the field with no other tools than those provided by nature herself. As for example the crushing of ore which in the former we do with heavy iron pestles in heavier mortars of the same metal, in the latter we get along very well with two flat stones. And above all things he must learn to "average a ledge." The valuable ore on a ledge lies in bunches and small veins in the gang or barren rock. As the value of the whole body depends entirely upon the proportion existing between these two, it is of primary importance to the prospector who would properly describe his claim that he be able to determine this proportion by an examination of the ledge. There are many methods of doing this, one of which is described at length in the article headed "The Purchase of a Mine." But for the prospector there is no one equal to the effect produced upon him by a sight of the ledge. Knowing the character of the ore and its value, he should be able to tell at once from merely looking at the vein, the proportion existing between the ore and the gang in the vein matter. The knowledge necessary for this exercise of judgment can only be acquired from long experience and as a result of actual inspection of ore bodies. The would-be prospector should then never neglect an opportunity of improving and increasing his stock of information in this regard, and should bring his judgment to the test by ascertaining, whenever it is practicable, the result of working ores in the mill or furnace; and comparing it with his previously formed opinion. There is no better practice for example than that of estimating the yield in bullion of the ores which are mined, taking them in weekly or monthly lots. This, if steadily adhered to, will in time give a man an amount of knowledge upon the subject which he will find almost priceless.

Having secured his theoretical knowledge by study in the schools and supplemented it by his study and observations of the mines, the prospector is ready to begin his actual work. The first thing that we must do is to purchase an outfit. This must be adapted to the life he is going to lead and must be complete, or he will suffer severely for the lack of articles he should have procured. But as it must not be made too small so it should not be made too large, or he will find that he has burdened himself with a lot of things which are not of enough use to make their transportation profitable. A good outfit for the prospector—and parenthetically it may be said that this list as far as the personal outfit is concerned, is one well suited to the traveler in the mines—should consist of two pairs of heavy blankets, eight pounds in weight each. A buffalo robe or better yet, a blanket lined rubber *poncho* for sleeping on. A suit of strong gray *woolen* clothes, a pair of brown jean trousers, a change of woolen underclothing, woolen socks, a pair of heavy boots, a soft felt hat, three or four large handkerchiefs, a pair of buckskin gauntlets, and such toilet articles as he desires to take. These should all go into a strong canvas bag made with strings to tie up the open end. It will do no harm if this bag be made waterproof. He should have a breech-loading or magazine rifle of some kind or a shot gun. Around his waist he should wear a strong sash, and to it have attached his holster and his knife sheath, carry in the former a Colt's revolver, of heavy size, and in the latter a heavy hunting knife. His ammunition should if possible fit the rifle as well as the revolver. If he be a smoker, he will carry his tobacco and pipe. For transportation a good mustang, as free from tricks and bad habits as he can get it, should be bought. Mustangs are better than mules for mountain work because they have better backs for the saddle and larger areas of hoof, the latter being an important point when there is much travelling to do over sandy deserts. They are quite as sure-footed and will live on the same forage. He should buy a Mexican saddle fitted with rings, straps or thongs to tie on his pack, saddle bags, catinas, water canteen, &c. Speaking of this last, it should be large and be covered with thick felt. If it has a cork for a stopper, this should always be secured by a cord to the neck of the canteen that it may not be lost. One of the stirrups, preferably the left, should be fitted with a leather tube in which the barrel of the rifle may be placed, and there should be a strap fastened to the horn of the saddle, with which you can secure the stock by wrapping it round once and then putting the end of the strap over the horn. This tube and strap is the best method of carrying the gun or rifle yet discovered, as it is easy to cast the weapon loose and it does not pound itself to pieces against the saddle. The bridle should be made with a whip at the end of the reins and the long stake rope should be either attached to a halter worn by the animal or knotted in such a manner that it will not slip around the neck. While travelling the rope is coiled up and tied to a thong on the right of the saddle in front. If a staking pin be a part of the outfit the thong must be passed through the ring at the top and a small piece of leather sewn on the saddle flaps for the pin to go through in such a way as to prevent its jogging up and down. And by the way, I may mention here that the holster should have a hole cut in the end through which a small cord or a thong like a leather shoe lace should be passed and tied around the leg. Properly put on it will not hurt the rider while its usefulness as preventing the hammering of the leg by the heavy revolver will be found to be very great. For the work of prospecting a "poll," pick and prospecting pan made of iron should be carried. The pan serves for washing out sand or as a dish for bathing in. A frying pan, eight inches in diameter, made of wrought iron; a coffee pot, tin cup, fork and spoon; a good supply of matches in a tin case the shape of a bottle with a good cork in it or what is better still a wide mouthed glass stoppered bottle in a tin box; a pocket compass—and let it be a good one—and a spy-glass or pair of field glasses. For provisions the prospector takes with him bacon, flour, beans, tea, pepper and salt and a box of yeast powders. These should all be packed in bags which go into a canvass sack somewhat of the shape of that in which the blankets and clothes are put. A short time spent in the kitchen or in learning how to cook will pay the prospector as large an interest on the investment as that which he can get from any he can make. Sage bush cooking while not very good under any circumstances is execrably bad if the cook be a perfect novice, and as not only the comfort of the trip but oftentimes the health of the prospector depends upon what he eats, it will pay him well to make his food as good as he can. While the list as given above contains all that is absolutely necessary I cannot help urging that Chilli peppers and those strong red onions be added to it whenever it is practicable. The former in hot climates are almost a necessity, while the latter will at all times improve the fare to a very great and pleasurable degree. There is another use to which onions may be put which will often alone compensate for the trouble of packing them. Should the prospector run short of water he will, if he places a piece of raw onion in his mouth find that the torture of thirst is at once destroyed and that the swelling of the lips and tongue from the lack of water is prevented. With a plentiful supply, and one large onion will be sufficient for a day, he will find that he can resist the effects of a lack of water for some time, or if the fluid is scarce that he can get along with very little. This is often an important consideration. The onion will also prevent the lips cracking from the effects of alkali dust, or if they are cracked will relieve the pain. The prospector should carry some quinine with him and some pills to act upon the bowels as well as a remedy for dysentery.

Having collected his outfit he will proceed to pack his animal. Placing upon the mustang's back the blanket—a folded blanket is far better than a saddle cloth as it can be washed and hung up to dry—which has been carefully folded without wrinkles, he puts on the saddle and pinches it securely. The saddle bags are packed with the various small things which go into them, and the bag containing the provisions placed behind the cantle of the saddle where it is securely fastened by two thongs which are tied in such a way as to divide the bag into thirds. On top of this, the bag containing the clothing and blankets is placed and secured firmly in the same way. The pick goes into a strap made for it on the right saddle flap or skirt and is always put in with the point sticking out behind. It should be arranged in such a way that under no circumstances can this point strike against the horse's skin. The coffee-pot, frying-pan and prospecting-pan are lashed on the bags in a position where the rider will not rest against them. The tin cup, which should be one that was pressed into shape, may have a lanyard attached to the handle and be carried with the lanyard tucked under and around the belt or sash. The stake rope being coiled up and tied to the saddle and the rifle being put into place and fastened, the proprietor mounts. It is always well for him to wear spurs, as nothing else will have any effect upon a mustang. And then he leaves the camp to be gone any where from one week to six months, for if he can eke out his provisions by the killing of game he will stay in the field until he finds a ledge "if it takes all summer." He has started out prospecting, therefore the main work of his expedition is the finding of a ledge of paying ore. But while doing this he and his horse must live. Provisions for himself he has with him, but forage for his horse and water for both must be found. As grass is generally found in the neighborhood of water, the business of the prospector is to see where he can get the latter. He must before starting out in the morning make up his mind where he will camp at night, and there are certain indications given by the shape of the surrounding country which will guide him to a very great extent. The first of these is the character of the mountains. If they be snow-capped, water is almost always to be found at the base. But as the base of a mountain is generally a rather large extent of country, the prospector needs something more to indicate to him where he shall ride. This he finds in the natural water sheds or natural drainage of the district. Water is more apt to be found at the lower end of a valley or canyon, for example, than it is on a hill-side, and by taking careful observations with his glass, and ascertaining by the aid of his compass the direction in which he is to travel, the prospector will rarely fail to find a good camping ground. Having found one he will of course stay there until he has prospected the surrounding country thoroughly. Not only does he have the advantage of knowing that wood, water and feed are plenty, but he can save his horse a great deal of labor by relieving him of the weight which must be carried while travelling. It is always well to hide the things which are left in camp, and the provision bag must be tied up in a tree or *cached*, that is, buried under heavy stones, to keep it from the coyotes. When possible, suspending it in a tree is always the best, for the simple reason that while grizzly bears are not as plenty as blackberries in the mountains, all stories to the contrary notwithstanding, they are occasionally found, and it requires a much heavier *cache* than one man can make to be impervious to "cabb's" strong claws. Bears will dig up *caches* merely for the fun of doing it, apparently; and scatter the contents around even when they do not eat the provisions. Where there are bears, coyotes are as a rule, not far off, and they will eat anything that can be eaten. They are cowardly brutes, and while not dangerous, are often exceedingly annoying. When they are in the neighborhood it is always well to stake the horse rather than hobble him, and under no circumstances should the hobbles ever be placed on the hind feet. A mustang, as long as he can kick, can drive off any number of coyotes. This caution about placing hobbles upon the hind feet is almost superfluous, for a proper sense of his own dignity will as a rule prompt the mustang to enter a demurrer against anything of the kind, and the demurrer in question generally appeals to the judgment of the court with the directness and force of a stroke of lightning. If the provision bag be placed in a tree, do not suspend it by a cord passing over a branch and fastened to the trunk, but take the trouble to climb up and tie it to the branch. Grizzly bears are very cunning; "Heap wisdom in the old gray man," as the Indians say; and if they see a cord fastened to the trunk will tear it loose, thereby letting the bag fall.

Speaking of Indians reminds me that it may be the prospector will be obliged to traverse a bad Indian country, or he may be at work when they are on the war path. Should he know either one of these facts beforehand he will be wise if he takes a spell at work as a miner in some mine or joins the company of scouts generally raised in such cases. Foolhardiness is not bravery, and prospecting in a country where an Indian war is going on, is about as foolhardy a thing as a man can do. If he must do it, however, there are certain precautions which he might as well take, particularly as there is no one there to see him take them except his horse, and he will not say anything about them. In the first place then, he will travel chiefly at night or in the very early morning. Starting out at twelve and journeying until five or as long as the mists hold, will as a rule, be safe. Of course in order to do this he must know something about the country, the lay of the land and the places where water can be found. During the day he must hide somehow. He can only permit himself to kindle a fire at night, cooking then all of the provisions necessary for two or three days in order that the fire be built as seldom as possible. Even when he does kindle it, he must "mask it" as it is called. Taking his pick he digs a trench about five feet long and roofs it over with flat stones or brush, on which he piles dirt. With the stones he arranges a place just over the fire large enough to hold the coffee pot or frying pan. At the other end of the trench, if water be plenty, he makes a pile of loose brush which has been thoroughly wet. The smoke from the fire, which by the use of dry twigs or buffalo chips, should be as small in amount as possible, when it encounters this wet brushwood becomes cooled off at once and will not rise. The fire should always be built, if possible, in some place naturally screened by rocks or bushes so that the light cannot be seen from the neighboring mountains, and when one utensil is taken off of the hole another should be placed there instantly. If this is all properly done a man can cook within half a mile of an Indian and give no sign. As soon as the cooking is done the fire must be extinguished at once by heaping sand or earth upon it. Do not put it out by water, as heavy clouds of steam always rise up when this is done. As soon as the fire is extinguished mount your horse and ride on for a mile or two, or better yet, do your cooking just before you begin your night march. I have spoken of the necessity which exists in an Indian country of cooking as much as possible at once. Flour may be made into bread, beans may be boiled or baked, and both may be kept for a long time. Mr. J. S. Phillips in his chapter on Prospecting gives a most excellent suggestion which I can heartily endorse. He says "I boiled, when in security, one-fourth of a pound of tea in a quart of water, and after removing the tea leaves, continued the boiling of this strong tea water until it evaporated to about a pint, which I carried forward for use when required. It will be found that one teaspoonfull of this when added to a cup of water makes a much more palatable and refreshing beverage for washing down your frugal meal than water, and it will prevent the headache that would otherwise result." This suggestion of his about the using of tea makes me think of another which, whether there be Indians or not, should always be followed, After breakfast pour what is left into the canteen from the teapot, straining out the leaves, and add enough water to fill it. This cold weak tea is far more refreshing than water, and if it becomes lukewarm from the heat of the sun, can be drunk without nausea. If the water be bad, having alkali in it for example, it is almost undrinkable without the addition of tea. Under any and all circumstanees eat cooked food. No matter what the danger may be, the prospector must take time to cook. Not only are raw flour, bacon and beans excessively difficult to eat, how difficult no one knows who has not tried them, but they are dangerously unhealthy. A very short experience of them will bring on dysentery of a very bad type, and if the prospector gets sick in an Indian country, his chances are small indeed. It is true that there are very few sights more ridiculons than watching a stalwart man chewing raw beans or trying to eat paste, and the expressions of his face while doing it would make the fortune of a low comedian, but it is fun dearly bought at the expense of a bad attack of sickness. If it is positively necessary to eat one's food raw, at any rate leave vegetable food alone. The best thing to take under such circumstances is jerked beef, for while this is tougher than any known substance unless it be rawhide, and will cost many a jaw ache before one gets it down, it will not make the person eating it sick. If a man knows beforehand that he is to have great difficulties in making fires for cooking he should provide himself with a store of this jerked beef, and, if possible, with a bag of parched corn. This latter is very good food although somewhat dry, and will keep indefinitely. In travelling in an Indian country, the most common precaution is to avoid placing oneself on a skyline by riding on the crest of a hill. It is scarcely necessary to say, I suppose, that under any circumstances the person will avoid, unless it be absolutely necessary, the discharge of firearms.

There is a rule, and a good one, which should always be followed while prospecting. If you are overtaken by darkness before you have reached your camp, your horse will find his way better than you can and you will be safe in your trust to him. This applies equally well in a case where you are trying to find water, or where you are trying to reach a camp you have left in the morning. In the one, the horse will scent the water and make for it; in the other he will always find his way. In case you are obliged to camp without water, be careful to stake your horse securely, for if he can get away he will always go back to the place you have left in search of something to drink. This question of the supply of water is of all things the most important to the person travelling in the mountains or desert. In case none can be found, you can relieve the necessities of your horse to a certain extent by peeling the thick cactus and giving him the sponge-like stuff inside which is so full of sap. As nothing seems to hurt a mustang he can take this and live on it for a while. You must be exceedingly careful, however, not to let the avidity with which he takes it tempt you to suck much of the sap as it acts strangely upon the bowels. Wherever you find willows, cottonwoods, wild rye, or other plants you may conclude there is water, and you will often find it by digging a short distance. Do not, however, look on cactus or green-wood as indicative of the fluid, for if you do, you may dig for a week and find nothing.

It sometimes happens in the mountains that you wish to travel through snow in order to examine a ledge which crops prominently. In such a case you can make snow shoes by lacing willows into a kind of flat tray, two feet long by one wide. The interstices between the twigs should be not less than three-quarters of an inch in every direction, as while using the shoes you must permit the snow to fall through when the foot is lifted. In binding these shoes on the feet, the ball of the foot must be nearer the toe of the shoe than the heel, so that when the foot is lifted and advanced the heel will drag in the snow. Unless they are put on in this way the wearer will be continually tripping and falling down. In very cold climates it is necessary to place some extra covering on the feet. A piece of blanket, or in default of that, a gunny sack, cut into a triangular shape and wrapped over the boot, the two long ends being tied together, will be found to afford ample protection under any ordinary circumstances. As the feet must be kept warm in cold weather so the bowels must be kept warm when the weather is hot. It is a singular fact that the greatest preventive against dysentery or any form of cholera is a flannel band around the abdomen. This "cummerbund," as it is called in India, should be about ten inches wide and long enough to go once and a half around the body, the double being placed in front. It can be secured by pins or tapes, and the prospector should always carry a spare one.

Much of the work of the prospector is described in the article headed "Locating a Mine," and a reference to it will give a fairly complete account of how this work is done. But in considering such a subject as prospecting as a profession it is necessary to not only describe the knowledge and kinds of information needful, the method of obtaining them, the outfit which must be procured, the precautions which must be taken and the dangers which must be avoided; but some account must be given of the formations in which the prospector is apt to find the sought for ledges and their geographical distribution. There are also certain signs or indications found in the country over which he travels which will give him many hints of great value. First for a broad generalization. The mining history of the world has demonstrated one thing; that all systems or groups or fissure veins containing valuable metals are found at the junction, or in close proximity to that junction, or the primary and secondary formations. Sometimes in the former alone, sometimes solely in the latter, but generally in both. From this important fact we deduce the following rule: If we can not find a place at or near the junction or their two formations, we but spend our time foolishly if we prospect for mines. It is in this that the knowledge of geology which I have supposed the prospector to possess comes with the greatest value. By an examination of the country itself in a general way he is enabled to tell where to make his more particular search for valuable ledges. While this rule applies to copper, tin, gold and silver deposits, for the two latter we must discover something more; namely, evidence of metamorphic action. There must have been heat applied to the veins after they were formed. The effect of this heat upon them is but little understood, and it is not known why this action was necessary, but as a result of all experience in the matter it may be said there is "no metamorphic action upon the ledges, no gold and silver." While on the one hand if we wish to find gold, silver, copper or tin we look for a junction of the secondary with the primitive formations, and, in the case of the two former, for metamorphic action; on the other hand if we are searching for lead, antimony, zinc or mercury we must look away from the primitive *state*, anywhere from two miles to ten, and we do not need any evidence of the action of heat. These two general rules are almost infallible, and may serve to guide us at any time in our search for ledges. Now for the geographical distribution of the mining fields. In this country there are four in number west of the Mississippi river. The first begins at the Guadaloupe and Sierra Madre in Mexico, and thence runs in a northwesterly course through the territory of Arizona. The second begins north of the Colorado river where the Sierra Nevada rises and continues in a northwesterly direction for hundreds of miles. On the west it shows the talcose clay state of California overlying the granite and porphyry, while in the east there are numerous patches of clay slate and lime stone. This field has been marked by the development of the richest ledge the world has ever seen, the great Comstock in Nevada. It bends to the west through Oregon and to the east again in British Columbia, then running into the regions of perpetual snow in Alaska. Along this whole range on both sides, there are mines which we know of as far as the range has been prospected, and we may reasonably suppose that there are countless groups of veins whose existence is not more than suspected. The third is that which lies along the chain of the Wahsatch mountains. Beginning north of the Colorado, it rises east for some hundreds of miles, and thence north to join the Rocky mountains. It has been less developed than any of the fields, but has been marked by very rich ore where development has been made. The fourth is the range of the Rocky mountains with its various spurs. Beginning in the southerly portion of New Mexico, it runs north through Colorado and Wyoming, thence northwest through Montana and Idaho into British Columbia, where it turns to the north and runs parallel to the Sierra Nevada. In these four fields are to be found the best opportunities for the prospector. Up to the present time the exploration of them has not been more than begun, and where there has been one ledge found there are a thousand yet to find. Large areas of them have not yet seen the prospector at all, and their mineral treasures sleep undisturbed by his pick. The great transcontinental railways are cutting them, rendering the transportation of the products of their mines when opened, a thing easy of accomplishment. To the trained and competent prospector they offer opportunities of acquiring fortune which cannot be surpassed. He may find within them any climate he wishes to work in, facilities for mining which leave nothing to be desired and every species of metal known to men.

I have spoken of the fact that veins of the precious metals are generally found near the junction of the primitive and secondary formations. While this is true we need something more than the presence of the two formations to warrant the work of prospecting. We must find that distortion of the *strata* has taken place; that forces have been at work which would result in the formation of fractures into which the water carrying mineral could run. It is a favorable sign when we find that there are ledges interlacing the stratified rocks. The characteristic stains of oxide of iron disseminated through the vein and the pressure of sulphurets of iron, as for example, pyrites; are looked upon as being signs of continuance in the vein. When the talcose or argillaceous clay slates are greatly folded and distorted for long distances, it may be taken as a good indication of gold bearing veins. To the old prospector the appearance of the country and of the *strata* seen will tell a story. He will say that he prospects here because it is "likely ground," although in what the "likely" characteristics of the ground consist he is unable to explain. It is an undeniable fact that good mining ground is as easily recognized as good farming land, and that an old miner or prospector will rarely be deceived, but it would be impossible to describe this peculiar appearance upon paper. There are certain deposits which should be avoided.

Porous volcanic bed rock may be said to be one of the poorest grounds for the prospector. It is true that the copper mines of Lake Superior are found in this deposit, but they are, as far as I know, the sole exception to this general rule, and may therefore be considered, not unfairly, as the traditional one. The modern carbonates of lime and magnesia and the modern clay slates rarely show veins of the precious metals unless it be that a pocket of siver ore is found in the lime, and this does not happen very often. These deposits, however, form good ground in which to look for lead, iron, and coal—if the latter be the mineral sought for, the slates and shales of the carboniferous ore are, of course, the best of indications. A common practice is hunting for ledges in the neighborhood of others that are well known and fully developed. This practice is not one that can be endorsed. It rarely happens that two great veins lie alongside of each other, and it is much better for the prospector to turn his attention to places a few miles away. One of the most prominent instances of this fact can be seen in the Comstock Lode in Nevada. Although there are hundreds of locations in and around Virginia City, I never heard that any of them produced anything upon development, except those which are on the great ledge itself. Hundreds of thousands of dollars have been spent on these locations with no return, and although it will, probably, always be the case that men will take up ground in the vicinity of a great ledge, and although it is certainly a fact that the ground so taken up may be made the basis for fraudulent operations in the stock market, it is equally true that they rarely, if ever, turn out to be paying properties. It seems as if nature, when she made a big ledge of paying ore, became, as far as that particular location is concerned, exhausted, and that to find anything of value we must avoid the ledge in question. It is therefore the case that for the honest prospector, and I am supposing, of course, that the man who wishes to become a prospector is, and will be, honest, it is far better to go into "fresh fields and pastures new."

The amount of work to be done in a claim by the prospector is determined, first, by the law as settled by the government, and second, by his ideas as to what is necessary in order to sell it or invest capital in it. Both may be ascertained by an examination of the mining law, and other articles in another part of this book. For the mining men who have the necessary education and who are willing to undergo the severe training, and to live the life of hardship which prospecting involves, there are few professions or occupations in which more dazzling or richer rewards are offered in return for hard work. The great need of the present day, opportunities for men who have plenty of brains and resolution, but little money, of these prospecting may be considered to be as good as any. It may be learned while a man is supporting himself as a miner, it may be carried on in the same way, and the returns are almost certain, although they may be long delayed. When they do come, however, they more than make up for the hardships and the toil which have preceded them.

—*Alfred Balch.*

LOCATING A MINE.

THE vast mining interests of the United States have grown up from very humble beginnings. While we may trace, properly, mining in America to the copper mines of the Southwest, places in which ore was dug and smelted in order to get something stronger and more lasting than the rude stone implements made of iztli as the ancient Aztecs and the Toltecs before them called obsidian, for the use of men; there is no use of going back to unrecorded time to find the tiny shoot which has expanded into such an enormous tree, under whose branches so many men find shelter and employment. Great industries are like great movements in nature, they are marked by the same peculiarities and depend upon the same or cognate laws for their growth and their decline. As the scientists of to-day are as one in their position that to understand such a theory as that of evolution we must assume that it is going on around us, that new forms of life are constantly being evolved from lower forms by the process of natural selection, and that any statement which depends upon an assumption that the action of the law of evolution is at an end, that we are examining a final result rather than the working by causes leading to a result is necessarily an insufficient and circumscribed statement; so for us to assume that any great industry is merely the result of all that has been done is to limit ourselves in a manner not warranted by the facts. It is patent to the most cursory student that any great branch of human work embraces to-day not only the most advanced but the most primitive efforts of men in that direction, while we have the great Bessemer converters forcing out their streams of liquid steel, we have puddling furnaces and crucibles; and, if we examine the operations of the iron workers of India, China and Africa we find still more primitive methods in vogue. From the clay furnace, the tree-trunk bellows, the balls of ore mixed with rice straw of the Ashantee, to the smelting furnace, the puddling furnace, and the crucible is no greater advance than from the rude methods employed by the mound-builder to mine and reduce the copper of the Upper Mississippi Valley to the giant hoisting works, the stamp mills and the perfect plant of a mine upon the Comstock. To study the growth then of any industry like that of mining we must study all forms of it; the simple as well as the complex, the beginning of the science as well as the highest point of development reached by it. "Great oaks from little acorns grow," and if we would understand the oak we must examine into and try to comprehend the acorn.

It is this fact which gives the philosophical value to the work done in the location or discovery of mines. For no matter how great the mine may be, how valuable or how rich its product, there was a time when it slept undisturbed in the bosom of the earth, undreamed of by those who passed over it. There was a time when the first piece of its ore was examined by an eye quick to read the lesson written by old Dame Nature for him who could decipher the more or less obscure hieroglyphics—who can tell how many thousands of years ago! There was a time when the mine was located, when, commercially speaking, that mine had its beginning, when it became known. Following out the simile chosen at the beginning of this article, there was a time when the first step was taken, when the operation of the commercial law which has resulted in the great shaft, the long tunnels with their forests of timber, the powerful hoisting works, the reduction works, the mills, with their loud-sounding stamps, began. This time was when the solitary prospector, idly sitting upon some "cropping," perhaps, broke a piece of the ore in two and saw in the "gang" the rich streak which showed him that the piece of dull rock represented fortune. That was the first step in the great divorce suit instituted by man between the "gang" and the metal, the beginning of the mighty struggle during which nature was to be forced to yield up her treasures for the use and benefit of her creatures.

The actual work of the location or discovery of mines is done by a class of men called "prospectors" in the west. In the preceding article the men and their qualifications for their work are described; our concern just now is with the work itself. Mines may be divided into two great classes, the stratified and those which are confined to ledges. I am aware that all deposits of rock or mineral are, strictly speaking, *strata*, but I wish to make the difference between those deposits which cover large areas, and those which are more confined, plain. All deposits of ore have length, breadth, and thickness in common with all forms of matter, but the proportion existing between these three attributes varies enormously. In the great coal fields we have deposits which extend over large areas. Formed during the carboniferous period, there were thousands of square miles covered with the trees and plants which solidified into the coal we burn to-day. Hence it is that while the *strata* of coal have a dip in the synclinal or anti-clinal folds, that dip was given to them after they were formed, the original deposit of vegetable matter being flat, or nearly so. But in another class of mines, those in which we find silver or gold ores embedded in a quartz "gang," the ledge, whether formed by Plutonic action, by infiltration, or in any other way, was not formed horizontally. It was either shot up from below in a liquid form, or the crevice being formed by some convulsion of nature, the rock accumulated or was formed in it by some natural action. The question of the origin of these mines is one which will take far too much time to treat of here. But assuming that, in whatever way they were formed, the process took place after or before the formation of the country rock surrounding them, whether that rock be granite, porphyry, limestone, or any other found near them, we can see at once that, there is betweeen them and what I have called the stratified deposits of mineral, a wide difference. As there was this difference in the formation so is there a difference in the conditions under which those formations exist to-day, and this again implies a difference, which we find to exist, in the methods adopted for the discovery of these deposits. In other words, the conditions under which the various deposits exist although different, being fixed for each class; the man who would find those deposits must accommodate himself to the conditions. The sportsman who would shoot wild ducks does not hunt for them as he would quail.

Taking as an example of the stratified deposits one of coal in Pennsylvania, the work to be done by the prospector or locator—the man who is desirous of finding that deposit, is not difficult. The conditions under which that coal was formed being conditions which existed over a long period of time, all of the *strata* formed during that period present some of the same characteristics, whether it be the coal itself, or the shale or the slate. Each *stratum* was formed during a period of quiescence, a period in which there were no convulsions, as we have agreed to call the more violent and sudden operations of nature. The subsidence, or the upheaval was, it is true, going on, but it was going on very slowly. Had we been living during that period we would not have been conscious of the action, any more than those living in England are conscious of the subsidence going on there. After the *strata* were formed they were bent into the anticlinal and synclinal folds during the great crumpling process to which this continent was subjected, and then denudation planed off the tops of the synclinal ridges so that we have to-day cross-sections, as it were, of the *strata*, originally formed horizontally, one on top of the other. We may illustrate this by bending a jelly cake and cutting off the curve, we would then have a *stratum* of cake, one of jelly, two of cake, one of jelly, and one of cake. If we imagine a *stratum* of shale formed first, then a *stratum* of coal, and this in turn covered with a *stratum* of slate, then if we suppose these to be bent upward into a great fold and the top of the fold cut off, we will have in our cross-section a *stratum* of slate, one of coal, two of shale, one of coal and one of slate, again. While it is undoubtedly a fact that there are shales and slates which have no connection with coal; or which, to speak more accurately, were not formed during the carboniferous period, if we have the knowledge that we are in a region of country which exhibits deposits of the carboniferous, we may legitimately reason when we find our first *stratum* of slate that our *stratum* of coal will be found next to it, and that of shale in its proper place. It is scarcely necessary to say that this series is purely illustrative, and is not instanced for the purpose of describing the manner in which coal is always found to exist. It merely serves to point out the fact that the conditions under which the *strata* of the carboniferous age were formed having been the same, or nearly so, we may reason from the presence of one *stratum* that other and more valuable ones may be found.

The first discovery of coal in Virginia was made by a man named Bunson. He found a lump of black stone which he used to support a pan in which he was cooking, and he noticed that the stone itself burnt up, thereby tipping the "fat into the fire." At least, this is the story as told, and

"I tell the tale as 'twas told to me;
I cannot tell how true it be."

But whether Bunson lost his dinner and found coal, certain it is that coal must have been originally discovered in some way analogous to this. No amount of natural induction would ever teach a man that he could get warmth and heat out of a stone, and such coal must have appeared to the man who first saw it. Therefore, the first prospectors, the first locators of a coal mine must have discovered the mine purely by accident. Following them came the class of men, so largely represented by the prospectors of to-day, who, having seen black stones burn, when they found black stones tried them in the fire to see if they would burn. A step above these is the class who recognize coal as coal the moment they see it, and who, judging by the cleavage or the way in which it breaks, the appearance, the gravity, and any other of the attributes which experience has taught them coal always possesses, have no need to apply the fire test in order to know that it is coal which they have found. The methods by which these two classes arrive at the same conclusion are both outcomes of what might be called a rude experience. The first is the *experimentum crucis*, the experience formulated into a syllogism something like this:

Coal is a black stone which will burn;
This black stone burns;
Therefore this black stone is coal.

The second class reason in a more complex syllogism, but none the less as the result of experience which is personal. There is a third class of prospectors who reason from the experience of others. To arrive at their methods we must go back to our consideration of the conditions under which the coal was formed. During the carboniferous period, life, in both vegetable and animal forms, existed upon the earth. It is known that forms of life in all ages have left behind, embalmed in the rocks, unmistakable traces of their existence, and these traces we have agreed to call fossils. In the great book of nature, that page which we call the carboniferous period has upon it some characters which are peculiar to itself, interspersed with those which run through many pages. When, then, we find a part of some page, and on it find the characters which we know are confined to the carboniferous, we reason at once that it is the carboniferous that is spread out before us. As the conditions which brought about the forms of life seen in their fossils in the coal existed during the formation of the shales and the slates, we may expect to find those same fossils in those shales and slates. And, as a matter of fact, we do so find them. Observations of many men extended over many years, tabulated and reasoned from, have given to the student of geology and mineralogy a method of identifying the coal whenever and wherever he sees it. It is quite competent to imagine a man who had never seen the coal itself, but who had seen and studied pictures and casts of its fossils, a man, too, who did not know that coal was black, finding a piece of stone having in it a characteristic fossil and pronouncing it to be coal. But science has gone further than this. In the presence of the coal itself the student is no better off than the man who tries it by fire; the former identifies it by its fossil, the latter because it will burn. In the presence of the shale, the student has an enormous advantage over the tester by fire, because the fossils will tell him that it was formed during the carboniferous period, and he may expect to find coal near, while neither the shale nor the fossils will tell the fire tester anything at all. Hence it follows that the prospector for coal must be a man to whom the *strata* ordinarily associated with the coal will tell a story. The man who works by the light of the syllogism given above, must, before he can apply it to his work, find the coal itself. No matter how much he may wish to discover the mineral, the ground over which he walks is a book whose pages he cannot read. He cannot tell that he is near the discovery until that discovery has been made; within a few feet of the vein he is mentally miles away.

The process of examining a country for coal is one which does not differ from any other form of geological surveying. The pages studied by the prospector or the geologist are the "croppings" of *strata*, the edges where they have been cut by denudation or by glacier, and which have not been covered up by earth. There are few places, especially in mountainous or hilly regions where the rocks do not crop out. A ledge being seen, the prospector examines it; he breaks the pieces of rock in two with his hammer; he looks for fossils. In this period of the world's history, with the geological surveys which are carried on and maintained by the governments, we have the general character of almost any district ascertained for us. No man, for example, would think of looking for coal in the Laurentian belt in the northern part of New York and the southern part of the Province of Ontario. He would know beforehand that such search would be unavailing, and would result in disappointment. But to actually find the *stratum* of coal is the work of far more particular men, if I may be allowed the use of the expression, than the geological surveyors. The members of the survey are acquiring information by which they may map out a large district; the prospector for coal cares nothing about the district as a whole, his attention is confined to the one *stratum* he is in search of. He therefore examines more particularly, more closely than do the surveyors. He finds a *stratum* of carboniferous shale, but has no interest in the discovery beyond that which attaches itself to it as the possible indication of the presence of the more valuable mineral. The shale is valueless to him; to the surveyor it is as valuable as the coal being a stratum in the measures. In fact, if full of fossils it is more valuable. To the prospector the number of fossils found in the shale is significant. If they are few he reasons that the coal lies below the *stratum*, and to find it he must search away from the dip: if they are many he reasons that the coal lies above the shale, and he must look in the direction of the dip. The character of the fossils, whether vegetable or animal in origin, will tell a story, and the parts of vegetables, as the roots or branches of plants, will give him information. The deductions to be arrived at from these indications and the character of the fossils themselves, their description or their nature does not enter properly into such a subject as that which I am treating. These and other things are to be learned in the study of geology, whether that study take place in the class-room or in the mine; or better than either separately, in both. And this leads me naturally to the statement that the most successful prospectors are practical men—men who have learned the characteristics of the coal of whatever kind in the coal itself. The difference between this class and the purely scientific men is the difference which exists between theoretical and practical knowledge, the difference seen, for example, in the knowledge of a city possessed by a man who lives there, and one has spent many hours poring over a map.

There are other deposits of mineral which although stratified in the limited sense which I have used the word are not to be discovered by a study of fossils. In the search for them we are approaching the method of discovery which must be employed in the location of the ledge mines. We may properly divide the process of location of minerals into three classes: 1st. That in which the *strata* associated with the mineral we are anxious to find will indicate to us its possible presence; the mineral itself being one the deposits of which cover a large area. In this class the best and most striking example is the coal which we have just been discussing 3d. The mineral existing in ledges which are narrow although long, and whose width is wholly in the earth. A ledge of quartz is a good example of this variety. Formed in rocks which were there before it was formed, it is a wholly separate thing, and one which is not and cannot except to a very slight extent, be indicated by any other *strata*. In the case of a coal bed, if we find it on one side of a synclinal or anticlinal fold, we may conclude that we will find it on the other side, because we know that it was probably formed over a very large area. But in the case of a quartz ledge we never find it anywhere else; we never, so to speak, discover that there is a continuation of the story whose first chapters we found so interesting because so valuable. That ledge is by itself, is alone. Midway between these two classes is number 2 which has some of the characteristics of each. The *strata* in it were formed over large areas, and have been subjected to the folding process, and we may look for continuations of the *stratum* when once found. But we cannot discover it by the indications contained in the other *strata*, and fossils do not teach us anything. Of this class the best examples are some of the iron ores which, found in immense bodies extending over large areas are frequently of enormous thickness. In the location of iron mines the chief work to be done lies in the actual finding of them, and this is not as absurd as it at first sight appears to be from the fact of its being so perfectly self-evident. As the *strata* above and below a bed of red hematite for example will not indicate the presence of the ore in any way save possibly by the color, it follows that the prospector must look for the hematite until he finds it. Fortunately, and this may be generally said about all minerals belonging to this second class the characteristics of the ore are such that it can be identified at once. There is no such thing as mistaking it; that is by a person who knows anything at all about what he is in search of. As it generally exists in large bodies, it is as a rule easily found, and the work of the prospector is thereby lightened to no slight extent. In mines of this second class the color of the mineral is one of the chief guides to its discovery. The ores of iron, either red or brown hematites, or those of copper may be distinguished often at long distances by the sense of sight alone. When found the prospector examines them by breaking the lumps with his hammer and sometimes subjects them to some simple form of smelting. As a rule, however, he recognizes them at once by their appearance, and as their value is perfectly well known and varies but slightly, little requires to be done after the discovery. He has, of course, to examine the extent of the deposit as far as he can and to take such measurements as are possible under the circumstances. It is a characteristic of this second class that the values of the ores are known to be far more fixed than those of the first or third. Coal is coal of course, but all coal is not equally good or equally valuable. As to quartz mines they vary in value with a regularity which would be charming from its very invariableness were it not so extremely irritating to their possessors. But the ledges of this second class are always themselves worth just about so much. The presence of metal in red hematite for example is constant, and the value of the mine may be calculated almost mathematically by ascertaining the cost of reducing the ore in the place where it is found. This reduces the work of the prospector enormously. While he is obliged to find out when he discovers a bed of coal, whether it be hard or soft, "black" or "brown"; its heating power is short, and when he discovers a quartz ledge what the value of the rock is, if it is merely a pocket or is a permanent vein; when he locates a body of iron ore he can assume all of this for granted. The prospector for the minerals of the second class has certain facts, the knowledge of which guides him to a limited extent. He knows, in case he is in search of iron, that the bottom of the streams flowing over the bed are apt to be colored by the ore, and he can find this color particularly in the clays. But in the search after ores of the second class as in any other pursuit, special knowledge is necesary which can only be acquired by study or experience.

The prospecting for and the location of mines of the first and second classes is to a very great extent a sporadic occupation. There are few if any, men who pursue it as a settled business, one to which they devote their lives. The reasons for this are obvious. Lands containing the minerals in the Eastern states are generally owned by persons whose knowledge of them is confined to a more or less disheartening experience of their lack of value for agricultural purposes, or to companies formed for the purpose of developing those minerals. The man who finds the mine on the first has to settle with the prior owner of the land before he can acquire a title to the property. Then too, as the minerals themselves belong to classes which take up whole districts and whose presence is naturally expected from the known fact of the existence of other beds, the owners of lands are always on the lookout for such beds. These causes operating together make the profession of prospecting one which gives but few returns. In order to find a distinct class of prospectors, of men whose sole business is to find and locate mines we must find some place where the fact of the discovery of the mine gives the title to the property because it is only in such a place that the prospector is repaid by his work for his work, and it is only in such a place that the title to the mine becomes a piece of property that can be realized on at once. A region which will support a class of prospectors must also be one in which the existence of other mines can only be inferred from those already found. You must be able to suppose, not to conclude, that because you have a mine, another can find one. It must be that each mine is complete in itself, and as its existence could not be predicated from that of any other so its discovery can be no guarantee that others will be made. It is only in this way that the finding of mines can be made a business because it is only in this way that there can be any reason for such a business. In the coal regions of Pennsylvania property in the neighborhood of coal mines has a value simply from the fact that it is in that neighborhood. Men reason that land near a coal mine is apt to contain coal, and an examination of the physical character of the country will enable them to reason with considerable amount of certainty about their chances of discovering a new bed or the continuation of an old one. But prospectors can only exist as a class where there is none of this reasoning possible because they make a business of hunting for and finding mines, the previous existence of which had not been suspected. In order then to have a class of prospectors you must have natural conditions and artificial conditions, not only must the ore bodies be unrelated to each other but the laws must be such that men finding them will receive a reward in the shape of acquiring property at once. In no part of this country are these conditions so perfectly carried out as in the mineral regions of the West. The law gives, under certain easily fulfilled stipulations, absolute property in the locations made to the prospector; and from the existence of a thousand known mines you could not predicate that of the thousand and first with any degree of certainty. It follows then that in the west we might naturally look for the prospector in what may be called his most perfect state of development, and as a fact we there find a class whose sole business is the hunting for, and the location of ore bearing ledges and veins.

The work of the prospector in his search after mines is very peculiar. As far as the mine itself is concerned, he starts out on his hunt without any very definite idea of where he is going to find it. He "concludes" or he "reckons" that a given range of hills are "likely looking," and he proceeds to prospect them. The chances that he fails in his search or that he succeeds are about even. The only indications from which he can reason at all are of the slightest possible character. If he knows that there are what are called recent placers on some river he may conclude that somewhere along that river there are free gold-bearing ledges, but beyond this he has little to guide him. The work of prospecting divides itself naturally into the three kinds of mines, prospected for, placer, pocket and ledge. That "all things may be decently and in order" I will take them in the series as named.

The outfit of a placer miner or rather of a man who prospects for placer mines is of course selected with a view to the kind of work to be done. Placer mines as they are called in the west, or "diggings" as they are more familiarly styled, are places where the gold having been torn from the ledges by the process of denudation, generally carried on by means of water, and swept down by the floods has finally found a resting place. Gold being very much heavier than the quartz or other rock associated with it soon sinks to the bottom of the water. If the stream be very violent it will, especially if it be in small pieces, be carried along until it comes to some place where there is an eddy or a pool, in which the water lingers for a time. Here it will sink at once and rest upon the bottom. The water still moving has power enough to carry the clay and the lighter pebbles along with it leaving the gold and larger stones behind. This process of separating the gold from the rocks in which it was originally, may have been carried on on a very grand or a very small scale. In the one case, millions of tons of rock have been torn away and ground to powder by the action of the water, reducing high mountains during the process to small hills or cutting them away altogether.

On whatever scale the work has been done the subsequent action upon the gold and the rock is the same. It is always swept down by the water until it finds a resting-place, while the small pebbles and the clay are carried away. It may be that the gold is deposited all along the stream during the long years which succeed each other in uncounted decades while this work is going on, and then comes some great flood strong enough and fierce enough to tear up all the gold so slowly deposited and sweep it with the large stones further down. But sooner or later it finds a place from which it is never moved except by man. These places are called "placers," whether large as in the case of the gravel mines of California, or small, they are always the same. They are the resting-places of the gold, the places where it has lodged after denudation has torn it out of its quartz, and water has carried it far away from where the ledge in which it was formed or originally stood. To find these places the prospector doth seriously incline. Loading up his pick, shovel and pan, together with his food, he starts out to hunt for some "diggings" as he calls them. He could not tell you why he selects a particular spot as a "likely location," but experience has taught him where to look with best chances of success. If he finds an old river-bed whose sides show in their water-worn condition where the water ran in the old days long before the time of man, and following it up he sees that these sides suddenly widen out until they form a basin and then contract again, he will say at once, "Thar wer' a mighty big eddy here onct;" and he will be right. If he finds a place where the old river ran over a high ledge of rocks, either as a water-fall or a sharp rapid with a pool below it, he will "reckon it's a kinder likely spot," and he will begin to dig. Hundreds of signs speak to the old prospector trumpet-tongued, and guided by their silent voices he begins his search for the yellow metal.

Taking his pick he loosens the soil and shovels it out. He knows that somewhere beneath the surface of the ground and the centre of the earth is what is called the "bed rock;" that is the *stratum* of rock or clay below which the old river did not dig and above which it deposited the gold. This may be anywhere from five feet to two hundred, but as a rule it is not anything like the latter distance down. Reaching the bed rock in time, his first work is the looking for large nuggets. Of course while sinking the shaft he has kept a bright lookout for the "color" as he lovingly calls the gold in his quaint slang. Should he find pieces of the yellow metal large enough to be picked out with his fingers, he at once concludes that his claim is enormously valuable. This, however, is rarely the case, for as a general rule he must resort to the pan to separate the gold from the gravel. "Panning," as it is called, is the simplest of all operations to look at, and while not difficult to learn is yet one in which there is a certain knack which takes time to acquire. The prospector knows by looking at the kind of dirt likely to contain gold, and he rejects what he finds on top of his shaft without the slightest hesitation. But when he begins to get down below and to find a kind of clayey sand having in it more or less black sand, he separates that carefully from the gravel and fills the pan. Taking it to the side of the stream, if stream there be in the neighborhood, he first picks it all over carefully to separate the pebbles. This is often done in a quicker way by filling the pan with water and then using the fingers as a kind of sieve, allowing the finer stuff to pass between them as they are shaken to and fro in the water. Having got the pebbles out the prospector stirs the masses of clay with his fingers until the water is fully charged with it, and then, after allowing that water to settle for a moment, he pours it carefully away. He repeats this operation until the clay is all dissolved and washed out of the mass in the pan. This as a rule reduces the amount of stuff in the pan to no slight extent. Then the real work of separating the gold begins. Filling the pan with water and taking it in both hands, generally resting the elbows on the knees as he sits on some convenient stone, the prospector gives a peculiar circling motion to the water. It is done in such a way that each time the little wave comes around the pan, a small amount of the sand will be swept over the edge. If he has a partner, and prospectors after placers rarely travel alone, this partner pours in more water. A constant repetition of the process results in gradually reducing the bulk of stuff in the pan until when he pours the water off after a scientific twist which spreads all the stuff left over the bottom in a thin layer, he can see specks of gold shining in the sunlight, and he knows beyond a peradventure that he has found a placer which is valuable. Having found their placer, his partner and himself proceed to locate it legally by complying with the regulations of the mining district in which it is situated, or doing what is required by the United States law.[1] And it should be mentioned here that among mining men the district regulations are often somewhat different from those of the Government, so that it will often pay the prospector to familiarize himself with them. These differences between local and general law while permitted by the latter are far less frequent now than they used to be. Miners have discovered that the law

[1] See chapter on Mining Laws.

passed by the Government is so practical and so just that there is no necessity for any change.

The second class of prospectors in the far west, those who hunt for pockets, are the most improvident and the most peculiar of all men in the business. A "pocket" is the technical name for a small or large deposit of nuggets of gold. How pockets originated or what brought the gold together in the manner in which it is found is a question which cannot be answered here. The theories upon the subject are as many as theories generally are in cases where men are at a loss to explain anything. Certain it is that pockets exist and that large sums of money have been taken out of them. They are of two kinds, those found in old or present water-courses, and those on hill-sides. The first were of course created by the same action which has brought about the existence of the placers. They are generally holes in the rocks at the foot of some waterfall into which large nuggets have fallen. The search after them is the same as that after the placer mines. Hill pockets, or mountain pockets as they are sometimes called, are holes upon a hill-side in which gold has accumulated. Their origin is to the last degree mysterious. The hunt for them, however, forms the occupation of a class of men called "pocket hunters," and is carried on in this way: The prospector starts out armed with his pick, shovel and pan. He has absolutely nothing to guide him in his choice of ground to be tried, and one place being as good as another, his route may be traced by the little holes out of which he has taken a panful of dirt to wash. We will suppose that after a more or less prolonged search, he finds in one pan of dirt a few specks of color. If this be at the base of a hill, and he generally tries the dirt in these places, he proceeds to wash dirt taken from holes ten feet apart in a line horizontal to the spot he first found the color. He may find gold in several of these places, but he prosecutes his search until he establishes two points beyond which he does not find the gold in the dirt.

Between these two points is the base line or an imaginary triangle, the apex of which is, he hopes, the wished for pocket. The theory upon which the pocket miner works is simple in the extreme. He reasons that the gold in the pocket being slowly distributed in the form of float or fine gold by the action of denudation and as slowly washed down hill by the rain, gradually widens out as it moves covering *a larger or smaller*, a constantly increasing area. Having a base line for this imaginary triangle of, let us suppose, one hundred feet in length, he strikes a line twenty feet up, and this he proceeds to test by washing pans of dirt taken every few feet across it until he has established two points as before, beyond which he fails to find the gold on either side. This gives him a second line, which may be called a sector of his triangle. If this second line is shorter than the first and if it corresponds to the first; that is if a line bisecting the first and second would run up the hill, the prospector assumes at once that there is pocket. But should the second line be longer than the first, there being no natural configuration of the surface of the ground to account for this, as for example gullies or ridges, the prospector finds himself at a loss. Assuming, however, that he finds everything all right in the second line, he takes a third still higher up. The first and the second together will give him very close instructions as to the length of the third line and where to locate it. The first being one hundred feet, and the second forty, he aims to make the third about ten. Having done so he begins his search for the pocket itself and when he finds it, as he almost surely would under such a combination of circumstances as I have imagined, he may find that it is what is called a "washed pocket" or one in which denudation has dispersed all the gold; or on the other hand he may find that it is an exceedingly valuable deposit. Large sums of money have been taken out of pockets discovered in this manner. It is scarcely necessary to say that of all modes of livelihood adopted by men, pocket mining or prospecting is the most precarious. While the pocket miner must find ten or even twenty thousand dollars worth of gold which he gets out in a day's work, he is much more apt to go months or even years without finding any. The class of pocket miners is one which is rapidly dying out, and one of them is rarely seen now. It used to be recruited from placer miners, and the men who went into it were generally old. It was noticeable, however, that a pocket miner who was once successful rarely if ever gave up the pursuit.

The third class and highest development of the *genus* prospector is that the members of it search for and discover ledges containing the precious metals. The work is exceedingly hard and full of strange vicissitudes, for to-day the prospector may be so poor as to find it difficult to secure credit for a side of bacon while to-morrow he may be worth thousands of dollars. In beginning the search or the prospecting trip, the prospector secures what is called his "grub stake." This generally consists of a side of bacon, a bag of flour, one of beans, some tea or coffee, some sugar and salt, and a few chili or red peppers. His personal outfit consists of a gray suit generally covered with one of brown jeans, a pair of blankets, a felt hat, strong boots, revolver, ammunition, knife, canteen, pipe, tobacco, fire bag containing matches, a rubber blanket or a buffalo robe and one or two personal conveniences of some sort or other. His camping outfit includes an iron pan which may be used as a frying pan, a plate or a pan to wash ore in; an iron pot of the kind known as a Dutch oven, a tea pot and tin mug. For the actual work of prospecting he takes a pick, shovel, a horn spoon, as an ellipse cut from the outer curve of a horn, is called, and sometimes a small pestle and mortar. If he be well off when he starts he is apt to add to his stores a small quantity of mercury and a large iron spoon. If he be the possessor of a horse or mule he packs all these things upon it, but if not he secures a *burro*—the Spanish name for a donkey—and makes the animal carry the "plunder." Some prospectors carry a heavy hammer with them. Starting out he leaves the mining town for a trip which may last anywhere from one month to six or as long in fact as the provisions hold out. He has nothing to guide him in his search beyond the fact that he believes that there may be locations in the district into which he is going. To a certain extent his search might be called an indefinite one from the fact that the ledges may be discovered in one place as well as another, and, therefore, all places are alike at first. The greatest assistance given to the prospector come from the "float." A ledge of rock "cropping out" or appearing above the surface of the ground at the top of the hill gradually crumbles by the action of water and air upon it. This action, scientifically considered, is a form of denudation ordinarily called by both scientists and miners, "weathering." As the pieces of the vein fall off or become loosened, they, aided by the rain, move away from the ledge, and as a matter of course always roll down hill. These pieces are called "float rock," and the name is applied to them irrespective of the mineral contained in them. There may be "barren" float or "country" float just as there are "barren" ledges or "country" rock. The prospector never passes one of these accumulations of float at the foot of a hill or on the side of the mountain without taking the precaution of breaking and examining a number of stones. In fact the prospector is always breaking stones; now a spur or point of some ledge projecting from the earth and now a loose pebble which he finds laying on the surface of the ground. We will suppose that he finds in a piece of float he has just broken in two, the wished for ore. He recognizes it as quickly as one would recognize the face of a friend after a mask is taken off. The next thing the prospector has to do is to "trace the float" or find out where it came from. In this he has one almost invariable rule to guide him. Wherever it was that the float started from it did not come up hill. If he breaks a number of pieces of float and finds that they all contain the same ore and if he sees by looking up the hill side that the stones are pretty regularly scattered over it below a line about half way up he may conclude at once that the ledge is there. If he finds the stones are all over the hill side as far up as he can see, he concludes that the ledge crops out on top. He can tell by examination whether the float has been there for a very long time or if it be comparatively recent.

In either case he simply walks to where the ledge is, and as a rule he generally finds it pretty easily, and proceeds to "locate" it. But it may be that the prospector finds his pieces of float in a water course either ancient or present; or at the mouth of a *cañon*. In such a case the work to be done by him is much more complex and difficult and involves the expenditure of a greater or less length of time.

The search for the ledge after finding the float may take a month or a year. In fact instances are not wanting in the history of mining in the west where men have spent five and six years hunting for a ledge where the float was particularly rich. Should the float be discovered in the bed of a water course or at the mouth of a cañon, up that water course or cañon the prospector goes. He is particularly careful to examine all loose stones found on the way because he reasons that where one piece of float exists it is probably not alone; and the discovery of other pieces will always prove two very important points, namely that he is on the right track and that the piece of float found by him at first was not "a stranger." The greater number of pieces of float found the nearer the prospector reasons he is to the mine. At length there comes a point beyond which he cannot find any. He then begins the search after the ledge on each side of the water course or cañon and this search is conducted in the same way that he works when hunting for one of whose existence he has received no intimation from the discovery of float. He walks over the ground breaking off and examining a piece of any spur or ledge of rock he may see. Sometimes but rarely he may remove the surface soil with his pick and shovel in order to find what kind of mineral is in the bed rock. Working in this way and in a direction at right angles to the "strike" or longitudinal line of the *strata*, he examines everything in sight until he either gives up the search in disgust or finds the ledge. It may be said here that the former is a rare termination to the trip, for prospectors are of all men the most patient and unwearying in the prosecution of their work.

Having found the ledge either by walking up a hill to where it is or by tracing float and examining the district for a time extending over months, the work of location begins. This may be properly divided into three parts. An examination of the ledge to ascertain its value, compliance with the necessary forms to secure possession, and the securing of facilities for working. To take these in their order, the prospector secures from as many points as he may small pieces of ore or ledge matter. These he selects from the most promising points laid bare by weathering or by his efforts with the pick. Placing them between two flat stones he pulverizes them to the size of peas. He then mixes them thoroughly and spreading them out selects half. These he pulverizes more finely and mixing again, again takes a half or a third. He continues this work until he has got about ten ounces of what he considers a fair average sample of all the rock chosen at first. Pulverizing this yet more finely, in fact as fine as he can get it, he washes it in a pan or horn spoon—"horns" it as the miners say—in order to find the color if there be free gold in it. If it contain sulphurets he roasts it in his iron spoon over the fire. As free silver is seldom found except in the form of wire in the clay seams it is recognized at once by its appearance. Whatever method be taken to assure himself of the value of the ledge, the prospector always depends to a considerable extent upon the appearance of the ores. He is familiar with the look of chlorides, sulphurets or carbonates, and an examination of the ledge will determine for him by the eye, the proportion existing between these and the barren "gang" or rock surrounding the ore. Valuable ore being always mixed with gang vein matter or barren rock—these all mean the same thing when used in this sense—the proportion existing in the ledge between the ore and the gang is a very important point to ascertain. The prospector measures the thickness of the ledge and traces it as far as he can find the croppings. He also examines the "walls" or ledges lying on each side of it and endeavors to find a ledge or ledges parallel to it at a short distance away. He then "locates" the mine using the word in a strict sense; that is, he proceeds to comply with the directions of the law in order to make it his property. He measures off a parallelogram fifteen hundred feet long by six hundred feet wide and builds piles of stones at each corner. In one or more of these he places a notice of his location. When he returns to the nearest recorder's office he files a copy of the notice of location and a description of the claim, and he then has complied with all that is necessary to make that claim his property. Certain amounts of work must be done each year in order to hold it, but these are prescribed and set forth in the Mining Law and the decisions of the Land Office. The prospector may also claim a mill site within easy distance of his ledge as well as a water right if he can find one. The mill site must not exceed five acres in extent and must be upon non-mineral ground. As the possession of a mill site and the water right increases the value of the property greatly, they are almost always taken up or located when it is practicable. The prospector then has found his mine, and by that act together with compliance with certain formalities which are very simple, has become its owner. He may sell it, develop it, lease it, or allow his title to lapse. It may make him very rich or he may find that he has lost his time and labor. What becomes of the property after he has got it is of no interest to anyone but himself, and the consideration of such a point must be made under some other heading than that of the location of a mine.

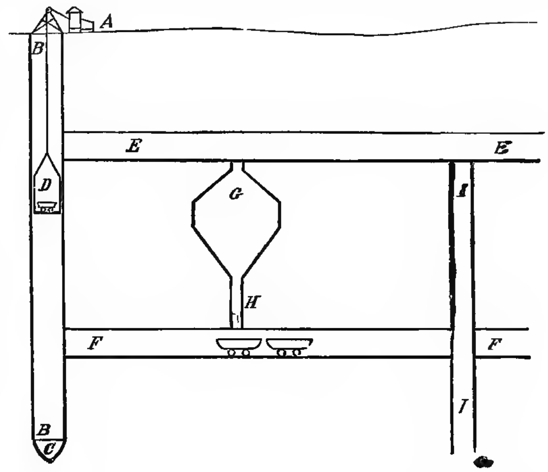
—*Alfred Balch.*

THE OPERATION OF A MINE.

A GREAT business, a great ship, a great army must be managed by some one. There must be some one man to whom questions may be finally referred; who shall decide all points one way or the other. That man must have various qualities of mind or he cannot grapple with the problems submitted to him, he must have knowledge or he is powerless before the questions which present themselves, he must be decided or his decisions are valueless because there is nothing permanent about them, he must be candid or he will persist in mistakes and will not save himself by changing his policy before it be too late. He must be a business man, a practical man, a theoretical man, an executive man. In few words, he must be an efficient man. These are briefly the qualities which must be found in a mining superintendent. The business connected with the mine being of great extent he must be able from previous knowledge and training to settle questions appertaining to it at once and with a due regard for the interests of all parties or there is a waste of money. There being an enormous amount of machinery employed, he must understand not only the operation of such machinery when put up but the method of constructing it. He must be a surveyor and understand the questions which are studied by the civil engineer because he may be required to build roads and bridges or to construct canals; and in any event he is at all times required to know the state in which the mine under his charge is. He must be a miner, for otherwise he cannot know when the men employed are working to the best advantage. Questions of *strata* or of the policy in connection with faults occur in the management of mines, therefore he must be a geologist or he is powerless to meet them. The ore varies in value or changes in character; he must be a mineralogist to know what to do and why he does it. At this point, too, he brings chemistry to his aid, and in his laboratory finds out either personally or from his assayer, what conclusions to draw as to the practical working of the ore from the indications given by, and the results of, the tests. While he may not be able to make these tests himself or it may not pay him to so employ his time, he must be competent to draw conclusions from them. He has to superintend the building of furnaces and he must therefore know the value of mortars, the pressure of air blasts, the strength of fire-brick, and the angles of incidence which effect heat. His furnaces have to treat ores and he must understand the value and proportion of fluxes and be prepared to vary them when the character of the ores change. The mine itself is a vast underground working having in it avenues called shafts, streets called levels, workshops called "breasts," "faces," or "stopes." There are many men employed in these places, he must know to supply them with air. Enormous amounts of bad air and noxious gases are set free, he must know how to get these out. His mine may heat and he must know what to do to cool it. The men employed may strike and the superintendent must understand the problems of political economy which are included in the relation of labor and capital. In fact the list of the different branches of theoretical and practical knowledge which he must possess is almost endless, and the reason why is very simple. As interests involving vast sums of money are committed to his charge, unless he understands and can decide rightly in the questions created by them, he will be inefficient and worse than worthless in his position.

In view of this fact can the practice of employing any man as a mining superintendent who is destitute of the special training necessary for such a position be looked upon as being wise? Is it possible that men who have a part of the training only, business men or geologists, or engineers, or machinists, or chemists, or miners, can succeed? It must be remembered that as the successful management of a large mine involves questions which relate to each and all of these special branches of information, the chemist may be confronted at any time with one only to be settled by the machinist, or the business man with one which must be referred to the geologist. The mining superintendent must be a "many-sided" man if he would be a successful one in his position, he must be prepared to treat two subjects, one after the other, as different as are the calculations of an eclipse and placing of a market value upon a wheat crop. In order to treat the questions which have to be settled by him; in other words, to write an article under such a title as that at the beginning of this, it is necessary to divide the subject into two parts. These may be stated as, 1st, the mining of the ore or those questions which affect the mine itself, and 2nd, the working of the ore or those which arise in the separation of the valuable metal and its preparation for the market.

First then, as to the mining of the ore. The obvious commencement of mining upon any ledge or ore body is digging the ore out. Given a ledge or ore body the first work is that of making a hole. But as such a deposit can not be called a mine and as the really important questions of mining are only presented for solution after that deposit by the work done upon it, has become a mine in the strict sense of the word, it follows that in order to examine these questions in detail it is necessary to presuppose the mine to have been created by the development of the deposit. Supposing then that this has been done and that the property consists of deposit, shaft or tunnel, levels, breasts and stopes, what are the points which naturally arise in the mining or getting out of the ore. And here again the question which is obviously the first to be settled is that of how to dig or tear the ore from the deposit of which it forms a part. If the ore be soft and easily worked, this is generally done by the manual labor of wielding the pick. The miners cut the ore away in the breasts with the pick alone. But if it be hard the drill is brought into play and three miners working together, two strike while the third turns the drill in the hole. The invention and perfection after many changes of the diamond drill has brought machinery to the aid of the mine owner, and the amount of drilling or "boring," as it is generally called, done by them is vastly in excess of anything which was done before. They are most valuable parts of the "plant" or stock of machinery owned by the company, and are to be found in all mines the character of whose ore warrants their use. The holes having been drilled or bored, cartridges of some explosive are placed in them and fired, the result being the tearing out of large masses of the ore. For a long time powder of the ordinary kind was the only substance obtainable for the purpose but as mining became more and more of a settled industry carried on under more perfect scientific methods, explosives of far greater force and efficiency were discovered and applied. Nitro-glycerine, blasting powder or dynamite are now used almost exclusively. They are exploded by a fuse or by electricity, and are vastly more valuable than the common powder. The actual work of mining or getting out ore from the deposit is pretty much confined to the two methods of picking and blasting. There are cases of course where a deposit is found in such a shape that the breaking of the ore with sledge hammers is all that is necessary, but as such deposits are exceedingly rare, we may conclude, for practical purposes of inquiry, that the pick and the drill in whatever form the latter may be used, are the representatives of the methods employed. And speaking of the latter, a word should be said about the power drills worked either by compressed air, steam or transmitted power, those in which it is sought to imitate the action of the hand drills. The distinguishing characteristic between these and the "diamonds" is the fact that they are made to strike instead of bore. As a rule they are not very effective from the fact that so few of them "clear" themselves; that is, get rid of the rock pounded up by them, effectually. They have their uses, however, the greatest being for employment in shallow working where the holes sought to be drilled are not very deep. The ore having been torn from its bed has to be carried in some way to the shaft. This is generally done in cars running on rails or "trams," pushed by men or hauled by horses or mules. These cars run along the levels and the ore is either loaded into them by hand or allowed to run into them from the "chutes." If the ore is being cut from the face of a level, the former method is the one necessarily resorted to but in every other case the latter



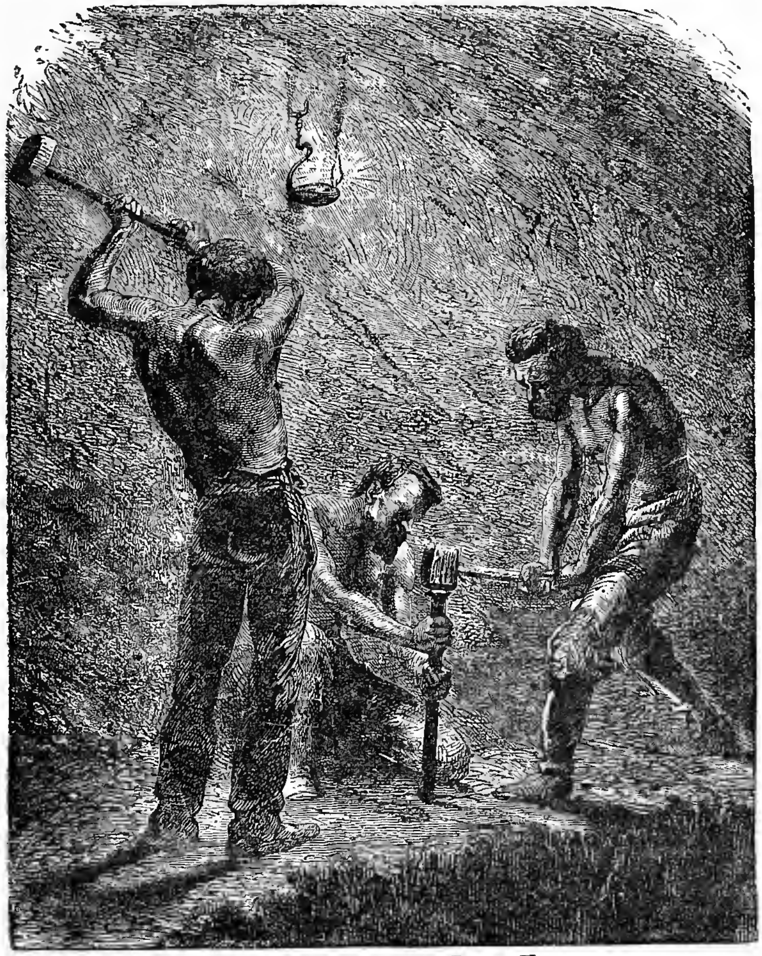
is the one adopted. A reference to the cut will explain this. Let A represent the hoisting works, BB the shaft, D the cage having in it a car or wagon, EE Level No. 1, FF Level No. 2, G the breast or place from which the miners are cutting ore and H the chute. In the cut this is all represented as though the deposit were perpendicular while as a matter of fact deposits generally dip at a more or less acute angle. But the work in any case is the same. The ore which is taken out from the end of Level No. 2 must be loaded into the cars by hand. But that which is cut in the breast G will, if allowed to do so, roll down the chute H by the force of gravity. Any simple gate will stop it and when the cars are placed underneath the chute the opening of this gate will allow the ore to roll out and fill them. The labor of handling the ore then is reduced to the lowest point, and as labor saved is money saved, the use of levels and chutes is easily seen. The ore having been got into the cars, they are hauled to the shaft and run into the cages in which they are hoisted to the surface. The spot where the ore is placed ready for sale, if it need no smelting or working, as for example, coal; or when it is heaped to wait for further treatment, is called the "dump"—the etymology of the word is apparent as it is there that the cars are dumped or emptied. This dump may be either a pile upon the surface of the ground or it may be a lofty structure of wood built for the purpose of allowing the ore in subsequent operations to move by the power of gravity exactly as it did in the shoots. So far the questions which have arisen have not been very important. Any miner knows how to operate a drill or fire a cartridge, construct a chute or load cars. But when the ore is removed a space is created which brings with it very serious questions. As each stratum rests upon that beneath and in turn supports that above, when one is removed the pressure on the lower one and the support given to the upper one ceases simultaneously.

This at once brings us to the important subject of timbering the mine and "leveling" all cuttings. The timbers placed in a mine are so placed for the purpose of supporting the stratum above, called technically the "hanging wall" or "roof." Their number and size depend entirely upon the nature of this hanging wall, its strength and cohesion. This, in turn, depends upon the kind of rock it is composed of, as some kinds of rock are more liable to break and fall in than others, it follows that they need more support. If, for example, a seam of coal be overhung by a stratum of poor shale, as fast as a few feet of the coal are worked out timbers must be inserted in their place. But if you are getting out iron ore and you have a heavy and tough limestone for your roof, few timbers are required, as the pillars left will support that roof. For in cutting out ore, no superintendent will allow all of the deposit to be extracted. Certain parts of it called "pillars," "columns," "buttresses," and a large number of other terms, are left in place. Their object is to support the roof and to prevent a "cave," as the falling of that roof is called. No part of the work of a mine Boss is more important than the determination of what proportion of the deposit to leave in this way and the number of timbers required. Timbers can only be used as auxillary to the pillars, because it would be impossible to substitute them entirely for the ore body. The pressure of the superincumbent strata is so enormous that the strongest timbers are crushed, or bent and broken by it. I have seen an oak timber, twelve inches square and five feet long, crushed down until it was only three and a half feet long. I do not mean bent but absolutely shortened by the force exerted upon it, the ends jammed together in the same way that a piece of rubber may be squeezed in a vice. Such a pressure as this is one which defies all calculation; we can only state it by stating its effects. The superintendent of the mine must then examine his hanging wall, and determine as the work goes on how many and of what size are the timbers required. But as there is pressure downward in a mine when the ore is removed so there is pressure upward. The "floors" of the levels or the breasts "heave," and they have to be constantly cut down or levelled in order to permit of the work of active mining being carried on. This, however, is properly a branch of the "dead work" of the mine, and will be alluded to more at length when I reach that division of my subject. In timbering a system has been devised and patented, in which each timber forms a part of a whole series of supports. Under it the timbers are all cut of one certain shape, and are put together in the mine in the same way that a piece of machinery is "assembled." Each one placed in position is at once a supplement to those placed before, does its own share of the work, and prepares the way for the next in order.

No matter how thoroughly the timbering may be done, there is always danger, and as the area of the worked portion of the mine increases so does this danger increase. That this should be the case is almost self-evident. As there must always be a difference in the amount of support given to the superincumbent *strata*, between that furnished by the ore deposit itself and that of the aggregate of the pillars and timbers; and as the more extensive the working the greater becomes the sum of this difference, the danger of caving must always be in direct ratio to the area of working. Then, again, the superincumbent *strata* themselves aid in the work of their support. We have already seen that there is a difference between a strong bed of limestone and a *stratum* of poor shale. If we suppose the superincumbent *strata* to be of any thickness, it follows that they will be supported to a certain extent by their own resistance to breakage. But the larger the area excavated under them, the less will the *strata* be able to resist the tendency to break down in the centre; the greater becomes the leverage exerted upon them at the edges of the excavation. As the pillars of ore left behind contain valuable mineral, and as they sometimes amount to more than a half of the whole deposit existing in the worked region, it follows that their extraction is work which will pay. There comes a time then in the history of the mine when it is desirable on the score of safety, as well as that of economy, to do something which will at once replace the ore taken out, and allow that which has been left behind to be extracted. There is another danger about these worked areas which is found in coal mines. It is that they become reservoirs or places in which the dangerous fire-damp collects. The superintendent then determines to "pull down the roof." In order to do this, he causes the pillars to be removed one by one, replacing them as far as may be necessary with timbers. Upon this work, as it is excessively dangerous, he employs only his most experienced men. Having removed the pillars, or such of them as he considers safe to move, he may do either one of two things. He may shut up that part of the mine and trust to time and the pressure upon the roof to gradually fill up the excavated portion. In this case he simply lets the thing alone, and after a longer or shorter period natural forces bring about the desired result. Or he may decide that he will hurry the thing up. In this case, he has a number of cartridges inserted in the roof of the worked district, and connected by wires. Causing all the men to leave the mine, he explodes these himself, or has them exploded in his presence by some one else, in each case the operation being performed at a distance by electricity. There being no support for the roof, for so far as practicable even the timbers are taken out, the explosion of so many cartridges at so many points brings the whole roof down in pieces. As broken stone will always occupy more space than that taken by the stone when unbroken, the excavated area is filled up. It must not be supposed that this process of "pulling down the roof" is one which moves all the superincumbent *strata*. On the contrary, the *stratum* affected by it is that one generally immediately overlying the ore deposit. In time, if the mining in any district be very extensive, the whole district will undoubtedly sink, but this requires a long period, and is an operation of extreme slowness. When the roof is pulled down, the superintendent, if the mine be one of coal, orders all approaches to the deserted district to be sealed up with walls built of stone and mortar, in order to prevent the dangerous gases collecting in the interstices between the stones, and so preparing for an explosion. In mines where such gases are not generated, this precaution is one which is of course unnecessary.

From the time that the miner has got down in the shaft a sufficient distance to begin the first level or cross cut to that when the property is abandoned forever, the ventilation of the workings is a great and almost constantly increasing difficulty. Not alone is it a task of great magnitude to persuade the air to enter the mine but in these days of extentensive workings and liberal use of explosives the difficulty of forcing the bad air and the gases generated by the ore or by the explosive agents out of the workings is a very great one. Fortunately experience has shown that currents of air can be made to move from one place or another, can be directed in such a way that they will search out the most obscure corners, provided the persons managing them know how. There are two principles which are relied upon to ventilate a mine, that of heat expanding the air and the abhorence of a vacuum by nature. Add to these a system of pumping or forcing air into a place and we have the three ideas upon the expansion of which into practical methods all ventilation of mining properties depends. There are various causes which develop heat in mines. The lamps or candles by the light of which the miner works, the heat given out by the bodies of the men as the result of that work, the oxydation of sulphur if any be present in the mineral or in the walls, being among them. There may be, too, the heat of thermal springs or, if the mine be deep enough, that which is found in the rock. If we suppose a shaft to be sunk say two thousand feet and if in the centre of that shaft we placed a tube or box or any substance, wood for example, which runs from the surface of the ground to the bottom of the shaft there would at once be created a circulation of air. The air around the sides of the shaft being heated by the walls would rise and the vacuum so created would draw the cold air down through the box. But if we kindled a fire below the box the current of air would be down the shaft and up the box. The system of ventilating a mine by heat is simply the one which we have imagined expanded to the extent necessary to ventilate the whole mine. If we run off at one side from the bottom of our shaft a level of five hundred feet in length and carried the box into the face of it we would have precisely the same thing taking place as before. The air as heated by the walls would travel along the level and ascend the shaft while the cold air would come through the box. If instead of constructing a box we placed a division in the shaft cutting it into two equal parts the cold air would descend on one side and the warm air would ascend on the other. Suppose however that we had two shafts one at each end of the level. Then the air would come down one, traverse the level and go up the other. The direction in which it would travel would depend upon the size of the shafts or the amount of heat generated. If the shafts were of unequal size, the air would come down the smaller and go up the larger. If it is the same, the air would move in the direction of that shaft the centre or equilibrium of heat was nearest to. If the centre or equilibrium of heat was exactly in the centre of the level and if the friction on the air was exactly equal in each shaft, then we could cause the air to move whichever way we pleased by building a fire at the foot of the shaft we wished it to ascend. Keeping that fire burning for a day would be sufficient to cause the air to ascend that shaft in preference to the other for all time because the cold air constantly descending through one shaft would cool that shaft off and so move the point of equilibrium of heat nearer to the other. The ventilation of a mine where pumping is not necessary is merely an expansion of the system which has just been outlined. But there are two most important variations possible in the application of this that it is well nigh impossible to lay down any one rule. The experienced and able superintendent will select that which under all the conditions present seems to promise the best results; and if he finds, as he sometimes will, that the system adopted at first is deficient, he may change it or resort to auxiliary methods to aid it. It is generally the case that auxiliary heat, in the shape of fires maintained at the foot of the shaft or that portion of it through which the air ascends, is employed. There are other methods too, such as the employment of a descending column of water, falling through a pipe and impinging into a trough, which will force the air into boxes from which it may be taken to various parts of the workings.

The most important of these, however, is the pumping or forcing of air into the mines by the employment of pressure blowers or air pumps. The operation of these may be seen



Mining Life.—Boring a Blast Hole.

—*From "La Vie Souterraine," by L. Simonin.*

system. We may either take the fresh air in through a box to the workings or we may take the foul air out. Each has its advantages. In the first we find the introduction of the fresh air and the removal of the foul easier than in the second. In the second the foul air and gases generated by explosions are carried off at once and are not forced to travel through the level to the shaft. We may dispense with the box or "Solar" as it is sometimes called and force the air to travel into one level, thence through the breasts into the other and thence out. In this case the levels themselves are made the channels or pipes for the air. The best method when it is practicable is to draw the foul air through the boxes, it being of great importance to remove the gases and heat as rapidly as possible. It may be said, however, that the determination of a method of ventilation so entirely depends upon the peculiarities of the mine to be ventilated to great advantage in the deep mines of the Comstock, where millions of cubic feet of air are forced into the deep workings during every twenty-four hours. If pumps be employed they should be double acting, that is the piston head should be solid and valves placed at each end of the cylinder. If blowers are used they should be chosen among the "pressure" blowers for the simple reason that fans have rarely enough power to do much good. A case in point occurred in one of the Comstock mines. The supply of air being insufficient a large and powerful fan was added to the blowers and pumps already in use. The men complained that the supply was less than before and an investigation showed that the air was actually being forced out through the fan although this was running at a high rate of speed. As the pumps and blowers may be employed to force the air in, so they may be used to draw it out. This however, must be considered a wasteful application of power as it is more difficult to create a vacuum and cause the air to move into it than it is to move the air itself. It sometimes, but rarely happens that the conditions found in a given working will necessitate this method of ventilation. Such conditions being purely and necessarily special do not call for more than an allusion in such an article as this.

Speaking of pumps for forcing air into the mine brings us naturally to those which hoist out water, that bane of miners! No consideration in the working or operation of a mine is more grave than this one of the removal of the water. It is of such importance as to sometimes, and in fact, not seldom, cause the abandonment of the property and is one of the risks which can never be estimated beforehand. When contemplating a purchase of course if the mine be entered by a tunnel, as speaking in general terms, it always will be when it is practicable, the question of drainage is simple in the extreme. All that must be done is to allow the water to run through the canal cut for it in the bottom of the tunnel. But in the mines where shafts have been sunk, the water must be hoisted out by pumping. And just here it may be proper to say that in the writer's opinion there never was a more perfect machine devised by man than the Cornish pumping engine. If the requirements for perfection in any mechanical contrivance be cheapness in working, ease of graduation or the amount of work done, simplicity of parts and adaptability to the end in view then the Cornish pumps must be pronounced to be perfect. No other word will describe it. The reader by referring to the cut will see at the bottom of the shaft B B a rounded place marked C. This is the "rump" or "rumph," the basin into which all the water in the mine is allowed to run. Into it open the suction pipes of the pumps, and from it the water which is pumped out is taken. It should be large enough to receive the water from the mine and to allow it to settle before being removed. The suction pipes from the pumps which lead into it should of course be carefully screened in order to prevent the possibility of small stones being sucked up into them. The rump should also be made large enough to permit of the bailing of the water by large casks, in case such a proceeding becomes necessary, for it sometimes happens that a subterranean body of water being tapped during the working, the mine becomes flooded and the pumps are utterly insufficient to clear it. An example of this was the flooding of the Savage mine in the Comstock. In such a case bailing must be resorted to. And incidentally it may be pointed out that in such a case the pumps used in many of our mines, pumps to which the steam is carried by a supply pipe from the surface become perfectly worthless, owing to the fact that the steam is so cooled down in the pipe as to lose its pressure. The Cornish pump on the contrary will work even if its rod be in the water half or three-quarters of its length. For the drawing of the mine into the rump it is necessary to cut canals in the floors of the levels. These are called "channel-ways," and should be large enough to permit any ordinary amount of water passing along them. If cut in the centre of the level the channel way must be covered with boards in order to prevent the falling into it of lumps of ore and dirt. In fact whether it be made in the centre or at the side it is always good policy to cover it in. From the levels to the rump the water must be taken in pipes of some kind, or if the shaft be timbered it may be allowed to find its way down between the timber casing and the walls. It is good policy, however, to construct pipes either of wood or metal for it to run through, as it is often of such a character as to rot the wood rapidly, and it is far cheaper to renew the pipes than it is to replace the casing of a shaft. There is use to which this water may be put which is worthy of allusion and comment.

So far we have been considering the working of a mine through a shaft, a system of levels and stoping from level to level. But it sometimes happens that we wish to sink "winzes" or small shafts within the mine which do not reach to the surface. These may be sunk for the purpose of connecting two levels, or for purposes of discovery. In the cut 1 I represents a winze connecting levels 1 and 2 and prospecting into the ore body below level F F. In sinking them the winze "chamber" or place large enough to work in, is first hollowed out, and then the work is done in the same way as that of sinking the shaft. For a short distance the hoisting of rock out of a winze may be done by an ordinary hand capstan or crank barrel, such as those used to lift water in buckets out of wells. But when the winze is sunk to any depth, this becomes far too laborious work to be performed by hand and it is necessary to employ power of some kind. If the amount of air available in such a place is sufficient, an engine is of course erected and run. But, as often happens, this is not the case and we have our choice of four methods. A horse power, transmitted power by wire ropes, compressed air and the weight of a body of water. Of these the transmitted is the best power when it can be applied, the compressed air if the work be light and the pressure of the column of water conducted in a pipe from the surface and utilized in some form of water engine when the work is very heavy. In case the water be used, it is advisable to construct an additional rump near the engine and to pump from that in order to save the power necessary to lift the water from the deep workings. As the power secured in this way costs first what it takes to raise the water to the surface again, any saving in this is a direct saving. One of the most expensive divisions of labor in a mine is what is ordinarily called "dead work." It is that work which is done in order to allow of ore being extracted, and may be compared to the building of a bridge in order to reach a desired spot. It is a means to an end. While the object of mining is distinctly that of taking out ore, it ofttimes, in fact almost always happens that a great deal of labor must be done and large amounts of money expended, before the ore can be got at. This is the dead work, and in nothing does the superintendent show his ability more than in the way in which he plans out and has this work done. He must avoid on the one hand the doing of so much that the profits of the mine are swallowed up and on the other, of doing so little that the mine is in danger of becoming "boxed," that is, of getting into such a state that the ore can be neither cut nor removed in the cheapest way. Theoretically speaking the ventilation and drainage are properly parts of the dead work, but their importance is such that they have been by common consent relegated to separate divisions. We have already had in the leveling or "plaining" of floors of the levels, cross cuts, breasts or whatever part of the mine where a heave has taken place, a reference to the dead work. The extension of levels so that when a portion of the vein or deposit is worked out, a fresh portion is ready for working, is dead work. To look at it in a general way a mine always consists of three parts, that in which the ore has been extracted, that from which the ore is being taken, and that from which it is to be taken in the future.

The preparation of this third division for the miners, getting it into shape for easy access, ventilating and draining it, is all dead work. A good superintendent always keeps mine, by doing this dead work ahead of the actual work of extraction of the ore. It is of course the case that during the time the dead work is being done, there is often some ore extracted, but it is rare that rock which is not ore has not to be taken out also.

The ore being ready for hoisting to the surface some power with which to do this is necessary. At first when the shaft is not very deep, hand capstans may be used, or a horse "whin" employed. But as time goes on steam must be brought into play. The boilers have to be put into place, the great hoisting engines built and the "pit head," "derrick" or whatever the structure over the shaft which carries the enormous "sheaves" or pulleys over which the cables run, may be called, erected. The superintendent must know how to plan these things in order to obtain the requisite amount of power. As their size varies with each mine it is very difficult to say much about them, except in a general way. Such a question as the pressure of steam to be employed is, for example, settled almost entirely by that of the value of the fuel available. With the kind of wood which engineers are often forced to use in the West, a low pressure is all that can be obtained. With good coal, a high pressure may be utilized. It would expand this article far beyond its limits were I to attempt to go into the respective merits of high and low pressure hoisting engines. It is proper, however, for me to mention one fact. The weight of the descending cap and wagons can be utilized whenever there is a double shaft, and it is therefore always wise to have such shaft when the mine will warrant the necessary expenditure. I so state the proviso advisedly. There is often the mistake made of beginning with an expenditure for hoisting works and shafts which subsequent developments do not justify, and a superintendent should know his mine thoroughly before advising such an outlay of the company's money. The character or details of the engine employed, the style used and the expense necessary to secure it, each superintendent must decide after examining the mine and the work to be done. There are many hoisting engines adapted for different kinds of work and it would be impossible to distinguish between them when writing generally as I am now.

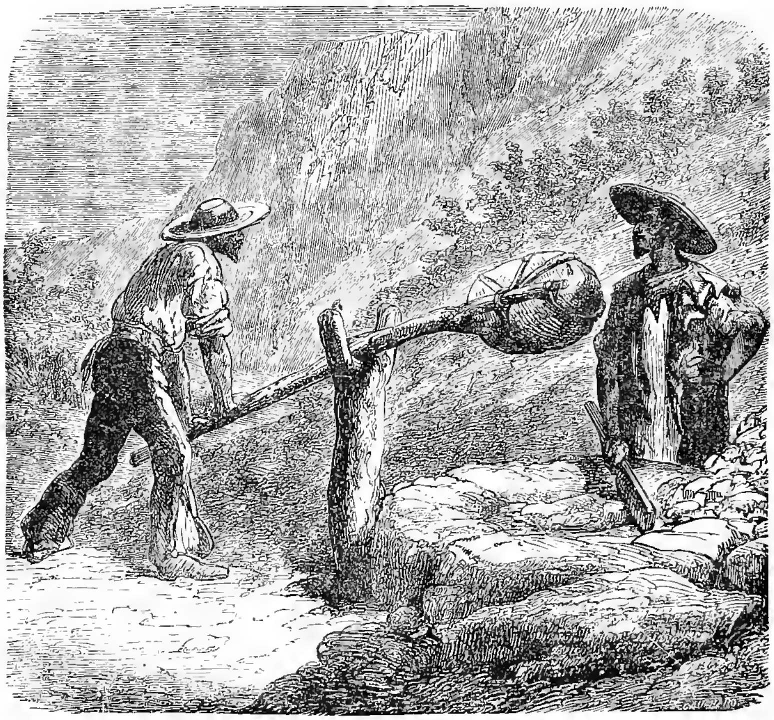
The ore being upon the surface of the ground we must face the question of "what will he do with it," to quote from Bulwer. And this in turn is governed by the character of the ore itself and the uses to which it is to be put. It may be all ready for use, as is coal; or the first part of the work may only have been done, as in the case of iron. I shall not attempt to give full and minute instructions for reaching the products of mines after they have been extracted and hoisted to the surface. Such instructions would be far too technical for the general reader and may be property sought for in works upon practical metallurgy. But I shall in a general way indicate the processes necessary for the handling of ores and the reasons why those processes are employed. Beginning then with that to which the least work is done, coal has simply to be screened to separate the different sized lumps, and is then ready for sale. It sometimes happens when the coal is "dirty" or largely mixed with shale or slate that it must be picked over by hand, but this is rarely the case except when the seam is very narrow. Coal that is mined then is ready for market. Taking the ore of quicksilver as one which after it is mined, one operation has to be performed before it is ready for market, we find that when the cinnabar or sulphuret of mercury, the ore usually found, is to be treated, we have to build a furnace. The treatment of the ore depends upon two facts. First, that mercury is a metal easily sublimed or turned into vapor; and second, that sulphur in combination with it will unite with lime in the presence of heat and set the mercury free. Proceeding then from our knowledge of these two facts, we mix the cinnabar, previously broken into small pieces, with quick-lime and expose the mass to the action of fire. The reaction which takes place is precisely that indicated by the two chemical facts to which allusion has been made. The heat causes the sulphur to leave the mercury and to unite with the lime, setting the mercury free in a metallic state. It then causes the mercury to become a vapor to turn into fumes. Having secured the metal in this form, all that we have to do is to cause it to condense back in a fluid shape and the operation is conducted by simply cooling it. Practically, a reverberatory furnace is built and the mass of ore mixed with lime is placed upon the hearth. The mercurial fumes are conducted away from it into the condensing chambers through which as they pass they are met by sprays of falling water. These chambers are so constructed as to cause the fumes to pass slowly through them and to give the water sprays a chance to extract the heat and so cool the metal. The bottoms of the chambers, technically called the "tanks," are shallow basins partly filled with water into which the mercury in a fluid state falls. When the mercury is secured all that has to be done is to place it in the iron flasks in which it is sold and send it to market.

In the consideration of this system in securing the mercury which exist in the ore in a marketable state, we have touched upon a simple example of the principle upon which the reduction of all metals depends. It was when we spoke of mixing the ore with lime. Ores of metal are bodies in which the metal exists in combination with other chemical substances, and with gang, or other matter which contains no mineral. The gang may be removed mechanically as when we crush rock containing free gold, we may wash the gang out in a pan. But when the metal is chemically combined with other things we must supply during our operations some substance which will extract the combining chemical elements and leave the metal. The substances so supplied are technically called "fluxes," and depend for their operation upon the laws of chemical affinity. It is not necessary to go into those laws here. It is sufficient to say that the affinity existing between A and B is greater than that between A and C under certain conditions; and that given those conditions, we can cause A to leave C and combine with B. It often happens that this action will take place more rapidly in the presence of heat, and we therefore build furnaces or structures in which we may cause heat to aid this action. When we supplied the heat to the mixture of cinnabar and quicklime, we caused the sulphur in the cinnabar to leave the mercury and combine with the lime. This the sulphur did, because in the presence of heat its affinity for lime is greater than for quicksilver. Many people imagine that furnaces melt ores in some such way as grease may be melted in a pan. This is a mistake. The furnaces simply permit the combining element present in the ore to leave the metal and combine with something else; and the metal set free is melted and run into convenient forms.

Iron ore being upon the surface and ready for working requires sometimes two processes before it is ready for market. It must be roasted if it contain sulphur, and then smelted. In the first place the ore being piled in loose stacks or placed in roasting furnaces is exposed to the action of a slow fire for some time. The sulphur in it being heated becomes sublimed, and either by burning unites with the oxygen of the air or is driven off in sulphur fumes. Having been roasted, the ore is mixed with proper proportions of flux and is smelted. If the ore be a carbonate of iron, the combining element of the carbon unites with the oxygen forced in by the air-blast and burns away. But in the treatment of such an ore we have to get rid of the gang, and this is so intimately mixed with it that we never hope to do so by mechanical means. We therefore ascertain what chemical elements are in that gang and supply in the fluxes used some material which by uniting with it will change the form in which it is, permit the metal to separate from it and enable us to remove the two separately. If the ore be that which is often found and worked, the carbonate of iron mixed with argillaceous earths and clays we add lime stone, and if there be no silica in the ore, a certain amount of sand. In the presence of heat the argillaceous earths and clays, the lime stone and the silica unite to form a fusible glass-like substance called "slag," having a different specific gravity from the iron. The carbonate of iron having the carbon burnt out by the oxygen in the blast and being melted by the heat of the burning coal, sinks down to the bottom of the furnace to which place the slag also runs. But the specific gravity of the slag and the iron being different they form two layers in the furnace which may be compared to water and oil in a glass; and they may be tapped and drawn out separately. The questions of most importance in the smelting of iron ore are those which relate to the building of the furnaces, the proportions and kinds of fluxes used and the economical use of coal.

To settle these questions the superintendent must know how to build a furnace. The importance of this knowledge is very great, for upon the shape given to the furnace depends the amount of metal which can be worked. Some ores require greater time for their passage through the furnace than others; or must be exposed to the action of the fluxes for a longer period. The internal shape of the furnace will, to a large extent, regulate the rapidity with which the ore goes through. As the object in every case is to pass the ore through with the greatest speed consistent with its reduction, the superintendent will, in building his furnace, make such changes as may be necessary to suit the particular kind of ore which he is dealing with. The kind of fuel obtainable brings with it the question of whether a hot or cold blast is to be used to obtain the best results from the working. It may be said generally, that the hot blast, or the air forced into the furnace raised to a temperature of about 600°, will enable the superintendent to use ordinary coal in place of coke or charcoal. It is said that "hot blast" iron is inferior to "cold blast," but I am not certain that this has been conclusively proved. At any rate, as the object of the superintendent is always to get the largest return in money as the result of the operation of the mine as a whole, the blast used, and the iron made, will depend upon the individual conditions under which the particular mine is worked. Fluxes being of enormous importance, the superintendent will not only look out at all times for a convenient source of supply, but will examine into the proportions being used with great care, in order to see exactly where his work stands, whether he is working the ore to the best possible advantage, and at the least possible expenditure of money. The result of the operation of the furnace in metal and slag will teach him a great deal. If he finds his metal too hard, for example, he will know that the iron, after reaching a metallic state, is exposed to the action of carbon for too long a time. He must then hasten its passage through the coal. If he finds that the slag is sluggish, and will not run over the "slag-stone" easily, he knows that the proportions of the flux to the ore must be varied in some way. It would be impossible for me to go into a list of the indications which point to a change in the treatment of the ore being necessary, for the simple reason that were I to do so I would write a whole book instead of a single article. Suffice it that I point them out in this general way as an example of the method by which the superintendent ascertains if the work be going on right, and, at the same time, as an instance of the kind of questions which the superintendent has to smelting of such rock will cost more than the metal yielded by it will amount to. But if two and a half tons of the rock be taken, and the ore separated out, we get one ton of ore to smelt in the furnace and a ton and a half of gang which we throw away. Smelting that ton of ore may pay very well. This is what is called the concentration of ore. The primitive method of doing it was the picking over and sorting of the ore by hand, which was a very slow and costly process. As there is a difference in the specific gravity of the ore and the gang, advantage is taken of the fact to separate them, and machines more or less complicated, and working with water or without, have been devised for the work. Some of them are very effective. It is always a measure of economy when the ore is such as to permit of its being done, and the conditions are favorable, to concentrate the ore before treatment in the furnaces, and it will often make the difference between a paying and a non-paying property.

To the three classes already specified we must add a fourth, that in which the ore after it is extracted from the mine has to be worked, but in which the plant for such work

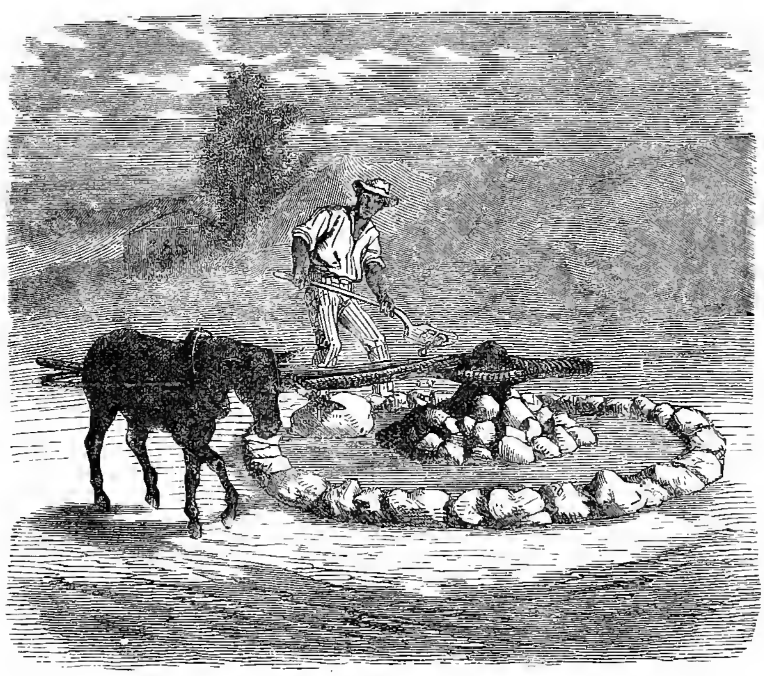


Mining Life.—Crushing Ore by the Old Mexican Process.
—From "*La Souterraine*," by *L. Simonin*.

meet. This latter contains, inferentially, a description of the kind of man the successful superintendent must be.

All deposits of ore which have to be treated by fire in order to extract the metal contained in them, are treated by modifications of the two processes described, roasting and smelting. The details of the treatment vary with the minerals, as do the fluxes employed, and the shapes of the furnaces. We have, then, three classes of ores; first, those which are ready for sale as soon as mined, second, those which have to be roasted, and third, those which require smelting. There is a process often necessary for the economical treatment of ores which applies to those of the second and third. It is a part of the preparation of the ores for the furnaces, and is called "concentration." It is applied to such ores as consist in the veins or deposits of ore intermixed with gang. With such ores it is of course perfectly apparent that the treatment in a furnace should only be applied to the ore itself, and not to the gang, as that contains no valuable metal. Supposing that in a ton of rock, as taken from the deposit, there is forty per cent. of ore and sixty per cent. of gang. It may easily be that the does not include a smelting furnace. Such ores are worked by crushing and mixing direct with some substance which will combine with the chemical form of matter in combination with the metal. An example of this class is the ore carrying the precious metals in combination with sulphur. The ore is mined, roasted and taken to the mill. Here it is broken with some crushing machinery into lumps about the size of an ordinary potato, and then placed in the battery. Heavy stamps being caused to fall upon it, pound it into a fine powder, in which condition it passed through the screens, as the fine sieves are called. From there it is taken to the pans, where, being mixed with mercury by the action of the revolving mullers, the amalgam or paste composed of mercury, gold and silver is formed. The whole mass being removed to the settlers, the fine gang, vein matter, and in fact everything except the amalgam, is washed away, and the amalgam is then taken and "retorted." That is, it is placed in a retort and heated, when the mercury sublimes and passes away in vapor only to be condensed and used again, while the gold and silver are left behind. These being melted, are formed into the familiar "bricks." It will be noticed that in this process the ore was roasted to drive off the sulphur, being as far as that part of the work is concerned, treated as though it had to be smelted. But should the ore be a quartz carrying fine or native gold, this roasting would not be necessary. In the treatment of the ores of the precious metals, there are various modifications demanded by those in the character and kind of ore to be worked. Among these may be mentioned chlorination and treatment by the special processes and methods.

The opening of the mine, its ventilation and drainage, the extraction of the ore and its treatment, have all been described generally, and this part of the duties of a superintendent has been sufficiently indicated. But there are other points which arise in the management of a great mining property which must be alluded to briefly, and first among them is the question of labor. Good miners are men who are always worth a great deal of money, and who cannot always be got, especially in new districts. While they do not necessarily know very much about the many questions which serve to worry the minds of the superintendent and those who have the mine in charge, they should understand their business thoroughly. Experienced miners will save large amounts of money to the owners during the year, and for this reason. They know how to manage that portion of the work committed to them. An inexperienced or green hand will often do more damage than he does good, and he rarely is able to give the "Underground Agent," "Captain," or "Mining Boss," as the assistant superintendent underground is called, the information about the workings which is of so much value. He does not do his work as well as a rule, and he requires constant supervision.* A very necessary part of the work of a mining superintendent is the laying out of roads and the building of bridges if any be needed. This comes directly into the question of the transportation of ore after being mined. If the pit head be on top of a hill, and the mill or furnaces be at the bottom, as in such case they almost always are, the transportation of the ore may be effected by wagons over a good road. This should be built in such a way that no ordinary rain will wash it into heavy gutters. It is well, if it be possible to have it wide enough for the passage of two wagons at once, but if this be impracticable, places at which the wagons may pass each other in ascending and descending should be carefully built. The grade should not be too steep or the wagons will be racked to pieces and yet should be steep enough to give the animals used little to do beyond steering the wagons down hill. When the hill side is straight, it is often economical to construct double "teams" or railways and to allow the loaded wagons to pull the empty ones up. If it be impracticable to build a road or if the ore have to be carried across a "bassanca," canon or deep gully, it will often pay to send it in buckets suspended from rollers which travel upon a single rail and string piece supported by posts. The power in this case is furnished by a long and endless wire rope passing at the mill or mine around a drum. An important consideration for the mining engineer is often the supply of water for the mine and mill. This has sometimes to be brought a long distance, as that which is pumped from the mine is rarely available for the boilers from the quantity of chemical substances contained in it. If possible the water should be got from a spring which does not dry up at any period of the year and the ditch, pipe or flume used to bring it to where it is wanted should always be constructed large enough to give all that is necessary for some years to come.



Mining Life—Arrastra or Mexican Mill for Treatment of Gold and Silver Ores.

From "*La Vie Souterraine*," *by L. Simonin.*

A powder house or place in which to keep explosives should always be constructed. If there is a deserted drift or tunnel, by placing in it two heavy gates or doors at least ten feet apart it forms an excellent magazine. It should always be ventilated by openings or grates in these doors. If a house has to be built it should be so at a distance from the works and pit-head and should be solidly constructed of stone and surrounded by a wall. The keys of the gate and door should always be in the hands of the clerk of the mine or the storekeeper, who should be responsible for the powder and should never be allowed to issue it except in person.

A capable superintendent should see that arrangements for the introduction into the mining camps of such things as groceries and dry goods by storekeepers are made, although it is a mistake, unless we find that the men are outrageously fleeced, for him to advise the company to run a store.

* See Article on Labor Problems, close of this Part.

Miners are as much given to lying as are other men, and stories about the amount of profit made by the store out of them are sure to set afloat and frequently give no small aid to those who wish to start strikes. If the company own the ground around the mine, as they often do, it is well to let it to the miners to build houses upon. In such case a small ground rent should always be charged in order that the men may not think that they own the lots in fee. An agreement should be made by the company to take the improvements made at a fair valuation in case the men leave, or what is better yet the custom should be known to prevail. The ground rent and the purchase of the houses built gives the superintendent a check upon the men and enables him to insist upon the premises being kept in good order. Such things as drainage and the supply of water should as a rule be attended to by the company, enough being charged in each case to give a fair interest on the money expended. That nothing can be worse than for the company to do things for the miners for nothing—may be laid down as a general rule. The exception to this, for like all rules it has an exception, is the furnishing of a hospital and medical attendance free for those who become injured in the mine by accident or as the result of any cause directly connected with the mine. When there are several mines near together, the companies can unite to fit up a hospital for the benefit of all employed. The physician who attends to the hospital will of course have a certain amount of practice among the miners and their families, but as this is insufficient to support him, the company should supplement it by such payments as may be necessary. Reading clubs and free libraries should be encouraged to the utmost; or if the latter are not free the charge for them should be of the most nominal kind. When the men get up clubs or libraries, the Superintendent should, without interfering with them in any way, make his approbation of such things strongly felt by liberal donations of books. As the libraries should be encouraged, so the liquor saloons should be discouraged. A man who as soon as the monthly pay day comes, after squaring up his account proceeds to spend every cent he has left on whiskey or gin, may help to increase the profits of the saloon keeper, but he is not much good under ground. Not only does he "lay off" until the spree and its effects have passed away, but, when he does go to cutting again he is not trustworthy. It is scarcely necessary to say that a superintendent who drinks himself cannot preach the value of temperance very loudly. Of course, if there be many children in the camp, the company will see that a good school is provided. It will receive more than the money expended in the increased value of the labor of the boys when they come to take their place under ground. It is of some importance for the superintendent to remember that he represents the company to the men, and that his influence whether for good or evil, cannot be overestimated. He rules a large body of men, and if he be fit for the place, he rules them wisely. He is not there simply to make the greatest output possible for any one year. He is there to manage a great property, and to manage it so that it will always be worth as much as when he took hold of it, except of course in the one matter of the amount of ore in the mine. He can only so manage it by remembering that an important diversion of the interests under his control consists of the labor employed. If he treats the men in such a way, and he very easily can, as to bring about constant strikes he is unfit for his position. If on the other hand they are satisfied, the company will find that in choosing him they made a wise choice, and that the financial result of his management is one which shows a comfortable balance on the credit side of the ledger.

—*Alfred Balch.*

THE MINER AND THE CAPITALIST.

IN the old days, "the days of 49" as the song has it, the plant required by the miner in the West was a pick, shovel and pan. When he found his placer he, aided by his partners, constructed a "long tom" or a sluice-way, and in time, perhaps, built a ditch and flume. But in mining the days were essentially those of small things. The man who could not afford a "tom," or the expense of mercury for the "rifles," could make ways with his pan alone if the claim was good. He could save some money and in time, as the result of those savings, could construct the things necessary for increasing his gains more rapidly. Any man could begin by himself with a fair chance, providing he brought strength, sobriety and shrewdness to his aid, of making a handsome amount of money. But as time went on and the "diggings" got worked out, the search for the precious metals began to assume a more business-like character. It was no longer that the miner of to-day acted as a teamster next week only to return to mining in a month or two. What had been an incident in a man's life became his life's business. The form of mining changed when the quartz ledges, or "reefs" as they are called in Australia, were discovered. It was found that expensive plants were required to work them, and the reign of the capitalist and the company began. It became necessary for the men who found the mines to have money before they could develop them, as hoisting works cost more than a pick, and stamp mills were more expensive than pans. It was discovered that the ores which contained the precious metals must be reduced by expensive processes before they could be made to yield the gold and the silver. The time had come, in short, in the history of Western mining, when it was beginning to be a business in which vast amounts of capital were to be invested, and financial questions were to be considered in connection with it; when the President who looked after the business interests of the company, never having handled a pick in his life, was to be as important a person to the stockholders or owners as the superintendent. This change in the process of mining brought about a separation between the men interested. Those who found the mines, the prospectors, and those who operated them when found became two distinct classes.

As the prospector is poor; that is, as he rarely has, even under the most favorable circumstances, more money than what suffices to support him; or, as is generally the case, he is obliged to labor for that support, the question of how the prospector shall reach the capitalist, how the man with a valuable property, requiring money to make it yield its treasures, shall reach the man who has the necessary money and is willing to devote it to this object is one of great importance. It is of importance to both prospector and capitalist, for the union of the money and the mine will result in benefit to both. The prospector gets his mine as the result of a search which consumes more or less time. Having located it and filed his location, he becomes the sole owner of that piece of property which may be worth millions or may not be worth anything. By law the prospector, in order to hold his property, is obliged to do a certain amount of work every year. He must either spend within each twelve months one hundred dollars upon the mine, or he must put in labor to this extent. There is a conventional amount of work recognized in many mining districts as being equivalent to this hundred dollars, the sinking of a shaft, or driving of a tunnel eight feet by four, being supposed to cost ten dollars a mining foot, so that sinking such a shaft ten feet would be considered as an expenditure of one hundred dollars upon the claim. This assessment work, as it is called, ceases after a United States Patent is obtained for the property, but a locator or his assigns could hold a claim to doomsday without a patent if they did one hundred dollars worth of work on it each year. The requirements of the law, in the matter of assessment work, have had an exceedingly good result. In the old days (prior to 1872) when all that was necessary to hold a ledge was to locate it, the prospectors in mining districts were as a rule, mine poor. They owned so many locations that they never considered it necessary to do anything to any of them, and the ledges remained undeveloped while their owners strutted about, the imaginary owners of millions they never took any steps to get. Under the present law, the assessment work compels men to limit the number of claims held by them, for the simple reason that they cannot afford to do the work or spend the money necessary to hold them, upon any very great number. This again, by concentrating their attention and their efforts upon a few ledges, has led to the development of those ledges; and just here it may be said that a mine which has just been located is worth but very little money except in very rare cases. A ledge of rock may be exceedingly rich, very thick, have clay seams and walls complete, may crop out for three or four thousand feet and yet be a property which is not valuable. I concede that this would be an extreme case, but it is a possible one. Prospectors are far too apt to consider that any kind of a claim, if the surface indications are good, is worth a great deal of money. The sums which they mention as those for which they would sell are ridiculous. Fifty thousand, one hundred thousand, two hundred thousand, half-a-million or a million, are words which flow as readily from their lips as though they were talking about grains of sand rather than dollars, each one of which has in it one hundred cents. They do not seem to realize that they are simply showing their own folly. They will point to some "coyote hole" of a shaft about ten or twenty feet deep, and talk about the mine! They will tell you that they have ten thousand tons of ore in sight when there is neither shaft nor tunnel, sunk or driven. They will talk of a property worth a hundred thousand dollars when that property is absolutely without development, and their knowledge of it is confined to surface examination of the croppings, the "horning" of a dozen specimens and perhaps three or four assays. They do not seem to realize that all of this kind of talk is not only foolish and unbusiness-like, but that it injures them. Business men with money are not fools; on the contrary they are as a rule exceedingly "level-headed" individuals. Having made their money by shrewdness and forethought, they have learned the lesson thoroughly that when a thing is bought for a dollar, it is so bought because it may be sold for a dollar and a half.

There are unfortunately far too many instances in the mining history of the West, where the business men of the East have succumbed to the glamor which mining seems to be able to throw over the great majority of those who come in contact with it. They have spent their money foolishly, and have purchased, for large sums, properties which had nothing more to recommend them than the two facts that they were in a good neighborhood and the surface indications were favorable. In some cases these purchases have turned out well, but in the great majority they have been speculations which have ended disastrously for those who have gone into them. It may be conceded that the prospectors who have thus sold have attained what might be called their first object, that of obtaining money for their claims; but on the other hand, every claim so bought which has turned out badly has injured the district in which it was located far more than ten times the sums paid for it. And that this is a fact may be demonstrated with but little trouble. It is a common saying that "capitalists are like sheep, where one goes another will follow." This is true, but not in the derogatory sense in which it is generally used. Capital seeks interest as naturally as gold seeks quicksilver; the man who puts money out does so because he expects to see it return with increase. Capitalists then are men who have a keen sense of where their money will so increase, and when B finds that A has invested money in any business and secured an enlargement of his wealth, the attention of B is drawn to that business with a certainty and to a degree which nothing else will secure. No descriptions of a channel for the profitable investment of money, no laudatory articles in newspapers, no assurances from friends or acquaintances, no talk of this or that reason for the investment of money, will speak half as loudly to B as will the knowledge that A has put in a dollar and received in turn a dollar and a half or a quarter, ten cents or five. In the one case B listens—if he listens at all—with a half-hearted interest; in the other, his attention is instantly aroused. Now as every man, who has ever been in a mining district, will conclude at once, the number of properties in one which is fairly prospected and which is rich, that will pay if capital be judiciously invested upon them, is as a rule very large. The original location of the "Roaring Tiger" is, we will suppose, on a good ledge, with walls, clay seams and everything else which makes a "true fissure vein" complete. Upon opening the mine it is found to widen as it goes down, the ore is easily mined and worked, the milling results are handsome, wood and water are plenty, labor can be got easily and, in short, the property is one which will give a handsome return for the money invested. We will further suppose that the money necessary to develop it has been invested by A, that hoisting and reduction works have been built, and that A is receiving for his outlay handsome returns. But there are extensions 1, 2, 3 and 4 on the "Roaring Tiger" west, and 1, 2 and 3 east; and there are parallel ledges carrying the same kind of ore, and with the same or better indications after the "prospecting development" has been done.

A cannot handle the extensions let alone the other veins. For these to be developed and made profitable B and C and D and the rest of the alphabet must come in, examine the properties and invest money in them. A then is but the pioneer of the capital in his relation to the whole district, and if the pioneer report the country a fraud, as he will do if he loses the money invested, it will be many years before B, C and D are seen in the neighborhood. But this may be carried out still farther. B is a friend or an acquaintance of A, and is attracted to the district by A's success in the original location of the "Roaring Tiger." As he was attracted by the success of A so his success in turn attracts C, and D is brought in by the knowledge that C has made money. The investment in the district by each capitalist then, after the first, is at once the result of the previous successes made there and the cause of investments by others. Of course the same causes which led to the original investment by A are still operating in the case of B, and they have weight in B's mind. But as any man who has ever attempted to place a mine or sell a location knows they do not operate to the same extent. The first capitalist may get a venture into an untried field by the reports of its wealth, the second always requires to know how the first succeeded. No amount of description, no matter how rose-colored, will weigh in the mind of the second against a failure of the first. The first sheep on trying to jump the wall got knocked back, and the second respectfully declines to make a battering ram of himself.

Every miner knows, and I am writing now for miners who have good properties which they wish to see developed, and in which they hope to interest capital, that each mine, unless it be a first extension, and not always then, stands alone. It is impossible to reason with certainty that because the "Roaring Tiger" is a good mine, the "Purring Lion," which lies beside it, is also good. That the same work which demonstrated the value of the first must be done before the value of the second can be ascertained or known. It is true that capitalists do not always know this, and that as a result of their lack of knowledge, the "Purring Lion" is purchased simply from the success of the "Roaring Tiger." No men are quicker to laugh at such purchasers than the miners in the district, where the properties are located, and they often conceive and express no small amount of contempt for the "Eastern sharps as bought a coyote hole in the croppings." But they permitted the property to be sold in that condition. There is a fellow feeling among them which leads one to endorse the claim of another. They shrink from doing anything which does not seem to be square, they would hesitate a long time before they would talk to a man who had an idea of purchaseing Jack's claim with half of the frankness that they would talk to Jack about the property. They have an idea that the capitalist has plenty of money, and they know that Jack has got a "damned small pile." In default of the purchase of property owned by themselves they are willing to help Jack to a sale of his, and they are naturally anxious that the money shall be invested in the district. And so they stand by and see the money invested by the capitalist with a full knowledge, not that the investment will be a dead loss, for I am not supposing for a moment that Jack's claim has more "salt than sugar" about it, but that the investment is not warranted by the development of the mine, and is consequently a very risky one. Now I am not advocating any low down tricks, and there is no one who would more heartily despise a man who came to him and told him that Jack's property was not all that it was claimed to be. I believe in white dealing as much as any man living. But I know that the feeling among the miners which permits Jack to sell his claim when it is nothing more than a prospect is a wrong feeling and which works infinite harm to Jack first and to every man in the camp afterwards. And I know that there are hundreds of districts in the West that have been ruined by the fact that the prospects owned by the Jacks and the Toms and the Petes have been sold for sums of money which were in excess of their real value.

Every miner who reads this paper knows this as well as I do. Now what I want to do is to show the miners who know this how to avoid having this fate or that which is akin to it, the retarding, the setting back of a district for those in which they now are.

And in the first place I will say that a good mine is generally worth a large sum of money. I say generally because of course it is not impossible that the vein may pinch, or that there may be a "horse" coming in or something else may be found out which will prove the property to be worthless. But, generally speaking, a good mine is undoubtedly worth a large sum of money. The prospector who owns the mine or his partner who advanced the "grub stake" and paid the fees for registration, have put in time and money, and have secured as the result of such investment a piece of property. It is right and just that they should get a return for that property, that it should pay them, and pay them handsomely for the work done and the money invested. But when the property is first acquired, it is not a mine, it is only a prospect. The difference betweeen these two is enormous. A good mine is generally worth a large sum of money—a good prospect is never worth more than a small sum. Take a mine of free milling ore for example, which has a shaft or tunnel exploiting it below water line. Let there be a ledge of six feet in thickness at the lowest point reached against a thickness of four feet on the croppings. Let there be in it two levels, one cutting the vein north and the other south, supposing the strike to be north and south, and let the two aggregate five hundred feet of cutting. Let the walls be good walls, clearly defined and with the clay seams complete. That mine is a good mine to sell and is worth a large sum of money. Why? Because it has been proved to be worth it. It is not a risky speculation when a man purchases it and the man who sells it gives an assumed value for what he gets as well as a prospective value. It may be that in the next fifty feet down the ore will pinch or it may in the same distance widen still more. The risk of the one may legitimately set against the chance of the other by the purchaser. In any event there are just so many tons of ore in sight, and each ton of that ore will yield just so much when milled. But suppose that some mine is a prospect only with perhaps a cutting into the vein ten feet deep, showing the ore below the weathered rock. It is worth very little. Why again? Because it has not been proved to be worth anything. The risk of its pinching is enormously increased, for the state of the vein below the water line is not known, while the chance of its widening out is enormously diminished. And there is practically no ore in sight. The purchase of it becomes an exceedingly risky speculation, and the man who sells it gives prospective value only. It may be worth a great deal it is true but it may not. Nothing is known, nothing is sure; it is all speculation and all risk. Now it is a commercial and natural law which, like all natural laws, cannot be broken with impunity by any one; that in proportion to the risk must be the profit. If men take great risks commercially they must have the chance of wishing enormous profits. It is therefore the case that when the capitalist takes all the risk he must and will, unless he be a fool, take all the profit. It is another commercial law, or rather an extension of the first, that in proportion to the sacrifice shall be the return. With these two laws clearly in our heads let us see how the miner and the capitalist, the man who found the property and the man who has money to develop it, and who wishes to purchase it, stand in relation to the two periods in the history of the mine to which allusion has been made. As the prospect is prior in point of time to the developed mine, I will reverse the order in which they have been maintained, and take the prospect first; and for the sake of convenience I will call the commercial laws to which I have alluded, number one and number two.

The prospector found the mine, let us suppose after a search which took one year's time. He spent then 365 days on it, and his time and labor being worth, say fifteen dollars a day; in that the mine cost him $5475. It will be noticed that I put the price of his labor at a high figure. This is done because the knowledge which enabled him to find the mine is worth just so much money, while his labor might be worth anywhere from two to six dollars a day, his knowledge makes his time worth more. It cost him or his partner something to buy food for him during this time, and I will put that down at a high figure also, ten dollars a week. There are very few camps where a man cannot in these days buy grub for a week for ten dollars. This added to the former sum amounts to $9125. Then there are recording fees which will bring it up higher, and the time spent by the prospector in talking to the capitalist or in writing to him; the time, in short, it took to bring about the sale. Putting these and all other expenses down liberally $10,000 will cover everything the prospect has cost the man who found it up to the time of its sale. Under law number one, $10,000 represents the risk to the prospector; under law number two it represents the sacrifice. Now the proportion which exists between risk and profit is a direct proportion, and the proportion which exists between sacrifice and return is well known. In this case the sacrifice having been made the prospector has a right to look for a return, and that sacrifice having been a risk, he has a right to expect a large return. Had he sacrificed his time in the employment of others, he would have been fully compensated by a payment of the $5475, because there would have been no risk. I am supposing that he would have lived during the year at the expense of his employer. In that case law number one would not have applied, as there would have been no risk. The difference, then, between the amount he has a right to receive for the prospect and the $5475 is a difference caused by the operation of law number one. In other words, it is because he has taken the risk of losing the $10,000 that he should receive more than $10,000. And it is in consequence of his taking this risk that he has acquired a property which is worth more than $10,000. Suppose he had made an agreement by which for a year's work, boarding himself, he was to receive a mill worth $10,000. He would have taken no risk, and the mill would only be worth $10,000 when he got it. So then, when he has sacrificed $10,000 to get the prospect, and has risked the loss of that amount, he has a right to receive, and does receive in property, a great deal more. Now comes the question of how much more and this is governed in the same way and by the same law. If he has got such a prospect as the one which I have described, that is a prospect which, when developed, is legitimately worth say $100,000, his risk, as soon as the value of that prospect is ascertained is annihilated, and for his sacrifice he gets a large return. But while the prospect remains undeveloped his risk continues. Not to such an extent as formerly, because the prospect when located and examined, as well as it may be on the surface, is most certainly worth more than no prospect at all. Before he found it his sacrifice was all risk, now for his sacrifice he has a piece of property to which there is some risk attached. In proportion to that risk is the value of the property, and if we can ascertain the risk we can determine the value. And at this point we must consider the interests of the capitalists. The risk of the capitalist who purchases the property is here precisely the same as that of the prospector who sells it. The sacrifice of the prospector is, in case of sale, at $10,000, transferred to the capitalist, and the risk of the investment goes with it from the former to the latter. The sacrifice, as far as the prospector is concerned, has the element of risk taken from it and becomes the same as that which would have been made by him, had he worked a year for the mill. He gets paid for his time but he does not get paid for his risk, and he therefore loses that which he had a right to receive. On the other hand as the risk is less when the claim is located than it was before it was discovered, the capitalist when he pays $10,000 makes a sacrifice which has less risk attached to it than was attached to that made by the prospector. If he then only pays $10,000 he gains what the prospector loses, namely, the degree in which the risk is lessened from the time when it was all risk to the time of the sale. It is right and just that he should pay for this exactly as it is right and just that the prospector should be paid for it. But while, if the risk taken at first by the prospector were annihilated by the development of the mine, the capitalist would pay $100,000 for the property; every particle of risk which remains will reduce that amount. Supposing the sacrifice to be $10,000 and the value of the mine when located and developed to be $100,000; supposing, too, the development of the ledge which annihilates this risk to be 200 feet of shafting and 500 feet of levels, 700 feet in all. Putting this at the assessment values as already given it would amount to an expenditure of $7000. It costs $7000 to annihilate the risk remaining after the mine is discovered, and this makes the mine worth $100,000. The sacrifice is $17,000, $10,000 at first to discover the ledge and $7000 to develop the mine. All the risk then is represented by $83,000, what proportion of this exists after the location and before the 700 feet of work has been done? In order to get at this we must remember that the risk is constantly decreasing during the process of development, and that it is decreasing much faster than the work is done. The difference in the risk between the time the shaft is begun and the time it is down 200 feet is much greater than between the time the shaft is sunk to this point and the end of the first level of 200 feet to the north. This is apparent at once. The shaft shows the vein does not pinch at the water line, and that it is a fissure vein, while the level merely shows that the vein does not fault below, a fact that could have been assumed with considerable degree of certainty from the croppings. The expenditure of $2000 on the shaft has lessened the risk enormously, far more, in fact, than the expenditure of $2000 on the north level, and the expenditure of the $2000 on the north level lessens the risk far more than the expenditure of $3000, driving the 300 feet of level to the south. The north level tells us that the vein does not fault, a fact we could have assumed from the croppings; the south level merely repeats this assurance, gives us more ore in sight. Reversing the calculations on the respective amounts of the risk as removed by the three parts of the work, and applying it to the $83,000 which represents the whole risk, we find that each section of the work represents a constantly increasing risk. We have four sections, the drift to the south, the drift to the north, the shaft and the hunt for the mine. If we may assume that the drift to the south increases the value of the mine by the amount of ore it brings into sight we may say that the risk is but little changed by it. That is, the south level does not so much decrease the risk as it increases the known value of the mine. If we suppose that the ore in sight is worth $50,000 of the whole value of the mine, the south level has given us $30,000 of value in right. The north level has given us $20,000 worth of ore in sight, and by proving that the vein does not fault below, has taken away $10,000 of risk. This leaves the shaft and the location representing $40,000—of what? of risk, because the main object accomplished by the shaft is the proving that the mine is a good one, or in other words, annihilating risk; until that is proved the location has but little value except that of risk.

Now let us go back a little bit. The sacrifice of the prospector was $10,000, and the risk was enormous. For that sacrifice and that risk he got the location. The location with a 200 feet shaft in it represents $40,000. That shaft increases the sacrifice to $12,000, making the risk represent $28,000. The question of what part of this attaches to the location and what to the shaft may be reasoned as before. At 190 feet down the shaft, which at 200 feet makes a property costing $12,000, worth $40,000, certainly makes that property worth $39,500. Ten feet then increases the value of the property $500. But ten times ten feet makes much more difference in the value than ten times $500. The property which with a shaft 200 feet deep is worth $40,000, with a shaft only 100 feet deep is not worth more than $15,000. $1000 for the shaft has annihilated $4000 worth of risk. Following this up we would arrive at the statement that before any development is made on a location, the claim itself is not legitimately worth the amount of the sacrifice, supposing the sacrifice to be such as we have mentioned, and this is unquestionably true. The sacrifice has been made, but the risk is so great that the property is not worth in its then condition, the amount of that sacrifice. A claim which has merely surface indications, which has not been developed and which has only been located and thereby become property, is not worth, under commercial laws, the amount sacrificed to obtain it.

I began this article by stating that I was writing for miners and prospectors, for the men who find the claims rather than for the men who would purchase them. It may be urged at once by the miners who read what I have written, that I am not practical enough, that I do not give what they would have a right to expect from the title of this article; the information by the aid of which they may sell their properties. I think, however, that I have done so, and for this reason. I think that it is of primary importance if two men would consummate a sale of property, that they should, as far as possible, find out what each thinks of that property. If I wish to buy a saddle from a storekeeper, I ask him the price and he tells me. By the fact of his telling he conveys to me his estimate of the value to him of that saddle. As I began the bargain he assumes that I want the saddle and that he as seller shall put a price upon it. In the sale of the saddle I give him money which I have got by writing this article, for example, and buy the saddle, and he gives me the saddle which he bought and paid for, at a sufficient increase to give him a profit and in turn buys my money. Each of us is both buyer and seller, while I begin the negotiations which lead to the sale. But suppose he begins them, he asks me what I will give for the saddle. He has a saddle and he wants my money now; before, it was I had my money and wanted his saddle. The sale is the same in each case, but the causes which lead to the sale are different. It is I who fix the price in the second case as it was the storekeeper who fixed it in the first. In each case there is a reserve veto. If the storekeeper tells me a price at first which is more than I care to pay, I do not buy. If I offer him less in the second than he is willing to sell for, he does not sell. But in each case the one who begins the negotiation attempts by his first question to find out what the ideas of the other are in connection with the sale or purchase of the saddle. Now, it is perfectly evident that it would be of great advantage to me when I asked the storekeeper what was the price of the saddle, to know exactly what that storekeeper thought that saddle worth, just as it would be of great advantage to the storekeeper when he offered the saddle to me, to know just how much I wanted the saddle; in other words, to know what I thought the saddle worth to me, and the reasons why I fixed the sum in my own mind at which I would buy. Now, to apply this long illustration: The prospector with a claim or mine is in the position of the storekeeper having the saddle to sell. He has got something he wants to dispose of, or with which he wants to buy money. The capitalist is the man who has that money. It is of great advantage to the prospector to understand how the capitalist will reason about the claim or mine offered to him, and if he will read over what I have written again he will see how that reasoning is done. I have heard prospectors say that capitalists wanted the mine for nothing, and were not willing to give a decent sum for it. I have generally found that in such a case the sum asked was out of all reason and that there was little, if anything, to show in the mine. It may be accepted as a truth beyond all question that a good mining property can be sold at any time for a handsome profit on the money spent to acquire it and a fair return for the risk taken; but it is equally true that a prospect alone is worth but very little. It is true that capitalists will sometimes foolishly purchase claims for sums which are absurd; and it may be that their purchase will turn out well. But the men who do so, certainly do not do very much good to the districts in which they purchase, and their number is necessarily small. How many undeveloped mines are there west of the Mississippi River, which, if developed would prove to be valuable properties? Who can answer that question? No one. There may be ten thousand; it is far more likely that there are a million.

From where is the money to come which in the next hundred, or two hundred, or three hundred years, will develop these mines? From capitalists, from men who have money before they invest in the mines. Is it reasonable to suppose that the uncounted millions necessary to do all of this development will be invested on guess work? Most certainly not. It is but a few years since the capitalists in the East first began to put money into mining claims, and already they have learned a lesson or two about the value of prospects. No man who is caught once gets caught again. But as the time goes on more and more capital turns towards the mines, capital which will be invested wisely, judiciously, on business principles and in accordance with commercial laws. The class of fools still exists and always will, but the class of fools never built up any great industry. It behooves the prospectors then to find out what they must do to attract the attention of business men to their properties and having found this out, to do it. To sell their saddles they must put themselves in the place of the men they wish to purchase them. And what they have to do is develop their claims, to sell mines instead of prospects. It is of primary importance if they would take advantage of the tide of wealth which is now setting towards them, that they should have the value of their properties proved beyond the peradventure of a doubt. Take the example which I have been reasoning from. The sacrifice of $10,000 by itself was not worth the money. With $7,000 added to it it was worth a golden return, a fortune. It may be objected at once that the prospector rarely has $7,000 to put out upon a mine, and my reader may mutter to himself or comment to his partner that they know the value of development just as well as I do. In the first case, I may say that my experience is, and I think the experience of every miner will confirm mine, that the class of prospectors who make money in mining are those who when they get a claim they think is worth money stick to that claim, work when they can afford to in it and when they can not, go to work for somebody else until they have got together enough to give them food during another spell. I know one case where two men worked in this way on a claim for four years. They were partners in it, and as soon as they had a grub stake and enough to buy powder they would go to work tunneling. During that four years they ran a tunnel eleven hundred feet long, tapping the ledge at a depth of twelve hundred and fifty and drove nine hundred feet by levels. When they struck the ledge they were offered $72,000 for the mine which they refused. They waited until they had driven the levels and when they sold, got $250,000 in cash and fifteen per cent. of the stock. Now I know that those men had no help from any one. It is true they were good miners, and could get work at any time and make good wages. After they struck the ledge they sold some of the ore, and this gave them some money, but while they were driving that long tunnel it was all barren work. And what those men did other men can do. There is another class of prospectors that I never saw make any money, except by accident. It is the class of men who are mine poor, who have so many claims they can barely pay or do the assessment work and who sit around and talk everlastingly about capitals, waiting for some fool to come along and buy on the strength of what they say exists below the croppings. This is the class the members of which are all millionaires and owe ten dollar store bills, who would be insulted if you offered them five hundred or a thousand dollars for any one of their claims, who talk—heavens, how they do talk—of some one of their locations and say it is worth a hundred thousand or swear with much profanity that they will not sell under half a million. If you are a miner, my reader, you know these men, for the camps are full of them. I remember one of them who wanted to bond a claim to me for $150,000, on which the fees for recording were actually not paid. It is true he kindly said that if I would advance the $12 necessary I might deduct it from the $150,000 to be paid to him when I sold the mine. I suppose it is scarcely necessary to say that that mine was not bonded. Half, aye, nine-tenths of the growling heard in camps comes from just such men, yet I leave it to any white man on earth to say whether capitalists who know the value of money are to be blamed for respectfully declining such bargains as these.

Prospectors must learn that their claims must be developed before they can realize from them sums anywhere near what the properties, if good, are worth. And now to give them a few hints on what else must be done: as the majority of prospectors know how to develop a mine and how to make it show what it is worth, there is no need for me to take up space describing this. But to get a mine in condition for sale while the actual development is of primary importance, there are other things which will facilitate the transaction enormously, and the first of these is a note book containing a full and accurate record of the mine from the day of its discovery. The measurements should be put down exactly as they were found to be when made with the tape, not as they may be guessed. These measurements should be taken as least once a week during development, and should include the amount of work done in sinking or diving, as well as the width of the vein. Notes of the character of the rock found during the week, its hardness, and anything else noticed about it should be kept. The conditions of the walls and seams should be recorded from time to time; the finding of water and the time taken to free the mine of it should be included in the log. Kept in this way the note-book becomes a complete history of the mine from the day of the location of the claim to that of the sale. It forms a record which is of enormous value to the parties to the transaction. The entries in it as to the amount of ore worked at the customs mills, if any has been so worked, and the mill returns will do more to sell the mine than most prospectors imagine. It is, of course, easy enough to "cook" such a book, but as the purchaser may say that he will have thirty or forty tons worked himself, and will so say if he be wise, such "cooking" only results in proving to his satisfaction that the ore has fallen off in value as the work went on; a conclusion which will end the transaction as a rule. In keeping such a book then, as in other things, "honesty is the best policy;" a maxim none the less true because trite. The note-book should include every piece of information about the mine which comes to the knowledge of the prospector, it should record failures as well as successes. As a rule I have found that as much information is to be derived from the one as from the other. A valuable adjunct to the note-book, one which might be almost called a companion volume in stone, is a complete series of specimens. This should embrace those taken from the cropping, from the walls, the seams, the "horses," if any be encountered, and the vein; and should represent as fully as may be the mine in its different stages of development. It is as important to save specimens of the barren "gang" as of the ore. The object of these is the same as that of the note-book, to give to the purchaser every particle of information possible about the mine, each specimen should be carefully labeled. Doing this is neither short-sighted policy nor unwise. Supposing the mine to be a good one, and I am, of course, imagining that it is an honest property, the more information about it accessible to the purchaser, the speedier is his recognition of its merits. A man who knows his business when buying a mine can, of course, find out by examination a great deal about it, because a developed mine is a piece of property that tells its own story. There is always, however, the work of becoming acquainted with it to be done, and this the owner should, if possible, prepare in advance. There is the same difference made to the purchaser when this is done that exists when a man receives a letter of introduction to another from a mutual friend. He can, of course, go to that other and introduce himself, but his business is greatly facilitated when he has the letter given to him beforehand. The preparation of a mine for sale in this way will often turn the scale in favor of that property as against another of equal merit, and the prospector should, therefore, always when it is possible so prepare it. Assuming that the mine itself is found to be satisfactory both in its development and probable value as an investment, there are certain questions which have to be asked by the purchaser and answered by some one, therefore the owner of the mine should prepare himself with the answers beforehand. These are inquiries into the economical working of the mine when purchased. First among them are those which relate to the mill. As a matter of course the prospector when he has been able to do so, has located a mill site himself, which he includes in the property he offers for sale. But when this is not possible he should ascertain where a mill site can be purchased and should bond it for some reasonable figure. The supply of water and its cost, either when bought or the expenditure necessary for a ditch, if one has to be built, should form an item in the note-book. The supply of fuel, its cost and its character whether good or bad, should be examined and noted in the same way. Where the timber for the mine is to be procured, its value on the spot and the cost of transportion should be ascertained. Each and all of these things will, of course, be verified by the purchaser, but the owner of the mine should prepare the way for him by ascertaining all of the information beforehand. A man who buys a mine can find out all of these things for himself, but it will lessen the work to be done by him and shorten the time necessary for the transaction greatly if he is at once referred to the place where he can get the desired information. For example, suppose the supply of timber must be procured from a place distant twenty miles. The purchaser can find this out by inquiry, but it will take him more or less time.

If the owner of the mine has the information ready for him, he has nothing to do but to verify it. In the one case there is vexatious delay; in the other there is nothing but a legitimate expenditure of time. The fullest possible information on the question of labor, its supply, cost and efficiency should be prepared. This is of so much importance that the work necessary to prepare it is time well spent. It should include a full description of the policy and terms of the miners' union if one exists in the place. As the purchaser of the mine will probably wish to have a milling-test made of the ore under his own supervision, the owner when it is practicable should know where he can get transportation for the ore at once. The negotiations which lead to the sale of the property are rarely carried on without some preliminary talk on the subject, and the owner has time enough and sufficient notice of the necessity for such transportation to enable him to make arrangements for it. In this connection I should say that he should also know where the men to get out the ore may be found and what it will cost to employ them. From his own experience of the mine he will know with considerable certainty, how much labor will be required and how long it will take to extract a given number of tons of rock. There is one point I must urge in the strongest manner I know how. In all such arrangements and in all advice given to the purchaser by the owner, the latter must act and advise as though he were doing it all himself. It often happens that the work done in a milling-test for example is paid for by the purchaser owing to the inability of the owner. In such a case the owner should identify the interests of the purchaser with his own. He should guard him as far as possible from those who would, if they could, fleece him in transactions. If labor is required and the owner knows that Bill is a good miner, Bill being a personal friend of his, it is right and proper that he should recommend Bill for the job. But if the price of labor in the district be four dollars and a half a day or ten dollars a mining foot in blasting out ore, he should not allow Bill to charge five or ten and a half. He should not allow himself to reason that Bill is a good fellow, poor and needs the money. Not only is it honest for him to guard the interests of the purchaser, as his own, and therefore right, but it pays. The principle of allowing Bill to make the extra fifty cents which if the owner of the mine wish he can almost always do, will when carried into other things represent the district to the purchaser as more expensive than it really is It seems a very small thing to say that fifty cents a ton more on forty tons only amounts to $20, a sum the purchaser will not miss and which will do Bill a great deal of good. This may all be true. But when the owner talks to the purchaser about ten or twenty thousand tons of ore in sight, only needed to be mined and worked to yield its treasures, he does not realize that the purchaser being a business man, calculates the expense of the mining in his mind, and that the fifty cents a ton which did Bill so much good and did the purchaser no harm becomes five or ten thousand dollars, a sum sufficient to turn the scale and make a man decline a sale.

It may be said with truth that money is never so useful as in selling a mine. If the owner can afford to pay for the experiments needed to prove the value of his property himself, he is in an infinitely stronger position than he is when he is forced to ask the purchaser to pay for them. The majority of men are unwilling to put out money for what may not bring any return, and they will therefore hesitate over the preliminary expenses, while perfectly willing to pay a very much greater sum if the experiments are satisfactory. My own belief as to what is fair in such matters is this. If the owner of the mine pays for the drilling test, including expenses of transportation, etc., the purchaser should agree to pay that money in case the test is satisfactory. And for this reason:—The owner of the mine has proved its value to his own satisfaction by the work done upon it during the development. Any work done during the negotiations is done for the benefit of the customer, and if that work succeeds in placing his mine in the relation occupied by that of the owner towards the property; in other words, if the work convinces him of the property's value, then he should pay for it, because there was no need of the work being done to convince the owner. On the other hand it is fair that the owner should advance that money if he can, because the result of that test is a part of the risk, and it is not fair to ask the purchaser to assume any risk before the actual sale of the mine.

A few words on the last branch of my subject, what it is necessary for the owner to do when he seeks the purchaser, and I have done. I will suppose that Jones, who owns the "Roaring Tiger," in New Mexico, wishes to get acquainted with Smith, the capitalist in New York, and dispose of the property. And first I should say that this applies to all sales of mines. It is a mistake for Jones to sell the "Roaring Tiger outright. He will, of course, be obliged to sell the control because Smith will not invest in the mine unless he acquire this; but he should retain an interest, from twenty-five to forty per cent. of the stock. The reason why he should do so is, that supposing the "Roaring Tiger" to be a really good mine, he can rarely get its full value; in fact, I may say he can never get its full value. In selling the control and retaining the interest, he should always stipulate what amount of working capital Smith is to raise in addition to the sum paid for the control, and that amount should be sufficient in his opinion, as formed from his knowledge of the mine and the expense of working in the district, to make the property a paying one. To return, however, to the question of how Jones is to make the acquaintance of Smith and interest him in the property. The first step is, of course, for Jones to come to New York, as it is pretty certain Smith will not go to New Mexico. Jones brings with him his note-book, kept as I have described, and with every particular of information in it he has been able to acquire. In negotiating the sale of a property at a distance the note-book becomes of infinitely greater value than before. Jones also brings a full series of specimens, or as full as he can. He should by all means avoid the mistake of bringing only those that are rich, for he will find that if he shows rock which goes thousands of dollars to the ton and none of less value, Smith will have nothing to do with him. Having arrived in New York, he gets at Smith in the best way he can. If he knows anyone who knows Smith, of course the work is easy. If he does not, the best thing he can do is to walk boldly into some office and state his business. It is probable, in fact, certain that, he will meet with rebuffs, but if he be the kind of man I am supposing him to be, he will keep this work up until he succeeds. Every prospector knows what a job it is to find a ledge; how many weary miles of country have to be walked over, how long and careful is the search sometimes when "tracing float." Well, when Jones comes to New York he has to "prospect" for Smith before he can "locate" him, and if he only prospects long enough he will find him to a certainty. Having found him, he should remember that Smith is probably a busy man and has no time to waste, therefore he should make his story a short one but one that covers all points, and he should tell that story without any previous "chin;" Smith does not want to talk about the weather, nor is he interested in the inconveniences of an emigrant trip. The morning paper has told him what the weather for the day will be and he never travels by the emigrant train. Jones having told his story, Smith, if he be the right Smith, will feel sufficient interest in it to make further inquiries. He will send out some one in whom he has confidence to examine the mine or he will go himself. The sum of money to be paid for such part of the property as Jones wishes to sell being different in every case is of no interest to us here. It is sufficient that a general outline of the considerations which affect the mind of the capitalist and of the work to be done by the owner have been given at some length, and it would be useless, in fact, impossible to attempt to make the instructions minutely particular.

—*Alfred Balch.*

THE PURCHASE OF MINES '

MINING as a business in this country received an enormous impetus a few years ago. The growth of mining for coal, iron and copper in the east was one which was necessarily slow from the fact that it was parallel to and coexistent with the growth of the country itself, and mines that were known had to wait until there was a demand for their product before they could be worked.

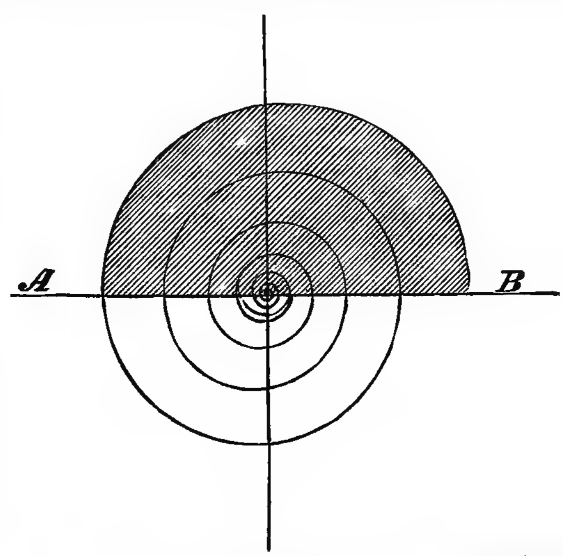
This did not apply to the mines of the west, those which yielded gold and silver; for the simple reason that there was always a demand for the metals contained in them. But when gold was first discovered in California in 1848, and the rush began in '49, the country was not as wealthy as it is now, the means of transportation were exceedingly primitive and business men found that there were chances enough for the employment of capital at home without looking for them so far away. People too, were not then as accustomed to travelling as they are now, and the conservative men in the community shrank from any such radical changes in their habits as that involved in a transfer of their household gods to the Golden Gate. Hence it was that the tide of emigration which flowed westward at that time was chiefly made up of the more adventurous and daring spirits, and this in turn produced in the minds of those who were left behind, the idea that it was a somewhat wild and foolish kind of person who would engage in gold mining. This feeling was anything but decreased by the fact that those who returned from the west on visits, by their habits, their stories and their methods of looking at things, convinced those who saw them that they were very wild persons indeed. But as the years rolled on the wealth of the east increased enormously, and there was a revolution effected in the methods of transportation. People travelled more, and the country, as the newspapers in their growth began to give more and more news about it, became in the minds of the people less and less of a number of parts widely separated and with but slight connection. It was impossible for a man who read day after day of what had taken place the day before in California, to look on California as being very far away, especially when he was conscious that eight days' time would land him in San Francisco. Time and the altered conditions then, had destroyed one of the great bars to investment in the west on the part of eastern men when, in 1875 the Great Bonanza was discovered in the Con. Virginia and California on the Comstock. The wildest stories were told about it, but the truth was wild enough. Over seventy-nine millions of dollars were taken out of the two mines and paid as dividends to the stockholders, and that they were so taken was the result of shrewdness and skill in management aided by a judicious use of capital. This was a proposition which eastern business men could understand. It was one which they could look upon without the feeling which had accompanied the idea of gold and silver mining in their minds for such a long time, namely, that the business was one in which it was all speculation and little certainty. It presented to them the proposition, as it had never been presented before, that intelligence and money invested in mines stood more than a fair chance of bringing ample returns. And as a result of all this the business men of the east began to turn their attention westward. They found that the case of the Great Bonanza was not a solitary case; that there were hundreds of mines of the precious metals which were yielding dividends as the result of money invested. And so began a rush of capital into the mining regions which was as strange in its way as the rush of emigration in '49. Men with money having been slow to believe anything now believed everything. Hundreds of thousands of dollars were brought into the districts, their owners fairly hunting for properties in which to invest. In their estimation and from their standpoint a mine was a mine, and provided they bought a mine they were satisfied. It was not to be supposed that a state of things which included the purchase of properties for large sums by men who knew absolutely nothing at all about what they were paying for, —should not include cases of gross fraud. The capitalists were cheated right and left, sometimes consciously and sometimes unconsciously. Ledges upon which no work had been done at all or which did not contain a pound of ore were sold for sums which were, in view of the facts, wildly absurd. The capitalists were crazy, and full advantage was taken by the prospectors of their craze. But along with the sale of properties worth nothing went that of properties worth a great deal. Mines having paying ore in them were bought, opened, worked and dividends got from them. It was this that saved the business and that kept up the flow of money to the west. Eastern men found that there was an opening for capital, and that returns could be got from its investment by that surest of all tests, experience. But they found too that the business must be conducted in a business way to make it profitable; that if it were not so conducted it would burn their fingers badly, and that such burns were very painful. Perhaps it would be more correct for me to say that they are finding this out, for the process of discovery and the learning of the lesson is not yet completed. The fools who think that "croppings" are equivalent to a mine, who think that assays will give them the value of a property, and who imagine that all that is necessary to acquire a fortune from mining is to buy a ledge, are not all dead yet, but they are, fortunately, rapidly dying. The injury they have done to themselves is as nothing to the injury they have done to the districts and to mining. For every dollar they have lost through their own blind and insensate idiocy, they have kept one hundred out of the districts and have thereby retarded to that degree the development of mineral wealth. They have never done the least amount of good either to themselves or to others by their investment while they have done an infinite amount of harm. I heard one of them say once that he considered gold mining the greatest fraud on earth, and I found that he based his opinion upon the fact that he had bought a ledge which turned out to be perfectly barren on the strength of some assays made from a piece of rock said to have been taken from it. I did not report the $60,000 he had paid and lost, but I did very much regret the fact that he had it in his power to make such a statement upon such apparently good grounds to those who did not inquire into the case.

The origin of all the losses made by eastern men in their purchases of mining properties has been the fact that they have attempted to engage in a business about which they knew nothing at all. And the odd part of it is that they only show the effects of this extraordinary idea when they invest in gold or silver mines. If one of them bought a locomotive he would never dream of acting as an engineer, or if he bought a steamboat he would not examine the boilers himself. In the one case he would hire an engineer, in the other a boiler inspector to do the work for him. But if he buys a mine he seems to consider that he is perfectly able to examine and determine upon the property or to run it after he has acquired the title. This is absurd. The knowledge necessary to examine a mine properly is only acquired after years of study and work, and no more comes by inspiration or revelation than does that of how to manage a bank or run a ship. The purchasing capitalist should be content with paying for his mine after it has been examined by an expert and pronounced to be worth the money; and when he gets it he should employ some one who knows how, which he does not, to operate it for him. It is no more difficult to find honest and capable men who understand mining than it is to find the same class in any other occupation. If the business men in the east will bring to the investment of money in mines, the same shrewdness which they show in other things, they will find that the business is one that will give handsome returns. Nothing is more fatal to their success than the idea that mining is a kind of investment which will run itself or which is not governed by the same business principles applicable in any other occupation. Mining is not the wild speculation which so many people imagine it to be; it is, on the contrary, a business which is as safe as the raising of wheat. It is true that a vein may fault and the mine come to an abrupt end, or the vein may pinch and "peter" out; but for that matter, the crop may fail from drought or may be eaten up by grasshoppers. Each variety of business has in it ups and downs. The only point is that business men should learn that proper precautions will reduce the proportion of the latter to the former enormously.

As I am writing this article to tell men how to buy a mine I will assume that the capitalist has had his attention called to a piece of mining property, that he is disposed to purchase it, and that he has the money both for the purchase and for the development and working of the mine when purchased. It is hardly necessary to say that what applies to one imaginary purchaser applies as well to a company. The mine having been found, it is necessary to determine as nearly as possible its value as an investment or the chance of getting a return for the money placed in the mine for the mine itself. This question properly divides itself into three, each of which may be considered as a factor seriously affecting the final result or the return of the money invested with increase. 1st, The ore body and questions which affect it. 2d, The working of the ore. 3d, The property acquired by the purchase. All inquiries necessary for the proper investment of money in mines are embraced under these three heads, and although in some cases the line of demarkation between them is not very distinct, I shall treat them as though it were.

First then as to the ore body itself. Gold and silver sometimes occur in a native or metallic state, but they are more often found in the former ore, that is in chemical combination with other elements. These ores are generally called after the combining element rather than the metal, as when we speak, in this connection, of carbonates and chlorides, we mean the combination of carbon or chlorine with the metal. I am of course talking in very general terms and not in any purely scientific way. Taking as an example a ledge containing the chlorides of silver, it would be found that the ledge is a body of quartz having in it small veins like their slabs, nodules or bunches of the ore. The vein matter is called "gang" or "gangue" and this gang is worthless, being barren quartz without any ore in it. But the valuable ore is contained in this gang. The result then of this preliminary examination is learning the lesson that the ledge is not a homogeneous body of ore, and this is one of the most important distinctions between a gold or silver mine and one of iron. If we find a deposit of one of the hematites we find that the ore is, to a very great extent, the same throughout the whole thickness of the vein, and if we arrive at the value of one piece by an assay, we can estimate from that the value of the whole. But if we assay a single piece of ore from a ledge containing this chloride of silver, we can predicate absolutely nothing from the result. This has been one of the hardest lessons for eastern business men to learn. Knowing, as many of them have known, that a sample from an iron mine or coal vein represents fairly the whole deposit, they have reasoned that a sample from a ledge of silver or gold ore is equally significant. They have not realized that the conditions of the existence of the ore in the ledge are different conditions; and have therefore attached to the assays of the silver bearing ledge the same value they knew from experience, was attached to those of specimens taken from a bed of iron ore, and in doing this they have given to the assays a significance far in excess of the fact. An assay of ore is, as most people know, an examination by fire and chemical reagents of a piece of ore. In making one the assayer takes a piece of ore about the size of a hazel nut, and ascertains by methods of no particular interest here, what it contains. As far as it goes it is absolutely correct, for the assayer finds out to the thousandth part of a cent, the amount of gold, silver, copper, lead, iron or any other metal contained in the piece assayed. He tells you that the ore assayed goes 7000 ounces to the ton and he is perfectly correct in what he says, for a ton of that kind of ore would undoubtedly yield 7000 ounces of silver. But from the fact that the ledge is not homogeneous, when the assayer tells you the result of the assay he tells you absolutely nothing about the ledge except the fact that it did at one time contain a lump of ore, that lump which he has assayed, which was valuable. Suppose that you have a ledge of quartz containing among other things some ruby silver. It would be quite possible to take from it two specimens for assay, one of the gang and one of the ruby. The result of the assay of the first would be *nil;* that of the second would be far up into the thousands. It would be as absurd to reason that the ledge was worth nothing from the first as it would be to reason that it was worth thousands of dollars to the ton, from the second. It must not be supposed that I am decrying the results of assaying, for I am not. I am simply trying to explain why those results have not the significance which has been attached to them and why the purchase of a mine upon the information derived from assays is a foolish purchase. In their place assays are of enormous value, and it would be impossible to mine successfully did we not have them. They may be compared to a compass on board ship, for they point out to us where to go; but he would be a most unwise captain who, because he had a compass, thought it unnecessary to take any observations of the sun.

As the ore exists in the ledge in combination with the gang and as the ore is valuable and the gang worthless, it follows that it is the proportion existing between the ore and the gang, in the ledge, which determines the value of the ledge. If there be a great deal of gang and very little ore, the ledge is worth but little or may be commercially worth nothing at all. If the reverse of this be true, the ledge is worth a great deal of money. Now comes the question of how to ascertain this proportion. We have already seen that an assay being the determination of the value of a particular piece of ore, is worthless in revealing the value of the whole ledge. But we can by taking proper precautions make this assay give us this information. If we submit a specimen to the assayer which contains an average amount of gang and an average amount of ore, the result will be what we wish to arrive at. Suppose that the proportion of barren gang to the valuable ore is as six to four; if we prepare a specimen having in it sixty per cent. by weight, of gang and forty per cent. of ore, the result of the assay of that specimen will be the value of the ledge. And the value of the result of such an assay will depend entirely upon the care and thoroughness with which this average specimen is prepared. As to the fact that it is only in this way that the value of the ledge as a whole can be ascertained, nothing is more common than to hear men say who have ledges for sale that their specimens are average specimens. As a matter of fact I do not believe that an average specimen was ever found in any mine in the world. It seems to me that as the proportions of the gang and the ore are constantly varying, the supposition that a single piece may be found which will in itself represent all of these variations, when tried by the almost theoretically accurate test of a fire assay, is an absurd one. At least I never heard of an assay of a single piece of rock which experience proved to have represented the value of the mine, nor did I ever know any person who had heard of one. In order then to get an average specimen we must do one or two things, either work a quantity of rock sufficient to represent the whole mine, in which case we get an average result of working; or mix together all the varieties of ore and gang and find the value of the specimen, in which case we simply work on a small scale an average lot of rock. Taking the latter first, in order to prepare such a specimen we must take a very large number of small pieces of rock. The best way to secure these is taking a pick and cutting a small ditch or groove across the face of the ledge. This should run from one wall of the ledge to the other, and should be about one inch wide and one deep. A large number of these grooves should be cut, not less than fifteen, and if the



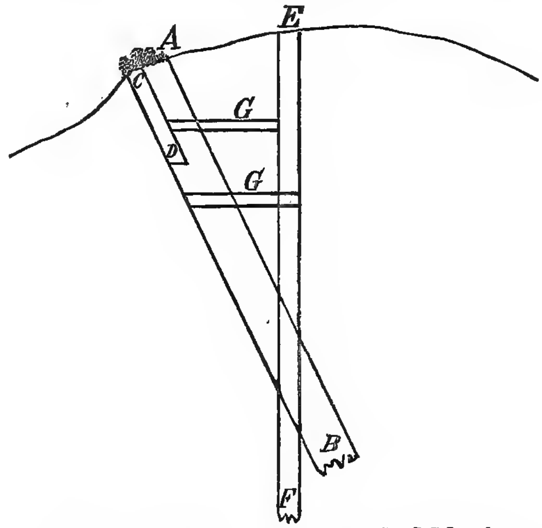
Watch spring Coil, A B line dividing the centre—Shaded half taken for further experiment.

ledge crops out for the full length of the claim, they may be cut every hundred feet. The stuff which is cut out of them should be reduced to the size of hazel nuts and spread out upon a flat surface. It should be heaped up and spread out again a great number of times, and finally should be worked with the fingers or a small stick into a figure resembling a watch-spring lying on its side. It should then be divided by a line through the center and one half carefully removed and placed by itself. The remaining half should be reduced to the size of peas by pounding it in a mortar or on a flat stone. This should in turn be heaped up and spread out as before, and one-half be taken in the same way. The half now taken, a quarter of the original should again be worked by mixing and spreading out, and by the same method reduced one-half. The person who is conducting this test should be careful each time to sweep up all the dust, and should see that this dust becomes fairly scattered during the process of spreading the stuff out. The process is continued until the amount is reduced to about five ounces, which is carefully gathered up and saved. The second half of the first separation should now be taken and treated in the same way until it is reduced to five ounces, which should be added to the five already obtained. The ten ounces should then be placed in a mortar and reduced until the stuff is as fine as flour. It is then mixed thoroughly in the mortar and spread out on a large sheet of white paper, until it is not more than a quarter of an inch thick. Two lines at right angles to each other should then be drawn and the opposite quarters of the mass taken and thoroughly mixed. This will give the two halves separate. Each half should be treated as the whole mass was until two specimens, each containing one hundred grains, have been separated out, and these specimens should be assayed. If the two assays correspond within a few cents to the ton, it may be concluded that the work has been done properly, but should there be any great difference between them there is nothing to be done but to begin all over again and cut fresh grooves across the face of the ledge.

It should be remembered that the more places from which the ore is taken, or in other words the more grooves cut, the better and more reliable is the final result. This method is the most reliable one which can be applied to a ledge before any work has been done upon it. Should there be a shaft extending say two hundred feet down, and two levels upon it is, say five hundred feet in all, the ledge may be said to be prospected and we may apply a milling test to it. This is much more expensive than the former and much more valuable as a means of determining the value of the mine. To make it we take from fifty to one hundred tons of ore secured in this way. Beginning at the top of the shaft, we cut lumps of ore from the vein the whole way down. Upon each level we cut out ore along the top, being careful to take it from the full width of the vein, and we cut a full section of the vein across the two faces of each level. The ore so secured is carried to a customs mill and, taking the precaution of having the batteries and pans or furnaces thoroughly cleaned, then worked. While the ore is being crushed a spoonful of the "slime," as the crushed ore mixed with water is called, is taken every ten or fifteen minutes from in front of each stamp, and thrown into a bucket. Being thoroughly mixed it is then dried and subjected to the same process as that already described in order to get specimens for assay out of it. In a milling test, however, we generally make ten assays and average on the results. Examining the batteries after the operation of crushing is at an end, in order to see if, as sometimes happens, the gold or silver in a metallic state has refused to pass through the screens, we take the birch or result in metal of the working and ascertain its value. Supposing that every part of the test and the preparations for it to have been carried out properly we will have arrived at a very close estimate of the value of the ore in the mine. These tests, particularly the last, are troublesome to make, take time and cost money, but it is time, trouble and money well spent to make them. The purchase of a mine is an operation which involves the expenditure of a more or less large sum of money, while its development and working is apt to cost a great deal more than its purchase. It is rarely that a mine can be made to pay without the expenditure of fifty thousand dollars, and it far oftener costs a hundred and fifty. These outlays are legitimate if warranted by the condition of the mine, but it is of primary importance to ascertain if that condition will so warrant them. Economy here may well be said to be "penny wise but pound foolish" policy. Supposing that the ore is found to be all right and to warrant the belief that the mine will pay as an investment, the next question in order is the state of the ledge. A ledge of quartz may be compared to a leaf of a book. It has a leaf on each side of it, of barren or country rock, called the "walls," and it may run all the way down to the binding, or it may be merely a margin pasted on. All that we can see at first is that like the other leaves it has an edge. To drop the simile, all we can know from the "croppings" or appearance of the ledge at the surface of the ground is that there is a ledge there. We may conclude that if the ledge is continuous, if it is the same width or wider a thousand feet under ground, and if it carries the same proportion of ore and gang throughout, that it is a good property. But it may be a "pocket" ledge, that is, it may end when we get fifty or a hundred feet down; or it may fault or be cut off and disappear. The ore may give out and the gang alone remain. Now these points must be ascertained if possible before purchasing the property, because upon them depends the value of that property. As far as faults are concerned, they may generally be discovered if they exist by an examination of the surrounding country. The question of whether the ledge is a pocket is one of infinitely more complex character, to the solving of which must be brought far more reasoning power and closer observation. As each mining district possesses peculiarities of its own, the expert, before attempting to reason about a ledge, especially if that ledge be undeveloped, examines all the mines he can get into in that district. By such examination he will be enabled to determine what are the peculiar features of ledges there. Having done this, he returns to the ledge he thinks of purchasing or of which he is to recommend the purchase. He examines the walls to find out the kind of rock they are composed of. If he finds the same kind of rock on each side of the ledge, and if he ascertains that the strike of the ledge is different from that of the walls, he concludes that the ledge is probably a fissure. If in addition to this he finds that the walls next to the ledge are smooth and have a soapy feel, and he sees clay seams between the ledge and the walls, his previous conclusion is confirmed. Should he on the contrary find that the strike of the ledge is the same as that of the walls, that the ledge lies between two *strata* of different rock and that there are no clay seams he will, as a rule, be inclined to look on the property with anything but favorable eyes, because he will feel almost certain that it is a pocket. The ore itself will tell a tale to him. If he finds that it is equally distributed throughout the gang and is a variety of ore which in that district has been found to be permanent, he will reason that the ledge probably carries the ore all through it. But in the examination of the ledge the two most important points to be determined are the existence of faults, if any, and if it be a fissure vein, a careful examination will generally determine these sufficiently to warrant a purchase of the mine or a refusal to have anything to do with it.

It will be conceded I think that examinations of the ore and the ledge such as those which have been generally described, are somewhat more satisfactory than those made as a rule by investors, for the simple reason that they are more thorough. But the ore and the ledge having been proved to be all that is desired, more has to be done before the mine can be properly bought. There are the questions which relate to the working of the ore. As the metal has to be extracted from the ore before the mine can pay, the cost of doing this will often prevent the mine being a legitimate commercial investment. This cost divides itself into two parts, that of getting the ore out of the mine and that of working it after it is so got out. The would be purchaser should inquire carefully into these points if he would not find his money evaporating into thin air. The cost of getting the ore out includes the price and value of the labor to be obtained. The rate of wages should be ascertained and the contract prices of work be got at. As a rule in mining it is better to have work done by the piece, as it often happens that in trying to save the profit to the contractor the owner loses more than he makes. If there be a miners' union in the district the purchaser should make himself thoroughly familiar with its workings and the rates established by it so that he may find out whether he is to make a profit himself or pay all his money to his men. The history of that union in the past will give him a fair insight into its policy in the future. As mines require timbering, the cost of the timber and the expense of transportation must be ascertained. In making an examination into this branch of the subject it is necessary to find out from the character of the walls, how much timber will probably be required. The ore must be hoisted out so the cost of hoisting engines must be known, and the freighting rates to the mines from the shops. The rate at which rails can be laid down at the mine for use in tunnels and levels should find a place in the note book. If steam is to be used to hoist, the price and heating value of the fuel to make that steam; and the source and character of the water, whether it be water that will corrode the boilers rapidly, must be ascertained. The cost of blasting powder, of picks and drills and of all other things must be known; and in case of the picks and drills the rapidity with which they will wear out as governed by the hardness of the rock. The ore being upon the surface of the ground it has been mined and now must be worked. The first thing to discover is how it is to be worked to the greatest advantage. Does it require a crushing mill pans and settlers, or is it a smelting ore, and are furnaces needed? Will it pay better to work it on the ground, or ship it and have it worked anywhere from one to one hundred miles away? If a mill or furnace is to be built the purchaser must find out where the mill site is to be secured and its cost. He must know the supply of water if there be one, and the cost. If the ore must be smelted, he must ascertain what kind of fuel he requires, and the cost, of laying it down at the furnace. Its value, too, must be known. If the ore has to be carried from the mine to a mill or furnace, the question of the facilities for road making comes in and must be answered together with that of the cost. All these and many other points must be inquired into before the question of whether it will pay to work the ore which is satisfactorily found in this ledge which is probably permanent, can be answered. It does not do to buy the mine first and to find out these things afterwards, because when this is done, it often happens that the purchaser is forced to resolve to let his loss on the purchase of the mine end his connection with it. Nor does it do to buy the mine and then spend money making experiments on working it. Before one dollar is paid for the transfer of the property a clear and plain answer to the question "will the ore pay after it is mined and worked a sufficient return to give me fifteen per cent. on the purchase money" must be had. There must be no If, or But or Perhaps about it. It must be known in the same way that the probable return from a purchase of wheat land is known. Giving the mine, if the vein proves permanent and no unforeseen accident occurs, I can make just such an amount by the expenditure of just so much money. When mining is gone into in this way, it is a business and not a speculation.

There is a third branch of the subject-matter of the purchase which must be inquired into before that purchase can be made. It is that of the property transferred. And the first thing to be ascertained is the question of title. It often happens in a mining district that claims being hastily made and carelessly stated, overlap each other. A search through the recorder's books must be made to see if the property to be bought is claimed by any one else, and if it is, whether that claim is good. It must also be found out whether the assessment work, providing the claim is not patented, has been done during the previous year or two, and if that work is recorded by the United States surveyor in the district. The question of title having been satisfactorily settled, the "plant" or stock of tools, machinery, etc., transferred with the mine must be examined. If there be a mill, the engine and boilers should be inspected, the pans and settlers cleaned and viewed to find out if they are in good condition. If there is a furnace, it should be examined with the same object. The work done upon the mine in sinking a shaft, mining a tunnel or driving levels should be surveyed in order to find out if it has been done properly, or is sufficient. There is such a thing known as getting a mine into such a shape as to prevent the cheap extraction of the ore, and in such a case it is often necessary to do all the work over again. Supposing, for example, that the ledge dips at an angle of 53°, and that a slope two hundred feet in depth has been sunk in the foot wall. It may be known the "output" through the slope is, say, ten tons a day. But the purchaser may intend to put up works which will reduce one hundred tons per day. In such a case he finds that he cannot get such an output through the slope, and that it is necessary to sink a shaft to strike the ledge at say, six hundred feet, and run level on to it. In that case the slope is of no use except, of course, for ventilation. Or it may be that the work done in sinking a perpendicular shaft



A B Ledge C D Slope. E F Shaft. G G Levels.

was done at one end of a claim, and that in order to work the mine to the point of output wished it is necessary to sink nearer the centre. Or the tunnels and levels may be too small. These points must all be examined into and answers arrived at before the value of the property can be known with any degree of certainty. Careful and accurate measurement of the ground and of the ledge must be taken in order that the details of the property purchased may be known to the purchaser.

It may be laid down as a general rule applicable to the purchase of all ledges containing gold and silver, that it is unwise to buy mere prospects or locations. It is of course, the fact that a ledge which has been only located and on which no work has been done may be bought for far less money than one the value of which has been proved by development, but on the other hand it pays the capitalist to expend more money and take a smaller chance of loss. All that can be said of any ledge when it is located is, that the prospects warrant the finding out whether it is a mine. From the fact that every dollar expended upon the development at first is not only so much towards the preparation of the mine for working, but is also a reason for the expenditure of another dollar, it follows that the work of development is work for which there is always a reason. The indications found in the croppings are such as to warrant making a cutting, say ten feet deep. If the ledge is found to be at this point, one which looks well, it is right and proper that the shaft should be commenced and sunk, say, ten feet more. The croppings warranted the first excavation, that in turn warranted the second. And this process of reasoning is one which is constantly being applied as the work goes on. Each foot sunk is a step towards the development, and a reason for taking another step. But from the fact that the croppings can only be properly looked upon as sufficient to warrant the commencement of development, it is unbusiness-like to purchase a ledge upon the strength of what they may reveal. The capitalist who pays anywhere from fifty to two hundred thousand dollars for a claim, does not pay that money for the privilege of proving the ledge to be barren. He pays that money for what he believes to be a mine, and it is only when he gets a mine, a piece of property which will pay him his money back with interest, when worked, that he is warranted in paying the money at all. It is then of primary importance for him to know that he is buying a mine. Until the ledge is developed he can not know this with any degree of certainty, and he has no right, speaking in a business sense, to pay a heavy sum for the chance of finding this out. It often happens, however, that prospectors have acquired the titles to properties which show well upon the surface, and as the result of assessment work, the prospectors themselves being too poor to do the necessary work of development. In such a case, the position of affairs is this. Here is a valuable property, for I am supposing that the ledge is really a good one, and will pay if developed and worked, the owner of which is unable to do anything with it. Such a property the owner will try to sell, as he is conscious of the fact that it will remain forever in his hands unexplored. If the capitalist knew—which he never can know with certainty—that the ledge is what I have supposed it to be he would be perfectly justified in purchasing it. But as he can not know this he is not so justified. On the other hand, if the ledge be really valuable it should not be sold by the prospector as though it were of little worth. At first sight this appears to be somewhat of a deadlock, but like most deadlocks, there is a way out of it. While the capitalist is not justified in paying for that ledge as though it were a mine, he is perfectly justified in paying to find out if it be one. His possible loss then is confined to what money he puts out for development, an expenditure he can stop at any moment, if the indications be such as to show him that his money is being wasted. If we suppose that the water line for the district is one hundred and fifty feet down, two hundred feet of shafting will generally prospect a ledge pretty well. If to this be added five hundred feet of levels, that ledge may be said to be fairly opened. Now taking assessment values as a basis, we can call this seven hundred feet of work, $7000, and supposing the plant necessary to do it cost $3000 we have $10,000 as the sum to be expended At the risk of being charged with reiteration I must once more point out the fact that each $1000 expended gives at once direct return in development and is a warrant for the expenditure of the next. It is this fact which makes it proper for the capitalist to agree to spend his money. If he buys the ledge outright for $10,000, and it is a mighty poor ledge he could get for that, he has lost his money if the vein pinches. He has nothing to warrant the payment, except the croppings and surface indications. But in the case of the spending of the money for development he is constantly receiving new proofs of the wisdom of his expenditure, or, on the other hand, if he does not receive such proof, he can at any time decline to lose any more. The capitalist should then, if he find a ledge which from its surface indications he believes to be a good one, but which needs developments the owner is unable to make, be willing to make such developments. In such a case he agrees to spend so much money upon the ledge for development, or such a part thereof as the result of that development shall warrant. He at the same time bonds the mine for a certain fixed sum, to be paid for the controlling interest or for the whole property in case, upon development, the mine shall turn out to be a good one.

The deed should always specify the amount of development which is to be done, as well as the time it is to be done in. As for example, the shafting is set down at two hundred feet and the levels to be driven at five hundred; when this seven hundred feet of work has been done, the capitalist must decide as a result of an examination of the mine in its then state, whether it will pay the purchase money as agreed upon. If he declines to do so, the property reverts to the original owner whose title becomes as clear as if the capitalist had never acquired a prospective interest in it, and had never expended a dollar upon it It sometimes happens when such an arrangement is made that the mine, when developed, turns out to be worth less than the sum agreed upon as its purchase price although still a valuable property. Supposing that the purchase price named was $100,000; the mine may easily turn out not to be worth this but to be a good investment at $50,000. On the other hand, it may turn out to be a mine which would be cheap at $200,000. One of these chances may be fairly set against the other. The capitalist however should be careful before agreeing to a purchase price, to examine into the property as thoroughly as may be possible, and to set that price at a sum which in view of all that he can discover about the ledge seems to be a fair and reasonable one. Even if the first of the two results of the development of the mine mentioned be the one which is arrived at; if the property turn out to be worth less than the sum agreed upon, the capitalist rarely loses his money as invested. If he declines to pay the sum originally specified as he has under his bond a perfect right to do, he will often, if he make a fair offer for the mine succeed in purchasing it for a less sum. The difficulty of finding a purchaser for a mine is such that the prospector is rarely unwilling to sell at a fair figure. It sometimes, and I might say often, happens that the prospector will offer to give the control for the development. That is in consideration of a specified sum being spent in the development of a mine and in the purchase of hoisting and reduction works, he will transfer anything over fifty-one per cent. of the property. And just here let me say a few words about acquiring the control. Nothing can be more foolish and more of a mistake than for the capitalist who purchases an interest in a mine to invest his money for other men to manage. Time and time again has experience proved that this is the most ill judged proceeding any man with money ever went into. The way in which it is generally brought about is the purchase where there are several owners of the interest of one. The capitalist if he go into mining at all should in all cases have the control of the property, and for a very simple reason. The men who find the mines, the prospectors, rarely if ever can be considered business men. They may be and probably are perfectly honest, but they do not know how to handle money in a way which will make every dollar pay for one hundred cents worth of work or supplies. When such men are placed in control the shrinkage in sums of money placed in their hands and the waste, not as a result of dishonesty but simply from a lack of knowledge, becomes very great. It is therefore necessary that business men should attend to regulating the expenditures upon the mine, because if they do not, those expenditures will be far in excess of what is legitimate and right in the premises. To return however to the proposition stated at the beginning of this digression, that of the prospector giving the control for the development, While this offer is often made it is one which is, except in very rare cases, unwise for the capitalist to accept. And for this reason. Nothing is apparently fairer than for the owner of a ledge to say "I have a ledge which I own. From the surface indications I think that it is of value and will if developed pay handsomely. You from your examinations agree with me. I have the ledge but no money; you have the money but no ledge. You take your money and work my ledge for the benefit of both and I will give you a larger interest than that which I retain to pay you for doing this." But when we examine into this proposition we find that it is not one which is either wise or business-like. The arrangement is never made unless the capitalist agrees to do a certain specified amount of work or spend a certain specified sum of money. As the essence of the fact that it is legitimate business for him to agree to begin the development and carry it on providing at every point the development made warrants further development being made, lies in the proviso, and as such a contract as that which we are considering is without this proviso, it follows that the purchase of the control for the development does not differ except in name from the purchase of the location. No matter how little the ledge as you go down may warrant the doing of further work, the sum mentioned in the agreement must be spent of course; the capitalist can at any time cut the gordian knot by refusing to pay any more money, but if the prospector be of the opinion, as he frequently is, that the full amount of work mentioned will, if done, prove the value of the mine to be great, he can seriously annoy and embarrass the capitalist by law suits and other vexatious proceedings.

There is in mining, or rather the investment in mines, a fundamental commercial law of which all these directions as to purchasers may be said to be the "croppings." This law is the one which teaches us from experience, that mines of the precious metals have been formed in such a way as to make them uncertain properties. All the directions given have had as their sole object the giving to the capitalist of greater certainty in business operations, greater security for his investments. In obedience to that other commercial law which reaches the possible profit always in proportion to the certain risk, mines which pay, generally pay handsomely for the money invested. It is possible by taking due precautions, to determine to a very great extent what this risk is, and it is therefore wise to take those precautions. The difference in the risk of purchasing a mine which has been developed sufficiently to prove that it is a mine and not a pocket, and that taken in the purchase of a location upon the strength of the croppings and surface indications, can scarcely be over stated. But supposing that the ledge be proved by development to be a mine, that the ore is abundant and valuable and that it can be worked at a profit; there is still a question which is of great importance, namely what that profit will be. It is a known fact that property in a mine differs from that in land, for example, in one very important particular. If a man owns a lot in a city that property is, barring such an accident as the swallowing up of the city during an earthquake, property for ever. As long as men live on the earth and congregate in that city so long will that piece of ground have a value. That value may vary but there will always be something left. But in a mine this is all changed. There will come a time when that mine can no longer be worked, when from natural causes it must cease to pay, when it costs to get the ore out and separate the metal from it just the sum represented by the metal when separated. The ultimate value of that mine then, is represented by the sum which can be taken out prior to that time. There are many opinions as to the depth which mines may be worked, but we will suppose that under all the conditions existing in a certain district a particular mine can not be worked at a greater depth than 3,000 feet. The claim is 1,500 feet long. We will also suppose that the ledge of paying rock is five feet thick. We have then 22,500,000 cubic feet of ore which we can take out. When this is done, that mine is at an end; it has as far as the question of property is concerned, ceased to be. Now if the amount of money paid for the property be represented by x and the amount expended for plant for the extraction and for the working of the twenty-two and a half millions of cubic feet of ore be represented by y, then x + y will represent all the money put into or expended upon the mine. The amount of money which that mine must yield in order to make it a paying and legitimate business investment is (x + y) a sufficient sum to answer the requirements of interest. In other words that mine must pay back all the money invested in it together with an increase or its purchase will result in a loss. As the time in which this must be done is limited from the fact that the existence of the mine is limited, it follows that the purchaser must see his way to such a return clearly from the start. The fact that the mine may not be exhausted during his life does not alter this conclusion in any way because, supposing the commercial life of the mine to be ten years, and the purchaser to die at the end of five, the mine is a property at the time of that death being but half worked. Practically this question resolves itself into that of the dividends which the mine must pay or the interest on the money invested which it must yield. I have already placed that at fifteen per cent. of the purchase money, because although this is rather high there are so many risks to be looked on as possible that it does not seem to me it should be reduced. As the result of all examinatious then the purchaser must see fifteen per cent. on the investment in sight from the start. If he does see a higher per centage so much the better, but he must not see a lower, if he would go into an investment in a mine with the same degree of certainty and guided by the same amount of business caution asked for and shown by him in other business transactions.

In conclusion, I have but one word more to add. There is a class of men in the community who have given the best years of their lives to the study of mines and mining. They are as a rule honest, capable and trustworthy. The employment of them by capitalists who wish to purchase mines will save thousands of dollars and will give results which are out of all proportion to the money paid. The substitution for their trained experience and their knowledge, of the "common sense," by the light of which so many men have purchased mines in the past is a substitution which is characterized by no sense, common or uncommon; and which is the most expensive folly the mind of man ever conceived or acted upon.

—*Alfred Balch.*

SALTED LEDGES AND WILDCAT MINES.

FRAUD in mining is as confidently expected by some people as is the rising of the sun in the morning. They will tell you that the man who touches a gold mine has lost whatever sense he ever had, and they will repeat with much cynicism the trite saying about "a fool and his money." As there have been many instances of fraud in the business, few if any of those who speak so sneeringly of it lack an example to which they may triumphantly point as an instance in point; and as you listen to the story of how Smith was taken in, and done for by that guileless prospector Jones, you are forced to admit that Jones stocked the cards on Smith and got away with the pile. In all honesty it is but fair to say that the *genus* Smith who has lost its money, has by its own folly in many cases, prepared the way for the work subsequently got in on it by the *genus* Jones; and that if Smith had displayed ordinary caution, Jones would have had no chance. It is, however, unquestionably true that the losses by fraud in mining have been enormous, and that many men have cause to regret that they ever put one dollar into the business. It cannot be said that mining has been marked by any unusual number of frauds; that is, distinguished as one form of business among other forms, by fraud. It is probably the fact that as much money has been lost in every variety of occupation among men by dishonest practices as was ever thrown away in mining, but it is unquestionably true that there is about mining frauds a brilliancy of execution and a clearness of cut in the pattern, marking them among frauds in general with a degree of distinctness which attracts the attention at once. A "salted" ledge once bought, the money has gone forever, and gone too, in the intensely aggravating form of a lump. The sum lost is generally large, and there is rarely, if ever, any redress. The owner of the ledge can contemplate his property with the disgust which animates the soul of a man who knows he has been cheated, intensified by the reflection that he will have the greatest possible difficulty in persuading others to share his loss in any way. The annoyance, too, is cumulative. I have known a man who had bought a property at a price about five times what it was worth, keep his temper beautifully until he learnt that to retain possession of it he must do one hundred dollars worth of work upon it each year, when he lost his philosophy and broke out into strange oaths. The government assessment work was the last straw. The peculiarly disagreeable character of mining swindlers is due to the fact that money once paid, one must pay more in order to have even a chance of getting back any at all. Whether this demand for more takes the form of the disbursement necessary to purchase hoisting works and mills or the miller, but no less inexorable cry for "more mud," it is none the less disagreeable. Nothing dampens a man's willingness to pay out money more than the knowledge that he has already paid and lost in the operation. And in gold or silver mining the loss, if loss there be, is generally a positive loss and one about which no man can make any mistake. It seems to partake somewhat of the character of the gain. That is in bullion which has a value the moment it is taken out of the "chill" or iron mould of the brick. There is no question about a market, it can be sold at once; taken to the mint the gold twenties are poured out for it as soon as its value is known.

The frauds in gold and silver mining may be divided into two great classes indicated by the title of this article. The "Salted Ledges" are the frauds perpetrated by Jones, the sale to Smith of ledges which have no valuable mineral in them. The "Wild Cat Mines" are the frauds perpetrated by Smith upon the public at large through the medium of the stock market. The two classes may be said to be the positive and the superlative of mining frauds, for the first is to the second in importance what a retail business is to a wholesale. While thousands of dollars have been lost through the Salted Ledges, millions have been thrown away in the Wild Cat mines. Taking the lesser of the two evils first, the conditions necessary for the sale of the Salted Ledges are a flow of capital into mining, the success of some of those engaged in it, a ledge of some kind to salt, shrewdness on the part of the men who negotiate the sale and credulity, and a lack of knowledge on the part of those who pay the money. Given these conditions fraud is always possible; and given these conditions, fraud will always be practiced. In order to illustrate how it is done, a story may be told, which is strictly true, except in the names given; these, for obvious reasons, being fictitious. In mining camps in the West the men generally assemble in some place for an hour or two during the evening and there tell yarns. Among these none is more popular than that of the "$100,000 Picnic;" and you can rarely get any number of Pacific Coast miners together without hearing it if the conversation turns upon the tricks which have been played upon the "mining sharps" from the East. In 1867, as the story goes, Mr. Henry Thompson arrived in the city of Albany with a mine for sale. Having succeeded in getting some introductions to capitalists, Mr. Thompson being a most plausible talker, told them of his errand and of the property he had for sale. This was situated in Idaho, and, being undoubtedly the finest mine in the territory was appropriately named the "Flower of Idaho." It was owned by Mr. Thompson and his two partners, and consisted of a ledge of quartz carrying ore of high grade. Although the ore was scattered through it very irregularly, Mr. Thompson stated that taking the ledge all through, the rock would run from $50 to $250 a ton with one average, say $112,50. Mr. Thompson expressed himself as exceedingly anxious not to overstate anything. One of the capitalists, Mr. John Smith, a gentleman who had made a great deal of money in railroads and who was looked upon, and justly, too, as being one of the shrewdest men in the State of New York, listened to Mr. Thompson's story with eager ears. He had heard that other men were making money in mines; he had read as what man had not in '76, of the enormous yield of the Great Bonanza in the Comstock. Naturally of an enterprising turn of mind, Mr. Smith had some of the specimens produced by Mr. Thompson assayed and the result showed that the half had not been told by this honest miner, for some of them went high up into the thousands. Mr Thompson gained not a little credit too by telling Mr. Smith that the higher assays were not to be depended upon as they could not be taken as representing the ledge. Having secured in this way a character for fairness which shone with a golden tinted splendor, Mr. Thompson pointed out the profits of the enterprise by telling Mr. Smith that the cost of mining and milling would together amount to about $25 per ton. The high estimate was given he said because labor and transportation in Idaho were very expensive. Mr. Smith asked how many tons could be extracted in a day, and Mr. Thompson replied, still speaking with that moderation which had characterized him all through, that twenty to thirty was not a large estimate. $2,000 to $3,000 profit a day was enough to make Mr. Smith open his eyes. But Mr. Thompson's story was not yet told. He had not come East to tell a mere "prospect of which he spoke with proper contempt," he had a mine which was fairly opened. His partners and himself had sunk a shaft 100 feet and had driven a level 250 feet so that the vein was in a condition to be examined. More than that. He had a little money, and if the purchasers would sign a contract to buy at his figures, $100,000 in cash and 30 per cent. of the stock, providing an inspection of the mine by their own expert confirmed the story as told, he would pay the expenses of that expert to and from the mine. He did not ask Mr. Smith to buy, but he did ask him if he thought well of the property as described, to select an expert and let him view the mine. He also explained that while he was able to pay the expenses he was not able to pay the salary of the expert and he therefore expected Mr. Smith to assume this part of the burden. The story as told and the proposition as made captivated Mr. Smith, and he called a meeting of those of his friends whom he was willing to let into a "good thing," and laid the proposition before them. Thompson told his story once more, and explained that the contract must contain a clause binding them if they purchased the mine to raise $250,000 as working capital. Mr. Smith showed the result of the assays he had had made and offered to subscribe $100,000 out of the $350,000 necessary to carry the whole thing through. "Money talks" as they say in the betting ring. Mr. Smith was known by every one present to be a man who had been the architect of his own fortunes, and his ability and shrewdness were universally acknowledged and respected. It did not take five minutes to have the amount necessary subscribed and the contract giving $100,000 in cash to the owners of the mine for 70 per cent. of the property and the raising of the working capital was signed before those in the room left to go home.

Then came the question of an expert. And, just here, a most fortunate thing happened. Mr. Smith's son, John, Jr., had first graduated with credit from a school of mines which I will locate in Kamskatka for fear of being invidious. He had taken prize after prize, could talk learnedly about various strange things, and delighted his father who was naturally proud of the boy's ability, by the perfect familiarity he showed with the specimens which had been exhibited by Thompson. This latter individual had told Mr. Smith that John, Jr. was wasted in the East, and that his true field of usefulness was aiding in the development of the great mining industries of the West; that West that Mr. Thompson was pleased to call Boundless. Mr. Smith noticed, with pleasure, that Thompson, who was so evidently a practical man, seemed to esteem highly the opinions given by John, Jr., and he did not fail to observe that he had also on one or two occasions confessed that he was wrong after arguments held with "the boy." Mr. Smith, naturally, was anxious to give his son a start, and when he proposed to his associates that John, Jr. be sent as their representative they agreed at once. The same proposition having been made to Thompson, he replied, "It ain't for me to say who shall go, Mr. Smith. I'm ready to take any one you say; but I should like to have your son with me as I believe he'll keep your interests in sight, an' I know he'll be pleasant like to travel with." And so it was settled; Thompson and John, Jr. left Albany for Idaho. During the trip Thompson beguiled the time with stories about mines and mining, in many of which he was forced to allude to the dishonest tricks which had been played. These he reprobated, not from any high moral standpoint, but from a business point of view, claiming that they did not pay. Arriving at the terminus of the railroad Thompson and his companion were met by Brown, one of the partners in the mine, with a wagon in which to make the rest of the trip. The drive took two days, through magnificent scenery, and the weather was delicious. About the food there was just that suspicion of roughness which is so delightful; the pan of bacon and beans stood beside the canned meat and vegetables on the table. Brown proved himself to be a most entertaining fellow, although somewhat more volatile than the sober Thompson. He, also, told stories about the way in which unsuspecting Eastern men had been fleeced in fraudulent ledges, and his outspoken admiration of smartness gave Thompson a chances to once more repeat those little observations about the shortsightedness of dishonesty. John, Jr. fell in love with the country, and thought his companions two of the most delightful men he ever met.

Reaching the mine at last, John, Jr. went into it. He found that Thompson's statements in Albany had been short rather than in excess of the truth. The shaft was 108 feet, or eight feet more than had been claimed, while the level exceeded the length stated by thirteen, being 273 feet long. The next morning Thompson said to him, "Now, Mr. Smith, I reckon you'd better kinder let me show you about the mine, an' then leave you to yourself. You kin examine the property an' make up your mind 'bout it any way you like, but I ain't got no call to point out much to you. I'll answer any questions you may hev to ask, but I want you to do the work without help. Then when you gits back you kin kinder bet in your 'pinion,' an' you can't say as how I influenced you."

"I shall want to do some assaying," said John, Jr., after expressing his opinion of the perfect fairness of Thompson's plan.

"Certainly," said Thompson, "don't forget the assayin'. Only we ain't got no place fur you here. We've got horn spoons, but they ain't the most reliable things in the world."

"I ought to have brought a furnace and things with me, I suppose," said John Jr., in the tone used by a young man when he thinks he has made a mistake which causes his seniors to think him "green."

"Waal," said Thompson, "I had a right to tell you. I 'spose you've got a place at home?"

"Yes, father fitted up a splendid laboratory for me."

"'Spose, then, that you take your specimens all the same. Brown here will make a lot o' little bags an' you can seal the specimens up. Then, when you gits East, you kin assay 'em at your leisure. Number the bags an' keep a record an' you'll get along all right, I reckon."

It was so determined. John Jr. took specimens from the vein and the walls; he examined the country for faults, he worked hard at measurements. The evening of the second day as he sat tying up the specimens in the bags and sealing them with his ring, he said, "I find this ledge to be one of the most interesting deposits I ever saw. It lies in the fracture of an anti-clinal fold, and is, I think, an alluvial deposit of quartz which has been subjected to metamorphic action. The marks of the great denuding agencies are plainly visible and it gives every indication of permanence, for I find that the quartzite visible near the surface gives place to true quartz below. It is really delightful to examine a formation which is so thoroughly scientific in its character."

"Jes' so," murmured Brown, respectfully, while Thompson added "Thar's heaps in these yer veins 'round here, Mr. Smith, as we miners can't see."

A week having been passed at the mine, John Jr. announced that he was ready to return. He told Thompson that if the assays were all right the mine was as good as sold. The bags containing the specimens were placed in two grain sacks which were at Thompson's suggestion sealed up. During the journey back, John Jr., also at the suggestion of his companion, looked after them himself and never allowed them out of his possession until they reached Chicago, from which place he shipped them to Albany in a strong box by a different route from that traveled by himself. As Thompson said "This thing's business with me, Mr. Smith; an' thar's a sight dependin' on them bags, so I don't wan't no chances took." Arriving in Albany, the assays were made by John Jr. in the presence of the men interested, and at Thompson's suggestion portions of the specimens were sent for independent analysis by assayers in New York. The reports confirmed each other and Thompson's statements; the capitalists, feeling that they had a good thing, came to the front, the $100,000 was paid, the mine incorporated, the 30 per cent. of stock issued to Thompson as representing the ex-owners, the $250,000 was raised for working capital, and Thompson left for the West. A short time afterwards a superintendent was sent out and the Company were greatly astonished to hear from him that the "Flower of Idaho" was a worthless ledge of quartz which would not average ten dollars to the ton!

The way in which the swindle had been worked was simplicity itself. By making a bread seal, Thompson had been able to open the bags while John Jr. was on a hunt after a mythical grizzly of which Brown had told him and after which Brown took him, the day before he left for the East. Having opened them Thompson substituted for a part of their contents some rich ore procured from a mine at some distance away. Then he sealed them up again. When John Jr. and Brown returned Thompson was engaged in cooking, and the seal was burnt. John Jr. had been deceived for the simple reason that he had trusted to his assays to tell him the value of the ore. The true history of the mine was somewhat different from that told by the guileless Thompson. It had been opened to its then extent by men, who, having become convinced that it was worthless, had abandoned it in disgust. Thompson, who was a gambler by profession, had with his partners taken possession of the property and had spent enough money upon it to clear it of water, when they had sold it in the manner described.

Although there was no Thompson, Smith or Brown in the original transaction, and although the "Flower of Idaho" was not sold in Albany, and although John Jr. did not graduate in Kamschatka, this story is strictly true. It illustrates well the methods taken to dispose of salted ledges although the salt in this case was placed in the bags rather than in the mine. Instances have not been lacking where the latter work has been done by men who desired to sell worthless and fraudulent claims. In such case the ore is procured from a mine somewhere in the neighborhood, if possible, and mixed with that on the dump. The faces of the levels and the sides of the shafts are "plugged" at intervals; that is, holes are made in which the valuable ore is placed. Great skill is sometimes shown in this plugging operation, and a very natural appearance is given to the deposit. But as a rule, the men who are deceived are those who have made the salted ledges possible. They are those, who, without any previous training have attempted to purchase mines by the guidance of "common sense." To them there is no difference in the appearance of the salt and the surrounding vein matter, and they cannot tell when they see a hole drilled before their eyes, and a shot fired, that the ore torn out has previously been put in for the purpose of being torn out. The men who sell the fraudulent veins are quick to "take the measure of the emigrant's foot" as they term it and know well just how far they can go and how barefaced they can make the swindle.

It is not very often, however, that men attempt to salt a developed mine. As a rule they confine themselves to some ledge on which they own a claim, and for a very simple reason. The smaller the area of observation of the value of a ledge the greater the ease with which that ledge is salted. If a ledge be found that has not more than twenty or thirty feet showing on the surface, it is comparatively easy to prepare it for sale to an "emigrant," as the late arrival from the East is called. The owner gets some weathered ore from some mine in the district which carries the same kind of gang. This he scatters along the ledge and around it. Then procuring some that is not weathered, he proceeds to make a cutting in the ledge of say, ten feet deep. In this he places some of the salt, mixing the remainder with the rock thrown into the dump. He generally fills up the place where one blast has been fired with the mixture of salt and vein matter. Now, to a person unaccustomed to mines, a vein prepared in this way is not only enticing, but exceedingly deceptive. It is almost impossible for him to tell that it has been salted, and although the steps to be taken to reveal the fraud are as simple as anything in the world, he will rarely take them. He sees the vein and the rock lying all around it; he has some of this rock assayed and he concludes at once, being guided by sense of a most common kind, that the claim is valuable. In his "Roughing It," which, by the by, is the most reliable description of life on the Pacific Coast ever written, Mark Twain gives an account of a mine, or rather ledge, in Virginia City which was salted with half-melted Mexican dollars. The man who salted it must have been green at his business, for he could scarcely hope to persuade any one, even the most typical emigrant that ever crossed the Sierras, that Nature created silver with a mint stamp upon it! And yet I do not know. The folly shown by men who have invested in mines has been so monstrous as to almost come up to the swallowing of such a yarn as this.

But the salted ledges are as nothing when weighed in the balance of fraud compared to the wild cat mines. While it is true that the stock-markets have enabled the man interested in mining property to find money to develop those properties, it is also true that they have made it possible to float mines and mining stock which are absolutely worthless. In such a business as the dealing in the stock of mines there are necessarily enormous fluctuations in the value of the securities, and as a result speculators gather around the exchanges like flies around a honey-pot. As all men have in them the desire for gambling implanted to a greater or less extent,—that is, the desire to make money rapidly, and the willingness to risk money in order to so make it, such chances as those given by a stock market when securities are varying ten or twenty dollars a share in an hour, are too good to neglect. The result of this is that men with money come in and furnish the wherewithal to carry on the game. Many of them have other occupations, and merely risk a few thousands or hundreds "as a flyer," as they term it. These men rarely if ever know very much about the value of mining property, and they will place their money in any stock that promises to give a return or to rise in value. It is this class that the fraudulent promoter of mining companies is in search of. This fraudulent promoter whom for the sake of convenience I will call John Stone, having used up the names of Brown, Smith, Thomson and Jones, secures a ledge somewhere. He is careful to get it in an old camp where there are well-known mines, or in a perfectly new one. He incorporates the mine and has the certificates of stock printed. Then he pays the necessary fees to have the mine listed on the Board. Altogether his expenses amount to about $1500 so far. He may or may not have paid anything for his claim, because he can always find some man who has a claim he is willing to throw into the pool for the sake of a chance in the steal. Having listed the stock he proceeds by the aid of brokers who may or may not be in collusion with him, to deal in it. One broker sells and another buys, and in this way it is given a showing on the lists. In the meantime he gets up a flaming prospectus which he scatters broadcast throughout the community. The letters from the mine are printed in the stock papers and advertisements are inserted calling attention to the unexampled opportunities for investment offered by the "Untamed Feline M. and M. Co." The process may be longer or shorter according to circumstances, but sooner or later the public bite. The cost of making them do so is variously estimated at from five to twenty thousand dollars. When the public begins to buy the stock it is fed out to them cautiously at first, but as time goes on in constantly increasing blocks. When they are loaded up, the time comes for the first assessment, which the letters from the superintendent excuse on the ground that a "bone" has been discovered in the mine, or the sinking has opened a subterranean body of water and the mine is flooded, or the ore body is slower in coming into sight than had been expected, or an out-house has burned down, or the mule owned by the company has died of colic.

It does not matter what the story is, the result of the assessment is always the same. Some men allow the stock to be sold and content themselves with the first loss without striving to make it larger. Others pay up and hold on, hoping that the next news heard will be that of sudden development of ore. In time the process is repeated again and again until finally the mine—on the street—has been exhausted and the operators turn their attention to some new one. It sometimes happens that Johnston in picking out a ledge to work in this way stumbles by accident upon one which is really valuable, In such a case his astonishment and confusion are really comic. He is so amazed at finding that the property is worth something and will pay if honestly managed, that he is positively at a loss to know what to do with it. In one instance that I know of a mine that had been begun as a swindle turned out to be extraordinarily rich, and the Johnston in the case promptly substituted for the superintendent in charge, a man who had been working for him as a superintendent of mines for over twelve years, one who had never worked for him before; naively remarking that in that mine he wanted a superintendent who knew "something about mining." This method of floating a mine on the public is one which is as common as are wild cat mines. There is another and quite as effective a fashion. It is that in which the mine is never listed upon the stock boards at all but is "placed" as a property to be listed. This method depends for its success upon the amiable principle of dividing or seeming to divide, the results of the steal. There are a large class of men to be found hanging around every stock exchange who are ready to work as tools for any scoundrel who wishes to employ them. They are generally those who have lost all they had in stocks and now wish to get even. If it is necessary that others shall lose in order to permit of this, they are willing to watch those losses with perfect equanimity. These men Johnston employs as "cappers" for this game. He tells them that he has the stock of this new and terribly valuable mine for sale and that he intends to let a certain number of men into the pool. That is, that a certain amount of money being necessary to start the pool, or in other words, to enable the men in the pool to work the market, he is willing to sell a certain amount of the stock, to those who will buy it, for less money than it will be sold for when it is placed in the Board. He is willing to give the cappers a percentage on sales, either in cash or stock. Armed with the information thus given to them the cappers start out to place that stock among their friends, and as each one generally knows several men who have more or less money to spare, a good deal of stock is disposed of in this way. The cappers, when they approach a man, always point out to him that they are giving him a chance to buy "on the inside prices." That, purely from love and affection for him, they have brought this chance to him, and really, without wishing to influence him, they can not understand how any man in his senses can decline such an opportunity for making money as that offered by the "Untamed Feline." The rich they tell him is *nil* as when the mine is listed, which it will be as soon as the pool stock is sold—and, by the way, there is not much of that stock left—the shares they offer him at $2 will be placed on the Board at $5. That prominent stock operator, Mr. Johnston, who is so rich, is heavily interested and will not allow the stock to be sold for less than $5 when it gets into the Board. Now all of this kind of talk when translated means that the stock sold at first is so sold because the pool wants money enough to work the market in the manner described, and the reference to that prominent operator, Mr. Johnston, simply implies that that prominent operator who is so rich does not consider the mine good enough to make it worth while going into it. It sometimes happens that the individual who is approached by the capper is really honest enough to believe that the money received for the pool stock is to be expended for that mysterious operation he has heard men call "development." But it is not unusual for the capper to make no bones about telling him that the mine is to be sold to the general public through the market, and that the pool stock is sold to obtain the money necessary "to work the street." It is pointed out that when the stock begins to go at $5 a share, the purchaser in the pool will make $500 for his investment of $200; and the strange assurance of safety for him in going into the fraud is given, that his stock will be sold to people who are to be deluded into purchasing it through the use of his money and that of others. A fraud is made to guarantee the safety of a fraud. It would seem as though the veriest fool that ever lived would decline to touch such a thing as this, that he would say he would at least have the management of any cheating schemes he placed money in. But experience has shown men to reason in some strange way that when a person makes them a partner in a scheme of rascality, he cannot mean to cheat them! And so the game goes on, the pool stock is sold and the mine is never even listed on the Board.

It is extraordinary how successful this method is among small speculators in mining stocks. They invest their money with a fatuous kind of idiocy which would be amusing were not the results so disastrous. The aggregate of the money so lost is something amazing, and were it to be stated in a lump sum, supposing it to be possible to get the statistics for making such calculation, would astonish every one who saw the statement. I have not the slightest doubt that the amount of money thrown away in such schemes as the one which I have described would, were the facts known, be found to equal that which has been paid as dividends from all the gold mines ever worked. This statement seems to be wildly extravagant, but it is one which is made after a good deal of reflection. The operation of placing mines among people in the shape of sales of pool stock is one which is going on all the time. There are men who have made large fortunes out of it, and many of them do nothing else. The loss of money through it may be compared to a leak in a reservoir, the amount of water lost in any one minute or any one hour is small, but it is going on day and night, week in and week out, through all the months in the year and years, as time flies by, are filling up into decades and centuries. And in this sale of pool stock in mines there is not one leak but many. It is going on in San Francisco and New York, in Chicago and Philadelphia, in St. Louis and Boston; in short, wherever there is a class of men with money willing to risk that money in small amounts in a business of which they know nothing.

There is yet another class of mining swindles in the operation of which neither the stock board nor the cappers are employed. They might be called the "advertisement frauds," as they are worked chiefly through the medium of advertisements in newspapers. In one of these cases, the Mr. Johnston who is manipulating the mine hires an office and advertises liberally in the papers. He selects, as a rule, those journals which will reach, as he thinks, that class in the community which invests money as a permanant thing. He has no wish to touch the pockets of business men, because he wants investors who will be content to let well enough alone as long as a reasonable showing is made, and who will not be so fearfully particular in their questions. Among the papers particularly affected by this Mr. Johnston, the religious journals stand first. He knows that people who take them have developed in them to an extraordinary degree that queer belief that things seen in print are always true, and that they attach a kind of fetish-like solemnity and reliability to a line of words appearing in the ———, whatever the religious paper may be called. In writing his advertisement, Mr. Johnston, while careful to describe the advantages to be derived from an investment in that particular mine, contrives to give to the description an air of sober probability which is exceedingly taking, and which is calculated to deceive the very elect. As a fact, the deception of the elect is the object aimed at. If he can secure an office in some building devoted to or identified with a semi-religious business, he is willing to pay a handsome rent. If he cannot, he gets one as near as possible. In his office he has a handsome array of specimens placed on tables or in cases, and finely executed plans of the work already done and to be done in the mine. The work to be done is often shown in dotted lines, but I regret to say that I found in one instance a discrepancy existing between the state of the mine as it really was and the plan as shown. The mine did not have the amount of development shown in the office plans, as I knew from personal knowledge, and as this trick was played once, I can conceive that it may have been played again. However, to return to the advertising fraud. Having prepared his web, the spider patiently waits until some foolish fly walks in. The fly in question is often some clergyman with either money to invest of his own or of some one else; his ward, for example, if he be a guardian. The spider explains to the fly the value of the mine, shows him specimens which, as he is utterly unable to understand anything about them, prove exceedingly convincing, and points out with honest pride the amount of work done. He explains that as soon as the development has reached a certain point, which he indicates with a pen-handle, the "out-put" through the shaft will amount to enough to justify dividends which, he casually mentions, will be large. The fly gathers from the explanation of the plan that the shaft is the hole in the ground, and not caring to ask what is meant by the "out-put," regards the word as an assurance of large returns for the investment. Ultimately the fly makes a purchase, and having done so, congratulates himself upon his wisdom. It will often happen that the spider, if the crop of flies be large, or if he have money enough of his own, will declare a dividend and pay back a portion of the money.

In such a case, the flies fairly swarm around him, and he keeps the game up until something happens or he thinks that he has made about all there is to make. Then he disappears and the flies swarm together, refusing to be comforted and indulging in that useless recrimination common among flies in all ages. For the successful carrying through of the advertising fraud, it is imperatively necessary that the spider prevent the flies selling stock to each other. As long as he can control the transfers, he is comparatively safe, because the value of the stock remains a credit value. The instant that the stock is sold by one fly to another, inquiries are made as to the basis upon which this value rests and these result generally in the discovery by the spider, that it is time for him to fold his tent and silently steal away. This word "steal" comes in well here. The barefaced character of some of these advertising frauds was once brought to my notice in a curious way. I found that the agents of two properties, one supposed to be situated in Colorado and the other in New Mexico, had their offices in the same building and in adjoining rooms; and that in the prosecution of their business they were both using the same set of specimens. The specimens, by-the-by, came from a mine in Utah! If my reader will pause for a moment and think, he will see that this case contains elements of a strongly humorous character. It may be said that while giving so many instances of fraud and descriptions of how frauds are carried on, I should say something about how to prevent frauds being practiced upon my readers. This I can do by simply repeating the old English proverb "never buy a pig in a poke (sack)." In other words do not put your money into that which you do not understand; do not engage in a business of which you know nothing without at least getting the advice of some one who does know something. And as far as mining is concerned, do not take the advice of a man as ignorant as yourself. Do not imagine that because a man has made money by an investment in mining stock he is thereby qualified to direct your investments. Put it down to his luck if you like, but do not put it down to his wisdom. Understand me, I do not mean that because a man makes money in the mines you should therefore believe him to be without knowledge of mines. But I do mean that the simple fact that he has so made money should not be allowed to convince you that he has this knowledge.

If you know that from his business training he is a man likely to have acquired such knowledge, then the fact that he makes or has made money may be looked upon as an additional reason for trusting to and following his advice, but it must be remembered that it can only be an additional reason to some one possessed before; can only be evidence corroborating that which has already been given as evidence in chief, and can not, or rather should not, be taken as that evidence in chief. It is perfectly evident that when the blind leads the blind both are apt to "fall into the ditch," and the man who invests his money on the strength of advice received from men who know no more of the investment than he does himself, has certainly not increased the wisdom of the investment. He has, it is true, secured some one to abuse if the investment turns out badly, and this may or may not be a comfort to him in such an event, but it is undeniable that abuse of even your dearest friend is but a poor substitute for a bank account. There is another thing. Advice in such cases as generally given, is gratuitous, and of all worthless things in this world gratuitous advice is the least valuable. It may be laid down as an axiom that "nothing for nothing and but little for sixpence" is the rule which governs the business operations of men. When a man is paid for the advice given by him, he is justified in putting forth the effort or making the sacrifice which will place him in possession of the information upon which to base that advice; and his counsel therefore becomes of value. But when he is not so paid, he does not make the sacrifice or put forth the effort; and his advice becomes guess-work. As a general statement it may be said that one man's guess is as good as that of another, and that when you go to another man and get a guess from him, you might have stayed at home and done the guessing yourself.

But a mine may be listed on the stock boards, its stock may be sold and purchased in open market, the ledge may be a good one, the ore may pay, the company may own hoisting and reduction works, and the property may be one which could declare and pay dividends; yet that mine must be set down among the list of wild-cat investments. In this case it is because the management of the mine has become a wild-cat management, one that works the property for profits on the street. The reason why this may come to pass is very simple. As the ores of gold and silver lie in the ledges in irregular masses, and as the proportion of paying ore to barren ledge matter or gang, is one which is constantly and everlastingly varying, it follows that the value of the rock as extracted, or of the mine at any one particular moment is constantly changing. The value of a coal mine is governed by the market, or in other words by the price and demand existing for coal. The cost of extracting the mineral being known, the profit depends upon the price at which the mineral may be sold. But in a gold or silver mine the conditions of value are different. There is always a demand for the product and the price is always about the same. The value of the mine depends then upon the yield. If gold mines existed under the same natural conditions as those found in seams of coal, gold mining would not be attended by any risks at all, for the seam of coal is generally about the same thickness, and the coal has about the same value; so that, barring "faults" in the measures, given the market value of the coal, and the cost of production, the value of the mine may be calculated in the turn of a hand. As the natural conditions found in gold mines are different from those in mines of coal, it follows that the value of the mine can not be so calculated. That value is always changing as shown by the change in the prices given for the stock.

A sudden discovery of a body of ore—technically a "bonanza"—will affect the value of the mine at once, and the stock will rise. A sudden discovery that an ore body has been worked out and come to an end will also affect the value of a mine, and the stock will fall. The desired point in the history of a mine to reach is the payment of dividends; the point which it is not desired to reach, is the levying of assessments. Between these two, there are an infinite number of marchings upon the scale over which the pendulum swings, and the stock of that mine varies in price as the pendulum goes in one direction or the other with the delicacy of a thermometer. But it is perfectly possible to make that stock so vary by inducing the public to believe that the pendulum is moving, when there is in fact no movement at all, or if there be a movement, it is one in an opposite direction to that which is generally supposed. It is this that makes the "milking of the street," to use the expressive slang of the victims, possible.

It would seem at first as though from the fact that so many men are employed in mines, all of whom must have knowledge of what is going on, and of the work done, that the discovery of paying ore could not be concealed. But under the present methods of mining it is quite possible to keep the information as to the value of the mine in the near future a secret confined to a small number of persons. The diamond drills will bring out in their long "cores" a perfect section of the rock they have been boring, and assays of these cores will tell the superintendent or the assayer what there is beyond the place where the men are working. No one else can know anything of it. As the superintendent is always appointed by the Board of Trustees, he naturally reveals to them the information given by the assays to him, and as he can operate the mine in any way he chooses, he may manage it in such fashion as to permit the Trustees to work the stock as they see fit. Suppose for example that the superintendent discovers from the cores which come from the sinking of the shaft, that the working is near a valuable body of ore. Suppose too, that he is sinking a "winze" or underground shaft, five hundred feet distant from the main shaft and that the cores taken from the bottom of this winze show the same kind of ore. He reasons at once that he is near a bonanza, or ore body. He communicates his conclusion and his reasons for arriving at it to the Trustees. If that information was in turn communicated to the public, the stock would rise at once. The Trustees, however, want to make as much money as possible—the superintendent "stands in" on the game—and they accordingly set rumors afloat to the effect that the mine is in a bad way. Some accident happens conveniently to the pumps, and the water collects or a fire breaks out and some machinery or buildings burn down. Any excuse will do for an assessment, and the assessment is promptly levied.

Under its influence the stock goes down, and in a cautious way the Trustees buy that stock up as it falls in price. The work of sinking the shaft and winze having been discontinued, the miners know nothing about the bonanza and there is nothing to check the fall in the price of the stock. When this operation has been continued long enough, the work on the shaft and the winze is resumed and the news comes that the mine has "struck it rich." Up goes the stock in the market, a "boom" is begun and carried on and the trustees gradually unload the stock which they had bought at an enormous advance. The money has been made by them in the street. It is this fact that the Trustees are always placed in possession of information about the mine in advance of the public that makes the "control" of a mine so valuable. The Trustees are elected by the votes of the stockholders as representing the shares in the property, and if there be one hundred thousand shares, fifty-one thousand will elect the board. The representatives of that fifty-one thousand; the men in other words, who own those shares are the men who will have during the year following any election the knowledge of the real condition of the mine. So valuable has this knowledge been found to be that an active fight is often made for it by stock operators, and I have personally seen one of these fights in which the price of the stock of a certain prominent mine rose from $20 a share to $273 before the control was finally obtained. Of course this method of "milking the street" can only be looked upon as a very dishonest thing. It is a deliberate robbery carried on under forms of law and is one for which no remedy has as yet been found. It is difficult perhaps to suggest a system which would put an end to it from the fact that men if they wish to cheat will generally find means to do so. It may be said however, that a State Mining Board or Commission such as that which exists in the majority of states for the regulation of insurance companies; and a law requiring the publication of reports once a week of all assays made during the week, such report to be certified to, under oath by the superintendent, and assayer, and a false oath to be treated criminally as perjury, would probably do some good. It would certainly make men more cautious than they are now about the information furnished by them.

Or to put it in another way, if a law could be contrived that would make it an exceedingly dangerous thing to engage in the manipulation of stocks by false reports, for every one engaged in it, the result could not be anything but good. Until such a law is framed, passed and put into operation the business of using the information derived from the control of the mine will continue to be as flourishing as it is at present. While the chances taken by men with money when they place that money in mines are great from the fact that mining is under any circumstances a precarious business, the investments are legitimate because the possible returns are in proportion to the risks of loss. But when those chances are increased and complicated by wild cat management, they are not only very greatly increased and complicated but the legitimacy of the investment is almost wholly destroyed. In the case where the chances of mining are alone taken, the majority of the risks may be guarded against by proper precautions, care in examination and conservative management. But when the investor is exposed to the robberies which are the result of wild cat management, he is powerless. No amount of precaution will save him from the lies which are told and which affect the value of his property as soon as uttered; no care in examination is of any use when that examination cannot be made; no conservatism in management can be shown by the man who has nothing to do with that management and against whom that management is arrayed. But it may be said that if there were no fools there would be few if any knaves in this world. It is undoubtedly the fact that the men who make the sale of salted ledges and wildcat mines possible are the men who buy them. And that they do so buy them is the result of an idea which is of all ideas the most absurdly ridiculous. It is this. People have a belief that mining is a thing which is utterly different from anything else in the world in one respect, that it does not require the same care in investment and the same caution before engaging in it as is demanded by other forms of business.

This idea is a form of lunacy. The men who would laugh in your face if you suggested to them that they should attempt to argue a case of theirs in court; or who would look on you as a fool if you advised them to attempt the care of one of their children suffering from small-pox; or who would make remarks derogatory to your sanity if you asked them to buy and run a steamer, will calmly go into the business of mining when they know absolutely nothing about it and will actually expect to make money in it. Why they should do so, why they should select mining as the field in which they are to display their absurdity, no one knows. That must be added to the long list of the mysterious things which no one can account for. But that they do so can be seen every day. From the business man who invests a few hundreds in a "flyer" in the mining stock market to the capitalist who pays his tens of thousands for a ledge which he finds is worthless, all seem to be moved by the same craze, the craze for investment in a business about which they are wholly ignorant. Is it then any wonder that they lose their money, any wonder that the investments turn out badly? Mining is a business in which money can be made as surely as in any other, provided men will take the precautions necessary to insure the safety of their investments. Without these precautions it is about as risky as it is possible to imagine, and as long as men will persist in going into it without taking these precautions so long will it be that they will lose their money.

—*Alfred Balch.*

GOLD MINING FROM THE INVESTOR'S POINT OF VIEW.

GOLD-MINING is popularly considered as a speculation, almost as a species of gambling by some nervous people, and is certainly never regarded in the light of a sound investment or a steady-going business enterprise. Why is this so? Why, for instance, should a man run more risk in investing his money below ground than above it? Agriculture is not regarded as a speculation, though it is in reality far more of a speculation than gold-mining, for it depends upon seasons, which can neither be foreseen nor controlled, and the market value of the produce is liable to fluctuations such as gold never experiences, nor is ever likely to. Why then should gold-mining be deemed speculative? Simply because those who invest their money in a gold-mining enterprise cast their usual business-like shrewdness and caution to the winds, and rush headlong on the bidding of some superficially attractive prospectus, without devoting to it a particle of the inquiry and common sense which they would exhibit over the purchase of the smallest retail business. Those who cater for the public taste in gold-mining shares are quite aware of this fact, and with characteristic sharpness, they avail themselves of it. The result is that numbers of companies are floated, and vast sums of shareholders' capital are sunk, and upon undertakings that never deserved the slightest expenditure of either their time or their money. And then the gold-mining industry generally gets branded as a speculation, a thing to be avoided by all sensible sober men. While this state of feeling exists, and so long as investors are content to blame anybody else rather than themselves and their own ignorance, bogus affairs will continue to spring up and grow at their expense. The promoter, or some capitalist representing him is necessary to the formation of a company under the present circumstances. Heaping abuse on the heads of promoters will never save investors from losing their money. Their one and only safeguard is to use their own common sense in judging of the merits of a concern, instead of rushing like a flock of sheep through a gap in a hedge, and expecting to find ready-coined gold on the other side waiting for them to collect it. It must be remembered too that many a property which would give handsome returns to an individual capitalist or miner possessing the requisite knowledge, would fail to pay in the hands of a company, by reason of the cumbrous and costly machinery, I mean financial machinery, with which a company is necessarily burdened.

With these introductory observations, I will proceed to indicate the heads upon which, as it seems to me, the capitalist should thoroughly assure himself before investing in gold-mining shares.

Title.—The first consideration is the title on which the property is held. When a freehold is acquired from a private individual, the greatest precautions are necesary to ensure that his rights are unimpeachable. Several lamentable instances have occured where the purchasing company has maintained possession of the acquired property only after long and costly litigation, and instances are not wanting where the company has been quite ousted by the conspiracy of the vendor and his confederates, when the property had been rendered valuable by the expenditure of the company's money. Preference should generally be given to concessions held direct from government, supposing that the conditions are sufficiently clear and just. Of course discrimination is necessary with governments as with individuals. Governments which have exhibited dishonest tendencies, or have repudiated their obligations, should be avoided as much as dishonest individuals. It is a usual thing for a government to demand the deposit of a caution-money as a guarantee for the performance of the contract on the concessionaire's part; when this is more than a nominal sum, the honesty of the government will be a matter for particular consideration. The duration of a lease or concession for the working of a gold-mine should not be less than 21 years.

Mining Laws.—A point very generally overlooked is the nature of the Mining Laws and Regulations of the country in which the gold mine is situated and under which it is to be worked, as well as the manner in which these laws are administered. The laws must be sufficiently liberal to admit of the adoption of whatever machines, appliances, and processes may be found requisite, such as the right to acquire by purchase, a fair price as between the two parties, land which may be necessary for the erection of works, the storage and conveyance of water, and the deposit of refuse. They must contain no arbitrary restrictions or local prejudices, such as would interfere with the full liberty of the company's officers to carry out necessary operations, and full protection from the local officials must be given for conducting the operations. This question of mining laws is one that demands the most serious attention from investors. It is one too that has received far too little consideration from foreign states, whose mineral resources have been left undeveloped largely on this account. For it must be remembered that the richer the mine, the greater is the likelihood that unprincipled men will avail themselves of any flaw that exists in the laws to enable them to oust the purchasers, or to make onerous terms in various ways, and place the company at a great disadvantage. Another point, which, though not coming strictly under this section, demands equal attention, is whether the local government ever has, or is ever likely to, impose special taxes upon industries working under foreign capital.

Climate.—The climate of the country has a direct influence upon the success of an undertaking. Operations carried on in a notoriously unhealthy climate have many drawbacks. Additional expense is entailed for tending the sick, the work is liable to be seriously interrupted, wages are likely to be high in proportion to the work, and the effective work of the men is greatly reduced. In the first place, a man of any position in the ranks of the gold miners will require an exorbitant salary to reside in, or even to visit, a locality where he may live only a few months or even weeks. During his illness, things have to take pretty much their own course, and the result of protracted illness is to undermine the energies and abilities of the man upon whom the success of the undertaking may be said absolutely to depend. Effective gold mining is in a great measure a matter of personal experience gained on the spot. When the superintendent has to be frequently changed on account of illness or death, the advantage of his experience is thrown away, and his successor has to go through almost the same stages before acquiring the same local knowledge.

Other climatic conditions must not be overlooked. Great heat or drought may suspend operations for a lengthened period by cutting off the water-supply. Excessive rainfall may create floods of such a nature as to prevent locomotion for a considerable time, and cause great destruction to dams, water-wheels, and machinery, or necessitate an expenditure of capital to establish preventive measures. Extreme cold may interrupt the working by freezing the water, and rendering the appliances temporarily useless. The presence of these unfavorable conditions will demand a very rich ore, and unusually good circumstances in other respects, in order to compensate for them. They may even occur in such an aggravated degree as to render the richest mine quite unprofitable to the shareholders.

Water-supply.—Water is useful and necessary in almost all industries, but in gold mining it is absolutely indispensable. As a motive power, it is the cheapest that can be obtained, and is always desirable on that account; but of course very cheap and abundant fuel will counterbalance a lack of water for this purpose. In the treatment of the ore, however, no available substitute for water has yet been found. Nor is the purity of the water a matter of indifference. Water intended for use in the treatment of the ore cannot be too pure; dirty water, water obtained in draining the mine, or water containing considerable proportions of salts in solution, is quite inadmissible for this purpose, though it may be applied to driving the machinery, and thus render a larger quantity of good water available for the washing processes. The source from which the water-supply is to be drawn is, therefore, a question for primary consideration: whether it can be obtained from the surface, or whether it must be sought for below, or whether both supplies are to be brought into requisition. The existence of a river or stream in close proximity to the mine is a great advantage, provided that drought or frost do not render it useless for a considerable portion of the year, and that it is not subject to excessive floods at other seasons. If there be a river at some distance, it will be a question whether the ore should be carried to it, or the water be led to the ore, with a consideration of the relative facilities, cost, and advantages in either case. An approximate idea should be gained of the annual rainfall, and whether it is pretty equally distributed throughout the year, or whether it comes as a deluge for a short period and leaves the remainder of the twelve months dry. If the rainfall is considerable but spasmodic, it may be stored in reservoirs for subsequent use. The engineer reporting upon the mine should study the country in relation to its suitability for making such reservoirs, and permitting the water to be conducted to the point where it is to be applied. Sometimes mountain lakes prove most valuable in this respect. The cost of the construction of the reservoirs and conduits, if necessary, will have to be taken into account and provided for. It will be found to vary much, according as ditches, wooden flumes, or iron pipes are the requisite channels; and the expense of maintaining them in repair must not be lost sight of. Where no surface-water is obtainable, it may be feasible to procure a supply by sinking a well. In this case, all possible data should be collected as to the probability of finding a suitable and sufficient flow, and what the cost is likely to amount to. Well-water may be found very acceptable as an auxiliary supply in some cases; but when the working of the mine has to depend entirely upon it, common sense would demand that the company should have abundant and reliable evidence of its existence, before entertaining the acquisition of the property.

Timber.—Timber may be considered as a two-fold necessary; heavy timber for constructive purposes, and inferior wood for fuel, unless other fuel is available. The mine may require a large amount of timber for supporting the walls and roofs of the workings, and a considerable quantity is sure to be needed for building the works, if not for making dams and reservoirs. It is important to know not only that there are plenty of trees, but that their wood is applicable to the purposes intended. Many a tree is worthless as timber on account of its inherent defects, its liability to decay, or the rapidity with which it is destroyed by insects. Many trees are equally worthless as firewood; and some are too valuable for other industrial purposes to be obtainable at anything like a reasonable price. The question of the cost at which the timber can be procured, and of the certainty of securing an ample supply, should be inquired into with great care. It is an advantage to the mine when suitable timber is growing on the surface of the property itself, and is included in the purchase. When it has to be brought from a distance or imported, its cost of transport will be a heavy item. Insufficient supplies of timber would render some mines quite unworkable.

Fuel.—The question of fuel has been touched upon under the heading, Timber. It is employed in two capacities: for the purpose of raising steam to drive the machinery, and for the purpose of roasting portions of the ore. In the first application it may be in a great measure rendered unnecessary by a bountiful supply of water for motive power. In the second application, it cannot be so replaced. A certain proportion of pyritous ore occurs in every gold mine, and some process of roasting or oxidizing by means of dry or wet heat, is essential for extracting the gold from it. There are many mines where such a state of things would render the undertaking a complete failure. Fuel is therefore a necessary more or less requisite in all cases. When firewood is not to be had, coal or other fuel may be obtainable at a reasonable figure, including its delivery at the actual point where it is to be employed.

Transport.—The accessibility of a mine, and the extent to which a country is opened up, are matters of no mean import. All the materials requisite for the mine must be carried to it, building materials, machinery, fuel, and the miners' necessaries. The transport of the extracted gold from the mine is an affair of little difficulty under any conditions of travel; but when it is inconvenient or impossible, from want of water or other causes, to treat the ore at, or close to the mine, it may be necessary to transport the ore a considerable distance, and the question then becomes a vital one. Even where this is not the case, but when the gold exists largely in the sulphides (pyrites), and no means is at hand for treating them on the spot, their conveyance to a better adapted locality may have great influence upon the success of the undertaking. The existence of roads, waterways, or railways available for the purposes of the undertaking, is therefore a prime necessity. When the construction of roads is necessary and possible, their cost should be estimated and taken into consideration in judging of the merits of the enterprise.

Labor.—In an industry entailing the employment of so many men, the labor question is one that is sure to demand the closest attention, and the greatest exercise of judgment. The first consideration will be whether the native labor is available, and here many questions will propose themselves. In some instances, the natives are sufficiently numerous, but are prevented by caste or prejudice from engaging in mining operations; in other cases, they may be a pastoral or agricultural race, that has never performed mining tasks, and will need to be taught before it can be utilized; again, feasts, fasts, and religious observances may prevent work being carried on with anything like regularity, and where more than one race or religious sect is employed, the difficulty will be increased; also the ignorance or laziness of the native laborer may render him virtually worthless. The presence of plentiful, cheap, and really efficient native labor is one of the greatest blessings under which a mining enterprise can be started. When it does not exist, it may be deemed necessary to import foreign labor, than which no greater disadvantage can be. By importing foreign labor, I do not mean the drafting of men from one portion of a country to another but the introduction of men of different race, religion, and relation, such as Chinese into India, or Mexicans into Africa. One consequence of such an importation is very likely to be frequent collisions between the strangers and the natives, giving rise to many troubles, both direct and indirect. Another consideration will be, whether the climate is suited to the habits of the imported laborers; if it is unsuitable, there will be difficulty in getting the men to remain, unless at very high wages, and their effective capacity will be much reduced. So also with the food: a race accustomed to live on fish would object to being kept on rice, and one habitually consuming large quantities of meat would not content itself with maize, unless this disadvantage were compensated for by increased wages; and, in that case, probably the men would regard the emigration as a means of making money wherewith to improve their condition on returning home, and would therefore be continually shifting. This would deprive their labor of that advantage which is gained by generations following the same occupation under one another's guidance, and each new comer would need the same amount of teaching as his predecessor. Then again, in a half-settled country, where alluvial gold deposits chance to occur in the neighborhood of the mine being worked, it will be found that the strangers will remain at wages just long enough to acquire the necessary knowledge, and to be a sufficiently powerful body for self-preservation, and then they will quit servitude, and go in search of gold on their own account. This is an especial danger in employing Chinese labor, and the experience gained on this point in Australia and California should be a sufficient warning to prevent the experiment being repeated elsewhere. Of course there is no objection to the introduction of foreign labor when the requisite conditions can be fulfilled. Other conditions being equal, the rate of wages will decide whether the mine can be profitably worked or not.

Cost of Necessaries.—In some new and thinly peopled countries, commodities of all kinds are excessively dear. Then the market prices of the ordinary necessaries of life, such as food and clothing, run very high, and the rates of wages may be expected to rise in proportion. The high price or scarcity of other articles, such as illuminating materials, tools, ironwork of all kinds, mercury for amalgamating, carpentry, &c., will tend to swell the incidental expenses, and therefore require the mine to be all the richer in order to support the increased cost of getting the gold. The question of the suitability of the food for the laborers employed has been already alluded to, as affecting both the nominal price of the labor, and the amount of work done for the money.

The Mine.—A so-called gold mine may be either of three things. (1.) It may be a recent alluvial deposit, that is to say, a mass of auriferous material which has been broken up, and its gold liberated by bodies of water still exist, though perhaps a little changed in position. Such is an ordinary "alluvial" or "placer." (2.) It may be a similar deposit formed by rivers and lakes which have altogether ceased to exist, and have, in very many instances, been subsequently covered to a varying depth by a flow of igneous rock. This is termed a "deep lead" or "dead river." (3.) It may be a mine proper, where the gold is secreted in the interstices of quartz or other rock. This distinction is necessary as a preliminary step to a discussion of their features and requisites, as the mode of working differs not a little.

(1.) *An Alluvial or Placer* is worked by removing the whole mass, and passing it with water through a long series of apparatus where the gold is arrested. The first essential is an abundant water-supply, the consumption of water in this operation being immense, as the whole mass of the deposit is transported by its agency. The next consideration will be the position of the deposit, whether it lies actually upon the surface, or is covered with more or less loose earth: if the latter, whether this loose earth must be removed, or whether the deposit can be worked from beneath it, and what the cost of supporting it or removing it respectively will be; whether the deposit can be directly dislodged by the application of water under the pressure of considerable fall, or whether it must be dug out by manual labor before being brought under the disintegrating and separating influence of the water; whether the position of the deposit in relation to the source of the water supply will permit the water to be carried in open ditches and wooden flumes, or whether it will have to be conducted in pipes, and what the probable cost will be,—where the distance is great, a large margin must be allowed for loss by evaporation and leakage, when estimating the supply. Another requisite, without which the preceding are useless, is an abundant space for the deposit of the immense quantity of earth which is disturbed and transported. There must be a possibility of depositing this refuse where it will do no harm, either to private property or by stopping up water-courses. An alluvial without this accommodation is utterly valueless, because it cannot be worked. The space where the refuse is to be deposited must necessarily be on a lower level than the alluvial, in order that the refuse may be carried to it by the flow of the water. Where this space has to be acquired at the hands of private occupiers, its actual undisputed possession should be considered as necessary a preliminary as the very title deeds of the property.

(2.) *A Deep Lead or Dead River* demands much the same conditions as the preceding, but in a magnified degree. The difficulties of tracing the deposit, estimating the extent and richness, and working it are all increased. Sometimes, too, the auriferous material is cemented together in such a way as to need the appliances of a reduction works, in order to recover the gold, thus adding to the cost.

(3.) *Mines*, or undisturbed deposits of mineral, are much more frequently made the object of joint-stock enterprise in this country than either alluvial or deep leads. The first question relating to a mine is its accessibility, or the opportunity which it presents for opening it up. The most desirable condition is where the mineral can be attacked by a level adit, driven with just sufficient rise as it advances to permit the water which is met with to make its escape. The greater the amount of ore lying above this adit, the more valuable is the mine. When the mineral has to be reached by sinking a shaft, great additional and permanent cost is incurred by raising all the material from a depth, and for pumping machinery to keep the workings dry, and there is always the risk of a flood, a waterspout or a hidden reservoir suddenly filling the mine with water, and suspending operations for a long time, or even for ever. But though great preference is due to a mine that can be developed by adit levels, most mines sooner or later have to be worked by means of deeper drivings, and this must hardly be considered a fault, when other conditions are favorable. The character of the ground has great influence upon the cost of working: soft ground may cost less for excavating, but will require all the passages to be kept open by means of timber, which may add immensely to the cost if timber is not readily and cheaply procurable. On the whole, with modern drills and explosives, hard rock that needs no timbering is generally to be preferred. But a certain quantity of timber is always necessary in the veins or lodes themselves, and where these are of great width, the consumption of timber is enormous, and the cost is proportionate.

The Ore.—The extractable proportion of gold in the ore and the cost entailed in getting it out, will vary greatly with the character of the ore. Sometimes the gold occurs almost entirely in the free state, that is to say, associated with no metallic mineral, but only with such minerals as quartz. In this case its extraction and recovery are very simple and inexpensive, and, under suitable conditions, an extremely minute quantity of gold, in other words, an exceedingly poor ore may give handsome returns. Frequently a large portion of the gold is intimately associated with ores of the baser metals, particularly with sulphides, and arsenides, and indeed occasionally the ore contains no appreciable quantity of gold in a free state. It must not be supposed that the gold is *chemically* combined with any other substance, but the microscope has proved that the tiny atoms of gold are sometimes completely enveloped by a film of other mineral, so thin as to be beyond actual measurement yet sufficing to exert considerable influence on the mode of treatment. But I wish here to call particular attention to the fact that, in Hibernian language, gold is not always gold. However rich the ore may be, it is like one-half of a bank note, utterly useless without the complementary half, or the possibility of getting the gold out. While the gold is *in* the ore it is of no value to anybody; it becomes valuable only when it is got at; consequently in judging of the worth of ore the basis for the calculation is the gold that can be extracted from it, and the cost at which this extraction can be effected. Where the ore is refractory, and needs roasting or other processes, the cost and provision of the necessary materials, labor, and plant will demand consideration, as well as the working expenses of the process. From a careful perusal and comparison of the preceding paragraphs, it will be evident that a rich ore is *not* the only desideratum; 3 oz. of gold per ton of ore under unfavorable conditions may be far less remunerative than 3 dwt. under favorable conditions; and the intended investor must look a great deal farther than at the assays of the mineral, which are a groundless basis, if he wishes to place his money in a sound undertaking. It must not be expected that any mine will satisfy in the highest possible degree all the conditions I have alluded to. But no mine is worth the serious attention of a capitalist, if the report made upon it does not afford a reliable statement of its position in regard to these several points; and it will remain with the intended investor to exercise his criticism and judgment, and to decide finally whether the undertaking possesses sufficient favorable or satisfactory points to make it worth the price which is asked for it, and the additional expenditure necessary to make it productive.

—Compiled from a pamphlet on gold mining, by Albert G. Lock, F.R.G.S.

THE PROBLEMS OF LABOR.

THE Superintendent of a mine as representing the company owning it, at the beginning of his term is met with the great labor problems which affect the business. The mine to be properly worked must be supplied with a large number of men, and those men must by of different trades. Mining employs first, the miners themselves or the men who actually tear the ore out of the deposit. But supplimenting these come the carpenters, the blacksmiths, the engineers, the furnace men, the millwrights, the mill hands and the representatives of all the trades which find employment in and around a great mining property. As the men employed are skilled workmen, for there is but little about a mine that mere laboring men can do as compared with the tradesmen, it follows that there are degrees in the efficiency of the labor to be obtained. Strictly speaking, there are degrees of efficiency in the commonest labor, because one man is necessarily stronger or weaker than another, can work a longer or shorter time, and his work is done more or less thoroughly. But the degree in efficiency apparent where skilled labor is employed is very much greater than that seen in ordinary labor, and so it is that the training which the workmen employed have received, either in that mine or others, becomes one of the greatest problems in the labor question as they affect mining. Poor miners are the most expensive men ever employed, for they cost infinitely more than they bring in. As the trade under consideration becomes more difficult to learn this lack of skill in its representatives becomes more costly. The mining carpenter, or the mining blacksmith for example, may by their inefficiency cause the loss of thousands of dollars. The work done in a mine can be compared to a great structure, each part of which is supported by, and in turn supports other parts. Every expenditure of strength in mining is the result of former expenditures and prepares the way for expenditures in the future. As this is the case, inefficiency in the labor employed, bad or careless work, may be the cause at any time of loss which casts into the shade the cost of the work itself. And it is this fact coupled with one other which gives their great importance to the questions of labor which affect mines. That other fact is mines must "go on" continually, that any stoppage is enormously expensive, that the property is either being improved or decreasing in value. There is no middle course possible. If a man owns a field he may cultivate it or not as he pleases. If he does not, the field becomes from the fact that it lies fallow, more valuable than it was before. But if a man own a mine, he can not stop work upon it without the property decreasing in value. Water collects in it, the roof caves, the floor heaves, the timbers rot; in short, the mine is injured. Not alone does he lose the interest of the money invested in the mine; but the property actually deteriorates in value. When then through those results of labor difficulties, which we call strikes, the mine is shut down, the owners of that mine lose enormous amounts of money, and as the loss is a cumulative loss, as every day which passes before the mine is worked again increases that loss; the conditions which lead to the causes of that loss are conditions which must be studied carefully. The labor problems in connection with mining may be stated as coming generally under the following heads: the supply of labor, the efficiency of labor, the just demands of labor, the price of labor, the union and the regulation of labor, so that the men may be in the best condition to work well.

As the number of men employed in and about a mine is very great when that mine becomes developed, the supply of labor is one of the most important of those questions which affect the economical working of the property. This is particularly true in new mining districts where the population is small and the demand for men is great. In such districts it often happens that miners are sought for, but not obtained, and the superintendent is forced to see the property remain without the development which it should receive for pure lack of labor with which to do the work. In such a case he is obliged to face the question, of what may be done to substitute for the skilled labor required of unskilled men, whose work while not as efficient as that of the trained miner is yet work, and to a certain extent this may be done, but when it is done the arrangement of the work and the system under which the mine is managed, is necessarily subject to change. The most perfect system of mining yet devised by man is the contract system. Under it, the hardness of the rock and the difficulty of getting it out, the conditions under which the mining is done in any particular part of the workings, and the amount of dead work it is necessary to do in order to keep that part in its then state of development or to increase that development, being known the superintendent lets out the work to the "contract gangs" or "shifts" the corps of men who do the work.

Having stated the conditions under which the work is to be done, the size of the cutting to be made, the amount of dead work to be "carried" or performed during the cutting of the ore, he states the price at which he will pay for each cubic foot. These contracts should always specify the exact amount to be paid for the work, and the prices as so fixed should be invariably adhered to. Nothing is more calculated to bring about disagreements between the superintendent and the men than the kind of contracts which give any chance to either party to change the terms after the work has been done. It may be that the work has been far less difficult than was expected at the time that the contract was made or it may be that it was far harder. In the one case the men who have taken the contract will make very high wages during the month—all contracts should be made for a month—while in the other they will make but little. Aside from the fact that this will average up in the long run, and that each party to the contract will come out even at the end of the year, nothing is more difficult than to fairly adjust the honest differences of opinion existing between the employer and the employed in such matters.

While it naturally seems that handing a man three or four hundred dollars as the result of a month's work is giving him too much; that is, is paying him more than the work is worth, on the other hand giving him but thirty or forty seems like too little. While the miner in the first place might be willing to concede that he was getting more than he had earned, he certainly would look on the second payment as being less than he was entitled to.

Now I think that every superintendent who has seen the contract system in operation will concede that the trouble brought about in the raising of the second sum, by the cutting down of the first, even when that cutting is done with the full consent of the miner, costs more in the end than the amount of money saved. If in nothing else, in the time taken up. A good superintendent is generally worth and paid a large salary. He is paid that salary by the company for his skill and ability in managing the mine and, as a rule, the management of the mine will take up all the time that he has to spare. If that time be employed settling the differences which arise between the shifts and the "underground adjust," "mine boss" or "assistant superintendent," as the superintendent's chief assistant is variously called; the company can scarcely be said to be getting the full worth of their money. These disputes as to the value of the work done are generally intensely vexatious, and a small sum will often bring about a serious difficulty with the men. Not only is the time of the superintendent wasted but the time of the miner as well. In mines where the contract system is in operation payments of wages are always one month behind. That is, the work done in April is paid for on the last Saturday or Friday in May. This month is taken up in calculating the amount of work done and deducting the charges against the men. The clerk of the mine generally has the pay roll made up on the 15th of May, and the men are then notified what the office calculations of the amount coming to them amount to. I never saw a month pass when the calculations already made by the miners did not differ from those made by the office, nor did I ever hear of any man who had seen one. From the 15th to the 20th are the adjustment days, two words which are coupled with as much profanity as any two in the language, during which the superintendent's time is taken up almost wholly in listening to the claims for more money as advanced by the miner and the reasons of the mine boss for estimating the work at the price named. The miners lose their time, not alone those who have a difference to adjust but those who hang around to hear what the result of the discussion is, as well. And whatever that adjustment may be it fails to give satisfaction. The men accept it, because they are forced to, but they do so with much grumbling. A superintendent once said to me, "I dread adjustment days, they break up the work of the whole mine to that extent that the output looks as if we were ruuning on half time." Another evil, and a great one, is the amount of drinking done during adjustment. The men having nothing to do, resort naturally to the dram shops or saloons and pour down liquor, thereby rendering themselves unfit for work. When they begin again under the settled contract system, whether the payment be by percentage or so much a cubic foot, none of these difficulties arise. The miners when they take the contract know exactly—in the latter system—what they are to receive, and the calculation being simply a matter of measurement, which is made by the mine boss, or the clerk of the mine, in the presence of the shift, or of the leader as representing the shift, few if any disputes arise. Even iu the mine, changes to the shifts for blacksmith work, powder, cars or "vibbles," the tallies which are returned to the leader can neither be disputed nor gainsayed. Adjustment days become an exploded terror and months may pass without an appeal being made to the superintendent. To return to the question of the supply of labor when unskilled men must be employed. I have seen most excellent results from a modification of the contract system. The skilled miners were made the sub-contractors for the work, and that work was done by them under the specifications as made by the mine boss in regard to measurements. They employed their own men on percentages which were recorded in the office, and payments were made direct to the men under those percentages as agreed upon. The advantages of the system are almost self-apparent. Every part of the work was done under the direction of a skilled miner, who was responsible for it, and the unskilled labor received an amount of direction and supervision which could never have been given by the officials of the mine. Some such system as this must be adopted in the working of a mine when the supply of skilled labor is deficient; for if, as is undoubtedly the case, the system of daily wages is a bad one when skilled miners are employed its evils become intensified when skilled labor is all that can be obtained. The skilled miner may "shirk" when he is on wages, and as a general rule will do so; but what work he does do, will be properly done. The unskillful laborer will shirk and do his work badly into the bargain. The supervision of the work, done in a mine, is divided into so many parts, the work is being done at so many different points at once, that unless the company were to employ an inspector or "viewer" for each face, breast and stope, it would be impossible to tell whether that work was going on right.

And it is this fact which makes the contract system of all others the fairest. Under it a man is paid for what he does, not for what he is supposed to do. If he chooses to work hard, he gets more money; if he does not so choose he gets less. He is paid, too, in proportion to his skill. A good miner is a man who has learned to utilize his strength to the utmost and to get the largest return from his labor. Such a man deserves to receive more money; his work is worth more to the company than that of the man who has not so much skill. While this is generally true of all trades, it is especially so of mining. If a compositor sets up, corrects and distributes a stick of matter, his work as far as that stick is concerned is at an end forever. The time he took in setting up, the state of the proof or the time taken to distribute, providing always that the distribution be clean, can have no earthly effect upon the next stick passing through his hands But with the miner it is different. As each section of the work prepares the way for those following, and as the ease and economy with which each section can be done depends upon the manner in which all previous sections were done, the state in which the miner leaves the sections is a thing which is of direct pecuniary concern to the company. This fact is generally recognized in the eagerness with which superintendents will hail the chance of employing good men. But as the value of the work done by those men may be said to be constantly varying between that which is worth most, the work of the typical miner, the man who knows his trade thoroughly, who works hard and who guards the mine carefully; and that which is worth least, the work of the shirking "ne'er-do-weel," who leaves his seam half worked, his timbers half put in, and sends his kibbles out half filled; so the payments should vary. In mining as in every other branch of human industry it is impossible to devise a system which will perfectly meet all cases arising under it. The best that we can do is to employ the one which meets the largest number of these cases; and I think the contract system may be said to be the best yet devised for the industry. I have already spoken at some length of the necessity of "fixed contracts," but it may be as well to describe more in detail what this contract system is. Under the contract system the owners of the mine furnish the property to be worked upon and supply that part of it necessary for the working, in which capital is required. As for example, it costs a great deal of money to purchase the hoisting machinery necessary to lift the product of the mine to the surface; therefore the company supplies the hoisting engines. They sink the shaft, drive the levels, supply the ventilation and drain the mine. The mine is then in a condition to be worked, and the contract system begins. The miners possess the labor necessary to work the mine, and the company says in effect to them, "We will pay you for that labor as shown by results. We will declare upon what conditions that labor is to be performed and what work has to be done in our opinion to prevent the mine becoming diminished in value. For such amounts of work done by you under those conditions we will pay the price agreed upon by both parties to the contract." The miners then become men working for themselves, in the same way that a job carpenter works for himself, and in proportion to the work done is the amount of money paid. The price of that work is settled by the company and is regulated by the hardness of the ground, the conditions under which the work is to be done and any other considerations which affect the net amount of effective work a man can do in a day's time. The price having been settled by the company the miners may take the contract or leave it, as they see fit. There is no compulsion in the matter one way or the other. If the price named, or any price is too little to pay for the work, the miners will refuse to accept the contract, and in order to have that particular work done, the price must be raised.

If on the other hand the mine boss fixes the price at a sum in excess of its real value, the contract is taken at once and the company loses money. As a rule, the mine boss fixes a price beyond which the company will not go and the men then have a chance to "bid down," the one offering to take the contract at the least sum securing it. It is always well to settle the order in which the "shift options" are to come, that is the order in which the shifts may take the contracts beforehand, and the drawing of numbers is as good a way as any for this unless the men agree among themselves to some other method. In any case shift with option number one, must have the right to accept a contract or decline it before shift with option number two. Of course if the first shift accepts the contract and the second underbid, the second gets it; but the system of options will prevent a great deal of confusion. The awarding of the contracts goes on something after this fashion. The clerk of the mine calls out, "Face of level number two. Ten feet. Same size. Dead work the same. Fifty cents." This means that the face of the level number two is to be driven in ten feet, that the size of the level is to be maintained and that the dead work, such as cutting the canal for drainage, is to be the same. Fifty cents is given as the price which will be paid for each cubic foot of rock extracted. The clerk then calls the numbers of the options until the leader of a shift answers "aye." The clerk then says "number 16 has it at fifty cents. Any bids?" Number 17 may say "forty-five cents," being an under bid of five cents, and number 18 may say "forty," a second underbid. The lowest bidder gets the contract, and the price bid by him is the price at which the work will be reckoned. Of course the figures given above are purely illustrative. Having secured their contracts the shifts begin the work. The company charges them, or should charge them, for every thing they require. Blacksmith work in sharpening picks and drills, cartridges of powder, charges for cars in which the rock is carried to the surface are all paid by the shifts. This is not unfair, because the price at which contracts are taken is settled with a view to such charges, and the fact that the charges are made induces the men to be economical with supplies. At this point comes in the chance given to the miners by the contract system of making a great deal of money or very little. As the character of the vein or seam often changes within a few feet, and as contracts are, or should be, always made "on the face" or in view of these conditions of the place to be worked it follows that if the rock becomes softer the men get ahead faster, while if it becomes harder they get ahead more slowly. As the amount of money received by them depends wholly on the amount of work done as judged by the result, if the one change takes place they make more and if the other they make less. The charges against the shifts are best based upon the "tallies" or little pieces of wood having upon them the name of the leader or the number of the shift. These should be of different shapes or colors to prevent confusion; as, for example, a round "tally" may be given for blacksmith work in sharpening a pick or drill, a square one given for a cartridge and an oblong one for a car.

The numbers or names should be stamped into the wood rather than painted. At the end of the month these are counted by the clerk and returned to the shift, the leader of which gives a receipt for them, and in accordance with the terms of that receipt finds the amount deducted on pay-day from that due to his shift. The individual sums due the members of a shift should always be settled by percentages, and it is well to have the agreement in writing so there may be no dispute. Men may change from one shift to another at the end of the month, but the Superintendent should not allow such changes to be made, except at such times. The principle upon which the contract system is based, and which it is always well to keep in mind, may be divided into two parts; first, that a thing once settled, is settled forever, as far as that month is concerned; and second, that once a month the details of the system may be completely changed around and modified to suit the changed conditions of the mine. It is upon this principle, or rather upon these two principles, that the whole value of the system depends. It is given enough rapidity to make it a thoroughly business method of carrying on the work, and enough elasticity to enable it to adapt itself to the ever varying state of the property.

In mines where wages are paid, the men receive just so much money per day of so many hours, and the amount of work done by them depends upon their individual honesty, or the amount of supervision exercised over them. As it is a fact that not one man in a thousand will work for others with anything like the zeal he will display in working for himself, it follows that to get from the miners under wages anything like the amount of work which should be furnished for the money paid, a close supervision must be maintained. For reasons already stated, such supervision is an excessively difficult thing to keep up, and unless the number of viewers be very large, the men will have plenty of time to shirk. In this connection I may say that while Cornwall has given us many things in mining, which are of the utmost value, the practice of putting white jackets on the captains of the mine is an absurd one, for the simple reason that the men can see a captain long before he can see them, and hence his inspection or "viewing" becomes of little account. The radical difficulty about a wages mine, is the fact that it works against the interests of the men as well as the company. If the wages are settled at $5 a day—any sum will do as an example—the skilled miner gets nothing for his skill, experience and knowledge. The amount received by him is the same as that paid to another man who has just begun cutting, and whose work is not worth half the value of his. He loses the money he has a right to expect, as the result of his training and experience. On the other hand, the company gains when they pay him only $5 for labor worth $3 and experience and skill worth $4, but they lose heavily when they pay $5 to the man who has but the $3 worth of labor to give in return, and is totally without the $4 worth of experience. The aggregate of the sum so paid is far greater than the aggregate of that saved. It may be objected at once by the miners that if this be true, miners as a class are better off, because as a class they receive more money. I confess I do not agree with this view, although I have heard some of my mining friends urge it very stoutly. It would be a sound view were all miners part of one great firm, turning their wages in, and drawing money out, in proportion to the value of their work. But this is not, and never can be, the case. My reasons for thinking the wages system bad for the miners, I can briefly state as follows: First, it is right that every man as he goes through life should receive a constantly increasing sum for his labor. A man's work should be paid for in proportion to his strength, or that which enables him to do the work at all, and in proportion to his knowledge or that which makes his work valuable. If you will think for a moment you will see that these are the only two considerations which enter into the value of the work as done. Strength on one hand, knowledge on the other.

It is a physical law that the time of a man's greatest strength is between twenty and forty-five, and that after that period his strength declines. But suppose you put a man of twenty-five who knew nothing of mining into a coal seam along side of a miner of fifty, which would cut the most coal? The miner, every time. Why? Because with less strength, but with greater knowledge, the miner would make each blow of the pick tell, while the laborer would lose half or three-quarters of his work. Knowledge, then, comes in and replaces strength. But in the infinitely complex industry, which we call mining, knowledge is worth far more than strength. Take one instance. What man on earth who knew nothing about mining would leave a breast after a month's work in it, in such a condition that miners would be willing to go into it and begin to blast? Not one. The work of the miner then must be such, that after he has worked out a place, others can safely work beyond him. Knowledge alone will bring this about; strength will ruin the mine. Knowledge then is more valuable than strength, and being more valuable should be better paid. But this knowledge can only be got by experience, and experience takes time to acquire. Therefore as men get older they should be better paid. As under the wages system they are paid the same, this is the method of reasoning by which I arrive at my first objection to wages. My second objection is the fact that the wages system prevents the young men receiving a reward in direct proportion to the quickness with which they learn their trade. Take two young men, just out of their time and beginning cutting. One of them will learn with extraordinary rapidity the various kinds of knowledge which go to make up the miner; the other will stay just at the point where he left off. In my opinion the first should receive something more than the second because his work is worth more to the Company. Under the wages system he receives the same. Not alone does he not receive anything more for his improvement as a miner, but the wages system takes from him all inducement to improve. To improve oneself, to increase one's stock of knowledge requires effort, and that effort will not be made unless a man receives something for it. If a miner knows that everything learnt by him will return to his direct advantage, he will try to learn. But if on the other hand, he knows that his labor of learning is labor wasted, he will not make the effort. It is true that even under the wages system the young man who works to improve himself, who labors to make himself a better and more valuable miner, will, some time, receive a reward for that labor. In time he will attract the attention of the superintendent and will receive advancement. But the time is a long time, and when he does receive the advancement, the other men whom he has passed in the race are sure to accuse the superintendent of favoritism. "So and so is the boss' pet," they will say. Under the contract system the miner gets a reward at once for every particle of knowledge which he has and the men are the first to find out his merits. I have seen a man of twenty-two the leader of a shift which was never empty. He could get the best men in the mine to work with him, and he always had more applications than he had places. When at the age of twenty-four that man was made "night boss," the superintendent simply confirmed the choice already made by the miners. His advancement by the way did not stop there. At the age of thirty-five he was made superintendent of the mine he had gone into as a boy to drive the horses before the cars, twenty years before. But, it is urged, the wages system makes the Company pay out more money in the long run than the contract system. To a certain extent this is true. It obliges the Company to pay the same wages to the poor miner as to the good; in other words the wages system is the system clung to, and believed in, by the "no-account" men. It is the system of the drones. In it the Company is always trying to get the wages down to the amount represented by the average value of the work done by each man, and as the poor miners are always in excess of the good ones, the rate while not much above that which should be paid to these inefficient men is very far below that which should be paid to the efficient. On the other hand the miners are always trying to raise the sum paid to each to the amount which the work of the good man is worth. In this struggle the great majority of the troubles of the miners and the companies are born. It must be remembered that many of the men, who are poor miners at forty years of age, had they been subjected to the spur as applied by a system which gave them a tangible reward for improvement, as soon as that improvement was made, would have been far more valuable The numbing effect of the wages system upon the faculties is shown disastrously in their case.

I have mentioned the struggle which goes on between the miners and the company and the cause which leads to it. It is necessary to consider this struggle more at length and the machinery employed on each side, by the aid of which it is conducted. First and foremost in such consideration comes the complicated question of the miners' unions. I say complicated because the question of the union is generally so considered. To me it seems that the question is an excessively simple one, if a person will but take the trouble to examine it. Some light may be thrown upon it by an examination of how the union, as it exists to day, came to be formed. The union may be traced to the benevolent clubs which were common in English mines many decades of years ago. The miners found that if they wanted to provide against the effects of accidents, the troubles attendant upon those accidents were lessened. A contribution of a shilling or six pence a month gave a man medical attendance and allowance when he was sick, or paid for a decent interment when he died, and gave a small sum of money to his widow. The results of the clubs were found to be so excellent that men who had once joined them rarely left them. But as time went on the miners made a second discovery. They found that while coöperation between them would provide for illness or death, the same coöperation made their voices far more powerful in the conduct of the mine. The owners of the mine on the one hand had money, and wanted labor as cheap as they could get it; the miners on the other had labor and wanted all the money which could be got for it. While the discharge of one man would not affect the owners at all, if the whole force quit work it would affect them a great deal. And so the miners said "we will band ourselves together and act in all things as one man." This they did, and the owners found that the operation of a mine had a new element introduced into it. It is undoubtedly a fact that the union has done an enormous amount of good. It has brought about discussion among the miners, out of which discussions have arisen improvements in mining; it has forced owners to pay more attention to the wants of the men, their safety, and their comfort; and it has proved a check upon the owners in many ways. In all of these things it has done good. On the other hand it has done an enormous amount of harm to the men, as well as the owners. Having great power, it has often used that power without proper caution. It has often refused to acknowledge the fact that the question of wages is one which is governed by other things beside the willingness of the company to pay. To tell a miners' union that the rate of wages governed in Pennsylvania by the rate of discount, as established by the Bank of England, would seem to the members of that union a wildly absurd statement, yet it is one which is susceptible of proof.

The miners' union forces us to regard labor as being one individual factor in our calculations. While we may say that the union has ruined the business, and in some respects this is true, it is yet a fact that the union exists, and that it will exist to all time. While miners themselves are forced to concede that the union has done harm to them in the past, they are conscious that it has, on the whole, done more good than harm, and that the balance must therefore be strong in its favor. As this is unquestionably true, it follows that in the consideration of the union, we must accept this fact as one prior to any such consideration, and base all our reflections upon the continued existence of that union. Capital being governed by certain commercial laws well understood, although, perhaps, not formulated, by every capitalist: it follows that capital will always work in the same way. The first and most imperative of these laws is to guard capital against loss. The second is to so manage capital as to secure interest or increase for its use. When men place large amounts of money in mines, and an investment in a mine is necessarily a large one, by the owners, although strictly speaking the size of an investment has nothing to do with the operation of the two laws mentioned; they require that it be safe and that it yield interest or profit. We have already seen that shutting down a mine makes that mine less valuable than it was before, and that the decrease in value is one which is cumulative. A strike on the part of the men employed threatens the safety of the capital invested or exposes it to a chance of loss. But a strike brings the output to an abrupt stop.

As the profit or interest upon the mine depends wholly upon the out-put, the strike causes the interest on the capital or profit of the investment to cease. When, then, a strike occurs, the company has both of these imperative commercial laws urging it to bring about as soon as possible a termination to that strike. Were it not for the operation of these laws, the company would allow the men on strike to stay there until they got tired. As there are these commercial laws affecting capital, so there are the same laws affecting labor. The miner has his strength and his knowledge, which may be called his capital, and he wants that strength and knowledge secured from loss, and as large a return as possible in the shape of wages or profit. He goes into a strike, as a rule, because the profit derived by him from his strength and knowledge, is not as large as he thinks it should be. The result of the strike upon him is the same result seen in the case of company representing capital. As when the strike began the company found its capital exposed to loss from the decrease in the value of the mine, so the miner finds his capital exposed to loss indirect and direct; indirect because his capability for work is decreased by idleness, and the habits he too often forms during the strike; and direct because, as his capital consists of his strength and knowledge first, and his savings second, he is obliged to live on those savings. The fact that the union funds support him does not change this, for he gets out of the union only what he put in. If he is supported by the funds of other unions, then it is merely an amplification of the first state of things. The operation of the second law during a strike, is the same in the case of the miner, as in that of the company. The interest or profit of the company depends upon the out-put; when that ceases the interest ceases. The profit of the miner depends upon his wages, when they cease it comes to an end. The strike, then, affects both parties to it in the same way, and as that effect is in each case a bad one, both parties are anxious to end it.

The courses which force the termination of the strike are to be found, as a rule, in the operation of the first law, that which governs the loss. The company may be obliged to yield rather than see the mine deteriorate any more in value, the miner may be starved out. But the causes which bring about the terms of settlement are to be found in the second law, and as a rule these causes are those which affect the company, and not those which affect the miner. It may be laid down as a principle, applicable in all cases, when business is carried on, that there is a point beyond which disbursements cannot be made. If the company pay wages which swallow up all the profits of the mine, there is no return to them for the capital invested. As the mine may be supposed to represent the capital invested in it by the company and the labor or capital invested in it by the miners, so the capital invested in the mine may be said to be the aggregate of both. The profit of the working is to be divided between the two, and the share which goes to the company being called interest, and the share going to the miners being called wages. As it is right that the latter should have a part of this profit in the shape of wages, so it is right that the former should have a part in the shape of interest. If the demands of the striking miners are such as to give them, should the terms be agreed upon, all this profit, the company will never accede to them. If on the other hand the company are receiving more than a fair share of these profits they will accede to the demands of the strikers at once.

I may be asked why I have gone into this long examination of the different theoretical interests which affect a strike. My reasons for doing so are simply these: It is necessary before we can cure a disease to know what conditions brought that disease into existence. For the company on the one hand, to say that a strike is simply folly on the part of the men, that it is brought about by the machinations of those who delight in making trouble, that if it were not for the demagogues it would never have happened is as absurd as it is for the miners on the other to say that the refusal by the company to accede to their demands is dictated wholly by a desire on the company's part to grind them down. Each of these accusations may have in it a certain amount of truth. It may be that the strike was folly on the part of the miners, that it was brought about by interested men and that had it not been for the demagogues it would never have taken place, but to suppose that a large body of hard working men, men who fully realize what it is to pay for the support of their wives and children out of their wages, will go on strike simply because others tell them to do so is to suppose a thing which is utterly ridiculous. So it may be that the company desires to receive as large a share of the profit in the shape of interest as it can, but to accuse it of a desire to degrade labor by grinding down the miners is folly of the wildest sort. Yet these are the positions generally taken by each party in the fight, and half the difficulty experienced in adjusting matters amicably arises from the fact that each party proceeds upon one of these absurd assumptions. As a matter of fact there is at the base of the strike on the part of the miners a belief, either true or false, that they are not getting as great a share of the profit of the mine as they are entitled to, and the refusal of the company to accede to their demands arises wholly from a consciousness that were they to do so their share of the profits would cease. It all comes down then to a question of profits or to the question of how much money is got from the operation of the mine. If both parties to the strike, the company and the Union, will recognize this fact and will in their arbitration meeting calmly ascertain and consider what the profits are, a piece of information not at all difficult to get, and will then quietly determine the proportion which should exist between the interest which goes to the company, and the wages which go to the men, they will find little or no trouble in arriving at a solution of their difficulty. But if they go into a conference or arbitration meeting for the purpose of indulging in mutual recriminations, for the sake of making charges of personal animosity and personal feeling against each other, that strike is apt to last until both parties learn more sense. I remember being present at an arbitration meeting of the representatives of the Union and the Superintendent at which the speeches made were of the most bitterly personal character on each side. Accusations of a desire to grind down the laboring men—it is extraordinary how fond the Union orators are of this phrase—on the part of the company, and of rank folly, black ingratitude, and a wish to create trouble on the part of the miners, were freely made. The meeting got more and more stormy and the prospect of a settlement seemed to be very remote, when an old miner got up and made a speech which I thought the best one I ever heard. It ran something like this: "I come here, men and Mr. Chair, for to find out if I were goin' to work agin. I didn't come here for to call no names 'cause my old woman an' me can git up that kind o' 'musement any time we likes. Now ther's a good many old women in this yer camp as can do that kind o' work a heap better nor me, an' I moves you Mr. Chair as how we gets them old women in here to 'buse each other while we goes out into the yard an' settles this yer question o' goin' to work an' what the company will give a day." It did a man good to hear the laughter which followed this speech, laughter caused the more readily as I afterwards found out, from the fact that old Sandy's wife was a notorious shrew. The old man's speech was effective, though, and the question of wages was settled before the meeting broke up. Once or twice during the discussion things began to wear a threatening aspect, but an allusion to Molly always brought good humor with it. I have often thought of Sandy's speech since that time.

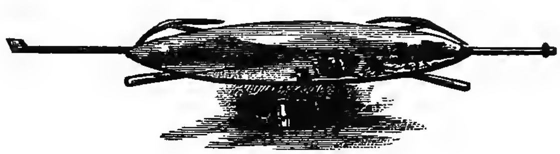
But at best the system of strikes in order to increase wages is a make shift system. It is a mistake which is brought about, by that other mistake, the system of wages itself. As long as the work of men is given a fictitious value, instead of being estimated at its real worth, so long will it be that the company will estimate the value below, and the men estimate it above, the proper point. The company as controlling the disbursements has a powerful weapon in its hands, while in the union which controls the labor it meets a "foeman worthy of its steel." But of the two, the men suffer the most. The company may lose the interest in its money and lose a part of that money in the decrease in value of the mine; between the men and the gaunt twin wolves of poverty and starvation there ever stands the daily wage. The struggle may be kept up a month, three months, even a year; but a time comes when they can no longer hold out. Then, broken down by their suffering, and dispirited by their failure they are forced to yield. They cannot stand the looks of the wife as she sees them come home day after day, only to tell that the strike is not ended; they cannot face the cries of the little ones for food when there is no food to give them. The storekeepers can give no more credit, the cupboard is empty, even bread cannot be had. They are starved out. All the misery and suffering and pain has been of no avail, the company have held out and the union is broken down. Such a failure means much. It means that the power of the union has proved naught, that they have been leaning on a broken reed. To restore that power will take years of time during which the company, the check of the union having been removed, will manage things as it sees fit. And all this misery has been incurred and this failure has been brought about from what? Simply that the union made its demands such that the Company could not accede to them. While the union has great power, its members should recollect that an unwise use of that power will react upon them. They should be careful to examine into the question of profits before committing themselves; they should see that the question of wages has two sides; and if any man begins to talk about grinding down the laboring man, they should promptly rule his speech out of order.

There are other considerations which affect labor in relation to its efficiency and value which the superintendent is forced to consider. And first among these may be placed that of temperance. In some respects miners are like sailors, their pay comes to them in large sums and at comparatively long intervals, and their labor is very hard. It follows that drinking prevails among them to a greater or less extent. Not only is this bad for the men themselves who spend their money foolishly, but a drinking miner is never a desirable man to have in the mine. His work is rarely good work, and he can not be trusted to take those precautions, or to see them taken, which are the sole safeguard of the property. His judgment cannot be relied upon. It is therefore wise for a superintendent to encourage among the men, both by precept and example, anything which will aid in decreasing drinking. Temperance societies and leagues have done a great deal of good, and when it can be arranged that the men find a direct advantage in joining them, their work is made easier and their influence increased. This may be done by the company in the form of donations of books to the library or by giving picnics or pleasure excursions to the members. I have seen one mine where the company established a "sick fund" in connection with the temperance league, the benefits of which were only to be obtained by a membership in good standing for six months or more; and the result was most excellent. For the young men, amusement in any form outside of the bar rooms, should be encouraged to the utmost. Base ball clubs, reading rooms, debating societies and other forms of recreation all produce good results.

It should also be known that drinking men are not wanted, and that the first discharges will be distributed among them. In fact, every exertion possible should be made to discourage intemperance, if nothing else, on account of the fearful risk which accompanies it. A glass of beer too much may make an engineer run a cage into the "sheeves" and the safety clutches may not work. I remember an instance of this kind that resulted in the death of eleven men. A timber badly placed may bring about a "cave." The risks necessarily taken in mining are too great to permit of their being increased by any habit which can be cured. A superintendent's power is very great, and his influence is still greater. Both are never better exercised than on the side of temperance. It is wise economy for the company to see that money for school-houses is not wanting, and that churches do not remain things to be built, for lack of funds. Few expenditures give larger returns than those made for these purposes. In fact the more steadily the company keep before them the idea that the miners are men and not machines, the better work they will have done and the more valuable will become their property. It pays, and pays well, to see that the men have comfortable quarters although the ownership of the houses by the company, and their lease to the men is not as a rule a wise practice, as it is frequently charged that the company's rents are exorbitant, and an excuse is given for the reputation of that little statement about grinding in connection with the poor man. If one of the men employed, however, wishes to build, it is wise for the company to advance a part of the money necessary, providing always that his character for sobriety and industry will warrant such an advance. It must always be understood, however, that such advance is the direct result of the personal character of the man to whom it is made, and is a recognition of the qualities in him which go to make up the miner who is valuable to the company. It should never be understood that the men have any right to such an advance or loan. It is well, too, for the company to require a man to save up a part of the money necessary, before they consent to advance the remainder. The company should always see that facilities for saving money are given to the men, and if there be no savings bank in the place, should always act in that capacity, paying the regular interest on deposits. This work is troublesome, and takes time, but it pays in the better character of the labor; while it would be wildly absurd for the company to interfere directly in purely personal matters among the men, it is certainly a fact that a good superintendent can do a great deal among them by his influence, if he will take the trouble to exert it, and such influence when exerted for their good is not only increased but gratefully acknowledged. A liberal policy on the part of the company pays better than any investment they can make. When the mine is running smoothly, and the men are contented, the largest out-put is obtained and the work is done in the best way. When there are constant squabbles and fights going on, the work of the mine is badly done. It is as easy for a superintendent to work in one direction as in the other, and upon the direction in which he works will depend in a great degree, the final result of the operation of the mine, the dividends paid to the stockholders.

It will be gathered easily from what I have written, that it is my opinion that liberal treatment of the men combined with a proper system in the management of the mine will produce the best results for the owners. This, as a general proposition, will not probably be disputed by any one. But I have written to little purpose, if I have not shown my belief in the contract system, and my utter lack of belief in that of wages. I regard the contract system as being the wisest because its benefits are equally felt by the employer and the employed; and as being the best because under it the difficulties between labor and capital are adjusted as fast as they arise. Strikes, where it is in operation, are rarely made because there is rarely felt to be any need for them. The miner by his acceptance of the contract regulates at what price he will work once every month. The company by the price placed upon the work, states once a month what they can afford to pay. A difference in the values is not allowed to remain in existence constantly rolling up like a snow-ball until its very size compels attention; it is settled at once, and when it is small. In the contract system the ounce of prevention is always being applied, and the necessity for the pound of cure is never felt. It brings about a state of things in which the mine goes along smoothly and easily, with no friction and no trouble. The men are contented, and the superintendent is satisfied. More work is done, so more money is paid; the company has a larger output for sale and the men get more wages. Better work is done and the mine is left in better condition for the future. I believe that in the contract system one-half if not three-quarters of the problems of labor find their solution, and I believe that the wages system would create those problems in a mine in which the superintendent was an archangel and the men taken from the Hosts of Heaven.

—*Alfred Balch.*



PART X.

METALLURGY AND METALLURGICAL PROCESS—THE LATEST DISCOVERIES—THE INDUSTRIAL APPLICATION OF METALS—MINING TOOLS—METALLURGICAL MEMORANDA.

PROCESSES of metallurgy have proved the salvation of many American Mining Districts. Many of the gold fields of Georgia, the gold gravels of North Carolina, the gold fields of Nova Scotia are to-day worked at a profit where ten, twenty, thirty years ago they would have bankrupted their owners and left them unhappy victims of glittering imagination. Nowhere in the world have the processes for operating mines been more quickly adapted to the wants of the work, and new and wonderful ways contrived to overcome new and wonderful difficulties. Every year brings cumulative evidences of our progress in this direction, and the great spirit of private initiative that animates our mining men is producing the most valuable and praiseworthy results; In PART X., of the MINES, MINERS, AND MINING INTERESTS OF THE UNITED STATES some metallurgical processes are set forth that will be found of interest, together with a careful gleaning of the field of recent metallurgical discovery and experiment. The chief industrial applications of metals, their properties, and some papers that were procured too late to find a place in the PART properly belonging to them, make up the contents of PART X.

IRON.

WITH respect to its useful properties, iron occupies the first place among the metals. By far the strongest, and, at the same time, one of the lightest, its applications in the arts of construction are much more numerous than those of any other metal. Being capable of assuming, according to the treatment which it undergoes, the forms of wrought iron, cast iron, and steel, it is susceptible of the widest variations in its characters. Extracted from its ores in the form of cast iron, it is melted with comparative facility, and, according to the mode of operating in the foundry, may be made to yield castings which are easily filed and turned, or may be rendered so hard that no tool is able to touch it. By judicious treatment with heat and atmospheric air the cast iron is converted into steel, the strongest, and one of the hardest and most elastic of all materials, as well as the only one of which a magnetic needle can be made. Continued a little further, the joint action of heat and atmospheric air converts the steel into wrought iron, possessing great strength and toughness, yet soft enough to be turned, bored, and punched with ease, and, especially when heated, to be rolled and twisted into the most varied forms without cracking. With less disposition to melt under the action of heat than any other common metal, wrought iron is sufficiently softened at a bright red heat to be *welded*, or joined to another piece, in the most perfect manner, without the use of solder of any kind. Being capable of acquiring and of losing the properties of a magnet with great rapidity, soft iron (wrought iron) is the only material which is adapted for the construction of electro-magnetic and magneto-electric apparatus. It is not too much to assert that scarcely a step of importance has ever been made in the industrial progress of any community to which some one of the three modifications of iron has not been indispensable. Possessed of so many valuable qualities, iron is still the cheapest of all the metals, since the ores from which it is extracted are scattered in profusion through the crust of the earth, and can be made to yield the metal in abundance by a moderate expenditure of time, labor, and fuel.

The difficulty of separating the iron from the other substances with which it is associated in the ore, is of course greater in proportion as these foreign matters are more numerous; thus, when the iron is combined with oxygen only, as in the magnetic iron ore, red hæmatite, and specular iron ore, the metal may be extracted at once in the form of malleable iron, by merely heating the ore in contact with carbon (charcoal), which combines with the oxygen; and this, which is the primitive process for obtaining wrought iron, is still followed in places where the above ores can be readily obtained, and wood is abundant for conversion into charcoal. Even brown hæmatite and spathic ore can be treated in a similar manner if the water and the carbonic acid which they respectively contain be previously expelled by calcination. But in the clay iron-stones and in blackband, the earthy matter (clay, &c.) which is present renders such a process impracticable, and it is necessary to raise such ores to a much higher temperature, in contact with lime, to liquefy the clay so that it may be separated from the iron; when the high temperature causes the iron to combine with the carbon of the fuel, forming cast iron, from which the carbon is removed by a subsequent process, in order to obtain wrought iron.

Extraction of Iron from its Ores in the Form of Cast Iron.—The ore to be smelted is broken up into lumps about twice the size of a fist, and in some cases it is found advantageous to prepare it for smelting by a preliminary process of *calcining* or *roasting*. For this purpose the ore is mixed with small coal, and built up on a foundation of lumps of coal, into huge pyramidal heaps or *clamps*, which are kindled at the windward end, and allowed to smoulder for months, being prolonged, as may be requisite, by fresh additions of ore and fuel at the opposite extremity. The ore may be calcined with an addition of only one-twentieth of its weight of coal, if it contain, as is the case with blackband, a large proportion of bituminous or combustible matter, whilst a clay ironstone may require as much as one-fifth of its weight of coal. This calcination in heaps is a very uncertain process, on account of the irregular distribution of the heat; some parts of the ore being scarcely affected, while others are over-heated and melted so that they can be smelted only with difficulty. This plan is only adopted in districts where fuel is very cheap. During the process of calcination the ore loses about one-fourth in weight, in consequence of the expulsion of water and carbonic acid, and the combustion of the bituminous matter. A portion of the sulphur from the pyrites contained in the ore is also burnt off during the roasting process, entering into combination with oxygen from the air, to form sulphurous acid gas. Many ores are rendered much more porous by this process, and are then more readily smelted. The expulsion of water and carbonic acid would, of course, be effected by the heat of the smelting furnace if this preliminary roasting were omitted: but the sulphur would not be removed to the same extent, and, since this is one of the most damaging impurities in iron, the roasting is a necessary preparation for ores containing much pyrites, and is always practiced in Scotland. During the calcination of the ore, the oxygen of the air combines with the protoxide of iron (ferrous oxide) which is contained in it, converting it into the sesquioxide (ferric oxide), which is less liable to enter into combination with the silica present in the ore, and thus to cause a loss of iron in the slag during the subsequent smelting process. In South Wales the ore is roasted in furnaces, or *running-kilns*, resembling lime-kilns, into which it is thrown at the top, alternately with layers of small coal, the roasted ore being raked out at the bottom of the furnace. Calcination has been much less practiced since the introduction of the hot blast.

Process of smelting[1] *Iron Ores.*—Since this operation re-

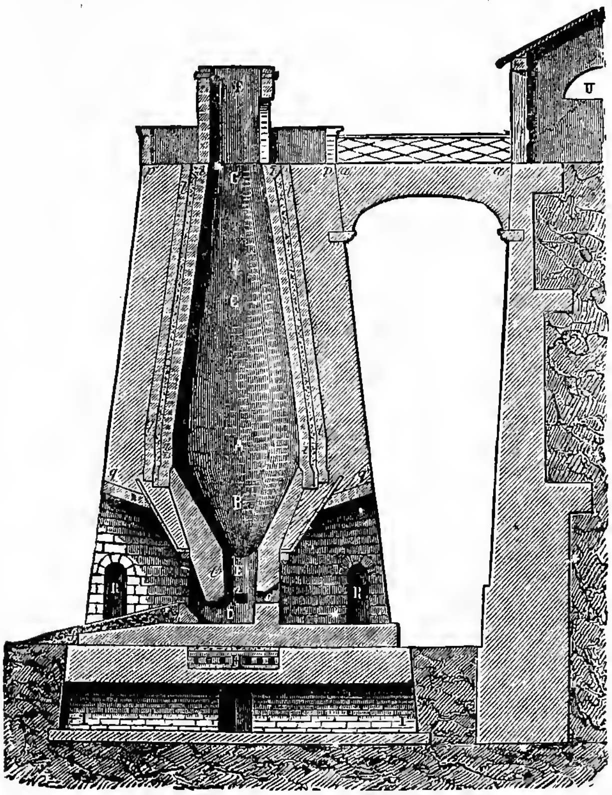


Fig. 1.—Blast-furnace for Smelting Iron Ores.

quires a very high temperature, it is carried out in a *blast furnace*, which does not depend upon the draught of a chimney, but has a strong blast of air forced into it from beneath.

[1] From the German *Schmelzen*, to melt.

This blast varies much in form and dimensions according to circumstances, which will be better understood when the smelting process has been described. Fig. 1. shows a common form, and exhibits the essential features of its construction. The chimney, *tunnel-head* F, has three openings at the side, closed by iron doors, through which the ore and fuel are introduced into the furnace, when they fall through the *throat* or *tunnel-hole*, G, into the *body* C, which is generally of a barrel-shaped form, widening as it descends, and thus allowing a free descent of the materials until they reach the *boshes* A, after which the furnace contracts rapidly, as at B, in order somewhat to check the descent of the solid materials, and attain its smallest diameter at the top of the *hearth* E, which is at its upper part a nearly cylindrical passage, but is made almost rectangular at the lower part, into which,

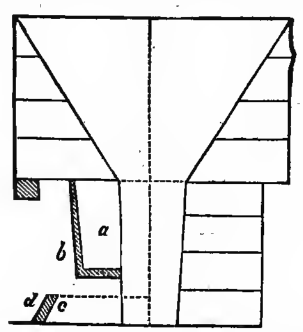


Fig. 2.—Boshes, Hearth, and Crucible of Blast Furnaces.

through apertures *o o* in the walls, a blast of air is forced. The blast-pipes, or *tuyerès*, are usually three in number, and are situated on three sides of the hearth. The fourth side is constructed differently from these three, its upper part being formed by a heavy block of stone *a* (Fig. 2), called the *tymp-stone*, which is supported by a cast-iron *tymp-plate b*, built into the masonry of the furnace, whilst the lower part is enclosed by the *dam-stone c*, faced externally with a thick cast-iron *dam-plate d*. That portion of the hearth which is shut in by the dam-stone is called the *crucible*, for it is here that the cast-iron produced in the furnace accumulates in a melted state, covered with a layer of melted earthy matter or *slag*.[1] The space between the tymp and dam-stones is rammed up with good binding sand, in which an opening is made, just above the dam stone, through which the slag is allowed to flow out of the furnace. The melted cast-iron is never permitted to rise to the level of this opening, but is run out once or twice in twenty-four hours through a *tap-hole* at the bottom of the crucible, which is rammed up again with binding sand.

The dimensions of blast-furnaces vary much according to the conditions of their working, but some idea of them may be acquired from the following:—

Height of blast-furnace, from 45 ft. to 100 ft.
Height of boshes from commencement of hearth, about 15 ft.
Greatest diameter at the boshes, from 13 ft. to 18 ft,
Diameter of chimney at charging-platform, about 10 ft.
Diameter of hearth, 3 ft. to 9 ft.
Depth of crucible, from 8 to 10 inches.
Total depth of hearth, 6 ft. to 8 ft.
Depth from tuyère holes to bottom of hearth, from 12 to 36 inches.

When the coal and ore are soft, and easily crushed, they are liable to obstruct the passage of the blast if there be too much pressure from the column of material above, so that the furnace must not be so high as when harder materials are employed. But in such a case, the diameter of the hearth and body of the furnace may be increased, whereas when hard ores and anthracite coal are employed, the diameter must be reduced, sometimes to one-half, and the height increased. The compression caused by the weight of materials in the furnace sometimes amounts to one-fourth of the bulk of the charge, so that 7,500 cubic feet of materials measured in the charging barrows may be thrown into a furnace of

[1] From the German *schlacke*, dross.

6,000 cubic feet in capacity. The tuyères,[1] or *twyers*, through which the blast of air is forced into the furnace, are formed of conical tubes of cast iron (*a b d c*, Fig. 3), having double walls between which water is introduced through the pipes *t t'*, and made to circulate as shown by the arrows, in order to keep them from being melted. They are between 2 and 3 inches wide at the opening into the furnace, and are built into the walls, as shown in Fig. 4, which represents a section of the hearth at the level of the tuyères. The openings are inclined somewhat in different directions, so that the blasts coming from them shall not exactly meet each other. The air is forced into the tuyère through a movable nozzle (B, Fig. 3) of copper or sheet-iron, connected by a leathern hose (A) with the pipe coming from the blowing machine, with a large forcing

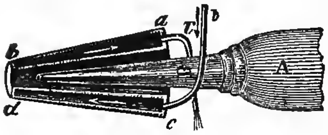


FIG. 3.—Tuyère of blast furnaces.

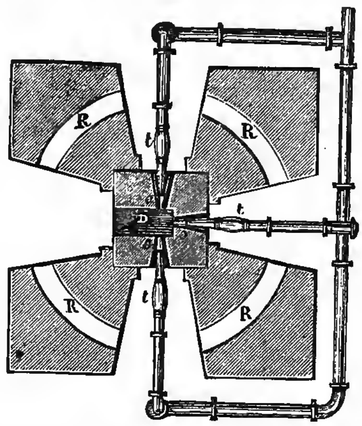


FIG. 4.—Arrangement of Tuyères in Blast-furnace. *t*, Pipes conveying the blast. *o*, Openings in the sides of the hearth D. R. Arched passages for the labourers.

pump worked by steam power, and capable of supplying air, at the rate of from 4,000, to 10,000 cubic feet per minute, to each furnace. The pressure of the blast as it issues into the furnace usually amounts to 2½ lbs. or 3 lbs. upon the inch, but it is sometimes increased to 5 lbs. In charcoal furnaces, the fuel being very porous, a pressure of 1 lb. upon the inch is sufficient; in furnaces fed with coke, about 3 lbs. upon the inch; but where anthracite is employed, the blast has a pressure of 4 lbs. When a blast of high pressure is employed, it becomes necessary to stop up the space between the tuyère and the nozzle of the pipe conveying the blast. The elbow pipe, which connects the blast-pipe with the air main (Fig. 4), has usually a small peep-hole closed with glass or mica, so that the temperature of the hearth, as indicated by the color of its glow, may be observed by looking through the tuyère.

In some modern furnaces the number of tuyères has been much increased. *Rachette's blast-furnace*, which is used in the iron-works of the Ural for smelting magnetic ore, and yields 30 tons of iron in 24 hours, is a furnace of a narrow oblong section, with eight tuyères on each side. It widens as it ascends, unlike the older blast furnace, so that the width is greatest at the mouth, which causes the charge to sink more uniformly in horizontal layers. When the air is blown into the furnace at the ordinary temperature of the atmosphere, it is spoken of as a *cold-blast* furnace, whilst a *hot-blast* furnace is one in which the air is heated to 500° or 600° F. (about the melting point of lead), by being forced through a considerable length of red-hot iron pipes, before it enters the furnace. At first sight it would appear to be immaterial whether the blast of air be heated before or after it is forced into the fire, since, in either case, the same quantity of heat must be lost in raising the air to the temperature of the fire itself, whether a part of this heat be produced by fuel burnt in order to warm the iron pipes, or the whole of it be produced by fuel consumed in the furnace. In the stoves for heating the blast, however, the carbon of the fuel is converted into carbonic *acid*, whilst in the blast-furnace it is converted into carbonic *oxide*, combining, in the latter case, with only half as much oxygen as in the former, and producing less than one-third as much heat, so that 2 cwt. of coal burnt in the stove will go as far above 7 cwt. burnt in the furnace. Moreover, when cold air is blown into the furnace, it must pass through a much larger quantity of the heated fuel before it is raised to the temperature of the fire than would be the case if it had been heated before entering, so that the hot blast has less cooling effect upon the fire, and a much higher temperature may be produced by the same consumption of fuel, or a fire sufficiently hot for smelting the iron ore may be raised with a smaller consumption of fuel than when a cold blast is employed. The economy of fuel is still greater when the blast is heated without any extra expenditure of fuel, by employing the waste heat derived from the furnace itself. An improved method of heating the blast consists in employing two chambers of fire-brick, in which fire-bricks are loosely stacked. Into each of these chambers, alternately, the flame of a coal fire is passed until the bricks are heated to redness; the fire is then diverted into the other chamber, whilst the blast is sent over the hot bricks, when it becomes heated to 1,300° F. before entering the blast-furnace. By the time this chamber has been cooled, the other is heated and ready to do duty again. These *regenerative stoves*, as they are called, have been employed, with great advantage, in other cases.

In the construction of the blast-furnace, very infusible materials are necessary, especially in the crucible and hearth, where the highest temperature prevails. For these portions of the furnace, millstone grit or Newcastle sandstone is sometimes employed (though fire-brick has been lately used), but the upper part or body of the furnace, which is not exposed to so high a temperature, is lined either with fire-brick, or sometimes with blocks of *slag* from the furnace itself, which undergoes an alteration in structure, rendering it less fusible, when exposed to the heat of this portion of the fire. The fire-brick lining (*i l*, Fig. 1) of the furnace is double, a space of about three inches being left between the two portions, and rammed up with powdered coke or sand, which yields to the expansion of the brick-work, and hinders the conduction of the heat to the external part of the structure. Much attention is given to the slope of the boshes, for if this be too steep, the materials will fall too quickly, and if it be not steep enough, they will stick to the sides, and form obstructions or *scaffolds*, preventing the descent of the materials above. Three or more blast-furnaces are generally built in a row, and vaulted passages are left around the hearth to allow easy access to the tuyères and the crucible. When the masonry of the blast-furnace is slight, it is strengthened by iron hoops and bars (*cupola* furnace), or it is sometimes cased externally with boiler plates riveted together.

The *fuel* of blast-furnaces in England is almost exclusively coal or coke, for charcoal is far too expensive for general use, though its freedom from sulphur enables a better quality of iron to be manufactured with it. In Austria, charcoal from wood or peat is the only fuel employed and iron of the finest quality is the result. The Swedish iron works also use charcoal only. In hot-blast furnaces, coal may be employed without having been coked, because the higher temperature which prevails in the furnace allows it to become converted into coke in the upper part of the fire; but for cold-blast furnaces, coke is the ordinary fuel, a hard-burnt, dense quality being preferred. For lighting or *putting the furnace in blast*, much time is required, since there would be great danger of cracking the lining by a sudden application of a very high temperature. Before the dam-stone is fixed in its place, fagots are kindled in the opening below the tymp-stone, so that the flame and heated air may be drawn up into the furnace and gradually warm it. After a few days, a quantity of coal or coke is thrown at the throat of the furnace, and gradually increased until the furnace is filled; the blast is then gradually turned on, and when the fuel has sunk down sufficiently, the smelting operation is commenced. The drying and warming of the furnace occupy a month or more, according to its size.

For the convenience of charging the furnace with fuel

[1] From the French *tuyau*, a pipe.

and ore, a gallery runs round it at the level of the tunnel-hole, to which the materials are brought in iron wagons or barrows, either up an inclined plane, or along a railway carried from the slope over against the furnace. From three to six cwt. of iron ore, according to its richness, is thrown on the top of the burning fuel, together with about one-third its weight of limestone or quicklime, which is employed as a *flux*,[1] to bring the clay of the ore to a liquid state in the fire, in order that it may be separated from the iron. Upon this a charge of fuel is thrown consisting of about four to six cwt. The descent of the charge in the furnace is very gradual, from forty to fifty hours being usually occupied in its passage from the top to the bottom. After an interval of half an hour or so, fresh charges of ore, flux, and fuel are introduced, and the furnace is thus fed, night and day in many places, for six or seven years, before it is found necessary to *blow it out* in order that its lining may be repaired. The melted cast iron which is produced runs down into the crucible, together with the liquid slag, formed by the action of the lime in the flux upon the clay in the ore. The cast iron, being the heavier of the two, accumulates at the bottom, and above it five or six times its bulk of liquid slag, which flows over a notch in the dam plate, and is generally received in iron moulds and cast into large blocks of fifteen to twenty cwt. each. At intervals, of twelve hours, generally, the furnace is *tapped* by opening the tap-hole with an iron rod, and a *cast* is made, that is, the liquid cast iron is run out and cast into *pigs*, or rough half-round bars, either in thick iron moulds, or in trenches excavated in strongly binding sand, and communicating with a central channel into which the cast iron flows from the furnace. The pigs of iron are about three feet long and four inches in diameter, and weigh two and a half cwt. About five or six tons are usually run out at each tapping.

The *foundry iron* intended for the manufacture of castings is generally run into sand moulds; but *forge iron*, which is to be afterwards converted into wrought iron, is cast in iron moulds, partly to avoid contamination with the sand, and partly to render the metal brittle, so that it may be easily broken up for the puddling process which it next undergoes. The blast is suspended during the operation of tapping, and turned on again at the end, in order to force all the iron and slag out of the hearth.

Steel.—The difference between steel and wrought iron (or soft iron, as it is sometimes called) is chiefly seen in their behaviour when raised to a high temperature and suddenly cooled by being plunged into water; when wrought iron undergoes little if any change; while steel is rendered almost as hard as diamond, and so brittle that it snaps off if an attempt be made to bend it. If this very hard brittle steel be again heated to a temperature far short of redness, and cooled, it becomes much softer than before and extremely elastic, so that when forcibly bent it springs back into its former position, whereas wrought iron would retain a permanent bend. It will be remembered that cast iron is also greatly hardened by being suddenly cooled, but it cannot be rendered elastic like steel. The property of being hardened by chilling is dependent upon the presence of carbon in the metal, for chemically pure iron does not exhibit it, though all specimens of commercial wrought iron are slightly hardened when so treated, because they contain a small proportion of carbon. It is, therefore, difficult to define the exact limit beyond which wrought iron passes into steel. Bar iron, containing as much as two parts of carbon in a thousand of metal, would be so decidedly hardened by chilling as to be termed a *steely iron*, and a slight increase in the quantity would produce a *mild steel*, such as the *homogeneous metal* of which cannon and armor-plates are forged. A proportion of carbon, amounting to three parts in the thousand, is contained in the Bessemer steel rails, and in the steel of which spades and hammers are commonly made. Twice this proportion of carbon, or six parts in a thousand, is contained in steel ramrods; and the steel employed for tools commonly contains ten or twelve parts of carbon in a thousand. When the carbon amounts to fourteen parts in a thousand, the steel becomes more fusible and resembles white cast iron.

Bar iron, which contains only a minute proportion of carbon, has a tensile strength of about 57,500 lbs. (nearly 26 tons) per square inch[1]; but when the proportion of carbon amounts to three or five parts in a thousand, its tensile strength is increased to 90,000 or 100,000 lbs. (40 tons or 45 tons) per square inch, while it is still soft enough to be easily punched and flanged. Such a metal is well suited for boiler-plates and similar purposes. For armor-plates designed to protect ships, by offering resistance to blows from shot at high velocities, it appears to be desirable that the proportion of carbon should not exceed two parts in a thousand, for, although an increased proportion of this element is attended with increased resistance to tension (or to a force tending to pull the particles of the metal asunder), as well as to penetration by dead pressure, it renders an armor-plate more liable to fracture under the sudden and powerful blow of a shot.

In addition to hardness and increased tensile strength, the presence of carbon confers another valuable property upon the iron, namely, the capability of retaining magnetism. When a bar of soft iron is placed in contact with a magnet, or in the axis of a coil of wire through which a galvanic current is transmitted, the iron bar acquires all the properties of a magnet, becoming capable of attracting iron filings, and, if freely suspended, of pointing, like a compass needle, north and south. It loses these magnetic properties as soon as the permanent magnet is removed, or the galvanic current is discontinued in the surrounding wire. A bar of steel, however, would retain its magnetic properties. Just as all specimens of commercial bar iron are slightly hardened by chilling, in consequence of their containing a minute quantity of carbon, so they are all slightly retentive of magnetism in proportion to the quantity of carbon present. In the manufacture of electro-magnetic instruments of various kinds, the action of which depends upon the sudden loss of magnetic power by a bar of iron when the galvanic current is interrupted, it becomes of great importance to select the softest commercial iron, so that it may lose its magnetic power as quickly as possible. On the other hand, the hardest steel is selected for the production of permanent magnets, and it has been noticed that the addition of the metal tungsten to steel increases its power of retaining magnetism.

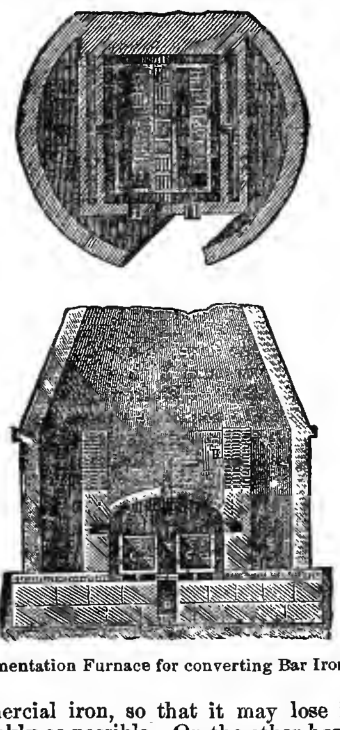


Fig. 5.—Cementation Furnace for converting Bar Iron into Steel.

Steel rings when struck, much more than iron, and this property is relied upon by the steel-maker as one of the tests of its quality.

[1] From the Latin *fluo*, to flow.

[1] The British Board of Trade gives 5 tons per square inch as the *working strain* to which it is safe to expose bar iron in actual practice.

Conversion of Bar Iron into Steel by Cementation.—The process of *cementation* by which until lately nearly all English steel was produced, consists in heating bar iron in contact with charcoal, in a closed chest, until it has acquired a proper proportion of carbon.

The cementation furnace (Fig. 5) is dome-shaped, like the furnace of a glass-house, and is enclosed in a conical jacket of brick work which serves to carry off the smoke from the flues. The hearth of the furnace is divided into two parts by the grate G, traversing the whole length (13 or 14 feet) of the furnace, in which a coal fire is maintained, the flame of which is made to circulate above, below, and around the fire-clay chests or *pots*, or *troughs* C placed one on each side of the grate, before escaping through the flues in the wall H and through the opening M. These troughs are 10 or 12 feet long. and about 3 feet in depth and width, so that each will contain seven or eight tons of bar iron, together with the charcoal necessary for its conversion into steel. A small opening is left at about the middle of one end of each chest, through which the end of one of the bars undergoing cementation is allowed to project; this *proof-bar* is withdrawn from time to time, through a small door in the wall of the furnace, for the purpose of watching the progress of the cementation. There is also a small door in the wall of the furnace, a little above the top of each trough. through which the bars of iron may be introduced and withdrawn, a larger door being made in the middle of the wall to allow the passage of the workmen. The nature of the *cement* or carbonaceous material employed varies in different works, but the bulk of it nearly always consists of ground charcoal from hard wood, with which there are sometimes mixed a little common salt and some ashes of the charcoal. The salt and the alkaline matters contained in the ashes are believed by some persons to have a beneficial effect in converting into a glass the silica which is contained in the charcoal, and thus preventing it from imparting silicon to the steel. The bars of iron should be of the purest description if the best steel is to be produced. They are about three inches broad, and one-third of an inch thick.

In order to fill the troughs, the workman stands upon an iron platform between the two, and sifts the cement powder into them, so as to form a layer of about half an inch in depth, upon which the bars are arranged, standing upon their edges, at about an inch apart. More cement powder is now sifted over these, so as to fill up the intervals between them, and to cover them entirely to the depth of about an inch. Upon this a second layer of bars is placed, then more of the charcoal powder, and so on until the trough is filled to within a few inches; it is then covered in with four or five inches of fire-clay or some similar material, well rammed down, and the fire is gradually applied during the first two or three days, to avoid the risk of splitting the troughs. A temperature high enough to melt copper (estimated at about 2,000° of Fahrenheit's scale) is required to enable the bar iron to acquire a proper proportion of carbon, and the troughs are maintained at this temperature for a period proportionate to the hardness which the steel is required to possess; four days being sufficient for producing the steel of which saws and springs are made, while six or eight days are required for shear steel, and ten days or more are required for the very hard steel of which cold chisels are made. The fire is then gradually let down, to avoid sudden change of temperature, so that some days elapse before the troughs are cool enough to be opened. About three weeks are commonly occupied in the conversion of the bar iron into steel—one to get up the heat, one to keep it at the required degree, and one to cool it down; so that only about sixteen cementations can be executed in a year by a single furnace. The bars are found to have upon their surface bubbles or blisters of considerable size, whence they are called *blister steel*. On breaking the bars, the fracture exhibits a silvery lustre and a well-marked crystalline structure. The proportion of carbon which has entered into combination with the iron depends upon the duration of the cementing process, but it rarely exceeds fourteen parts in a thousand parts of the metal. The chemical changes which are involved in the process of cementation are not yet thoroughly understood. The passage of the infusible solid carbon into the interior of the solid iron bar obviously requires explanation. It might be imagined that the external particles of iron which are in contact with the charcoal, becoming surcharged with carbon, impart a portion of that element to the next layer, and so on, until the particles in the very centre of the bar had acquired a proper share of carbon; but such an explanation would require that the outside of the bar, at the close of the process, should be very much richer in carbon than the inside, and we have no evidence that this is the case.

The following explanation appears more probable. The small quantity of oxygen contained in the air remaining in the trough, and present in the pores of the charcoal, enters into combination with the carbon to form carbonic oxide gas ; this gas, in contact with iron at a high temperature, gives up one-half of its carbon to the metal, and becomes converted into carbonic acid gas; but this carbonic acid, in contact with the strongly-heated carbon, is reconverted into carbonic oxide, which again transfers one-half of its carbon to the metal, these changes recurring many times in the same order until the whole of the iron is converted into steel. The observations of chemists during the last few years have shown that red-hot iron allows the passage of gas through its substance, and that this metal has the power of absorbing a considerable quantity of carbonic oxide, which renders it easy to account for the transference of carbon from the charcoal into the interior of the bar. Other gases containing carbon are capable of imparting that element to iron; thus, if coal gas, which contains carbon in combination with hydrogen, be passed for an hour through an iron tube containing some soft iron wires heated to bright redness, the wires will absorb carbon from the gas and become converted into steel. The blisters, which are distributed sparsely and irregularly over the surface of the bars, are commonly believed to be due to the action of particles of oxide of iron, or of slag, accidentally occurring in the iron bars, upon the carbon combined with the iron, giving rise to carbonic-oxide gas, which escapes as a bubble through the softening iron. As might be anticipated, the blistered steel, in its present condition, is only fitted for very rough articles, such as shovels; its largely crystalline structure renders it deficient in tenacity, and the bars are further weakened by their want of uniformity and by the presence of the blisters.

Conversion of Blister Steel into Cast Steel.—The blister steel is broken up into pieces of a convenient size for packing close together, and about 30 lbs. of it are introduced into a tall narrow crucible (Fig. 6), about two feet high, made of fire-clay mixed with black-lead, and provided with a closely-fitting cover. Some steel-makers add a little bottle-

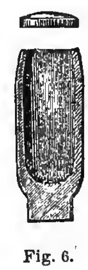


Fig. 6.

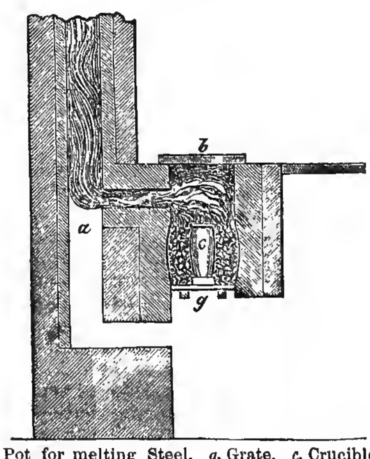


Fig 7.—Furnace and Pot for melting Steel. *g*, Grate. *c*, Crucible. *b*, Cover of Furnace. *a*, Chimney.

glass to fuse over the surface and prevent oxidation of the steel. The crucibles are placed in a small furnace (Fig. 7) holding six, twelve, or more, about one foot wide and two feet deep, the opening of which is usually on a level with the floor, to facilitate the lifting of the crucibles. Several of these furnaces are connected by flues with the high chimney of the works, so that a powerful draught may be produced. Hard coke broken into small pieces is employed to raise the crucible to a bright red heat; the steel is then introduced, the crucible covered, and the furnace filled up with coke; when the steel is melted, the crucible is lifted out with a pair of tongs, and its contents poured into a rectangular or octagonal mould of cast iron which has been previously heated and is placed vertically for the steel to be poured in. The mould is made in two halves, closely fitting together, so that it may be opened for the removal of the bar of cast steel, and is coated inside with coal-tar soot. The quality of the cast steel produced is in some measure dependent upon the temperature at which it is poured, so that an experienced workman is employed for the purpose. For the production of large castings of steel in this way, the requisite number of crucibles must be emptied into the mould as nearly as possible at the same time. At the factory of Krupp at Essen, near Cologne, a casting of 16 tons may be produced in this way, 400 men being well drilled to co-operate in emptying 1,200 crucibles, so that the melted steel may flow in an uninterrupted stream along the gutters leading to the mould. Great alterations and improvements in the manufacture of cast steel will probably result from the introduction of the regenerative gas-furnace of Siemens, in which steel may be easily melted in large quantities. Cast steel is much more uniform in structure than tilted steel, and has a very compact granular texture, without lustre, indicating high tenacity, as may be seen on inspecting its fracture; though here, as in the case of bar iron, it must be borne in mind, that when fracture takes place slowly, it will present a more or less distinctly fibrous appearance; the granular structure becoming evident only on sudden fracture. The higher the quality of the steel, the finer is the granular structure exhibited by sudden breaking. The lower qualities somewhat resemble bar iron in fracture. When produced by the process just described, cast steel has the serious defect of being brittle at a high temperature, so that it is forged with difficulty, and does not admit of being welded. But a method of correcting this was patented by Heath, in 1839, which consists simply in adding to the cast steel, in the melting-pot, about one-hundredth of its weight of *carburet of manganese*, the result of the action of heat upon a mixture of black oxide of manganese (ore of manganese) and charcoal, or some other substance containing carbon, such as coal tar. After this addition, the cast steel possesses much more tenacity at a high temperature, and can be welded either to itself or to wrought iron, so that it may be employed for the fabrication of many implements which were formerly obliged to be made of shear steel. Thus, the blades of table knives can be made of cast steel welded on to an iron *tang*, as that part of the knife is called which is fixed into the handle. Another important consequence of the introduction of Heath's process has been a reduction of about one-third in the price of cast steel, by enabling it to be produced from an inferior quality of bar iron, instead of the very expensive descriptions which it was necessary to employ previously to this discovery.

The mode in which this addition of manganese acts to produce so great an improvement in the quality of the cast steel is by no means understood. It does not appear to depend upon the formation of an alloy of manganese with the steel, for the bulk of that metal is found in the slag from the melting-pots, only a minute proportion entering into the composition of the steel; but that even this small quantity affects the quality of the metal, appears to have been proved by the observation that the manganiferous steel, if melted a second time, becomes as red-short as if no manganese had been added, probably because the small proportion of that metal is removed by the oxygen of the air when re-melting. It is commonly believed that manganese has a particular tendency to encourage the removal of sulphur, phosphorus, and silicon in the slag both from steel and iron, though its precise mode of action has not been defined. For the manufacture of some tools requiring rough usage, such as the chisels of planes, it is customary to employ a bar of iron faced with steel, the cutting edge being, of course, made upon the steel side, which receives great support from the wrought iron. To produce such a compound bar, a bar of iron is polished upon that surface which is to be faced with steel, heated to redness, sprinkled with borax to cleanse the oxide from its surface, and placed in the ingot mould destined to receive the cast steel, which then adheres firmly to the polished iron, so that the two may be forged together.

Production of Bessemer Steel.—It has been already stated that Bessemer's process for converting cast iron into malleable iron depends upon the removal of the carbon by forcing air through the liquid metal, and if this process be arrested before the removal of the carbon is completed, the metal will have the composition of steel. Another process by which this kind of steel is produced consists in depriving the cast iron of nearly the whole of its carbon, so as to obtain wrought iron, which is then converted into steel by adding the proper proportion of carbon in the form of *Spiegel-eisen*. The *converter* (Fig. 8) in which this process is carried out is made of wrought iron boiler-plate, and lined with fire-clay or other refractory material to protect it from oxidation. It is sometimes large enough to contain ten tons of cast iron for a charge, and is suspended on trunnions so that it may be easily tilted for charging and discharging. A six-ton converter is 11 feet high, and 5½ feet in its widest diameter.

Through the bottom of this vessel there are several openings to admit the blast of air, which is blown in at a pressure of fifteen or twenty pounds upon the inch through 35 holes, from 7 tuyères with five holes each. (The number of tuyère holes employed varies, in different works, between 35 and 150, their diameter varying from ¼ to ⅝ inch.) The converter having been heated by burning a little fuel within it, is charged with pig iron which has been previously melted in a separate furnace, a pig iron containing a large proportion of graphite and silicon and a small proportion of sulphur and phosphorus being selected. The air, bubbling through the liquid metal, induces an intense combustion of the iron, producing a large quantity of the black or magnetic oxide of iron which is carried up by the force of the blast together with the nitrogen of the air, which does not act upon the iron. The bubbles of this gas being forced up through the melted metal, effectually mix the unoxidized portion with the melted oxide, which converts the carbon of the cast iron into carbonic oxide gas, and the silicon into silicic acid, the latter combining with some oxide of iron to form a slag which appears as a froth at the mouth of the converter.

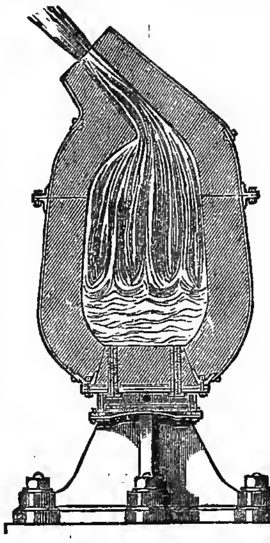


FIG. 8.—Bessemer's Converting Vessel.

The silicon is always oxidized before the carbon, and during the first ten minutes or so, very little flame appears at the mouth of the converter. Since, in this process, a portion of the iron itself is the fuel undergoing combustion, the temperature is much higher than that of the puddling furnace, in which coal is the fuel, for a given quantity of oxygen, in the act of burning iron, produces above one-third more heat than in the act of burning carbon. The temperature produced in the converter is able to effect the complete fusion of the purified iron, which remains liquid throughout the operation instead of separating in a pasty form as in the process of puddling. The manifestation of energy during the conversion is very striking: the roaring of the blast in passing through the molten iron, the long flame of the carbonic oxide, variegated by the combustion of small quantities of metals, the brilliant scintillations from the iron, and the white hot flakes of slag whirled upward by the blast combine to produce a volcanic effect which is not easily forgotten. The operation usually lasts for only twenty minutes, its termination being indicated by the almost total disappearance of the flame of carbonic oxide, but a far more exact method of ascertaining when the requisite amount of carbon has been removed, consists in viewing the flame through an optical instrument known as the *spectroscope*, which enables the observer to detect certain lines in the spectrum or image of the flame, the disappearance of which lines marks, to within a few seconds, the conclusion of the process. If Bessemer iron were acquired, the contents of the converter would now be discharged into a ladle (Fig. 9) and thence into moulds having the form of the required bars, but it has been already explained that the necessity for employing a high-priced pig iron prevents the economical application of this otherwise excellent process to the production of malleable iron in this country.

SPIEGEL-EISEN.

Iron	82.86.
Manganese	10.71
Silicon	1.00
Carbon	4.32
	98.89

The German name *Spiegel-eisen* (mirror-iron) alludes to the brilliant silvery lustre of the metal, the fracture of which

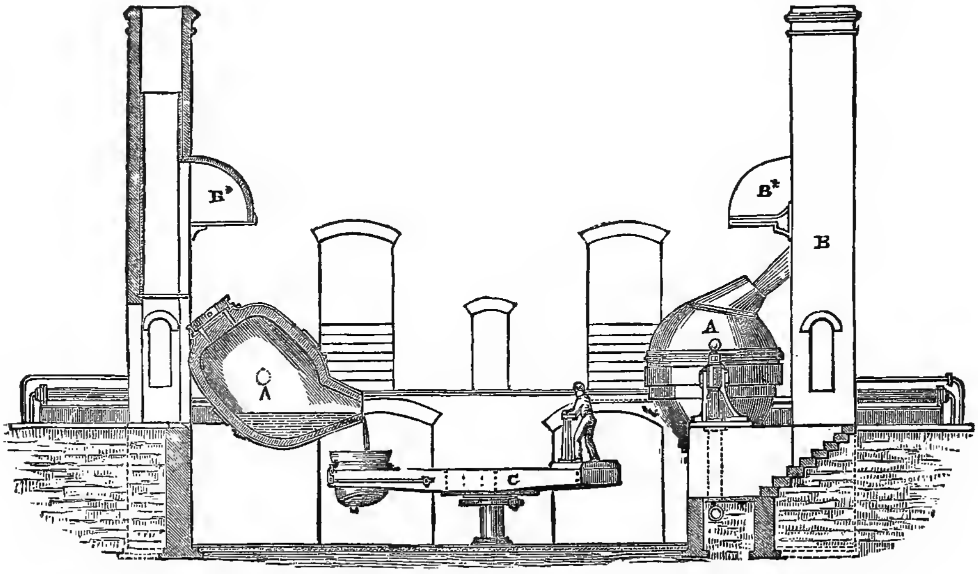


Fig. 9.—Bessemer's process. A, Converting vessel. B*, Hood for carrying the carbonic oxide gas into the chimney B, C, Crane for swinging the ladle under the converter.

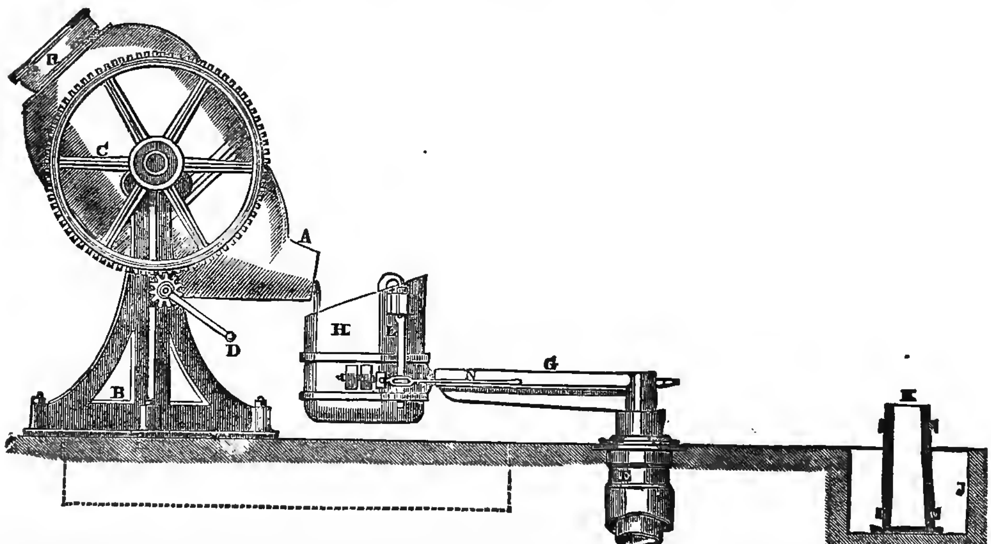


Fig. 10.—Operation of transferring Bessemer Steel from the converter to the ladle. A, The converter. B, Standards supporting the trunnions or axes of the converter. C, Spur-wheel for tipping the converter by means of the pinion moved by the handle D. E, G, Hydraulic crane for swinging the casting-ladle H. J, Casting pit. K, One of the ingot moulds. L, Rod terminating in a conical fire-clay plug, which closes the opening in the bottom of the casting-ladle, and may be raised by the handle N to permit the flow of the metal into the moulds.

In order to convert the decarbonised metal into steel, the requisite proportion of carbon is added in the form of *Spiegeleisen* or *specular iron* (which must not be confused with the specular *ore*). This may be defined as a special variety of white cast iron containing a large quantity of carbon in chemical combination, together with much manganese. It is obtained by smelting, in a blast-furnace with charcoal, a spathic iron ore containing a large proportion of manganese, such as that from the Brendon Hills. The result of the analysis of a sample of this material is here given.

exhibits a foliated crystalline appearance of great beauty. The presence of manganese is probably of importance with regard to the use of Spiegel-eisen as an ingredient of Bessemer steel. It is introduced in a melted state, in the proportion of about 1 part to 30 parts of the pig iron employed, into the converter, which is tilted into a horizontal position to receive it, the blast being interrupted during the addition, and afterwards turned on again, for a few seconds, when the converter has resumed its former position, in order to diffuse the Spiegel-eisen through the liquid iron, after which the steel is transferred to the moulds, being poured, for that purpose, into a large iron ladle lined with loam (H. Fig. 10) which is swung under the converter by a crane (G.), and, after receiving the metal, is swung back over the wrought iron ingot moulds (K), the steel being run out by raising a fire-clay plug in the bottom of the ladle. In making a large casting the ingot mould employed is so massive as to be equal in weight to the metal required to be cast in it, so that it may cool the ingot quickly, and prevent the formation of large crystals in the metal. Another and more recent form of converter suggested by Bessemer, shown in Figs. 11, 12, has a globular form and seven feet in diameter, the air-blast being introduced through a single tuyère passed through the top of the converter, and made of circular fire-bricks (D, Fig. 12) strengthened by a stout iron rod passing down the centre and terminating in a kind of rosette with numerous apertures, through which the air is projected into the liquid iron. When the conversion is finished, the tuyère is lifted out by an ingenious hydraulic crane (E), and the converter tipped by the action of a hydraulic ram, in order to discharge

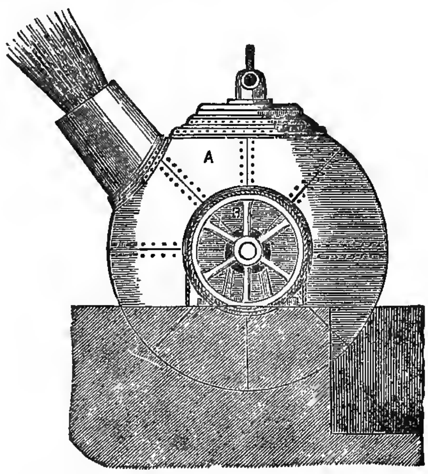


Fig. 11.—Bessemer's Globular Converting Vessel.

its contents into the casting-ladle. It is said that two such converters are capable of producing 200 tons of cast-steel weekly, which would require, by the old process of melting blistered steel, 4,750 crucibles, and 760 melting furnaces.

In order to secure perfect uniformity in the composition and therefore in the quality of the Bessemer steel, the practice has been introduced of actually weighing the casting-ladle, running the fused malleable iron from the converter into it, and then weighing it a second time to ascertain precisely the quantity of metal introduced, the calculated proportion of Spiegel-eisen being then added in a melted state, and mixed with the iron by a mechanical agitator made of iron coated with loam, which is made to rotate rapidly in reverse directions for three or four minutes, before tipping the steel into the ingot-moulds. To obtain a sufficient quantity of Spiegel-eisen of uniform composition, the melted metal is run from the blast-furnace on to a revolving table which divides it into drops and scatters them into a cistern of water, so that they become converted into granules like shot. By mixing well together, say 500 tons of granulated Spiegel-eisen, so as to obtain a perfectly uniform mixture, it is ensured that each charge added to the iron in the converter will contain the same proportion of maganese, silicon and carbon. The granulated metal is not melted, which would cause an alteration in its composition by the oxidizing action of the air, but is merely heated to redness, out of contact with the air, in a kind of crucible, whence it is allowed to drop, through a pipe, into the liquid wrought iron which has been weighed in the casting-ladle. The extensive manufacture of cast-steel rails by the Bessemer process has led to a very perfect organization of the works. The cast iron is run direct from the blast-furnace, into a 12-ton ladle mounted on wheels, and taken to the converting-house, where there are six vessels, each capable of converting 5 tons. The 5 tons of steel are run from the casting-ladle into twenty ingot moulds, so that each ingot weighs 5 cwt. These ingots, when removed from the mould, are reheated in a reverberatory furnace, the hearth of which is fixed on a spindle by which it is made to revolve slowly (once in two minutes) so that the flame of the coal fire may act equally upon all the ingots standing separately, on end, and bring them to the proper temperature for the rolling mill. The railway lines of cast steel are far more durable than those laid with puddled bars. These old wrought-iron rails are capable of being converted into steel, by cutting them up, heating them to redness with a little fuel, in the converter itself, and running the melted cast iron in upon them; when the blast is turned on they soon dissolve, and are converted into steel like the rest of the metal. 100 tons of pig iron, treated by the puddling process, yield 75 tons of railway bars, whilst 85 tons of steel bars are obtained by Bessemer's process. The very large steel

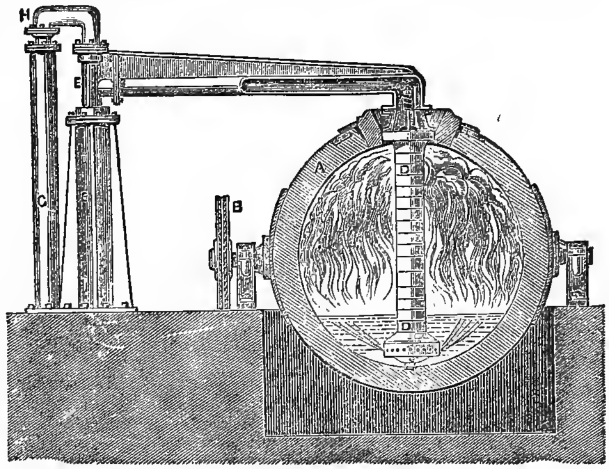


Fig. 12.—Section of Bessemer's globular Converting Vessels. A, The converter. B, Pulley wheel for tipping the converter, connected by a wire rope with a hydraulic ram. C, Pipe conveying the blast. E, Elbow-pipe with telescopic joint.

ingots, sometimes 8 feet long and 3 feet square, and weighing 15 tons, obtainable by this process, cannot be properly forged under the steam-hammer, so that a most ingenious combination of hammer and press worked by hydraulic power has been devised for the purpose. Cast-steel shot, weighing 300 lbs. each, are made by cutting off pieces from a solid cylinder of steel softened by heat, moulding them by pressure between curved surfaces, and rolling them between two iron tables with corresponding grooves of hemispherical section. The lower table is forced with immense pressure against the upper one by the hydraulic ram, and is at the same time slowly turned on its axis. Three balls are made at once in little more than as many minutes.

The effect of hammering or rolling in augmenting the tensile strength of the cast steel obtained by Bessemer's process is much greater than in the case of malleable iron, for the ingots of Bessemer steel which gave a mean tensile strength of 27¼ tons per square inch, had it increased to 68½ tons by hammering or rolling. It is alleged by those who are well acquainted with the art of steel-making, that the presence of a minute proportion of silicon in steel is essential to the production of sound ingots, since when this element is entirely absent, the steel disengages gas as it cools in the mould, and boils up with great violence, an effect which is prevented by the addition of ½ part of silicon to 1,000 parts of steel. The silicon present in the Spiegel-eisen employed in Bessemer's process is therefore regarded as of great importance. A great number of most complete analyses of steel are required to settle this and many other important points in the chemistry of this material, which is daily growing in importance, and with respect to which new theories are continually propounded; at one time *nitrogen* being regarded as an all-important element, at another *titanium*, every theory being apparently supported by a number of chemical analyses and determinations of tensile strength, too often undertaken in the interest of the theory rather than in the unprejudiced search after the truth.

Siemens devised a process for the production of steel by allowing masses of malleable iron, directly they are reduced from the ore, to dissolve in a bath of melted pig iron heated

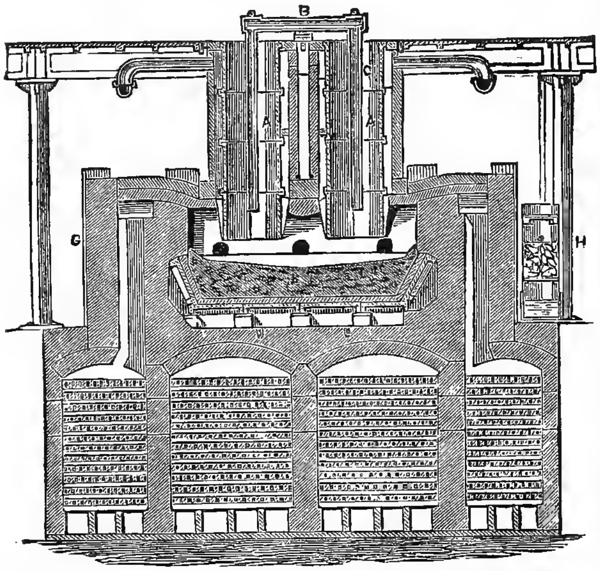


Fig. 13.—Furnace proposed by Siemens, for making cast steel in his Regenerative Furnace. Beneath are shown the chambers containing fire-brick for accumulating the heat of the products of combustion before they pass into the chimney. B. Blast-pipe, from which pipes descend at right angles into the small blast-furnaces A.

in hearth or combustion-chamber of the regenerative gas-furnace. For this purpose, a small blast-furnace (A. Fig. 13) is constructed above the combustion-chamber, so that its lower opening may rest in the cast iron melted in the latter; this blast furnace being fed with hæmatite ore and small coke, produces spongy masses of malleable iron, which do not combine with the carbon to form cast iron as in the ordinary blast-furnace, because the temperature is much lower on account of the limited dimensions of the furnace. These spongy masses of iron are speedily dissolved by the cast iron, and the proportion of iron to carbon becomes raised by degrees to that necessary to constitute steel, which is retained in the liquid state by the very high temperature which the regenerative or accumulative principle of the Siemens' furnace renders easy of attainment.

Puddled steel is an inferior description, employed by boiler-makers and ship-builders, and obtained, as its name implies, by arresting the puddling process when there is still enough carbon (from five to ten parts in a thousand) left to constitute a low steel, when the damper is shut, and the puddled balls treated as in the case of iron. To produce this material small charges, sometimes only 2 cwt., are puddled, and in bringing the iron *to nature*, the flame of the fire is supplied with less air than when fibrous bar iron is being manufactured, so that less of the carbon may be extracted. The presence of manganese in the iron to be puddled is decidedly favorable to the production of puddled steel, perhaps because the slags containing this metal are more thinly liquid, and cover the surface of the iron more effectually, thus hindering the complete removal of the carbon. By refining a white cast iron containing manganese in a forge constructed on the same principleas the English refinery hearth *natural steel* or *German steel* is obtained. The spathic ores containing manganese yield an iron especially adopted for conversion into natural steel, for which reason such ores are sometimes designated "steel ores."

There is as much difference of opinion respecting the effect of the presence of foreign matters upon steel as in the case of bar iron, and for similar reasons, namely, that the quality of steel is so much affected by variations in the mechanical treatment to which it is subjected, that it is difficult to ascertain whether a particular defect in the steel is due to these variations or to the presence of such substances as silicon, sulphur and phosphorus, which are seldom exactly estimated in the analysis of steel by persons whom practical experience has enabled to decide upon the quality of the metal. It is generally allowed that these three elements are injurious to steel, but it is undecided what proportion of each may be present without serious deterioration. There appears to be little question that steel containing five parts of *silicon* in a thousand does not admit of being forged.

Sulphur confers red-shortness upon steel as it does upon bar iron, but the former appears to suffer less injury than the latter from the presence of a given proportion of sulphur. Steel containing more than two parts of sulphur in a thousand is decidedly brittle at a red heat, so that it is useless for forging and can only be employed for castings, for which purpose it is adapted by its increased fluidity when melted. Red-short steel, like iron having the same defect, appears tougher than other qualities of steel, except at an elevated temperature. Manganese is believed to counteract, to a great extent, the red-shortness caused by the presence of sulphur in steel. How much *phosphorus* can be tolerated in steel has been made the subject of much discussion. It is said that steel manufacturers object to bar iron as a material for converting into steel when it contains even one part of phosphorus in a thousand. It is alleged by some that steel made from ores containing titanium is superior in quality, but no conclusive evidence has yet been adduced to show that titanium is really beneficial in its effect upon steel. A ready test for distinguishing between steel and wrought iron consists in placing a drop of diluted nitric acid (*aqua fortis*) upon a clean surface of the metal, when a greenish-grey stain appears upon the iron, whilst the steel exhibits a black spot due to the separation of carbon.

Extract of malleable Iron directly from the ore. —The modern method of smelting iron ores in the blast-furnace, so as to obtain cast iron, which is converted by subsequent process into malleable iron, owes its origin to the necessity created by the great demand for that metal, of extracting it from the poorer ores, such as clay ironstone, which could not be made to yield their iron by a more direct process. In the early history of the metallurgy of iron, there is no mention of cast iron, the intermediate product of the modern iron smelting, the metal being obtained at once in a malleable condition by a process which is still practised, under various modifications, in districts where ores composed of nearly pure oxide or carbonate of iron can be obtained, together with a sufficient supply of the charcoal which is necessary for the operation. The direct process of extracting malleable iron is commonly spoken of as the *Catalan process*, since it has been practised from a very remote period in the Spanish province of Catalonia, where the magnetic iron ore and hæmatite of the Pyrenees are smelted with the charcoal supplied by the surrounding forests. The smelting works comprise a forge, blowing machine, and a hammer, but the first alone will be here described in order to illustrate this method of treating iron ores. The crucible or bath is a nearly rectangular trough (M, Fig. 14) well built around with masonry, about 17 inches deep, 21 inches long, and 18½ inches wide. The bottom of the crucible is composed of a block of granite, which is supported upon small arches to keep it dry.

That side of the hearth at which the blast from the tuyère (T) enters is perpendicular, being built up of massive pieces of iron (*t*), the blast-pipe, or tuyère, of copper, being supported upon the uppermost piece in such a manner that its inclination to the bottom of the crucible can be varied at pleasure, since this appears to exercise much influence upon the success of the operation. The wall opposite to the blast is built up of wedge-shaped pieces of iron (*s*) and presents a curved surface. The working side of the hearth is composed of three thick pieces of iron placed end to end, the side opposite to it being lined with fire-clay, and having a moderate inclination.

To begin the operation of smelting, the hearth is about half filled with burning charcoal, and a shovel is held so as to divide the space above the fuel into two unequal compartments, the larger one, next to the blast-pipe, being filled with charcoal, whilst the other, about half its size, is charged with the ore, previously calcined, broken into small pieces and sifted from the dust; the ore is piled up in a ridge (f) upon the side (g) of the hearth, so that it may be raked into the fire as the charge sinks down. The shovel forming the temporary partition having been withdrawn, the blast is gradually applied so that it may attain its full force after about two hours, the fuel and ore being continually pressed down into the hearth by the laborers. One portion of the oxide of iron is reduced to the metallic state by the carbonic oxide formed from the carbon of the charcoal and the oxygen of the air-blast, but the metallic iron thus produced is not exposed to a sufficiently high temperature to enable it to acquire enough carbon for its conversion into cast iron, and it is obtained in the form of spongy masses of malleable iron or steely iron, according

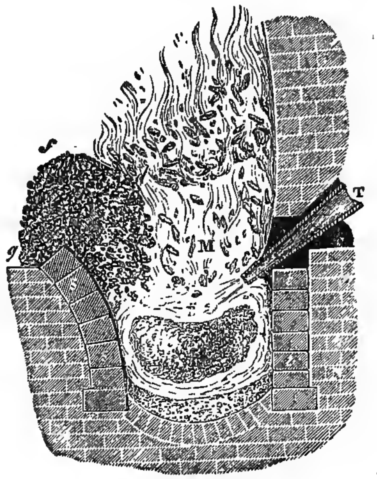


FIG. 14.—Catalan Forge.

to the proportion of carbon taken up by the metal. This depends, to a great extent, upon the manner in which the operation is conducted. If the *siftings* from the broken ore, moistened with water to prevent their dispersion, be added to the charge in large proportion, the iron contains less carbon and is less steely than when these are employed in smaller quantity, probably because the oxidizing action which they exert at a high temperature is unfavorable to the acquisition of carbon by the metal. The iron is also less steely when the blast is directed down to the bottom of the hearth, so that it is less exposed, as it separates from the ore, to the action of unburnt gases very rich in carbon. A large proportion of the oxide of iron escapes reduction, and combines with the silica contained in the ore and fuel, to form a very fusible silicate of iron, the bulk of which is run off through an opening at the bottom of the crucible. In about five or six hours, enough ore is reduced to furnish two or three hundredweight of metal, in lumps which are welded together by pressing them with an iron rod, on the end of which they are transported to the hammer, where they are stamped into a compact state, and afterwards forged into bars. The iron thus obtained is usually of excellent quality, not having become contaminated with foreign matters to the same extent as the melted pig iron from the blast furnace; but the process is a very extravagant one, the ore being made to yield no more than one-third of its weight of metal, with a consumption of more than its own weight of charcoal.

—*Compiled from Metals: their Properties and Treatment.*

COPPER.

THE use of metallic copper dates from an earlier period than that of iron, although the former metal is by no means so plentifully diffused over the earth's surface as the latter. Copper, however, is of much more frequent occurrence in the pure metallic state, and some of the ores of copper can be much more easily made to yield their metal in a malleable condition.

Extraction of Copper from its Ores.—Probably no other metallurgic operation presents such an appearance of complexity as the smelting of copper ores, but this is due to the great variety of the ores to be treated, which necessitates their introduction at different stages of the process. Thus, a smelting process adapted for copper pyrites must contain provisions for the removal of arsenic and sulphur, which are not present in the carbonates and the oxides of copper, so that the processes of smelting are arranged in such a manner that these ores, as well as the slags obtained in some of the operations, can be introduced after the sulphur and arsenic have been expelled.

In a work like the present, it is not advisable to attempt a detailed account of smelting processes which are subject to frequent alterations in order to suit different lots of ore, particularly when such alterations result from the application of practical experience on the part of the smelter, and do not admit of clear explanation upon simple chemical principles. A general outline only of the extraction of copper from its ores will be given here, and before this is entered upon, it may assist the reader to state that it may be summed up under the following heads:

1. *Roasting processes*, intended to expel arsenic and sulphur and to convert the iron into oxide of iron.
2. *Melting processes*, intended to remove the oxide of iron by dissolving it with silica at a high temperature, and to obtain the copper as a pure combination of copper with sulphur (sulphide of copper).
3. Roasting and melting, in a single process, to expel the sulphur and obtain metallic copper.

Before being subjected to the first process, the ores are broken into pieces of the size of a nut, and so assorted that the lot to be smelted may contain about eight or ten parts of metallic copper in the hundred. Moreover, as there is much *gangue* or earthy matter associated with the ores, they are, if possible, so mixed that they may serve as *fluxes* to each other, by producing chemical compounds capable of becoming liquefied by the high temperature of the furnace.

The *fluor*[1] *spar*, which is so commonly associated with copper pyrites, derives its name from its power to effect the liquefaction of earthy substances. Fluor spar is composed

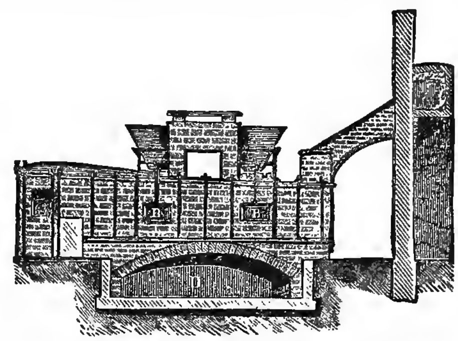


FIG. 15.—Furnace for roasting Copper Ores. BB, Working Doors. D, Vault for receiving the roasted ore.

of calcium and fluorine; if it be strongly heated in contact with silica (quartz) which consists of oxygen combined with silicon, the latter takes up the fluorine to form fluoride of silicon gas, whilst the calcium and oxygen unite to produce lime, which combines with another portion of the silica to form a silicate of lime. The silicate of lime would not easily fuse into a slag by itself, but when clay and oxide of iron are present, as is always the case in the melting furnaces, a slag is readily produced.

First Process in Copper-smelting. Calcining or Roasting to Expel Arsenic and Part of the Sulphur.—The roasting furnace or *calciner* (Figs. 15, 16, 17) is a *reverberatory* furnace, with a hearth (A) of large size (about sixteen feet by fourteen) to allow of the ore being spread out in a thin layer upon it. The hearth is commonly built of fire-bricks set on edge and

[1] From the Latin *fluo*, to flow.

bedded in fire-clay, and the flame is reverberated upon it by an arch of about two feet in average height. At one end of the hearth, near the fire-place, there is an opening or flue (O) through which air may be admitted to the hearth, to furnish the oxygen necessary for the chemical changes effected in the roasting process. On each side of

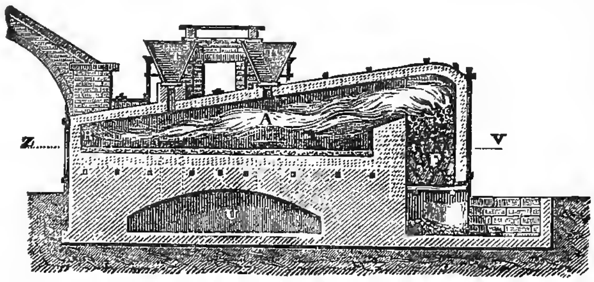


FIG. 16.—Furnace for roasting Copper Ores. Section through the line X Y of the plan (fig. 17).

the hearth there are two openings (r) closed with iron doors, through which the roasted ore is raked out into the arch (U) beneath the furnace. The ore is admitted by opening the hoppers (T) over the arch of the furnace, where it is previously warmed by the waste heat. The fuel employed in the calciners at Swansea is anthracite mixed with one-fourth of bituminous or caking coal, which is necessary to counteract the tendency of anthracite to split up into small pieces and choke the air passages of the fire, the bituminous coal being softened by the heat, and binding the anthracite together. The fire of the calciners requires special management in order that the ore upon the hearth may be brought to the proper temperature. Anthracite coal is not easily made to burn in an ordinary grate, and, when burning, it raises the bars to so high a temperature that they rapidly oxidize and burn away. To avoid this a layer of *clinker* or fused ash from the coal is built up on the bars of the grate (F) so as to preserve them from direct contact with the glowing coal, and air-passages are made through this layer, so that the air becomes heated in passing through them, before it actually reaches the fire, the combustion of the anthracite being thus effected by a current of heated air. The oxygen of the air, passing through the column of heated

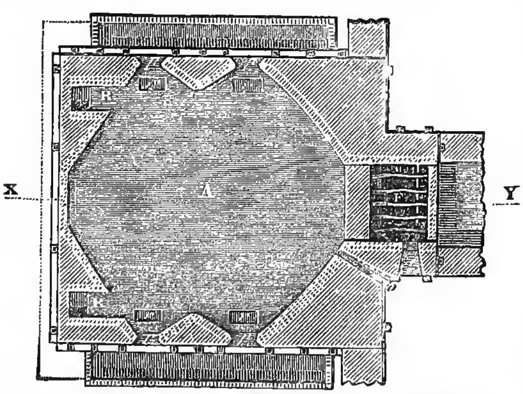


FIG. 17.—Furnace for roasting Copper Ores. Plan at the line of Z Y of the section (fig. 16).

fuel, combines with the carbon to form carbonic oxide, and this gas, being highly heated, takes fire in the air admitted on to the hearth of the furnace, giving a sheet of flame which is drawn through the furnace by the action of the chimney with which the flues (R) communicate, and raises the ore to the temperature necessary for roasting it. Since the air is heavier than the burning gas, a layer of air always exists beneath the latter, separating it from the ore, thus preventing the ore from attaining its melting point, and securing a sufficient supply of oxygen.

Each calciner is charged with three tons of the broken ore, which is spread evenly over the hearth, and roasted for twelve hours, being occasionally raked over through the working-doors (p) in order to expose fresh portions to the action of the air, and to prevent any part of the ore from being melted. At this high temperature, the arsenic present in the copper ore combines with oxygen from the air to form *arsenious acid* (white arsenic) which passes, in the form of vapor, into the flues. About half of the sulphur in the ore also combines with oxygen to form *sulphurous acid* gas which passes up the chimney, a small quantity of *sulphuric acid* being also formed and remaining in the ore as sulphate of copper. Since iron exerts the greater chemical attraction for oxygen, and copper for sulphur, a large proportion of iron acquires oxygen and becomes converted into the *oxide of iron*, while a much smaller proportion of the copper combines with the oxygen from the air to form *suboxide of copper*. When the gases and vapors issuing from the calciners are allowed to escape directly into the air, they form a dense grey cloud of *copper-smoke* which contains the sulphurous acid, mixed with a little vapor of sulphuric acid, the arsenious acid, which condenses in the air to a fine powder, and some hydrofluoric acid gas, produced from the fluor spar. The injurious effect of these products upon the health and vegetation of the neighborhood has induced the copper smelters to devise means for condensing them by passing them into flues and condensing chambers where they are met by showers of water. At some works it has been found profitable to convert the sulphurous acid into oil of vitriol instead of allowing it to escape, but in this case it is necessary to prevent the products of combustion of the fuel from mixing with copper-smoke. *Spence's calciner* employed for this purpose has the fire passing under the hearth instead of over it. This furnace is 50 feet long, and the ore is gradually raked from the cooler to the hotter end as it becomes less fusible. The waste heat of an adjoining smelting furnace is sometimes employed in these calciners, and the calcined ore is raked at once into the smelting furnace. In *Gerstenhöffer's furnace* the ores are crushed between rollers, and allowed to fall over rows of red hot bricks in a vertical furnace, through which a blast of heated air is passed in order to burn the sulphur into sulphurous acid, which is then conducted into the leaden chambers, where it is converted into oil of vitrol.

2nd Process in Copper-smelting. Melting for Coarse Metal, to Dissolve the Oxide of Iron as a Silicate.—It has been seen that the 1st process has had the effect of converting a large proportion of the sulphuret of iron present in the pyrites into oxide of iron, which it is the object of the present process to remove by causing it to combine with Silica, to form a compound capable of being melted and separated from the rest of the ore. At this stage the copper ores containing silica (quartz) can be introduced with advantage, provided that they are free from sulphur. It must not be forgotten that, during the process of calcining, a small proportion of the sulphuret of copper in the pyrites has been converted into an oxide of copper, which resembles the oxide of iron in its property of combining with silica at a high temperature, to form a melted silicate which would pass away in the slag, entailing a considerable loss of copper. This is prevented by the sulphuret of iron which is still present in the calcined ore, and, at the high temperature at which the fusion is effected, exchanges constituents with the oxide of copper, forming oxide of iron and sulphuret of copper. The slag from the 4th process to be presently described, is also appropriately introduced in this fusion, since it contains a considerable quantity of oxide of copper, which exchanges, as above, with the sulphuret of iron in the calcined ore, furnishing more sulphuret of copper to pass into the coarse metal, and oxide of iron to be removed in the slag. The slag from the 4th process (called *metal slag*) also furnishes silica to assist in removing the oxide of iron. In some cases, the smelter adds some fluor spar in order to facilitate the fusion of the charge. The *ore-furnace* (Figs. 18, 19), as it is called, in which the melting for coarse metal is effected, is also a reverberatory furnace, but its hearth (A) is much smaller than that of the calciner (usually about one-third of the size), because the charge has to be made at a much higher temperature; for which reason, also, the fire-grate is larger in proportion; the hearth is also slightly inclined on all sides towards a depression or cavity (B) at one side, which serves as a crucible in which the melted coarse metal collects. The fuel is a mixture of anthracite with one-third of bituminous coal. The charge of this furnace is composed of the following materials, selected for the reasons given above, viz.:—

Calcined or roasted ore, usually about 18 cwt.

Ores containing oxide of copper and silica, 3 cwt.

Metal-slag from process 4, containing oxide of iron, silica, and some oxide of copper, 6 cwt.

Fluor-spar occasionally.

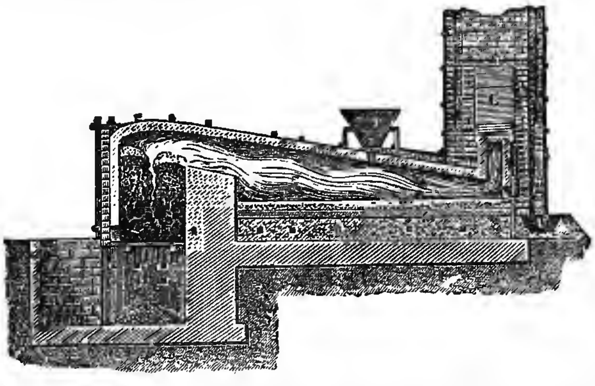


Fig. 18.—Section of Ore-furnace for smelting Copper Ores. T, Hopper for introducing the charge. *p*, Tap-hole for discharging the slag into the slag-moulds U. C, Flue leading to the chimney.

The slag is the first to fuse, in about half-an-hour after the charge has been introduced, and by degrees the whole of the materials become liquid, and enter into violent ebullition, caused by disengagement of sulphurous acid gas, produced by a secondary decomposition of no importance from a metallurgic point of view, save that the ebullition favors the intimate mixture of the melted matters on the hearth.

After three or four hours, the furnace man mixes up the melted matters with a rake, and raises the temperature very considerably, to favor the separation of the coarse metal from the slag. In about half an hour the tap-hole (*b*, Fig. 19), which communicates with the cavity in the hearth is opened, and the *matt** or *regulus* of coarse metal is run out, through an iron gutter (*a*) into an iron box, perforated at the bottom, and standing in a cistern through which water is constantly running; the coarse metal is thus *granulated* or divided into small irregular grains, in order to

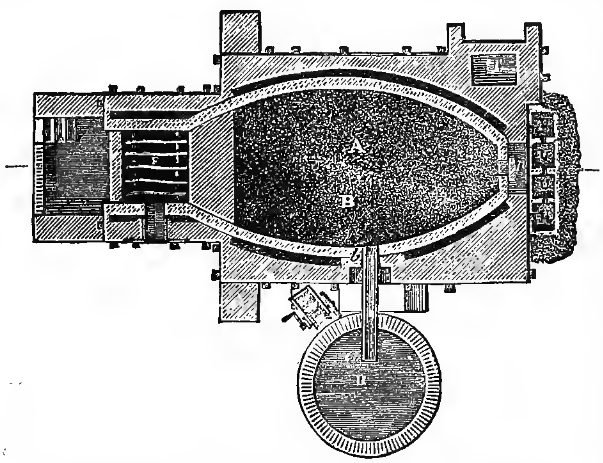


Fig. 19.—Plan of Ore Furnaces for Smelting Copper Ores. F, the Grate. E, Tank for Granulating the Coarse Metal.

fit it for undergoing the next operation. Sometimes the regulus from two or three operations is allowed to accumulate in the furnace before tapping, the slag alone being raked out before the introduction of a fresh charge.

* From the French *mat*, heavy.

The iron box containing the regulus is raised from out of the cistern by a winch (W), and its contents are carried to the calcining furnace.

This coarse metal contains copper, iron, and sulphur in about the same proportion in which they are present in pure copper pyrites, so that the copper amounts to about 33 parts in the hundred, or nearly four times the proportion contained in the raw ore at the commencement of the process. The slag (*ore-furnace slag*) is raked out into sand-moulds (U. Fig. 19), connected with each other by openings in their sides, where it solidifies into blocks of a black, somewhat glassy, appearance, interspersed with white fragments of quartz. It is used for rough building purposes in the neighborhood of the copper works. The ore-furnace slag is composed essentially of oxide of iron (ferrous oxide) and silica combined in about equal proportions, and would be spoken of, in chemical language, as a *silicate of iron* or *ferrous silicate.* It contains also a little copper, usually amounting to one part in 140 parts, representing a loss to the smelter which appears unavoidable. Occasionally, a small quantity of regulus is found at the bottom of the blocks of slag, from which it is separated by hand-picking.

3d. Process in Copper-smelting. Calcination of the Coarse Metal to convert more of the Sulphuret of Iron into Oxide.—Now that the earthy matter has been removed in the slag, it is far easier to oxidize the sulphuret of iron than it was in the first calcining process. To effect this three tons of the granulated coarse metal are roasted in the calcining furnace (Fig. 19) for 24 hours, the temperature being moderated at the commencement, to avoid fusion, and gradually raised in proportion as the removal of the sulphur diminishes the fusibility of the charge, which is raked over every two hours. About one half of the sulphur is converted by the oxygen of the air into sulphurous and sulphuric acids, which escape in vapor, another portion of oxygen combining with the iron from which the sulphur has been removed, to form oxide of iron, so that the roasted coarse metal consists essentially of sulphuret of copper, oxide of iron, and some unchanged sulphuret of iron.

4th. Process in Copper-smelting. Fusion of the Calcined Coarse Metal to Remove all the Iron and to Obtain Fine Metal.—The principles involved in this process are the same as in the second process, viz., the conversion of unaltered sulphuret of iron into oxide of iron by exchange with oxide of copper added for that purpose, and the removal of the oxide of iron in the slag, in combination with silica.

The fusion is effected in a furnace which does not differ materially from that employed in the second process, expect that there is no cavity in the hearth, which is made to slope from all parts towards the tap-hole (Fig. 19). The charge consists of—

Calcined coarse metal (about one ton).

Roaster-slag from the 5th process	About 12 cwt.
Refinery-slag from the 6th process	
Ores containing oxide and carbonate of copper	

(The roaster and refinery slags contain silica in combination with the oxides of iron and copper.) These materials are fused together for about six hours, when they divide, as before, into regulus or matt, and a slag which remains above it. The regulus is sometimes run out into water (like the coarse metal process), when it is called *fine metal*, and sometimes cast into pig-moulds of sand, when it constitutes *blue-metal*, its surface exhibiting a bluish color, due to its still containing a considerable proportion of sulphuret of iron, in consequence of a deficiency of oxide of copper in the charge. This regulus is composed essentially of copper and sulphur, and contains about 77 parts copper in the hundred. The presence of a little sulphuret of iron in this regulus gives rise to considerable differences in its color and appearance, so that it is called by several different names, which do not really imply any important difference in chemical composition.

In some cases, when the charge has contained an excess of oxide of copper, the fine metal has a red brown color, due to the presence of much red oxide of copper and metallic copper, and a pimply appearance caused by the escape of sulphurous acid gas it is then called *pimple metal.* When it is intended to manufacture *best selected copper* for making brass, gun-metal, &c., the blue metal is run into a series of sand-moulds. Since the various impurities which are present tend to collect in a small quantity of metallic copper which is deposited at the bottom of the melted mass, the pigs which are cast first will be the most impure, whilst the others yield the best selected copper in the subsequent operations of smelting. The first pigs yield *bottoms* or *tile-copper* (so called from the shape of the ingots) when smelted. The composition of a sample of these bottoms is here given, in 100 parts: Copper 74, Tin 14, Antimony 4½, Lead 1, Iron 2½, Sulphur 4. It is evident that the metallic copper which has separated, has decomposed the sulphurets of tin, antimony, &c, contained in the blue metal, and has combined with those metals to form an alloy, which is heavier than the blue metal and sinks to the bottom. In some smelting-works, where the fine metal is not obtained in so pure a condition, and contains only 60 parts of copper in the hundred, it is again submitted to the two processes of calcining and melting exactly as in processes 3 and 4, when it yields *black copper or coarse copper*, which contains from 70 to 80 parts of copper in the hundred. The *metal-slag*, as the slag from the 4th process is termed, presents an appearance very different from that of the ore-furnace slag; it is very crystalline and lustrous, and consists chiefly of oxide of iron combined with silica, but it contains a considerable proportion of copper, partly in the form of an oxide in combination with silica, and partly as small particles of metallic copper disseminated through the mass. In some specimens of the metal-slag, the copper appears in very fine brilliant filaments forming *copper-moss.* This slag is usually employed as a part of the charge in the 2nd process (melting for coarse metal), but it is sometimes fused in a separate furnace with powdered coal, when a brittle matt is obtained which contains a very large proportion of copper, and is called *white metal,* a name which is also occasionally applied to fine metal.

5th Process in Copper-Smelting. Calcining or Roasting the Fine Metal to remove Sulphur and obtain Blistered Copper.—The manner in which this process is carried out is varied according to the degree of purity of the fine metal, but the chemical principles which it involves are the following: When a compound of copper with sulphur is heated in air, the sulphur combines with the oxygen of the air, and is thus gradually removed in the form of sulphurous acid gas, the copper also combining with oxygen, and being left as oxide of copper. Further, when an oxide of copper (or compound of copper with oxygen) is melted in contact with a sulphuret of copper (or compound of copper with sulphur), the oxygen of the former combines with the sulphur of the latter to form sulphurous acid gas, and the copper is separated in the metallic state. The pigs of blue metal are introduced, to the amount of 1½ tons, into a reverberatory furnace, where they are roasted, at a gradually increasing temperature, so as to avoid fusion, for about four hours, in order that a part of the sulphuret of copper may be converted into oxide of copper. When it is judged that this has been effected to a proper extent, the temperature is further raised so as to fuse the materials upon the hearth, the doors of the furnace being closed in order to avoid access of air. As soon as the mass is fairly liquefied, the temperature is somewhat reduced, being again raised towards the close. During this fusion, a violent effervescence is observed in the liquid mass, due to the escape of sulphurous acid gas formed by the union of the sulphur from the sulphuret, with the oxygen from the oxide of copper, whilst metallic copper subsides, in a fused state, and is run out in sand-moulds, where it solidifies into ingots which preserve a blistered appearance caused by the escape of sulphurous acid during solidification. The duration of the process depends upon the degree of purity of the blue metal under treatment, but it varies between 12 and 24 hours. A small quantity of slag (called *roaster-slag*) is formed during the fusion, which resembles pumice in its porous texture, but has a dark red-brown color, and consists of the oxides of iron and copper combined with derived silica partly from the hearth of the furnace, and partly from the sand-moulds in which the ingots of blue metal are cast. This slag contains about 16 parts of copper in a hundred, and is used as a portion of the charge in the 4th process. The roasting furnace employed in this process is often constructed with an air-channel (Fig. 20) traversing the whole length of the fire-bridge, open to the air at both ends, and communicating with the hearth of the furnace through two openings (*b b*) in the brickwork. This permits the introduction of heated air into the hearth, by which the roasting is much facilitated.

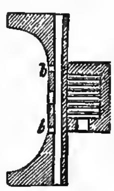


Fig. 20.

6th Process of Copper-smelting. Refining and Toughening, to purify the Copper.—The pigs of blistered copper are far from pure; it contains considerable proportions of sulphur, arsenic, iron, tin, lead and other foreign substances, varying according to the descriptions of ore employed. In order to remove these impurities, the oxygen of atmospheric air is brought into use. The furnace employed does not differ from the melting furnace used in the 2nd process (Fig. 18), and the blistered copper to be refined is piled, in charges of 6 or 8 tons, upon the hearth, in such a manner as to allow air to circulate freely among the ingots. A moderate heat is applied at first, to allow the oxygen of the air to act upon the blistered copper, an action which is facilitated by the porous structure of the metal. The sulphur then becomes converted into sulphurous acid gas, and the arsenic into arsenious acid which passes off in vapor, whilst the iron, tin, lead and other foreign metals are converted into oxides, as well as a portion of the copper. After being roasted for about six hours, the metal is melted, when a thin layer of slag is formed upon its surface; after raking this off, a small sample of the copper is withdrawn and examined by the refiner, who can judge from the appearance of its fracture how long the subsequent process of toughening will probably occupy. In order to toughen the metal, its surface is covered with wood-charcoal or anthracite, which is renewed from time to time, so as to shield the copper from further oxidation, and the melted metal is stirred with a pole of young wood (usually birch) until a small sample half cut through with a chisel and then broken, exhibits a fine close grain, a silky fracture, and a light red color; and a small ingot cast for the purpose and hammered when red hot, is found to be soft and free from cracks at the edges. The copper is then said to be at *tough-pitch,* and is taken out in iron ladles lined with clay, and cast into ingots of *tough-cake* copper. The effect of this process of *poling,* as it is termed, in toughening the copper, depends upon the removal of oxygen from the metal. When the blistered copper has been refined, as above described, by being very slowly melted in contact with air, it is found to have taken up a small proportion of oxygen, which is probably contained in the metal as an oxide (*suboxide*) of copper. The presence of the oxygen, though it does not amount to more than two or three parts in a thousand of copper, has the effect of rendering the copper brittle or *dry,* so that a small ingot of it cracks at the edges when hammered, and its fracture exhibits a deep red color and a coarse-grained, somewhat crystalline structure. When the melted metal is stirred with the pole, the combustible gases, generated from the wood by the heat, effect the removal of the oxygen from the metal, and bring it by degrees to tough-pitch. If, during the operation of casting the ingots, the surface of the metal on the hearth be not well covered with charcoal or anthracite, the copper will *go back* or become brittle again, in consequence of the absorption of oxygen from the air.

If the process of poling be continued after the copper has been brought to tough-pitch, it becomes even more brittle than before it was poled, an effect which was formerly ascribed to the combination of the copper with a little carbon from the wood; but since analysis has failed to prove the presence of the carbon, the following less simple explanation, based upon experiment, is now generally received. Perfectly pure copper exhibits the malleability and ductility of the metal in the highest perfection, but these qualities are deteriorated by the presence of small proportions of the various foreign matters, such as sulphur, tin, antimony, &c., which cannot be entirely removed in the refining process. The injurious effect of these impurities, however, is counteracted in some measnre by the presence of a small proportion of oxygen (not exceeding two parts in a thousand), so that if this element be entirely removed, the copper will be *overpoled*, exhibiting a brittle character due to some of the above named impurities. On the other hand, if too much oxygen has been left in the metal, the copper is dry or *underpoled*. The effect of overpoling upon the metal may be remedied by allowing air to act for a short time upon the melted copper, that a small quantity of oxygen may be absorbed by it. When the copper is intended for rolling into sheets, it is usual to add lead, in the proportion of about five parts to a thousand of copper, just before skimming the surface in order to ladle out the copper. The metal is well stirred after the addition of lead, in order that the action of the air may produce an oxide of lead which combines with the oxides of tin, antimony, and other foreign metals, to form a liquid slag which rises to the surface of the metal and is skimmed off before casting. It is necessary that the removal of the lead from the copper by oxidation should be as complete as possible, since its presence would prevent the scale of oxide of copper from being easily detached from the sheet during the process of rolling an even $\frac{1}{10}$th part of lead in 100 parts of copper suffices to injure its quality. This treatment of the metal with lead is called *scorification*, from the *scoria* or slag which forms upon the surface. The *refinery slag*, skimmed from the surface of the melted copper before commencing the process of poling, has a dull brown-red colour, with a purple shade, and consists almost entirely of an oxide of copper (suboxide) combined with silica derived from the hearth and from the sand-moulds employed to cast the blistered copper. It is employed in the 4th process (fusion for fine metal). The hearths of the copper-furnaces become strongly impregnated with copper in course of time, and are broken out in order that the metal may be removed from them.

Effect of the presence of Foreign Matters upon the quality of Copper.—From the circumstance that the refiner tests the quality of copper by forging a *hot* sample, it will be inferred that the effect of impurities upon its malleability and tenacity is more perceptible at a high than at a low temperature. The foreign matters which commercial copper is liable to contain are arsenic, sulphur, antimony, tin, bismuth, lead, silver, iron, and nickel. Of these, sulphur and antimony are generally considered the most injurious in diminishing the malleability and tenacity of the metal. Arsenic is very commonly found in copper, amounting in some of the Spanish coppers, to as much as one part in a thousand, and was formerly supposed to be as injurious to the quality of the copper as antimony is, but modern experience has shown that copper may be easily rolled and drawn into wire even when it contains a considerable proportion of arsenic. A small proportion of tin is believed to increase the toughness of copper, but bismuth and nickel have the opposite effect.

The conducting power of copper for electricity is reduced in a most striking manner by the presence of foreign matters, so that, in the construction of telegraphic apparatus, it is important that the purest attainable copper wire should be employed. Pure copper is scarcely inferior to silver in its conducting power, and the conducting power of the native copper from Lake Superior, which is almost pure, stands to that of pure copper in the proportion of 93 to 100, whilst the Australian (Burra Burra) copper, also very pure, has a conducting power of 89, and the Spanish copper, which contains much arsenic, has a conducting power only one-seventh of that of pure copper, or in the proportion of 14 to 100. The addition of a small proportion of phosphorus (about five parts in a thousand) to copper is found to harden it and somewhat to increase its tenacity; it is also said to render it less liable to corrosion when exposed to the action of seawater. By adding arsenic to copper, in about the proportion of one to ten, a white somewhat malleable metal is obtained, which is not easily tarnished by air, and is much harder than copper. This compound, which is employed for clock dials and for thermometer and barometer scales, is made by heating five parts of copper clippings with two parts of white arsenic (arsenious acid) arranged in alternate layers and covered with common salt, in a covered earthen crucible.

—*Compiled from "Metals, their Properties and Treatment."*

METALLURGY OF THE PRECIOUS OR NOBLE METALS.

THE process in actual use for the extraction of metals generally from their natural sources are so numerous and vary so much in details, according to circumstances, that only a brief outline of some of the more important methods in use in the case of the chief metals can be attempted here.

Gold.—For the most part this element is found native, and generally in a state of considerable freedom from other metals, the nature of the accompanying metals, when present, varying with the locality. Silver is very frequently associated with native gold; that from Australia and California often containing five to ten, or even more per cent. of this metal, with small quantities of copper and iron in addition. Brazillian gold often contains palladium, and that from Russia platinum. In Hungary gold is found associated with tellurion, whilst the Huelva and Tharsis pyrites and many other minerals contain small quantities of this precious metal interspersed throughout masses of other metallic sulphides. As a rule, the metal occurs in quartzose and granitic rocks, but large quantities have been obtained from time immemorial from the sands of river-beds and from alluvial deposits of the matters washed down by streams from mountainous districts where these rocks occur. Occasionally in these deposits the gold is found in smaller or larger masses known as *nuggets*, some of which have been found of considerable magnitude, weighing upwards of one, and even of two cwt., and worth several thousand pounds sterling; generally, however, the gold occurs in minute grains or "dust." From alluvial soils the gold is separated by simple mechanical means, the earthy mass being agitated with water in a wide shallow

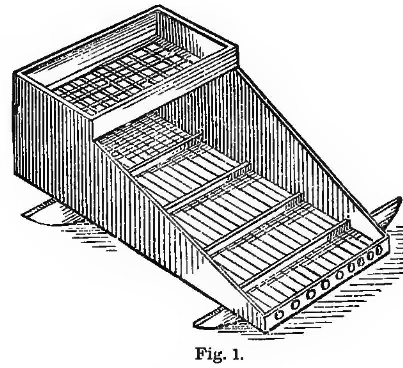


Fig. 1.

basin, technically termed a "pan," a peculiar motion being communicated by the hand so as to scoop out of the pan the muddy water whilst the heavier particles of metal are retained. When necessary, stones and hardened masses are previously roughly pulverized, or they are mechanically picked out by the hand during washing. For systematic working a washing-machine, known as a "cradle," is employed (Fig. 1), consisting of a kind of wooden box, some six or seven feet long and about two feet wide, mounted on rockers so that the bottom has a gentle slope from end to the other; across the bottom are nailed wooden bars (riffle bars, so as to make a series of small shallow weirs in the cradle; at the top end is fixed a sieve, on to which the earth is shovelled, a constant stream of water being kept running on to the mass; the larger stones are thus left on the sieve, whilst the clayey portion, the small gravel, and the gold dust are washed through and deposited in the shallow pools formed by the riffle-bars. Every now and then the deposited particles are removed and dried in the sun, and the lighter earthy particles blown away by the breath, and the small pebbles picked out. Where the soil is a stiff clay, the mass is stirred up with water in a tub with paddles of revolving arms before cradling; and occasionally, instead of carrying the washing so far as to separate all the earthy matters (which often entails loss by the washing away of the finest particles of gold), the cradling is only carried on to a certain point, the gold being extracted from the partially washed mass by amalgamation; this operation, however, is more commonly employed in the case of the powder obtained by stamping or grinding quartzose auriferous rocks, and the washing is then more frequently effected by making the water and suspended matters pass over a series of blankets stretched tightly on frames so as to make a series of very slightly inclined planes; the woolen surfaces arrest the particles of gold with more or less earthy matter. From time to time the deposit is removed, and the gold extracted by means of mercury. Occasionally a kind of magnified cradle is used, consisting of a series of slightly inclined wooden troughs or sluices, ten to twelve feet long, so that the stream from one is delivered on to the next, and so on. Riffle bars are placed in these troughs either directly across or at an angle. When the washing has gone on for a short time mercury is allowed to flow into the upper trough; this runs down, being retained by the riffle-bars, so that the mercury dissolves the accumulated particles of gold. In order to retain the finest particles of gold which sometimes escape through being washed down too rapidly to be absorbed by the little pools of mercury in the sluices, amalgamated plates are placed at the end of the lowest trough; so that the effluent "slimes" must pass over them; the amalgam of gold and copper thus formed is from time to time removed and worked up with the fluid mercury amalgam.

In the extraction of gold from gold quartz, the stamped rock (washed by blankets or sluices when requisite) is placed in an iron pan with a certain quantity of mercury; a stream of water flows into the pan, the overflow passing into another pan at a lower level also containing mercury. Several pans are generally connected in series, each being provided with an agitator worked by steam or water power after the fashion of a mortar mill; the gold is then dissolved out, the agitator continually bringing the auriferous particles and the mercury in contact. Fresh quantities of stamped quartz are continually introduced until the mercury has taken up so much gold as partially to lose its fluidity; the amalgam is then squeezed through chamois leather, whereby a fluid amalgam, containing only a small quantity of gold, is separated, and a nearly solid rich amalgam retained. The fluid amalgam is used over again in the pans, the solid mass being carefully distilled so as to separate the mercury and leave the gold and other metals dissolved out. Certain auriferous minerals, when treated with mercury, do not allow the gold to be wholly dissolved out, the gold becoming sulphurized or otherwise changed on the surface so as to prevent contact between the gold and the mercury. This is especially the case with ores containing sulphur, arsenic or tellurion. To avoid this it has been proposed by Crookes, and also by Wurtz (of New York), to add small quantities of sodium to the mercury. The sodium amalgam thus obtained causes the mercury to wet the metallic particles (probably by destroying the film of gold sulphide, or by preventing its formation). An additional advantage in this process is that the loss by "flouring" of the mercury (reduction to fine particles which do not again coalesce and are consequently washed away) is to a large extent prevented; the mercury being always clean and bright, any small particles mechanically dislodged are readily reabsorbed into the rest of the mass of mercury.

When obtained from certain ores, the gold thus extracted is apt to contain small qantities of foreign metals which destroy its tenacity and other valuable properties; in many cases these metals, if present in the mass left on distilling off the mercury, can be removed by simply melting the residue in crucibles with an oxidizing flux, such as a mixture of nitre and borax; the foreign impurities are thus removed, being oxidized by the nitre, the oxides thus produced being taken up by the melted borax. Another method of purifying gold, especially suited for gold rendered brittle by the presence of tin and antimony, was introduced a few years ago by Mr. F. B. Miller of the Sydney mint; this consists of passing a stream of chlorine gas through the molten metal, when silver and baser metals are converted into chloride, the latter being expelled if volatile, whilst the gold remains unchanged; in this way perfectly pure gold is readily prepared, whilst the silver chloride formed can be readily reduced to the metallic state, and the silver thus obtained separate from the gold. When the silver, in an alloy of gold and silver, largely preponderates, as is the case when silver containing small quantities of gold is extracted from such sources as Spanish pyrites, &c., a more convenient mode of separating the gold is to treat the alloy with nitric or sulphuric acid, when the silver dissolves and the gold is left undissolved (§ 24). In the assaying of coinage alloys, this mode of separation is largely used.

A mode of extracting gold by purely chemical means from gold quartz and other similar sources has been proposed by Calvert: the crushed quartz is subjected to the action of cold chlorine gas so as to convert the gold and other metals present into chlorides which are subsequently washed out by water; from the solution thus obtained metallic gold in a pure state is separated by adding solution of ferrous sulphate, or better, by blowing sulphur dioxide through the liquid;[1] the gold thus separates as a fine powder which is allowed to subside, washed, collected, and fused into an ingot. If silver be also present the metal may be extracted by treating the chlorinated mass with brine, which dissolves the silver chloride, and subsequently separates the silver from the solution thus obtained. Another process, patented by Longmaid, for separating gold from substances containing it consists in fusing the ore in a reverberatory furnace with roasted pyrites, lime, and fluor spar; some gold subsides to the bottom, whilst some remains suspended and is separated by placing iron plates in the fused mass; the gold adheres to these and is then dissolved off from them by immersing them in a bath of melted lead. In this way there is ultimately obtained a gold-lead alloy, from which the gold is separated by cupellation. Neither this process nor Calvert's seems to have come into any considerable practical use, although a process much the same in principle as the latter has been worked in Silesia; this method, described by Plattner in the Jurors' Report of the 1851 Exhibition, consisted in roasting the ore (an arsenical pyrites containing gold to the extent of somewhat less than ½ oz. per ton) so as to drive off arsenic and sulphur, treating the residue with chlorine gas, and then dissolving out by water the chlorides of iron and gold and separating the latter by a reducing agent such as sulphuretted hydrogen.

SILVER.

BESIDES occurring native in Mexico, Chili, and Peru, and in smaller quantities in many other places, this metal occurs in combination with sulphur, forming several kinds of ores according to the quantity and character of the other associated substances; also as chloride (horn silver), iodide, arsenide, bromide, and as antimony and mercury alloys. Considerable quantities are now extracted, the lead smelted from lead sulphide containing small quantities of silver; whilst the Spanish pyrites largely used for the production of sulphuric yields a residue on burning off the sulphur from which silver and copper are obtained in some quantity. From these sources the silver is extracted by methods which naturally fall under one or other of the three classes known as *lead processes, wet methods, amalgamation processes*, the distinctive feature of the first class being that from a suitable mixture of ores a silver-lead alloy is smelted, from which the precious metal is subsequently separated; whilst in the second class the silver is obtained in aqueous solution by treatment with appropriate reagents, and is thence precipitated by chemical agency; and in the third class the silver is extracted by means of mercury somewhat after the fashion of gold, but usually by processes involving more complex chemical actions.

Lead Processes.—When silver exists in the metallic state disseminated through a rocky matrix, a silver-lead alloy is readily formed by merely fusing together the ore and a sufficient quantity of metallic lead, whereby the silver is, as it were, dissolved out of the matrix by the molten lead, much as gold is out of gold quartz by mercury. When the silver

[1] The chemical changes thus taking place may be written:

$$2AuCl_3 + 6FeSO_4 = 2Au + Fe_2Cl_6 + 2Fe_2(SO_4)_3,$$
$$2AuCl_3 + 3SO_2 + 6H_2O = 2Au + 6HCl + 3SO_4H_2.$$

is not present in the metallic state, a silver-lead alloy can be obtained by mixing with the silver ores, galena (lead sulphide), or other lead ores and then smelting the whole together so as to reduce both lead and silver to the metallic state. From the argentiferous lead thus obtained the silver is then extracted by processes the exact character of which depends upon circumstances; if the silver-lead alloys be sufficiently rich in silver and tolerably free from copper, the lead and other foreign base metals present in greater or less quantity are removed by a process termed "cupellation," which consists in fusing the alloy in a shallow dish (*cupel*) made of porous material, such as compressed bone-ash, clay, or marl, moistened with wood-ash liquor, whilst a stream of air plays over its surface; the lead and foreign base metals oxidize and the oxides fuse and are partially absorbed by the cupel and partially blown away by the current of air or drawn off in the liquid state forming the lead oxides commercially known as *litharge* and *massecot.* Finally, when all the foreign metals are oxidized a mass of fused silver is left containing in addition any gold or platinum which may happen to have been originally present; the clearing away of the last traces of oxide produces a rather singular appearance on the surface of fused metal, technically termed the "brightening." The fused silver, especially at high temperatures, absorbs oxygen from the air and on cooling is apt to give it out again, forming peculiar miniature volcanic cones where the escape of gas forces the yet liquid metal in the interior up through the newly-formed thin solid crust; this phenomenon is spoken of as "vegetation," or "spitting," and with large masses of silver (one cwt. or so) is often extremely well defined, the cones being an inch or two in height.

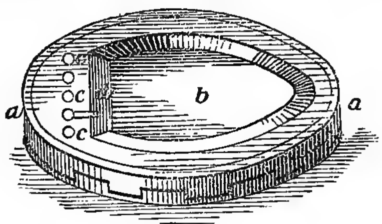


Fig. 2.

Fig. 2 represents the form of cupel usually employed in this country; an egg-shaped ring of half-inch boiler plate, *a, a,* strengthened by cross-bars at the bottom, constitutes a sieve-like frame into which is rammed by mallets, a mixture of bone-ashes and a little wood-ash moistened with weak potash solution; the upper surface of the mass thus formed is worked into a concave form

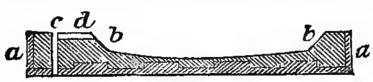


Fig. 3.

b, b, exhibited in section in Fig. 3, the concavity being bordered by a ledge of two or three inches in width all

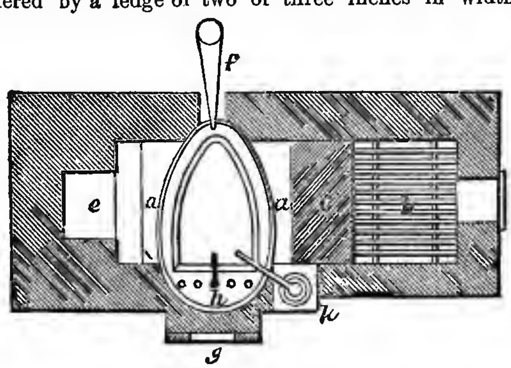


Fig. 4.

round save at the base of the oval, where it is much wider. In this wide part of the ledge or *breast* are bored holes, *c, c, c,* for the purpose of drawing off the fused litharge by means of a temporary channel, termed a "gate," *d,* scooped in the substance of the cupel as occasion requires. According to the amount of silver lead alloy to be worked at a time, the metal ring is from two to four feet long and eighteen to thirty-six inches wide, by four to six inches deep, the thickness of bone-ash in the thinnest part being an inch or a little more. The cupel is set in brick work under the arch of a small reverberatory furnace represented in plan in Fig. 4, and in section in Fig. 5, *a–a,* cupel; *b,* fireplace; *c,* bridge over which the flame from the fire passes, being reflected downwards, as it were, by the arch *d,* and passing to the chimney by the flue *e–e,* running finally underground. The oxidation of the lead is greatly quickened by blowing a stream of air over the fused metal, from the nozzle *f,* whilst the operation may be watched from time to time through the door-hole opposite to the nozzle *g.* As the lead oxidizes and the fused litharge are removed by the gate *h,* (running through the perforations in the cupel and being received underneath in an irod truck or "bogie" *i*), the level of the metal in the cupel is kept approximately

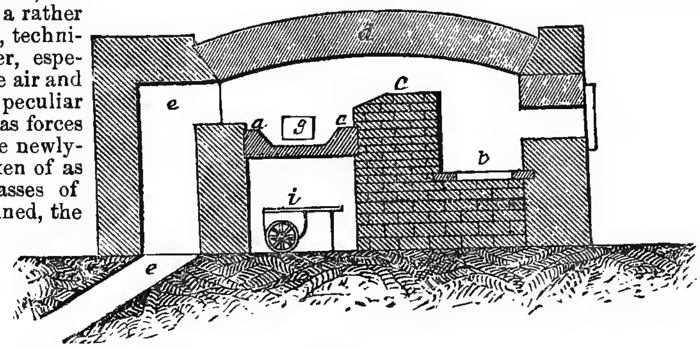


Fig. 5.

constant by running into the cupel through a shute or gutter fused argentiferous lead from the subsidiary pot *k,* in which is a supply of metal, kept molten by a small fire. In this way many cwts. of argentiferous lead are gradually worked up in the same cupel, and ultimately a mass of molten silver of several hundred ounces in weight is obtained. This is drawn off when the operation is finished through a hole bored in the bottom of the cupel; this hole is then stopped up with a plug of ash, and the operation is conducted over again. Usually the finishing of the refining is conducted in a separate cupel, the concentration of the silver by removal of lead, &c., being only carried on up to a certain point in the first cupelling furnace, a somewhat higher temperature being required towards the close of the operation; moreover, the litharge separated at the close of the process is apt to contain a little silver, wherefore it is collected apart and reduced to the metallic state and worked over again as argentiferous lead.

When silver is associated with considerable quantities of copper, the separation of the precious metal is often effected by a combination of processes consisting of three stages; first, a ternary copper silver lead alloy is prepared by adding to the argentiferous copper ore galena (if not naturally admixed therewith), and smelting the whole, or by adding argentiferous lead to a poor silver copper alloy already smelted or otherwise extracted. This ternary alloy is cast into thin cakes weighing three or four cwt. each. Secondly, these cakes are submitted to the process of liquation or "sweating," whereby a rich argentiferous lead runs away in the fluid state whilst the copper remains as a spongy skeleton, which retains a little silver; to extract this, the spongy copper is again fused with lead and the alloy sweated a second time. Thirdly, the argentiferous lead containing a little copper, is either used again for the alloy employed in another first sweating so as to concentrate silver therein, and is then treated by the cupellation process, or is directly cupelled without further concentration, if rich enough. In the case of ores in which copper is absent, or only present in small quantities, but which are very rich in lead (*e. g.* ordinary galena) some ingenious devices are in use for concentrating the small portions of silver present in the lead smelted from such ores, so as to extract it without being obliged to re-oxidize all the metallic lead by cupellation. The best-known process of this kind was invented by H. L. Pattinson, and is hence termed "Pattinsonage." It is based on the fact that if an alloy of lead and silver in which the former metal preponderates be allowed to solidify slowly, crystals form consisting of lead retaining much less silver than the original alloy, whilst the fluid portion is proportionately richer in silver; or in other words, that an alloy of silver and lead melts at a lower temperature than another similar alloy containing less silver, whilst such alloys do not remain permanently commingled but have a tendency to separate one from the other, just as oil and water do after shaking up into an emulsion. In practice the operation is carried out by melting the argentiferous lead in one of the central members of a series of from eight to twelve hemispherical iron melting-pots, each mounted in a separate furnace, but all arranged side by side. When melted, the fire is withdrawn or dampered down and the lead allowed to cool, the formation of crystals being facilitated by sprinkling water on the top and well stirring in the crusts thus produced. By means of a perforated ladle the crystals are fished out and drained, the ladle being supported by chains from a crane overhead, so that its contents can be readily transferred to the next pot on the right-hand side. When about two-thirds of the lead has thus been fished out, the yet fluid portion is transferred to the next pot on the left, and there worked up in a similar fashion along with the "bottoms," or fluid residues of previous operations, or what comes to the same thing, with pigs of argentiferous lead of the same degree of richness. The poorest first crystals in every pot in the series are thus continually passed into the next adjacent pot on the right to be worked over again, whilst the richer bottoms continually travel to the left. Finally, in the two end pots there are formed respectively crystals of lead so poor in silver that it will not pay to work them any further, and bottoms so rich in silver that they are more conveniently cupelled than Pattinsonized. These end limits are usually reached when the lead retains no more than about 300 grains of silver to the ton (⅝ oz.) and when it contains about two per cent. of silver (some 600 oz.) per ton.

Parkes' process for desilverizing lead consists in fusing the argentiferous lead with zinc. From the mixture of metals thus produced, the zinc separates on standing, floating up to the top, whilst the lead remains at the bottom; or rather an alloy of lead and zinc containing about 1¼ per cent. of lead floats up to the top, whilst an alloy of the same metals but containing only about 1½ per cent. of zinc subsides; the lighter zinc alloy is found to contain almost the whole of the silver present. Zinc being a volatile metal, is recovered by distillation from the ternary alloy thus gained, whilst the residual silver lead alloy is cupelled, more lead being added if necessary for the operation. One objection to this process is that the desilverized lead retains zinc, which must be removed by a refining process before the lead is marketable; this is accomplished in various ways, one of the most successful of which is blowing superheated steam through the fused metal, whereby the zinc is oxidized and removed (more or less lead being also oxidized).

Wet Processes.—Among the numerous methods of this kind that have been proposed and worked may be mentioned the process of Augustin for the extraction of silver from copper pyrites; this consists in roasting the ore so as to form oxide of iron and oxide or sulphate of copper with sulphate of silver; the roasted ore is then mixed with common salt and again roasted so that silver chloride[1] is formed (*vide* § 43); the resulting mass is then powdered and treated with warm brine so as to dissolve out the silver chloride, and from the solution thus obtained the silver is precipitated by metallic copper. A modification of this process was proposed by Percy, consisting mainly in the use of sodium with sulphate as a solvent for the silver chloride in lieu of common salt, and precipitation of the silver as sulphide by means of sodium sulphide. With some kinds of ores, carefully roasting suffices to convert silver sulphide present into sulphate, which is dissolved out (along with more or less of the sulphates of other metals) by means of water, and then treated with copper, etc., so as to throw down metallic silver. In Henderson's process for the extraction of copper from cupriferous pyrites containing but little copper (really a modification of Augustin's process), a liquid is obtained containing the chlorides of sodium, iron, and copper, with minute quantities of silver chloride, and much sodium sulphate, etc. To isolate the silver from this solution Claudet employs a soluble iodide, whereby silver iodide is precipitated, the copper being then extracted from the mother liquors by precipitation with iron. The silver iodide is then treated with zinc, whereby metallic silver is formed together with zinc iodide, the aqueous solution of which is used to precipitate the silver from a fresh quantity of liquor; the metallic silver thus obtained contains an appreciable quantity of gold. Another process for treating the same liquid has been recently described by Mr. J. Gibb,[1] as worked successfully on the large scale; this consists in treating the liquors with sulphuretted hydrogen (prepared from alkali waste by hydrochloric acid) so as to precipitate about one-sixteenth of the copper present as sulphide. This precipitate is found to contain practically the whole of the silver; it is separated from the rest of the liquor and dried without draining or washing, so that a certain amount of soluble chlorides still adhere to it. By calcining this precipitate at a low temperature the copper sulphide is oxodized to copper sulphate, which is removed by washing with water, and silver chloride is left in an impure state. From the copper sulphate solution thus obtained the copper is precipitated by means of iron, as is that from the liquor separated from the sulphuretted hydrogen precipitated.

Amalgamation Processes.—The amalgamation processes in use for the extraction of silver from its ores differ from the method employed in the case of gold as described above (§ 46), in that the silver usually occurs mineralized by combination with non-metals, and hence has to be set free from its compounds before it can be dissolved by the mercury, whilst the gold being already in the metallic state usually requires no such treatment. With certain classes of ores the decomposition of the silver compound is effected by the mercury itself, so that a much greater loss of this latter metal is brought about than that due to imperfect condensation during distillation, flouring, and the like. In others the natural silver compound is previously transformed by roasting or other treatment into some other compound more readily attacked by the mercury; whilst in others the separation of metallic silver is effected by means of cheaper reagents, either employed before treatment with the mercury or simultaneously therewith. One of the rudest and most wasteful of these processes, so far as mercury is concerned, is that still largely employed in Mexico, and known as the "Patio" process, being partly carried on in a *patio* or paved space. The ore containing the silver as sulphide, with more or less chloride, is first stamped and then ground with water to a fine powder in a rude but effective mill known as an *arrastre*. The thin mud thus formed is run into a reservoir where most of the water evaporates. The thick paste thus produced is then laid on the patio forming a circular mass of about a foot in depth and forty to fifty feet diameter, weighing some sixty or seventy tons. Salt is then added to the extent of one-fortieth to one-twentieth of the weight and the whole mass well intermixed by treading by mules. After some twenty-four hours from one to two per cent. of "magistral" is added, and the whole again well trodden in and intermixed. The magistral is an impure mixture of iron and copper sulphates, prepared by partially "weathering" copper pyrites by exposure to the air in a wet state, and then completing the oxidation by gentle calcination with a little salt. Mercury is now squirted on to the mixture in a shower by squeezing it through bags or running in from a sheet, and the whole well intermixed by treading; about six parts of mercury are used for every one part of silver present. A chemical action is thus set up and facilitated by turning over and stirring the heap daily for about four weeks. The ultimate effect of this is to form sulphate of soda from the partial oxidation of the sulphur

[1] By virtue of the Reactions—

$$Ag_2S+2O_2=Ag_2SO_4.$$
$$Ag_2SO_4+2NaCl=2AgCl+Na_2SO_4.$$

If unoxidized silver sulphide be present during the roasting with salt, it also becomes converted into chloride, thus:—

$$Ag_2S+2NaCl=2O_2=2AgCl+Na_2SO_4.$$

[1] *Chemical News*, xxxi. p. 165.

in the silver sulphide and its reaction on the salt, together with that produced by the mutual decomposition of the iron and copper sulphates with the salt, forming in addition iron and copper chlorides. Much mercury is lost by conversion into chloride and also by "flouring," the residual mercury dissolves the liberated silver, and is finally separated from the mud and metallic salts by a stream of water. The progress of the oxidation is tested daily, and more magistral added to increase the action if necessary, or lime added to decompose the metallic salts and retard the action if the mass heats too much, as in that case the loss of mercury becomes greater. Finally, the amalgam is placed in large canvas bags holding nearly a ton; much fluid amalgam is thus forced out by weight alone; the residual mass is then squeezed and moulded into wedge-shaped solid masses, which are then piled on an iron plate with a hole in it so as to form a circular kind of dome; over this an iron bell ("capellina") is dropped and its edges luted to the iron plats; burning charcoal is then placed in a temorary cylindrical brick furnace built round the bell, so that the mercury is distilled off from the amalgam, the vapor passing through the hole in the bottom plate into a tube dipping into water in a suitable receiver.

In what is termed the "Saxon," or Freiberg process, the silver ores are mixed with pyrites containiug a little copper (if not already containing such a mixture naturally), and with common salt, and then generally roasted so as to form silver chloride and sodium sulphate, with iron and copper chlorides. The silver chloride thus formed is reduced to the metallic state by placing the roasted mass in a stout barrel with water and lumps of metallic iron, the barrel being rotated for some hours; mercury is then put in and the whole again rotated slowly for nearly a day. Ultimately an amalgam of silver is produced, from which the earthy matters are washed away, and the fluid mercury separated by squeezing; the solid mercurial alloy is then distilled.[1] Various modifications of both the Saxon and patio processes are introduced in certain localities according to the special character of the ores used. At Halsbrücke, where the Saxon process is chiefly employed, silver ores are used containing several metals, notably antimony, bismuth, arsenic, copper, iron, lead, zinc, and sometimes nickel, and cobalt; consequently the crude silver left on distilling the amalgam is very impure. On the other hand the "plata pina," from the Mexican capellina distilling process, is frequently almost fine silver, the impurities averaging about six parts in the 1000 (Makins) whilst the silver from other sources is of intermediate character according to the ore employed.

In order to obtain pure, or, as it is usually termed, "fine" silver, from the impure crude product, refining by cupellation is usually adopted. The metal to be refined is melted along with lead and the whole cupelled; as the lead oxidizes the other metals are also oxidized and removed, so that finally almost chemically pure silver is obtained. If, however, gold or platinum were present originally these metals are contained in the refined silver. Should gold be present, the high value of this metal makes it worth while to extract it by the wet process, consisting of boiling the auriferous silver with nitric or sulphuric acid which dissolves the silver.

PLATINUM.

THIS metal has been known for nearly a century and a half, being originally found in South America and named after silver (*plata*) of which it was supposed to be an impure ore. As experience soon taught this ore was quite unworkable by ordinary metallurgical processes, it was disregarded until the researches of Wood, Berzelius, and Vauquelain, and more especially of Wollaston, and subsequently of Deville and Debray, demonstrated its peculiar properties and their value for numerous purposes, and showed how the metal could be practically worked. Besides occurring in South America platinum is found native but associated with small quantities of somewhat analogous but less used metals, in the Oural mountains and valleys, and in California, Mexico, San Domingo, and Australia. It occurs either as nuggets sometimes weighing upwards of 20 lbs. or as small grains somewhat after the fashion of gold, and is generally found in the alluvial deposits. The accompanying metals, palladium, iridium, osmium, rhodium, and ruthenium, are more or less completely separated from the platinum by processes essentially of one or other of the following three kinds: either the ore is fused by the aid of an oxyhydrogen flame on a bed of lime, by which means palladium and osmium are volatilized, and a fused alloy of the other metals left in which platinum largely predominates, iridium being present only in small quantities, and rhodium and ruthenium only to a yet lesser extent; or the platinum is separated by a wet process due to Wollaston; or an alloy of lead, platinum, and small quantities of palladium, is formed by fusing the platinum ore with galena, litharge, and a flux of pounded glass, the other metals being undissolved by the newly reduced lead (Deville and Debray); from this alloy the lead is removed by oxidation in hot air, after the manner of cupellation, an oxyhydrogen flame being used, the palladium present being thus also expelled.

Of these three processes, the first yields an alloy which is well adapted to the manufacture of crucibles and other vessels intended to resist high temperatures and the action of chemicals, as it is less fusible than platinum and more resistant as to corrosion; but it is not so well suited for the manufacture of large vessels such as sulphuric acid concentrators, in which the junctions are fused together by a skillful application of an oxyhydrogen blowpipe (autogenous soldering). Deville and Debray's process also is apt to yield a less pure metal than Wollaston's, owing to the difficulty in completely removing by subsidence the particles of the other metals undissolved by the molten lead. Hence for certain special purposes (such as the resistance coils of Siemen's pyrometer, § 84), platinum thus prepared cannot be employed even though it have been freed from palladium and osmium by means of the oxyhydrogen blowpipe.

Wollaston's process, by which absolutely pure platinum can, with due care, be obtained, essentially consists in treating the platinum ore with nitric acid, after washing with hydrochloric acid for the purpose of removing any baser metals, magnetic iron ore, &c., present; the latter can to a large extent be separated by a magnet. A mixture of nitric and hydrochloric acids, *aqua regia*, is then allowed to act on the purified ore for some hours or days, certain proportions and strengths being usually chosen, so as to prevent as much as possible the solution of iridium, which mostly remains undissolved in combination with osmium and a little rhodium and ruthenium, forming white metallic scales termed *osmiridium:* about three parts of hydrochloric acid of sp. gr. 1·20, and one of nitric acid of sp. gr. 1·36, will answer well, or analogous mixtures containing about the same percentages of anhydrous hydrochloric and nitric acids. The acid solution of platinum is then treated with sal-ammoniac, whereby platino-chloride of ammonium is precipitated, iridium, rhodium, and palladium being retained in solution. To avoid the possible contamination of the precipitate with iridiochloride of ammonium, it is well washed with water and pressed; the latter salt being much more soluble than platino-chloride of ammonium is thus removed. Finally the precipitate is strongly heated, whereby a spongy mass of platinum is left;[1] this is made into a

[1] By virtue of the following actions; the metallic iron converts the copper chloride present into spongy metallic copper—

$$Fe + CuCl_2 = FeCl_2 + Cu;$$

this reacts on the silver chloride setting free silver and reproducing a copper chloride (cuprous chloride for the most part.)

$$2AgCl + 2Cu = 2Ag + Cu_2Cl_2.$$

If the mercury be added before the silver has been reduced to the metallic state by the first rotating of the barrel and contents, much mercury is lost owing to its conversion into chloride by taking the place of the metallic copper in this second reaction.

[1] The following equations represent the production of ammonium platino-chloride and its decomposition by heat. By the action of the chlorine set free from the aqua regia, platinum chloride is formed—

$$Pt + 2\,Cl_2 = Pt\,Cl_4.$$

On adding sal-ammoniac to this, combination occurs and ammonium platino-chloride results—

$$PtCl_4 + 2\,NH_4Cl = Pt.\,(NH_4)_2\,Cl_6.$$

paste with water and pressed into moulds, which are slowly dried and gradually heated to whiteness and then forged into compact masses; or the spongy platinum is pressed into cakes and fused in a lime crucible by the oxyhydrogen flame. From the mother liquors of the platino-chloride of ammonium more of that salt can be obtained by precipitating all metals by a plate of zinc, redissolving in aqua regia and adding sal-ammoniac; this precipitate is apt to contain iridium. From the final mother liquor palladium is separated by neutralizing with sodium carbonate and adding mercury cyanide solution, whereby palladium cyanide is thrown down from which metallic palladium in a spongy state is obtained by simply heating. The mother liquors of this precipitate contain rhodium: from the osmiridium left undissolved by the aqua regia in the first instance, the metals osmium and iridium with smaller quantities of rhodium and ruthenium are separated by special processes.

Fig. 1 represents one simple form of Deville and Debray's oxyhydrogen furnace from the fusion of platinum, &c.;

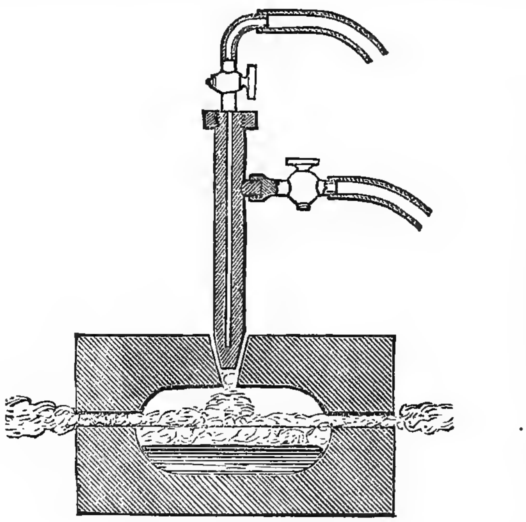


FIG. 1.

the receptacle for the metal to be fused is a compact mass of lime or marble (which immediately becomes converted into quicklime on the inner surface by the heat) hollowed out into a dish shape; this is covered by a similar block in the crown of which is a perforation by means of which the oxyhydrogen flame is made to play

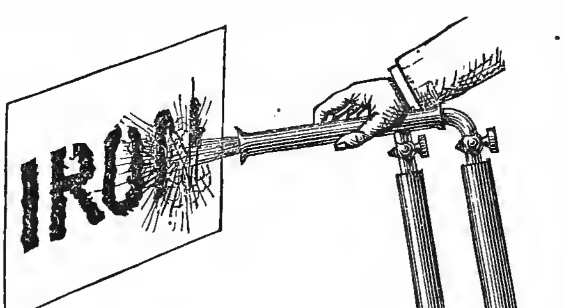


FIG. 2.

inside the crucible furnace; for large masses several distinct flames may be employed. The most convenient form of oxyhydrogen burner for this purpose is simply an ordinary blowing lamp, *i.e.* two tubes arranged concentrically, the combustible gas passing into the annular space outside, and the blast of air or oxygen being passed through the interior tube, the supply of each gas being regulated by cocks. A large flame of this kind supplied with oxygen and hydrogen (best from cylinders of the compressed gases) enables many effective combustion experiments to be made: a steel carving-knife burns with great brilliancy in the flame, and if a large plate of thin sheet iron be held in a vertical position, and the flame cautiously moved over its flat surface, writing may be roughly traced by the perforation of the plate thus brought about (Fig. 2). With even a small flame, such as that used for the lime light, thin platinum foil may be similarly perforated; for this purpose it is not necessary to use hydrogen gas, as ordinary coal gas will often produce the same result; carbon, oxide and oxygen, also, will suffice, the heat evolved in the oxidation of carbon oxide being superior to that produced during the combustion of hydrogen, a given quantity of oxygen being employed.

Compiled from "Metals and their Industrial Applications."

Finally, this compound breaks up on heating, forming sal-ammoniac, chlorine, and platinum—

$$Pt(NH_4)_2Cl_6 = Pt + 2Cl_2 + 2NH_4Cl,$$

the sal ammoniac being to some extent further decomposed by the chlorine in virtue of a secondary reaction.

ZINC.

THE peculiar properties of the alloy of this metal with copper, termed *brass*, have been known from a very early period, many of the so-called antique bronzes containing so much more zinc than tin as to approach much more nearly to brasses than to bronzes in character and composition: these alloys were probably obtained by smelting together a natural or artificial mixture of minerals containing copper and zinc, the processes for the isolation of the latter metal being of comparatively modern origin, depending on the volatility of the metal at a red-heat, *i. e.* being processes of distillation. The chief ores of zinc worked for metallurgical purposes come from New Jersey and the United States, Belgium, Silesia, and Spain, considerable deposits being also found in various parts of Great Britain. They consist mainly of oxide, sulphide, carbonate and silicate, the former being found in New Jersey: *zinc blende* (the sulphide) usually accompanies galena and sometimes pyrites, whilst *calamine* (the carbonate) is found in Derbyshire without intermixture with lead ores, though often it occurs in the vicinity of galena: the silicate (*electric calamine*) is chiefly imported into this country. When blende (known as "black jack" from its color when tolerably pure save a little iron sulphide) is employed as a source of zinc it is subjected to a prolonged roasting for the purpose of burning off the sulphur and forming an oxide of zinc;[1] if lead be contained this roasting must be carried on for a longer period than if the blende be free from this metal: from the oxide thus produced the metallic zinc is reduced by mixing with small coal (anthracite) and heating in a distilling arrangement, in principle not unlike the "capellina" apparatus used for silver amalgam, or in fireclay retorts like those used in the gasworks. Calamine is usually roasted before being submitted to the distillation process, for the purpose of expelling moisture and carbon dioxide and of opening the pores of the mass and rendering it easy to pulverize and mix with the powdered anthracite; frequently a mixture of calcined blende and calamine, or of red zinc ore (oxide of zinc) and calamine is employed instead of one kind of ore only.

The character of the distilling arrangement employed varies considerably in different localities; one of the oldest forms (Fig. 1) consist of a number of large crucibles filled with the mixture of zinc ore and small coal and heated by a reverberatory furnace; each crucible is closed with a cover luted on air-tight: the vapor of zinc and the carbon oxide formed by the heating are conducted out of the crucible through a hole in the bottom, into which is cemented a fireclay pipe passing down through the floor of the reverberatory furnace into a vault below; iron tubes are affixed to the lower ends of these fireclay pipes, dipping downwards into vessels containing water, so that the zinc condenses in the tubes and runs down into the vessels underneath. To

[1] $2ZnS + 3O_2 = 2ZnO + 2SO_2$.

prevent the mass in the crucibles falling down the tubes blocks of wood are inserted into the fireclay pipes; these become carbonized by the heat, and are then sufficiently porous to allow of the vapors passing downwards through them, whilst retaining sufficient strength to prevent the superincumbent solid matter from breaking through them. The iron tubes are cleared out by a rod from time to time lest the condensed zinc and the "fume," or oxide, carried over should block them up.

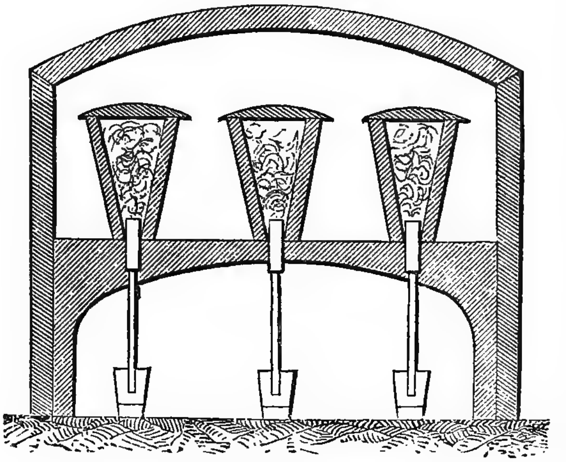


FIG. 1.

In Silesia retorts are used shaped like small gas retorts or large muffles; the vapors are led away into a rectangular downward condensing tube, luted on to the mouth of the retort; several of these retorts, sometimes twenty, are mounted in a "bench" and heated by the same furnace. In what is termed the Belgian process, a large number of retorts are employed mounted in a kind of kiln, each retort being placed at an angle of about 30° with the horizon, the mouths being lowest: short clay condensing pipes are luted into the mouths of the retorts: to these are affixed conical wrought-iron pipes with a narrow terminal orifice some ¾ inch in diameter: the metallic zinc collects in the clay pipes, whilst the iron conical terminals retain a considerable amount of zinc oxide which is collected and used over again with a fresh charge. As many as eighty retorts are sometimes mounted in the same bench, to equalize the rate of working off; those at the top are usually made smaller and are charged with more easily reducible ores, so that the lesser heat communicated to them may not interfere with the process, as a whole, by causing delay through great differences in the time required to work off the charge in each retort. The waste heat from the bench of retorts is employed to roast and calcine ores for a new operation, and to dry and season the fire clay retorts and tubes kept in stock for renewals in case of breakages, &c.

When the zinc ores used contain *cadmium*, this metal is chiefly contained in the first portions of zinc that distil over; the fume which is condensed at the same time is brownish and contains much cadmium oxide; from this fume, or from the cadmiferous zinc, metallic cadmium can be separated, best by a wet process, consisting of solution in acid, precipitation of cadmium sulphide by a current of sulphuretted hydrogen, whereby this metal is completely separated from zinc, conversion of the sulphide into carbonate by solution in acid and precipitation by an alkaline carbonate, and finally distillation of the carbonate, (or of the oxide prepared therefrom by gentle ignition) with lamp-black, whereby metallic cadimum is obtained as a distillate. Metallic cadmium, however, is but little used, the main industrial application of this element being the use of its sulphide as a brilliant yellow pigment; certain of its salts (iodide and bromide) are also employed in medicine and for photography.

—Compiled from "Metals and their Chief Industrial Applications."

THE PHYSICAL PROPERTIES OF METALS.

ONE of the most characteristic properties of metals is the power possessed by them when in more or less compact masses of acquiring (by polishing, pressure, or other mechanical treatment) such a condition of surface that light incident thereon is for the most part again reflected, whereby a peculiar glistening appearance is presented, known as the *metallic lustre.* When fused, lumps are cut with a sharp instrument, or when the metals form crystalline masses which are broken across, the severed surfaces exhibit this peculiar feature; and in many cases when the metal is obtained by chemical action from certain of its compounds, so as to form a deposit on a glass surface (*e. g.* silver), or if the vapor of the metal be condensed on such a surface (*e. g.* arsenic), the glass presents the well-known appearance of a *mirror* of more or less brilliancy according to the nature of the metal, and the way in which it is precipitated on the surface. When prepared by certain chemical processes, the metals often present the appearance of lustreless minute particles, generally black when very small. Metals in this "spongy" condition, however, can often be made to exhibit a considerable amount of brilliancy by strongly compressing a portion of the dry powder against a polished steel or agate surface, when the powder more or less agglutinates into cakes exhibiting lustre on the sides that were next to the polished surfaces; or by simply rubbing in a smooth mortar with a pestle a little of the powder, brilliant streaks are produced by the pressure. Gold, platinum, and silver in particular exhibit this property, the ordinary metals having a strong tendency, when in a fine state of division, to oxidize or rust on the surface; and this greatly interferes with the coherence of the compressed masses, and with their brilliancy when rubbed or polished. If a little spongy silver (prepared by boiling pure silver chloride with sugar and caustic soda, thoroughly washing, and drying) be placed between a pair of dies and compressed by a coining press, a slightly brittle but still coherent coin will be obtained, exhibiting considerable brilliancy on the surfaces that were in contact with the polished portions of the die-surfaces; and an analogous result is obtained if precipitated gold of a dull brown shade (thrown down by ferrous sulphate from gold chloride solution) be employed instead of silver. The peculiar lustre characteristic of metals is, however, not wholly confined to these substances; certain minerals, *e. g.* galena, and some of the non-metals, *e. g.* graphite, occur in nature in masses exhibiting a metal-like lustre when fractured, whilst selenion, silicon, and other non-metals can be artificially prepared in states where they exhibit a closely similar lustre, as can also various compound substances, *e. g.* mosaic gold (tin disulphide). The effect of pressure in heightening the brilliancy of a metallic surface is well seen in the industrial process of *burnishing;* when a layer of metal, such as gold or silver, is deposited by electrical or chemical means on the surface of an object to be silvered or gilt, it usually happens that the freshly covered surface is more or less deficient in lustre, or, as it is technically termed, "dead"; by the skilled application of pressure with a burnisher of polished steel or stone the dead surface is compressed and made to shine with brilliancy. For the final touches on electro-silvered or gilt articles, and for the gilding on china, &c., a burnisher is preferred made of "bloodstone," a compact variety of hæmatite. The ordinary household processes of cleaning and polishing steel and other metallic articles partly depend on the pressure exerted on the surface, although the main action consists in abrading, by means of a fine crystalline powder (usually prepared chalk, or peroxide of iron prepared by calcination of green vitriol or by levigation of burnt pyrites, &c.), the particles of rusted or tarnished metal, so as to display the underlying pure metallic surface.

Owing to the influence of the air, moisture, vapors arising from putrefaction, &c., metallic surfaces, even when highly polished and brilliant, become more or less rapidly tarnished, so that the power of reflecting light is to a considerable extent lost. Before the invention of glass, polished metallic surfaces were employed as *mirrors;* and for reflecting telescopes such surfaces are still in use. Now, however, it is usual to employ as mirrors glass surfaces, behind which a thin coating of some lustrous metallic mass is placed, so that the smooth surface of the glass at once determines the peculiar reflective power of the metal applied to it, and preserves the metal from mechanical injury, and from the corrosion of the air. For this reason these household appliances are ordinarily termed "looking-glasses," although, strictly speaking, it is not the glass that is the essential part. Three principal methods of applying these metallic substances to glass are in use; the best plate-glass mirrors (perfectly plain surfaces) are prepared by spreading out on a table surrounded by a deep groove or gutter, and capable of being raised on hinges so as to be placed at any angle with the horizon, a sheet of tinfoil, and smoothing it with a soft brush; mercury is then poured on and gently rubbed over the tinfoil with a hare's-foot or a roll of flannel, so as to penetrate and brighten the tin; more mercury is then poured on, and the surface cleansed from dross, &c.; finally, the perfectly clean sheet of glass is dexterously slid fluid by slightly warming it before pouring into the vessel to be silvered. It is noticeable that an alloy of three parts of potassium and one of sodium is fluid at the ordinary temperature, being the only metal or mixture of metals known possessing this character, mercury, solutions of metals in mercury, and the newly-discovered metal gallium (under certain conditions) excepted. This mixture possesses the power of adhering to the inside of a glass bottle, forming a well-defined mirror; fused stereotype metal, plumber's solder, and analogous alloys can also, with careful management, be poured into hot glass bottles and shaken over the surface so as to form mirrors of considerable brilliancy, although this method is never practically used. A method which has of late years come largely into use for silvering mirrors of various kinds, and notably the reflectors of telescopes and lighthouses, is based on the power of certain chemical reagents to throw down silver in the metallic state from certain of its solutions, &c., the reduced silver in many

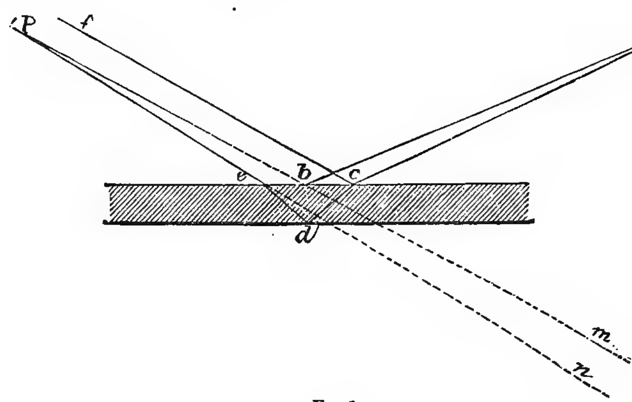


Fig. 1.

over the brilliant mercurial surface in such a way as to avoid enclosing any particles of dust or air-bubbles between the metal and glass. The table is then slightly raised at one end, so that the surplus mercury may gradually run off and be caught in the gutter; and the slope is increased daily, a piece of flannel being placed on the glass with weights on it to facilitate the draining off of the mercury. After two to four weeks, according to the size of the plate, the mirror is complete, the tin amalgam having been completely set, and being tolerably firmly adherent to the glass, although easily rubbed off and scratched on account of its slight tenacity. To preserve the back of the mirror from injury, a suitable wooden frame is provided, in which the whole is fixed, when a finished mirror is the result.

cases adhering firmly to the surface of the vessel in which the action takes place, or to objects immersed in the liquid. Thus, if calcium tartrate in a moist state be placed in a glass vessel with a crystal of silver nitrate and a drop of ammonia solution, and the mixture cautiously heated, and made to flow successively over the whole inner surface of the glass, a fine mirror may be developed. Aldehyde, oil of cloves and other essential oils, grape-sugar, and some other organic substances may also be employed as reducing agents, especially the first substance.

If a "mirror" (*i. e.* a glass surface with a brilliant metallic film behind) be carefully examined, it will be found that in most positions it will give a double image of any object reflected, one image being usually more brilliant than the

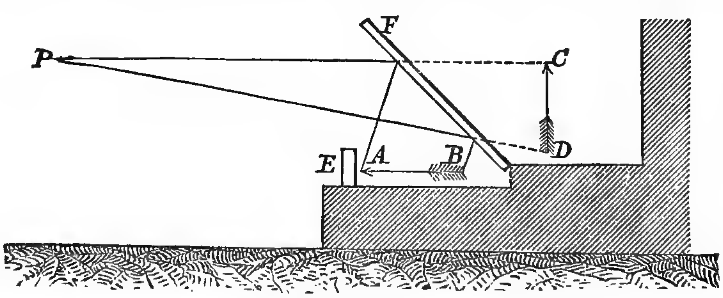


Fig. 2.

For curved surfaces, such as the insides of globes, flasks, &c., for ornamental purposes, a somewhat different plan is employed; a fluid or semi-fluid amalgam capable of adhering to glass is poured into the vessel to be "silvered," and shaken about therein until the inner surface is covered with a film of the composition; the surplus amalgam is then poured out and used for other similar objects. A mixture of one part each of lead, tin, and bismuth, with two parts of mercury, answers well, the mixture being made perfectly

other. Fig. 1 illustrates how this is brought about; a ray of light from an object at *a*, strikes the glass surface at *b*, and is reflected to the eye of the observer at *P*, so that an image is seen situated at *m*. Another ray of light incident on the glass at a point *c*, is partly reflected along *cf*, this portion of the ray consequently never reaching the eye at *P* at all; the rest of the ray enters the glass, being refracted along *cd*; at the junction of the glass and metallic surfaces reflection takes place along *de*, and at *e* the ray is refracted along *e P*, thus also reaching the eye of the observer, but necessarily causing the image formed to be seen apparently situated at *n*, a point different from *m*. The relative quantities of light passing along *e P* and *b P* (that is, the relative brightness of the two images) depend on the degree of obliquity of the incident light *c*; the greater the angle *a b P* (*i. e.* the more obliquely the light falls on the mirror), the brighter is the image at *n*. The power of glass thus to reflect light to a considerable extent without any metallic film behind is utilized in the illusion known popularly as "Pepper's ghost," which consists simply of a large pane of glass sloping forwards from the stage at an angle of about 45° (Fig. 2.) Objects such as *A B*, placed between the footlights *E*, and the pane of glass *F* in a horizontal position, and strongly illuminated, will produce to a spectator in front at *P*, a virtual image or "ghost," apparently situated at *C D*, the illusion being heightened by hiding, by means of screens, all the apparatus in front of the pane from the audience, and darkening that part of the stage behind the pane, the real objects furnishing the ghosts being placed on a dead-black ground. When the lights *E* are extinguished, and other lights illuminating the stage behind the pane turned on, the ghosts disappear, whilst the real actors at *D C* on the stage behind the pane become visible *through* the transparent glass.

Color by Reflection and Transmission.—As a rule, metals reflect visible light of all degrees of refrangibility nearly alike, *i. e.*, most metals appear of a *white* color. Copper, however, possesses the power of reflecting red rays more powerfully than others, and consequently appears red: similarly, gold possesses a bright yellow or orange color, and the alkaline-earthy metals calcium, barium, and strontium, appear slightly yellow. Brass, aluminium bronze, and other alloys of copper possess a rich yellow color, the shade depending on the composition; as a rule, the alloys of a colored and a colorlesss metal exhibit a regular gradation of tint, the color becoming less intense as the percentage of colorless metal increases. Although the light reflected from polished surfaces of most metals is nearly white, yet frequently there is a slight tinge of some color; thus whilst tin, silver, platinum, and others have a nearly pure white color, and hence appear alike when equally burnished, lead and zinc have a bluish shade, and iron and arsenic a greyish hue; these faint tints are best seen by repeatedly reflecting light from the metallic surface, as when a tube polished internally, and open at both ends, is looked into obliquely. The deepening of the yellow tint exhibited when light is once reflected from a gold surface to a red-orange by repeated reflections is readily seen by looking obliquely into an empty metal tankard gilded internally. The pigments and coloring materials largely used in the arts under the name of *bronze powders*, are mainly divers colored alloys stamped and ground to fine powders, and in some cases subjected subsequently to heating and sulphurizing processes so as to develop peculiar shades; *tinsel* is usually paper overlaid with a thin film of silver or other white alloy, and coated over with a transparent colored varnish, or is paper coated with a white or bronze powdered metal, and rolled till the surface is brightly lustrous.

Few metals can be reduced to so fine a degree of tenuity as to allow light to pass through them readily; when this can be done it is usually found that one kind of light is absorbed more readily than others, so that the transmitted light is colored, being deficient in the more absorbed rays. The transmitted light is sometimes complementary to the reflected color, or nearly so, but not invariably; thus gold can be reduced by beating to leaves of thickness not exceeding one two-hundred thousandth inch, and in this condition permits a green light to pass through the color being dependent on the amount of silver added to the gold, the light being more inclined to violet with much silver; by passing electric sparks in vacuo through glass tubes into which metal wires are fused, the glass becomes coated with a continuous film of metallic particles detached from the wires by the sparks; a film of gold thus prepared transmits a fine green light, whilst silver gives a beautiful blue shade. Copper transmits a dull green, and platinum a bluish grey; zinc and cadmium furnish a deep bluish grey, whilst iron films transmit a tint nearly neutral, but slightly brownish.

Density.—Most of the metals used in the arts in the free state are of considerable density, aluminium being by far the lightest, a circumstance which, together with its considerable strength and power of resisting the tarnishing effects of the air, renders it peculiarly suitable for numerous purposes: the draw-tubes of telescopes, opera glasses, &c., and the graduated circles of surveying instruments, &c., are often made of this metal for these reasons. According to the way in which a piece of metal has been obtained, its density will vary somewhat, being increased by hammering or any mechanical action which forces the particles together, *e. g.* wire drawing or sheet-rolling. The following table gives the numerical values of the average densities of most

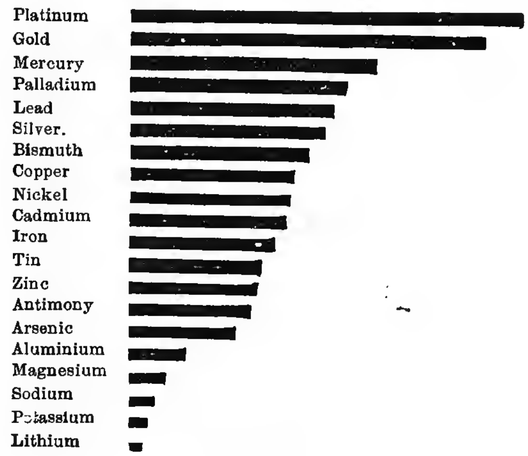


FIG. 3.

of the more important metals, whilst Fig. 3 exhibits the same numbers graphically, the lengths of the lines applied to each metal being the ratios of these numbers.

Specific Gravity of Metals (Water=1.)

Platinum	21.5	Iron	7.8
Gold	19.3	Tin	7.3
Mercury	13.6	Zinc	7.1
Palladium	11.8	Antimony	6.7
Lead	11.3	Arsenic	5.6
Silver	10.6	Aluminium	2.6
Bismuth	9.8	Magnesium	1.8
Copper	8.9	Sodium	0.97
Nickel	8.8	Potassium	0.86
Cadmium	8.7	Lithium	0.59

These numbers necessarily represent the numbers of grammes weighed by one cubic centimetre of each metal; when multiplied by 1,000 they represent approximately the number of ounces per cubic foot. Independently of the changes in density produced by differences in the state of physical aggregation of metals, alterations of temperature of course affect this property, since expansion is caused by increase of temperature, and consequently a given bulk of metal will weigh less at a high temperature than at a lower one.

It is noticeable that the specific gravity of an alloy always approximates more or less closely to that calculated on the assumption that the constituent metals hang together side by side without interference: *i.e. the bulk of an alloy approximates to the united bulks of the constituents.* Thus an alloy of equal *volumes* of platinum and aluminium would, on this assumption, have a specific gravity of 12.05, the calculation running thus:—

		Grammes.
100 cubic centimetres of platinum	weigh	2,150
100 " " " aluminium	"	260
200 " " " the alloy	"	2,410

$$\text{or, 1 cubic centimetre of the alloy weighs } \frac{2410\cdot}{200\cdot} \text{ grammes} = 12\cdot05.$$

On the other hand an alloy of equal *weights* of these two metals would have a specific gravity of 4.64.

$$\begin{array}{llll} 100 \text{ grammes of platinum occupy} & \dfrac{100}{21{\cdot}5} & = 4{\cdot}65 & \text{cubic cents.} \\ \quad 100 \quad \text{"} \quad \text{aluminium "} & \dfrac{100}{2{\cdot}6} & = 38{\cdot}46 & \text{"} \quad \text{"} \\ \hline \quad 200 \quad \text{"} \quad \text{the alloy "} & & \ 43{\cdot}11 & \text{"} \quad \text{"} \end{array}$$

whence 1 cubic cent. weighs $\dfrac{200}{43{\cdot}11} = 4{\cdot}64$ grammes.

In the case of most alloys this proposition is not exactly true, there being generally more or less expansion or contraction during the mixture of the constituents, so that the specific gravity of the alloy becomes either raised above or lowered below that thus calculated: sometimes this difference is somewhat marked, but usually it is not great enough materially to vitiate the generality of the above rule.

Crystallizability.—Some few metals readily assume the crystalline condition on slow cooling after fusion; notably this is the case with bismuth; others do not readily become crystalline, and on this property depends much of their usefulness, as a crystalline texture denotes comparative brittleness. Wrought iron occasionally passes from its normal *fibrous* texture to a crystalline state; this effect appears to be brought about by long continued vibration and subjection to blows, and has been accordingly the cause of various accidents, *e. g.* when a railway axle having become crystalline through long use, breaks owing to the diminished strength thereby caused. Many metals can be obtained crystalline when deposited from a solution by galvanic action; thus lead and silver when slowly precipitated by other metals occur in finely developed crystalline arborescences the formation of which constitutes the familiar experiments of the "lead-tree" and "silver-tree" or *Arbor Dianæ.* Many "native" metals (*e. g,* copper) occur crystallized, being presumably produced by actions of this kind. Frequently the presence of a minute quantity of a foreign metal greatly promotes the crystallization of a metal which becomes crystalline only with difficulty when perfectly pure.

Malleability and Brittleness.—Many metals are sufficiently devoid of the character known as *brittleness,* or tendency to fly to pieces when struck or pressed, to be hammered out into thin leaves, or rolled out into thin sheets; some metals are readily "malleable" at one temperature but brittle at another: in all cases the presence of minute amounts of other metals or non-metallic impurities exerts a marked influence on the degree in which this quality is possessed. Zinc is crystalline and brittle at ordinary temperatures, but can readily be rolled into thin sheets at 100°—150°, whilst at about 200° and upwards it again becomes brittle, and can be powdered in a mortar; sheet zinc for gutters, &c., is therefore rolled hot. Gold is rendered brittle by the presence of traces of antimony; and similar effects on the malleability of many metals are produced by small admixtures with certain other metals, &c. The ten chief metals all possess the power of being extended into thin sheets under the rolling press, and into leaves of greater or less tenuity under the hammer, but to very different extents; lead and zinc falling short of the others, the former on account of its extreme softness and consequent want of tenacity when reduced to thin leaves, the latter on account of the difficulty of working very thin sheets of the metal at the temperature at which its malleability is most marked. They may be thus arranged in order of malleability, the first two being nearly equal:—

Gold, Silver, Copper, Platinum, Iron, Aluminium, Tin, Zinc, Lead, Mercury (solid). It is very probable that mercury (in a frozen state) should be ranged higher up in the series; palladium, like platinum, is highly malleable, though less so than gold or silver, which possess the property to an extraordinary extent; in the ordinary process of gold-beating leaves are obtained so thin that one grain of finished leaves covers at least thirty-five square inches, whilst the extension of this metal can be pushed much further, so that coherent leaves of $\frac{1}{370{,}000}$ inch in thickness have been obtained, one grain of gold covering about seventy-five square inches: the usual thickness of English gold leaf is about double this, or $\frac{1}{200{,}000}$ inch. Silver can similarly be beaten until a given weight of metal is even more extended, one grain covering ninety-eight square inches. The leaves however are not quite so thin as gold leaves, on account of the lower specific gravity of silver. Iron has been beaten into leaves of $\frac{1}{2500}$ inch in thickness.

The manufacturer of thin leaf gold (*gold-beating*) is carried out in the following way. Gold is alloyed with small quantities of other metals according to the color required in the finished leaf; thus there were exhibited in the 1851 Exhibition, by Messrs. Marshall leaves of twelve colors grading from red to nearly white, and designated as—red: pale red: extra deep: deep: orange: lemon: deep pale: pale: pale-pale: deep party: party: and fine gold. The deeper colors are obtained with gold alloyed with from twelve to sixteen grains of copper per ounce and no silver; the middle ones with six to eight grains of copper and twelve to twenty of silver; and the paler ones with from two to twenty grains of silver, copper being omitted. As a curious fact, if silver be added to alloy containing more than eight or ten grains of copper the malleability is sensibly diminished, although no marked ill result is brought about by the addition of silver to fine gold or to gold containing only small quantities of copper. Ordinary gold leaf, such as is used for decorative purposes, contains about twelve grains of silver and nine of copper per ounce. The alloy is heated in crucibles to somewhat above melting-point, cast into ingots, and rolled into ribbons about one and a half inch wide and of such thinness that an ounce extends to a length of about ten feet: no marked difference in malleability is noticeable whether the cast ingot be cooled quickly or slowly. The ribbon is then cut into pieces weighing about six grains each, which are piled between sheets of vellum or parchment paper to the number of about 160 or 170: the *cutch* thus produced is beaten with a seventeen-pound hammer for about twenty minutes, at the end of which time the metal has become extended nearly to the size of the parchments (some three inches square). The rough squares thus formed are quartered and piled again between sheets of prepared gut (*goldbeater's skin*) forming a *shoder* (or *sholder*) consisting of some 700 pieces of metal, the contents of a cutch after quartering being all placed in the same shoder. The beating is then carried on for about two hours with a nine-pound hammer: when the leaves have become extended to the dimensions of the shoder (some four-and-a-half inches square) they are again quartered by a tool made of bamboo sharpened to a cutting edge. These quarters are again piled between fine skin five inches square forming a *mould,* the contents of one shoder filling three moulds (about 900 leaves to the mould). Finally, the mould is beaten for about two hours more till the metal extends to the edges of the skins and here and there flows over: from the finished leaf thus produced squares of three inches and three-eighths are cut from the central portions by a bamboo tool, and piled in a "book" made of soft paper rubbed over with red ochre or red chalk. During the earlier part of the beating the blows are directed mainly towards the center, which causes cracks and rents towards the edges of the leaves; these cracks, however, become perfectly closed up again subsequently as the blows fall on the other portions, the edges of the cracks *welding* together perfectly, so that the finished leaf exhibits no trace of them. The leaves first begin to show light through when the thickness is about $\frac{1}{150000}$ inch, the color being green with gold containing little or no silver, but verging towards pale violet when much of the latter metal is present. The beating is rarely continued until the leaves are less than $\frac{1}{200000}$ inch in thickness, as the saving of the precious metal hardly compensates for the extra labor and the greater waste (through spoiled leaves, and the "pouring over," at the edges of the mould); moreover the thinnest possible leaf does not "cover" so well, being more translucent. Fine gold beats as well as, but not better than that containing small quantities of alloy, whilst it is superior in welding power, so that the leaves are more apt to stick together when one part touches another, and so on. The "mould" skins when old are generally employed for the "shoder," in which the excellence of the skin surface is not of such moment.

Ductility.—Although the property of being drawn into wire is closely allied to that of being rolled or hammered into foil and leaves, yet the two are not necessarily possessed to equal extents by the same metal; gold, silver, and platinum are pre-eminently "ductile," whilst copper and iron are but little inferior to them in this respect. Aluminium and zinc can be obtained in tolerably thin wire, whilst lead and tin have so little cohesion that they cannot be drawn beyond a very limited degree of fineness. On the small scale, wires are readily obtained by casting the metals into thin pencils,[1] slightly pointing the ends of these and passing them into a funnel-shaped hole in a steel plate (*draw-plate*) of suitable size, gripping with pliers the protruding pointed part, and forcibly pulling the whole bar through the hole, the process being then repeated with a slightly smaller hole. Fig. 5

Fig. 5

represents the section of the draw-plate through the holes; a series of holes are generally worked in the same plate, gradually diminishing in diameter from one end of the plate to the other, the complete perforated plate being often termed a "jigger." To obtain greater steadiness in the pull, the pliers should be attached to a band or cord which is gradually wound up on an axle by a handle, the pliers being so constructed that the greater the force required to draw the wire through, the more firmly they grip the end of it: this is easily effected by turning up the handle ends (the panel in which the jaws open being horizontal) and passing over them a triangle of iron to the base of which the band is attached (Fig. 6): the greater the strain on the band, the more firmly is the wire held: the draw-plate is kept in position by being pressed against two vertical projections or "chucks." It is generally necessary to "anneal" the wire from time to time, otherwise it becomes hard or more or less liable to crack or break after having passed through a certain number of holes: "hard-drawn" (or unannealed) wires, however, are usually considerably more capable of resisting tensile strains than the same wires after annealing.

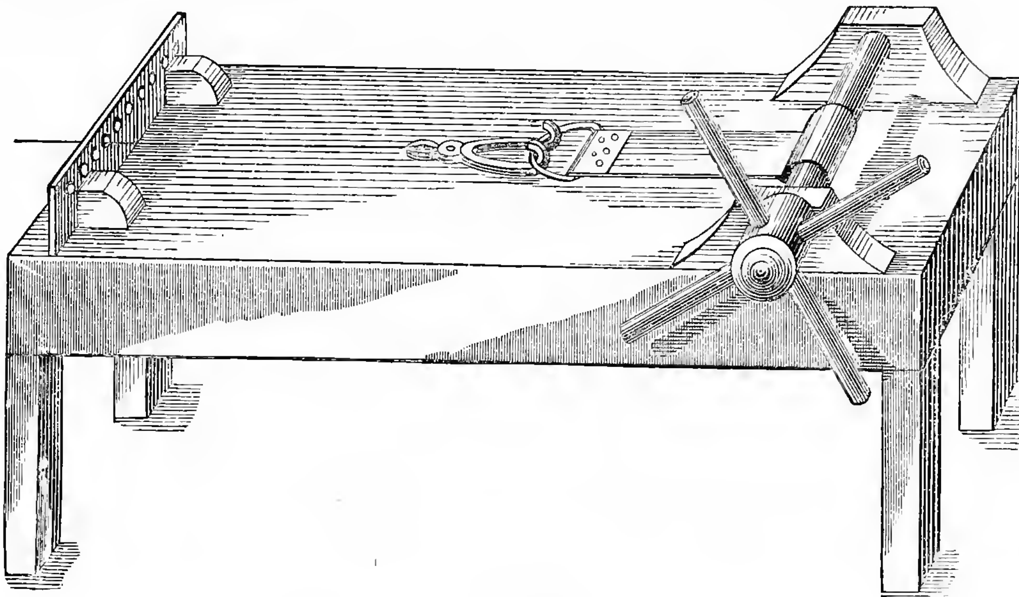


Fig. 6.

In drawing wire on a manufacturing scale, the process is just the same in principle, only, instead of drawing the wire through the draw-plate by hand by means of a wheel and axle, &c., the wire is pulled through by hand with pliers for a foot or two, and this portion then fastened to a revolving drum which then pulls the rest of the wire through, coiling up the drawn out portion on the drum; the wire is then passed through the next smaller hole, being uncoiled from the first drum, and coiled again on a second in so doing, and so on until drawn to the required degree of fineness. In this way the great lengths of wire are drawn at one operation.

Wollaston succeeded in obtaining wires of platinum, gold, and iron of excessive tenuity by first drawing the metals into fine wire, and then casting round this wire a cylinder of another metal, and drawing the compound cylinder again to the utmost possible extent; both the outside metal and the internal wire were thus elongated together; finally, the outside metal was dissolved off by some appropriate solvent, and thus the internal wire was left. To prepare the platinum and gold wires silver was used for the external cylinder, the silver being finally dissolved off by nitric acid. To make the iron wire, silver was also used for the cylinder, but was ultimately dissolved off by means of mercury. In this way a platinum wire was obtained less than $\frac{1}{30000}$ inch in diameter. Some metals require to be heated in order to acquire sufficient softness to enable them to be readily drawn into wire; thus with aluminium. Others are in practice often used in a heated state to facilitate the operation, although the heating is not essential to the ductility of the body. Thus with steel and iron wires or rods of considerable thickness, the "drawing" operation being modified into a kind of rolling, the hot metal being passed between grooved rollers of successfully smaller and smaller grooves. Those alloys which are brittle are necessarily non-ductile, but alloys which are malleable are usually more or less ductile. Brass, a particularly malleable alloy, is also excessively ductile, wires of this alloy having been drawn so fine by means of an ordinary drawbench that seven feet of wire only weighed one grain. It is noticeable that "virgin" brass (made by mixing fresh copper and zinc together, not by remelting old alloy, &c.) is much more ductile than other kinds of brass, even though apparently of the same chemical composition. Many metals which are only drawn into wire with difficulty, can be obtained in a wire-like form by an ingenious process called "squirting." The metal is melted and allowed to cool, and when close upon the solidifying point is forced by mechanical means (hydraulic pressure, &c.) through an orifice of the requisite diameter; the metal, coming in contact with the air, is quickly chilled, and solidified to a wire or rod, which is wound on a drum as fast as it is prepared. By an appropriately formed jet or orifice a long continuous *tube* may be squirted instead of a rod. In this way the ordinary tin, lead, and "compo" tubing used for gas, water, spirits, &c., is manufactured, as is also magnesium wire. Rifle bullets are made by squirting lead into rods half an inch thick

1 For metals of moderately-low melting-points the fused substance may be drawn up into a hot thin glass tube or pipe-stem by suction, and allowed to solidify therein. By fusing the metal in the bowl of a tobacco-pipe and tilting this so that the stem is inclined downwards, the molten metal can often be made to form a rough wire or thin rod in the stem, readily obtainable by breaking away the pipe-clay after cooling.

or so, from which portions are cut off and squeezed into shape by machinery.

Tenacity.—The more crystalline a metal or alloy is the less its power of resisting strains and stresses of various kinds; the more fibrous in structure the better it will resist strain, especially in the direction of fibres.

By forming metals into wires of equal dimensions, and then determining the weight requisite to break these wires, the differences in tenacity exhibited by metals and alloys may be readily demonstrated. A convenient apparatus for this purpose is made of an iron tripod six or seven feet high (Fig. 6), the legs of which are stayed together at the bottom and in the middle; from the top of the tripod is suspended by a stout hook a dynamometer or spring balance furnished with a hook at the bottom, whilst about half way up the tripod is affixed a horizontal axle, supported by the stay in such a position that the centre of the axle is perpendicularly beneath the hook of the dynamometer. This axle is provided with a winch, and round it is coiled a stout rope or leather band with a hook at the end. The wire to be tested is formed into a ring about three or four inches in diameter, the ends being intertwisted and soldered together; the hooks attached to the bottom of the dynamometer and to the rope are then inserted in this ring, and the handle turned so as to wind up the rope and stretch the ring until its form becomes a narrow oblong. The tension is then increased by winding the rope until the wire breaks; the reading of the dynamometer is noted by an assistant at the moment of rupture.

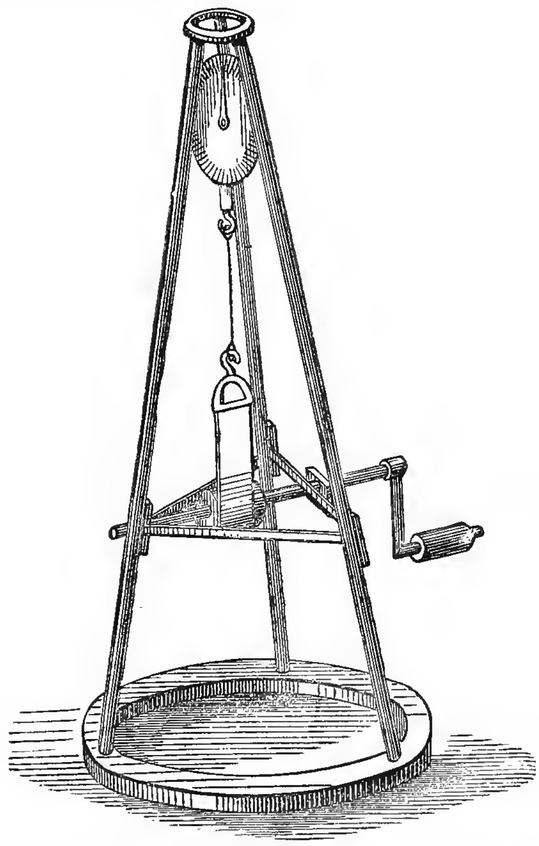


Fig. 6.

In this kind of way the order of tenacity of the metals is found to be as follows:

25 Iron.
16 Copper.
14 Platinum.
12 Aluminium.
10 Silver.
8 Gold.
7 Zinc.
1.5 Tin.
1 Lead

These numbers represent the relative average breaking strains of wires of the same dimensions. The actual value obtained with any particular wire, however, is largely influenced by the purity of the metal, by the character of the strain (whether applied suddenly, or slowly and gradually), and by the physical condition of the wire (whether hard drawn or annealed). Thus, Wertheim [1] obtained the following values representing the weights in kilogrammes required to break wires one square millimetre in section:—

	Gradual strain.	*Strain suddenly applied.*
Cast Steel, hard drawn	—	83·8
" annealed	65·7	—
Piano wire (steel)	70·0	99·1
" annealed	40·0	53·9
Iron wire, hard drawn	61·1	65·1
" annealed	46·9	50·3
Copper wire, hard drawn	40·3	41·0
" annealed	30·5	31·7
Platinum wire, hard drawn	34·1	35·0
" annealed	23·5	27·7
Palladium wire, hard drawn	—	27·2
" annealed	27·4	—
Silver wire, hard drawn	29·0	29.6
" annealed	16·0	16·5
Commercial zinc, drawn	12·8	15·8
" annealed	—	14·4
Pure zinc, cast	4·5	—
Gold wire, hard drawn	27·0	28.4
" annealed	10·1	11·1
Cadmium, drawn	2 24	—
" annealed	—	4·8
Lead, cast	1·25	2·21
" drawn	2·07	2·36
" annealed	1·80	2 04
Tin wire, hard drawn	3·45	3·00
" annealed	1·70	3·62

Somewhat different values have been obtained by other experimenters, the difference being probably mainly due to the presence of minute traces of impurity in the metals examined, etc. Thus Matthiessen gives the following values, somewhat different from the above. The numbers represent the number of pounds weight required to break hard-drawn double wires, No. 23 gauge.

Steel	above	200
Iron		80—90
Platinum		45—50
Silver		45—50
Copper		25—30
Gold		20—25
Tin	under	7
Lead	"	7

Wires sometimes vary very much in tenacity at different temperatures; as might be anticipated *a priori*, those metals which melt most easily become most weakened on heating. Thus Wertheim (*loc. cit.*) found the following values for various annealed wires (as before in kilogrammes per wire of one square millimeter section.

	At 15°.	*At* 100°.	*At* 200°.
Iron	46 9	51·1	46·9
Copper	30·0	22·1	—
Platinum	23.5	22·6	19·7
Silver	16·0	14·0	14·0
Zinc	14·4	12·2	7·3
Gold	10·1	12·6	12·1
Cadmium	4·8	2·6	—
Lead	1·8	0·5	—
Tin	1·7	0·85	—

Thus lead, tin, cadmium and zinc, which melt the lowest of the above, are from only one-half to one-third as strong at 200° as at 15°; copper, silver, and platinum are much less weakened on heating; whilst iron and gold are actually stronger at 100° than at 15°, and are but little weaker at 200° than at 100°.

Certain alloys possess much greater strength than their constituents, and on this property depends much of their practical use; thus gun-metal, standard gold (gold copper alloy), a silver platinum alloy used for electrical purposes, steel, and phosphor bronze (which last two may be regarded as analogous to alloys) are much more tenacious than either of their constituents severally: thus Matthiessen found the following values (as before in pounds per double wire, hard drawn, No. 23 gauge).

[1] *Annales de Chimie,* [iii.] xxii. 440.

Metals Separately.		*Alloys.*	
Copper	25–30	Gun-metal containing 12 per cent. tin	80–90
Tin	under 7		
Copper	25-30	Standard gold: gold copper alloy, (22 carat gold)	70–75
Gold	20–25		
Silver	45–50	Silver platinum alloy (⅔ silver, 3 platinum)	75–80
Platinum	45–50		
Iron	80–90	Steel	above 200

As a general rule, however, the effect of alloying metals together is to impair their tenacity; thus gold is rendered brittle by the presence of a trace of antimony, and an alloy of two parts tin and one of platinum is quite brittle. As already stated, the union of non metals with metals usually wholly destroys the metallic characters, and in particular this chemical union usually gives rise to a product possessing but little toughness and tenacity, such as is requisite for manufacturing purposes, (such products as glass, earthenware, bricks, and various minerals, etc., excepted). Steel and phosphor bronze, however, as above stated, form notable exceptions to this rule, the presence of one per cent. or less of carbon in the first, and of a like quantity of phosphorus in the second, communicating to the substances iron and bronze a considerably greater power of resisting wear and tear and other special qualities. The accurate determination of the tensile strength of wire ropes, bars, etc., of their power of resisting crushing and transverse strains, bending and twisting agencies, etc., is of very great importance to the architect and engineer. Ingenious and powerful machinery for this purpose has been constructed by Mr. David Kirkaldy,[1] whose machines will measure any kind of strain or stress from ten to one million pounds, applied not only to metals but to wood and building materials generally. Modifications of this testing machinery are employed in some iron works, etc., for the purpose of continually examining the strength and value of certain of the products, (*e. g.* Bessemer rails and the like).

Other Physical Properties.—Closely connected with the physical structure which enables metals to exhibit the phenomena of crystallization, malleability, and ductility is the power which some possess of returning to their original shape when deflected therefrom by some external force not too great (*elasticity*); a property possessed to an extreme degree by good steel. The operations of wire-drawing, rolling, hammering, and the like generally increase the elasticity of metals, whilst annealing and fusing usually diminish it. Some metals are almost wholly devoid of elasticity; thus lead scarcely exhibits a trace of this property, being so soft that it is readily abraded by the nail. Some metals and alloys, when worked into appropriate shapes and struck, continue vibrating for some time, and hence are powerfully *sonorous*, (*e. g.* aluminium, bell-metal, steel, standard gold, etc).

The chief value of many metals and alloys for industrial purposes lies in their possession to a greater or less extent of a combination of properties of somewhat opposite kinds; whilst they possess sufficient rigidity to keep their shape even with moderately hard usage and to bear "wear and tear," when once fashioned into articles of domestic and everyday use, they have power of yielding to pressure, &c. to a sufficient extent to enable them to be readily worked into these forms. In some cases the requisite softness for this latter purpose is hardly attained until the temperature is considerably raised; thus most articles of wrought iron are made when the metal is softened by heat so as to yield readily to percussion (*forging*) and other shaping processes. Closely connected with this softening or incipient conversion into a pliable mass of heat, is the phenomena of *welding*, or the adherence together of two separate metallic masses when united by pressure in such a way as to form a joint as strong as the other parts. Iron and plantium possess this power at a high temperature; sodium and some of the rarer metals at the ordinary temperature; gold also can be welded cold, under certain conditions, as in gold-beating. On the possession of these properties depend most of the metal-fashioned crafts, those where the metals are fused and cast being the main exceptions.

Thus in the manufacture of steel pens, as carried out by Messrs. Gillott & Sons, there are no less than eighteen stages between the conditions of bar steel and finished pen; and most of the stages are different applications of these properties of metals in reference to the shaping of the material into the required form. The bar steel is first converted into thin sheets, which are again rolled to the requisite degree of thinness; from the rolled steel "blanks" are punched out by a machine, leaving a kind of skeleton or network of "scrap steel" (Fig. 7), which is melted up or welded together and used over again. Two "side slits"

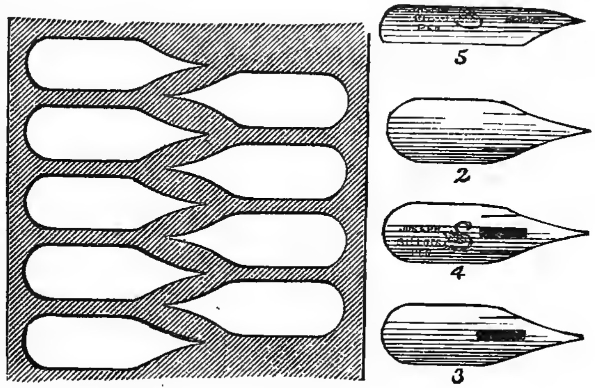


Fig. 7.

are then made in the blank (No. 2), and a somewhat wider centre slit (No. 3) pierced, a portion of metal being punched out in making the orifice; the metal is then annealed and marked with the maker's name; a device or trade mark is raised by embossing (No. 4), and then the hitherto flat pen is converted into a portion of a cylinder, or curved (technically, "raised") by a suitable machine No. 5); after which it is hardened, tempered, and cleaned by scouring with emery, &c.; the tip is then "straight-ground," *i. e.* the metal is thinned at the writing end by grinding in the direction of the length of the pen, after which it is "cross-ground," in the transverse direction. Finally the slit from the nib to the punched-out central part is cut, and the pen is colored and varnished for sale. Similarly the production of an ordinary pin necessitates a number of stages in the shaping process, which is thus carried out by Messrs. Taylor of Birmingham. Virgin brass having been cast into thin elongated bars, is drawn into wire of the required diameter, which is supplied to the pin-making machine from a drum on which it is coiled. The end of the wire is adjusted to the machine, which gradually draws it through a series of pegs so arranged as to straighten the wire and take the curve from the drum out of it; the wire next passes into a kind of die, when a rapidly acting hammer strikes the slightly projected end in such a fashion as to flatten it out and fit it into an expansion in the end of the die groove forming the "solid head" (formerly the head was made of a coil of thinner wire slipped over the pin wire, and hammered into shape; such heads were liable to come off). The head being completed, a knife cuts off the proper length from the wire, and the partially made pin is detached from the die and falls into a groove in which it is suspended by the head whilst the other end is abraded to a point by a kind of revolving cylindrical file. All these operations are performed automatically by the machine, and so rapidly that 200 complete pins are turned out of the machine per minute. Finally the pins are cleansed by agitation in barrels with fuller's earth and water, washed, and coated with tin by boiling with granulated tin and cream of tartar, &c.

Again the manufacture of table-spoons and forks, many kinds of brass-work, cutlery, percussion-caps, copper pans and kettles, medals and coins, and a thousand-and-one articles of every-day use, all depend upon the possibility of forcing the metal into various shapes without fracturing it, by mechanical processes, such as forging, punching, pressing, embossing, and the like. One of the prettiest illustrations

[1] Testing and Experimental Works, 99 Southwark Street, S. E. The specimens in Mr. Kirkaldy's museum, illustrating the results arrived at with many years' employment of his testing machinery on all sorts of material, are of a most interesting and instructive character.

of the application of pressing and shaping force as afforded by the processes in use for "tea-pot spinning," *i. e.* the production of Britannia-metal teapot by a process technically termed *spinning*.

The alloy being rolled into sheets of convenient thickness, a circular disc is cut out and placed in a kind of lathe as represented in Fig. 8, the metal disc being pressed against a

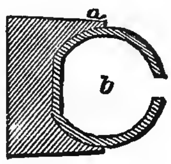


Fig. 8.

nearly hemispherical wooden chuck *a*. The lathe being set in motion the workman presses against the off-side of the disc with a peculiarly shaped tool *b*, held steadily by means tools held one in each hand and applied, the one within and other without the rim of the bowl, the metal is gradually bent inwards as it revolves, so as finally to take an almost globnlar shape; Fig. 10 indicates the closing state of this operation, the nearly globular bowl thus formed being shown in section in Fig 9 *b*. Finally the lid, spout, handle, &c, are attached, and the whole brightened and polished for the market. During the spinning the edge of the disc, some forty or fifty inches in circumference, becomes diminished to almost half that in the bowl, and to about one quarter in the globular pot, the metal being thus as it were pressed in upon itself, as well as somewhat extended, the superficial area of the outside of the globular pot being somewhat greater than that of one side of the circular disc used in the first instance. In a similar fashion jugs and analogous vessels are "spun up," out of plates, the lips for pouring being subsequently shaped by carefully hammering or pressing out the metal on a wooden or metal mould. Silver articles, *e. g.* bowls, teapots, &c., are frequently curved by an analogous operation; the second stage, however, cannot so well be ap-

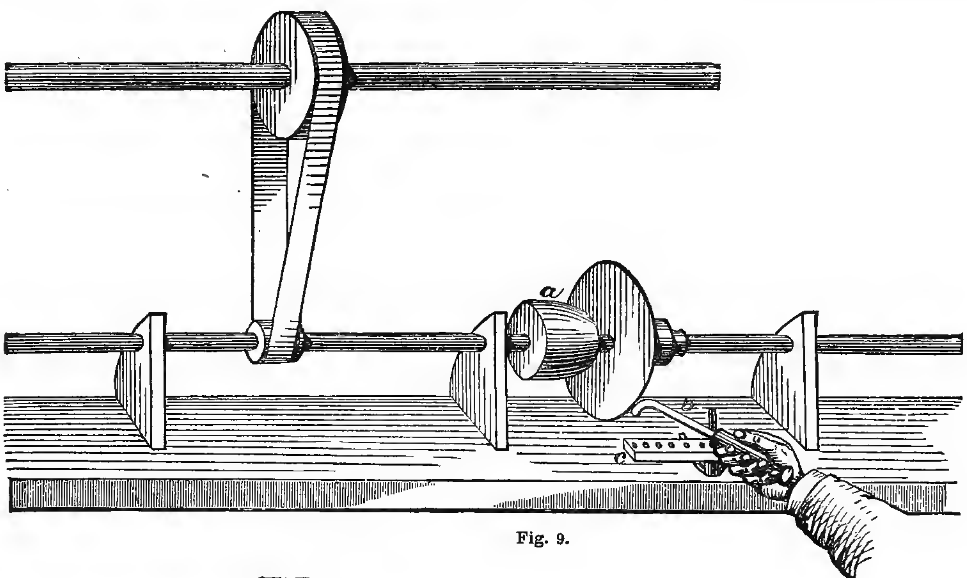


Fig. 9.

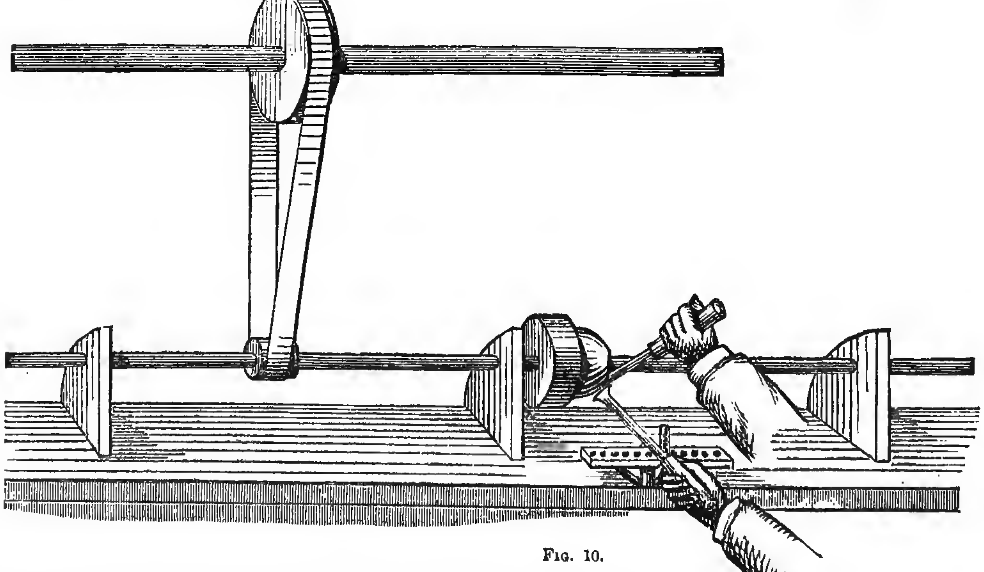


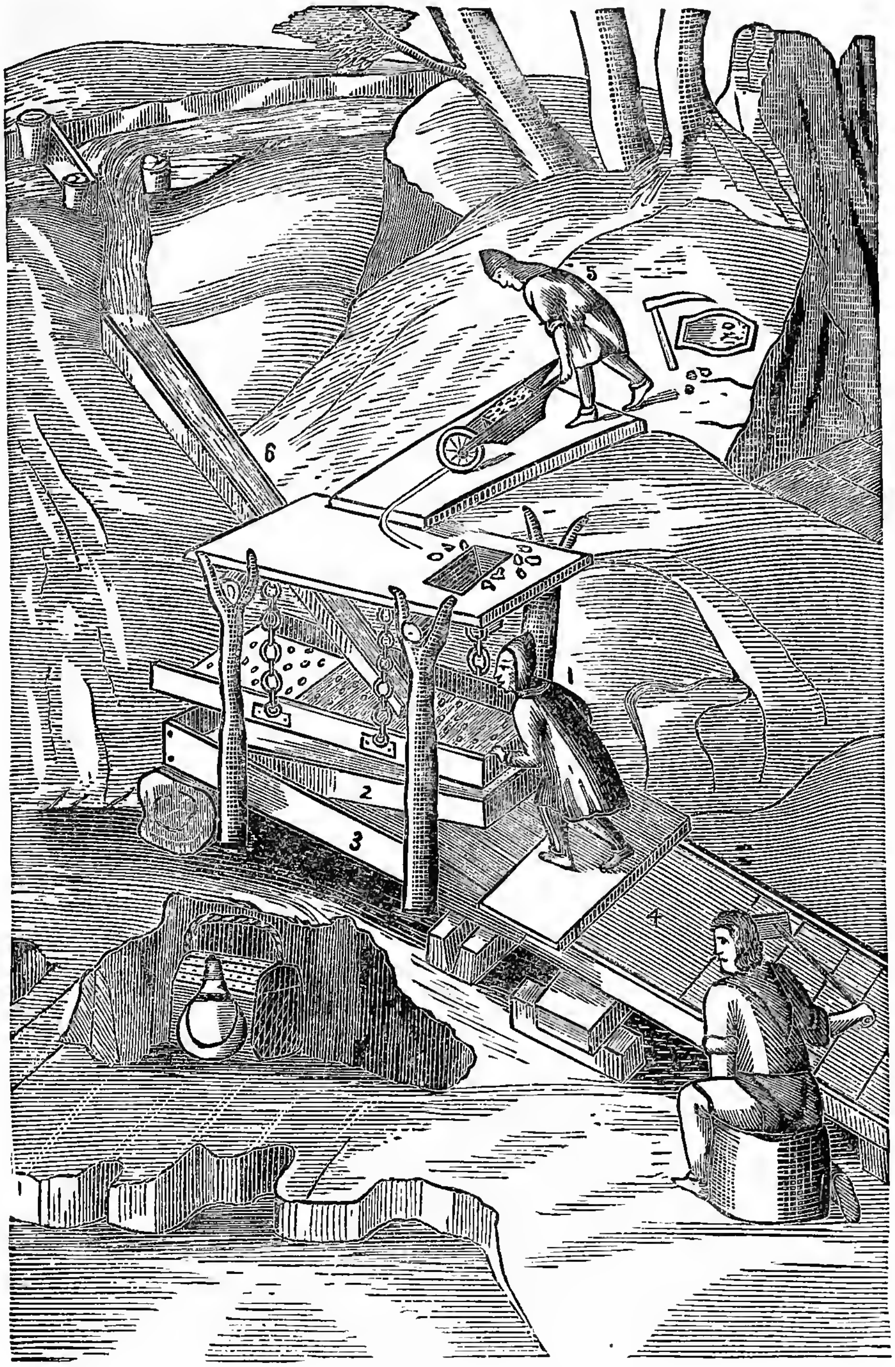
Fig. 10.

of the rest, *c*, so as gradually to bend the disc over the mould, *a*, and so to convert the disc into a bowl. The bowl thus formed is taken off the lathe and set with the convex part fixed into the concavity of a hollowed-out chuck (shown in section *a* Fig. 9); by the aid of two diffierently shaped plied to silver, so that if a closed-in vessel is required like a teapot, it is usually made in two halves, neatly soldered together.

—*Compiled from "Metals and their Chief Industrial Applications.*

WASHING GOLD ALLUVIA 200 YEARS AGO.

DURING the spring of 1881 Mr. Melville Attwood F. G. S. read before the California State Geological Society a paper "On the Milling of Gold Quartz" which contained the following interesting statement:



MACHINE FOR WASHING GOLD ALLUVIA 200 YEARS AGO.

"If we search the records of past times, we shall find that a great deal has been done years ago, which might be applied with great advantage even at the present time, in proof of which examine the drawings which I have brought for your inspection. The engraving I copied from Sir John Pettus' book on the "Laws of Metals, &c.," published in 1683, nearly 200 years ago. You will see how much better it is calculated to wash gold alluvia than our modern rocker.

An explanation of the engraving, taken from the book referred to, is as follows:

1. The man that worketh with the rattar.

2. The middle floor whereon that which goeth through the rattar doth fall.

3. The lower floor whereon that which cometh from the middle floor doth fall.

4. The plain receiver of that which falls upon both.

5. The person that stands on a board and out of a wheelbarrow throws the matter or ore, into the tunnel which guides it into the ratter.

6. The channel in which water doth run into the rattar.

"Then some of the gold washers use upon their hearths the strong timode black and russet woolen cloth, over which they drive their works, because the woolen cloth is rough and hairy, so that the small and round grains of gold will remain, and not run forth (as it will from the timode), whereby the gold upon the black cloth may apparently be known, though it be small and little. Others use instead of the timode or black woolen cloths, linsey-woolsey (half linen and half woolen; wrought in the manner as the timode is), upon which the gold doth stick better, and such cloths do last longer, because of the linen that is among the woolen, which doth strengthen it; therefore it is better for this work."

HYDRAULIC MINING IN CALIFORNIA.

IN crossing ravines, flumes or wrought iron pipes are used. Many miners object to flumes on account of their continual cost and danger of destruction by fire. Where used, and practicable, they are set on heavier grades than ditches, 30 to 35 feet per mile, and, consequently, are proportionately of smaller area than the ditches. In their construction a straight line is the most desirable. Curves, when required, should be carefully set, so that the flume may discharge its maximum quantity. Many ditches in California have miles of fluming. The annexed sketch will show the ordinary style of construction.

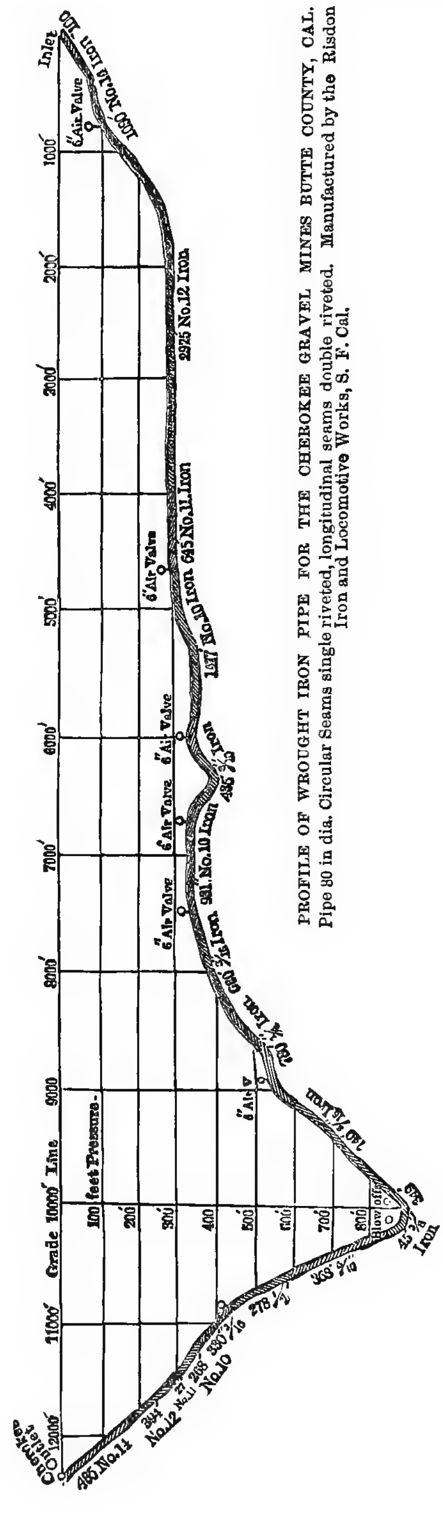
Table showing Details of Construction of Wrought Iron Pipe for the Spring Valley Water Company of San Francisco.

Thickness of the Bands.	*Width of the Bands*	*Thickness of the Sleeves.*	*Width of the Sleeves.*	*Width of the Sheets used in the Pipes.*	*Thickness of the Iron used in the Pipes.*	*Diameter of Rivets used.*
Inches.	*Inches.*	*No.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
6-16	4½	11	5½	42	¼	½
¼	4½	11	6½	42	3-16	½
¼	4½	11	5½	44	3-16	½
¼	4½	9	6½	42	No. 9	⅜
¼	4½	9	5½	40	No. 11	5-16
¼	4½	9	5½	42	No. 11	5-16
¼	4½	9	5½	40	No. 12	6-16
¼	4½	9	5½	38	No. 12	5-16

Pitch of the Circle Seams in the Outside Courses.	*Pitch of the Circle Seams in the Inside Courses.*	*Amount of two Laps.*	*Space Between Double Row.*	*Length to the Joining Holes in the Outside Courses.*	*Length to the Joining Holes in the Inside Courses.*	*Whole Length of the Outside Courses.*
Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1.45229	1.4106233	2	1.10	36.63931	55.01431	59.739
1.45229	1.4207516	2	1.10	56.63931	55.40931	59.73931
1.45229	1.4267515	2	1.10	56.63931	55.40931	59 73931
1.197	1.7915	1.625	.625	67.456	66.5999	59.706
,9934692	.9816157517	1.5	.625	57.6212136	56.9337136	59.746
.9934692	.9816157517	1.5	.625	57.6212136	66.9337136	69.746
.9934692	.9837709	1.25	.625	57.6212136	57·0587136	59.496
.9934692	.9837709	1,25	.625	57.6212136	57.0587136	59.496

Whole Length of the Inside Courses.	*Spaces in the Circle Seams.*	*Pitch of the Double Row.*	*Spaces in the Double Row.*	*Amount of the two Outside Spaces of the Double Row.*	*Amount of two Laps for the Double Row.*
Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
58.114	39	1.7223	22	2.1094	2
58.51931	39	1.7223	22	2.1094	2
58,50931	39	1.7223	23	2.3071	2
68.8492	48	1.468	26	2.207	1.625
69.0573	58	1.468	25	2.05	1.25
59.0573	58	1.468	26	2.332	1.5
58.9333	58	1.468	25	2.05	1.25
58.9333	58	1.468	24	1.518	1.25

The planking ordinarily used is of heart sugar pine 1½ to 2 inches thick, and 12 to 18 inches wide. Where the boards join, pine battens 3 inches wide 1½ thick cover the seam. Sills, post and caps support and strengthen the flume every four feet. The posts are mortised into the caps. The sills extend about 20 inches beyond the posts, and to them side braces[1] are nailed to strengthen the structure. This extension of the sill timbers affords a place for the accumulation of snow and ice, and in the mountains such accumulations frequently break them off, and occasionally destroy a flume. To avoid damages from slides, snow and wind storms, the flumes are set in as close as possible to the bank, and rest, wholly or partially, as the general topography and cost will admit. Stringers running the



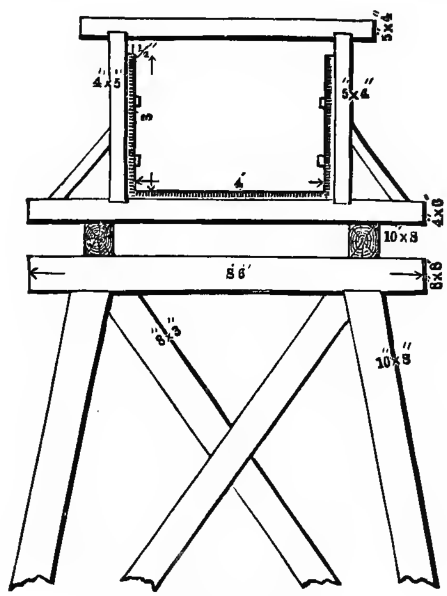
PROFILE OF WROUGHT IRON PIPE FOR THE CHEROKEE GRAVEL MINES BUTTE COUNTY, CAL.
Pipe 30 in dia. Circular Seams single riveted, longitudinal seams double riveted. Manufactured by the Risdon Iron and Locomotive Works, S. F. Cal.

entire length of the flume are placed beneath the sills just outside the post. They are not absolutely necessary, but in point of economy are most valuable, as they preserve the timbers. As occasion may demand the flume is trestled, the main supports being placed every eight feet. The scantling and struts used are in accordance with the requirements of the work.

[1] Side braces and extra extension of the sill are in many cases only an unnecessary expenditure of money.

Wrought Iron Pipes.—The use of sheet iron pipes for conveying water in large quantities originated with the hydraulic miner. The insignificant weight, coupled with their great strength (tensile), admirably adapted them to the service for which they have been employed.

The general sizes of the pipes used in the mines are 40, 30, 22, 15, and 11 inches in diameter, of riveted light sheet iron, No. 16, 14, or 12 iron, Birmingham gauge, made in lengths of about 20 feet, and put together in a stove-pipe fashion, neither rivets nor wire being used to hold the joints in place.



SKETCH OF FLUME.

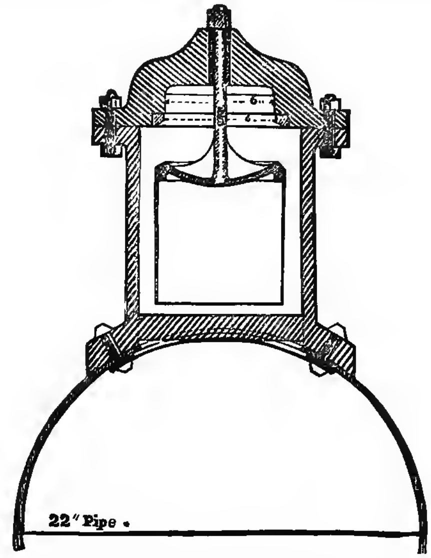
These pipes are light and can be readily and cheaply moved; this in hydraulic mining is of great importance, as it is often requisite to change the position of the lines of pipe. Pipe put together in this rough manner will remain tight when subjected to even as great a pressure as 240 pounds to the square inch. When the pressure requires it, lead joints are used. (See sketch.) *A* represents the pipe; *B* the iron sleeve, between which and the pipe the lead, represented by the dotted lines, is poured. *C* is the flange, bolted to one length of the pipe on the inside for the other pipe to fit over, as shown. Though roughly made and of very light iron, this kind of pipe (connected more like stove pipe than water pipe) is found in practice to be more serviceable, and from its form floating particles of matter readily render it water-tight. Such a pipe, 12 inches in diameter made of No. 18 iron is riveted in the longitudinal seams every 1 to 1¼ inches, whilst in the round seams the rivets may be as much as three inches apart; the rivets small ones, one-eighth or an inch in diameter, showing daylight between the iron, but after water has run through the pipe a short time nearly every leak stops. If necessary, however, 1 or 2 bags of sawdust and a few shovelfuls of earth put in the inlet, will usually make all tight.

This class of pipe is now being replaced by one of better make on which the round seams are made with rivets three-quarters of an inch apart, and the longitudinal seams are double riveted with rivets one inch apart in the row, and with about one-half inch apart from one row to the other. If riveted with care such pipes, after being dipped in an asphaltum bath, are excellent and will last for many years. For the asphaltum bath the following preparations can be used:

Crude asphaltum	28%
Coal tar (free from oily substances)	72%
Or,	
Refined asphaltum	16½%
Coal tar (free from oily substances)	83½%

When the mass has been boiled to a proper consistency, and by test the coating is found to be brittle, it at once indicates that the mixture has been boiled too hot, or that there was too much oil in the tar or asphaltum. After the pipes are dipped they are raised out of the bath and the superfluous asphaltum allowed to drip off, so there is no waste.

Thickness of the Iron, Rivets, Etc.—The thickness of the iron is usually proportionate to the head of water and the diameter of the pipe. Pipes made of the different sizes of iron here mentioned will stand the following strain per sectional inch:



AIR VALVE FOR 22-INCH WATER PIPE.

No. of Iron.	*Made to stand strain per sectional in. Lbs. avd'ps*
12	7,000 to 9.000
12 to 9	9,000 to 12,000
9 to 3-16	12,000 to 14,000
¼ to ⅜	17,000 to 18,000

The head of the water in pounds avoirdupois, multiplied by the diameter of the pipe in inches and divided by the above co-efficients, gives twice the thickness of the iron to be used. Allowance must be made for the security required; that is, if the breakage of the pipe will cause much damage, it is advisable to lower the margin for greater safety.

The diameter of the rivets used are

No. 18	*No.* 16	*Nos.* 14, 12, 11	*Nos.* 10, 8, 7,	¼ in.	5-16 in.	⅜ in.
5-92 in.	6-32 in.	5-16 in.	⅜ in.	½ in.	⅝ in.	¾ in.

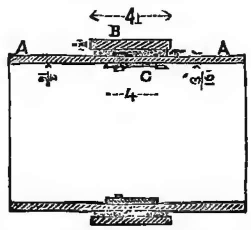
and are usually spaced to make the pipe light, that is, closer than is necessary for the strength of the seam; but this in turn is governed by the pressure on the pipes.

When the pipe is made and put in position, air valves are provided to allow the escape of air from the pipe whilst filling, and especially to prevent any collapse should a break occur. These valves are of many forms, the most usual being a piece of leather loaded and forming a valve opening to the inside of the pipe, and when shut covering a plain hole of from one inch to four inches on the top side of the valve. Where required a better class of valve is used, which sinks and opens when the water leaves it, and floats and shuts when the water rises up to it. (See sketch.) An important point is the admission of the water in the pipe in such a way as to prevent air from being sucked into and travelling along the pipe, which will happen and in large quantities unless the water is regulated. The best plan is to put a gate in the pipe a little below the level where the water enters it, and regulate the flow by this gate, and by this means a steady pressure without violent oscillation can be obtained. Usually, however, the water first flows through a funnel-shaped pipe, which allows the air to escape as it enters, and with a little care this can be made to answer very well. In some instance an air or stand pipe is put in a distance from the entrance or inlet. This catches the air as it travels along the top of the pipe and allows its escape.

The following table shows the usual distances of rivets for corresponding thickness of iron; items relate to 22-inch wrought-iron pipe:

Thickness of the Iron used.	*Diameter of the Rivets.*	*Length of the Rivets.*	*Pitch of the circle seams.*	*No. of Rivets in each circle seam.*	*Pitch of the rivets in the longitudinal seams or double row.*	*Width between the centers of the rivets in the double row.*
No. 12	5-16 in.	⅜	1 in.	69	1⅜	⅝ in.
No 11	5-16 in.	⅝	1 in.	59	1⅝	⅝ in.
No. 9	⅜	1 3-16 in.	1 3-16 in.	59	1 7-16 in. full	⅝ in.
3-16 in.	½	1¼ in.	1 7-16 in.	33	1 11-16 in. full	1 1-10 in.
¼ in.	½	1½ in.	1 7-16 in.	39	1 1 -16 in. full	1 1-10 in.

The accompanying figures[1] given in tabular form show the details of construction of wrought iron pipe 18 inches in



LEAD JOINT FOR PIPE.

diameter, 5,800 feet long, manufactured by the Risdon Iron and Locomotive Works, San Francisco, for the Spring Valley Water Company, which supplies the city of San Francisco. The information here afforded to mechanical engineers is sufficiently explicit for the construction of wrought-iron pipes.

This pipe has a tensile strain of about 5,000 or 6,000 pounds per sectional inch, and has been made with this low coefficient in order to withstand the pulsation caused by a single acting plunger pump, making as high as 36 single strokes (four in length) per minute.

These oscillations are found in practice to run from five to nine pounds per stroke when the air vessel is properly charged, otherwise by carelessness it may exceed 50 pounds per stroke.

At Cherokee there is an inverted siphon of wrought iron. The pipe has an approximate inner diameter of 30 inches, discharging 52 cubic feet of water per second. It has been in continuous use for five years, and now in first-class order. The iron used was ordinary English plate of fair quality. The greatest pressure it sustains is 887 feet, and the thickness of the iron at that point is three-eighths of an inch.

The annexed[2] plan, taken from the original survey on file in the office of the company, shows the line of the pipe and different sizes of iron used in construction of the siphon. The maximum strains on the several sizes of iron used are given in the following table.

Size of Iron.		*Greatest Pressure.*		*Maximum tensile strain on iron per square inch in pounds.*
No.	*Thickness in decimals of an inch.*	*Feet.*	*Pounds.*	
14	.083	170	74	13.374
12	.109	288	125	17,202
11	.012	293	127	15,875
10	.134	355	154	17.240
3-16	.187	435	188	15,080
½	.250	594	257	15,420
5-16	.312	842	365	17,594
¾	.375	887	384	15,360

The Virginia Water Company, Nevada, have constructed a similar wrought iron siphon, 11½ inches in diameter. The maximum pressure in its greatest depression is 1,720 feet, equal to 750 pounds per square inch. The thickness of the iron at the lowest point of depression is No. 0. The pipe was hot-riveted, ⅝ inch rivets, double row on straight seam and single row on round seam. This pipe, when tested, is said to have stood a pressure of 1,400 per square inch.[1]

A paper by Augustus J. Bowie, Jr., A. B. Transaction American Institute of Mining Engineers.

[1] The data were obtained from Joseph Moore, M. E., Supt. of the Risdon Iron and Locomotive Works, under whose immediate direction the pipe was constructed.

[2] The *Mining and Scientific Press*, of January 7, 1871, contains a detailed account of the construction of this pipe, and also gives a diagram of the line.

[1] The Virginia City Water Company has constructed a second siphon, made of lap-welded pipe, 10 inches inner diameter, ¼-inch iron, and placed it alongside the siphon already built.

MECHANICAL AND LEGAL HISTORY OF HYDRAULIC NOZZLES.

A CURIOUS legal contest which has, for a number of years, been waged over a patented machine, has recently been decided by Judge Sawyer, of the United States Circuit Court, District of California. It involved the title and ownership of the famous hydraulic mining machine known as the Little Giant, heretofore made and sold by Richard Hoskin, of Marysville, Cal., but which was formerly made and sold by R. R. & Joseph Craig, of Nevada City. This machine has done more to encourage and develop the hydraulic mining industry of the world than all other causes. It solved the problem of practically handling large streams of water under great pressures, which is a necessity in working our large hydraulic claims on a profitable scale.

Some of our readers may not understand the nature of the work that such a machine is called upon to perform. Some idea may be gathered from a mere statement of the circumstances under which they are used. In some of our large mines the reservoir from which the water is taken is 300 feet above the point where the water is to be used, and the water is conducted from this reservoir to the Little Giant, or hydraulic machine, through large sheet-iron pipes, which in some cases are two feet in diameter. Before the water reaches the Little Giant it is under an enormous pressure, and it issues from the nozzle of the machine with such force that it is projected in a solid stream from 100 to 150 feet against the bank to be washed and literally carries all before it. So compact and solid is the stream near where it issues from the nozzle, that a person could no more strike a heavy crowbar through it than he could through an equal body of iron or steel. Sometimes the banks are very high, in which case the Giant must be kept at a respectful distance from it, otherwise it is in danger of being buried when the bank caves or falls in. The usual method of attacking a bank is to direct the stream at its base and wash out or burrow a tunnel, so as to cut it under the bank until the upper portion falls or caves down in a broken mass. The stream then cleans up the debris which has fallen and washes it into the flume, down which it courses, depositing its articles of gold in the riffles which are distributed over the bottom of the flume.

Hydraulic mining was first carried on by conducting the water through an ordinary two-inch hose and projecting it through an inch nozzle, such as is now used by our fire department for conducting water from fire engines and throwing it upon a fire. This was necesarily slow business, as the stream would do but little execution against a tough cement bank. There was no scarcity of water, but there was no competent machine for handling a large stream. Even with a small hose and nozzle, such as we have described, the labor of holding and directing the nozzle was almost Herculean. The hose had a tendency to fly from side to side, especially when it got a little bent, and the nozzle-man was a lucky one indeed that didn't get thrashed by his pipe and nozzle several times a day. In 1864, J. M. Allenwood, of Timbuctoo, Yuba county, patented what was afterwards known as the "Gooseneck machine." It had two joints; a lower horizontal joint and an upper joint made of a short section of canvas. This machine was one step in the right direction, but the canvas joint was liable to get "kinked," and then the machine would fly around like a whirligig and knocked everything over within its reach. This the miners called "bucking." The machine was, however, used in several mines by using a block and tackle for holding it to its work. In 1867, Jenkin W. Richards, of Michigan Bluff, Placer county, devised a double-jointed machine to take the place of the usual nozzle. It was intended, with this machine, to get the desired range of motion from the two joints, and thus avoid the necessity of bending the hose in order to change the direction of the stream.

This machine never amounted to much, as its joints were found to be almost as unreliable as the hose. It was, therefore, abandoned as a failure, and inventors came to the conclusion that two-jointed machines would never answer. In 1869, the Craigs—R. R. and Joseph—above mentioned, devised and patented a single-joint, ball and socket machine, which it was at first supposed would answer every purpose. Other inventors followed, all with single-jointed machines —except in one or two instances, where some sanguine inventor would bring out a nondescript two-jointed machine to be tested and then taken back to the foundry to be broken up for old iron. Such was the Shaw, the Rice, the Gorman and Hoskin and a number of others. In 1870, Frank H. Fisher, of Nevada City, invented his famous "Hydraulic Chief." This was a two-jointed machine, and the first successful two-jointed machine that any one had produced. Its element of success was in its upper joint. Instead of the canvas or hose section used in the Allenwood machine, he substituted a metallic joint that worked on pivots on both sides, so that the nozzle could only be moved up and down on this joint, while it got its side motions from the horizontal, or lower joint. This machine was a success, and became quite popular for the short time it had been in the field. In the meantime the Craigs commenced suit against several of the machines, Hoskin amongst the rest, and threatened Fisher with a suit, alleging that all of the machines were infringements upon their Globe, or ball and socket single-jointed machine.

Instead of contesting the case with the Craigs, Hoskin compromised his suit with them and entered into a compact with them by which Hoskin was to be the manufacturer and seller and the combination was to drive out competition and control the market. Hoskin then got up the present Little Giant, which was simply a duplication of Fisher's Hydraulic Chief, with slight changes. They also purchased from the inventors, Macy & Martin, a patent which covered the use of riffles in a hydraulic discharge pipe. This "riffle" patent was the key to the situation. Without the riffles none of the machines could be successfully used, and all of their machines were using them. Craig then commenced suit against Fisher in the United States Circuit Court to prevent him from using the riffles and served a preliminary injunction on him *pendente lite.* Fisher was contumacious, and persisted in using the riffles, even after the injunction was served, and as a consequence he was brought before the court on an order to show cause why he should not be punished for contempt of court. Judge Sawyer, after due consideration of the case, fined Fisher $100 and gave him a severe lecture on the danger and possible consequences of violating an order of the court, and warned him to desist in the future from committing any further contempt. Fisher was not altogether subdued by this fine and lecture, but returned to his home in Nevada City, determined to get around the Craigs and the order of the court in some way; but, nevertheless, he did not act without the advice of his counsel. His business was in jeopardy unless he could use riffles in some way in his discharge pipe, because, without the riffles the water which issued from the nozzle would scatter and be ineffectual. He therefore purchased a number of old, worn-out pipes in which riffles had been placed by Macy & Martin, the inventors, and taking out the riffles, placed them in new discharge pipes of his Hydraulic Chief. Again he was brought before the court for contempt, and Judge Sawyer, after considering the case, rendered the decision which has ever since been recognized as authority in like cases, viz: "In a combination of two elements it is an infringement to manufacture one of these elements and combine it with one of the other elements, although the other element is purchased from the patentee himself." Fisher was therefore found guilty of a contempt of court. This being the second offense, Fisher was fined $500 and ordered to be confined in the San Jose jail for 30 days. Fisher says his confinement was not irksome and not altogether without enjoyment. He spent most of his time in a steeple, with a spy-glass in his hand, from whence he became quite familiar with the landmarks around the bucolic city of San Jose. The balance of his time he spent on parole, wandering through the streets and taking needed exercise. After his release he one day happened in the *Mining and Scientific Press* Patent Agency in this city where he was informed by Mr. Jno. L. Boone, who was at that time connected with the agency, that his patent could be reissued so as to cover the upper joint of the Little Giant machine. Munn and Co., of New York, had taken out the original patent, but had only patented the lever attachment by which the machine was handled. A reissue of his patent was then applied for, through the *Mining and Scientific Press* Patent Agency, and in due time the new patent was issued with a claim for the upper joint. Fisher then employed the law firm of Morgan & Heydenfeldt, and a suit was commenced against the Craigs for injuring the reissued patent.

Meanwhile the Craigs had not been idle. They had purchased the old Allenwood patent of 1864, and immediately they reissued it so as to cover broadly a two jointed machine. With this patent they went into court, and defeated Fisher's suit by anticipating his invention with the Allenwood machine. This put a quietus on Fisher. He had become deeply involved financially in his several battles with the Craigs, and it now became necessary to seek other means to afford him a livelihood. He obtained employment in the San Francisco Mint, where he has remained ever since. About two years ago, he again reissued his patent with good success, and he then employed our friend, Jno. L. Boone, Esq., who had meanwhile commenced the practice of law, to commence another suit against Hoskin and the Craigs. This suit was contested on the part of the Craigs by the same attorneys who had successfully defeated the former suit, and the case was prosecuted before the same Judge. This time, however, Fisher was successful, and a decision was rendered in his favor in the early part of the present term, and as the Macy & Martin patent on the riffles has expired, Fisher now succeeds to his legitimate rights, and will hereafter furnish hydraulic mining machines.

—*Mining and Scientific Press.*

THE DRAINAGE OF MINES.

THERE are few situations where workings can be carried to any considerable depth below the surface of the ground without interruption from the accumulation of the water. The surrounding rocks always contain more or less of water, which occupies their joints, fissures, or cavities, and this water rapidly accumulates wherever the excavations are deepest, and must be removed in order that the works may be carried on.

Adit Levels are driven in many cases to draw off this water as fast as it gathers, wherever the formation of the ground is favorable. In some instances very extensive districts have been drained by adits to depths of many fathoms. Thus the great Gwennap adit in Cornwall, which was constructed about a century ago, drains nearly 30 square miles of country by means of branches to a depth varying from 30 to 90 fathoms. The total length of this adit, with its branches, is about 40 miles. Another great adit, known as the Ernst August adit, was finished a few years ago in Saxony, and drains a large series of mines in the Hartz Mountains, some of them to a depth of 214 fathoms. This adit, with its branches, is 14 miles in length; part of it is navigable by boats; and it occupied nearly 13 years in construction—costing £85,500. Sometimes, however, an adit is inadmissible or insufficient, thus—if the mine is situated in a very low place, if it occupies an isolated portion of country, if the water be required at the surface for ore-dressing operations, or if the ground be so little uneven that a very long level would be required in order to drain any considerable depth of workings, some different mode of drainage is necessary.

Pumps and Pitwork.—In trial shafts for workings of small extent, or in a country already partially drained by surrounding mines, water buckets may be used, the water being raised by means of a tackle. As the water increases, however, this mode is found quite inadequate, and some form of pump is necessary. The common suction pump, shown in fig. 1, is rarely used in mining operations, as it will only raise water to a height of about 30 feet, but occasionally, and for temporary purposes, such pumps are used in successive lifts. The mode of action is as follows.

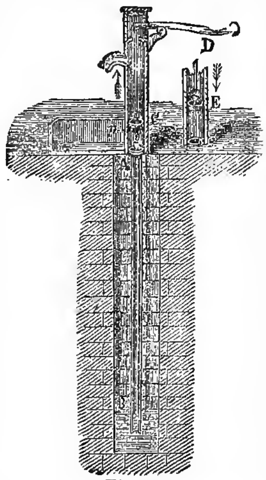


Fig. 1.

The long pipe A B is called the suction pipe, and it must be long enough to reach into the water in the well. The upper end of the suction pipe is furnished with a valve E opening upwards. Above the suction pipe is the working barrel C, containing a well-fitting piston *p*, which is worked up and down by the lever or brake-staff D. This piston or "bucket" contains a valve *v′* opening upwards. When the working begins the water in the suction pipe A B stands at the same level as that in the well. On raising the piston as indicated by the arrow, the valve *v* rises, and the air between it and the water in the suction pipe is rarefied, and the pressure of air on the water in the well causes it to rise in the pipe. When the piston is depressed as at E the valve *v* at the top of the suction pipe closes, that in the piston *v′* opens, and the excess of air is between *v* and *v′* passes out into the general atmosphere. The piston is now again drawn up, the water rises again in the suction pipe, and at length— if the suction pipe is not more than 30 feet long—passes through the valve *v* into the working barrel. The piston now again descends, and the water passes through this valve *v′*, and when it is again drawn up this valve closes, the piston serves as a bucket to raise the water as far as the spout, from which it flows in an intermittent stream. The water thus rises because the pressure of the air upon its surface in the well is greater than the pressure in the suction pipe. If all the air in the pipe were to be withdrawn it would rise until the weight or pressure of water AB was the same as that of the air on the water in the well, or about 15 lbs. to the square inch, varying a little from time to time. This pressure is given by a column of water about 34 feet high. Owing to the difficulty of making all the fittings air tight, about 30 feet is all that can be ordinarily reckoned upon.

Practically, it is found that if the distance A B is 30 feet or under, water may be raised by means of this pump, but if more than 30 feet, the pump will fail. For greater depths, therefore, the pump is modified slightly, as shown in fig. 2. The suction pipe *a*, now called the "windbore" or "snore," is reduced to about 10 or 12 feet, and pieces of pipe, called "pumps," are added above the working barrel to the required or most convenient height—often more than 100 ft. The whole arrangement is now shown in fig. 2, and is called a "bucket" or "drawing lift; *a* is the windbore, *b* is the "door-piece" containing the valve or "clack" *c*; *o* is the door, *d* is the bucket with its clack, *e* is the working barrel, which is bored truly cylindrical, *f* is the first of the "pumps," all of which are about 1 inch greater in diameter than the working barrel. The different pieces are made with flanged joints as shown for convenience of fixing; *g* is the "collar-launder," from which the stream of water is delivered.

This kind of drawing lift is well suited for use in a shaft which is being continually deepened, as additional pumps may be added at the top from time to time. If, however, the depth is more than about 30 fathoms, the water is usually raised in two or more distinct lifts—the drawing lift delivering its water from the collar-launder *r*, fig. 3, into a cistern A, from which it is forced to the surface by the "plunger" or ram *a*, shown in the figure. By the ascent of the plunger "pole" *a* in the "case" *b*, the water which fills the cistern A is made to rise through the wind-bore *h* and clack *c* into the H. piece H. When the pole descends, the clack *c* closes, the water raises the clack *e*, and passes upwards into the pumps above. As the pole again rises, the clack *e* is closed, *c* opens, and a fresh portion of water passes into the H piece. The cistern is kept full by the delivery of water from the top of the drawing lift by the collar-launder *r*, and also, in many cases, by the water from the upper portion of the mine, which is led into it instead of being allowed to fall to the bottom of the mine; *f* is the top pump of the drawing lift, and *f′* the bottom pump of the plunger lift. The plunger pole *a* works in the case *b* through a stuffing box at *i*. The mode of attaching the plunger pole *a′* and the bucket-rod *k* to the main rod *l l*, by means of the "glands" *m m*, and the "set-offs" *n*, is clear from the figure.

The pumps are made of cast iron, generally in lengths of 9 feet, but with a few shorter "matching pieces" in 3 and 6 feet lengths. They are cast about $\frac{3}{8}$ths to $\frac{5}{8}$ths of an inch thick, according to size, intended height of lift, etc., with several projecting ribs for strength. The flanges are about 1 in. thick. The valves or "clacks" are usually of leather strengthened with iron, and it is here that the wear is greatest. The chief peculiarity is, that the hinges or centres of the valves work within guides instead of upon centres, so that the whole valve has liberty to rise a few inches, thus giving a greater water space in the early part of the stroke. Sometimes valves of metal, variously constructed, are used, and occasionally the valves are partly or entirely made of india-rubber. For convenience of access to the valves they are placed in "door pieces," as shown in side view in fig. 2, where *o* is a movable door giving access to the valve *c*.

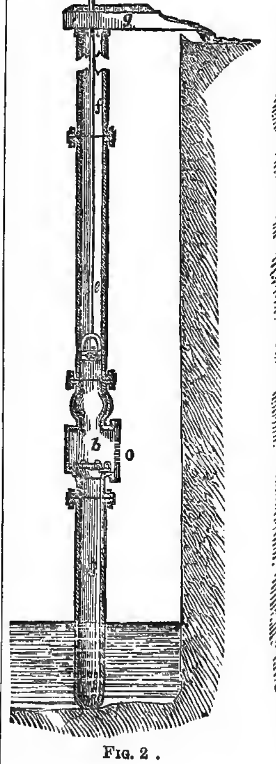


Fig. 2.

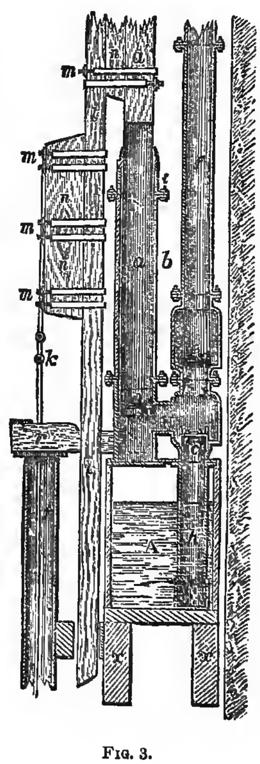


Fig. 3.

The cisterns for the successive lifts are made of wood 3 inches or more in thickness, strongly bound with iron strapping plates, and supported on strong "bearers," *xx*, Fig. 2, which are let into the sides of the shaft.

Sometimes the water to be raised is of a highly corrosive nature, especially that from copper and lead mines. In such cases it is good economy to make the valve seats, working barrel, and other important parts, of gun-metal, and to line the pumps with thin staves of oak or other hard wood. The "pumps" are fastened together with bolts and nuts,

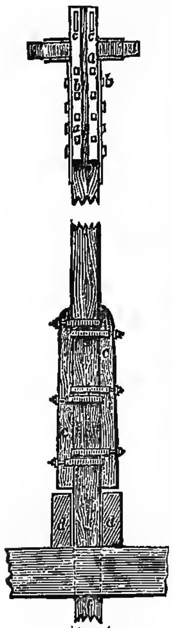


Fig. 4.

"flange-pins," as they are called in Cornwall, where it is customary to place between the flanges rings of thin iron bound round with "bal-shag," a coarse kind of flannel. This, when tightly screwed up, makes the joint air-tight, while it does not interfere with the ready separation of the pumps in case of need.

The "main rod," part of which is shown at *ll*, Fig. 3, is in deep mines made of the longest and straightest balks of Norway pine which can be obtained. The secondary rods are attached to this by "set-offs," as shown at *nn* in the same figure. The different lengths of the main rod are halved together, bolted through, and secured with strong strapping plates.

The upper end is attached to the outer end of the engine "beam" or "bob" by wrought-iron straps, secured by bolts *b* and cottars *c*, as shown in Fig. 4.

At intervals down the shaft catch-pieces *cc* are secured, and bearers fixed across *dd*, in order to take up the weight of the rods in case of a breakage, to prevent the whole mass of many tons weight from falling to the bottom of the shaft. They also prevent the engine from making too long a stroke, or going too far out, and so breaking off the cylinder cover.

The water is raised in the lower or drawing lift by the up or "in-door" stroke of the engine, but the remaining, or plunger lifts, are worked by the down or out-door stroke; the weight of the rods forcing the water up the column of pumps.

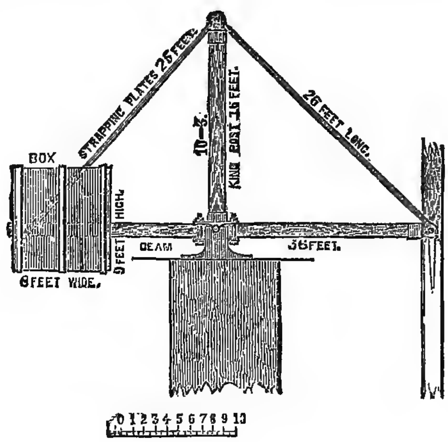


Fig. 5.

Balance Bobs.—When the mine is deep the weight of the rods is more than sufficient for the purpose, and the surplus is generally counterbalanced by "balance-bobs," placed either at surface or in chambers excavated by the side of the shaft underground. Thus at Davey's engine at the consolidated copper mines in Gwennap, Cornwall, the main rod was one-third of a mile long, and weighed 95 tons. The other rods weighed 40 tons, or together 135 tons. 39 tons were required to balance the column of water in the pumps, and the remaining 96 tons were balanced—partly by counter-weights, partly by special hydraulic machinery. One of these balance-bobs is shown at Fig. 5. For raising the heavy portions of "pit-work," as this pumping machinery is called, a powerful "capstan" is fixed just outside the engine-house. Very few of the shafts in the Cornish mines are vertical, and many are of varying inclination, so that it is necessary not only to provide friction rollers, but also to connect the different sections of the main rods by anglo-bobs. One mode of doing this is shown in Fig. 6, where a portion of the ground at the side of the shaft is cut away for the reception of the "balance-bob" *v*, the arms of which are pivoted to sections of the rod *aaa*. Other modes of effecting change of motion by friction-wheels and guide-rails are used where from the hardness of the ground or other reasons, this mode is inadmissible.

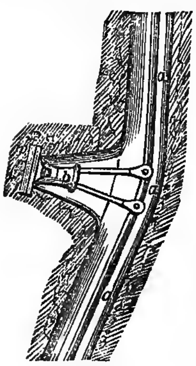


Fig. 6.

—From Principles of Metal Mining.

BLASTING.

In this age of improvement I know of no important industry, in which so much hard labor and money are lost for want of intelligent study and use of modern improvements, as in the simple operation of blasting. When you bear in mind the fact that blasting of minerals lies at the very foundation of all that distinguishes civilized from barbarous life, you will at once admit that its importance makes it well worthy of our attention. You are all aware that the houses of civilized men are very much superior to those of the barbarous races. The first point of difference is in the foundation, and almost the first things needed for the foundation of a house for civilized man are powder and blasting to get stone for the foundation. Another point of superiority of civilized life is the abundance of manufactured iron and glass, yet I think that not one pound of all the immense quantities of these articles manufactured around Pittsburg is obtained without drilling and blasting to prepare either the coal, iron ore, limestone, or sand used in its manufacture. But the very nature of the work of quarrying seems to draw to it many men of one idea who work hard and think little; who having made holes in rocks for many years, insist, therefore, that they know all about blasting and persistently oppose all modern improvements. Many farmers are living yet who have cut many harvests with a sickle before the days of cradles, mowing and reaping machines, etc. These might with the same propriety resist the use of mowing and reaping machines because they know all about farming. Another reason why improvements are not introduced in blasting is because the owners of mines seldom give any personal attention to blasting, but leave it all to the others, who seldom take any interest in improvements, and are often prejudiced against them and condemn them without a trial. The subject of blasting may be divided into three divisions:

1st. The hole and how to make it. 2d. The explosive used. 3d. The manner of firing the charge.

1st. The Hole and How to Make It.—The common way of making the hole is by either churn or jumper hand-drills. Three men usually form a gang, and the gang make from eight to twelve lineal feet of hole per day in hard rock. By either of these modes it is practically impossible to make a round hole—generally a three-cornered hole being made, which is very objectionable—because, if the hole is perfectly round it will present a uniform circular surface to the pressure, and retain the blast until its force is fully developed. But with a three-cornered hole the pressure on the long sides of the hole is concentrated at the corners, which, being required to resist more than their share of the pressure, give way and permit the explosive gases to escape before their force is fully developed, and only a large amount of smoke is produced. A much better plan is to have the holes made by machinery; this secures a cheaper and better hole, being perfectly round, and thus retains the explosive gases until their power is perfectly developed, and do more execution on the rock and with less smoke. In close or underground work, where the air is bad, this is found to be of great advantage. With the latest improved steam drills a gang of three men often make from seventy-five to one hundred feet of hole in one day.

2nd. The Explosive Used.—Explosives may be divided into chemical and mechanical combinations. Chemical explosives embrace what are known as nitro-glycerine, gun-cotton, dynamite, dualin, hercules, Ditmore-powder, rendrock, mica-powder, etc. These are produced mainly by the combination of nitric acid, sulphuric acid, and fatty matter or glycerine, with cotton, tan bark, paper pulp, saw dust, soda, mica scales, pulverized charcoal, etc., as absorbents. These will explode under water, which makes an excellent tamping. Most of them are unfit for sporting or military use; because their explosion is so instantaneous, it ruptures the gun before the ball can start. Their force is more like the blow of a large sledge, whose force is spent in an instant, while the explosion of black powder is more like the action of a powerful spring, which starts the projectile more slowly and continues to propel it until it escapes at the muzzle of the gun. The manufacture of chemical explosives is of comparatively recent date, and in many cases is as yet imperfectly understood. Many alarming accidents have occurred in the handling of some of them, which has given a bad name to the whole family. But enough is now known about some of them to prove them to be perfectly safe when properly understood and handled, and very profitable in certain kinds of blasting.

Mechanically combined explosives are common black powder, carbo-azoteen, and mahoning powder. These are composed mainly of saltpeter or nitrate of soda, sulphur, and charcoal, or tan bark. All of these ingredients are first finely pulverized separately, and then mixed in certain proportions, and incorporated by being run under heavy wheels or rollers for from two to six hours, so as to mix uniformly and bring a certain proportion of each ingredient in immediate contact with the other ingredients. The mass is then generally submitted to strong hydraulic or screw pressure, and then is called pressed cake. Then it is crushed by corrugated rollers and by means of sieves separated into the different sized grains of blasting, sporting, or military powder, each of which has its peculiar mark or name. Carbo-azoteen is made by boiling these ingredients together, and has never been a success. Mechanically combined explosives must be kept perfectly dry; even a slight degree of dampness injures them. As a rule, the finer the grain the quicker the explosion and the smaller the charge; while for large blasts in rock, powder is now used to good advantage in grains as large as grains of corn, and in large artillery charges still larger grains are used, called pebble powder. We now come to the

3d. Mode of Firing the charge.—Three modes are used—squib, fuse, and electricity. Squibs are made of about six inches of rye straw, filled with fine powder, and are used principally in coal blasting. The hole being drilled horizontally three to five feet into the coal, a charge of eight to twelve inches of F F blasting powder is generally put in, then an iron rod five-sixteenths of an inch in diameter, called, a needle, is inserted in the hole back to the powder, then the hole is tamped full by having dry clay or clay pounded solid into it, and the needle is withdrawn, leaving an open passage like a pipe through the tamping to the powder. The squib is inserted in the mouth of this hole and a slow match applied to the outside end; the recoil of the powder burning in the straw throws the burning squib back along the needle hole or pipe to the powder chamber, and the explosion takes place. This mode of firing can only be used in horizontal holes. Fuse consists of a thread of black powder incased in a wrapping of tarred hemp, and called hemp fuse—or in a wrapping of cotton, and called cotton fuse; then, to make it waterproof, a tarred tape is wrapped spirally around it, and then it is called single tape fuse, and will resist dampness a long time; or a double wrapping of tarred tape is wrapped around it, and called double tape fuse, which will burn and fire a charge of powder under twenty feet of water. In all of these fuses there is a central cotton thread, which has been saturated with saltpeter, which makes it continue to burn when it would otherwise go out. Every precaution is taken to make the fuse continue to burn until the fire reaches the powder, and the explosion is produced. But, from some cause or another, holes sometimes hang fire, and are a source of great danger to the miner or quarryman. Holes thus charged, which ordinarily should explode in from one to three minutes, have been known to hang fire for twenty-four hours and then explode. The third mode of firing is by electricity. When using it, the hole, the charge, and the tamping are the same as in firing with a fuse, but, instead of inserting the common fuse already described, an electric exploder is used, which is made thus: A copper cap, one-quarter of an inch diameter and about one inch long, is filled one-third full of fulminate of mercury, into which is inserted the ends of two insulated copper wires connected by a small thread of platinum wire, and the end of the cap is then closed by means of melted sulphur, making it waterproof. Electric fuses are made four, six, ten, and fifteen feet long, with about two inches of the outer end stripped of the insulation and tinned. In using them the blaster selects an electric fuse long enough to reach the bottom of the hole and leave a few inches of wire out of the hole, then puts in enough powder to cover the bottom of the hole one-half inch deep, then his exploder, then one-fourth less powder than if fired with a fuse, and tamps the hole the same as with ordinary fuse; any number of holes may be thus prepared of equal or unequal depth or distances apart.

Directions for Firing.—One wire of the first hole is now connected to one wire of the second hole, and the remaining wire of the second to one wire of the third hole, and so on until all are connected; there will then be one wire of the last hole and one wire of the first hole left unconnected. These wires are then connected by means of long conducting wires to the battery at a place of safety, and, when everything is ready, the circuit is closed, and the small thread of platinum wire in the bottom of each hole becomes red hot, and each cap is exploded with great force at the same instant, and each hole assists its neighbor. And thus by simultaneous explosion, with only three-quarters of the powder used in ordinary fuse blasting, more than double the rock is moved with the same drilling. In quarries where fuse is used it is not uncommon to find six inches or a foot, or even two feet, of the bottom of the holes remaining unruptured after the blast has been fired and cleared away—the drilling of the unexploded piece of hole was so much hard labor lost, and the powder it contained was lost, for if the powder had done what was intended no part of the hole would have been left unexploded. No part of the hole is thus left unexploded where electricity is used, because in firing by electricity the first point ruptured is at the bottom of the hole, and the full force of all the explosive is spent in enlarging the rupture.

For profitable blasting by either mode of firing, the bottom of the hole in open work should be at least one-tenth less from the open front of the rock than the depth of the hole; thus, if the hole is ten feet deep, the bottom of the hole should be not more than nine feet from the face of the rock, and in some rock not more than eight feet, so as to make the bottom of the hole the weakest part of the blast. But if the hole is ten feet deep and filled up four feet with powder, and fired with a fuse at the top of the powder, there will only be six feet of rock on the top of the first point of rupture, and there being nine feet in front of the hole, makes the top the weakest part, and the result is a great discharge of projectiles through the air, to the great danger of all around, and much of the material is lost; but if the same single hole had been fired by electricity at the bottom of the hole, the bottom rock would have been forced out, and the top rocks would tumble down and do no damage, and all be in place to be handled.

The contrast between firing with a squib and by electricity is still greater, because a fuse may sometimes burn to the bottom of the hole before firing the blast, but a squib must always fire at the top of the powder, and as the needle hole is a full quarter inch in diameter, the first blast is a jet of orange flame from the needle hole, which is partly consumed powder, and cools into dense smoke, to the great annoyance of the miner; in light work, only the top is blown off the hole, the first point of rupture taking place at the top of the powder. In conclusion, to show this is not idle theory, but actual fact, I may point to the shaft sunk this summer for the Chicago and Connellsville Coke Company, near Uniontown, under the superintendence of Mr. James Harrison. Mr. Harrison has had great experience in everything connected with modern mining improvements, and on commencing work on the shaft, procured the latest and best improved steam rock drill, an electro-magneto battery, and safe chemical explosives, and, with the assistance of Mr. Thomas, an experienced Welsh shaft sinker, he broke ground about the 15th of last March, and two weeks ago he had sunk the shaft three hundred and twenty-five feet to the coal; has got his ovens and all his buildings up, and, I presume, is now making coke, which, under the old plan of sinking, he could not have done before next April. I can also point to the shaft now being sunk by Mr. J. K. Taggart for E. K. Hyndman, near Connellsville, and to another near the same place, now being sunk by Mr. Hopkins for Mr. Wickham, of Connellsville, both of whom are using electricity and chemical explosives to good advantage. I may further add that theoretically blasting by electricity has been known to engineers for thirty or forty years, for large blasts such as Hell Gate. But it has only been within the last few years that the apparatus has been made so simple and portable as to be of any practical benefit in quarry work. It has now become so simple, and is so easily handled, that a youth can take the apparatus out of the tool-box, lay down the cable to a safe place, charge five or six holes, tamp and fire them, and take up the cable and replace apparatus in tool-box, all inside of ten minutes.

—A paper by Arthur Kirk, transactions Engineers' Society of Western Penna.

ROCK-BORING MACHINERY.

AN admirable sketch of the history and characteristics of rock-boring machinery is given in an interesting pamphlet by Mr. Richard Schram.[1] whose own invention for a rock drill was referred to in the *Mining Journal* a few weeks since. He remarked that during recent years the success attending the introduction of rock-boring machines for accomplishing various engineering works had induced many to decide upon substituting machine work for hand-labor in drilling for the purpose of blasting in mining and excavating operations. Some difficulties have been encountered in selecting a machine precisely suited for the particular work in hand, and thus a certain prejudice against the use of these machines in general has not unnaturally been created.

Referring to the causes which have led to rock-boring machines not having proved wholly successful, Mr. Schram is of opinion that it will be found upon inquiry that it is because their practical working has not been properly understood. Experience teaches us, he remarks, that in the employment of rock-boring machines it is as essential that the whole system of operations be sound and well-planned as that the machines themselves be effective and simple, so as not to require much or frequent repairing. Upon the first introduction of rock-boring machines old experienced miners were employed, and it was quite natural that they should endeavor to give the holes such directions, and proceed generally as nearly as possible in the same manner as they had been accustomed to do in hand-boring. If, however, we glance at the progress of any other branch of industry, we shall find that a more systematic method of working has invariably been the consequence of the introduction of machinery, and that to the improved organization and regularity thus accruing must be attributed no inconsiderable part of the great and manifold advantages of all machine work over hand-labor. Rock-boring by machinery forms no exception to the industries obeying this general law of progress, and upon its introduction rational systematic methods of working must be adopted. At the present time there is scarcely any branch of industry in which machinery does not play an important part. In some branches the mechanical appliances are so perfect that it would be impossible now to dispense with them; in others, on the contrary, the machines may be said to be in their infancy. To this last category rock-boring has hitherto belonged. The idea of using machinery in rock drilling was, Mr. Schram tells us, entertained long ago. In 1844, Burton, an Englishman, suggested the idea of employing compressed air to work a hammer striking upon a drill, but no practical support was given to the suggestion; and it was in the year 1854, that Bartlett, also an Englishman, and in 1855 that Schumann, of Freiberg, first appeared before the public with practical experiments. From these dates down to the present time improvements and developments in rock-boring machinery have succeeded one another with great rapidity.

[1] "The Application of Machine Power in Rock Drilling." By Richard Schram. London: G. Hill, Westminster Bridge-road.

Mr. Schram ranges the existing rock-boring machines into five classes—the ram system, embracing the Schwarzkopff and Warsop drills; the lever system, embracing Schumann's, Burleigh's, Sach's, McKean's, Warrington's, Ingersoll's, Dunn's, Roanhead, Cranston, Barrow, and many other machines; the duplex system, embracing the machines of Sommeiller and Ferroux; the rotary system, embracing the diamond drill, Brandt's, etc.; and the direct acting system, including Darlington's, Schram's, and Reynolds', without slide, and Osterkamp's, Schrams, Cederblom's and others, with slide.

Discussing the merits of the several systems, Mr. Schram remarks that the ram system as applied to rock-boring machines must prove impracticable, and must be so apparent to every one who has seen a worn-out hammer and hand-drill that it is unnecessary to give it any consideration. This lever system has, he says, long kept its place, and several machines constructed upon this system have done very good service, but he considers the disadvantages of the system are the great wear and tear to which the machines must be exposed, and the unpreventable loss of power, results which he regards as inseparable from a mode in which levers or tappets are actuated by the piston. The duplex system has, Mr. Schram states, only been employed in places where compressed air has been cheap and plentiful, as in the Mont Cenis and Gothard tunnels, but in either of these places machines of a later invention would have been found to work both better and more economically. By employing a separate engine to work the slide, the piston which carries the cutting tool runs perfectly free, and as those pistons are made of a large diameter and have a long stroke, the machines are consequently very powerful. But in proportion to their great consumption of compressed air (first in the subsidiary engine and again in the main cylinder) they prove very expensive in working. Moreover, in consequence of the great length of the machines, the holes must all be bored in a nearly horizontal position, thereby necessitating the use of a greater amount of explosive for blasting than would otherwise be necessary. The rotary system, as carried out for blasting operations, has likewise met with very limited approval.

It is true that Lisbeth's rotary hand-drill, as improved by Macdermott, works admirably in coal and soft slate, and no doubt the employment of these machines in coal mines is already extensive, and is rapidly spreading, but they are by no means adapted for the harder varieties of rock. Mr. Schram admits that for prospecting purposes the diamond drill is no doubt extremely valuable. One of the advantages held out in favor of rotary rock drills is that they are incessantly working into the stone, a condition evidently incompatible with any percussive action; but, on the other hand, the force of each blow of a percussion machine is very much greater than the force which in a rotary machine is constantly exerted. Moreover, the constant resistance to which the tool of a rotary drill is subjected necessitates a greater motive power, and after all, the actual work done is less than that of a percussion machine. An interesting trial of a rotary rock-boring machine invented by Brandt was made in 1877 in the Sonenwendstein Tunnel, on the Ebensee, in Austria. On the shore of the lake Ebensee an engine-house was built in which was erected a steam-engine with two steam cylinders, each 24 centimeters in diameter. Water under a very high pressure (stated to be 70 atmospheres) was carried in strong wrought-iron tubes into the tunnel, where it worked the rock-boring machines. These consisted of two auxiliary cylinders acting upon a crank-shaft laid at right angles across the drill, and a worm cut in the middle of this shaft caused the drill to rotate. The central part of the machinery formed a cylinder, in which was fitted a plunger piston attached to a joint, by means of which the machine was connected with a very strong stretcher or standard. Water being admitted to this cylinder, and exerting its force against the plunger, pressed the whole machine forward toward the rock, and thus maintained an enormous pressure on the cutting tool as it rotated. In the extreme end of the drill, which was hollow, there was a steel crown furnished with teeth which, through the rotary motion and the great force with which the apparatus was pressed against the rock, cut the stone in a similar manner to the diamond drill. Water was employed to clear out the debris from the holes.

The drill made 30 revolutions per minute, and, boring holes 7.5 centimeters diameter, it progressed at the rate of 3 centimeters per minute. This rock was dolomite. As great difficulty was experienced in commencing the holes, they were bored double their required depth—that is to say, double the depth at which the explosive proved to be effective, and before being charged and fired were filled up for half their depth with sand. After the first charges were fired the sand was removed from the remainder of the holes, which were then charged and fired again. The heavy expenses of working proved too great for the general adoption of this machine in other places. As belonging to the direct acting system without slides, Mr. Schram has mentioned the Darlington, Reynolds, and Schram machines. Simple as this system is, it is, he says, nevertheless unpractical, because the piston being propelled by expansion, the pressure is consequently least when it ought to be greatest—*i. e.*, at the end of each stroke. Another defect is that pressure is exerted on the lower side of the piston during the forward stroke, thereby counteracting the force of each blow to a most injurious degree. The Darlington machine especially requires twice the quantity of compressed air necessary for most other machines of the same size, notwithstanding which the effect in boring horizontal holes is over 100 per cent. less than in the case of machines of more modern construction. He describes one of his own machines of this class, but remarks that this system, simple as it is, is by no means practicable, as, though the machine will run at an extraordinary high speed, the boring results, as compared with the direct acting machines with slide, are not satisfactory. In the class of direct acting machines with slides are those by Osterkamp, Dœring, Schram, Cederblom, and others; and he here describes his own arrangement, which has certainly much to recommend it. The only moving parts of the machine are the main piston, the side piston and slide, and the rotating movement with its piston. It is an important feature in this machine that the slide rod is made in the form of a double spindle valve; by this method of construction it remains in position without any recoil until the piston has made the greater part of its stroke. As in some varieties of rock it happens that the drill often sticks fast, there is a reversing rod to suddenly reverse the slide, and thus pull the drill out of the hole. With careless workmen it would frequently happen that the piston would strike against the lower cylinder cover, therefore there is an air cushion at the lower end of the cylinder. In addition to this there are an iron ring and an India-rubber washer (exchanged for one of wrought iron when steam is used), with the object of moderating the violence of the shock such blows, inadvertently permitted, would cause. In order that the hole drilled be perfectly round, it is necessary that the cutting tool should partially rotate at each backward stroke so that its cutting edge shall every time strike the rock in a fresh place, but in order not to lose any power it must always make its forward stroke without rotating. For this purpose a twisted bar is employed, connected with a grooved disk, and a brake acted upon by a small piston. Communicating from the slide box with the cylinder is a small port, by means of which the compressed air exerts a constant pressure upon the upper end of the small piston. When the main piston makes its backward stroke the back end of the cylinder is in communication with the outlet, and consequently there is no pressure on the lower end of the small piston. The constant pressure on the upper end of this piston, therefore, now presses it upon the brake which presses upon the disk, preventing it from turning, and thus the main piston is forced to partially rotate round the twisted bar secured to the disk. But when the main piston makes its forward stroke, and steam or compressed air fills the back end of the cylinder, the motive fluid enters through small ports and presses on the lower end of the small piston, thus counterbalancing the constant pressure on the upper end. There being now no pressure on the brake the disk is free to rotate, and the main piston makes its forward stroke without rotating, partially turning the disk as it proceeds by means of the twisted bar. This machine is sometimes made with an automatic feed motion actuated directly by means of a piston, instead of, as in other rock-boring machines, through levers, but the inventor nevertheless recommends in all cases a manual feed, as, notwithstanding all the assertions to the contrary of eager rock-boring machine dealers, practical miners know that in some faulty rock the drill will and must occasionally stick fast. When this happens it takes much longer time to clear the cutting tool, if an automatic feed is in use than in simply giving the handle of a manual feed a turn or two, which is all that is necessary to loosen the drill and permit of the boring being proceeded with. Moreover the workmen are never so attentive to their work when they have nothing to do but to look on as they are when they have the machine constantly under hand. Thus, apart from the increased complication and greater wear and tear to which even the best automatic feed motion renders any machine liable, such a feed has always been found objectionable in actual practice.

Through the perfectly free action of the main piston, and because the motive fluid is admitted to the whole surface of its upper end, each blow is extremely powerful: moreover this free action, combined with that of the slide piston allows the machine to be run at a very high speed, and enables it to be worked with a very low pressure. Its principal feature, however, is its remarkably small consumption of compressed air, as an air compressor which would only be able to drive one machine constructed on the lever system will easily drive two of Schram's, the diameter of cylinder being the same in both cases. There being no parts exposed to blows, and the principal parts being directly actuated by the motive fluid, this machine is less liable to wear and tear than those of other systems. It should also be observed that the working parts are all inside the cylinders, so that rough-handed miners, unaccustomed to use more fragile instruments than sledge hammers and picks, may be safely intrusted with the handling of these rock drills.

Reverting for one moment to the slide action, it may be mentioned that this machine was at first constructed with a cylindrical slide, but considering the leakage of motive fluid caused by wear and tear which has always been found to result from the employment of this form of slide in steam engines, the inventor has considered it most practical to adopt the old form of D slide, which has this great advantage, that even after years of work it always fits perfectly tight on to the slide face. The supports and various other details connected with machine drilling are referred to at equal length, but as these will constantly vary with the work in hand, an abstract of Mr. Schram's remarks would be of little value; the book itself, which is really worthy of careful reading by all practical men, must be referred to for further information on the subject.

—*Mining Journal.*

ROCK-DRILLING MACHINERY.

TOOLS.—The method of fixing the tool to the end of the piston-rod has received a large amount of attention from inventors. In 1866, Jordan and Darlington introduced a loop clip. Later a binding ring came into use. Improvements on these methods are in progress, the object being to retain the tool on the axial line of the piston-rod, without resorting to rings, clips, or set screws. The form of the boring bit has also undergone radical changes, in some instances rendered necessary, not for the purpose of drilling a round hole, but for neutralizing the imperfect action of the turning gear employed. The following figures, which will explain themselves, show "bits" of various forms, the use of which is advocated by inventors of various rock-drills. Another form of tool for running down center or "rupturing" holes is shown in Fig. 2. The bit Z-shape, is the same size as the ordinary drills, but it has also an enlarged part, armed with a Z-shape cutting edge, 4 in. diameter. The length of the boring tools will depend upon the depth of the intended hole. At Ronchamp the longest hole was 9½ ft. At St. Gothard it is about 8 ft., while at Musconetcong Tunnel, New Jersey, the leading holes were usually 10 ft. deep, the longest 14 ft. In ordinary mine headings, and in the employment of comparatively small boring machines, the diameter of the boring steel may vary from ⅞ in to 1¼ in. For rupturing the rock with No. 1 dynamite, or Brain's No. 1 powder, the hole at bottom need not exceed 1 in. in diameter; but if second-class dynamite or compressed powder be employed the hole in that case should be larger. In changing a boring tool care must be taken that the cutting edge of the one to follow it is not wider than the intact cutting edge of the tool withdrawn. In the tool withdrawn it will be often found that the corners have been partly removed; the cutting edge of this tool is, therefore, that portion not rounded, but roughly parallel to the face of the hole. Many instances occurred in the rudimentary stage of boring, when machines were alleged to be useless—the fact having been that the cutting edge of the second tool was wider than that of the tool withdrawn, which, forced into a conical part of the hole, necessarily wedged itself fast, thereby stopping or retarding the working of the machine. As a common rule, the width of the different sets of boring tools at the points should vary from one-sixteenth to one-eighth of an inch from each other; or if the leading sets of tools are $1\frac{1}{4}$ in. wide at the point, the second or "follower" set may be $1\frac{1}{8}$ in., and the third 1 in. wide. No rule can be strictly laid down for determining the time and power requisite to bore holes of varying diameter; but experience seems to show that if a hole 12 in. deep and 1 in. diameter takes 4 minutes, a hole 2 in.

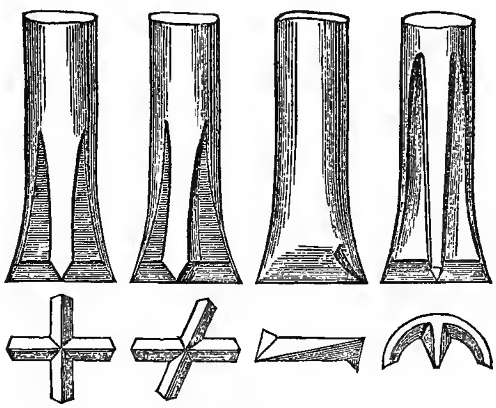


Fig. 1.

diameter and of like depth, bored with the same machine, and under the same conditions as to pressure of air and speed, will take 16 minutes. In other words, the machine and the fluid pressure being the same, the time and power to bore holes to a given depth are as the square of the diameter of the hole. It is, therefore, of considerable importance to keep the diameter of the shot-hole as small as possible, and to supplement mechanical power by employing strong rupturing explosives.

Tunnel or Mine.	*Machines employed.*	*Machines working together.*	*Machines in reserve for 1 in use.*	*Pressure air per sq. inch.*	*Form of tool employed.*
Mont Cenis . .	Sommellier'a . . .	10	7	90	Z
St. Gothard . .	Ferroux'a Dubois & François McKean's	6	68	90	X
Musconetcong	Ingersoll'a	6	. .	60–70	X
Maesteg	Beaumont'a	2	.	50	Semicircular.
Cumbran . . .	McKean's . . .	2	1	70–80	Flat tool.
Port Skewet . .	Geach'a	2	2	60	X
Saarbruck . .	Sach's	.	6	60	Flat tool.
Ronchamp . .	Dubois & Françoia	4	1	67	X & Z.
Blaozy	Darlington . . .	4	none	45	Flat tool.
Minera . . .	Darlington . . .	1–2	none	60	Flat tool.
Ballacockiah .	Darlington . . .	1–2	none	45	Flat tool.

Cut and Sink.—In tunnelling or sinking shafts by means of rock boring machinery, it is necessary to conduct the operations in some special manner. When machines were first introduced into our mines the miner insisted upon employing them as a mere substitute for the borer and the mallet, and boring the holes so as "to take advantage" of the ground. The result showed, however, that such a course was unsatisfactory. Not only was the time required to get a position for the machine, to fix, and to remove it excessive, but the work accomplished was not in proportion to its cost. The engineers of the Mont Cenis Tunnel were the first to recognize the fact that if power machines were to be successfully adopted the hand method of doing the work must be discarded and new conditions established. A given number, ten machines, were accordingly grouped together on a carriage, the natural rupturing lines of the rock disregarded, the holes drilled more or less with the axial line of the heading, the machines and carriage withdrawn, the holes charged, the explosive fired, and the stuff removed.

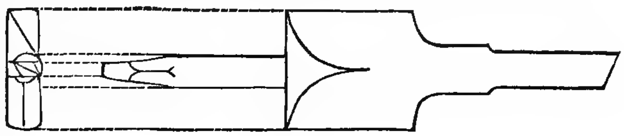


Fig. 2.

These series of operations constituted an "advance," while in America, and in one or two English mines, it is known as a "cut," and in shafts as a "sink.' At the time when the Mont Cenis Tunnel was driven, nitro-glycerine and dynamite had not been largely adopted for blasting purposes. Powder was the explosive used in the execution of that work; this together with the great length of the machines and comparatively narrow width of the heading—9 ft. 10 in.—thereby limiting the angling range of the machines, rendered a considerable number of holes necessary for effecting the removal of the rock. A face of $83\frac{1}{2}$ square ft. was perforated with from 60 to 70 holes, $2\frac{1}{2}$ ft. to 4 ft. deep. The Musconetcong Tunnel, New Jersey, was driven with the aid of dynamite. The advance heading, 8 ft high, was carried the entire width of the tunnel—26 ft. With two boring carriages, and strongly angling the machines on a

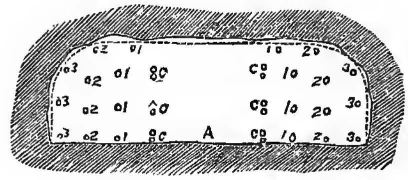


Fig. 3.

line from the top to the bottom of the tunnel towards its axial line, holes 10 ft. deep were made for bringing out the center "cut." The methods of arranging the holes for blasting may be distinguished as—

(*a*).—Mont Cenis and St. Gothard.
(*b*).—Musconetcong and Minera.
(*c*).—Brain's radial system.

(*a*).—The face of the Mont Cenis heading, allowing for contraction towards the top and rounding corners, represented an area of about 80 square feet. This "face" was subjected to the attack of 10 machines, giving 8 square feet of surface per machine, or nearly one hole for each square foot of surface.

The center of the face was perforated with a large hole, and immediately outside of this center 8 other holes were bored, constituting the "center of rupturing holes." Around this set of center holes a series of 3 sets of concentric and 2 sets of semi-concentric holes were drilled. The holes were subsequently fired in volleys and removed the rock—(1) the center, and (2) the portion concentric to the center.

(*b*).—At Musconetcong the tunnel heading, 26 feet wide by 8 feet high, gave a net area of about 175 square feet. This face was perforated with 36 holes by means of 6 powerful boring machines, each cylinder 5 in. diameter. The area of the face apportioned to each machine was 29 square feet. The number and depth of the holes to obtain a cut of 10 feet, or an actual lineal advance of 9 feet, were:

Cut	12	holes, each	$10\frac{1}{2}$	feet deep.
First square up.........	8	"	12	"
Second ditto	8	"	12	"
Third ditto...............	6	"	12	"
Four roof holes.........	2	"	10	"
			8	"
Total	36			

The aggregate depth of the 36 holes was 408 lineal feet; number of square feet of heading to one hole about 4·8. The following is Mr. Drinker's description of driving by the

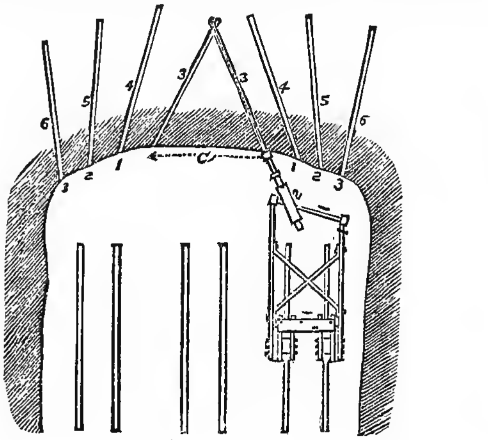


FIG. 4.

cut system: "The method of blasting by cuts is based on the extraordinary force developed by a comparatively small bulk of explosive matter. It consists in first blasting out an entering wedge or core, about 10 feet deep at the center, and subsequently squaring up the sides by several rounds. To do this 12 holes are first drilled by 6 machines, 3 on a side, the holes placed as shown in fig. 3, and marked *C; A* being the floor of the heading. Then 12 holes are drilled, 2 and 2, 6 on a side, with from 1½ to 2¼ in. "bits," the two sets being started about nine feet apart, and at such an angle as to meet or cross at the bottom, the largest bit being put in first. The holes are then charged with about 25 lbs. No. 1 and 50 lbs. No. 2 dynamite, and fired simultaneously by electricity. No. 1 is only used for cuts, inasmuch as in them a quick, strong powder compressed in a small bulk at the bottom of the holes is required where the greater resistance will be found, while the No. 2 added serves in filling up the holes, so starting the sides of the cut as the apex moves—the cut, *a*, being out, a second round of holes is started for the first squaring up, as shown by the numbers 1, 1, 1, 1, Figs. 3 and 4.

In these and subsequent rounds, 2, 2, 2, 2, and 3, 3, 3, the resistance is pretty equally distributed along the whole length of the holes, and as it is not so great as in the cut, No. 2 is used, as in the nitroglycerine being mixed with a larger proportion of absorbent matter, the force is thereby distributed over a greater space. In the first and second squaring up, rounds from 50 to 60 lbs. of No 2 are charged, and in the third, from 80 to 90 lbs., the holes getting stronger as the arch falls at the side. There are generally, also, one or two additional roof-holes in the third round that are not shown in the figure, their position being variable, according to the lay of the rock. The top holes in the first round are also designed to bring down the roof not shaken by the cut, and are, therefore given a strong angle towards the center, and always drilled from 12 to 14 feet deep. The plan, Fig. 4, shows the cut holes, 4, 5, and 6 the squaring up rounds.

"As to the relative depth, the holes of the first squaring up round are always drilled a foot or more deeper than the cut holes, and when blasted they generally bring out a foot additional of shaken rock at the apex of the cut."

(*c*).—**Brain's Radial System.**—This system, devised by Mr. W. Blanch Brain, of St. Annal's Cinderford, was introduced about three years ago at the Drybrook Iron Mines, in the Forest of Dean. The main object of the inventor was to perforate the face of the level without once shifting the stretcher-bar when placed at its proper height. M. André, in his work on Coal Mining, thus notices the radial system: "The fundamental principle which constitutes its distinctive character is to make the holes of a series to radiate from a fixed point. The object of this radiation is twofold—to utilize the face of the heading as an unsupported side, and to reduce to a minimum the time consumed in changing the position of the stretcher-bar. It will be obvious on reflection, that if these ends are attained without

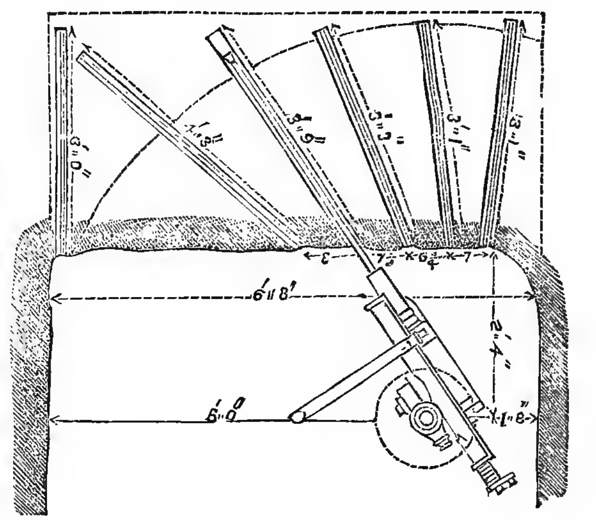


Fig. 5.

incurring a compensating loss, the merits of the system are beyond question, since their attainment leads to rapidity of progress, which is the main purpose of machine labor. It is evident that if the holes are made to radiate from a fixed point, and the horizontal position be avoided, none of them can be perpendicular to the face of the heading, and, consequently, the lines of fracture from each charge tend to reach this face. A consequence of this fact is that no unkeying of the face is necessary since each shot tends to blow outwards. Let it be assumed that the drift to be driven is six feet, eight inches in height. The width in this case is immaterial to the operation of the system. The stretcher-bar, which is to serve as a support to the machine, is fixed at a certain height from the floor, and at a certain distance from the face, as shown in Fig. 5. The height of the bar above the floor, with slight modifications to suit existing conditions, will be the same in all cases; but the distance of the bar from the face will be determined by the length of the machine, or at least by the distance from the centre of the clamp to the end of the piston-rod, into which the bit is fixed. It is obviously desirable to reduce the distance between the face of the heading and the stretcher-bar to the least possible, since the angle of the holes will rapidly increase as the distance is diminished. From the figure it will be observed that the stretcher-bar is fixed 1 ft. 8 in. from the top, 5 ft. from the bottom, and 2 ft. 4 in. from the face. The first and second series of holes are 3 ft. 1 in. deep; the third 3¼ ft. deep; the fourth 3¾ ft.; and the fifth 4¼ ft. deep. The bottom or lifting holes are 3 ft. long.

In a heading 6 ft. 8 in. by 6 ft 8 in., giving an area of 44 square feet, 29 holes were bored, representing a total lineal length of 69 ft. 8 in. As the cut or advance was about 3 ft., it follows that each hole removed nearly 7 cubic feet of rock.—*Mining Journal.*

THE TOOLS USED IN BREAKING ROCK.

THE principal tools used by miners in "breaking ground," as it is termed, are pick-axes or "picks," "pikes," "hacks," "slitters," or "mandrils," as they are variously called, of different kinds; hammers or "sledges," of different forms and weights; shovels; wedges or "gads," and "moyles;" borers or "boryers." Besides these we may mention such miscellaneous tools as "tamping bars," "prickers," "swab-sticks," hatchets or "dags," adzes, saws, and other tools used for blasting, timbering, and other special purposes. All these vary considerably in form, size, and other particulars in different districts, and when used for different purposes. We can only describe here the principal varieties.

Picks.—These are mostly made of iron, with points or "tips" of steel, while the handle, "helve," or "hilt" is formed of ash or hickory. In the metal mines of the West of England the picks are usually of the form shown in fig. 1, which is called the "poll-pick," having its head or "pane" *a* steeled as well as its point. This is the most useful tool the miner has, as it serves as a hammer as well as a pick. It is also very much used as a lever, the curve of the pick serving as a fulcrum, and great leverage being obtained through the handle or "hilt." It is also much used as a hammer to drive the "gad," an instrument presently to be described. A fair length is about 15 inches, the weight is about 4 lbs., but they are made occasionally but little over 2 lbs., and sometimes as much as 7 lbs. or even 10 lbs. The heaviest picks in Cornwall are used in the China clay pits of the centre of the county. Picks of very similar form are used in the lead mines of Derbyshire and Wales. When the pick is much used as a lever, the head is frequently formed as in fig. 2*a*, with a projection wing to afford increased support to the helve. This is called a jackass pick. Similar support is better afforded by making the eye portion of the pick somewhat deeper than usual. Ordinarily, for hard ground, the point is sharpened four-square, but for soft ground it is usually flattened, and for clay ground it is frequently spread out to a width of $1\frac{1}{2}''$ or $2''$, as in fig. 2*b*. Fig. 3 shows a form of pick frequently used in the iron mines of Somerset and Wales, weighing from 4 to 5 lbs. A very similar form, but made somewhat slighter, and weighing only 2 or 3 lbs., is used in the coal mines of South Wales. For sinking purposes they are made much heavier, often 7 lbs., when they are known as "hacks" in some parts. These are often 18 to 22 inches long. Helves of picks vary from 24 inches long in some poll-picks used in confined places, to 36 inches or more. Many other forms of pick are in common use, almost every district having its own special form. The cost of a poll-pick of $4\frac{1}{2}$ lbs. weight, the poll and tip well steeled, is in Cornwall at present about 2s. 6d.; the cost of the helve or "hilt" is 4d.

Hammers.—The chief kinds used in metal mines are mallets or "malls," used for "beating the borer;" "sledges," for breaking up large masses of rock, and for driving the "gad;" and "cobbing" and "spalling hammers" for further reducing the ore; "lath sledges" are used for driving the laths in ground requiring timbering. The head or "pane" is usually steeled, the handle or "hilt is made of ash or hickory. The "eye" is occasionally round, sometimes square, more usually, and much better, oval. Fig. 4 represents the "cat-head" mallet, used for "beating the borer" in many parts of Cornwall. It varies in weight from 4 to 9 lbs.—averaging, perhaps, 6 lbs. or 7 lbs. Fig. 5 is a "bloat-head" hammer used for single-handed boring in the extreme west of England, at St. Just. It weighs from $2\frac{1}{2}$ to 4 lbs. The hilts of these single-handed boring hammers are rarely so much as $18''$ long, but those for double-handed hammers are from 24 inches to 30 inches in length. These boring sledges are sometimes used for driving wedges or "gads," and the pool-pick is also largely used for this purpose. Sometimes a special "gad sledge" is provided for that purpose. It is much like that already figured, but longer in the head and narrower in the pane, and weighs about 7 or 8 lbs. The form shown in Fig. 6 is used for breaking up large rocks, but in this case the weight is often increased to 15 lbs., 20 lbs., or even more. These are sometimes called lump sledges. Fig. 7 represents a "lath-sledge," for driving the "laths" used in timbering tender ground in Cornwall and elsewhere. Fig. 8 shows a "spalling hammer" in common use; the weight will be from 3 to 6 lbs.

Shovels or Spades.—These also vary much in form and size. Fig. 9 represents the long-handled shovel, used almost universally throughout the west of England not only for removing loose material underground, but also for general use at the surface. The "plate" is from 8 inches to 12 inches wide, and 10 to 15 inches long, slightly hollowed and strengthened with a central rib extending about half way down. The point is often, and with great advantage, steeled. The handle or "hilt" is from 4 to 5 feet long in general, slightly curved. The weight of the plate is from 3 to 4 lbs.; the cost, unsteeled, from 2s. to 3s., steeling about 6d. extra. A shovel like Fig. 10 is much used in the iron mines of the north of England. The proper use of the long-handled shovel of the west of England is not very easily acquired; nor is it, perhaps, so well adapted for removing very light and loose material as the shorter handled shovels. For rough and coarse materials, however, its value cannot be over-estimated, as the point makes its way readily beneath or between the masses, and the knee serves as a fulcrum at the same time for the long lever handle. The vanning shovel, used in "vanning" tin and other ores, is somewhat like Fig. 9, but larger, rounded at the ends, and without the strengthening rib. It is made of very thin iron, so as not to exceed 2 or $2\frac{1}{2}$ lbs. in weight. The plate may be about $15''$ long; the handle about 3 feet. Much attention is paid so as to secure a proper curve for both plate and handle, as much of the success of the operation depends upon these particulars.

Wedges.—These are largely used for breaking down portions of rock, being driven by the pool-picks or hammers already mentioned. In Cornwall the wedges most commonly used are known as "gads," "pickers," and "moyles" or mules. The *gads* are usually made of steel, vary from 6 inches to 10 inches in length, and weigh from 1 to 5 or 6 lbs. Fig. 10 shows a very useful form. The *pickers* used in the Western mines are longer and narrower. They are used, as the name implies, to pick out the small fragments of loose rock which wedge in larger portions in some situations. Worn out steel borers make excellent gads and pickers.

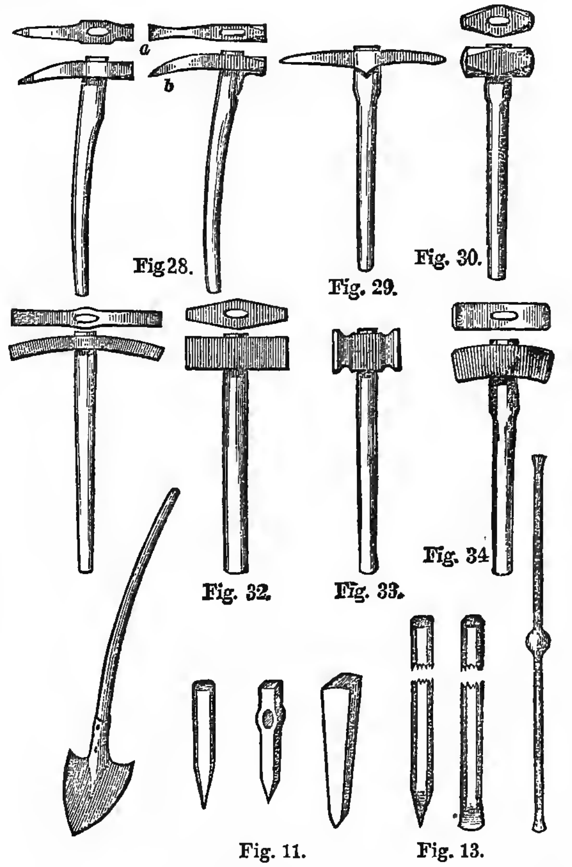


Fig28. Fig. 29. Fig. 30. Fig. 32. Fig. 33. Fig. 34

Fig. 9. Fig. 10. Fig. 11. Fig. 12. Fig. 13. Fig. 14.

In Saxony it is common to make the gads with an eye in the centre, as shown in fig. 11. The miner passes a string through the holes, and so carries a day's supply without inconvenience. The larger kinds of wedges known in Cornwall as "moyles" are used more especially in quarry work. They vary from ten inches to eighteen inches in length, and weigh from seven to twenty pounds. They are sometimes formed of iron throughout, but preferably with a steel tip.

The term gad is sometimes restricted to those which are brought to a point, those having a chisel edge are more properly termed wedges. The cost of steel wedges varies much from time to time, but at the present time is about 8d. per pound. Iron wedges cost rather less than half this amount.

Borers.—These are often called "striking borers," "drills," "bits," and sometimes "augers." Of course they are very different to true augers. Ordinary borers are worked by percussion, borers which revolve under pressure are seldom used in mining operations, except for deep trial borings. The borers used in metal mining are mostly of the form shown in fig. 13, varying in width from one and a half inches down to one inch, and in length from one foot to four feet,—the shorter being wider than the longer ones, in order to afford "clearance" as they succeed each other in boring deep holes. In open quarry work much longer and larger borers are used. In the west of Cornwall, at St. Just, the borers are lighter and smaller than elsewhere, single-handed boring being common as already mentioned. The best borers are made of steel throughout, but sometimes iron borers with steel tips are still used. For boring machines, the form of the cutting edge is very different from that shown in the figure—the chief forms being the "Z" and the "X." The jumper shown in fig. 14 is used in open quarry work, but not often by miners. It is sharpened and steeled at both ends, and is held by the lump in the middle.

Miscellaneous Tools.—The *tamping bar* is a bar of iron tipped with copper, or a rod of hard wood, used for ramming home a "tamping" of clay or earthy material so as to confine the gunpowder or other explosive in a bore-hole to increase its useful effect. The *pricker* was formerly much used to make a hole through the tamping, but since the invention of safety fuse it has gone very generally out of use, the tamping being now rammed around the fuse itself. *Swab-sticks* are rods of wood, with the fibres of the end beaten loose, and used for drawing wet mud or sludge out of a bore hole. Sometimes a kind of syringe known as a gun is used with good effect for this purpose. A hatchet or "dag" is very useful in preparing timber for tender ground, and in Cornwall the miners are expected to be expert in its use, and also in the use of a cross-cut saw, hand saw, adze, and auger.

—*From the "Principles of Metal Mining."*

ON DEAD WORK IN SHAFTS, ETC.

THE shafts for metal mines, besides the actual labour of excavating, require much additional attention before they are ready for daily use. Some shafts are intended for pumping only; some for pumping and raising ore; and many for the use of the miners in proceeding to and from their work in addition to these objects.

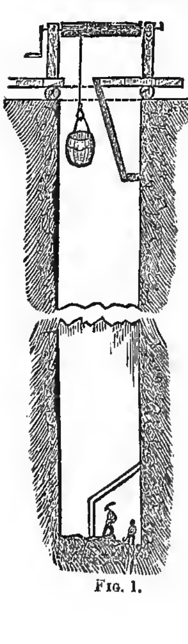


FIG. 1.

Protection from Danger.—As the shaft reaches a depth of 10 to 20 fathoms, it is usual—or at least proper—to protect the men working in the bottom from the danger arising from the occasional fall of stones or materials, since a very small stone falling upwards of 60 feet is sufficient to cause death. A portion of the shaft is covered over by a temporary sloping roof of boards called a "pent-house," as shown in fig. 1, and the men retire beneath this whenever anything is being raised or let down in the shaft.

Striking Deals.—To diminish the risk of accident from the upsetting of the kibbles, what are known as "striking deals" are used in some places. These are pieces of wood placed as shown in fig. 1, which serve to guide the ascending kibble through the opening at the top of the shaft. Fig. 2 is a plan of a shaft divided for pumping and "winding," or "drawing stuff," with a narrow central division for a ladder-way. The winding division a is boarded in entirely from the ladder-way b, but the portico c, containing dd, is only separated at intervals from the ladder-way.

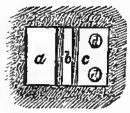


FIG. 2.

Ladders.—The ladders are usually made from 20 to 30 feet long. The "rungs" or "staves"—preferably 10″, but sometimes 12″ apart—are best made of iron bars let into the wooden sides, as shown in fig. 3. At the top and bottom, and at intervals throughout the length, longer bars cc pass quite through the sides, and are secured by a "cotter" as at d, or by a nut as at e. The ladders are placed in the shaft as shown in figs. 4, 5, of which 4 represents the safest mode, as the man-holes bb, in the "solars" aa, are under the ladders. When the ladders are placed as in fig. 5, a careless stepper may step back into the man-hole, and losing his hold on the ladder, may "fall away." Sometimes the man-holes are protected by trap-doors, but this leads to much delay, so that in practice they are seldom kept shut.

Partings.—Partings of the shafts consist of strong beams of wood, which either rest upon the timber "sets" of the shaft, or, in hard ground, are let into the country on either side; longitudinal timbers are nailed to these so as to form the shaft parting, and the same cross timbers serve to support the solars. In the great majority of the Cornish metal mines, and in many of those of South Wales and the North of England, the men go to and from their work by means of the ladder ways just described. The going down is not very hard work, but as the average daily amount of climbing is, perhaps from 400 to 600 feet, and *sometimes* as much as 1500, and as the men have frequently to bring up some of their tools for sharpening, the labor becomes very severe—as much in some instances as the whole of the work underground. In some mines the men are raised in the cages or skips used for raising ore, and this practice is increasing with the increasing use of wire-rope.

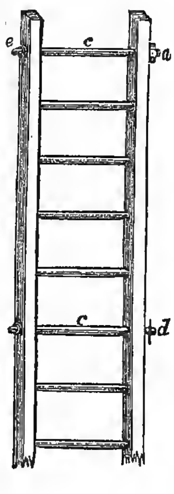


Fig. 3.

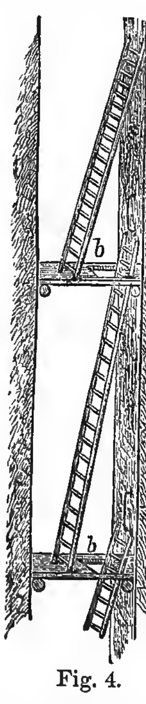


Fig. 4.

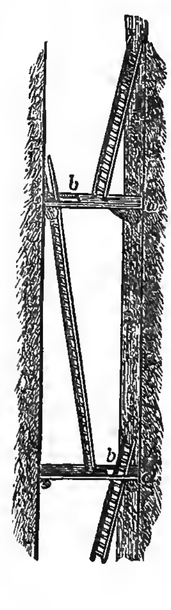


Fig. 5.

Safety Catch.—Sometimes the cages are fitted with safety catches which are intended to prevent the fall of the cage in case of the ropes breaking. One very convenient form of this contrivance consists of a strong spring which serves as the connection between the rope and the cage. The weight of the loaded cage keeps this spring bent, but if the rope should break it is at once relaxed, and, by its recoil, sets free some strong teeth, which immediately force themselves into the shaft railway or guides, and so keep the cage from falling. But all such contrivances are liable to get out of order unless constantly watched; and as it seems difficult to induce men to prepare for a danger which seems very remote, many practical miners prefer to do without all such appliances, and to trust entirely to the perfection of the rope, which is constantly under the inspection of the manager or his appointed agent.

From shallow depths, or while sinking, the men are often raised by means of the rope used for raising the "deads." The writer has been frequently brought up from a depth of between 30 and 40 fathoms standing with one foot in the kibble and holding on to the rope with his left hand; but such a mode cannot be recommended for depths of more than a few fathoms, especially if the rope is at all worn.

The Man-Engine.—In some of the larger Cornish mines the contrivance known as the "man-engine" is used for raising and lowering the men—a special shaft being devoted to this purpose, except that a ladder-way is also placed in the shaft.

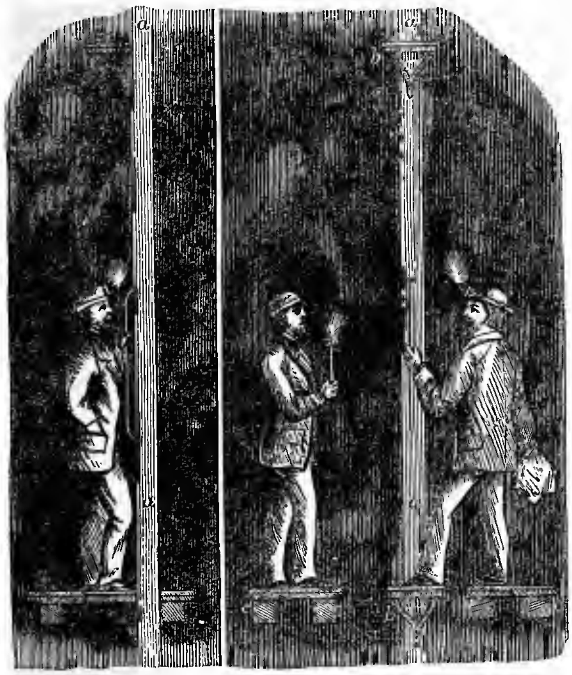


Fig. 6.

The man-engine consists of a beam of wood called the "rod," *a a*. Fig. 6, which is made to move up and down alternately through a space of twelve feet, by means of an engine devoted partially or entirely to that purpose. On the rod at *b b*, steps are fixed twelve feet apart, on which the men stand while it is in motion, holding on by iron handles provided for that purpose. When it stops for an instant before the motion is reversed the steps are level with the "sollars," which are placed in the sides of the shaft. It is evident that if the men who stand on the steps during the upward motion of the rod step on to the sollars during its downward motion, and step back to the rod when it again rises, they will be raised to the surface by successive lifts of twelve feet, without any labor on their part except the stepping off and on. As many men may thus be brought up from their work at one time as there are steps on the rod, and, as the sollars are fixed on both sides of the shaft, an equal number of men may be carried down at the same time, each stepping on the rod as the man leaving work steps off. The weight of the rods, with all connections, averages about 25 cwt. per fathom, or for a depth of 200 fathoms amounts to about 250 tons. The great weight is balanced by several of the "balance-bobs," to be described hereafter. The man-engine is so great an advantage to all concerned, both workmen and employers, that it would soon become generally used in deep mines unprovided with lifting cages but for its great expense. This is very great indeed, since most of the shafts in deep and therefore old mines are too narrow and irregular to allow of its introduction without a good deal of expense in cutting down the irregularities. Still, in large mines, the expense is well repaid by the advantage.

The cost of supplying a man-engine, with driving engine complete to a depth of 200 fathoms—exclusive of the cost of the shaft itself—cannot be taken at less than £2000 to £2500. The interest on the larger sum at 5 per cent., with 10 per cent. added for depreciation of plant and repairs, amounts to £375 per annum. The cost of coal and attendance for driving the engine, for oil and grease, etc., will amount to say £250 per annum in addition.

The labor of climbing from an average depth of 100 fathoms cannot be taken at less than 1 hour daily, or, with 3 shifts of 50 men at an average of 5d., the amount lost by climbing will be each day 62s. 6d., or, for a year of 240 working days, say £801, showing a clear gain of £175. For a depth of 310 fathoms the advantage is many times greater, since the exhaustion of the men from the labor of climbing and the time occupied will increase in a geometrical ratio. However, setting aside all calculations of cost, it is only necessary to look at the men who have just come up by ladders from deep mines to see that some mode of relieving them from such excessive toil is most necessary. The man-engine originated in Germany, where it is called the "fahr-kunst." The idea occurred to some of the German miners, who saw the reciprocating action of the pump rods, to attach steps to it, and this was actually carried into practice. In Cornwall the idea of a man-machine was first carried into effect by Mr. Loam, in 1835, at Tresavean mine in Gwennap, Cornwall, and an award of £500 was made to Mr. Loam for his great boon to the working miners by the Royal Cornwall Polytechnic Society.

—*From the Principles of Metal Mining.*

THE CONVEYANCE AND RAISING OF STUFF.

THE earliest mode of bringing the ore and deads from the "pitch," or the place of work, to the surface, was probably by carrying it in baskets of wicker-work, and this mode is still in use in many foreign mines. For centuries, however, the mode most usually adopted has been to place it in wheel-barrows, and to wheel it along the levels. In many metal mines this mode is still the only one in use, but some form of a tram-wagon is now very generally introduced.

The first improvement was to lay planks along the rough floor of the level, upon which the wheel of the barrow would run more easily. The wheel-barrow used for such purposes in Cornwall is shown in Fig. 1. It has no legs; is nearly parallel lengthwise; and its sides are but little inclined. Its ordinary load is about 1 cwt. to 1¼ cwt. It is usually made on the mine, and its cost varies from 8s. 6d. with a wooden wheel, to 12s. 6d. with an iron wheel. Such a wheel-barrow is admirably adapted for use underground in the old-fashioned narrow levels, and it is far more convenient for tipping sideways than is the ordinary navvy barrow, with side sloping sides and long legs.

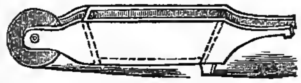


Fig. 1.

Tram-Wagons.—The introduction of a wider system of levels, and their increased length, due to the smaller number of shafts in deep mines, has led to the gradual introduction of tram-wagons, running upon four wheels. These are sometimes made of wood strengthened with iron bands, but are better of iron throughout. Fig. 2 shows a wagon made of boiler-plate. This, when 42 inches long, 30 inches wide, and 18 to 20 inches deep, will hold about a ton of iron ore; will weigh from 3 to 4 cwt.; and cost from £5 to £6.

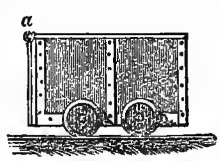


Fig. 2. — TRAM-WAGON, flanged wheels. Door at end, hinged at *a*, made of iron plates riveted.

Sometimes the wagons are made with plain wheels to run between tram-plates, of a form shown in fig. 3, at *a*, but a saving of iron is effected by using flanged wheels running upon wooden rails, 3 inches high and 2 inches wide, faced with thin bar iron, or upon iron rails nailed to wooden sleepers. Three forms of rail are shown in fig. 3, *b c d.* A convenient width between the rails is 36 inches, but the writer has seen gauges in use in Cornwall and South Wales varying from 42 inches downwards to 14 inches, the latter being used for the narrow levels in an old iron mine. The rails used weigh from 10 lbs. to 20 lbs. per yard of length.

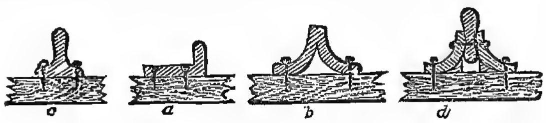


Fig. 2.

The tram-wagons are pushed along by boys or men, sometimes pulled by donkeys or horses, and in a few instances hauled along by wire-ropes or chains, which are coiled around winding-drums worked by stationary engines. Where possible the rails should have a downward inclination of about half an inch per fathom in the direction of the load, as this greatly facilitates the movement of the heavy weight, without materially impeding the return of the empty wagons. In the iron mines of the North of England and South Wales much greater inclinations are rendered necessary by the situation of the ores, and "tail-rope haulage" is exceedingly common.

Methods of Raising Ore.—The stuff having reached the shaft has next to be raised to the surface. From depths not exceeding 15 or 20 fathoms, the "tackle" shown in fig. 7 may be used with advantage. This plan is not to be recommended for greater depths, as the cost may be considerably lessened by the use of other appliances—the "horse-whim," derrick or whipsey-derry, water balance, or steam engine—described in the chapters on machinery for raising ore and pumping. The ore is raised either in "kibbles," "skips," or "cages." The kibble is simply an iron bucket made of boiler plates, riveted together as shown in figs. 1 and 7. They are attached to chains, hempen or wire ropes, and vary in capacity from 1 to 25 cwt. The small kibbles used with the tackle are called "winze-kibbles." They are made about 14 inches high and 12 inches in diameter; holding from 1 cwt. to $1\frac{1}{4}$ cwt. Whim-kibbles are of nearly the same form as winze-kibbles, but they are from 20 to 24 inches high, 14 to 18 inches wide, and made of somewhat thicker plate, with a loop below for greater facility of upsetting in landing. They hold from 4 to 6 cwt. Kibbles of

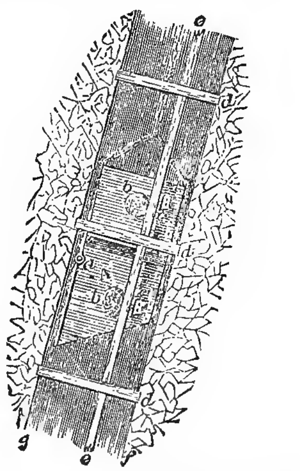


Fig. 4.—A, The Skip, with a hinged door at *a*, wheels at *b*, and guide pieces at *c*, *c*; *d*, *d*, cross timbers let into sides of shaft; *e*, *e*, guides; *f*, foot-wall; *g*, hanging wall of lode.

very large dimensions are occasionally used for deep shafts, and worked by water wheels or steam engines. At Dolcoath mine, in Cornwall, very large kibbles, capable of containing a ton or more of tin stuff, are worked in some of the old irregular shafts. The largest of these are more than 4 feet high, and about three feet 6 inches wide. When kibbles are used in deep shafts it is because they are much inclined and somewhat irregular. The lower side or foot-wall is often partially or entirely lined with "bed-plank" to reduce the friction. The amount of wear, of bed-plank and kibble is very great, the friction is enormous, and the breakages, owing to the strain on the ropes and machinery, are very frequent; so that the use of kibbles for deep or permanent shafts is not to be recommended. A much better plan is to straighten the shaft as much as possible, to put in guides or shaft railways, and to use skips running upon wheels as shown in fig. 4. These skips are now commonly raised by means of wire-rope, but unless the railway be put in very carefully the friction is still considerable, and in Cornwall a speed of 360 feet per minute has rarely been exceeded. For highly inclined shafts, the skips should have wheels as shown in the figure; but when the shaft is nearly vertical, simple guides will suffice. Fig. 5 is a plan of a shaft with double skip-board adapted for wheels, and fig. 6 a similar shaft arranged with "cover and filler" roads for guided skips. The cost of putting in a double skip-board or shaft railway will vary from £1 10s. to £3 10s. per fathom of length.

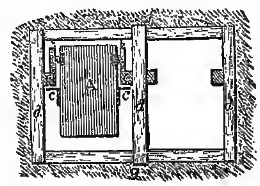


Fig. 5.—Plan of Double Skip-road or Shaft Railway. A, the skip; *b*, the wheels; *c*, *c*, guides; *d*, *d*, shaft timbers; *e*, *e*, the rails.

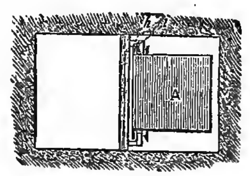


Fig. 6.—Plan of Double "Cover and Filler" Skip Road. A, the skip; *i*, the "cover;" *h*, the "filler."

The skip shown in fig. 4 is filled sometimes at the upper end, but sometimes the rails are bent round so as to allow it to take a horizontal position at the bottom of the shaft, when it is filled by opening the hinged door. This door is then secured with a catch until it reaches the surface, where the "lander" brings it over his wagon and opens the door, so allowing the stuff to slide down the sloping bottom.

Wherever possible, the use of a pair of cages running in a vertical shaft is to be recommended. These are arranged so that the loaded wagon from the "end," "stope," or "face of work" may be run directly into the cage, and raised to the surface with only one loading. In this manner a much greater speed may be attained; and nearly twice the quantity may be raised from the shaft with the same power as in the case of a pair of skips.

Comparative Cost.—From shafts from 10 to 15 fathoms deep, two men will raise on an average, with the tackle, about 12 tons in eight hours. The cost of this in Cornwall is 6s., or say 6d. per ton, or $\frac{1}{2}$d. per "ton-fathom." For depths of more than 15 fathoms a less quantity will be raised, or else a third man will be required, and the cost will be about $\frac{3}{4}$d. per ton fathom. A hempen rope about $1\frac{1}{4}''$ diameter, called a tackle-rope, is generally used with the tackle. With a one-horse whim, one man to receive the stuff and a boy to drive the horse, from 15 to 20 tons per eight hours may be raised from a depth of forty fathoms. The cost will be in Cornwall about 9s., or, say, 6d. per ton as before, but the depth being greater it will only be about 1-6th of a penny per ton-fathom. To raise a greater quantity, or from a greater depth, two horses will be necessary. With the "derrick" or "whipsey-derry" the cost will be a little more than with the horse-whim. Whim kibbles are often raised by means of chains, but the use of chains in shafts is not to be recommended. With large kibbles working in shafts of from 150 to 300 fathoms deep, from 20 to 30 tons per day of eight hours may be raised—the larger quantity, of course, from the shallower shaft. When engine power is used, the cost will be about 10s. to 12s., or, say, 1-30th of a penny per ton-fathom on an average. A water-wheel will save about 2-5ths of this. With a well-arranged skip and shaft railway the cost of raising ore, even where a steam engine is used, will be reduced to about 1-50th of a penny per ton-fathom, or less; and with a pair of cages in a vertical shaft with good arrangements will not exceed 1-100th of a penny per ton fathom.

In metal mines, where ores of a considerable specific gravity have to be dealt with, large cages are seldom needed. A wagon 30″ + 42″ + 20″ will hold about one ton of iron ore, and this is as much as it will be generally necessary or desirable to raise at one time. With good arrangements, a shaft of twelve feet by nine feet will be found large enough to allow of ample pumping space, a good ladderway, and a pair of cages capable of raising twenty tons per hour from a depth of two hundred fathoms. From the foregoing remarks it is evident that kibbles are only suitable for shafts of moderate depth, and preferably for those which are nearly vertical. Cages are only suitable for vertical shafts, but are valuable for all depths. For inclined shafts, skips running upon wheels are most suitable; and it will be worth while in every case to pay great attention to the rails or guides upon which they run. Where the inclination of the shaft from the horizontal does not exceed one in three, as in many ore beds and some few "flat" lodes, the ore may be brought up in the tram-wagons from the levels without using skips or cages, the same tramway being continued up the incline to the surface. In all cases, if at all possible, double roads should be used, or two pits should be put into communication to cause the weight of the descending cage to balance that which is ascending, so that the mineral only shall be lifted. Sometimes where both these modes are for some reason unsuitable, a "dummy" counterpoise may be used.

Ropes.—For shallow pits chain or hemp rope may be used with great propriety, because of the facility with which it may be coiled round small barrels or drums; but for considerable depths, and especially where great weights have to be lifted, the use of wire rope in some form is both safer and much more economical—and is, indeed, now almost universally used. Wire-ropes may be either round or flat, of iron-wire or steel. For round iron-wire ropes, drums of less than twelve feet should never be used; for flat ropes and ropes of steel wire, drums somewhat smaller may be used, but not to be recommended in general.

The following tables of the equivalent working strengths of chain, hemp rope, iron-wire rope, and steel wire rope, will be useful to the young student. They all refer to material of best quality.*

TABLE 1.—WEIGHT AND STRENGTH OF CHAINS.

Diameter of iron	5-16 in.	11-16 in.	15-16 in.
Weight per Fathom	5½ lbs.	28 lbs.	49 lbs.
Working Load	24 cwt.	54 cwt.	120 cwt.

TABLE 2.—WEIGHT AND STRENGTH OF GOOD HEMP ROPE.

Circumference	5½ in.	8 in.	12 in.
Weight per Fathom	7 lbs.	16 lbs.	36 lbs.
Working Load while new	24 cwt.	54 cwt.	120 cwt.
Breaking Strain	8 tons.	18 tons.	40 tons.

TABLE 3.—WEIGHT AND STRENGTH OF IRON-WIRE ROPE.

Circumference	2⅛ in.	3⅜ in.	4⅝ in.
Weight per Fathom	4 lbs.	9 lbs.	20 lbs.
Working Load	24 cwt.	54 cwt.	120 cwt.
Breaking Strain	8 tons.	18 tons.	40 tons.

TABLE 4.—WEIGHT AND STRENGTH OF STEEL-WIRE ROPE.

Circumference	1½ in.	2½ in.	3¾ in.
Weight per Fathom	2½ lbs.	5½ lbs.	12 lbs.
Working Load	24 cwt.	54 cwt.	120 cwt.
Breaking Strain	8 tons.	18 tons.	40 tons.

As shown in the tables, a very large allowance of strength is made for safe working, the working load being taken at less than one-sixth of the ultimate strength. With hemp rope and chains a greater allowance should be made, on account of the imperfection of material and workmanship to which they are especially liable. A large allowance must be made, too, for the strain due to the extra pull in starting. Sometimes this is somewhat relieved by mounting the bearings of the winding pulley or drum upon springs, but even when this is done the extra strain will be very considerable.

* Very complete tables of equivalent strengths are given in Molesworth's "Pocket-book of Engineering Formulæ."

The weight of the chain or rope itself must be taken into account when any considerable length is used, and this too will be much greater with chain or hemp rope than with wire rope. Indeed, for deep pits the use of chain would be forbidden by this consideration alone, as a chain of 300 fathoms long, capable of working with a load of 24 cwt., would itself weigh nearly one ton, while a steel-wire rope of the same strength would weigh only 750 lbs. To relieve the winding engine, and to enable it to overcome the weight of a long length of rope, the size of the drum is made to vary, or the speed of winding at first is reduced. This may be effected either by using a conical winding drum, or by using a flat rope and causing it to wind upon itself.

The Tackle.—The first machine used in mining operations for raising ore or deads is usually the tackle or windlass, shown in fig. 7. This is so simple that it scarcely needs a detailed explanation, but as it is usually made on the spot by the mine carpenter, a few words may not be out of place. The carpenter selects two pieces of "half-timber" *a a* long enough to reach across the shaft, and strong enough to bear the weight. These are called the "bearers," and they are afterwards planked over, except the small space

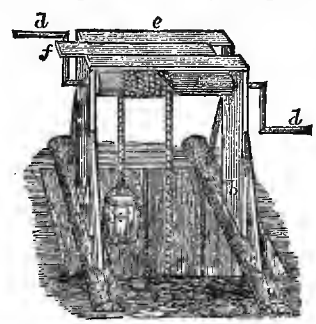


FIG. 7.

required for the kibbles. In the middle of these half-timber bearers the uprights *b b*, made of planks from 10 to 12 inches wide, 4 feet 6 inches long, and 1¼ to 1½ inches thick, are morticed. In the upper end of each upright a slot, about 10 inches long and 1½ inches wide, is cut, and the bottom lined with iron, to receive the iron handles, and to prevent the wood from splitting. The barrel *c* is made of a piece of Norway pine, from 4 to 6 feet long, and 8 or 10 inches thick. The ends of the barrel are strengthened with iron bands to prevent them from splitting when the handles are driven in.

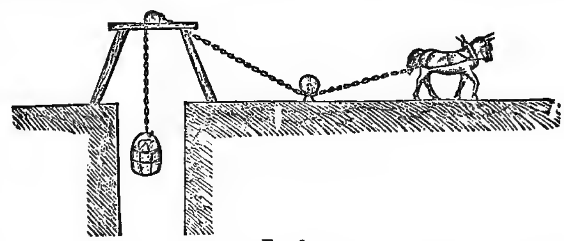


FIG. 8.

The handles *d d* are made of 1″ or 1½″ round iron, bent as shown, and squared and tapered at the ends for driving into the barrel. The handles serve also as an axle for the winding barrel. A piece of wood *e* is then fastened across the top of the tackle, and a groove is made in it to receive

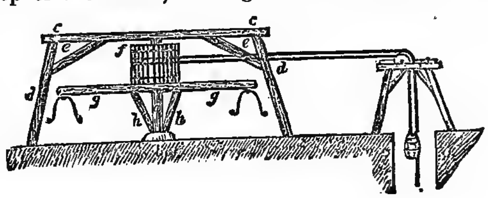


FIG. 9.

a sliding piece *f*, which, being pushed out beyond the bend of the handle, holds it when required, keeping the load from descending. Sometimes stays are fixed extending sideways from the uprights, as shown at *g g*. The cost of preparing and fixing this shaft-tackle should not exceed 25s. or 30s. for timber, iron-work, and labor. The tackle is well adapted for raising material from depths of less than 15 fathoms; for greater depths, up to 50 fathoms, the derrick or "whipsey-derry," fig. 8, is sometimes used, but it is slow in operation, and has little to recommend it except its small first cost, which is from £2, 10s. to £3, 10s.

The Horse-Whim, shown in fig. 9, is a much more efficient machine. This, too, is made on the mine, the mode of construction being as follows:—The axle *a* is of oak, about 12″ diameter, and 12 or 14 feet long. Three sets of arms are morticed into this at distances of 6, 8, and 10 feet from the lower end. Upon these arms wooden segments are nailed, and upon these again the 4-inch planks which form the barrel or cage. Each end of the axle is bound with iron, and each has an iron centre attached. The lower one works in a block of stone, shown at *b*, the upper in an iron socket fixed to the span beam *c c*. This is made of a piece of Norway or Swedish fir, 36 feet long and about 10 inches square, supported by the legs *d d*, which are morticed in the beam, and frequently strengthened with iron strapping plates. Stays are added at *e e*. The barrel *f* is 10 feet diameter; beneath it is placed the driving beam *gg*, 30 feet long, and strengthened by the stays *hh*. At one or both ends of the driving beam a bar of iron is fixed with a yoke to which a horse may be attached. The total cost of such a whim as here described is under £20, and is a very efficient machine.

The Poppet Heads are shown over the shaft to the right of the whim. The construction is as follows:—Two timber "horses" *i i* are first formed. The legs are 12 feet long, and as thick as possible, but not less than 10 or 12 inches. These are partly sunk in the ground, and the upper ends are morticed into the "caps," which are 9 or 10 feet long. The horses are placed one on each side of the shaft, about 5 or 6 feet apart, the centre of the space between being in line with the span-beam of the whim. Carriers are placed across the horses, and the bearings of the pulleys rest upon these. The pulleys are usually of different sizes. Where chain or hemp ropes are used for hauling, one may be about 4 feet and the other about 2 feet, each being 4 inches wide. Wire rope is seldom used with a whim, but should it be used the pulleys must be much larger. The total cost of the poppet heads for whim drawing will not much exceed £6. Very similar poppet heads, but larger, are used in many cases when winding with a steam engine or water wheel. It is not often that water wheels are arranged for hauling purposes, although in some instances, as at Wheal Friendship, near Tavistock, they have been used with excellent effect. The only peculiarity is the application of suitable gear for reversing or stopping the motion. There is no great difficulty in this, but the inconvenience is sufficient to prevent their extended use for such a purpose in shallow mines, and in deep mines a sufficiency of water power is rarely available, and what there is may be often more advantageously used for pumping. We shall therefore reserve our remarks upon water wheels for the chapter on "Pumping Machinery."

An easy and convenient, but not economical mode of using a fall of water for winding purposes is shown in section in fig. 10. The water enters at *a*, and falls upon the

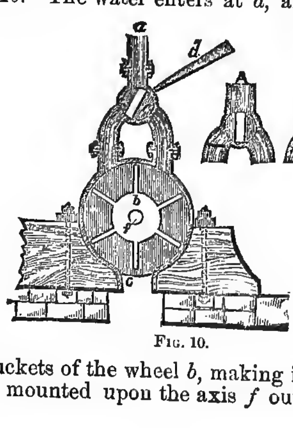


FIG. 10.

leaves or buckets of the wheel *b*, making its escape at *c*. A cogwheel is mounted upon the axis *f* outside the working barrel, which serves to communicate motion to the winding drum *g*, shown in fig. 11. The motion is stopped or reversed by the handle *d*, which moves the valve *e*, bringing the channel successively into the positions shown at A and B. The whole arrangement is shown in fig. 11, where *a* is the inlet for the water, *h* is the case containing the working wheel, *i* is the cogwheel fixed on its axis, and *g* the winding

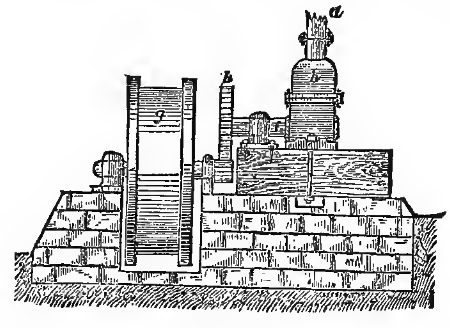


FIG. 11.

drum. This mode of using water power is suggested by a working model which is now in the Museum of Practical Geology in Jermyn Street, London. It is cheap, compact, and easily constructed, and but little likely to get out of repair, but the author is not aware that it is anywhere in use. When the fall of water is great, this simple arrangement will be found very efficient.

The Water-Balance.—In many of the open works on the northern side of the great coal basin of South Wales, water-balance machines are largely used for winding purposes, and for mines of not more than 100 fathoms deep; in a district affording a good supply of water, and free drainage by means of adits, they may be highly recommended. Sometimes they are used where there is no drainage, the water being pumped up from the bottom by an engine, but this is not to be recommended. In some cases the machines are placed at different levels, so that the same water is used five or six times over as many successible lifts. The tram, containing from 12 to 20 cwt., is placed in a cage over an empty water bucket, and the empty tram on a similar bucket at the top. Water is then made to flow into the upper bucket until its weight is great enough to cause it to descend, so raising the filled tram. On the arrival of the full bucket at the bottom of its fall, a self-acting valve opens and the water is discharged, so allowing the process to be repeated. The buckets are made of ½″ boiler-plate, circular in form, and some hold more than 2 tons of water. The landing chain is balanced by a chain which hangs below each bucket, and guide chains are used to keep the buckets from striking each other when the shafts are not divided. A speed of 300 to 400 feet per minute is easily attained by this machine, and the total cost of raising stuff is about 1½d. per ton per 50 fathoms. For great depths the weight of the machinery becomes so great that the economy is reduced or disappears. Somewhat similar machines are used in some of the iron mines of North Lancashire and Cumberland.

The Steam Engine.—For hauling in deep mines a steam engine is generally necessary, and although many forms of steam engine are employed for this purpose, our remarks will apply to two only—the double-acting high-pressure condensing engine, and the double-cylindered horizontal engine. Both these machines work the steam expansively, and both give good duty when in good order and when well attended; but the preference in the future will probably be given to the horizontal engine everywhere at any rate, except in Cornwall. The Cornish winding engine differs but little from the Cornish pumping engine, hereafter to be described, except that it is double acting, *i. e.*, it takes its steam on both sides of the piston instead of only on the upper side. It is, however, supplied with a heavy fly wheel to equalize the motion as much as possible. The driving crank is placed between the fly wheel and the winding drum. Neither a very rapid nor an equal motion is obtained by this form of engine, and the double-cylindered horizontal engine is on the whole much to be preferred. The Cornish double-acting engine is sometimes used for pumping, or for driving, stamping or crushing machinery.

Horizontal Engine.—The cylinder of this engine is fixed in a horizontal position, as show at AB in fig. 12. High-pressure steam is admitted alternately on each side of the piston. The piston-rod is terminated by the crosshead *g*, which works backwards and forwards between the guides *a b*. To this crosshead the connecting rod *g c* is attached, and this turns the drum or fly-wheel by means of the crank C and the main shaft *r*. The whole is fixed on heavy masonry as at C D. To equalize the motion two cylinders are used with their crank at right angles, so that one is exerting its greatest amount of force while the other is at its dead point. A common form of governor is shown at G. To economize steam it is used expansively. The condenser and its connections are not shown in the sketch, but they may be placed in any convenient situation. For winding purposes they are fitted with reversing gear and powerful friction brakes

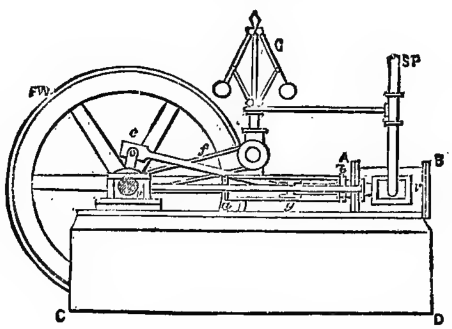


FIG. 12.

The advantage of the horizontal over the beam winding engine is greater compactness and less first cost for equal power, a saving of cost in the necessary buildings, and, if two cylinders be used, a more equable motion. Its only disadvantage is that the cylinders are apt to lose their true form, the lower part becoming more worn than the upper, owing to the weight of the piston. A remedy for this has been found by mounting the piston on the centre of a long piston-rod which passes through stuffing boxes placed at each end of the cylinder. Every winding engine should be fitted with some form of indicator, showing the attendant the exact position of the skip or cage in the shaft at a glance, as in this way many accidents from over-winding may be prevented. To prevent loss of steam by condensation in the steam-pipe, cylinders, etc., these parts, as well as the top of the boilers themselves, are covered with some non-conducting material. The modes of doing this will be explained in a future chapter. The principal forms of boilers will also be there described and illustrated.

—From the "Principles of Metal Mining."

NOTE ON HOEFER'S METHOD OF DETERMINING FAULTS IN MINERAL VEINS.

I DESIRE to call the attention of members of the Institute to a new method of plotting and determining faults in mineral deposits, suggested by Prof. Hans Hoefer, lately of the Mining School of Przibram, and now of the School of Leoben, and one of the editors of the Austrian *Zeitschrift für Berg-und Hüttenwesen*, in the 29th volume of which appears his paper on the subject. I will here give an abstract of its contents, which though partial, will be, I trust, sufficient for my purpose.

In the examination of a fault, we usually follow the rule of Zimmermann, which assumes that the hanging-wall of a faulting-fissure has slid downward in the direction of its dip; but dislocations (coal-seams in particular) show many cases in which one part of the seam has been shoved over the other; that is, the hanging-wall of the faulting-fissure has slid upward instead of downward. For a long time, every dislocation of a mineral deposit upon a cross-fissure was regarded as necessarily belonging to either one or the other of

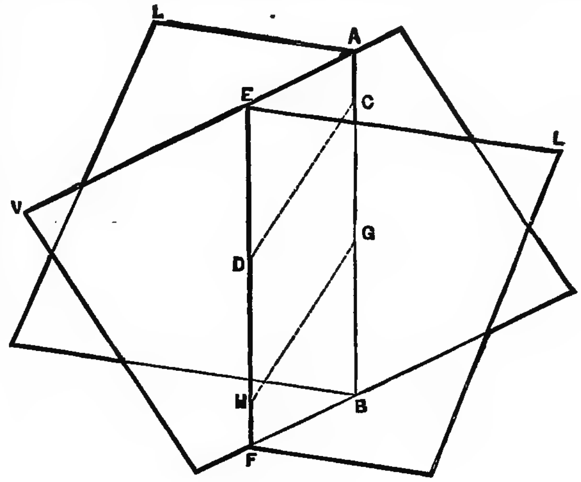


Fig. 1.

these two classes. It was either a slide (*Sprung*) or a heave (*Wechsel*). But it has been proved of one and the same fault that it may appear at one place to be a slide, while at another place, even in the same mine, it appeared to be a heave.

This phenomenon itself suffices to show that the classification of dislocations is not so simple as has been supposed, and the methods pursued by mine surveyors, based upon that classification, may, therefore, need improvement. These methods, as is well known, assume that throughout a given fault the motion of the hanging-wall has been everywhere the same, and consequently that the so-called vertical interval or "throw" determined by exploration of the two dislocated parts of the deposits at any one point is a guide for exploration at all other points. Practice, however, shows that this guide is not unerring. It does not always agree with the indications of actual movement and direction furnished by the striations of the walls of the faulting-fissure. These marks frequently do not follow the dip, but obliquely cross it. The oblique or other motion thus indicated is certainly one of the elements in the geometrical problem presented to the surveyor.

Fig. 1 may illustrate this point. Let *AB* be the line of intersection between the vein *L* and the faulting-fissure *V*, the striations of which indicate that the movement took place in the direction of *CD*. The dislocated continuation *L* of the vein being found at *EF*, the old rule would declare that the case was one of a heave or upward movement of the hanging-wall; and yet it is really an oblique slide. That the distinction is important appears when we consider that, if the vein being worked in the foot-wall of the faulting-fissure had contained an ore-body which was cut off by

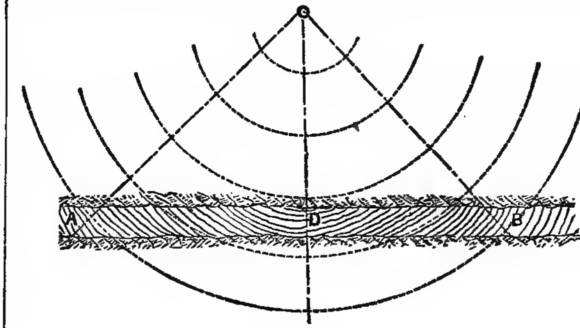


FIG. 2.

the fault at *G*, the old rule would require us to accept the continuation of this ore-body at some higher point in the hanging-wall of the fault; whereas, by the present hypothesis, it is at the lower point H, to which the striations tend. It is apparent that an oblique slide would not, according to the old rule, appear to be a slide at all, unless the striations (that is, the actual movement) were steeper in dip than the lines of intersection. In case L had been horizontally moved, the dislocation would, by the old rule, be a slide, if it had moved in one direction, and a heave, if it had moved in the other; whereas, in reality it would have been neither. But Professor Hoefer goes still further, and declares that the parallel uniform movement of the hanging-wall of a fault is not to be always assumed. The evidence of this statement is drawn especially from coal-seams; not, as I apprehend, because the dislocations of these deposits are different in nature from those of metalliferous veins, but because coal-mining has furnished more extensive excavations, and therefore a greater body of evidence than any other branch of the business. Moreover, we can with greater certainty judge what was the original position of a coal-bed than we can of a fissure-vein. When the latter suddenly changes dip, for instance, beyond a fault, we can not be sure that the change of dip did not exist before the dislocation took place, This phenomenon of a change of dip and also strike is frequent in coal-fields, under such conditions as make it reasonably certain that neither the original position of the coal nor irregularities in the faulting-fissure were the cause; but rather that the relative movement of the two parts of the deposit was not in parallel lines. In many cases where veins show a uniform dip, that is, approach in

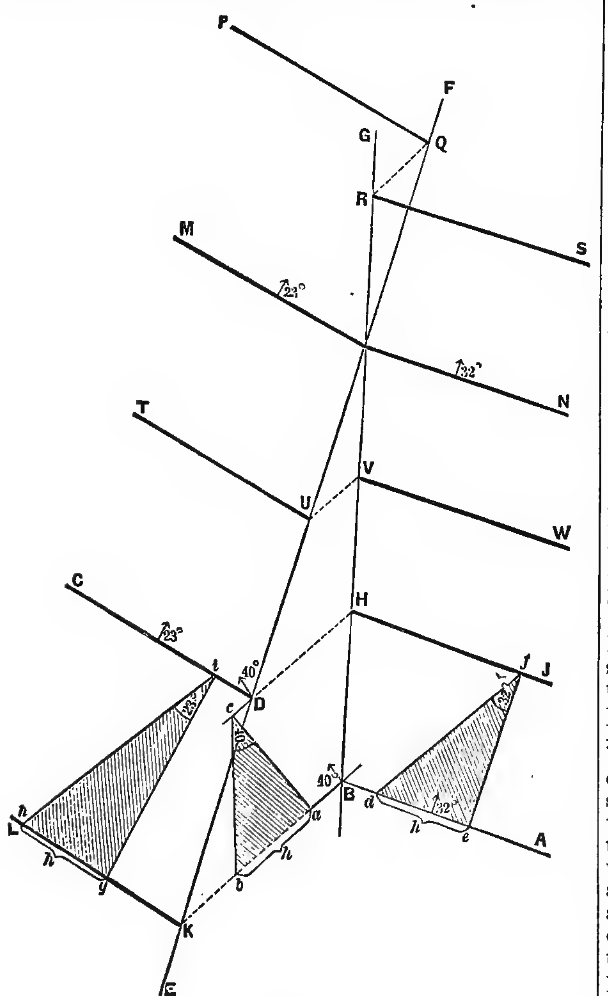


FIG. 3.

form a regular plane, and yet exhibit these changes beyond a fault, it is reasonable to infer, instead of a simple slide or heave, a partial révolution of the mass on the hanging-wall side of the fault around an axis normal to the plane of the faulting-fissure. A simple geometrical construction will show that when one mass of rock has moved in this manner

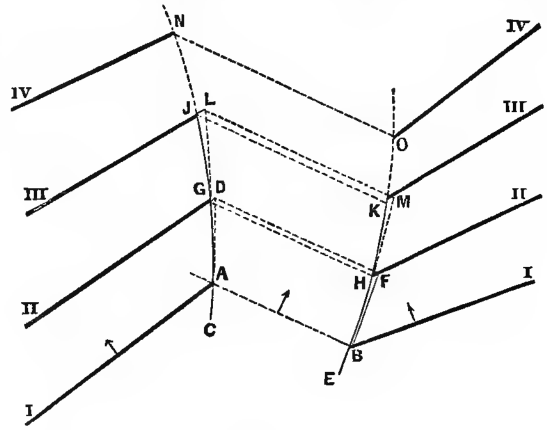


FIG 4.

upon another, the dislocated portion of the mineral deposit common to the two must acquire a different strike and dip from that which has remained unmoved. Professor Hoefer cites as an illustration a very extensive fault in the neighborhood of Aix, which shows to the southeast a greater vertical dislocation than toward the northwest, and can only be explained by a turning movement.

Fig. 2. shows how, in the simplest case, that of a revolution without vertical descent or ascent of the hanging-wall, the striations in the faulting fissure may indicate the axis of the revolution. In this figure, AB is a drift run in the faulting-fissure, and showing striations according to the dotted lines, which pitch in one direction at A, and in the opposite direction at B. In such a case, the center of movement would be found at the intersection of perpendiculars drawn through the line of striations. Thus, if striations were exposed at A, B, and D, the intersection of the perpendiculars would show the center of movement to be at C. In practice, however, it is likely that the several perpendiculars drawn through such striations would not intersect at a given point; and this would show that, besides the turning movement, there had also been a movement of translation of the whole mass, up, down, or along the plane of the fault. The complication of these two movements is, however, not beyond analysis, if the data are sufficiently abundant and exact. Even with the imperfect data usually afforded by the limited exposures in mines, it is much better to work upon a perfect than upon a crude and partial system; and Professor Hoefer thinks that not only the points already mentioned, but also the question of direction of movements (for example, in Fig. 2, whether from B to A, or A to B), can in many cases be satisfactorily determined by the plan he proposes.

This plan may be illustrated for a general case by Fig. 3. Let AB represent the course of a vein dipping 32° (as shown by the arrow), which has been explored on an upper level to where it is cut off by a cross-fissure having the strike BK and the dip of 40° (as shown by the arrow). Let it be assumed that upon a lower level the vein had been opened, with the strike CD and the dip of 23°; that on this level a fault was encountered at D, having the same strike and dip as that at B. By a simple construction, with the help of the triangle abc, in which the angle c is 40, and the side ab is the vertical distance h between the two levels, we find the point c and draw the line cD, which, being parallel to BK and also coinciding with the strike of the fault at D, proves the latter to be identical with the fault at B on the level above. We now determine the two lines of intersection EF and BG made by the fault, with the two portions AB and CD of the faulted vein. This can be done most easily by the aid of the two triangles, def, ghi, in which the base h is taken equal to the vertical distance between the two levels, and the angle opposite h is, in each case, the dip. AB and CD being already given; the corresponding lines, namely, HJ on the level of CD, and KL on the level of AB, are to be found. This is done by drawing HJ parallel to AB through the point f, and prolonging hg parallel to *CD*. The course of the fault at *B* is known; hence the line *BK* drawn on that course intersecting the line *KL* at *K* determines the point *K* for that level, while for the next lower level the point *H* is determined by producing the line *CD* parallel with *BK*; in like manner, the lower levels, *TU*, *VW*, *MON PQ*, *RS*, etc., can be plotted. It is evident that by drawing lines through *KD* and *BH*, the lines of intersection *EF* and *BG* are obtained. It is evident also that on the fourth level *M*, if in working from *M* the fault is encountered at *O*, it will not be necessary to cross-cut, as in the upper levels, to find the continuation of the vein; since at that point, which is the center of revolution, the vein can be found by simply breaking through the cross-fissure. In the next lower level, *PQ*, however, if the fault is encountered at *Q*, it will be necessary to cross-cut for the continuation of the vein in the direction *QR*, a direction opposite to that which would be necessary at *U* or *D*.

checks by graphic construction the errors of observations due to irregularities in the vein and fault. He points out also that this method indicates conclusions as to the nature of the movement which has taken place; since, if the two lines of intersection are parallel, the movement must have been parallel; while if they converge, the movement must have involved a revolution, and the points where they intersect must be the intersection of the axis of revolution with the plane of the fault.

This statement of Professor Hoefer's method suggests the following observations:

Evidently the graphic methods shown in Fig. 3 will not indicate, in case of a compound movement, involving both a revolution and a slide, either the existence, the direction, or the amount of the latter. The relative position of the two parts of the faulted vein, shown in Fig. 3, may have been reached by a simple revolution around an axis normal to

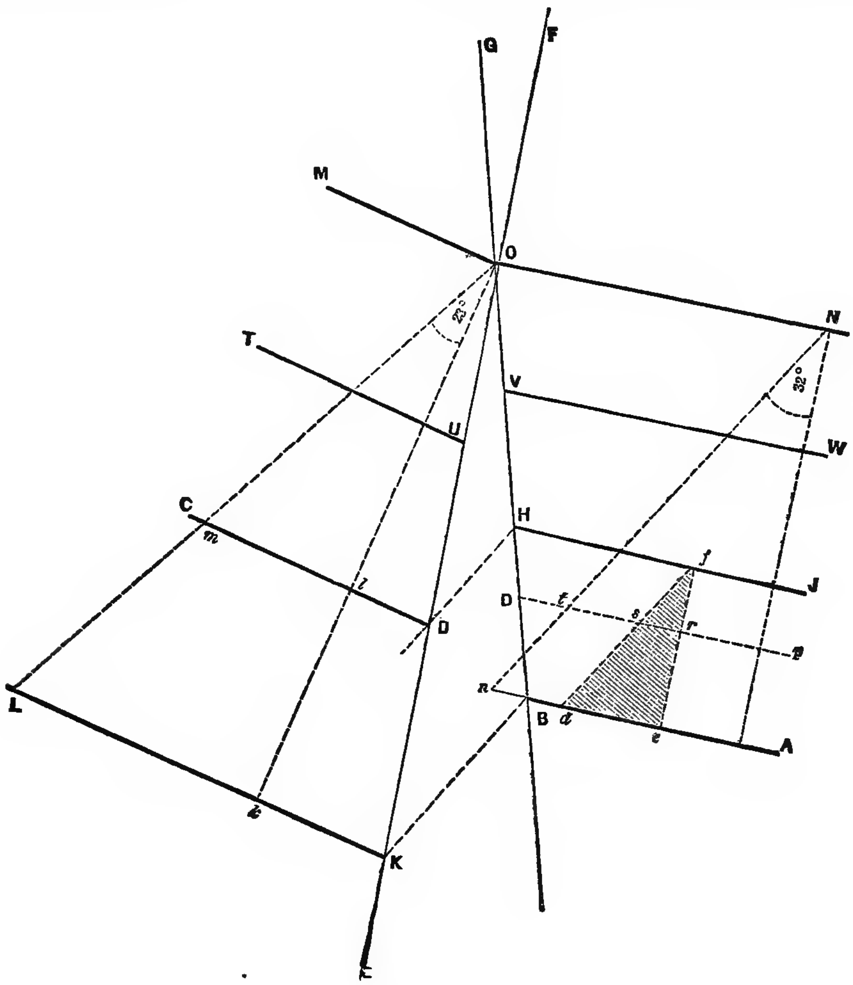


Fig. 5

It will be seen that in this case a revolution has been demonstrated without the help of the indications afforded by the striations.

Professor Hoefer indicates also how this graphic method may be applied to lines of intersection which are not straight, but curved; and to the still more complicated case of a varying strike at different levels in the faulting-fissure itself; that is, for instance, when *BK*, *HD*, *VU*, and *QR* are not parallel. Fig. 4 is the diagram he employs for this purpose. I will not, however, pause to explain it in detail.

Professor Hoefer recommends in practice the general method above described, on the ground that it involves no generic assumption or hypothesis, but makes the work of the surveyor in the first place purely descriptive, and also

the fault at *O*, or by a revolution around some other axis, normal to the fault, coupled with a slide along the fault. For instance, the axis of the revolution may have been at *U*, and the slide may have carried it *apparently* to *O*.

Yet this is precisely the case which may be expected to be most frequently encountered in practice. Simple revolutions must be rare, if, indeed, they ever occur. My own impression on this point is confirmed by the reply of Professor Hoefer to an inquiry which I addressed to him after perusing his paper. He says: "Circular movements combined with movements in straight lines are very frequent in our faults; in fact, I do not doubt at all that a continued careful study will show them to be the rule. Whether simple revolutions often occur, is very difficult to decide, from observations thus far available. You know how one-sided and incomplete the inquiry has heretofore been in this direction. In the southernmost district of Przibram, the Clementi vein shows in its selvages striations, the varying directions of which indicate a circular movement; and my studies (unfortunately interrupted by my departure) led me in this case to the belief that the movement had been circular only. But I did not consider the question definitely settled."

But to return to the illustration of Professor Hoefer's method given in Fig. 3, it is evident that although the method, applied as in that case, to a fault which has been determined in two places, at different levels, will not from these data alone, reveal the exact components of the movement which has taken place, it will nevertheless indicate for any level where the continuation of the vein is to be sought, beyond the fault. It is, however, often important to find the continuation, not merely of the vein, but also of an ore-body in the vein. Thus, in Fig. 3, the miner working from *C* to *D*, and finding the vein cut off by the fault, might know that by drifting into the faulting-fissure to *H*, on the same level, the vein would again be struck; but the point *H* would not in any case (except that of a simple and perfectly horizontal movement) be the point originally adjacent to *D*, before the faulting took place; and if there were at *D* a valuable ore-body, the question would still remain, in what direction from H the continuation of this ore-body should be sought.

For the case of a simple revolution around *O*, the solution of this question would be easy. It is shown in Fig. 5, which I have made by taking part of Professor Hoefer's Fig. 3, and adding two auxiliary triangles, *OLk* and *NnA*. The construction is as follows: From *O* draw *Ok* perpendicular to *KL*, and *OL*, making the angle $LOk = 23°$. Similarly construct from any point *N* on *ON* triangle *NnA*, making the angle at $N = 32°$. The distances cut off on the hypothenuse *OL* by the lines *LK*, *CD*, and *TU*, represent the hights (inclined measurement) between these levels. The same is true of the sections into which *Nn* is divided. The distance of *D* above the level *MO*, along the dip of the vein, is *Om*; and the point adjacent to *D* before the dislocation must lie at the same distance above *ON*. Taking $Nt = Om$, and drawing *Dp* through *t*, parallel with *HJ*, we have *D*, the point desired, which lies the distance *fr* vertically, or *fs*, inclined measurement, above *HJ*.

But if there has been a rectilinear as well as a circular relative movement of the vein masses on either side of the fault, point D^1 will not be the point formerly adjacent to *D*. The continuation of an ore-body cut off at *D* will lie at a distance and in a direction from D^1 directly dependent upon the extent and direction of the rectilinear movement. (I need hardly say that in all of these cases it is of no consequence whether both walls, or only one, actually moved. The total movement may be assumed to have affected one wall only.) In this case, the study of the striations in the faulting-fissure may give valuable, though perhaps rarely exact indications as to the direction of the movement. If the rectilinear movement followed the circular one, the striations may furnish a clear record of it in straight lines. If the two were (as is more probable) simultaneous, the striations would be strictly epicycloid curves; but for their interpretation it would be sufficiently accurate to consider them as fragments of ellipses, having their major axes inclined in the direction of the rectilinear movement. These indications would doubtless be in most instances of practice merely general guides to exploration. But after, by such exploration, the continuation of a given ore-body (as D, Fig 4) had been found, it is plain that the whole movement of the faulted vein could be analyzed and plotted, and that the continuation of any other ore-body could be sought with confidence. In the case before us it would be only requisite to determine the relations of the point actually found to D_1, its theoretical position on the hypothesis of purely circular motion; and the correction thus applied to D^1, could be applied to any other point similarly determined.

I should remark in conclusion, that all these constructions rested upon the assumption that the dip of each segment of the faulted vein is constant. That is, the vein is treated as a plane. But it would not be difficult to include in the method here shown, changes of dip and strike, as these might be discovered in actual working; and under certain circumstances, a change of dip might serve as a useful landmark in surveying. For instance, if in Fig. 3 there were a change of dip in the left-hand portion of the vein, at the level *CD*, then the corresponding change of dip must be shown on the line *GB*, at the point formerly adjacent to *D*; and the discovery of this point would at once, as has been already shown, permit the analysis of the movement which had taken place, and the deduction of all its resultant relations.

A paper by R. W. Raymond, Ph. D., Transactions American Institute of Mining Engineers.

THE SILVER MILL.

DEDUCTION from Practical Experience.—Iron producers, scientists, and railroad engineers have their societies for mutual benefit. Minute details of facts and forms which they develop conduce to general improvement. But no society of practical, actual workers in mining and metallurgy, as developed in the United States, exists to accumulate, and retain, from their several experiences, those minutiæ so essential to the maximum of economy and success.

From a lack of correct, minor details, the apparently superior mills do not always obtain the best results; and often from an old rattletrap mill most excellent results are obtained.

The causes are generally simple, but not always easily found, even by an experienced and observing millman.

It is often very convenient to lay the blame to the "peculiarities of the ore," when it may not belong there.

For an illustration of how deficiency in details may affect needless expense, mention may be made of a mill of recent manufacture and assumed to be first class in every respect. Although the intention was to grind the ore in the pans, the mullers and drivers were remarkably and unnecessarily heavy.

For the sake of exact figures, we will suppose the mill to be set up at Virginia, and working bonanza ore.

A set of shoes and dies would weigh about 1,400 pounds; at 5¼ cents, the cost would be $73.50. The value of the old iron left, after the set was worn out, would be less than $7.50, leaving a loss of $66.00 With mullers of minimum weight, the best average wear of castings is less than fifteen days; the excessive weight would grind them out three days sooner, a difference of $13.20, or nearly $1.00 per day; and these figures are where castings are the very cheapest.

Owing to the scattered and ever changing mining activities, with their unsettled and uncertain futures, and to the intoxicating effects of stocks, it is pretty certain that no mining society could enthuse a sufficiently interested membership; and the only authority available must continue to be, the men and builders, who chance to be selected to accomplish the desired results, be they better or worse. However, Americans need not be ashamed of their progress or status.

The prospecting miner who can extract good, free milling ore, can provide himself with machinery, of the capacity of 3 or 4 tons per day, with very little outlay, but he must be cautious not to drift into that error which has left so many wrecks, viz: the forfeiture of a success to an experiment.

It is commendable for those who can afford it to carefully experiment for improved methods. It is the life of progress.

But for milling on a more extended scale, for the greatest profits, heavier capital is requisite, and nothing more strongly emphasizes the saying, "the best is always the cheapest."

For the milling of raw ores two methods may be said to exist, which involve little difference in the mills, save the relative proportion of power, stamps, and pans.

The older and more familiar method is to crush coarse in the battery and grind in the pans. This involves greater power, greater wear of castings, and greater loss of quicksilver, and not always, better results.

A more recent, but not so universal method, is to crush fine in the battery and to keep the shoes barely off the dies. It may seem incredible that by the latter means more gold and silver may sometimes be extracted than by the former. Ore will naturally break where there is the most mineral, and from a fine comminution in the battery, the mineral will be nearly all disengaged. Quicksilver has a preference for gold and silver; but in grinding it is forced to take up base, which renders it inactive for the more precious metals. Result, more bullion and less value.

slimes before they have much hardened will cut the cohesion, and it is the cohesiveness in slimes that carries the quicksilver, and that cohesiveness, once established, brings all the difficulty of working them.

Of the two methods, a compromise ground is untenable. It is a fact, well known by the experienced, that when thoroughness of grinding is wanting, returns are also. This has

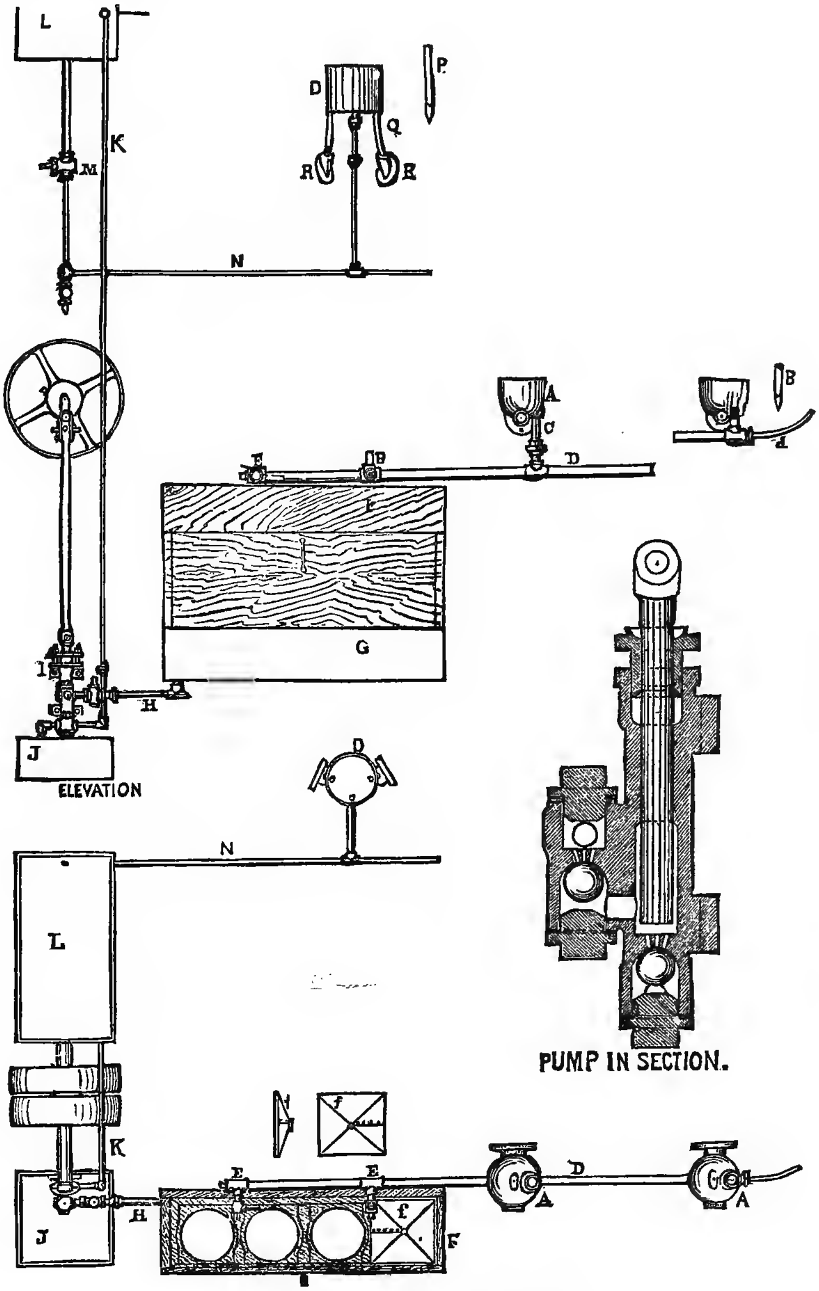


PLATE 1. QUICKSILVER PUMP SYSTEM.

It is a matter of doubt whether, taken all in all, there is an instance where amalgamation without grinding might not equal the more expensive grinding.

Comstock ore is always ground, but they never have exhaustively experimented otherwise. Again, fine crushing increases the percentage of slimes, and the system of working them separate (the sand for the Mine Co. which must not return below a given per cent., and the slimes for the Mill Co.) make it difficult to render the required returns to the mine.

The query might arise, "Would not the slimes exceed the ability to handle them?" Very little sand worked with the been thought a proof against not grinding, but the latter is not to be judged when fine crushing has been compromised.

In a proper conditioned pan pulp once between the shoes and dies would be sufficiently ground, but the amount is so small that it takes a long time for the mass to make the circuit; and to stop when half done would be no better than to alternate grinding one charge and not another.

Crushing.—Countless have been the devices for crushing ore, but that primary crushing device used by all aborigines, the stone mortar and pestle, as developed into the modern ponderous stamp battery, stands as prominently in the van as ever.

As a preparatory for the stamps the rockbreaker is generally a necessity. Of the various styles, so far as introduced, the Blake is so much the best that none other is to be considered in comparison with it.

Self-feeders, in their present perfection, not only make their advantage a saving felt on the pay roll, but increase the efficiency of the battery, and are a saving in the wear of castings. Three kinds are at present prominent in the market, all of which are now under the same control, and the buyer's choice is unbiased by rival owners.

Of these the Hendy feeder has been the most ably introduced, having passed other "jerky contrivances" in the lead. This feeder has generally given good satisfaction, but with it much more work is accomplished. It is important, for economic wear, that a stamp should commence to rise as soon as its force is expended; furthermore, that its rise should be with accelerated velocity; in other words, the cam should be so formed that the first degree of revolution after contact should raise the stamp less than the last degree before dropping, and the curvature of the cam should be as great as possible, and admit of the drop. Of course this can be only at the maximum drop.

Amalgamation.—In amalgamation, as in crushing, the popular process is one of many.

The modern amalgamating pan is a growth from the old arastra, and though quite simple in construction, has been the subject of a variety of forms. A better knowledge of what they can and should do, has narrowed these down to

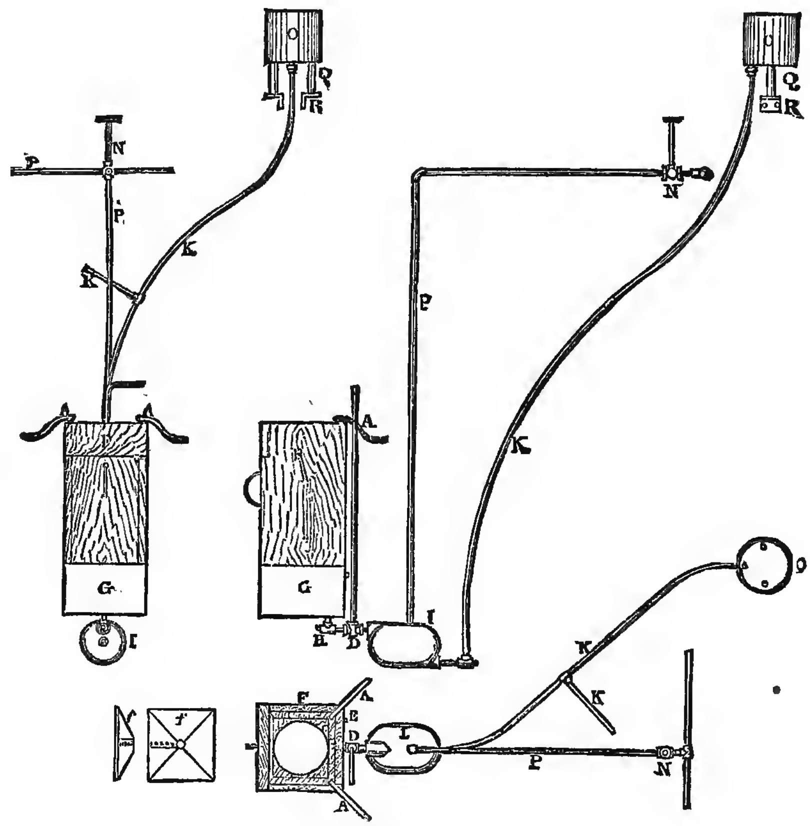


FIG. 2.

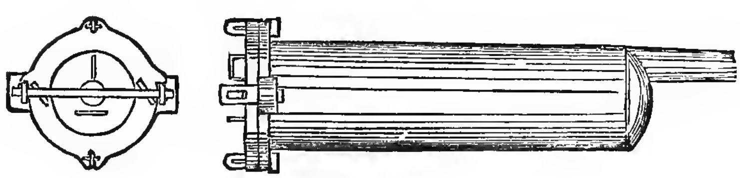


FIG. 3.

especially in wet sticky ores. Some fine dry ores, however, have a tendency to jar off, a circumstance that precludes precision.

The Tullock has for years fed the wet ores of the Comstock with satisfaction, and possibly a case of their failure anywhere might reflect as much on the mill man as on the machine.

The Standard as now improved is the simplest of feeders, and in dry ore probably unsurpassed.

Stamps are now made heavier, and are run faster than formerly; a modern stamp rarely weighs less than 800 lbs., and a stamp that makes no more than 90 drops per minute is counted slow. (The California Mill, Virginia, makes 102.) The wear and tear of a high speed battery of course is more, common generalities. The pan holds from one and one-half to two tons of pulp; the gearing underneath is open and plain; the muller is raised by a left hand screw on top, the handwheels of which should be large; the jam wheel being no smaller than the screw wheel from the fact that at times it is the subject of even greater application of muscle than the latter. Again, when in fast motion it is decidedly inconvenient to adjust a small wheel under a larger one.

As the muller and driver are held to position by but one bearing, it is strange that the inclination has been to make this short. Eighteen inches are none too long for the bore of a driver, and the shaft should pass entirely through it when the castings are new, provision being made in the cap for the end of the shaft when the castings are worn.

Much time and labor are saved in Babbitting the shaft, if it is made with a taper downward through the Babbitt; in which case, instead of withdrawing the shaft and cutting the old Babbitt, the new Babbitt is poured with the old, the taper preventing displacement even if the new Babbitt becomes broken.

But the most important feature of a pan—one which may involve many dollars per day, but which often receives but little attention, and, though simple in principle, is very often not understood because not studied—is the pulp currents.

These currents must needs be uniform and regular to insure uniform work, and they must be strong enough at the bottom of the pan to carry the quicksilver. The motion of the muller makes a current by throwing the pulp to the outside as it advances, which then rolls up at the side and over to the center to be thrown out again. This, so far, cannot be improved upon, and the only service left for the wings is to add to the pan capacity by preventing the pulp from running too high up the sides, to accomplish which the best shape is of an inverted plowshare. Having very naturally a good current above the muller, we have only to work in unison with this underneath.

With the grooves between the shoes leading straight out, the current is impelled only by centrifugal force, which is insufficient to carry the quicksilver; but if the point of a shoe touches the diameter, its outer end being a very few inches either forward or back, a current is forced proportionate to the angle of departure from the given diameter. If the dovetails in the muller and pan bottom are relatively similar, to admit of the shoe and die being one and the same pattern, the currents of the two will be similar and in unison. When the currents are outward they coincide with that above the muller, inward currents, being the reverse. A confusion of the two—unless one strongly overbalances the other—effects stagnation. It does not follow that because an inward current works contrariwise to the one above the muller, it cannot do good work; if it is strong they will compromise.

Definite rules for the angle of drought for shoes and dies cannot be laid down, because the speed of pan, the character and thickness of pulp, and, if grinding, the weight of muller, have each their influence.

It must rest with the millman to determine if the mechanical part of his amalgamation is perfect, or if his quicksilver is churned, or his castings cut out too quickly. A remedy is at hand, if systematically sought.

The speed of pans, a few years ago, was generally sixty or sixty-five revolutions per minute; eighty-five or ninety is more common now. With the slow motion the pulp should be thick, with the fast motion much thinner, and the charges of the latter are worked much sooner. A modern mill with fast batteries and fast pans accomplishes much more than the slow one of old.

The screw on the settler driver should, unlike the pans, be right handed, for besides being more convenient in case of a slipping belt, the power applied to turn the screw helps the muller along.

Settlers are of two classes, one having mullers with wooden shoes, and the other having arms with either wooden or iron shoes or stirrers.

For heavy, underground sand, the muller is easier to start and less liable to clog, and is more commonly used in such cases; but for well ground sand the other style is superior.

A settler should never be allowed to foul by an accumulation of heavy matter at the bottom; it is a positive preventive of good work. It may seem easier to advocate this than always to follow it.

A seeming natural remedy for such conditions is really an aggravation of it, namely, a liberal use of water. There is a point in the thinning when the quicksilver will be precipitated, but the heavy sand held in suspension.

If, after the charge is run out, which should leave about eight inches in the settler, a pan is drawn and no water added for a half hour, the warm charge will gather and carry the heavy sand; now enough water only is added to reduce it to an appearance of still some thickness, and this is all the water that is used in the charge. A horn spoon will show its success in advance of results.

Concentrators for a silver mill must necessarily be simple and capacious. Good agitators, shoveled out often, are profitable.

In some ores "sand sluices" are very effectual. A "sand sluice" for concentrating is a broad sluice twenty or twenty-four inches wide, and in it, at intervals of eight or ten feet, are vertical strips at the sides to hold unfastened riffles. Thin riffles are laid in and the sand runs over them for a time, say one or more hours, when another course of riffles one half inch, or less, thick, is laid on top of the others. This is repeated until the sluice is full, when it is shoveled out; meantime the sand should run through a duplicate sluice. These sluices should have a grade of about three and one half inches to the rod, it is then under control; for by starting with a thin riffle at the bottom, a strong current may be had, whereas a thick riffle will give a deadened current.

These sluices are an advantage where blankets are profitable, and if followed by blankets relieve the latter from much coarse, heavy material.

A blanket sluice should have a grade of about three inches in seven feet.

Quicksilver.—Quicksilver is lost both mechanically and chemically, and eternal vigilance is required in both directions.

The handling of quicksilver, when it is not in direct intercourse with the pulp, has its importance on the score of economy. Consequent upon continued lifting and carrying heavy quantities by the old method of hand labor, was a not insignificant loss.

Partly in proof of this is the bonanza of quicksilver an old mill is known to be.

To save this, and the heavy lugging by hand labor—which if the amount was expended upon water would seem immense—was attempted years ago by way of mechanical substitutes. To contend with was the heavy weight of the liquid and its close connection and relation with air, water, dirt, and amalgam, each of different gravities.

It has been well proved that a poor device for haudling quicksilver is even more extravagant than hand labor.

At one of the Raymond & Ely mills an elevator was put in, but after much bother and trouble was discarded. Later a quicksilver pump with downward working valves was tried. Illustrative of its success was its rapid introduction into other mills.

Yet as a complete system it still had some drawbacks, and the study from time and experience was required to develop its perfection—for it must continue to do its work without any special attention, and for unskilled hands.

Plate I. shows the arbitrary generalities which must be observed to obtain superiority.

Plate II. shows another system, perfected later, which is especially good for a small mill, as the expense is very light even for only two pans. At the Con. Va. & Cala. Mills the pump system is mainly employed; but for the single agitator pans the pressure system does the work.

Quicksilver Pump System.—The setter bowls, A, have a vertical discharge at one side; said discharge is four inches above the inlet, and one inch above the bottom of settler (inside), and is fitted for a wooden plug, B.

A one inch pipe C, connects the discharge to a one and one half inch pipe, D. This pipe D, has an incline of one inch in four feet, and at the upper end a small pipe (d) connects with a steam pipe for an occasional clearing out.

At the lower end of this pipe the strainers are situated. Short one inch pipes, E, may be turned to either of two strainers, and discharge on sheet iron covers (f). These covers may be locked by passing a rod over them.

Strainer box F, is of wood and contains four strainers. It is fitted to the top of a cast iron tank, G. Tank G is five feet long and one and a half wide, and one foot deep. Through the bottom of G a short one inch pipe connects to the pump, I.

The pump has a stroke of five inches, and makes forty per minute. The plunger is of steel, and the packing is ⅜ inch round rubber, to prepare which it should be dropped into melted tallow and wiped dry before cooling; this dispenses with oil on the plunger.

Around the plunger, below the stuffing box, is a recess into which water rises, making a hydraulic packing below the rubber. Rubber gasket ⅛ inch thick is used on the plugs.

A tank, J, stands under the pump to catch leakage. The pump should run only when throwing. The valves being of rubber and seating easily, and the plunger running in hydraulic packing, leaves no possibility for any grinding effect on the quicksilver.

The pump discharges through a ¾ inch pipe, K (this pipe should be well supported near the pump), into an upper reservoir, L. This reservoir stands on a frame work, twenty inches above the pans. The vertical discharge is one inch pipe for eighteen or twenty inches, down to a quicksilver cock (cast iron, with a stuffing box), M. From this cock the distributing pipe, N, is ¾ inch, leads in front of the pans, and may conveniently be on the floor (being protected by wooden strips on each side). At the lowest place in this pipe provision must be made to allow drainage into a settler, or to the reservoir below.

Between each of two pans a branch of pipe, N, enters the bottom of charging bowl, O.

Before entering the bowl the pipe is enlarged to one inch to accommodate a better size of wooden plug, P.

Charger, O, is of cast iron, stands seven inches above the top of the pans, and is supported by two stand pipes, Q (one inch), which connect to the pans by flanges, R. These flanges, for iron side pans, are bolted to the outside and stand at an angle of 60 degrees or more.

Flanges for wooden pans are shown in plate I.

A belt shifter for starting or stopping the pump should be operated from near the upper reservoir.

Quicksilver Pressure System.—A A are one inch pipes from the settlers (no bowls are used). The discharge is 3½ inches, or more, higher than the connected end, and one inch higher than the top of settler bottom. Strainer tank, G, is of cast iron, 1½ feet square by one foot deep.

Pipe E, near the top, is an overflow for water. H is a one inch pipe connecting through bottom of tank, G, to pressure chamber, I. Quicksilver cock, D, is operated by a lever, extending above the strainer for convenience of access.

Pressure chamber, I, has a capacity of a full charge of quicksilver.

P is a half inch pipe connecting to steam mud drum of boiler, or to natural water pressure, or to compressed air. Valve, N, should be convenient to charging bowls.

At the bottom of I a three quarter inch pipe, K, branches and enters through the bottom of two charging bowls, O, thus supplying four pans.

For wooden sided pans, flanges, R, bring the stand pipes, Q, on the top end of the staves.

In action cock, D, being open, the quicksilver will flow naturally into chamber, I, then by closing D and opening pressure valve, N, the quicksilver will be forced through pipe, K, into bowl, O. Six pounds pressure will raise quicksilver one foot. In case of a watermill, where the pressure may not be sufficient, an extra chamber, I, may be introduced half way to bowl, O, which will be self-acting.

After the piping is well put together it should be first tested with water.

The burr, from cutting the pipes, should be reamed off.

Amalgam.—A pan for scouring amalgam resembles a small settler, but should have attached to its arms a shoe extending from rim to cone, the outer end being five or six inches ahead.

Diameter of pan, 5 feet; depth, 1½ foot; speed, 25 per minute. Before retorting, the amalgam should be dried by a hydraulic press or by piling the amalgam some two feet high on a strainer, and allowed to drain for a couple of hours.

The choice of retorts is not of vital importance to success, but as a question of convenience and economy it is to be considered. The hooded central discharge retort, which admits of turning, was extensively introduced and is still largely used outside of the Comstock, where they are almost if not entirely discarded.

As a center discharge does not admit of being filled, a much smaller retort with top discharge will do equal work, for which due compensation is not given, by the turning of the former. In other words, the consumption of iron for a given amount of amalgam retorted is greatest with the center discharge. These are deductions from personal observations, where individual weights and number of charges were recorded, and were extended to several working side by side. The average life of a center discharge retort 14 inches by 5 feet, by 1½ inch thick, was under 35 charges.

The hood and the head with revolving bar attached to its center is doubtless the cheapest form of construction, but for large retorts decidedly inconvenient, and invite a bad job in adjusting the head.

A decided and unprecedented success was made, two years ago, by casting retorts on end, face up, rendering the metal dense and uniform.

Eight retorts cast in this way, of a plan similar to plate III., were made for the Brunswick Mill. They were 5½ feet long, 14 inches inside diameter, and 2 inches thick.

With charges varying from nineteen hundred to twenty-four hundred pounds, they endured upward of eighty-five fires. Compared with the previous average, the advantage is emphatic, the extra thickness of one half inch requiring no appreciable increase of fuel.

To avoid the hard labor of cutting the bullion of a large retorting, use paper to make divisions in the amalgam instead of sheet iron.

Quicksilver melts at—39°, evaporates slightly at ordinary temperatures, and boils at 662°. Its specific gravity is 13·6 at 32°.

2·038 cubic inches weigh 1 pound.

One cubic foot weighs 847·89 pounds.

In a column of quicksilver every foot in height gives a pressure of 5,888 pounds per square inch. That quicksilver will pass through a smaller aperture than water is a popular fallacy, naturally deduced from the fact that the former will often leak from a vessel that will hold the latter. An explanation for this seeming paradox is that quicksilver, being so much heavier, gives far greater pressure, and in wooden vessels, water, having the finer penetration, enters the fiber of the wood and swells it, thereby closing small openings, whereas quicksilver, entering only the open grain, has no expanding effect.

Gold melts at	2,016°,	its specific gravity is	10.3
Silver "	1,873°,	" " " "	10.5
Copper "	1,996°,	" " " "	8.9
Cast iron "	2,786°,	" " " "	7.8
Lead "	612°,	" " " "	11.3

1 oz. Troy of silver is worth	$ 1.2929
1 lb. " " "	18.854
1 ton " " "	37,709.50
1 cubic foot " "	12,355.20

1 oz. Troy of gold is worth	$ 20.6717
1 lb. " " "	301.46
1 ton " " "	602,927.36
1 cubic foot " "	361,808 64

3.89 cubic inches cast iron weigh 1 lb.

To compute the weight of an article of

Cast iron, multiply its cubic inches by	0.2607 lb.
Wrought iron, multiply its cubic inches by	0.2816 lb
Copper, multiply its cubic inches by	0.3212 lb.
Lead, multiply its cubic inches by	0.4102 lb.

Under a column of water 26·5 inches high there is a pressure of 1 pound per square inch.

A circumference equals the diameter multiplied by 3·1416.

The area of a circle equals one half of the diameter multiplied by one half of the circumference, or square of the diameter, multiplied by 0·7854.

The surface of a sphere is the circumference multiplied by the diameter.

The volume of a sphere is the cubic of the diameter multiplied by 0·5236.

Tensile strength of Rods per square inch.

Cast steel,	breaking load,	50 tons;	safety load,	12.5 tons
Swedish iron,	" "	36 "	" "	9.0 "
Common iron,	" "	28 "	" "	7.0 "

Strength of Ropes.

Let C represent the circumference:

New hemp will safely sustain . . . $\frac{0.4\,C^2}{6}$ tons.

Iron wire will safely sustain . . . $\frac{2.6\,C^2}{6}$ tons.

Steel wire will safely sustain . . . $\frac{3.75\,C^2}{6}$ tons.

Rust Joint Cement (Quick-Setting).—1 lb. sal ammoniac, 2 lbs. sulphur, 80 lbs. iron filings. Mix to a paste with water.

Slow-setting—2 lbs. sal-ammoniac, 1 lb. sulphur, 200 lbs. iron filings.

For holes in castings, take 1 part gum arabic, 1 part plaster Paris, and 1 part iron filings. Mix with a little water.

Babbitt metal, 3·7 copper, 0·89 tin, 7·3 antimony.

Metal that expands in cooling—Lead, 75 parts; antimony, 16·7; bismuth, 8·3.

Taper for keys for shafting—One-sixteenth inch to four inches.

—*A paper by M. P. Boss in the Scientific American.*

THE ORIGIN AND CLASSIFICATION OF ORE DEPOSITS.

THE mineral matters which have proved useful to man form three categories; first, the earthy: as gypsum, clay, marble; second, carbonaceous: as coal, lignite, petroleum; third, metallic: as iron, gold, silver.

The metals occur rarely native, oftener as ores, that is, combined with sulphur, silica, carbonic acid, etc. These form a series of deposits, of which the physical and chemical characters and history differ widely. They may be grouped into three classes, as follows:

1. Superficial deposits.
2. Stratified deposits.
3. Unstratified deposits.

Superficial Deposits.—These include the accumulations of gold, stream tin, platinum, gems, etc., which are obtained from the surface material, gravel, sand, and clay, derived from the mechanical decomposition of rock masses, through which metals or ores were sparsely distributed. Thus, gold usually occurs in small quantity in the quartz veins of metamorphic rocks. By the erosion of these rocks, having been freed from its matrix, and that more or less perfectly removed, this gold is concentrated by a natural washing process similar to that employed by man, but on a grander scale. In the same manner the oxide of tin, which is hard, heavy, and very resistant to chemical agents, is distributed sparsely through granitic rocks, or vein-stones; and where these have been eroded the cassiterite remains in the alluvial deposits of streams, where it can be cheaply and easily collected.

Superficial deposits have probably furnished nine-tenths of all the gold that has been obtained by man, the greater part of the tin, all the platinum and its associated metals—iridium, osmium, etc., and all the gems except the emerald, which in South America is obtained by mining. Thus it will be seen that the surface deposits are scarcely less important, economically, than the others. The superficial deposits of gold are for the most part confined to the foothills of mountain ranges, and are the products of the erosion effected by ages of frost, sun, rain, and ice, which are continually wearing down all the more elevated portions of the earth's surface. Shore waves also, in some instances, have worn away the rocks against which they have beaten, and have produced accumulations of *débris* that contain gold, platinum, gems, etc., in sufficient quantity to be economically worked. When a beach deposit of this kind has been raised above the sea level, it sometimes becomes convenient and profitable mining ground. On the coast of Oregon, at and above Port Orford, the beaches now yield gold, iridium, and osmium in sufficient quantity to afford profitable employment to quite a mining population, and in the Black Hills the old Potsdam sandstone beach, formed by the beating of the Silurian sea upon the cliffs of Laurentian and Huronian rocks, traversed by auriferous quartz veins, now constitute what are there known as the "cement deposits," from which a considerable portion of the gold of this region is obtained. As has been mentioned, however, the chief supply of gold in all ages has come from the *débris* that has accumulated at the foot of mountain slopes. All mountain *chains* are composed of metamorphic rocks, and nearly all the mountain ranges of the globe are traversed by quartz veins, in which are concentrated much of the gold that was originally finely disseminated through the sedimentary strata—conglomerates, sandstones, shales, etc.—now granites, schists, and slates.

By the lateral pressure that has metamorphosed the sedimentary rocks, and produced the segregation of the quartz veins, great folds and ridges were formed, which rising high above the general surface, act as condensers of moisture, and receive the most copious precipitation from the clouds. Hence on these mountain sides an enormous system of water power is developed, which is spent in grinding up the rocks and transporting the *débris* to the bottom of the slope. Here it is further washed, sorted, and the gold locally concentrated to form the rich "placer" diggings. As no great skill or expensive mining machinery is required to work the placer deposits, every man with good health, a pick, shovel, pan, and stock of provisions, may go into the business. Gold washing is the simplest, as it was probably the earliest of all mining enterprises, and has at different times employed nearly the entire population of a district or country; it is not surprising therefore, that it has resulted in the production of an enormous quantity of gold. It is evident, however, that most of the placers of the world have been already exhausted, and while the little known continent of Africa promises to furnish a large amount of metal from its "golden sands," we can hardly expect that the production of California, Australia, and New Zealand will ever be repeated in the world's history.

Stratified Deposits.—These may be subdivided into several groups, such as

1. Ore forming entire strata; *e. g.*, beds of iron ore.
2. Ore disseminated through strata; as copper in the schists of Mansfeldt, and in the sandstones of Lake Superior.
3. Segregated masses in strata; as sheets of copper in the Lake Superior sandstones; balls, kidneys, and sheets of clay ironstone in the shales of the coal measures, etc.

Unstratified Deposits.—These have been divided into

1. Eruptive masses.
2. Disseminated through eruptive rocks.
3. Contact deposits.
4. Stockworks.
5. Fahlbands.
6. Impregnations.
7. Chambers.
8. Mineral veins.

Of *eruptive masses* of metalliferous matter I must confess myself incredulous. Examples of these are cited in the crystalline iron ores of the Island of Elba, those of Nijni Tagilsk in Russia, and in Sweden, and even the iron ore beds of Lake Superior and Missouri. As late as 1854 this was the view taken of our crystalline iron ores by Whitney, in his "Metallic Wealth;" but great advantages have been since made in our knowledge of these deposits, and it is now generally conceded that all our crystalline iron ores are simply metamorphosed sedimentary beds. The evidence is accumulating that those of the Old World have the same character. Professor Otto Torell, the Director of the Geological Survey of Sweden, recently told me that he had visited all but one of the iron districts of Sweden, had found that in all these the iron ores were metamorphic, and he had no doubt that those yet unexamined were of similar nature. When metamorphic action has been peculiarly violent, the beds of iron ore have been more or less dismembered, and perhaps in some instances have been actually fused; but that any bed of iron ore is the result of an eruption from the interior of the earth is scarcely to be credited.

The examples of the occurrence of metalliferous matter *disseminated through eruptive rocks* are by no means uncommon, and the amygdaloid traps of Lake Superior, in which the cavities formed by gases have been more or less perfectly filled with copper, suggest themselves at once. Pyrites, magnetic iron, and platinum are found sparsely diffused through trap rocks, and are sometimes concentrated in such a way as to form valuable deposits when the trap decomposes. *Contact deposits* are usually understood to be accumulations of metal or ore along the planes of contact between two strata; and the sheets and strings of copper which are concentrated at the junction of the trap and sandstone in some parts of the south shore of Lake Superior, constitute illustrative examples of this class of mineral deposits. There is, however, considerable diversity in character among the deposits grouped under this head, the chief distinction being that in some cases the ore or metal has been segregated from one or the other of the strata at the time of their deposition, and in others it has come from a foreign source, and has been deposited in a more or less continuous sheet in cavities formed between the surfaces of the adjacent rock beds. To the second of these classes would seem to belong the argentiferous ores of Leadville, Colorado. These are deposited along the plane of junction between an underlying limestone and overlying porphyry, and undoubtedly accumulated in vacant spaces formed by the solution of the limestone. These ore bodies have apparently much in common with the pockets and chambers excavated in certain limestone beds, and subsequently filled with ore, to be described further on. The true structure of these Leadville ore bodies can, however, only be accurately learned when they shall be penetrated below the zone of unchanged sulphurets into which they will undoubtedly merge in depth. The term *Stockwork* is applied in the Old World to a mass of rock or veinstone penetrated in all directions by small intersecting sheets or veins in such a way that the whole mass is mined out. Some examples of this kind of deposit may be found in most of our mining districts, but the most important which have come under my observation are in the Oquirrh Mountains, in Utah, and at Silver Cliff, Colorado. In the first of these localities beds of quartzite, in the second, of porphyry, have been shattered, and the crevices between the fragments have been filled with ore deposited from solution. The name *Fahlband*, or rotten layer, originated in the silver mines of Konigsberg, in Norway, where there are parallel beds of rock impregnated with the sulphides of iron, copper, zinc, etc., and which, by their decomposition, have rendered these beds so soft as easily to be removed. We occasionally meet with pyritous rock in this country, which decomposes in the same way, but none yet known to me have any considerable importance as metalliferous deposits. *Impregnations* may be defined to be saturations of porous rock with a mineral solution or vapor from which ore has been deposited. The cinnabar which is sometimes found impregnating unchanged or metamorphosed sand stone, is generally cited as affording typical examples of impregnations. In such cases, which occur in California and South America, the deposit of ore has been ascribed by some writers to vapors, by others to solution, and it would seem that the latter is the more credible theory, although the vaporization of mercury is easily effected, and, like other metals, it may be transported by steam, as we have proof at the geysers in California. More familiar and satisfactory exhibitions of impregnation are, however, afforded by the copperbearing sandstones of Lake Superior, New Jersey, and New Mexico, and the silverbearing sandstones of Silver Reef, in Southern Utah. In all these cases it is evident that a porous rock was once saturated with a metalliferous solution, from which, in the Lake Superior region, metallic copper was precipitated; in New Jersey and New Mexico, sulphides of copper and iron; at Silver Reef, sulphide of silver. As such repositories of the metals are easily penetrated by surface-water and air, we usually find the sulphides decomposed to a considerable depth; the copper ores converted into carbonate and silicate, the sulphide of silver into the chloride.

Chambers or *pockets* in limestone form the receptacles of ore in many countries, but nowhere else are such striking examples of this class of deposit as those found in our western mining districts. From a study of these I have been led to add them to the catalogue of forms of ore deposit as a distinct and important addition to those given by other writers. The distinctive characters of those accumulations of ore in chambers and galleries has not been heretofore generally recognized, and a want of information in regard to their true nature has led to much litigation and heavy losses in mining. The best examples of chamber mines are the Eureka Consolidated, Richmond, etc., of Eureka, Nevada; the Emma, Flagstaff, Kessler, etc., in little Cottonwood district, and the Cave Mine, near Frisco, Utah. All these mines are alike in this, that the ore is found more or less completely filling irregular chambers in limestone. Some of these ore bodies are of great size, and the aggregate product of these chamber mines is so great as to make it necessary to record this as one of the most important forms of metalliferous deposit. From the Potts chamber in the Eureka Consolidated mine, it is said that ore of the value of a million dollars was taken, while a still larger amount was produced from the great chamber of the Emma. The origin of these chamber deposits is, in my judgment, simply this: A stratum of limestone, more than usually soluble in atmospheric water, carrying carbonic acid—which dissolves all limestones—has at some time been honeycombed by chambers and galleries such as those which traverse the limestone plateau of central Kentucky, of which the Mammoth Cave is an example. Subsequently this rock has been broken through and upheaved by the subterranean forces which have disturbed all our important mining districts, and through the fissures then formed mineral solutions ascend, flowing into any receptacle opened to them. Where these fissures cut an insoluble rock they become, when filled, simply fissure veins; but where a cavernous limestone was broken into, such caverns and galleries as were opened were more or less filled with ore. It has been suggested that the caves now holding ore were excavated by the metalliferous solution, but we find some of them entirely empty, with their sides encrusted with spar, and having all the characters of ordinary limestone caves, and even where the ore occurs, the walls of the cavity have the same character, are hard and unimpregnated with ore. Hence we must conclude that the chambers were formed, like modern caves, by surface water, and when the country was upheaved and the rock shattered only part of them were opened, and that these received the solution and ore, while the unopened ones remained empty. The character of the ore contained in the chambers varies much, as it does in the fissure veins of our mining districts; and the solutions from which they were filled must have been different in the different localities where they occur. Argentiferous galena was evidently the most abundant ore deposited in the chambers, as it is elsewhere; but in some cases this is associated with a large amount of iron sulphide, in others very little; while the ratio of gold to silver is inconstant, and the aggregate of both varies from nothing to several hundred dollars to the ton. The ores of Eureka run high in lead, contain much iron, and about seventy dollars in the precious metals, half gold, half silver. The ores of the Emma mine carried less iron, more lead, much more, silver, less gold, and a little copper; while those of the Cave mine at Frisco contain no lead, much iron, a little copper, and are sometimes exceedingly rich in both silver and gold. In all the chamber mines yet worked in this country the ore taken out is thoroughly oxidized, but in the deeper workings of some neighboring fissure veins the soft, ochery ores of the chambers are found changed below into compact masses of galena and iron pyrites; the galena carrying the silver, the pyrites the gold. Hence we may conclude that the ore origiually deposited in the caves consisted of sulphides, and that whenever these mines shall be worked below the water level ore of this character will be found. It should be said, however, that if the theory I have suggested of the formation of the limestone galleries is true, they will not be found to extend to so great a depth as the ore bodies of fissure veins, since the excavation of the limestone, if produced by atmospheric water, must be confined to the zone traversed by surface drainage. In a very dry and broken country the line of permanent water level may be very deep, as at Eureka, where the ore bodies extend and are oxidized to a depth of at least 1,400 feet. Such a condition of things could only exist in a very dry climate; but we have evidence that there have been great climatic changes in our western mining districts, according to King and Gilbert, two wet periods having been succeeded by two dry ones, the last prevailing now. We may therefore find chambers wrought in the limestone in a dry period below the present or normal water level. The enormous production of gold and silver from the chamber mines already worked proves the great importance and value of this class of deposits; and while we may predict that they will be fouud to be more superficial than true fissure veins, still no limit can be fixed to the future yield of mines of this character, even though they should not be profitably worked below 1,500 feet from the surface.

Mineral Veins.—Some writers on economic geology—Werner, Von Cotta, and Von Groddeck, for example—enumerate very different kinds of mineral veins, but disregarding the local characters which all ore deposits exhibit, and the hybrids which are formed by the blending of two distinct forms—not of uncommon occurrence, I agree with Whitney in recognizing but three distinct classes, viz.:

1. Gash veins.
2. Segregated veins.
3. Fissure veins.

Gash veins may be defined to be those which occur only in limestone, are confined to a single stratum or formation, and hence are limited in extent, both laterally and vertically. Typical examples of gash veins are furnished by our lead deposits of the Mississippi Valley. These occur at three horizons, viz.: about Galena, in the Galena limestone, belonging to the Trenton Group; in southeastern Missouri, where the mine La Motte is located, in the equivalent of the Calciferous sand rock; and in southwestern Missouri, where the mines of lead and zinc occur in the Lower Carboniferous limestone. The origin of deposits of this character is apparently quite simple. The cavities which form the repositories of the ore are generally the cleavage planes or joints of a soluble limestone rock, that become channels through which surface water charged with carbonic acid flows in a system of subterranean drainage. We usually find two sets of joints approximately at right angles to each other, and vertical if the rocks are horizontal. To form gash veins, one or both of these sets of vertical joints are locally enlarged into lenticular cavities or "gashes," whence the name; but sometimes caves of considerable size, irregular pockets, and vertical or horizontal galleries are formed. These are subsequently lined or filled with ore, sulphides of lead, zinc, and iron, originally disseminated through the limestone, and leached out of it by water which saturates and traverses all rocks in a humid climate. The solution thus formed reaching a cavity, has by evaporation deposited the ore as a lining to that cavity; narrow fissures being, perhaps, filled, walls of larger cavities coated with stalactites depending from the roof, etc. Subsequent solution has sometimes widened a fissure once filled with ore, leaving the ore body as a central partition, a curtain more or less complete hanging from the roof, or a mass of fragments mingled with infiltrated sand and clay in the floor of the cave. In southwestern Missouri the carboniferous limestone contains layers of chert, which are insoluble, and which sometimes form horizontal floors or ceilings of caverns. These, breaking down by their own weight, have formed masses of *débris*, cemented together by the ore, which has thus acquired its peculiar brecciated character.

From the description of gash veins given above, it will be seen that they have much in common with the pockets and chambers previously described; but there is this important difference, that the ore filling the gashes and irregular chambers of the leadbearing limestone is indigenous, having been derived from the leaching of the adjacent rock, while in the chamber mines of the West the ore is exotic, having been brought up through fissures from a remote source below; so that, while in physical characters the Western gold and silver bearing ore chambers resemble gash veins, they are really but appendages to true fissure veins, and only occur in a country that has been much broken by subterranean forces.

Segregated veins are confined to metamorphic rocks, are conformable with their bedding, and are limited in extent both laterally and vertically. Their ore bodies form lenticular masses of greater or less dimensions, of which the material is chiefly quartz, which has segregated *i. e.*, separated from the surrounding rock. The quartz veins so abundant in the gneisses and schists of Canada, New England, and the Alleghany Belt, are all examples of this class of ore deposits. The most important constituent of segregated veins is gold, which here seems to have been mechanically dispersed throughout sedimentary rocks, and to have been concentrated with the quartz in the process of metamorphism to which they have been subjected. With the gold we always find iron pyrites, sometimes chalcopyrite, and the latter occasionally in sufficient quantity to be worth working. From these remarks it may be inferred that segregated veins have no deep-seated origin, are less continuous in depth and laterally than fissure veins, and therefore constitute a less permanent foundation for mining enterprises. It may be said, however, that some of them are of enormous dimensions, and that they not unfrequently occur in succession, or so approximate that they are equivalent to a continuous mineral deposit.

Fissure veins occupy crevices which have been formed by subterranean forces and have been filled from a foreign source. They traverse indiscriminately all kinds of rock, and are without definite limits laterally or vertically. They have as characteristic features, smooth, striated, sometimes polished walls, slickensides, clay gouges or selvedges on one or both sides, and a banded or ribboned structure throughout. The vein-stone is usually quartz, and the constituents include the ores of all the metals. The mode of formation of fissure veins is apparently this: In the regions where the earth's crust is broken up in the adjustment of the cold and hard exterior to the cooling and shrinking nucleus, cracks are formed, often miles in extent, along which the rocks suffer displacement, sliding on each other to form what are known as "faults." As the planes of these faults are more or less undulated, with displacement, the bearing is upon the projecting bosses of each side. Between these, open fissures are left of greater or less dimensions. These reach down to a heated zone, and form the conduits through which thermal waters flow to the surface. Such waters coming in different localities from different depths, and reaching rocks of various composition under great pressure and high temperature, having great solvent power become loaded with various mineral matters. As they rise to the surface the pressure and temperature are reduced, and the materials held in solution are deposited to line and perhaps ultimately fill the channels through which they flow. This theory of the filling of mineral veins, *i. e.*, by precipitation from heated chemical solutions coming from below, is supported by such an array of facts that it must be accepted by all who will make a careful and unprejudiced study of the subject. It is true, however, that various other theories have been, at one time or another, put forth for the explanation of the phenomena. Among these a few deserve a passing notice. They are:

1. **The theory of igneous injection.**—According to which the matter filling mineral veins has been erupted like that of trap dikes, and such veins as those of Lake Superior, containing metallic copper, have been suggested as affording good examples. But here we find metallic copper and silver associated, and each chemically pure; whereas, if they had ever been fused, they certainly would have formed an alloy. The copper is also found in crystals of calc spar and other minerals, where it must have been deposited with the other constituents of the crystal, and that crystal formed from solution. Other opposing facts might be cited, but it will be sufficient to say that not one sound argument can be advanced in favor of this theory.

2. **Aqueous deposition from above.**—This theory, first advanced by Warner, but since generally abandoned, supposes the contents of mineral veins to have been deposited from a solution which flowed into the fissures from above; but in that case the vein matter should be horizontally stratified, limited in extent downward, and spread over the surface adjacent to the fissure; whereas no one has yet reached the limits in depth of the ore in a true fissure vein, and the characteristic banded structure can only have resulted from successive depositions of a long-continued flow of a hot solution. This theory has been recently advocated in this city by Prof. Stewart of Nevada; but it is not only not sustained, but really disproved by all the facts observed by the writer some years devoted to the study of our Western ore deposits.

3. **Lateral secretion.**—According to this theory, the material filling all mineral veins has leached into the cavity from the wall rocks. While this is true of gash veins, it can have played but a very subordinate part in the deposition of ore in fissure veins. This is proved by the facts that different sets of fissures which cut the same formation frequently contain very different ores; and where the rocks of totally different character are, by faulting, brought to form opposite walls of fissure, the ore may be symmetrically deposited in corresponding layers. It may also be said that the same fissure frequently traverses several formations, and yet its character may be essentially the same throughout.

4. **Sublimation.**—The facility with which certain metals are volatilized, and the fact that various minerals

have been deposited from vapor, have formed the basis of this theory; yet it is difficult to see how any one can ascribe more than a local and insignificant effect to this cause. It is true that the action of water, as steam, is much the same as when fluid and highly heated, in the solution and transport of minerals; and the deposit of mercury, sulphide of iron, and even gold, from the mingled water and steam of the California geysers proves this. So we may concede that steam has been an agent in the chemical solution and precipitation of ores; but this is a very different thing from the sublimation of the metals represented by these ores, and all knowledge and analogy indicate that the silica which forms so large a part of vein stones, and is so often seen in combs of interlocking crystals, has been deposited from an aqueous solution. But argument is really wasted in a discussion of the filling of fissure veins, since we have examples that seem to settle the question in favor of chemical precipitation from ascending hot water and steam. In the Steamboat Springs of Western Nevada, for example, we in fact catch mineral veins in the process of formation. These springs issue from extensive fissures which have been or are being filled with silicious veinstone that carries, according to M. Laur, oxide of iron, oxide of maganese, sulphide of iron, sulphide of copper and metallic gold, and exhibits the banded structure so frequently observed in mineral veins.

In regard to the precise chemical reactions which take place in the deposition of ores in veins, there is much yet to be learned, and this constitutes an interesting subject for original investigation, which I earnestly commend to those who are so situated that they cannot pursue it.

It may be noticed, however, that the thermal springs which are now forming deposits like those in fissure veins, contain alkaline carbonates and sulphides, and we have every reason to believe that highly carbonate alkaline waters containing sulphuretted hydrogen under varying conditions of temperature and pressure, are capable of taking into solution and depositing all the metals and minerals with which we meet in mineral veins.

To these necessarily brief notes on the filling of mineral veins should be added some interesting examples of the mechanical filling of fissures which have been recently brought to light in Western mining. These are furnished by the remarkable deposits of gold and silver ore, the Bassick and Bull-Domingo near Rosita, Colorado, and the Carbonate Mine at Frisco, Utah. All these are apparently true fissure veins, filled to as great a depth as they have yet been penetrated by well rounded pebbles and bowlders which have fallen or been washed in from above. The porous mass thus formed has been subsequently saturated with a hot ascending mineral solution, which has cemented the pebbles and bowlders together into a conglomerate ore. In the Bassick this ore consists of rich telluride of silver and gold, free gold, and the argentiferous sulphides of lead, zinc, copper, and iron. In the Bull-Domingo and Carbonate mines the cementing matrix is argentiferous galena. That the pebbles and bowlders have come from above is distinctly shown by the variety in their composition and organic matters associated with them. In the Bull-Domingo and the Bassick the pebbles consist of various kinds of igneous rock, mingled with which in the latter are masses of silicified wood and charcoal, while in the Carbonate mines the pebbles are mainly trachyte, but with these are others of limestone and quartzite.

Fossils and other foreign bodies have before this been found in mineral veins, and Von Cotta mentions the occurrence of quartz pebbles extending to the depth of 155 fathoms in the Grüner Lode at Schemnitz, Saxony, but no conglomerate veins like those mentioned above are known to exist elsewhere, and they constitute another of the many new forms of ore deposit which the exploration of the rich and varied mineral resources of the United States have brought to light. To enumerate and classify these has been the chief object of this article.

In regard to the ultimate source of the metallic matters which give value to our ore deposits but little can be said with certainty. The oldest rocks of which we have any knowledge, the Laurentian, contain gold and copper, which are indigenous; hence, as old as the rocks that contain them, and have been simply concentrated, and made conspicuous in the process of their metamorphism. The rocks are all sediments, and the ruins of pre-existing continents. By their erosion they have in turn furnished gold, copper, iron, etc., to later sediments by mechanical dispersion and chemical solution. We now find gold everywhere in the drift from the Canadian Highlands, and we have every reason to believe that all the sedimentary strata more recent than the Laurentian have acquired a slight impregnation of several metals from them in addition to what they have obtained from other sources, and we may conclude that the distribution of many of the metals is almost universal. Sea water has been proved to contain gold, silver, copper, lead, zinc, cobalt, nickel, iron, manganese, and arsenic; and there is little doubt that all the other metals would be found there if the search were sufficiently thorough. Hence, sedimentary rocks of every age must have received from the ocean in which they were deposited some portion of all the metals, and for the formation of metalliferous deposits some method of concentrating these would alone be required. A pretty theory to explain such concentration through the agency of marine plants and animals has been suggested by some German mineralogists, and amplified by Profs. Pumpelly and T. S. Hunt. Plants have been credited with the most active agency in this concentration, but evidence is still wanting that other animals or plants have played any important part in the formation of our mineral deposits. The remains of seaweeds are found in the greatest abundance in a number of our Palæozoic rocks, and it is almost certain that the carbonaceous ingredient in our great beds of bituminous shale has been derived from this source, and yet we find there no unusual concentration of metallic matter, and none of the precious metals have ever been detected in them.

The metallic solutions which have formed our ore deposits have been ascribed to two sources. One theory supposes that they have drained highly metalliferous zones deep in the interior of the earth; the other, that they have leached diffused metals from rocks of different kinds comparatively near the surface. The latter view is the one that commends itself to the judgment of the writer. However probable such a thing might seem, no evidence of the existence of distinct metallic or metalliferous zones in the interior of the earth has been gathered. On the contrary, volcanic emissions, which may be supposed to draw from a lower level than water could reach, are not specially rich in metallic matters, and the thermal waters which have by their deposit filled our mineral veins, must have derived their metallic salts from a zone not many thousand feet from the surface. The mineral springs, which are now doing a similar work, are but part of a round of circulation of surface water, which, falling from the clouds, penetrates the earth to a point where the temperature is such as to drive it back in steam. This, with fluid water under pressure and highly heated, possessing great solvent power, may be forced through vast beds of rock and these be effectually leached by the process. Should such rocks contain the minutest imaginary quantity of the metals, these must inevitably be taken into solution, and thus flow toward or to the surface to be deposited, when, by diminished temperature and pressure, the solvent power of the menstruum is diminished. It is evident from these facts that we cannot trace the history of the metals back beyond the Laurentian age. And since we find them diffused in greater or less quantity through the sedimentary rocks of all ages, and also find processes in action which are removing and redepositing them in the form of the ore deposits we mine, it is not necessary to look farther than this for a sufficient theory of their formation.

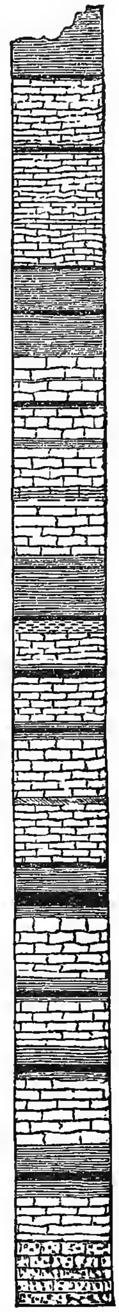
—*A paper by J. S. Newberry, School of Mines Quarterly.*

THE ANTHRACITE COAL FIELDS OF PENNSYLVANIA AND THEIR EXHAUSTION.

COAL is monarch of the modern industrial world, with its wonderfully diversified interests, and their ever-expanding development. But supreme as is this more than kingly power at the present time, comparatively brief as has been the period of its supremacy, and unlimited, in the popular apprehension, as are its apparent resources, yet already can we calculate its approximate duration and predict the end of its all-powerful but beneficent reign. This is especially the case with our limited Anthracite; the more widely diffused Bituminous having in reserve a much longer term of service—short indeed as a segment of the world's history, but so long compared with an average human life, as to be of slight practical concern to the present generation. The territory occupied by the Anthracite coal fields of Pennsylvania is but a diminutive spot compared with the area of Bituminous coal in Pennsylvania alone, to say nothing of its vast extent in other portions of the United States, Great Britain, France and Belgium. The area of the Anthracite of the United States is but 470 square miles, not one-twentieth the size of Lake Erie, while the wide-spread Bituminous coal fields cover twice the area of our four great lakes; the Anthracite making but an insignificant showing on the map of the continent. But the comparison with the Bituminous area is deceptive, unless the relative thickness of the two is taken into consideration. If the Anthracite beds were spread out as thinly as those of the Bituminous region, they would cover eight times their present area, or 3,780 square miles. And again, if the denuded spaces within the borders of the Anthracite coal fields were covered with a deposit of coal as thick as we may justly suppose they once were, and as the remaining still are, the available area would be increased to about 2,000 square miles, or 1,280,000 acres; equal to a coal deposit of 92,840,960,000 tons. Contemplating the number and extent of the coal beds shown in the accompanying cross-section, a total thickness of 107 feet, distributed in fifteen workable beds, interstratified with a full mile in thickness of rock and shale, we are lost in wonder at the luxuriant growth of tropical plants required to produce this vast amount of compressed fuel, and the mighty processes of nature by which it was placed in its present position. The ingenuity of scientists is taxed to account for this wonderful accumulation of fuel, once vegetable, now mineral; once waving in fresh green beauty on the surface of the earth, now buried under hundreds of feet of solid rock; once growing in a level deposit of mud so plastic that the lightest leaflet dropping on its surface left its impress, now the mud hardened into slate, and the rank vegetation changed to hard and glittering coal, rising and falling in geologic hills and valleys, surpassing in number, depth, extent, sharpness of flexure and acuteness of angle, anything visible in the light of upper day.

Some slight idea of the growth of these ancient forests may be gained from the computation, that to form only one of these large beds of coal required a deposit of vegetable matter perhaps one hundred feet in thickness. What shall we say then to the amount of vegetation stored away in the Mammoth bed, which extends through all three of the Anthracite coal fields, covering an area of 300 square miles, with an average thickness of twenty feet, and containing, it is estimated, 6,000,000,000 tons of coal! Not less wonderful and interesting than the coal deposits is the grand floor of conglomerate which underlies them; a vast sheet of rock, infinitely old, composed of fragments of other rocks infinitely older, bound together by an almost imperceptible cement which holds them so firmly that gunpowder will scarcely separate them. Whence came this great sea of pebbles, water-rounded and water-born, to their present resting-place? We find them now as the current has dropped them—masses of silex as large as ten-pound cannon balls, and almost as round, so shapely have they been worn by the actinn of some ancient current. These were deposited first, and then, in regular order, trending to the southwest, came sizes graduated down to those of a pea and grains of sand. This more than marble floor bears few saurian foot-prints; scarcely an impress of bird, or beast, or fish, or sign of animal life. Nothing but a bed of almost pure silica; a solid foundation on which to build up the mass of rock and the fossil fuel that we call Anthracite, older than the hills and predestined for the use of coming man. The pebble-laden flood ceased, and was followed by placid waters and gentle currents, bringing fine mud and silt to cover the rocky bed. Then the waters drained away, or the land rose, until fit for vegetable life, it was covered with the mighty flora of the carboniferous period. Again it sank, carrying with it its store of decayed and decaying vegetation, and another flood of pebbles rolled over it. How many ages were consumed in the process so briefly described, who can tell? Nature's operations are on too vast a scale, and her working time too long to admit of hasty activity in the production of results. It may well be said that all the years since the creation of man would he too short a time to produce a bed of coal. However long the process just described, it was of frequent repetition during the coal period; and thus we find pebble-beds, slate and coal in often recurring series, as in the following cross-section made at Treverton, the western terminus of the middle anthracite coal basis.

CROSS SECTION IN THE SOUTHERN ANTHRACITE COAL FIELD OF PA.



Red Ash Coal, 3 ft.	Sandrock.
" " 7 ft.	Gate.
" " 3 ft.	Little Tracy.
" " 6 ft.	Tracy.
" " 6 ft.	Diamond.
" " 3 ft.	Little Orchard.
" " 6 ft.	Orchard.
Grey Ash Coal, 10 ft.	Primrose.
White Ash Coal 5 ft.	Holmes.
" " 7 ft.	Seven Feet.
" " 25 ft.	Mammoth.
" " 6 ft.	Skidmore.
" " 9 ft.	Buck Mountain.
Red Ash Coal, 8 ft.	Lykens Valley, upper.
" " 3 ft.	Lykens Valley, lower.
Total Coal, 107 ft.	

But through all the changes of time and scene, the upheavals and depressions, the submergence and emergence of the land, we find a remarkable uniformity in the growth of plants, continuing almost without change throughout; sigillaria, lepidodendra, ferns, &c., following their kind, unvaried through successive series of strata, in each leaving their characteristic impress of stems and foliage on the enduring tables of the rocks. The coal flora is rich in variety and of great beauty, as Professor Lesquereux's careful research abundantly testifies. Their exact forms show a quiet condition of the waters, at least during the deposit of the slate covering of the coal beds; and the intervening rocks show the same facts. When impressions of the flora are found in the solid coal itself, we have the same evidence; but this is of rare occurrence. The best impressions usually occur in the smooth top slate covering the coal beds. When we examine the arrangement of the Pennsylvania Anthracite beds we wonder at their complexity. Without evidence of volcanic disruption, not even a protruded trap-dyke, or extensive up or down-throw, we often find contortions and disturbances of the strata. The beds are rarely horizontal, but lie at every angle, and sometimes even pass the perpendicular and fold back upon themselves. In places they occupy our mountain summits, nearly 2,000 feet above the level of the sea, and again depressed more than 3,000 feet below it, making a variation of a mile in altitude. Yet the coal, which is the frailest material in this rocky mass, is not destroyed, but generally in good workable condition—solid, almost crystallized, almost pure carbon, and frequently in beds too thick for economical working.

Faults in the Anthracite beds usually have a northwest and southeast direction, and show the beds compressed, and again correspondingly enlarged, but no sudden dislocations or breaking off of the strata. Soft coal or dirt faults, are of common occurrence in the red ash or softer coals in the western end of the Anthracite fields. The colored ash of burned coal is due, doubtless, to the presence of iron; but why this coloring matter is confined to the upper series of coals in the eastern portion of the range, and to the lower beds in the western district: and why there is a gradation in the middle district, from white ash in the lower, to grey in the middle, and red in the upper beds, are problems yet to be solved. How shall we account for the great disturbance of the strata from their original horizontal position? Was it caused by volcanic force—of which there are no indications—or by contraction of the earth's crust? And if the latter, why is it confined to the Anthracite region, and not extended to the Bituminous also? And how shall we explain the isolation of the smaller coal fields, like those of Rhode Island, Richmond, Va., or Deep River, in North Carolina; or the disproportion in the quantity between the limited area of Anthracite and the wide-spread fields of Bituminous? Why do we find an abundance of shells and remains of animal life in the latter, and rarely any in the former? A few saurian foot-prints recently found at the Ellangowan colliery, in Schuylkill county, and a few shells found in Glendower pit, in the Wyoming valley, are signal exceptions to an almost universal rule. After an exploration, covering the period from 1835 to 1850, Prof. H. D. Rogers and his corps of assistants failed to find any other specimens. Neither has Prof. Lesley in his new geological survey of Pennsylvania, nor the writer in his thirty years' residence and active service, underground and in surface explorations, been any more fortunate. Nor in all this area do we find a single workable bed of iron or limestone, and scarcely a covering of fertile soil. The coal once exhausted, nothing is left but the worthless shell, desolate and deserted. The Anthracite region, mainly confined to one-sixth the area of the four mountainous counties of Luzerne, Schuylkill, Carbon, and Northumberland, in Pennsylvania, is crowded with an industrious population, which increased fifty-one per cent. in ten years; that is from 229,700 in 1860, to 344,771 in 1870; whilst the four adjacent agricultural counties of similar area increased in the same time from 319,542 to 339,942, only six per cent. It is located on the parallel of 40° 30′, one hundred miles from any seashore, no part of it is less than 500 feet above tide—near the head waters of the large rivers that drain it, the Susquehanna, Schuylkill, Lehigh, and Delaware. The noisy trains crossing the valleys and climbing the mountains all merge, day and night, to these hives of industry, where multitudinous steam engines are hoisting and pumping, and breakers crushing. Thousands of miles of railroad thread the surface and dive into the interior, to roll out the black diamond flood in millions of tons of fuel to warm and employ the nation. The *fearful loss* of good material involved in mining and preparing Anthracite, as shown in the accompanying tables, though greatly to be deplored, seems to be almost inevitable. The disposition of the coal in large solid beds, and its highly inclined positions, involves strong supports to keep the superincumbent mass from crushing and closing the avenues to the mines; and these supports must consist of massive pillars of the solid coal itself. Wooden props, however ponderous and strong, can only be used for the minor supports. Some of this pillar coal is ultimately removed, but much of it is inevitably lost, especially in the larger beds which frequently range from 20 to 40 feet in thickness and are often inclined at an angle of from 40 to 70 degrees. It is estimated that not more than 66 per cent. of the coal is ever taken out of the mines. That which is brought to the surface is run through a huge structure from 80 to 100 feet high, very appropriately called a "breaker," ingeniously contrived for the destruction of coal. There are over 300 of these immense buildings in the Anthracite region, costing on an average $50,000 each, or an aggregate of $15,000,000. To the top of these the coal is hoisted, and then descends through a succession of rolls and screens, emerging at the bottom in a series of assorted sizes, from huge blocks of lump coal to unmerchantable dust, which forms a grievously large proportion of the whole. This process involves a loss of good coal, equal to 20 or 25 per cent., of the entire quantity mined. For the coal wasted in mining, say 40 per cent., and in preparing, 25 per cent., no one is paid; it is a total loss to landowner and shipper.

Plans for utilizing the waste coal dirt, or culm of Anthracite collieries, have been frequently suggested, but none have come into general use. The Anthracite Fuel Company, at Fort Ewen, on the Hudson, in 1877, used 90 per cent. coal dust and 10 per cent. fuel pitch, and made 300 tons of fuel per day, consuming over 50,000 tons of culm. The Delaware and Hudson Company also used at their mines 60,000 tons per annum. They now ship all their coal down to pea sizes, and consume the culm in generating steam. If all our coal companies would follow this examples it would enable them to sell half a million tons more coal, and burn the same amount of refuse, thus earning or saving a half million dollars per annnum, to add to their revenues. The Philadelphia and Reading Railroad Company has recently introduced a method of burning coal dust in the furnaces of its engines, and the plan appears to meet with success. The amount of water which drains into a mine from a mile or more of surface is enormous, for the average amount of rain and snow-fall is 58,840 cubic inches per square yard annually, and the miners are liable to absorb not only the rain fall on the surface immediately over them, but all that which, by contour of the surface or by converging strata, tends toward them. On an average possibility five tons of water are hoisted for every ton of coal raised—another loss chargeable to mining. The preponderance of waste coal, illustrated, by the accompanying tables, seems excessive; but the writer's experience in surveys of certain tracts of land, and in preparing maps which show the area exhausted, compared with the amount marketed from ten or more collieries, in a period of twenty years, proves that the loss is not over estimated, especially in the Mammoth bed, whose average thickness is 25 feet. An eight-foot bed of coal yields much better in proportion. When they exceed six or eight feet in thickness, especially if steeply inclined, they are not only expensive to mine, but a large proportion of the coal must be left to support the rocky roof. The Bituminous coals, particularly those of the United States, are not subject to those serious losses, and are quite cheaply mined and prepared. No breakers are required, as the only division is into coarse and fine coal, which are easily separated by screens; and the fine coal can be readily converted into coke, making a better condensed fuel than the coal in its natural shape. The bituminous beds are nearly horizontal and rarely more than six feet thick, so that it is necessary to have extensive pillars; and as the coal is above water level, or in shallow basins, it is not necessary to put up extensive hoisting and pumping machinery. The simple, natural ventilation of American Bituminous mines also does away with the extensive and costly appliances for this purpose of Anthracite mines, in spite of which so many miners annually fall victims to the noxious gases.

And Now as to the Harvesting.—The total amount still to be mined, according to the accompanying tables, is 26,361,076,000 tons. The total waste, as experience has shown, is equal to two-thirds of the coal deposit, and reaches the appalling amount of 17,574,000,666 tons, leaving thus only 8,782,075,333 tons to send to market. In all our calculation of Anthracite, we have counted the area as if in a level plain, and made no allowance for the undulations which must necessarily increase the amount of coal. But as many of the flexures are abrupt and broken, making much faulty and refuse coal, it will cover any over-estimate of area or thickness we have made in our calculations. Our tables show that 360,017,-817 tons have been sent to market in the fifty-eight years from 1820 to 1878, inclusive. Our consumption now amounts to 20,000,000 tons annually. The increase of production for the past ten years has been 187,112,857 tons. At this rate we shall reach our probable maximum output of 50,000,000 tons in the year 1900, and will finally exhaust the supply in one hundred and eighty-six years. The present product of the anthracite coal fields is (1878) as follows:

Southern	40 collieries	1,229,081 tons.
Middle	180 "	9,529,525 "
Northern	128 "	7,680,990 "
Total	348 "	18,439,596 "

At this rate the eastern end of the northern field is being rapidly exhausted. The middle field, too, which contains the lower productive coals, is likely to cease extensive mining about the year 1900; while the western portion of the northern field, extending from Pittston to the western end, and the southern field from Tamaqua to Tremont, comprising about 100 square miles, which contain more coal beds and deeper basins, must furnish the supply for the coming years. Partially successful experiments have been made to use petroleum as a substitute for coal to some extent. But is it not already evident, under the reckless prodigality of production, that this occult and mysterious supply of light, heat and color will be exhausted before the Anthracite, and can, at best, only temporarily retard the consumption of the latter? As already intimated, the question of the exhaustion of our coal supply is scarcely more at the present time than a curious and interesting calculation. It has not yet become so grave and portentous as in Great Britain, where a commission, with the Duke of Argyle, Sir Roderick Murchison and Sir W. G. Armstrong at its head, was recently appointed by Parliament to ascertain the probable duration of the coal supplies of the kingdom. There it is serious, indeed; for when Britain's coal fields are exhausted, her inherent vitality is gone, and her world-wide supremacy is on the wane. When her coal mines are abandoned as unproductive, her other industries will shrink to minimum, and her people become familiar with the sight of idle mills, silent factories, and deserted iron works, as cold and spectral as the ruined castles that remain from feudal times.

The modern growth and ultimate decadence of this great empire may be calculated from the statistics of her coal mines. In 1800 her coal product was about 10,000,000 tons; in 1854 it was 64,661,401 tons; and in 1877 it was swelled to 136,179,968 tons. This period was a time of continued prosperity, when England ruled the world, financially and commercially. In the twenty-three years from 1854 to 1876, inclusive, she produced the enormous quantity of 2,210,710,091 tons of coal; and, more wonderful still, exported only 222,196,109 tons—say ten per cent.—consuming the rest within her own borders. The average increase of her annual output has been 3½ per cent. Will it so continue or has she reached the summit of her industrial greatness and commercial supremacy, and will they now decline, and with it, her naval and military power, the subservient agent, and, to a large extent, the creature and result of those great interests? Her coal product in 1878 was less by 1,587,905 tons than that of 1877. Is this the beginning of the inevitable decline? There is reason to believe further on account of the great depression in business, that the production of 1879 will be less than that of 1878. Our anthracite product, compared with the coal product of Great Britain, is so small as to really seem insignificant. The English commission counts as available all coal beds over one foot thick—we count nothing under two and a half feet thick, nor below 4,000 feet in depth—showing a net amount in the explored coal fields of 90,207,285,898 tons; estimated amount in concealed areas, 56,273,000,000 tons; total, 146,480,285,398 tons, distributed as follows:—

	Explored.	*Unexplored.*	*Total.*
England	45,746,930,555	56,246,000,000	101,992,930,555
Wales	34,461,208,913	......	34,461,208,913
Scotland	9,843,465,930	No estimate.	9,843,465,930
Ireland	155,680,000	27,000,000	182,680,000
Total	90,207,285,398	56,273,000,000	146,480,285,398

The exhaustion of this magnificent mass of coal at this present rate of increase, viz: three and a half per cent. per annum, is estimated by Professor Jevons as follows:

1876, actual output	133,300,000 tons.
1886, estimated annual output	186,600,000 "
1896, " " "	261,200,000 "
1906, " " "	365,700,000 "
1916, " " "	512,000,000 "
1926, " " "	716,800,000 "
1936, " " "	1,003,500,000 "

Thus in sixty years the output would be nearly eight times the present amount, and about one fourth of the total amount to be found in Great Britain. This vast estimate seems too enormous. It does not allow for great loss when cost of labor and much competition will prevent the working of small coal beds under two feet in thickness, or for the cost of mining when from 2,000 to 3,000 feet deep. Nor is it possible that Great Britain's industries and export trade combined will ever require so great a quantity. Modern discoveries and improvements, in applied science, tend to diminish the consumption. The 8,000,000 tons annually required for gas works may be materially reduced by the use of the electric light. The domestic consumption, now equal to one fourth the product, or 33,000,000 tons a year, may increase. But will not the iron manufacturers be on the wane, and her coal exports—now ten per cent. of her coal product—fall off as those of other countries increase? We have about 340 collieries, and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly 4,000 collieries, and mines 132,000,000 tons, or 33,000 tons per colliery. The greater the yield per colliery the less the expense in mining. If we decrease the number of mines and increase their capacity not only to raise the coal, but to exhaust a constant current of foul air and dangerous gases, clouds of powder smoke and millions of gallons of water, we will reduce the cost of mining. Most of the Anthracite mining in the United States is now done at a less depth than 500 feet vertical; but as the coal nearer the surface becomes exhausted, the mines must go deeper and become more expensive. What folly it is to boast of our world's supply of Anthracite, and feverishly endeavor to force it into foreign markets, when we can so readily foresee its end! Would it not be wiser to limit its product, restrict its sale to remunerative prices, and consume it at our own firesides, and in our own manufactures? The monopoly of the Anthracite coal fields by some seven corporations, which, according to the accompanying tables, now control about two-thirds of the whole, and the best coal area, must prove, under economic management, a profitable investment for their stockholders. Mining, selling and transporting their own coal, as they do, individual enterprise cannot hope to compete with them, and must vanish from the ground, and their only rivalry will be with each other, and with the Bituminous trade. Fortunately for the public, this rivalry will always be keen enough to keep the price of coal at a fair low rate of cost and profit. The coal resources of Great Britain are all developed now, and in process of depletion; while in this country, when our 470 square miles of Anthracite are exhausted, we have more than 400 times that area, or 200,000 square miles of Bituminous, from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for 200 years. With an annual production of 50,000,000 tons, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the Bituminous supply would be reached in 800 years. What the annual consumption will be when this continent supports a teeming population of 400,000,000 souls, as will be the case some day, must be left to conjecture. But with half that population, as energetic, restless and inventive as our people in this stimulating climate have always been, under the hopes of success, such a country as this constantly holds out to tempt ambition and reward enterprise, it is a very moderate estimate, guided by the actual output already reached in Great Britain, to suppose that there will be ample use for one hundred million tons a year of Bituminous coal for home consumption alone.

If it be true, as Baron Liebig asserts, that civilization is the economy of the poor, we have it in our immense areas of Bituminous coal. There is no known agent that can answer as a substitute for the vast power and almost limitless usefulness of coal in its general adaptation to the wants of man; and that nation will maintain the foremost rank in enlightened modern civilization which controls, to the fullest extent, while it lasts, this wonderful combination of light and heat and force. We are wiser than our fathers; and from the modest but sublime altitude to which we are lifted by physical science, and the far-extended range of mental vision which it opens up to us, we can see further into the plans of Providence than those who went before us, and can conjecture the early, if not the remote future of the human race in our land and in other lands. Happy that people whose legislators study the best mode of developing the natural resources of their country, and whose great men become great by improving the condition and promoting the welfare of the human race. The greatest of England's five Georges was not either of those who wore the crown, but plain George Stephenson, of Manchester; and none of the royal Jameses did half so much for the civilization of his country as James Watt.

Output of Anthracite Coal from the Year 1820 to 1880, inclusive.

Year.	Schuylkill.	Lehigh.	Wyoming.	Total.
	Tons.	Tons.	Tons.	Tons.
1820,	. . . . .	365	. . . . .	365
1821,	. . . . .	1,073	. . . . .	1,073
1822,	1,480	2,240	. . . . .	3 720
1823,	1,128	5,823	. . . . .	6,951
1824,	1,567	9,541	. . . . .	11,108
1825,	6,500	28,393	. . . . .	34,893
1826,	16,767	31,280	. . . . .	48,047
1827,	31,360	32,074	. . . . .	63,434
1828,	47,284	30,232	. . . . .	77,516
1829,	79,973	25,110	7,000	112,083
1830,	89,984	41,750	43,000	174,734
1831,	81,854	40,966	64,000	176,820
1832,	209,271	70,000	84,000	363,871
1833,	252,971	123,001	111,777	487,748
1834.	226,692	106,244	43,700	376,636
1835,	339,508	131,250	90,000	560,758
1836,	432,045	148,211	103,861	684,117
1837,	530,152	223,902	115.387	870,441
1838,	446,875	213,615	98,207	738,697
1839,	475,077	221,025	120,300	818,402
1840,	490,596	225,313	148,47 0	864,384
1841,	624,466	143,037	192,270	950,973
1842,	583 273	272,540	252,599	1,108,418
1843,	710,200	267,793	285,605	1,263,698
1844,	887,937	377,002	365,911	1,630,850
1845,	1,131,724	409,453	451,836	2,013,013
1846,	1,308,500	517 116	518,389	2,344,005
1847,	1,665,736	633,507	583,067	2,882,309
1848	1,733,721	670,321	685,196	3,089,238
1849,	1,728,500	781,656	732,910	3,242,966
1850,	1,840,620	690.456	827,823	3,358,899
1851,	2,328.225	764,224	1,156,167	4,448,916
1852,	2,637,835	1,071,136	1,284,500	4,993,471
1853,	2,665,110	1,054,309	1,475,732	5,195,151
1854,	3,291,670	1,207,186	1,603,478	6,002,334
1855,	3,552,943	1,284,113	1,771,511	6,608,517
1856,	3,603,029	1,351,970	1,972,581	6,927,580
1857,	3,373,797	1,318,541	1,952,603	6,664,941
1858,	3,273,245	1,380,030	2,186,094	6,759,369
1859,	3,448,708	1,628,311	2,731,236	7,803,252
1860,	3,749,232	1,821,674	2,941,817	8,513,123
1861,	3.160,747	1,738,377	3,055,140	7,954,314
1862,	3,372,583	1,351,054	3,145,770	7,876,412
1863,	3,911,683	1,894,713	3,759,610	9,566,006
1864,	4,161,970	2,054,669	3,960,836	10,177,475
1865,	4,356,959	2,040.913	3,254,519	9,652,391
1866,	5,787,902	2,179,364	4,736,616	12,703,882
1867,	5,161,671	2,502,054	5,325,000	12,991,725
1868,	5,335,737	2,507,682	5,990,813	13 834,132
1869,	5,725,138	1,929,523	6,068,369	13,723,030
1870,	4,851,855	3,172,916	7,825,128	15,849,899
1871,	6,314,422	2,115'683	6,683,302	16,113,407
1872,	6,460,912	3,743,278	8,812,005	19,026,125
1873,	6,294,769	3,243,168	10,047,241	19,585,178
1874,	5,642,180	4,047,656	9,290,910	18,980,726
1875,	6,281,712	2,834,605	10,596,155	19,712,472
1876,	6 221,934	3,854,919	8,424,158	18,501,311
1877,	8,195,042	4,332,760	8,300,377	20,828,179
1878,	6,282,226	3,237,449	8,085,587	17,605,262
1879,	8,960,329	4,595,567	12,586,293	26,142,689
1880,	7,554,742	4,463,221	11,419,279	23,437,242

Anthracite Coal Areas owned by the Several Companies in the above Fields, and the per cent. of the whole in Tons.

Name of Company.	Schuylkill.		Middle.		Wyomiug.	
	Acres.		Acres.		Aves.	
Lehigh Valley	. . .		18,036	24 %	6,934	4 %
Lehigh and Wilkes-Barre	7,600	8 %	7,000	8 %	7,400	5 %
Delaware and Hudson	. . .	. . .	. . .	. . .	20.042	22 %
Delaware, Lackawanna & West'n	. . .	. . .	. . .	. . .	3,500	3 %
Pennsylvaoia Coal Company.	. . .	. . .	. . .	. . .	10.000	6 %
Philadelphia and Reading Coal and Iron Company	65,306	70 %	23,250	32 %		. . .
Pennsylvania Railroad Company	6,000	6 %	9,000	9 %	5,823	6 %
Girard Estate.	. . .	. . .	6,000	8 %	. . .	. . .
Gilbert & Co.	. . .	. . .	1,373	2 %	. . .	. . .
Alliance Coal Mining Company	3,172	3 %	. . .	. . .	. . .	. . .
All others.	11,362	13 %	15,981	17 %	73,021	64 %
Total	93,440	100 %	80,640	100 %	126,720	100 %

Area of Anthracite Coal Basins in Pennsylvania.

		Square miles.	
1.	Southern coal fields.		146
2.	Middle coal fields, Shamokin.	50	
	Middle coal fields, Mahanoy	41	
	Middle coal fields, Lehigh	37	
			128
3.	Northern Coal fields.		198
	Total area of all basins.		472
	Bituminous coal fields of the United States		196,400

United States Coal Product of 1869 and 1878.

Anthracite.	1869—Tons.	1878—Tons.
Pennsylvania	13,866,180	17,605,262
Bituminous.		
Pennsylvania	7,798,517	13,500,000
Illinois.	2,629,563	3,500,000
Ohio	2,527,285	5,000,000
Maryland.	1,819,824	1,679,322
Missouri	621,930	900,000
West Virginia	608,878	1,000,000
Indiana.	437,870	1,000,000
Iowa	263,487	1,500,000
Kentucky	150,582	900,000
Tennessee	133,418	375,000
Virginia	61,803	75,000
Kansas.	32,938	300,090
Oregon.		200,000
Michigan.	21,150	30,000
California		600,000
Rhode Island.	14,000	14,000
Alabama	11,000	200,000
Nebraska.	1,425	75,000
Wyoming.	60,000	100,000
Washington	17,844	150,000
Utah	5,800	60,000
Colorado	4,500	367.000
Total	31,077,994	49,139,584
Total for 1879, anthracite.	26,142,689	59,808,400
Total for 1880, anthracite.	23,437,242	

Coal Exports for the Fiscal Year ending June 30, 1878, United States.

Countries.	Tons. Anthracite.	Tons. Bituminous.
Austria.	202	
Brazil.	1,852	533
Central America	11	94
Chili.	1,093	510
China	3,659	. . . . . .
Danish West Indies	1,497	11,360
France.	764	. . . . . .
French West Indies and Guiana.	240	615
Miguelan, etc., islands.	30	. . . . . .
Other French possessions	. . . . . .	1
Nova Scotia	30,300	5,054
Qucbeo, Ontario, etc..	268,378	214,982
British Columbia.	17	1222
Newfoundland	98	. . . . . .
British West Indies and Honduras.	1,471	22
British East Indies.	454	. . . . . .
Hong Kong.	1,359	. . . . . .
Australasia.	10	. . . . . .
Hawaiian Islands	842	257
Hayti.	. . . . . .	713
Italy.	2,060	16
Japan	706	. . . . . .
Mexico.	756	3,144
Dutch East Indies	101	. . . . . .
Peru.	1,878	. . . . . .
Azores, Madcira	325	. . . . . .
San Domingo.	434	297
Cuba.	17,983	62,613
Porto Rico.	43	32
United States of Columbia.	3,373	17,490
Venezuela	630	580
Total.	340,566	319,637
Total, 1879	421,594	221,669
Total, 1880	411,706	198,431

A Paper by P. W. Sheafer, E.M., read before American Association for the Advancement of Science.

THE AVAILABLE TONNAGE OF THE BITUMINOUS COAL FIELDS OF PENNSYLVANIA.

THE great outspread of the coal measures over portions of thirty-one of the sixty-seven counties of Pennsylvania, and the large number of workable seams comprising the coal series,—together with some workable seams lately shown to belong to the (so-called) barren measures,—create the impression that these fields contain a practically inexhaustible supply of fuel, and those who have estimated or attempted to estimate their available tonnage have generally promulgated this view. But the *actual total contents* of this coal-field can be of little or no importance to us at present; *calculations including all seams*, whether thick enough to mine or not, whether pure enough to furnish the marketable fuel or not, whether accessible at reasonable depth or not, are of no practical value. As coal producers, we are interested, not in the total contents, but in the total amount of *easily accessible coal of good quality contained in beds thick enough for remunerative mining.* The estimates contained in this paper refer exclusively to workable and accessible coal of commercial value,—we may call it "*available*" *coal.* I am not aware that any one has as yet attempted to estimate in detail the amount of *available* coal in each county and in each bed. Heretofore the data to do this have been lacking, but now, since the completion by the geological survey of the series of county reports, illustrated by geologically colored county maps, it is possible to take up each county separately, and estimate in detail, approximately, at least, the contents of each seam. The general estimate to which I have referred as lacking the elements of detail essential to accuracy, have usually been made by multiplying the total *area* covered by coal measures by an *assumed average* of the united thicknesses of the workable seams. Thus some estimates place this area at between twelve and thirteen thousand square miles, and the average coal thickness at from fifteen to thirty feet or the amount of available coal at from 180,000,000,000 to 300,000,000,000 tons. By reference to the tables accompanying this paper it will be seen that these figures greatly exceed the total of my detailed estimates.

Calculations based on an *assumed* average thickness of coal must necessarily give untrustworthy results, because it is not possible to determine *a priori*, and in advance of detailed estimates, the average coal thickness in a field where every bed is subject to more or less radical variation in its thickness and quality. In counties containing throughout their entire area persistent seams of coal, large deductions are to be made for areas over which some beds thin to an unprofitable thickness or become locally too impure to furnish a marketable fuel. I have not attempted to calculate the several coal areas with any great degree of accuracy; with few exceptions, the areas expressed in acres reduced from measurements based on a unit of five square miles, hence these acreages nearly all appear as multiples of 3,200 acres. The maps from which the calculations were made are drawn on a scale of two miles to one inch, and as these are necessarily only approximately correct both in the ground plan and coloring, a finer differentiation would but lend false pretensions of accuracy to work necessarily involving errors of considerable magnitude. Seams less than two feet thick have been ignored. The areas of beds from two to three feet thick are calculated down to water-level; their areas beneath water-level have been ignored. Seams from three to five feet thick are estimated to a depth of one hundred and fifty feet beneath water-level. The areas of seams more than five feet thick are computed to a depth of four hundred feet beneath water-level when their quality and thickness are known. The areas of beds more than four feet thick lying above water-level, but over-laid by a great thickness of superimposed measures, have been calculated so as to include a distance of from one to two miles from their outcrop lines,—varying with the dip.

The maps from which the areas were computed are colored in five tints to represent the subdivisions of the carboniferous system of rocks, as follows:

Upper Barren Coal Measures.
Upper Productive Coal Measures.
Lower Barren Coal Measures.
Lower Productive Coal-Measures.
Conglomerate series (with coals).

The lower edge of the Upper Productive tint limits the area of the Pittsburgh bed; the Lower Barren tint defines that of the Freeport Upper coal, and the Lower Productive tint the Brookville coal bed; the areas of intermediate or higher seams were estimated from assumed intermediate out-crop lines. After computing the total area of each persistent seam in any county, the percentage of this area over which the bed will probably be found of workable quality and thickness, and its average thickness were arbitrarily assumed after a careful study of the data published in the county reports. It is evident that there is here introduced a large personal error; it is impossible to entirely eliminate such errors, but they can hardly be large enough to seriously impair the value of the conclusions. The mass of facts published in each county report thoroughly demonstrates the character and value of each coal seam and limits this personal error between *comparatively* narrow bounds.

But it matters little how much time and care are spent upon such work, the personal error must always be a factor of some importance. Even in the anthracite regions, which are so thoroughly developed by actual mining as well as by an immense amount of prospecting work, there seems to be some difficulty in estimating the available coal. In his report on the Philadelphia and Reading Coal and Iron Company's property, Mr. Joseph S. Harris estimates the total contents of the anthracite regions at 13,999.8 square miles one foot thick—equivalent to about 15,600,000,000 tons—and the coal area at 433 square miles. In a paper read September 1, 1879, before the American Association for the Advancement of Science, Mr. P. W. Sheafer estimates the total contents at 26,361,076,000 tons, placing the coal area at 470 square miles. It is evident that the discordance between these two estimates is due in part to an unavoidable personal error; Mr. Sheafer estimating the average coal thickness at nearly double that assumed by Mr. Harris—the estimate of coal areas differing very slightly. The coefficient of error is probably greatest in the counties containing very small available areas,—these have been most liberally estimated (Bradford, Cameron, Clinton, Forest, Crawford, Lycoming, McKean, Potter, Sullivan, Tioga, Venango, and Warren); but in the counties containing large available areas the estimates are probably much less than the actual amount, as I have strenuously endeavored to underestimate rather than exaggerate the available tonnage. The actual average coal contents per acre for each foot of bed measurement is somewhat in excess of 1,650 tons of 2240 pounds, but deducting *one-eleventh* for slate, bone and sulphuric partings, I have assumed an average of 1,500 tons of 2240 pounds per acre for each foot of bed measurement.

The total amount of available coal, limited as above to depth, thickness, etc., is 33,547,200,000 tons.[1] Assuming that 75 per cent. of this can be won in mining, we have 25,160,-400,000 tons as the possible product.

There is little doubt but that under good mining management fully 75 per cent. of this coal can be recovered. Under favorable circumstances, more than 90 per cent. should be won at mines worked on the long-wall plan or on a modification of the long-wall and panel systems.

The total available tonnage may be divided thus:

Beds over 6 feet thick,	10,957,200,000
Beds from 3 to 6 feet thick,	19,586,800,000
Beds from 2 to 3 feet thick,	3,003,200,000
Total,	33,547,200,000

Excluding coals less than three feet in thickness we have an available tonnage of 30,544,000,000 tons, of which 75 per cent. being recovered=22,908,000,000 tons as the possible output from seams three feet or more in thickness. Probably two-thirds of this amount lies favorably situated for mining, and at ordinary prices for labor can be mined and placed on the cars at an average cost not exceeding one dollar per ton; but the remaining third lies beneath water-level or beneath a thick covering of superior-imposed measures, and will probably cost from one dollar and a quarter to one dollar and a half per ton at the present price of labor.

[1] The estimates do not include the Broad Top Coal Field.

This two-thirds=15,272,000,000 tons, accessible above water-level, and contained in beds not less than three feet thick, is sufficient to maintain the present average yearly output from Pennsylvania for about eight hundred years, or to supply the whole world for fifty years. The statistics of production in Pennsylvania show a yearly increase of about 6 per cent. from 1864 to the present time. If this ratio of increase is maintained, the yearly output will reach an enormous figure in thirty or forty years (as shown in the first column of the following table); but as West Virginia, Ohio, Indiana, and several of the Western States are rapidly developing their coal resources and taking their share of the increased demand, it does not seem probable that this percentage of increase can long continue, and I have accordingly calculated another table on a scale of decreasing percentages of increase,—shown in the second column,—estimated on a basis of 16,000,000 tons production in 1880.

Year.	*Yearly Tonnage.*	*Yearly Tonnage.*	*Yearly increase (compounded.)*
1880	16,000,000	16,000,000	
1890	28,640,000	28,640,000	6 per cent.
1900	51,265,600	46,396,800	5 per cent.
1910	91,766,424	68,000,000	4 per cent.
1920	164,270,219	91,120,000	3 per cent.
1930	.....	111,166,450	2 per cent.
1940	.....	122,840,000	1 per cent.

Although the figures of the second column are much smaller than those of the first column, they still are in my opinion much in excess of any output we will ever reach in Pennsylvania. I am inclined to think that the ratio of increase will diminish more rapidly,—say 1 per cent. every five years,—that the maximum output will be reached between 1900 and1920, and will not exceed 50,000,000 tons per annum. At this rate more than five centuries will be required to exhaust the coal. Seams less than three feet in thickness, unless of unusual purity, or located in the counties forming the northern edge of the coal-field, are of little importance at present; nearly all the coal now marketed coming from seams averaging three and a half feet or more. Many of the smaller and more impure coals will never be marketed,—they will answer well to supply the local demand for domestic use and small manufacturing establishments. Probably 10 per cent. of the total available coal will be used to meet this demand, but only a small percentage of this will actually be won in mining, as small mines (*country banks*) worked vicariously from year to year are almost invariably mismanaged, and more than one-half of the coal irrecoverably lost. The possible output from beds above water-level, and more than three feet thick, has already been estimated at 15,272,000,000 tons. It will be safe to assume that one-third of this will be sufficiently good quality to furnish good coke, an amount (5,090,666,666 tons) sufficiently to smelt 2,500,000,000 tons of iron; the remaining ten thousand million tons will furnish excellent gas and steam coals. The average workable thickness and available tonnage of each seam are shown in the following table, which is illustrated by the columnar section drawn on a scale of two hundred feet to an inch.

Upper Barren Measures:			
Washington bed,	3′ to 3½′	787,200,000	
			787,200,000
Upper Productive Measures:			
Waynesburg bed	3′ to 5′	2,126,400,000	
Uniontown bed	2′ to 3′	312,000,000	
Sewickley bed	3′	432,000,000	
Redstone bed	2′ to 3′	326,400,000	
Pittsburg bed	6 to 12′	10,438,800,000	
			13,635,600,000
Lower Barren Measures:			
Brush Creek, Coleman, etc., beds		878,400,000	
			878,400,000
Lower Productive Measures:			
In Westmoreland, Fayette, and Allegheny counties		2,064,000,000	
Millerstown bed	3′	28,800,000	
Freeport Upper bed,	3′ to 5′	3,764,800,000	
Freeport Lower bed,	2′ to 6′	2,385,600,000	
Kittanning Upper bed	2′ to 4′	1,698,000,000	
Kittanning Middle bed	2′ to 3′	820,800;000	
Kittanning Lower bed	2′ to 6′	4,225,200,000	
Clarion coals	2′ to 3′	696,000,000	
Brookville bed	2′ to 4′	1,627,200,000	
			17,217,400,000
Conglomerate Series:			
Mercer coals	2′ to 3′	932,600,000	
Quakertown bed	2′	57,600,000	
Sharon coal horizon	2′ to 3′	38,400,000	
			1,028,600,000
Total			33,547,200,000

The Upper Barren measures furnish but one workable seam, the Upper Productive measures five beds, the Lower Barren measures three or four coals attaining workable size in parts of three or four counties, the Lower Productive measures eight workable seams, and the Conglomerate series three or four seams, workable over limited areas in the northwestern counties.

Upper Barren Measures.—This series furnishes but one seam of commercial importance, the Washington bed, which attains its best development in Washington and Fayette counties, but is not persistent as a workable seam in any other county. The series of rocks contains (see section) several other seams, but they are usually very thin and of poor quality, although one—the Waynesburg "A" bed—may prove workable over a small area in Fayette county.

Upper Productive Coal Measures.—*Waynesburg Bed.*—This is a seam of great importance in Greene and Washington counties attaining also a good thickness in Fayette and Westmoreland, holding the fifth place among the productive coal seams. Professor Stephenson's admirable maps show its depth beneath the surface at almost every cross-road and town in Greene and Washington counties, (see reports K, K K, K K K.)

Uniontown Bed.—This is locally workable in parts of Fayette and Greene counties. It is of little importance.

Sewickley Bed.—The same remarks apply equally well to this bed, and to the

Redstone Bed, which is also locally workable in Westmoreland and Allegheny counties, with an average thickness of from two to three feet.

Pittsburg Bed.—This is the best and most valuable seam of the bituminous coal area. It ranges from six to twelve feet in thickness, and according to my estimates contains nearly one-third of the available bituminous coal in Pennsylvania. Its most extensive areas are found in Fayette, Washington, Allegheny, Westmoreland, and Greene counties, small areas also occurring in Indiana, Somerset, and Beaver counties. The purity and quality of this coal, and the excellent character of coke made from it.—the famous Connellsville,—render it many times more valuable than any other seam.

In parts of Washington and in Greene county it lies deeply covered beneath a great thickness of overlying measures, but its depth at almost any point can be easily determined from Professor J. J. Stevenson's maps, (Report K and K K).

Lower Barren Measures.—In Indiana, Somerset, and Butler counties this series contains several beds attaining workable size over limited areas, and in Armstrong and Beaver counties there is also a small quantity of minable coal in these measures. It will probably be worked principally to supply the local demand.

Lower Productive Coal Measures.—In Fayette and Westmoreland the coals of this series contain a large amount of available coal; in Allegheny county the Freeport coals will furnish a large supply, but they are always of inferior quality. The tonnage of these three counties available from the Lower Productive measures was estimated *en masse*, the data not being sufficient to warrant a finer differentiation.

Millerstown Bed.—This is locally workable in Butler county. It will be mined to meet the local demand.

Freeport Upper Coal.—This bed is workable in parts of fifteen counties. It furnishes some excellent coal, is often a superior cooking coal, and in the western counties is always a strong steam and often a good gas coal. A small area of this seam in Clarion county is of a "block" character, and the coal has been used raw in a small furnace (10′ x 33′) to smelt the limestone carbonate ores. This bed ranks third among the productive seams.

Freeport Lower Coal.—A bed of great importance in Jefferson, Indiana, Clearfield, Cambria, Amstrong, Centre, and Allegheny counties, and workable in parts of Beaver, Butler, Elk, Blair, Cameron, Westmoreland, and Fayette counties. It ranks fourth among the productive seams, and will furnish a large supply of good steam, cooking, and gas coals, the character varying with the locality.

Kittanning Upper Coal.—Nearly all of the cannel coal in Pennsylvania occurs at this horizon. It is the celebrated "Darlington" Bed. The seam often consists partly of cannel and partly of bituminous coal, but is most frequently a bituminous seam of fair quality, attaining workable thickness in parts of Butler, Armstrong, Somerset, (bed "D,") Beaver, (cannel,) Indiana, Jefferson, Elk, and Lycoming counties. It holds the seventh place among the productive seams.

Kittanning Middle Coal.—This locally becomes workable in Butler, Lawrence, Jefferson, Armstrong, Elk, Cameron, and Clarion counties. It will furnish probably one half as much coal as the Kittanning Upper bed.

Kittanning Lower Coal.—In twenty-two counties this bed attains a workable thickness and lies above water-level, favorably situated for mining. The seam lettered "B" in Clinton, Bradford, Lycoming, Tioga, and Sullivan counties has been considered its eastern equivalent, (see Reports H H H H, H^5 and H^6, showing "B" =Lower Kittanning coal.) Along the Allegheny escarpment it is an excellent cooking coal, and in the western counties often a good gas coal, and always a strong steam coal. In point of production it probably ranks second only to the Pittsburg bed; but the Freeport Upper coal may possibly equal or slightly exceed it in the amount of easily accessible coal. It averages from two to four feet in the western, and from three to six feet in the eastern counties.

Clarion Bed.—This is formed in two sub-divisions in some of the western counties, its upper split being known as the "Scrub-grass" coal, (see Reports V, VV, QQ, QQQ.) Its output will probably be applied almost exclusively to satisfy the local demand It sometimes furnishes coal of excellent quality, but the bed is usually quite thin.

Brookville Bed.—Bed "A" of the Allegheny escarpment counties. It will be about equally productive with the Kittanning Upper seam, but often furnishes a very sulphurous fuel.

Conglomerate Series.—*Mercer Coals.*—The Mercer upper and lower coals are workable over limited areas in Lawrence, Jefferson, McKean, Elk, Mercer, Venango, and Forest (?) counties. Excepting in McKean, where their proximity to market enhances their value, and in Mercer county, where they attain their best development, they are of little importance. In Elk and Jefferson they will yield a considerable tonnage, but in the latter county at least this will be applied almost exclusively to meet the local demand.

Quakertown Coal.—Workable over a small area in Mercer county.

Sharon Coal.—In Mercer county this is a bed of great value, but its available area will be exhausted in the near future. This horizon will furnish a small amount of coal in Crawford and Warren counties, but in the latter county it is thin and of inferior quality. Its available tonnage has been estimated on a most liberal basis.

Area.—The area actually covered by the bituminous coal measures in Pennsylvania is about 9000 square miles. The Upper Productive series extend over but a small fractional portion of this area; the barren measures cover a considerable area, hiding beneath a thick covering large areas of the coals of the Lower Productive measures, otherwise easily accessible. The limits adopted in making these estimates necessarily compel the exclusion of many such areas in computing the available coal.

Estimates in detail for each county are given in the following tables in alphabetical order. It may appear that in many cases very small areas are assigned to persistent seams occurring over large areas. The explanation of this will be found in the impure or variable character of the bed, or its depth beneath water-level or beneath superimposed measures over a portion of the area. The casual observer is apt to form a favorable opinion of the quality, thickness, and regularity of coal seams not warranted by the actual facts. Finding several banks working on the same bed at different localities in a county or township, at all of which the bed is of fair quality and thickness, he is naturally led to infer that the seam will be found of equal value over the area he has examined; but he has perhaps, had no opportunity of examining an equal or greater number of trial openings, at which the bed was found to be *worthless*, for these have all been abandoned, have fallen shut, and the openings are almost obliterated. Unless this fact is kept constantly in view, and the variable nature of most of our bituminous coals (especially the smaller seams), thoroughly appreciated, estimates bascd on bed measurements made at *working banks* will almost invariably be found to exaggerate the true amount of available coal of marketable quality.

Allegheny County.

Name of bed.	*Average Coal thickness.*	*Acres.*	*Tons.*	*Sq. miles 1 ft. thick*
Redstone	2′	32,000	96,000,000	100
Pittsburg	10′	112,000	1,680,000,000	1,750
Lower Productive coals	6′	80,000	720,000,000	750
Total	....	....	2,496,000,000	2,600

Armstrong County.

Barren Measures	2½′	6,400	24,000,000	25
Freeport, Upper	4′	128,000	768,000,000	800
Freeport, Lower	3′	48,000	216,000,000	225
Kittanning, Upper	3′	64,000	288,000,000	300
Kittanning, Middle	3′	32,000	144,000,000	150
Kittanning, Lower	3′	80,000	360,000,000	375
Clarion coal	2½′	12,800	48,000,000	50
Brookville	2½′	6,400	24,00,0000	25
Total	....	....	1,872,000,000	1,950

Beaver County.

Pittsburg bed	8′	800	9,600,000	10
Brush Creek	3′	16,000	72,000,000	75
Freeport, Upper	3′	35,200	158,400,000	165
Freeport, Lower	2½′	12,800	48,000,000	50
Kittanning, Upper	2′	64,000	192,000,000	200
Kittanning, Lower	2′	51,200	153,600,000	160
Clarion coal	2′	6,400	19,200,000	20
Total	....	....	652,800,000	680

Blair County.

Freeport, Upper	4′	3,200	19,200,000	20
Freeport, Lower	2′	3,200	9,600,000	10
Kittanning, Lower	2½′	4,800	25,200,000	26
Brookville	4′	6,400	38,400,000	40
Total	....	....	92,400,000	96

Bradford County.

Kittanning, Lower ("B")	4′	4,480	26,900,000	28
Brookville, (Bed "A"	2′	6,400	19,200 000	20
Total	....	....	46,100,000	48

Butler County.

Lower Barrens	3′	48,000	216,000,000	225
Millerstown bed	3′	6,400	28,800,000	30
Freeport, Upper	4′	70,400	422,400,000	440
Freeport, Lower	6′	3,200	28,800 000	30
Kittanning, Upper	3′	83,200	374,400,000	390
Kittanning, Middle	3′	44,800	201,600,000	210
Kittanning, Lower	3′	32,000	144,000,000	150
Clarion	2′	48,000	144,000,000	150
Brookville	3′	32,000	144,000,000	150
Total	....	....	1,704,000,000	1,775

Cambria County.

Freeport, Upper	3½′	89,600	470,400,000	490
Freeport, Lower	2½′	64,000	240,000,000	250
Kittanning, Lower ("B")	3½′	128,000	672,000,000	700
Brookville, ("A")	3′	83,200	374,400,000	390
Total	....	....	1,756,800,000	1,830

Cameron County.

Kittanning, Middle	3′	3,200	14,400,000	15
Kittanning, Lower	3′	9,600	43,200,000	45
Brookville bed	3′	16,000	72,000.000	75
Total	....	....	129,600,000	135

Centre County.

Name of Bed.	*Average coal thickness*	*Acres.*	*Tons.*	*Sq. miles 1 ft. thick*
Freeport, Upper	4′	12,800	76,800,000	80
Freeport, Lower	4′	32,000	192,000,000	200
Kittanning, Lower	4½′	51,200	345,600,000	360
Brookville bed	3	44,800	134,400,000	210
Total	....	....	748,800,000	850

Clarion County.

Freeport, Upper	3½′	3,200	16,800,000	17½
Freeport, Lower	4′	3,200	19,200,000	20
Kittanning, Middle	2′	25,600	76,800,000	80
Kittanning, Lower	3′	96,000	432,000,000	450
Clarion	2′	32,000	96,000,000	100
Brookville	2½′	12,800	48,000,000	50
Total	....	...	688,800,000	717½

Clearfield County.

Freeport, Upper	4′	22,666	133,600,000	139
Freeport, Lower	4′	64,000	384,000,000	400
Kittanning, Lower	4½′	89,600	604,800,000	630
Brookville	3′	64,000	288,000,000	300
Total	....	....	1,410,400,000	1,469

Clinton County.

Kittanning, Lower, ("B")	3′	9,600	43,200,000	45
Brookville, ("A")	2′	6,400	19,200,000	20
Total	....	....	62,400,000	65

Crawford County.

Sharon Horizon	3′	3,200	14 400,000	15

Elk County.

Freeport, Upper	5′	3,200	24,000,000	25
Freeport, Lower	5′	6,400	48,000,000	50
Kittanning, Upper	2½′	16,000	60,000,000	62½
Kittanning, Middle	2½′	28,000	105,000,000	112½
Kittanning, Lower	3′	48,000	216,000,000	225
Clarion	2′	57,600	172,800,000	180
Mercer coals	3′	64,000	288,000,000	300
Total	....	...	913,800,000	955

Forest County.

Sharon and Mercer Horizons?	2′	1,280?	3,800,000?	4?

Fayette County.

Upper Barrens	3′	25,600	115,200,000	120
Waynesburg	5′	35,200	264,000,000	275
Uniontown	3′	48,000	216.000.000	225
Sewickley	3′	48,000	216,000,000	225
Redstone	3′	25,600	115,200,000	120
Pittsburg	12′	160,000	2,880,000,000	3,000
Lower Productive beds	4′	128,000	768,000,000	800
Totals	....	....	4,574,400,000	4,765

Greene County.

Waynesburg	5′	160,000	1,200,000,000	1,250
Uniontown	2′	32,000	96,000,000	100
Sewickley	3′	48,000	216,000,000	225
Pittsburg	8′	96,000	1,152,000,000	1,200
Total	....	....	2,664,000,000	2,775

Indiana County.

Pittsburg bed	7½′	12,800	144,000,000	150
Barren Measures	4′	32,000	192,000,000	200
Freeport, Upper	4′	192,000	1,152,000,000	1,200
Freeport, Lower	2½′	64,000	240 000,000	250
Kittanning Upper	2′	32,000	96,000,000	100
Kittanning, Lower, ("B")	3′	64,000	288,000,000	300
Brookville	2½′	19,200	72,000,000	75
Total	....	....	2,184,000,000	2,275

Jefferson County.

Name of Bed.	*Average Coal thickness*	*Acres.*	*Tons.*	*Sq. miles 1 ft. thick*
Freeport Upper	3′	48,000	216,000,000	225
Freeport, Lower	4′	160,000	960,000,000	1,000
Kittanning, Upper	3′	19,200	86,400,000	90
Kittanning, Middle	3′	16,000	72,000,000	75
Kittanning, Lower	2′	80,000	240,600,000	250
Brookville	3′	44,800	201,000,000	210
Mercer coals	3′	48,000	216,000,000	225
Total	....	...	1,992,000,000	2,085

Lawrence County.

Kittanning, Middle	3′	48,000	216,000,000	225
Kittanning, Lower	2′	32,000	96,000,000	100
Clarion	2′	12,800	38,400,000	40
Mercer, Upper	3′	6,400	28,800,000	30
Mercer, Lower	2′	6,400	19,200,000	20
Total	....	...	398,400,000	415

Lycoming County.

Kittanning, Upper ("D")	4′	3,200	19,200,000	20
Kittanning, Lower ("B")	3½′	6,400	33,600,000	35
Total	....	....	52,800,000	55

Mercer County.

Kittanning, Lower	2½′	3,200	12,000,000	12½
Clarion	3′	16,000	72,000,000	75
Mercer, Upper	2½′	25,600	96,000,000	100
Mercer, Lower	2½′	64,000	240,000,000	250
Quakertown	2′	19,200	57,600,000	60
Sharon	3′	3,200	14,400,000	15½
Total	....	....	492,000,000	513

McKean County.

Clarion coal	3′	3,200	14,400,000	15
Mercer coals	2′	9,600	28,800,000	30
Total	....	....	43,200,000	45

Potter County.

Kittanning, Lower ("B")	2′	3,200	14,400,000	15
Brookville ("A")	3′	3,200	9,600,000	10
Total	....	....	24,000,000	25

Sullivan County.[1]

Kittanning, Lower ("B")	3′	2,560	11,520,000	12

Somerset County.

Pittsburg	8′–10′	(Platt)	42,000,000	44
Lower Barrens	6′	41,600	374,400,000	390
Freeport, Upper	4′	51,200	307,200,000	320
Kittanning, Upper ("D")	4′	80,000	480,000,000	500
Kittanning, Lower ("B")	3½′	64,000	336,000,000	350
Brookville ("A")	3′	51,000	230,400,000	240
Total	....	....	1,770,000,000	1,844

Tioga County.

Kittanning, Lower ("B")	6′	12,800	115,200,000	120
Brookville ("A")	3′	3,200	14,400,000	15
Total	....	....	129,600,000	135

Venango County.

Kittanning, Lower	2½′	3,200	12,000,000	12½
Clarion	2′	6,400	19,200,000	20
Brookville	2′	3,200	9,600,000	10
Mercer coals	2½′	3,200	12,000,000	12½
Total	....	....	52,800,000	55

[1] Anthracite coal.

Washington County.

Washington coal	3½′	128,000	672,000,000	700
Waynesburg	3′	128,000	576,000,000	600
Pittsburg	6′	320,000	2,880,000,000	3,000
Total	....	.....	4,128,000,000	4,300

Westmoreland County.

Waynesburg	3′	19,200	86,400,000	90
Redstone	3′	25,600	115,200,000	120
Pittsburg	8′	137,600	1,651,200,000	1,720
Lower Productive coals	4′	96,000	576,000,000	600
Total	....	.....	2,428,800,000	2,530

Warren County.

Sharon Horizon	2′	3,200	9,600,000	10

The reports already published by the Second Geological Survey of Pennsylvania, descriptive of the bituminous coal area, now number twenty-one octavo volumes, besides two volumes and one atlas on the fossil flora of the coal measures, and a special volume on the coke industry of the Youghiogheny. Nearly all of these reports are illustrated by geologically colored county maps on a scale of two miles to one inch. Besides this series of maps, there is another series now in preparation on a scale of six miles to one inch, which, when completed, will be published in atlas form. At some time in the near future it is my intention to construct from these maps an accurately colored map of the bituminous coal area. I had hoped to illustrate this paper with such a map, drawn and colored to show the relative areas of the principal productive horizons, but as the maps of Cambria, Somerset, Clearfield, and Centre counties are not yet completed, I have thought best to wait until all of these are finished and approved by the State geologist. The estimates of areas and tonnage in these four counties probably contain larger errors than any of the remaining districts, as it is impossible in the absence of the geologically colored maps to accurately limit the productive areas.

The tables showing the county tonnage develop the fact that each county contains an average of but four or five accessible seams of commercial importance.

Two counties contain nine important seams.
Two counties contain eight important seams.
Four counties contain seven important seams.
Two counties contain six important seams.
Two counties contain five important seams.
Seven counties contain four important seams.
Two counties contain three important seams.
Seven counties contain two important seams.
Three counties contain one important seam.

If the counties are tabulated according to their available tonnage we find Fayette standing at the head, followed by Washington, Greene, Allegheny, Westmoreland, Indiana, Jefferson, Armstrong, Somerset, Cambria, Butler, Clearfield, etc., but we must not lose sight of the fact that this may not be the order in which they stand in reference to their present value and importance as coal-producing areas. Mr. Joseph S. Harris, in his able report on the Philadelphia and Reading Coal and Iron Company's property, has clearly shown that the *present money value* of any coal area depends largely upon the time at which development is commenced, the time elapsing before its maximum output is reached, and the time occupied in exhausting the tract, the present money value rapidly decreasing as any one of these variables is increased. The same principle is undoubtedly applicable to the bituminous coal areas. Those areas, so situated that their development can be economically prosecuted at present or in the near future, possess a much greater relative present value than areas not so favorably situated; thus some of the counties forming the northern rim of the bituminous coal area are, because of their proximity to the northern markets, and their present development, of much greater present importance as coal producers than centrally located areas containing many times as much available coal. The amount of coal excluded from these estimates on account of poor quality, depth beneath water-level or beneath overlying rocks is very great. As these estimates prove the existence of an amount of easily accessible coal of good quality sufficient to supply the demand for several centuries, estimates of the tonnage of these impure seams or inaccessible areas would be of no practical value to the present generation.

NOTE.—The coals named after the letters A and B, in Clinton, Lycoming, Tioga, Bradford, and Sullivan counties, have been classed above as Lower Productive coals, binding their equivalents in the Kittanning Lower and Brookville beds. The identification of these latter with beds A and B of the Alleghany mountain escarpment, is shown by Mr. William G. Platt, in Reports H^5, H^6. Prof. I. C. White has more lately suggested that the coals of these northeastern counties may belong to the Conglomerate series (see report on Susquehanna and Wayne.) As I am not convinced that enough is known about these coals to prove the correctness of Prof. White's suggestion, I have adhered to the old classification.

A paper by Dr. H. M. Chance, Proceedings American Institute Mining Engineers.

WINDING GEAR FOR MINES AND WIRE ROPE.

MR. HENRY A. VEZIN, in a paper contributed to the proceedings of the Engineers' Club of Philadelphia, describes the improved methods of haulage in use at the Von der Heydt mine, four miles from Saarbrücken, Rhenish Prussia, where two systems are used. One consists in the use of wire ropes with two engines, one at each end of the road; the other, in an endless chain drawn by one stationary engine. There are two roads with wire rope, one 5709 feet long, with ropes five-eighths of an inch in diameter, and the other 12,368 feet long, with ropes of ¾-inch diameter. When one engine is hauling the train, the one at the other end unwinds by letting its drum run loose, with the brake slightly set, so as to give its rope, which now acts as tail rope, enough tension to prevent its dragging on the intervening ground between the rollers. The tracks have many curves in the adits, levels, and cross-cuts in which they are laid. The wire ropes are of charcoal iron, the rollers of cast-iron, and these latter are set inclined in the curves to prevent the ropes from jumping out. The train, which consists of 100 cars coupled together, each car holding half a ton, is drawn at a velocity of 8 to 11½ feet per second, or 5·5 to 7·8 miles per hour. To each end of a train is coupled an iron guide-car with a device to guide the rope on the rollers, which device is only in use on the car at the rear of the train. If the loaded cars are brought to the end of the track in the mine without delay, and if they are unloaded promptly at the other end, 25 trains, carrying 1250 tons of coal, can be hauled out in 10 working hours on the shorter line, and 15 trains, or 750 tons, on the longer one. A conductor accompanies each train. The levels and adits passed through are provided with a telegraph cable, in which at every 1000 feet an apparatus for breaking the circuit is inserted. By pulling vigorously at the cable, the conductor can transmit signals, even when the train is running at full speed. These roads have been in operation for 20 years. Upon the arrival of a train at the mouth of the adit, the cars are pushed singly under the chains of two chain tramways. The length of each of these is 1738 feet, and each has a curve of 479 feet radius, forming an arc of 168 degrees. Sharper curves can not be passed without releasing the car from the chain, as described below. The cars are placed at intervals of about 50 feet, and serve as supports for the chain rendering rollers between the rails of the tracks unnecessary. The chain rests in forks which are riveted to one end of each car. These roads have been in use since 1872. The iron of the chains was originally ⅞ inch in diameter, and has been worn down to ⅓ inch. The principal chain tramway is in the Burbach adit, and delivers the coal to the same shipping-point as those described above. The cars are hauled by horses to the underground terminus. The length of the road is 5773 feet, consisting of two straight lines connected by a curve of 81·4 feet radius, forming an arc of 103 degrees. To pass this curve, the chain draws the cars up an incline, beyond the summit of which it passes around a guide-pulley placed so high as to release the cars. This point of release is the beginning of the curve, laid on a grade, down which the cars run by gravity to take their places automatically under the chain in the new direction. The cars are about 50 feet apart, as in the former case, so that 80 to 85 loaded ones and the same number of returning empty ones are always under the chain. It rests on the coal or on the edge of the car, its weight being sufficient to prevent slipping, so that forks are unnecessary. Each car holds ½ ton. This tramway, in October, 1880, had been working uninterruptedly since September, 1874, with a capacity of from 400 to 500 tons in ten working hours. It could easily, at its regular speed of 4.1 feet per second, or 2.8 miles per hour, deliver 1250 tons in the same time. The chain is made of iron four-fifths inch in diameter. The inside length of each link, or the pitch of the chain, is 3 inches. The chain is wound 1½ times around the driving-drum, which is covered with wood with a conical hollowed surface, on which the chain slips sideways as it is wound on the one side and off on the other. This wooden lagging cost $25, and lasts over a year before having to be turned off. The original lagging (of oak) was still in use in October, 1880. A cast-iron chain wheel-sleeve would cost $75 to $100, and wear out in four months, and would have the objection that its teeth would not accommodate themselves to the increased length of links or pitch resulting from wear. The grain of the wood is not placed radially, as it would become too smooth, but as nearly as possible with the circumference. The chain showed very slight signs of wear. It sustains a tension of two tons. The driving-engine, placed near the mouth of the adit, is connected with the drum by gearing, and is said to work with seven indicated horse-power. The drum is four to five feet in diameter. The same method of driving is used on the two short tramways. At the Burbach adit tramway, the cars, just before being released, are drawn up a slight incline and then run by gravity down a short curve and over a bridge to the shipping point.

The road with wire rope, as well as those with chains, are horizontal. The chief-engineer assured me that there would be no difficulty in overcoming grades of 14 to 15 degrees (25 feet to 26-8 feet per 100) without the use of forks on the cars, though it might be necessary to have the chain rather heavier than the four-fifth inch one.

Total Cost of Hauling Per Ton per 100 Feet.

By horses, 1-5 cents.

YEAR.	TRAMWAYS WITH WIRE ROPE.				TRAMWAYS WITH CHAINS.			
	Length, 5709 ft.		Length, 12,368 ft.		Length, 1738 ft. (above ground.)		Length, 5773 ft. (in Burbach adit.	
	Amount of coal hauled.	*Cost.*	*Amount of coal hauled.*	*Cost.*	*Amount of coal hauled.*	*Cost.*	*Amount of coal hauled.*	*Cost.*
	Tons.	Cts.	Tons.	Cts.	Tons.	Cts.	Tons.	Cts.
1872 .	292,955	0.58	112,880·0	0·52	. . . .	. . .	. . . . . .	. . .
1875 .	265,317	0.46	20,278·0	0·62	287,057	0·71	115,671	0·29
1879 .	230,152	0.29	99,626·5	0·37	330,001	0·40	119,987	0 22

That is to say, hauling with horses would have cost seven times as much in the Burbach adit as it did by chain in 1879.

Improved Winding Gear for Mines, etc.—Important improvements have recently been introduced by Mr. John Craven, of Wakefield, England, in the form and arrangement of winding gear for mines, the improvement consisting mainly in obviating the necessity of coiling ropes round the drums usually employed, and so removing the danger and expense arising from the great wear and frequent injury of the ropes by one coil chafing against the other. In order to effect these objects, the inventor employs a single winding rope, an upper set of grooved headgear pulleys, and a lower set of grooved winding pulleys, each consisting of two pulleys and an intermediate grooved pulley between the two sets. The rope is attached at one end to one of the cages, passes over one of the headgear pulleys, under one of the winding pulleys (to which the motive power is applied), and back over the intermediate pulley, and then under the other winding pulley, and thence over the other headgear to the other cage, to which the end of the rope is attached. This arrangement is designed to give greater durability to the rope, and to obviate all tendency to slipping of the rope, as in proportion as the weight of the load is increased the adhesion of the rope is augmented. The bearings of the intermediate pulley may be carried in a movable frame, either inclined or otherwise, so as to admit of the pulley being adjusted as required, in order to maintain the rope taut. The following specific advantages are claimed for the invention: No chafing of rope as in the ordinary system of drum, so that the ropes last longer; reduction of work for the engine to do in starting; reduction of strain upon the engine, &c., in stopping; speed, instead of being obtained by a large diameter of drum, is got from the engine running quickly; a smaller engine is required than with ordinary gear, owing to the comparative lightness of the winding pulley; the winding pulleys have only one groove each, and are of very small weight, comparatively; saving in first cost, the engine house being much narrower, and only one rope required instead of two; great adhesion, no slip occurring between the rope and the pulleys.

Iron Age.

The Preservation of Mining Steel Wire Ropes.—Complaints are constantly made as to the rapid wear and tear of steel wire ropes used for winding at mines, and this cannot be said to be owing so much to the quality of the material as to the sudden checking of the movements by the use of friction clips when there is a heavy strain upon the ropes. If checked by friction, the rope is liable to heat or tear, or if not allowed to slip at all, to snap off. Now, steel wire ropes are costly things, and should be made to last as long as it is possible for them to do, without giving way or breaking, and how this can be best effected has long been a momentous matter for the consideration of mine owners and mechanical engineers. But no system has been brought forward or adopted until recently by which the full value of a rope can be obtained, and the fraying and breaking of the strands effectually prevented. An invention, however, has recently been patented in London, and is described in the *Mining Journal*, which promises to be of considerable value. The invention is patented by Mr. R. B. Jones, of the firm of Garnock, Bibby & Co., of Liverpool, and James Hughes, an employee of the firm, and relates to improvements to clips, stoppers, or brakes for steel wire and other ropes, being also applicable as winches or for hauling purposes, so that a brief notice of the invention must be of more than ordinary interest to those daily using metallic ropes. The invention is designed to check the rope whilst working, without any of the severe punishment caused by hard compression or attrition, and without sensible wearing friction on the rope. For this purpose a brake is fixed, not the rope itself but on mechanism connected with V-pulleys, round which the rope is twined forming a figure of eight. The friction on the pulleys is so great by reason of the turn round each pulley given to the rope that no appreciable relative motion can take place between the pulleys and the rope. As a brake, however, is applied on the axles of the pulleys, or rather on brake wheels on these or on one of the axles, whatever friction is expended on stopping the rope is spent on the brake-block or the belt and brake-wheel and not on the rope. The apparatus is simple and effectual. Upon the overhanging ends of two shafts having bearings in a stout frame four pulleys are placed, two on each shaft, which are connected by spur gearing. On the other ends of the shafts are placed two brake-wheels with a single brake-strap, so arranged that a man, by means of a lever, can put a sufficiently powerful strain on the brake-strap so as to give the brake the requisite power.

Upon one of the shafts is a worm wheel, or first wheel of other train of gearing, and a clutch, so arranged that the gearing can be thrown into gear with the shaft at a moment's notice and be thrown out again, and the gearing can be worked either by hand or power. In operation the rope is passed from a reel through a guiding eye on to one of the other pulleys; it passes round that, then round the other outer pulley the opposite way, then round the opposite inner pulley, the direction being the same as in the first instance; and, lastly, it goes round the remaining pulley in the same direction as round its companion second pulley. The brake can be applied gradually or suddenly without any more friction or severe compression on the rope. By putting the clutch into gear the apparatus becomes a winch, and, the brake being thrown out of action, the rope hauled in. In lowering heavy weights the brake can be applied, the clutch thrown out of gear, and the descent regulated with the greatest nicety by hand pressure on the brake lever. The apparatus is no more severe on the rope when the brake is applied than at other times, excepting, of course, the increased tensile strain necessarily entailed when the lowering of a heavy weight is checked, and whilst in other winding apparatus there is the riding of one turn over the other to the great injury of the rope, in the Jones and Hughes apparatus the drum can be coiled to any depth but no turn rides on the other under pressure from the strain of the work performed. The apparatus can also be used merely as a stopper or brake, or a winch, as they may be desired; so if the winch be not required the spur wheels and winch need not be added, and it becomes a simple stopper. This simple machinery, so admirably adapted for clipping, stopping, hauling, or braking still wire ropes, and can be so easily arranged as to make a complete winch or stopper, should commend itself to mine owners as well calculated to preserve the ropes for winding, and so obtain from them a much larger amount of work than is now the case.

Testing Wire Ropes.—At the royal colliery of Friederichsthal, near Saarbruecken, a press has been erected for the purpose of testing wire ropes used for mining purposes. The cylinder of the press is supported by cast-iron standards, giving a clear vertical working space of about 1 meter between the fixed and movable clamps by which the test pieces are held. The latter is upon a crosshead parallel to a second one above the ram, the two being connected by side rods. The length of stroke and diameter of the ram are both 300 mm., and its effective surface is 707 square cm., which at the highest pressure of 200 atmospheres corresponds to a pull of 141.4 tons. The sides of the press cylinder are 100 mm., and the bottom 150 mm., thick; the side rods connecting the two crossheads are 90 mm. in diameter. The experiments described were made upon three ropes that had been laid aside after use. The first was a round steel rope of 28 mm. in diameter, with seven strands of seven wires each, and a hempen core of 10 mm. diameter. The total section of the wires was 250 square mm., and the tensile strength when new was guaranteed to be 28.2 tons by the maker, and proved to be 31.8 tons on trial. As it had been exposed to the air for some time, it was considerably and rather unequally rusted. The second rope, also of round steel, was 29 mm. in diameter, with six strands each of eleven wires 1.65 mm., upon a core of seven (one of 1.65 mm. and six of 1.45 mm.); the whole having a hempen core of 12 mm. The total section, apart from the six thicker core wires, was 200 square mm., and the tensile strength 21.89 tons guaranteed, and 26.63 tons actual. This was much better preserved than the preceding one, and the results obtained are considered as more accurate. The third rope was a flat one of cast steel wire, 60 mm. broad and 13 mm. thick, made up of six round ropes, each having strands of six 1.45 mm. wires and a hempen core of 2 mm., the section of the metal being 238 square mm. When new, the tensile strength guaranteed was 25 tons. There being no means of applying the press to the lifting of heavy loads of known weights, the loss due to friction produced by the hydraulic packing leather could not be directly observed, and was therefore calculated by Reuleaux's formula:

$\frac{F}{P} = \frac{1}{D}$ where F is the friction of the ram, D, the diameter of the ram, and P, the load upon it.

Moreover, if p = pressure per square cm. = 1.033 observed gauge pressure in atmospheres; p^1 = weight of ram and attached moving parts; q = section of ram; s = effective strain on the rope;

$$P = q\,p \quad F = \frac{q\,p}{D} - \frac{p^1}{D}$$

$$s = p\,q - p^1 \left\{ \frac{p\,q}{D} - \frac{p^1}{D} \right\} = \frac{D-1}{D} p\,q - \frac{D-1}{D} p^1 = \frac{D-1}{D} p\,q - C,$$

from which the following expression was obtained:

$$s = 727.75\,a - C,$$

Giving the actual strain on the rope from the observed gauge pressure in atmospheres a. C is a constant whose average value varied with the weight of the moving parts from 1375 to 1435 kg. The object of the experiments was to determine the value of different methods in use for attaching ropes to the drawing cages. These were: 1. Baumann's method, in which the end of the rope is fixed in a conical box by three wedges, the train being uniformly distributed by a hard metal packing, whose surface is accurately molded to that of the rope. 2. Similar method, but without protecting casing between the rope and the faces of the wedges, which are rough and hardened. 3. The ends of the wire were untwisted so as to nearly fill the conical box, and secured by an annular wedge. 4. Like No. 3, with the end secured by a conical plug. 5. Similar to 3 and 4, the joints being made by running in lead, zinc or hard composition metal. 6. End turned into a loop and secured by pairs of iron rings, driven home by blows upon an anvil; length of point 700 mm. 7. Loop with ends secured by three clamps with two bolts to each; length of joint, 500 mm. 8. Loop with three clamps, having four bolts to each; length of joint 600 mm.

Fastening.	*Breaking Strain.*		*Flat rope, 60 + 13 mm.*
	Round rope of 28 mm.	*Round rope of 24 mm.*	
	Tons.	*Tons.*	*Tons.*
Roughened vice jaws . . .	28.3—28.8	24.1—24.6	29.7
Clamp, No. I . .	27.7	24 1	. . . .
Clamp, No. II	23.3—25.5	22.6—23.4	28.1—30.3
Ring wedge, No. III	15.7—16.4	6.6—12.8	. . . .
Plug, No. IV	18.8—24.8	15.0—22.6	. . . .
Lead joint, No. V	12.1—16.1	12.1—18.3	5.2
Zinc joint, No. V	19.3—24.1	20.1—23.0	28.5—29.2
Hd. met. jnt., No. V	24.4—25.9	23.0—23.4	17.5
Loop, No. VI . . .	10.2—11.3	16.8—17.9	. . . .
Loop, No. VII . .	15.3—27.7	13.8—22.9	24.8—29.5
Loop, No. VIII	19.7—27.7	15.3—23.7	29.1—30.2

The variations in the above figure are caused by the rope slipping in the holder before the actual breaking strain was reached. This was especially the case with the lead joint No. 5, where the soft metal was invariably compressed and the rope was pulled out of the joint. Better results were obtained with zinc and hard metal, but the individual differences show that the metal must be cast at a high temperature to make a proper joint, when the wire is likely to be overheated, whereby its tenacity is diminished. Fastening No. 1 gave the best results, the strength of the joint being almost equal to that of the rope. The method of securing an eye with rings driven on proved thoroughly worthless, as the rings invariably slipped at a low strain.

Iron Age.

The Strength of Wire Ropes.—Among the different subjects upon which attention was bestowed by the French commission appointed in 1878 to investigate the causes of accidents in mines, the strength of wire ropes was not the least important. The report of the commission on this subject was recently published under the auspices of the Government, and constitutes an elaborate document, covering not only researches made in France, but giving observations made in England, Belgium and Germany. New iron wire ropes, during the first days of their use, stretch from 1 to 2 per cent., and when nearly worn out they undergo slow and continuous elongation. Many engineers and manufacturers profess to have no doubt that by vibration the iron of ropes becomes hard and breaks easier. Other manufacturers have produced the results of tests, which, according to them, prove that the wire of rope which has been in use shows the same tensile strength per unit of section. They freely acknowledge that the wires of an old rope have not each the same strength; but they claim that this is only the result of a decrease in the section due to abrasion and rusting. The results of some experiments submitted do not entirely bear out this argument. Thus, a rope consisting of six strands of 18 wires each (having a diameter of 0.0788 in.) was used 10 months and twenty days, and during that time had been hoisted and lowered 54,360 times, drawing 90,509 tons from a depth of 361 feet, and had been wound around the hoisting drum 233,235 times. The average result of the tests of the 18 wires of a strand in the new and in the old ropes was as follows:

Iron wire rope.	*Total tensile strength of wire Lbs.*	*Tensile strength per sq. in.—Lbs.*	*Elongation at rupture. Per cent.*	*Elastic limit. Per cent.*	*No. of bends.*
New	494.5	103,437	1.036	0.498	7.0
Old	385.8	86.055	0. 258	0.258	6.4

The diminution of the elasticity in the wire of the old rope shows that the iron has undergone a molecular change. It may be concluded that the tensile strength per square inch is really greater than above given, since rupture generally occurs at the point of smallest section of the wire, and since the sectional area is not uniform throughout its length. The annexed table gives the results of a second set of experiments, in which a number of the wires of the new rope were tested a second time, to determine the effect of the previous rupture; the diameter of the wires was .0709:

Wire rope.	*Tensile strength of each wire.*	*Tensile strength per sq. in. Lbs.*	*Total elongation. Per cent.*	*Elastic elongation Per cent.*	*No. of bends.*
New, first test	434.7	113,792	1.058	0.455	9.0
New, second test	437.6	114,645	0.670	0.520	7.9
Old	292.1	78,232	0.462	0.278	. . .

In this case the wire was not alone diminished to one-half, but the tensile strength, too, suffered appreciable reduction, which cannot be attributed as easily to errors in determining the section of the wire. This is shown by the results of the tests of the single wires. In the wires of the new rope, the difference between the best and the poorest was 15 per cent. of the average tensile strength, the poorest being 7 per cent. lower than the average. In those of the broken rope, the range is 24 per cent. But even the worst single wire had only a decrease of 41 per cent. in the tensile strength as compared with the average of the new wire rope.

The following figures were obtained by testing wire ropes at Creusot:

Specimen No. 1.	*New wire.*	*Seven months' service.*	*Eleven months' service*
Total tensile strength.	704	605	496
Percentage referred to new rope	220	189.2	156.2

This rope lasted 21 months, and the fignres express the average tensile strength in pounds.

Specimen No. 2.	*New wire.*	*Five m'nths*	*Nine m'nth.*	*Thirteen mos.*	*Eighteen mos.*	*Twenty-five mos.*
Total tensile strength in lbs. .	726	708.4	686.4	616	378.4	402.6
Percentage referred to new rope	220	217.8	187	165	114.4	121

The Cost of Wire Ropes in Anthracite Collieries.—In a paper contributed to the Transactions of the Engineers' Club of Philadelphia, Dr. H. M. Chance gives the following valuable table showing the tonnage raised by twenty-three wire ropes used at eleven different slopes in the anthracite coal regions on dips ranging from fifteen to sixty degrees; and the tonnage of six ropes at three shaft collieries. Nearly all of these ropes were made by the Roebling Company; are of seven strands of nineteen wires each, and were in use at some period from 1875–1880. The first cost of the ropes is calculated from Roebling's price list for October, 1880.

Slope.	*No. of ropes.*	*Diam. Inch.*	*Length. Feet.*	*Cost.*	*Tons.*	*Total tons.*	*Cost per ton.*	*Cost per 100 feet lift*
1 . . .	6	1¾	900	$3,240	66,616	375,700	0.86	0.095
2 . . .	2	2	1,000	1,520	98,280	196,560	0.77	0.077
3 . . .	1	1¾	850	510	203,700	203,700	0.25	0.029
4 . . .	2	1¾	1,000	1,200	37,175	74,350	1.61	0.161
5 . . .	1	1½	1,200	640	37,500	37,500	1.47	0.122
6 . . .	1	1¾	1,100	660	77,700	77,700	0.85	0.077
7 . . .	2	1⅜	950	760	41,825	83,650	0.90	0.094
8 . . .	1	1½	950	428	70,950	70,950	0.60	0.063
9 . . .	1	1½	675	304	102,200	102,200	0.29	0.043
10 . . .	4	1¾	820	2,952	149,037	596.150	0.50	0.061
11 . . .	2	2	1,050	1,596	166,650	333,309	0.48	0.046
Averages and totals,	23	. .	933	$13,710	93,556	2,151,760	0.64	0.069
SHAFTS.								
1 . .	2	1¾	925	$1,100	88,715	177,450	0.63	0.068
2 . . .	2	1¾	635	762	117,180	244,360	0.32	0.051
3 . . .	2	1¼	500	350	86,222	172,445	0.20	0.041
Averages and totals,	6	. . .	687	$2,222	97,376	684,255	0.38	0.053

In these tables, says Dr. Chance, the cost has been estimated by the actual tonnage (exclusive of the weight of the mine cars) raised. The coal raised does not exceed two-thirds of this amount, but the value of the discarded rope, estimated at one-third its cost, has been considered an equal offset, and the figures given may, therefore, be taken as the average cost per ton of merchantable coal.

—*Coal.*

THE VALUATION OF IRON MINES IN NEW YORK AND NEW JERSEY.

PROF. John C. Smock, assistant geologist of New Jersey, in a paper presented at the Washington Meeting of the American Institute of Mining Engineers, gives interesting data collected during the census, for a valuation of mines of iron ore, his figures relating particularly to those of New Jersey and New York. The mines which were selected for the several groups and mining districts include nearly all those from which the most full and carefully filled returns were received by the Census Bureau. They were also representatives of their respective districts, so that the averages obtained from them are good types of these districts. The New Jersey mines appear in six groups, each containing from three to eleven mines, or in all, thirty-four mines. The magnetic iron ores of New York are in four well-marked groups, and there are twenty-six mines in them. Then follow the red hematite mines of St. Lawrence and Jefferson counties; and lastly, the brown hematite groups of Dutchess and Columbia counties, and those of the adjacent parts of Connecticut and Massachusetts. The whole number of mines represented by the table is eighty-eight, of which 28 are hematite ores. The first column gives the value of the real estate; the second that of the plant; the third is the sum of these two, or the capital invested. Then follow the number of men employed, the amount of wages paid during the census year, the value of materials used in mining and preparing the ores for market. The seventh column gives the total expenditures, or cost of the ore. The product in tons is in the eighth column, while the cost per ton is in the ninth. The last column of the table shows the ratio between the real estate value and the product.

The first observation to be made on this table is the apparent discrepancies when capital and product are compared, as is done in the last column. The difference in ratios of product to capital are greatest among the groups of magnetic iron ore mines of New York, and between the hematites of Connecticut and Massachusetts. In the latter $3.17 of real estate produced a ton of ore, whereas, in Connecticut, it required an investment valued at $12.23, or nearly four times as much. Although much of this difference is inherent in the mines, and due to great disparity in actual value, somewhat of it must be credited to imperfect valuation, and a more accurate method of valuation would tend to the equalization of these ratios. Another observation is to be made in the variation in the cost of the ore per ton, ranging from $3.96 to $1.57. The greater cost is found to be in the groups of deeper mines. The larger proportion of open workings or pit work reduces the average cost. The larger size of the ore-bodies also affects favorably the cost; and the more expensive the plant, when compared with the total expenditures, the less is the cost of the ore. And, in general, the labor expenditure seems to enter more into the cost than the value of materials used, although the separation of these classes of expenses is nearly always incomplete. Other points for consideration and comparison will suggest themselves to the reader who may examine the table.

These elements are sufficient to give the basis for valuations, so far as the several districts are concerned. The problem is in the nature of an annuity; and, knowing the term and amount received annually, the question is, What is it worth? In the case of the New Jersey mines, the value of the real estate was placed at seven times the annual dividend or amount of profits. Thus, for example, taking the 34 mines in New Jersey, according to the table above, their product was 560,340 tons, which, at 78 cents per ton, would yield a dividend of $437, 065, and that multiplied by seven gives $3,059,456 as their valuation. It remains to fix the rate of interest to allow for a return of the investment, or what is known as a redemption fund. Authorities differ so widely that it is almost an arbitrary matter to assign any figure. The mean range is from 8 to 20 per cent. The rate allowable for redeeming the principal should not exceed 4 per cent.—that of our most reliable trust-

TABLE OF SELECTED STATISTICS OF IRON MINES.

	Mining Districts and Groups of Mines.	*Capital invested in real estate.*	*Capital invested in plant.*	*Total invested capital.*	*Number of men employed.*	*Amount of wages.*	*Value of materials used.*	*Total amount expended.*	*Tons of ore mined.*	*Cost per ton of ore.*	*Total capital in real estate per ton of ore mined.*
I.	Warren Co., N. J	$273,200	$72,104	$343,304	411	$118,751	$23,902	142,658	43,607	$3.27	$6.24
II.	Sussex Co., and western part of Morris Co., N. J	295,000	71,000	366,000	374	139,483	53,511	191,949	85,595	2.24	3.44
III.	Chester, Morris Co., N. J	260,000	40,290	290,290	233	66,147	16,152	82,299	40,460	2.03	6.15
IV.	Mine Hill—Irondale Range, Morris Co., N. J.	710,000	174,300	884,300	972	365,083	104,506	469,589	117,035	3.10	6.07
V.	Mt. Pleasant-Mt. Hope Range, Morris Co., N. J	540,000	152,000	692,000	639	300,990	125,093	426,083	125,685	3.39	4.29
VI.	Northern part of Morris Co., N. J.	925,000	129,770	1,054,770	1,017	425,314	161,009	686,323	147,958	3.96	6.25
	New Jersey Mines	2,993,200	639,464	3,632,664	3,646	1,415,723	484,173	1,898,896	560,340	3.38	5.34
VII.	Orange Co., N. Y	805,000	62,300	867,300	383	130,814	37,960	168,794	77,001	2.19	10.45
VIII.	Putnam Co., N. Y	522,030	44,805	566,825	434	165,465	46,000	211,465	66,800	3.16	7.81
IX.	Essex Co., N. Y	1,474,377	585,595	1,979,972	1,268	457,223	242,052	799,275	506,843	1.57	2.90
X.	Clinton Co., N. Y	376,000	115,500	490,500	699	190,870	38,800	229,670	80,645	2.84	4.65
	Red Hematite.										
XI.	St. Lawrence and Jefferson Counties, N. Y	358,000	102,000	460,000	366	162,689	28,500	181,189	84,374	2.15	4.24
	Hematite.										
XII.	Dutchess and Columbia Counties, N. Y	966,049	208,000	1,174,099	593	181,067	68,945	250,032	124,967	2.00	7.73
	Hematite.										
XIII.	Connecticut	381,000	33,500	414,500	180	60,667	20,553	81,220	31,141	2.61	12.23
	Hematite.										
XIV.	Berkshire, Mass	157,000	59,000	216,000	311	109,121	41,792	150,913	49,454	3.05	3.17

The enduring character of our iron mines in New Jersey and in New York is here to be noted, as it bears so closely upon this question of their value; it is particularly true of the magnetic iron ore mines. Many of them have been worked steadily for long periods, and some of them figure in our colonial history. Their production previous to 1840 was comparatively small, and the larger part of the aggregate amounts obtained from them belongs to the past three decades. Notwithstanding the extent to which they have been opened, there are no signs of exhaustion. It seems entirely safe to assert that many of these ore-bodies, now so largely explored, are practicably inexhaustible, at least by known methods of mining.

Assuming the rate of production of the census year, it is easy to ascertain how long it would have taken to raise the known amounts of ore estimated as coming from them. From fifteen to thirty-five years would have sufficed at the present rate in all of the larger mines, both in New Jersey and New York, and in others from 4 to 10 years. The average, for safety, Mr. Smock puts at 15 years. Having assumed the working term and the annual product, the remaining essential factor in all cases is the profit per ton. It was obtained by subtracting the cost from the average price at the mines in the several districts, as follows:

	Average price.	*Cost.*	
New Jersey mines	$4.16	$3.38	$0.78
Orange County, N. Y	3.00	2.19	0.81
Putnam County, N. Y	3.00	3.16	0.16
Essex County, N. Y	3.30	1.57	1.73
Clinton Connty, N. Y	4.50	2.84	1.66
St. Lawrence and Jefferson counties, N. Y.	2.70	2.15	0.55
Dutchess and Columbia counties, N. Y	3.90	2.00	1.90
Connecticut mines	4.80	2.61	2.19
Massachusetts mines	4.00	3.05	0.95

fund investments. Owing to the great permanency which characterizes many of our iron-mine properties, 10 per cent. has been thought to be a reasonable profit upon the capital, and 4 per cent. sufficient for its redemption. Turning to Hoskold's tables, we find that the present value of $1 per annum in fifteen years, allowing interest at 10 per cent. upon the purchase money, and redeeming the capital at 4 per cent., is $6669, or nearly the arbitrary multiplier which was used in the case of the New Jersey mines. With a higher rate of interest, for example, 20 per cent., the multiplier would be 3,061. These are the general principles which have been employed in the valuation of nearly all of the mines of New Jersey and in many of New York. As already stated, they are subject to almost endless modification, owing to the ever-varying combinations of the other essential elements, which need to be taken into account, and which vary almost with every mine.

Engineering and Mining Journal.

THE GREAT COMSTOCK LODE.

THE sister cities—Virginia City and Gold Hill, which form the "mining camp" of the Comstock—the greatest silver and gold-producing district in the world, are situated in Storey County, the southwestern part of the State of Nevada. The practicable ways of reaching the Comstock are as follows: From San Francisco, by the Central Pacific Railroad; northeastward to Reno, thence by the Virginia and Truckee Railroad, southward to Gold Hill and Virginia City; from New York and the East the route is by the Union Pacific Railroad. The "Washoe range" of mountains—the most prominent peak of which is Mt. Davidson—is an offshoot or spur of the Sierra Nevadas, which separate upper Nevada from California. This range occupies about two-thirds of Storey County, and runs from Carson City, the capital of Nevada, northward, passing Gold Hill and Virginia City on their west side, and extending to the Truckee River, the northern boundary of the county. Hill's valley, and the canyons are alike barren and destitute of natural growth, with the exception of the inevitable sage-brush. The Comstock Lode or vein, like other "true-fissure" veins, is a long, deep and comparatively thin mass of metalliferous quartz and other kindred matter, filling a fissure made in the solid rock by igneous action from below, the fissure and its vein being at a considerable inclination or slant from the horizontal. Veins of quartz are usually found at or near the base of mountains, and sloping nearly at the angle of the face of the mountains. They also tend to curve around in their length of course, following the curves of the mountains. The Comstock fissure and lode form no exception to the rule. The original developments, as those of the Ophir, Gould & Curry; Savage, Hale & Norcross; Chollar Potosi Imperial, down to the Belcher and Overman, embrace that part of the Lode which runs along the eastern slope of Mt. Davidson for a distance of about two miles. This distance has been greatly extended, however, by the comparatively new claims, such as Justice, Silver Hill, etc., south of Overman; and Sierra Nevada, Utah, and others, north of Ophir. Let it be understood that all these mines or claims are not merely various lengths of, say 100 to 1000 feet along the same line of Lode, so that the north line of one claim is the south line of the next, and so on. Although the Congressional law of 1872, in regard to mining claims, limits claims from the date of its action to 1,500 feet on the length of a lode or vein by 600 feet in width across its outcroppings. The original claims along the Comstock are generally understood to be indefinite in their extension eastward, or perpendicular to the course of the vein, so far as they do not interfere with other claims on parallel ledges or lodes. The case is different with the more recent claims which come under the above law.

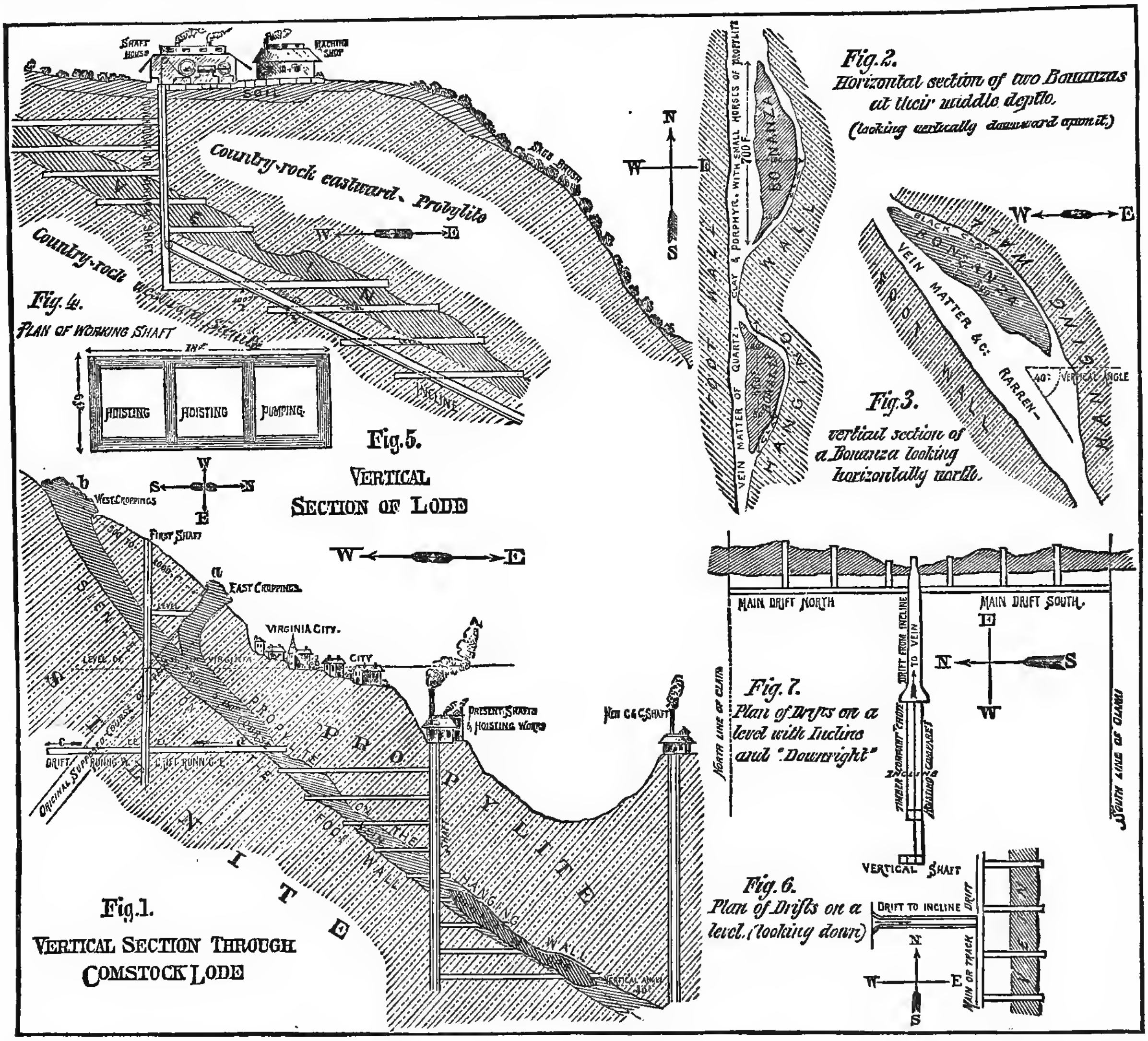


Fig. 1. Vertical Section Through Comstock Lode

Fig. 2. Horizontal section of two Bonanzas at their middle depth. (looking vertically downward upon it.)

Fig. 3. vertical section of a Bonanza looking horizontally north.

Fig. 4. Plan of Working Shaft

Fig. 5. Vertical Section of Lode

Fig. 6. Plan of Drifts on a level, (looking down)

Fig. 7. Plan of Drifts on a level with Incline and "Downright"

In order to see why fissures and their veins tend to occur at or near the bases of mountains, or between the mass of the mountain itself and its overlying stratum, it is necessary to understand that the mountains were *in situ* before the internal volcanic action or earthquake caused the fissure or rent. The fissure would naturally take the line of least resistance, wherever that might be. The mountain when it was thrown up would have already tilted the horizontal strata up to an angle with the horizontal, equal to that of its own surface slope. The dividing-line or boundary between the mountain itself as it extends downward, and the overlying strata which it has forced or tilted up, would naturally be the line of such least resistance to any internal pressure; on account, not only of their being distinct, but also on account of the great weight and solidity of the mountain mass. When the fissure was formed, there was in all probability a simultaneous ejection from below of a great quantity of semi-liquid and quartzose matter into said fissure. This, in ascending, broke large masses of the country rock from the "hanging" or upper wall, and also from the "foot" or lower wall, more especially from the former, which masses must have fallen into the vein and form the small and large "horses" which we so often hear spoken of in mining affairs. The quartzose matter would find its way to the top of the fissure as a rule, and there form the "outcrop" or "croppings," which, in some parts of the course of the lode, are more or less prominent, and in others not observable. But when the convulsion by which it was thrown up ceased, the quartzose matter being in a semi-liquid mobile state, as before said, would fall down again as it ascended, if in its passage it did not break the surrounding walls, and thus, form an impenetrable obstruction somewhere in its course to its own downward and backward fall. This obstruction would end the "bonanza" or chimney of ore. Below it the wall-rock would break in, and close up the fissure as just observed, until perhaps the descending quartz below had crushed in some more wall-rock, and formed another bottom for this lower "bonanza" of mineralized quartz. And so there might even be a third so-called "bonanza" some distance below that. Or these bonanzas might all have been formed at different times corresponding to various upheavals and earthquakes, when the same process would obtain, as in the case of the first and highest body of ore. These views would account for the fact that, as a rule, a second bonanza of rich ore is not "struck" in continuity downward with a former one, but only after passing through sometimes several hundred feet of the country rock, which either reduces the quartz and quartzose matter to a very narrow width, or else cuts it off entirely.

Mt. Davidson and Mt. Butler, the adjacent peak, consist of *sienite* which is a mechanical mixture of quartz, feldspar —both whitish and hornblende—a blackish mineral, presenting a coarse pepper-and-salt appearance, making a very hard rock similar to granite. This rock, therefore, constitutes the western or "foot" wall of the vein on the eastern slope of these mountains, although the west wall in the southern part of Gold Hill consists of other rocks called "metamorphic rocks," owing to the fact that they have been changed from their original character and position by the action of heat, moisture, etc., while north of these mountains a rock called "propylite"—so named by Baron Richthofen—and which is a kind of porphyritic feldspar of almost all colors—light green, blue, red, and black, resembling clay or argilaceous slate—forms the west wall. This last kind of rock—propylite—constitutes the east or hanging wall, continuously from one end of the vein to the other so far as worked.

Each of the inclosing walls of sienite and propylite is separated from the vein matter by a thin sheet of black clay called "selvage," and in the mine, if a drift or tunnel is run perpendicular to the course of the vein to reach it, the appearance of this clay indicates the immediate proximity of the vein, and when it reaches another clay selvage in going through the vein, it is known that the latter has been traversed. The "strike" or course of the vein is nearly magnetic north and south, and is 16½° east of true north, this being the magnetic variation. Its dip is directed eastward, and varies in the different claims from 34° to 45° downward from the horizontal. In rising, however, the vein at the top has been penetrated in the middle by a vast "horse" of about 650 feet wide, and this has tipped up the eastern half of the vein for a depth of 400 feet, so that it dips westward, as in Fig. 1, which represents a vertical section of the vein, showing its two branches at the top. It is more than probable that the vein matter pressed so hard in its ascent upon the hanging wall, that, when it reached a point where the weight of the overlying mass was comparatively light, it made another fissure or method of exit for itself, besides the first, and that this was the eastern half of the vein just spoken of; it is supposed by some that the hanging wall fell in at the top. Fig. 2 represents a horizontal section through a part of the Comstock Lode, showing the regularity of the course of the west or foot-wall, and the great irregularity of the hanging wall. In Fig. 3 is presented a horizontal section of two bonanzas or chimneys of ore, and Fig. 4 shows such a bonanza in vertical section, that is, as if the observer were looking northward through the vein. Bonanzas or ore bodies are generally found in the swells of the vein, and they usually traverse the vein southward, and at a steeper dip than its own. As will be noticed, the form of its horizontal section (that is, what would be seen if we suppose the top to be cut off perfectly level, and the observer to look vertically down upon the top of what is left), is rudely lenticular or egg-shaped. In fact, if we take an egg, and hold it horizontally—the ends pointing north and south—suppose the depth to be about 500 feet; width about 10 to 100, and length from end to end, about 650; we will not have a very fallacious idea of a bonanza. The original Gould & Curry bonanza was of these dimensions. The fine Savage, and Hale & Norcross bonanza, was about 800 feet long, but not so wide as the G. & C. The Imperial, Chollar, and the wonderfully rich Ophir and Mexican, had each a splendid body of ore, as also the Belcher and Crown Point, whose body of ore, on the 1,100 level, about the centre of the body, reached as high as 150 feet in width, and the enormous value of $2,000 a ton for about half a level of 100 feet deep.

The ore of the Comstock, whose valuable constituents are silver and gold, does not by any means all present the same appearance or constitution. There are three principal kinds of ore; one is the black sulphuret of silver, which is composed of sulphur and silver, and is usually found in an amorphous condition, that is, without crystallization, and sometimes contains considerable gold with it—although not often apparent to the eye. The blackish propylite before mentioned is often taken for this ore by visitors in the mine; but they may be distinguished by the fact that the ore presents a jet black, living appearance, while the propylite or "waste" rock has a dull look. The sulphuret of silver, also, occurs occasionally in small crystals of a cubical or octahedral shape, and can be cut like lead with the knife, which it also somewhat resembles in appearance; it is then called Silver Glance. An antimonial sulphuret of silver called Stephanite or Brittle Silver Ore, sometimes occurs, but is rare; and the Silver Glance is often mistaken for it, even by those who should know better. The Stephanite is easily distinguished by the fact that it is brittle, and for this reason cannot be cut by the knife like the Silver Glance, but breaks off. Another thing is, the great purity of the Comstock ore from arsenic, antimony, lead, and zinc has permitted the use of the simple pan-amalgamation process by quicksilver for the reduction of their gold and silver, which could not be the case if any considerable amount of antimony were present in them.

The second kind of ore is the yellow sulphuret. It is the common bisulphuret of iron or iron pyrites, and is of a whitish to yellowish color and shining. It is sometimes called "fools'" gold, because novices mistake it for that metal. It is often associated with a little copper pyrite—the sulphuret of copper, which is still more yellow, and similarly shining. Bnt the iron pyrites, although it must not be confounded with the gold itself, still is the ore which principally contains the gold of the Comstock, and, indeed, it may be said here that this is the same ore that contains nearly all the gold of the earth. The precious metal, however, is usually invisible in the pyrites.

The third kind of ore is the Chloride of Silver. It is white and light green, and is composed of silver and gas chlorine. It is very rich in silver, but contains little gold with it. Where it occurs compact, it is called Horn Silver, because it can be cut like horn or lead.

Besides these three principal kinds of ore, there sometimes occur minute bits or crystals of ruby silver ore (a compound of silver or sulphur with arsenic or antimony), and in the rich places small quantities of free gold and native silver occur; but these are exceptions, and not the rule.

The gangue or matrix which holds the ores in the Comstock vein is *quartz*, with often considerable chalky carbonate of lime and sulphate of lime or "gypsum." Although the quartz often occurs crystallized in fine hexagonal or six-sided prisms and pyramids, and some pretty specimens of fibrous and crystallized gypsum are sometimes found, the *ore* of the lode is remarkably free from crystallization.

Mt. Davidson and the other hills in all directions are dotted here and there with mound-like heaps of rocks of a light grayish tint, which mark the places where prospecting shafts or pits have been "sunk," or dug out. These are merely circular holes, generally about 10 feet in diameter and 50 to 80 feet in depth, and are untimbered.

Owing to the false dip to the westward of the eastern half of the vein, as shown in Fig. 1, the dip of the entire vein was originally supposed to be westward, that is, that it would cut through the center of the mountain, and this supposition was acted on, although it was clearly to be seen that there was another line of outcrop (*b* in Fig. 1) some hundred feet above and to the west of the line of outcrop *a*. But when in sinking, the west or footwall was reached, and the shaft sunk still deeper it was found that the hard sienite, of which Mt. Davidson consists, was encountered; and that in running a level or drift through this intensely hard rock, westward to *c*, where the vein if it dipped westward, should have been found, no vein was there; but that, in running a tunnel or drift eastward to *d*, the vein was discovered. Hence further exploration by the original shafts was abandoned, not only on account of the fact that every succeeding 100 feet downwards the vein would be at a rapidly increasing distance from the shaft, but also because of the very great cost and hard labor that was required in traversing such exceedingly hard rock.

New shafts, like that shown in Fig. 4, were commenced by nearly all the companies on the lode, about 1,000 feet east of their original ones, and on the site of the new shafts new hoisting works were forthwith erected. These shafts vary considerably in depth, owing to the difference of level of the surface from which they are begun. They are sunk vertically, and usually go down through and under the vein. They are commonly sunk 50 to 100 feet further, when, as a rule, an "incline" or inclined shaft is begun in the footwall —upward, to connect with the vertical or "downright" shaft, and downward, about 150 to 175 feet, which is the equivalent on the dip or incline for 100 feet vertically downwards. From this point in the incline, a tunnel or "drift" is run eastward to the vein to find it, and through its cross section or thickness to explore it. When the eastern clay, before spoken of which bounds the vein, is traversed, the miners return to the point of the drift, which is immediately to the west of the vein and in the footwall, and from there they commence a north and south drift, which is either entirely in the footwall, or else half its section in the footwall and half in the vein; and this is driven both ways, northward and southward, to the extremities of the claim of the particular company. This drift, in case it is driven in the footwall, is said to be "in the firm" or "in the solid," because it is in firm or solid ground. At several points along this drift, say at every hundred feet, cross drifts are driven eastward to explore the vein. From the north extremity of the main drift north, and also from the south extremity of the main drift south, the miners begin to pick and blast out ore, and they work in the vein towards the incline, up which the ore is sent to the downright shaft, through which it is hoisted to the surface. The men timber after taking out the ore, and other men follow behind them and above them, and standing on timbers take out the ore higher up, letting it fall down to the drift below, where it is carried to the surface as before. So again another set of men follow these, but still higher up, and so on, till the entire depth of a hundred feet of ore, from the main drift up to the level of the bottom of the downright shaft, has been removed and hoisted. Meanwhile the incline has been carried down by other men a hundred feet deeper, and the same process repeated at that level.

The foregoing is a very general view of the mining operations below ground—the most that can be presented in this one article. But a particular and clear view will be given of each and every part and detail of the work, above and below ground, in succeeding articles, so that a far better and more thorough knowledge of the entire subject will be secured by our readers than if they were to merely go upon the ground and visit the mines, and see what little they could for themselves; for even those who have been in the mines on a visit have a very meagre idea of how they are worked. They know they have been underground, through an intricate series of passages, and travelling along some ladders, and on a car or "giraffe;" that they have seen picks, and drills, and shovels, but they rarely retain anything but an exceedingly confused notion of these, together with a remembrance of great heat, half-clothed men, hard work, rock, candles and cars.

NOTE.—The first quartz claim on the Comstock Lode was located on the 22d of February, 1858, by one James Finney, who was nicknamed "Old Virginia," the croppings being called the "Virginia Croppings," and it was from him that Virginia City took its name. The first discovery of rich silver ore on the lode, however, was not made till June, 1859, when two Irishmen—O'Reilly and McLaughlin—found a rich vein of black sulphuret of silver on the ground of the present Ophir Company. This ground being owned at the time by Kirby and others—placer miners in Six Mile Canyon below the Ophir works—one Comstock was sent to purchase it from them, and the entire lode has since been called the "Comstock."

It is to the discovery and development of this gigantic lode that the great impulse to quartz or vein mining in the West was originally due. The wonderful richness of that vein at once attracted immigration of miners from all quarters, and much attention from scientific men—among them notably the learned Baron Richthofen. Claims were quickly taken along the lode in lengths of 50 to 1,200 feet, until a total distance of about two and a half miles had been located, which has now been greatly added to in both directions—north and south. The yield of gold and silver from the Ophir and other mines soon became enormous, more especially after the crude methods and instruments of mining had been replaced by a better system, as well as suitable and powerful machinery.

The following table presents the annual and total yield of bullion from the entire lode since its discovery:

Year.	*Yield.*
1859 to end of 1865, estimated,	$80,000,000
1866	11,732,100
1867	13,626,062
1868	8,499,769
1869	7,528,607
1870	8,321,528
1871	11,053,320
1872	11,897.612
1873	21,544,727
1874	22,400,783
1875	26,000,000
1876 estimated	35,000,000
Total yield to end of 1876	$257,604,508

Of this the Belcher Mine alone produced bullion from June 1st, 1871, to December 3d, 1874, to the amount of $16,772,965.

Taken as a whole, the Comstock has proved itself the most valuable silver and gold bearing lode in the world.

—*Albert P. Schock, E. M., in Scientific American.*

THE SUTRO TUNNEL.

IT is just twenty years since the Comstock lode was discovered in what was then a portion of the Territory of Utah. It was, as far as I am informed, the first discovery of a real silver mine within the borders of the United States, and, strange to say, it has proved to be not only one of the most valuable that has been found in the United States, but, in all probability, it will prove the most productive deposit of the precious metals of any known in the world. The yield thus far amounts to about four hundred millions of dollars in bullion; and at least an equal amount in low grade ores has actually been developed, but which ores, as I shall hereafter explain, have thus far not been extracted.

Strange as it appears, that the first silver lode discovered in the great West should have proved to be the most productive, it is equally strange that the first ore extracted from it should have been the richest. The first forty tons of ore taken from the Ophir mine on the Comstock lode were packed on mules and sent across the Sierrra Nevadas to San Francisco, and yielded $160,000, or an average of $4,000 per ton; and no body of ore approaching this in value per ton has since been found. You may readily imagine that the discovery of a mine containing ore yielding $4,000 per ton created an intense excitement among the enterprising men of California.

Extent of the Mining regions.—This discovery marks a new era in the tide of Western immigration, when men whose westward progress had been stopped by the Pacific Ocean commenced to retrace their steps eastwardly, overspreading the vast area of country lying between the eastern base of the Rocky mountains and the western base of the Sierra Nevadas. Here was a field well suited to the restless, adventurous spirit of the Western prospector; and so this immense stretch of country, embracing almost a million square miles, has within the last twenty years been traversed and prospected in every direction; and almost numberless mining camps have been established where not a mine was worked or even known at the time of the discovery of the Comstock lode, although several hundred thousand people, prior to that time, when on their way to California, had, to some extent, prospected this identical territory. Gold, silver, and also the useful metals seem to occur almost everywhere in these regions, although not always in paying quantities.

These explorations have disclosed what may be considered an unexplained fact, that the summit of the Sierra Nevada Mountains forms the dividing line of what may be termed the pure gold ores; that is to say, the pure gold ores are almost uniformly found west of the Sierra Nevadas, while silver ore in all varieties, though occasionally associated with more or less gold, is found to the eastward.

Backbone of America.—It appears that the backbone of the American continent, stretching from Cape Horn to the icy regions of the north, forms the great mineral store-house of the globe; and that portion lying within the boundaries of the United States constitutes one of the most important interests of this country. This interest should be fostered and developed; and permit me to say to you that your club, which has been properly styled the Bullion Club, will form an important factor in the development of this great source of wealth, by disseminating information, and by bringing together representative men from every section.

In this connection, I intended to have made some remarks upon the influence which the increased production of the precious metals and a bi-metallic currency have upon the prosperity of the commercial world; but I leave this subject to the abler hands of Judge Kelley, of Pennsylvania, who will, as I am informed, shortly address your club upon that subject. Permit me now, after these general remarks, to turn to the Comstock mines and the Sutro Tunnel.

The Comstock Lode.—The Comstock lode appears on the surface of a range of hills called the Washoe Mountains, lying to the east of the Sierra Nevadas, and running parallel therewith. The Comstock lode occurs mainly at the contact of two kinds of rock, and is, therefore, in fact, to a large extent, a contact vein, though in other parts, as at the north and south ends, it is surrounded by the same kind of country rock. The central portion of this mountain range is formed by Mount Davidson—a mountain rising to the height of something like 7,800 feet—and which consists of syenite; this is probably the oldest formation in that neighborhood. Immediately east, and, in fact, also west of the syenite of Mount Davidson, we find greenstone or porphyry, of which great varieties exist, which for convenience are called by the family name of propylite. Still farther east, we find the trachytic mountain range. There have been various theories advanced as to the origin of that lode, but there can be hardly a doubt that it is a true fissure vein. All the evidence tends to show that such is the fact.

Formation of the Fissure.—According to Baron von Richthofen (who is probably one of the ablest geologists now living, and who has made a careful examination of the Comstock section of country, spending nearly two years there), the syenite is the oldest formation, the propylite or greenstone coming next in order, while the trachyte is the outburst which appeared at the latest geological period. If we examine the locality, we find, as already indicated, that the Comstock lode occurs mainly between the syenite and the propylite. The probability is, that when the trachyte made its appearance, the upheaval was so great that it uplifted a large portion of the greenstone. The effect of this upheaval was that a fissure was formed at the plane of least resistance—that is, at the point of contact between the two rocks; large masses of country rock from the hanging-wall falling into the fissure, forming what we now call "horses," were the cause of keeping the fissure open. Had it not been for the fact of these masses falling into the fissure, it would, in all probability, have closed up again. But in this manner there was left an open channel down to an indefinite depth, which gradually became filled, probably by means of thermal agencies, or possibly by volatilization, according to the different theories which scientific men accept. These masses or horses must necessarily have fallen into the fissure from above; and, as a proof, we have the fact that in the Comstock lode every "horse" consists of greenstone, that being the upper rock; the syenite being at the bottom, none of it could have fallen into the lode. The open spaces thus left in the fissures were gradually filled, and the horses became surrounded by quartz and minerals, mainly silver ores, carrying more or less gold, which are sometimes accompanied by the base metals. I listened with great attention to the lecture which Professor Newberry delivered in this room last Thursday, in which he expressed the opinion that the particular fissure which he was describing had been filled in with ore by the process of deposits from thermal waters. It seems to be hardly probable that the Comstock lode was entirely filled in that way. It is probable that different processes were at work at different periods; and it is very likely that a portion of the vein matter which now fills that lode entered it by the process of volatilization.

Volatilization.—It seems difficult to imagine silver or gold in a gaseous form; but if you consider for a moment, it does not appear so strange. We know that all the substances of the entire globe exist in one of three forms: solid, liquid or gaseous; while some substances are familiar to us in all three forms.

Take water, for instance: we know it as a solid when it is ice; we know it as a liquid ordinarily; and we know it as a gas in the form of vapor. We know all of the metals in two of these forms, as solids, and as liquids when molten. We know some of the metals in all three of the forms. In fact, in our laboratories, we can convert many solids into liquids by melting, and even into gases by volatilization. Now if we imagine the great laboratory of natuie down in the bowels of the earth, where all the agencies probably exist which are necessary for reducing these various minerals to a gaseous state, the filling of fissure-veins with metals does not appear so difficult of explanation. We must try to realize the fact that in the laboratory of nature there may exist a pressure of millions of millions of pounds to the square inch, and that the steam which is there generated may be heated to white heat; that is, hot enough to melt iron or any other substance. If we imagine such a heat as that, we can readily perceive how any substance might be volatilized; and if to these two forces certain chemical agents are added, the transformation will seem still more probable. I doubt that a vein the size of the Comstock lode would ever have entirely been filled by deposits from water.

Downward Continuance.—These theories may be correct or not, but we do absolutely know that we here have a vein which lies between Mount Davidson, the syenitic mountain, and the propylite adjoining it, extending for a distance of four miles, and reaching downward as far as the miners have gone, and in all probability farther than mechanical means will ever permit man to go. There are obstacles in the way which will prevent an exploration to an indefinite depth. As far as the lode itself is concerned, we find that it retains its general characteristics at various depths; that it varies in width from fifty to one hundred and fifty feet; that it consists of solid quartz, interspersed with particles of ore; but that in many portions it is not sufficiently rich in ore to pay largely for extracting. It seems that the ore in the Comstock lode often occurs in the form of pockets, or channels, or chimneys, or, as we call them when we find a great body, "bonanzas." It is strange that, in the vein itself, a bonanza hardly ever occurs.

Bonanzas.—The lode descends on an incline eastwardly, following the dip of Mount Davidson; in places the pitch is greater than at others, but the average is about 45 degrees. The ore-bodies seem to occur outside and to the east of the vein; they are generally of a lenticular form. It frequently happens that, in sinking a shaft or in running a drift, no ore at all is found; a drift may run right over or under it: while the very next drift may show an ore body of great width. This accounts for the great fluctuations which have taken place in the stocks of the mining companies on the Comstock lode. People who are not familiar with the situation do not understand the reason for such fluctuations; but what I have stated will explain one of the causes. These ore bodies are not confined to any particular spot. The country to the east of the Comstock lode may contain ore bodies to an almost indefinite extent. If we imagine, which I firmly believe, that the Comstock lode continues downward for miles, then it is possible that these ore-bodies may make their appearance at comparatively lesser depths, several thousand feet to the eastward of the present workings. The disposition of these ore-bodies is not governed by any rule. It seems to be entirely arbitrary. We do not know where they are until we stumble upon them. The only way to look for them is to run drifts all through the country, and then to cross cut from these every one hundred or two hundred feet. Some men say that the Comstock lode is working out. That is nonsense. Several deposits have been found which were of such immense value as to astonish everybody; but these bonanzas were limited in number—probably not over a dozen altogether; and they were always found in the manner I have described.

Sinking Shafts.—They first commenced the working of these mines by endeavoring to sink a shaft, on an incline, down into the lode itself. It was soon found that this was a poor way of mining. It was considered necessary to start shafts farther to the east. Accordingly, shafts were started which would cut the lode at a depth of seven or eight hundred feet; but they found that these shafts at that depth struck the rock of Mount Davidson, and, owing to the meagre facilities which they then had for boring, they were obliged to give that up. They found it more profitable to start still other shafts farther east; and wheu these reached Mount Davidson rock, they were continued by inclines; lately, still other shafts were started so far east that they will not reach the lode until they have gone down to a depth of 3,000 feet; one of these shafts has lately been started on a gigantic scale, and so far east that it will not strike the west wall until it gets down to a depth of 4,000 feet. People look upon that as being rather an extreme undertaking, because the shaft will be so far away from the lode that they will have to drift, after it reaches a depth of 3,000 feet, still over 1,000 feet to get to the lode. So you see that it is not always advantageous to start a shaft so far away from the point designed to be reached.

Strength of Cables.—During the past twenty years enormous sums have been spent on these mines. Probably, in no mines of the world that have been worked, has there been such a lavish expenditure for machinery, in order to secure every facility for the successful working of the mines. Such an expenditure was necessary. The work could not have been performed otherwise. The result has been that the mines have been more rapidly developed than any other mines ever worked. Of course, the difficulties in mining increase as we go down. In the first place, after you get down below 2,000 feet, the steel cables have to be made of such a size (in order to sustain their own weight), that it becomes a very serious question whether they can be used in one length to much greater depth. This is a subject which has been discussed very fully in England and in Belgium; and the engineers there have come to the conclusion that it is not practicable to hoist with them after you get down over 2,500 feet; but the people on the Comstock lode say that they can go down over 3,000 feet and still use them. It is a question simply of the strength of material. These cables are made of fine steel wires woven together. There certainly must be a limit to their capacity, even if they are made tapering. If the cable is long enough, it will certainly break of its own weight, and without the attachment to it of any additional weight On the Comstock lode I do not think that this will cause any very great practical difficulty for several years to come; and before that difficulty does arise a new basis for hoisting work will have been utilized at the level of Sutro Tunnel, where they can start afresh.

Water and Temperature.—Another difficulty, and one of the greatest obstacles encountered in the working of these mines, is the presence of water, which is found in great quantities—and hot water at that. Gentlemen have different ideas about this water, and how it gets so hot. I have, from my own observation, formed my own ideas about it. I do not think, as is contended by many, that this water is heated by chemical decomposition. My theory is, that the water from rains and the melting snow upon the Sierra Nevada Mountains rapidly descends through the fissures of the crystalline rocks (and as they generally incline at a sharp angle, the water descends very rapidly), until it reaches a depth of several miles. We know (although by some it has been disputed) that the increase in heat is about one degree of Fahrenheit to every sixty feet of descent. I think that this has been demonstrated all over the world. Of course, there are instances where this is not the case; but those are the exceptions. On the Comstock lode this rule does not strictly apply, because the heat increases much faster as you descend. There, at the depth of 1,400 or 1,500 feet the mercury rises to 110°; and at 2,500 feet, the temperature of the rock is as high as 130°; and at 2,800 or 3,000 feet, it is as high as 150°. I have observed this matter for many years, and have looked into it pretty closely, and my idea is, that this water descends from the Sierra Nevada Mountains to a depth of 10,000 to 15,000 feet; that it is there converted into steam, and finally into superheated steam. Of course, there is then exercised an upward pressure which does not permit any more water to descend, because the pressure of the descending water is counterbalanced by the pressure of the superheated steam. I recollect that I had, a few years ago, a controversy with Professor Sterry Hunt (probably the best informed man on this subject in the United States) and some other gentlemen; and his idea was, that if there was so great a pressure down there, the steam would thereby be again converted into a liquid. But I do not think that bears upon my theory at all; because if the steam is reconverted into a liquid by the immense pressure, it would become steam again upon lessening or removing the pressure. If, therefore, the water descends until it becomes heated to a boiling point, it may then ascend, either because of capillary attraction or of pressure; and as it finds its way upward through the crevices of the rocks, it necessarily heats the rocks by the contact. And here it is where mistaken ideas come in; the rock does not heat the water at these higher points, but the water heats the rock. It seems to me quite evident that, as the water permeates all the cracks and fissures of the rock, the rock itself thus becomes heated. Of course the water loses some of its heat in its ascent. If we could go down 3,000 feet deeper than we are now, we should find boiling water. It is now 165° in some places.

At Steamboat, and in that immediate neighborhood, we find springs that are emitting great quantities of boiling water. On a direct line, these boiling springs are not over six or seven miles from the Comstock lode, and it is quite possible that these may be connected directly with that lode. The only difference between the hot water at the Comstock lode and that at the boiling springs is, that the water at Steamboat is somewhat sulphurous. Otherwise they are very much alike. That difference might be caused by the water passing over rocks containing sulphur.

Limit to Mining.—Accordingly, the limit of mining on the Comstock lode will be reached when the mines get to a depth where it is so hot that human beings can not exist any longer. Some think that said point will be reached very soon, considering the rapidity with which the mines are worked. The fact is, that now, already, where the men are working in the lower levels, it seems almost impossible for a human being to exist. The men could not work in such a heat but for the fact that in the particular locality where they are swinging their picks a stream of compressed air, or cool air from a blower, is directed upon them; but as they go to and from that particular locality, they have to pass through places which are intensely heated, and in which they could not exist for any length of time. By means of such appliances, using very large blowers and powerful compressing machinery, I have no doubt that the men could work these mines even where they contain boiling hot water. If you show the people a big bonanza, they will devise some way of getting out the ore. The only trouble is, that at this great depth it takes so much longer to explore the mines that people get impatient. Where it formerly took only three months to explore a new level, it now takes six, nine, or twelve months. I believe that the Comstock lode can be successfully worked for thirty, forty, or fifty years to come below its present depth; and there is work enough above it to last for a hundred years to come.

Mining Tunnels.—After these general remarks about the Comstock lode, I will now proceed to say a few words about the Sutro Tunnel. The idea of running a tunnel into a mountain for mining purposes is nothing new. It has been done ever since mining commenced. In Germany, where mining has been carried on largely, and also in Spain, and even in England, they have used tunnels quite extensively in connection with mining operation. In the Hartz Mountains, a great number of tunnels have been thus constructed. The topography of the country there is such that tunnels can be run to considerable depth, and they have been constructing tunnels for the last eight hundred years. At the end of the last century they constructed a tunnel 6½ miles in length; then, starting at a lower level, they constructed another tunnel, and so on, until finally a tunnel was completed, some twenty years ago, which had a length of fourteen miles, and which reached three hundred feet below the level of the next deepest tunnel. In other parts of Germany and in Hungary we find the same thing.

The Sutro Tunnel.—Fourteen or fifteen years ago, I proposed to run a tunnel into the Comstock lode, a distance of four miles. The people thought that it was an immense undertaking. Those who are interested in the mines would never have consented to contribute to such a work, for their interest is only of a temporary character; they calculate their profits from day to day, in the attempt to make a stock speculation. All such people care for is to make a "turn" in the stock, to sell at a high rate, and then they back the stock at a lower rate. In other words, the men owning shares in the mines were unwilling to give any portion of their earnings for the construction of a work which would not benefit them immediately; it troubled them but little what would become of the mines after some years. Their method of mining was a regular "grab" game. They looked for big bonanzas; they left the poor ore untouched and seemed unwilling to make any provision for the future which would enable them to work the lower grade of ore profitably. I did not, at that time, know much about these tunnels in Europe, but I saw that the construction of a tunnel to the Comstock lode was a common-sense proposition. I saw that it would be an immense benefit to run a tunnel reaching the mines at a depth of 1,700 feet. Many other people began to think so, too; they were finally convinced that it would be a good thing; but, instead of lending their aid and influence, and spending their money in the construction of the tunnel, they spent their money in fighting it. They spent more money in fighting the tunnel than we spent in constructing it; and they were beaten in the end. It was a question of millions. The object was to get possession of the work for themselves. They were determined to oust us. Finally, they found that they could not continue the opposition any longer, and that it would be impossible to work the mines without the assistance of a tunnel; and so at last we came to an understanding all around. We commenced, last spring, to negotiate the terms of a new agreement. They were pretty stiff-necked about it, and so were we. We thought, as they had held back so long, and as they had to have the aid of our tunnel finally, that we were entitled to make fair and equitable terms. And thus it took about three months to negotiate an arrangement. At last we came to an understanding, which is looked upon as being a fair arrangement for all parties concerned. Under that the agreement which we had originally entered into with the mining companies was modified. Under the original agreement we had contracted not only to run a tunnel to the Comstock lode, a distance of four miles, but we were also to construct a tunnel along the Comstock tunnel for three or four miles more. A part of the settlement is, that we agreed to reduce our royalty on all ores yielding under forty dollars per ton, from two dollars to one dollar per ton, while all ores yielding above forty dollars still pay two dollars. They, on their part, agree to pay for these lateral tunnels in the form of a loan; but it is really no loan at all, for we pay no interest upon it, and it is not repayable except by deducting half the royalties that we earn. So, if a mine finds no ore, we are never to repay it. It is therefore, not in the form of a debt. We are now engaged in constructing these lateral branches, and the mining companies pay us from $20,000 to $40,000 on the fifth day of every month, which fully pays for the work. We have, also, already commenced earning some royalty, though not a great deal as yet. We probably receive from $7,000 to $8,000 per month from that source; and as soon as the lateral tunnels are extended past each mine it commences to pay, and our royalties, therefore, will increase gradually. The production of the Comstock lode, at the present time, is very limited. The fact is, that during these pending difficulties they could not prospect their mines, and for three years they had hardly been doing anything. Since we have constructed the tunnel, and commenced carrying off the water which obstructed them, they have again begun to prepare for prospecting the mines. These preparations have occupied many months; they are now just about ready for a start; and I think that by the end of the year they will be able to prospect a number of the mines, and especially those that they call the water mines, such as the Savage and Hale & Norcross. From that time they will go right on prospecting and opening up the mines.

Difficulties in Tunneling.—In the construction of this tunnel we had a severe struggle to get along. On the one hand, we had these people opposing us, and on the other hand we encountered the difficulty of raising money sufficient to carry on the work, and that was about the "toughest job" of all. But still we succeeded. There were some gentlemen who took broad views of the matter, and partly through their influence and aid the money was forthcoming, and since then we got along reasonably well.

In one way and another we encountered many difficulties doing the work. We had to work our way inch by inch through solid rock. In these tunneling operations, we have first to drill a dozen or twenty holes, charge them with giant-powder. explode the blast, then wait for the smoke of the powder to disappear before we can commence loading the debris on the cars for removal. Under the circumstances, one can not get ahead very fast; but altogether we made quite as rapid progress as has ever been made in any similar undertaking. In fact, our progress was more rapid than was the construction of the Hoosac, the Mont Cenis, the St. Gothard, or any other tunnel.

A Chapter on Mules.—Up to the present time all the transportation has been done by means of mules. We found it more convenient to use mules than to use steam, because, under ground, steam is fatal to life. We are now preparing to use compressed air motors, built on the same plan as those in use on Second avenue in New York. We have now two motors building in England. We have been using mules for years, and have found that they are tolerably good animals; but there is a prejudice against mules, though they are very intelligent. I think that I could write a chapter on their traits, as I have had a very extensive experience with them. It has been said that they have a strong propensity for kicking, but I have never seen them kick when in the tunnel. They become very tame under ground; in fact, they become the miners' pets. The men become quite attached to them; and as the shift-mules pass along by the men at lunch, they will often receive from one a piece of pie, and from another a cup of coffee, etc. When a signal is given to fire a blast, the mules understand the signal, and will try to get out of the way of it just as the men do. Of course, under ground is very dark, and the mules become so accustomed to the darkness that even when they go out into the sunlight they cannot see very well, and when they go back from the sunlight into the mine, they cannot see at all. So we are in the habit of covering one eye with a piece of cloth whenever they go out, and keep the covering over the eye until they go into the tunnel again; we then remove the cloth, so they have one good eye to see with. We had to adopt this plan for preserving their sight, because the mule is so stubborn that he will not pull unless he can see his way ahead. We have found out another thing about mules. We tried horses at first, but we found that whenever anything touched the ears of a horse, he would throw up his head and break his skull against the overhanging rock; but if you touch a mule's ears he drops his head. For that reason we could not use horses; we employed mules, and they have answered very well.

Obstacles to Progress.—In carrying on a work of this kind, we meet all sorts of difficulties. Now and then we would get indications of water. The men would put in a blast, and the water would pour out in a perfect torrent, and the men would have, at times, to quit temporarily to escape it, and wait until the water had subsided sufficiently, so that they could go to drilling again. Every now and then we would come to a clay, that would swell and cave so as to reduce our progress of 150 feet (and afterward with improved machinery of 300 feet) per month to less than 50 feet per month. Sometimes we could not keep the roof up. As soon as we could get started a little way in our work of excavation, the rock would yield, and hundreds of feet would come pressing down on the timbers with such force that it was almost impossible to resist it. The worst ground that we came to was the swelling ground. This is sometimes clay, and sometimes it is rock. The moment you dig into it, it swells out; and no matter what size of timbers you use, it will snap them off as if they were but matches. Nothing will resist it. You must let it swell. In one place the swelling was so great that the track swelled up a foot or two seven different times, and each time we had to cut it down. The timbers used are a post and a cap. The pressure on this cap would be so great that the post would be pressed through the cap in twenty-four hours—just as though the cap were a piece of cheese. The only way to keep the timbers from breaking, in such ground, was to employ men to ease up the ground behind the timbers. That is to say, they would take away the rock or clay from behind the posts from time to time, until, after a year or so, the ground settles down to its natural state and does not swell any longer. We have very little trouble of that sort now; but I suppose we shall encounter it every now and then as we go on with the lateral tunnels.

Bad Air.—The greatest obstacle encountered by us was the heat and the poor air. Our last opening to the surface was at shaft No. 2, about 9,000 feet from the tunnel entrance. From there we had to go to the Comstock lode, a distance of 11,000 feet, without any natural air connection. After we got into a distance of 17,000 feet from the mouth of the tunnel, the heat became so intense and the air so bad that it was almost impossible to keep the air sufficiently cool and pure to sustain life. There was not oxygen enough in the air to make our candles burn. Although we blew in air by means of blowers and air-compressors, still at times there was not sufficient air to enable the men to work. In the place where the men were at work we could generally manage to keep the air sufficiently pure; but at some distance back from the face of the tunnel the air was so bad that one could hardly exist. In fact, in going through these portions of the tunnel, the men would often give out; and as for the mules, we could not get them there at all. A mule would make straight for the air pipe, and you could not get him away. We had one mule that would not go away from the air pipe at all. They beat him, but it was of no use. He had to be carried out, and that mule escaped. He never went into the tunnel again. A shift mule would always want to go to where the stream of air was rushing in, and he would monopolize it all to himself. He would never leave it, but would stand there, and as he bobbed his head up and down past the pipe, you would hear the air whistling by him.

Accidents.—We had some sad accidents happen. These air pipes are made of galvanized iron, and the leakage is prevented by wrapping the joints with canvas which is covered with tar or with white lead. I recollect that one day after a blast had been fired, one Garnett, the man whose duty is was to keep these joints wrapped, went forward (he was nearly fainting) to the end of the air pipe near the face of the tunnel; but before he got there, he fell down in a swoon. When the blaster went forward to examine the blast which had just been made, he found that two of the holes had not gone off, and so he reconnected them and fired the blast while this poor man was lying on the ground. It did not kill him, although he was riddled with rocks. He had about a hundred large and small pieces of rock in him, one being in the back of his head. I thought that he could not live for ten minutes; but he is alive now and as well as ever. The most curious part of it is that for a long time previous this man had been in ill health, and that application of rocks cured him. He has told me often since "that confounded thing cured me." It was rather a severe cure, but it was effectual.

As we approached shaft No. 2, 900 feet from the tunnel entrance, which had been abandoned some time previous, because it had filled by a great influx of water to the depth of about 900 feet; we bored a diamond drill-hole into it, and the pressure of that column of water, 900 feet high, was so great that it threw out the drill-rod and cast it a distance of several hundred feet, although the rod weighed several hundred pounds.

Caves.—Not long ago some timbers broke down, and the report came to me that a man had been killed. We found, however, that he was not injured, but that he had been caved on and could not get out. I started in with the doctor to see how he was getting on, We found that all the work had stopped, and that the man, who had been working in the ditch which we were then constructing in the floor of the tunnel for the purpose of carrying off the hot water, had been caved on and become surrounded by a lot of loose, fine gravel, up to his chest, and that the water running in around this gravel had packed it so tightly that the man could not move. We had to get him out in some way, and so three or four men (which were as many as could get into the confined space) got down alongside of him and tried to dig him out; but as fast as they would, the gravel would cave in again. When I reached the place the man had been fast for three or four hours. The miners had built dams above in the tunnel to stop the water from flowing down; for if the water had been permitted to come down, it would soon have risen to his mouth, and would have drowned him. He was so fast that he could only move the upper part of his body a little. I urged the men to work away with all their might at the dam to keep the water back; but after awhile they reported that it was of no use, that the water was rising above the dam. We did not want to see the man killed, and used every effort to rescue him. I told the men to pass a rope under his legs, and try to pull him out. We thought we had better pull him out, even if it did injure him somewhat, rather than let him drown; but as soon as we began to pull, he commenced to cry out, so that we had to give that plan up. Then the men dug again for awhile, until the foreman came and said that if we did not get him out within ten minutes, the water would be down in such volume as to drown him. Then the men worked again with the rope for dear life; at last they got one leg out, then they gave another jerk, and brought the man out.

Hospital.—As I have remarked, we employ a surgeon. There were many accidents although we had less than there were in other works. In the Hoosac tunnel, 185 men were killed in the construction of the work. In our tunnel, but 12 men were killed, and I do not think that of the 12, more than three or four were killed by anything actually happening in the tunnel itself. I told our men several years ago, that every man employed by the company must pay three dollars per month toward a hospital fund; that the company could not afford to give the men all the attention that they ought to receive in case of accident. The men remonstrated a good deal against this; they did not wish to spend their money in that way; each one thought that no accidents would happen to himself; but I made this payment compulsory, and after awhile the men became reconciled to it.

We employed a physician and opened a drug store. If a man was injured he received every attention. He had the care of nurses, physicians and medicine. But these miners are all members of an association, the Miners' Union, which does not permit of any man to work a shift of eight hours under four dollars per day. All the mine managers have agreed to yield to their wishes, and I think a man working in these hot places well earns his four dollars. But sometimes the union will interfere with us where they should not. They sent a deputation to me not long ago, to say that we were not paying four dollars per day. I said that we were. They said that we deducted three dollars per month for the hospital, and that therefore the men only received one hundred and twenty-seven dollars per month, which was not four dollars per day. I replied that that was for the benefit of the men themselves; that it was a work of benevolence; that I had inaugurated it solely for the benefit of the men. They insisted that the men should not be compelled to pay anything to that fund; and as we had to complete a certain amount of work at a given time, and could not afford to get into any trouble with the men, we had to yield in this matter.

Starting a Graveyard.—One labors under all sorts of difficulties in dealing with the men. It seems ridiculous; but the most difficult thing we had to do was to start a graveyard. It took some three years to start it. Whenever a man got killed or died, the men would get up a big funeral, and go off to Virginia City or some other place and bury the man. All work had to be stopped for one or two shifts. They would each lose their \$4.00 for wages; would pay \$300 or \$400 more for teams; and some would drink so freely as to be unfit for work the following day. I was determined to put a stop to that. So said I to the men: "Why cannot we have a grave-yard of our own and bury our men here?" I had a grave dug for the next man that died. The dead man's friends came and said they would not have the man buried there. I asked them why? They said that "it would be too lonely for the poor fellow." That seems ridiculous, but it is a fact. I did not wish to have any trouble over the matter, and so I let them bury the man where they chose. Every time a man died we had just the same trouble again. At last two miners got killed who had not paid their fees to the Miners' Union, and had been discarded. They had no friends there to object, and so we buried them there, and thus were able at last to start our own graveyard.

Advantages of the Sutro Tunnel.—But, gentlemen, I fear that I am detaining you too long with these outside matters, and will now begin to speak about the advantages of the Sutro Tunnel itself. The first great advantage of the Sutro Tunnel is, that it creates a new base of operations. We open a new surface for mining operations—a surface which is in fact a better surface than the original one. We are down 1,700 feet from the surface, and can introduce hundreds of millions. The Comstock lode has already yielded something like \$400,000,000, and there is in it an enormous quantity of low grade ore which has not been taken out.

Drainage.—The next important advantage secured by the tunnel is that we carry off the water. Instead of pumping this immense body of water to the surface, it is pumped into our tunnel, which saves 1,640 feet of pumping. When I last left the work there were running out about 12,000 tons of water every twenty-four hours. To lift this water to the surface, estimating it at a very low rate—indeed, at much less than it actually costs, say at 25 cents per ton, it would cost \$3,000 per day to pump it out to the surface. In order to carry off this volume of water (and we agreed to take the water within ninety days from the time we made the settlement with the mining companies), we had to provide the means. Some of this water has a temperature of 165°; some has a lower temperature; where it is all mixed together it is about 130° or 135°. If we were to let this water flow through this open tunnel, a distance of four miles, the heat would be so great that we could use the tunnel for no other purpose; the steam would suffocate the men. We were therefore compelled to construct a drain, and to place a wooden box in this drain. We had quite a controversy over the way this drain should be effected. Every man had his own ideas as to the best way; each engineer thought that he knew all about it. I contended that if we were to construct

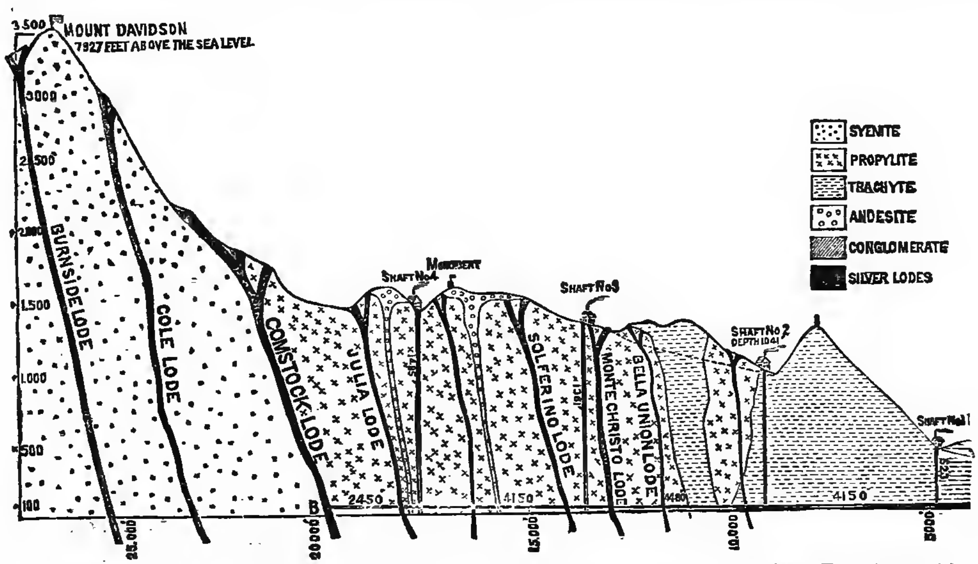


FIG. 8.—THE SUTAO TUNNEL. Geological cross-section of the country from the entrance of the Sutro Tuunel to and beyond the Comstock Lode; also the four shafts on the tunnel line.

water through the shafts, and thus get a fall of 1,700 feet; or we can take the water which exists at some point between the surface and the tunnel and let it flow down to run the machinery which is placed at the tunnel level. We thus could get an abundant water-power. A very small stream of water with a pressure of 1,700 feet will give an immense power. The time will come in the working of these mines when they will economize all of the water. In fact, the water which is brought in pipes from the Sierra Nevada Mountains can be most profitably used for that purpose; and the time will come when it will be so used extensively. You can readily perceive that a new surface at that point adds just as much to the working possibility of the Comstock lode.

The lode extends down indefinitely, and the ore bodies recur at different places; we cannot tell exactly how or where, because the distribution seems not to be governed by any known law. The tunnel adds to the working possibility of that lode certainly 1,640 feet, which is the level at the point where the Savage shaft is intercepted by our tunnel, and that shaft is away down the hill. That is, of course, an incalculable advantage; for those 1,640 feet are surely added to the working possibility of the Comstock lode, and ought to be worth to it a great many millions of dollars, perhaps a wooden flume, perfectly tight, of 3 inch yellow pine, we should be able to carry off the water and not radiate much heat from it. Others disputed it. I had machinery built for planing, tonguing, and grooving this yellow pine, and which cut it off, all in the same operation, so that the construction of this box was done at a very reasonable cost. We placed these boxes and joined them together with slips of iron $\frac{1}{4}$ by $1\frac{1}{2}$ inch, which were driven into the end of the boxes, and it made a continuous box so perfectly tight that when the covers (which were also tongued and grooved) were nailed on, and the water was turned in, there was not a leak from one end of the tunnel to the other; and, to the utter astonishment of everybody, the temperature of the tunnel has not been increased materially by the passage of the hot water through it; and the water, which was at 130° on entering the box, after flowing the four miles still has a temperature of 123°, having lost only 7° of heat in the passage. After it gets to the mouth of the tunnel the water is conducted down a shaft in the machine shop, where we have a water wheel placed at the bottom of the shaft 60 feet in depth, from whence the water is carried off by a tunnel, 1,100 feet in length, which serves as a tail race. From this small tunnel the water flows about a mile and a half to the Carson River. This water can now be used for many purposes. The first who utilized it were the boys, who made small ponds to swim in at the lower end of the town. It can be turned to account in heating hot houses. We have a rich soil there, which, if covered over by glass, will produce early vegetables and fruit at very little cost. We use the water first for power and then for irrigation.

Farming.—We have quite a farm belonging to the company, which will become very profitable indeed. The company owns over five thousand acres of land. The soil is very fertile, and all that is needed to make it highly productive is water. The water from the Comstock lode is particularly well adapted for irrigation, because it contains in solution sulphate of lime or gypsum, which is of itself a valuable addition to the soil, although that land is now so rich that it does not need any fertilization whatever.

Ventilation.—The tunnel will also be of great advantage for the purpose of ventilation, not so much, however, by the air going four miles directly through the tunnel; for we find that does not answer so well as to use the air in the lateral tunnels by connecting every shaft with the other shafts. By that means we get a draught of air from shaft to shaft that is wonderful. Not long ago we were laboring under a great difficulty in the south header of the tunnel which was not ventilated. In fact, for three months we could not do anything. The men in these heated places are taken with "cramps," as they call it. We really did not know what the difficulty was, until one day a mule died while in there, and I had the surgeon hold a post-mortem examination on it. He found every organ perfectly sound, until he came to his lungs, which were found to be congested with blood. We can carry ventilation down the shafts as deep as they may go; and this fact will make it possible to work the mines at much greater depths than they have yet been worked. The great volume of air going through a shaft causes an evaporation of moisture which covers the sides of the shaft, and in that way lessens the temperature. Up to lately it was so hot in the north header that the men could not do a full day's work; but about two weeks ago we made the connection by a drift with a shaft, and now the air there is delightful, and our men are doing double the work that they did before. This shows how much depends upon a proper system of ventilation. It is worth millions to the mines. When the temperature is so high and the air so impure as it usually is in the mines, the men cannot do much work; in the hottest places it takes six to eight men to do a day's work; a man can only work five minutes at a time, and then he must retire to a cooling station; but if you give the men good cool air, they can do a day's work.

Low Grade Ore.—Another very important thing in connection with our tunnel is the fact that it will make possible the extraction of the enormous body of the low-grade ore in the Comstock lode. As I have already said, $400,000,000 have been extracted from the different bonanzas. People speculate in mining shares to make a fortune, and they want to make it overnight; and in searching for these bonanzas they have passed by the low-grade ores, because they thought they would not pay, or would pay so little as to amount to nothing worth the effort required. By means of our tunnel we can transport the ore to the mouth for one cent per ton per mile, which is as cheaply as the best regulated surface railroad can do a similar work. We can afford to take these ores out and reduce them at the mouth of the tunnel. We have not yet commenced doing this; it has taken so much money for other purposes that we have not been able to do anything yet with the low-grade ores; but the time is coming when we shall be able to utilize them. Suppose that we are able to work 1,000 tons per day, which would not be considered very heavy work on the Comstock lode; that would give at least $2 or $3 per ton profit. They are willing to sell the ore to us at $1 per ton. We have established a scale of prices by which we are to pay $1 per ton for ore which yields under $15 per ton. But rock that yields $15 to the ton will assay a good deal more. Everything that we can get out of it is so much clear gain to the world; for under the old system they can never utilize these low-grade ores. I think there are $300,000,000 or $400,000,000 to be extracted from these ores now in sight in the 200 miles of drifts on the lode—enough to last for a hundred years' steady work.

Cheap Firewood.—There are other sources of revenue that the Sutro Tunnel Company will have. The Carson River, which flows within a mile and a half of the tunnel entrance, has its rise in the Sierra Nevada Mountains. There is wood enough there to last for many years, which can be floated down for less than $5.50 per cord. We can, by contracting therefor, a season in advance, get our wood there for less than $5; it is worth in Virginia City $10 per cord, and they often get $12, and the consumption is 600 cords per day. It will not cost over $1.50 to deliver it at Virginia City. There is also a profit to be made from the sale of timber.

Ice.—There is another article which may be made remunerative, and that is ice, which is used in these mines to an extent which is really marvelous. The quantity of ice water that a man working in the mine will drink would astonish you. You know what you can do in that way when taking a Turkish bath; but they can discount that several times over. They drink it by the gallon. The men will rub ice all over their bodies, and it does not make them feel chilly. They get so heated that the ice feels comfortable to the body. When the surveying engineers go into the mines they have to take with them big sacks of ice to rub their heads and bodies, or else they could do no work. I cannot state the number of tons per day used at the mines; but there is more ice used there than there is in the whole city of San Francisco. It sells there for $20 per ton. Certain parties largely monopolize the ice business there; but some of the mining companies are ready to take ice from us. We can make it for fifty cents per ton. It freezes from six to fifteen inches thick every winter. We shall have a tram road down to the river, propelled by water power, over which we can haul up wood, timber, and ice. That will be a great advantage in connection with the workings of these mines.

Royalty.—I will refer, in conclusion, to the royalty to which we are entitled. Before the settlement made last spring we were entitled to a royalty of $2 per ton for every ton of ore taken from the mines in all future time. Whether it was taken through the tunnel or not, they were to pay us $2 per ton. We, however, partly yielded our rights, and agreed to take $1 per ton for all ore that yields under $40 per ton, and for all ore that yields over $40 the old rate of $2 per ton was retained. As the lateral tunnels progress our revenue will increase. I think that the royalty alone will in the end amount to $100,000 per month.

We have another source of revenue, from the transportation of men and ores. The royalty is received for draining the mines. We receive that without doing any further service. For the transportation of ore and men we will make additional charges. On ore or rock we are entitled to charge 25 cents per ton per mile. Negotiations are now pending for opening some of the mines east of the Comstock, and the people will want to go to work through the tunnel and to take their ore out through it.

Mineral Land Grant.—I think that the most important possession of the Sutro Tunnel is its mineral grant. Under the Act of Congress of 1866, there was given to the Tunnel Company a strip of mineral land 2,000 feet in width on each side of the tunnel, forming the very heart of the Comstock country. The tunnel runs at right angles with the Comstock lode, which it reaches in a distance of four miles. After passing the Comstock lode we may go still three miles farther, through Mount Davidson, and beyond it. As far as this strip of land is concerned, we have discovered and opened several large ledges. We have cut one vein 120 feet thick, and we have just commenced to prospect it. We have run into it on one side—that is to say, we prospect the vein for a width of 4 feet, which is the size of the drift. That does not explore the vein. After we get in a certain distance we propose to cross-cut it at given intervals. We get assays of that ore varying from $2 to $43 per ton. There is no body of it that will assay at that rate; it is only in spots that it will do it. These veins are all of the same nature as the Comstock lode. We may here come across as big a bonanza as has ever been found on the Comstock lode. These veins were probably formed at the same time, and they may all unite somewhere; but we can never get to that place, as it is probably two or three miles down. Under the Act of Congress, we are entitled to all the mineral deposits we find on that grant, which were not owned in 1866, and worked according to the mining laws. The Comstock lode is, by words, specifically excepted; so that, of course, we have no claim to any part of it; but the Comstock mines have to pay their contributions for benefits derived.

To the other veins I think we have a pretty clear title, with the possible exception of one or two mines, which the companies claim to have possessed and held before this act was passed.

So far as our grant of land beyond the Comstock lode is concerned, I think it will before long be prospected by continuing the tunnel beyond its present end. We have to cut through the syenitic mountain, which nobody else could ever pierce. People there think that there are no mineral veins in the syenite.

Mount Davidson.—I have visited many of the mining districts of Europe, and I found that at Schemnitz, in Hungary, there is precisely the same formation as at the Comstock lode. I have mingled specimens of the country rock from the two places, and I have never found anybody in Nevada who could tell them apart. We have the syenite there, as well as the greenstone and the trachyte. We find at Schemnitz half a dozen veins in the syenite that have been worked for a long time. We know that there are outcrops on Mount Davidson which show well in metal. They have not gone into Mount Davidson, because they have been afraid of striking water. We do not care how much water we strike, for it will flow off through the tunnel. The water all comes from that side, from the Sierra Nevada Mountains. They have not gone into that mountain because they were afraid of being drowned out, and also because the rock is so hard that the men say that they can never get through it. I think that in this respect they are mistaken. We have never yet seen any rock that we could not go through with a 5 inch percussion drill. With it we can strike a blow of 1,000 pounds, at the rate of 300 per minute, which will drive the drill through almost anything. But we are not yet prepared to go into Mount Davidson. It will take considerable money to do so, and we have a use for all the money at present. The time will come before long when we will go ahead with that.

The same formation existing east of the Comstock lode also occurs beyond Mount Davidson. We there find the same propylite, with specimens of gold, on the surface, although there is no well-defined ledge. But you cannot tell anything about these outcroppings until you get down to a considerable depth, for the surface is all covered over with *dêbris.* You may find ore there, and you may not. You may find a chimney there. It is a mistaken idea to suppose that, because you find a vein of ore, you may be able to dig out the whole vein. The ore occurs in all mineral veins, in zones, chimneys, and spots. There is always some uncertainty in working a mine. You may explore and find a good showing of ore, but you cannot tell how far the ore goes. Experience teaches us that this is uncertain. But the ore does occur in zones, and you may have to dig a long distance through the vein before you find another zone.

Longevity of Mining Districts.—But if you take a whole mineral district you will find that there is a most extraordinary permanency about the aggregate yield. History tells us that the mines of Cornwall have been worked for over three thousand years, and they are being worked to this day, and the yield still is very considerable. The same is true of the mineral deposits of the Hartz Mountains. The mines there have been yielding for over eight hundred years. The same is true of the district of Freiberg. That has also been worked for centuries, and it still furnishes a good yield.

If you take the district of Schemnitz, you find that it is the same. If you go into Mexico, you find that the mines of the Veta Madre, of Guanajuato, have yielded over $800,000,000, and are yielding still. If they were to put up proper works there they could continue to work those mines for centuries to come. There is a chance for an enterprising man to go and dig a tunnel into those mines. I do not, myself, want to dig any more tunnels; it takes too long a time. So, too, the mines of Veta Grande, of Zacatecas, are still yielding four or five millions per year, though they have been worked almost since the discovery of America.

I consider that an enterprise like the Sutro Tunnel, based as it is upon the results obtained in a whole mining district, furnishes one of the most promising and surest investments in the world. It may take time to realize, but it is sure. These every-day ventures are gone into by everybody, and, as a result, there is only a little money to divide.

Security of Title.—Under the act of Congress we are given certain rights. At that time the United States was the sole owner of these lands. At the time of the passage of the Sutro Tunnel Act the government owned in fee all the mineral lands in the West. Shortly after that time a general law was passed, giving a title to any man under certain conditions who wants to purchase mineral lands. Immediately succeeding the Sutro Tunnel Act, this general act was passed. But our act has the precedence over all others, and our title is better than the title of anybody else holding mineral lands; for ours is the first act and the first grant of mineral lands made by the Government of the United States since its organization.

The cost of the Sutro Tunnel thus far has been about $3,800,000. That is according to the last balance sheet, and is exclusive of interest. Adding the interest, it would figure up about three millions more during the ten years. So I estimate the total cost of the tunnel to be about $7,000,000.

I have taken up your time much longer than I intended. I could go into other phases of the history of the tunnel, but it would take entirely too long.

—*An Address by Adolph Sutro, before the Bullion Club of New York.*

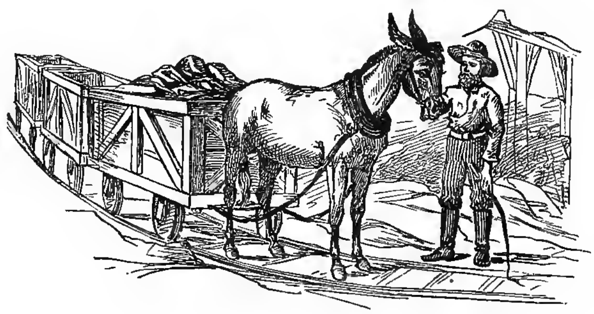
Nickel in Oregon.—At a late meeting of the San Francisco Microscopic Society, the first public and reliable notice was made of the important discovery of a large deposit of a rare form of nickel ore at a place about eight miles from the town of Canyonville, Douglass county, southern Oregon, and three miles from the Oregon and California railroad. The deposit closely resembles that discovered in New Caladonia, in 1864, as will be seen from an article on the subject in another column of this issue. Professor Liversidge, in

	Oregon Ore A.	*Oregon Ore B.*	*Garnierite.*	*Noumeite.*
Silica	48.21	40.35	47.23	47.90
Iron and Alumina oxide,	1.38	1.33	1.66	3.00
Nickel oxide	23.88	29.66	24.01	24.00
Magnesia	19.90	21.70	21.66	12.51
Water	6.63	7.00	5 26	12.73
	Amorphous—Hardness, 2.5; specific gravity, 2.45; color, pale apple green, becoming lighter by exposure. Adheres to tongue; not unctuous. Does not fall to pieces when placed in water.	Amorphous—Hardness, 2.0–2.5; specific gravity, 2.20; color, dark apple green, becoming lighter by exposure. Adheres to tongue; unctuous. Falls to pieces in water.	Amorphous—Hardness, 2.0–2.5; specific gravity, 2.27; color, apple green. Adheres to tongue; not unctuous. Falls to pieces in water.	Amorphous—Hardness, 2.5; specific gravity, 2.58; color, dark apple green. Does not adhere to tongue; unctuous. Does not fall to pieces in water.

1874, read a paper before the University of Sydney on the "Nickel Minerals from New Caledonia," wherein he says: "These minerals consist of two hydrated silicates of nickel and magnesia, which are found in small veins and fissures, traversing the serpentine occurring at Mont D'Or, not far from the town of Noumea, New Caledonia. They are associated with chromo iron, steatite and other minerals commonly occurring in serpentine, and are seen disseminated through the loose blocks and bowlders of that rock scattered over the surface of the ground. The chief differences between the two minerals are found in some of their physical properties, for chemically they do not differ so widely; in fact, both forms contain nearly equal proportions of nickel; their other constituents, however, vary considerably." In the "Transactions of the Royal Society of New South Wales," for 1876, is a long notice by the Vice-President of that society on the deposits of nickel ore in New Caledonia. In a pamphlet by Capt. A. E. Bruno, lately published in San Francisco, he says: "New Caledonia, discovered by Capt. Cook over 100 years ago, is, next to New Zealand, the largest island in the great South sea, being upwards of 220 miles in length and 40 in width. Its valleys and transverse plateaux contain large areas of transcendent fertility, teeming with spontaneous vegetation; yet no product of this prolific island figures in the world's commerce, except its sandal-wood, gold, copper and nickel ore—the latter presenting itself in the form of a magnesium hydro-silicate, which has received the name of garnierite." Dr. Hood has given the following comparative analysis of the Oregon and New Caledonia nickel ores: (see preceding page.)

The peculiarity of this rare deposit of nickel will be highly interesting to mining geologists, and we hope, ere long, to see works erected for its reduction in or near San Francisco, as the demand for this useful metal is daily increasing.

— *Mining and Scientific Press.*



PART XI.

STATISTICS OF MINES AND MINING—AMERICAN IRON AND STEEL PRODUCTION—THE COAL FIGURES FOR 1881—*GOLD AND SILVER TOTALS—THE MINING COMPANIES.*

THE reader has, doubtless, by this time, hastened on to Part XI of the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES, to dip into the great sea of statistics and fish out for himself grand columns and pregnant totals upon the enormous mining interests of this continent. The figures of the Iron and Steel production, compiled by the accurate Mr. Swank, are properly preceded with his report on the same subject prepared for the Tenth Census. The results of Mr. Clarence King's work in the same direction are given, with the maps prepared by him and published by the Census Bureau. The final reports of Mr. Raphael Pumpelly not having been published as late as August 15th, 1882, we have inserted, perforce, his preliminary papers upon the subjects under his charge. Other statistics gathered from other sources are added, and the part concludes with a long list of mining companies, which has been compiled at great trouble under the most careful supervision.

THE PRODUCTION OF THE PRECIOUS METALS.

THE following is from the Report of Mr. Clarence King, Tenth Census of the United States: Three principal methods have been adopted by statisticians in studying the bullion production of the United States. The first and most obvious plan has been to use as a basis the receipts of domestic bullion reported by the several mints and United States assay offices, ascertaining the probable total product by adding to the figures thus obtained the amount shipped abroad, as shown by the custom-house returns, and the probable amount consumed in the arts. The objections to this method are: The amount coined within a certain period does not necessarily correspond to the production for that period. In the same way the proportion of the domestic product exported may be largely affected by the stock of precious metals on hand at any given time. Both of these variations depend primarily upon fluctuations in the bullion market and international balance of trade. An average of a long series of years would give tolerably accurate results; but for any stated period the figures of coinage, export, and consumption in the arts are apt to be deceptive. Assuming the source of the bullion deposited at the mints to be correctly stated, there are still serious and unavoidable defects in the custom-house statistics, notwithstanding the care taken to secure accuracy. No account is taken of bullion transported overland into Canada, nor are the export figures for doré bullion, base bullion, ores, and matte shipped abroad always to be depended upon. This difficulty is particularly manifested in the last three instances. The regulations prescribed by the custom-house authorities are not followed by penalties sufficient to insure accurate invoicing of the values thus exported. It is well known that during the period of intense speculation in gold a very large proportion of both receipts and exports even of gold coin was entirely hidden from official scrutiny, with a still greater margin in the bullion movement, and although the inducements to a concealment of the actual movement do not now exist in the same force, it is still doubtful whether the official figures are entirely reliable. A less important source of error is the undisputed fact that not infrequently bullion of domestic production, after having been shipped abroad, is, from changes in the silver-bullion market or from the necessities of coinage, reimported into the United States. It will thus be seen that the best results which can be hoped for from the most careful application of the "consumption and export" method, are close approximations extending over considerable periods, but not the exact product for any given year. The system also fails to segregate the yield according to the productive source; and while the geographical distribution by state and territorial lines may be shown, it is hardly possible to carry the analysis further and ascertain in this way the yield of single districts or even counties. The director of the mint has examined the bullion product of the country critically from the "consumption and export" point of view, employing as a supplementary means of information the details obtainable by correspondence and circulars scattered through the mining districts. The substantial accuracy of the estimates thus reached has been fully borne out by the results of the present investigation.

The second or "transportation" method consists in estimating the product from the statistics of the express companies, freight lines, and banks which have the handling of the product from its original sources. This plan would give more satisfactory results if, in the first place, all the bullion, ores, etc., were transported from the producing points through these different channels alone; and if, in the second place, none of the product were reshipped from point to point and thus twice recorded. As a matter of fact, there is a considerable portion of the gold yield sent through the mails as registered matter, and a large proportion passes from the productive source into the market through private channels. Both of these means of conveyance are affected by proximity to main lines of communication, or, on the other hand, by the absence of express or railroad facilities; and in neither can the exact effect of these circumstances be very definitely counted upon. In the Pacific states and territories the great bulk of the mine output is handled by Wells, Fargo & Co.'s express, and upon the detailed returns of the many offices of this company Mr. J. J. Valentine, general superintendent, has been enabled to furnish very valuable estimates of the bullion production, covering a long series of years. The business connections of this express company in portions of the country not covered by their agencies, have rendered it impossible for Mr. Valentine to frame approximate estimates of the product of the mining territory outside of that from which Wells, Fargo & Co. are the principal transporters of bullion. But the impossibility of assigning to other channels the due proportion of the outflow through them; the fact that no record is made of the value of the gold bullion and dust sent through the mails; that no reliable allowance can be made for the undervaluation of gold dust and unassayed bullion by consignors, amounting in many cases to from five to ten per cent.; that there is no satisfactory means of checking the reshipments which are twice or more times recorded, combine to create a large margin which can hardly be definitely accounted for in making the total estimates. Notwithstanding these palpable but unavoidable defects in the system, much credit is due Mr. Valentine for the painstaking care with which he has prepared his annual estimates.

The third system is one which, were it practicable to pursue it into complete details, would lead to results more satisfactory than could be obtained in any other way. This may be termed the direct method. It would consist, if properly carried out, in obtaining from each bullion producer a statement of the quota contributed. The aggregate of the details thus reached would represent the actual total product of the country, and would, moreover, segregate it according to districts. In the census work conducted by the United States Geological Survey, the plan indicated has been followed to as minute detail as it was possible to extend it with the means at command. No attempt had ever been previously made which aimed at securing individual returns throughout the whole United States with the same degree of thoroughness: though the successful adoption of the direct method by Mr. A. Del Mar, in his investigation of the silver product of Nevada in 1876, showed the advantages of the plan. But even with all the care and time expended by the experts engaged in collecting these statistics, it was found to be impracticable to do more than obtain returns from the larger producers. In some instances well-based and careful estimates were submitted by the experts, covering aggregates of a large number of small mines, for whole districts. In other cases, and more especially in portions of the country where placer-mining on a small scale furnished a large proportion of the yield, reliance had to be placed on extraneous data. The chief obstacles encountered in the collection of bullion statistics directly from the producers were:

First. The wide extent of the field to be covered, and the vast number of mines to be reported upon. Even were the mines located in easily accessible places, the wide range of territory over which they are scattered would render the labor of personally visiting each productive district a tedious matter. But when it is considered that they are for the most part to be found in rugged mountainous tracts, often at high altitudes, and, when destitute of railroad communication, to be reached only by stage or on horseback, some idea may be gathered of the amount of work involved.

Second. The fact that a considerable yield is derived from small mines, the product from each of which, however insignificant in itself, goes to form part of an important aggregate, and should not be neglected.

Third. The reluctance of some mine owners and superintendents to give a full account of their operations, notwithstanding the strictly confidential manner in which these individual statements have been treated. On explanation of the purposes for which the statistics were collected, such objections were in most cases overruled, however, and invariably great courtesy was personally manifested.

Fourth. The fact that in a large majority of cases no systematic accounts are kept by mine owners, who were often unable to state from memory the precise output of their properties for a period which had elapsed some time before the inquiry was made.

Fifth. Many mines having changed hands during the census year, it was frequently impossible to obtain from the present holders a statement of the operations conducted prior to the change in ownership, or to communicate with the former owners if they had removed.

Sixth. When in the case of mines worked during only a portion of the census year, or during a season limited by the weather, water supply or other causes, operations had been suspended at the time the district was visited by the examin-

CALIFORNIA—PRODUCTION OF DEEP

	County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.					Ore raised and treated.	Average yield per ton.		
			Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.		Gold.	Silver.	Gold and silver.
		Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.
1	Amador	114,618	14 62	. .	14 62	81,056.4	1,675,584	. .	. .	1,675,584	108,136	12 49	. . . .	12 49
2	Calaveras . . .	42,628	10 74	. .	10 74	22,162.1	458,131	. .	. .	458,131	40,503	8 48	. . . .	8 58
3	El Dorado	4,520	26 76	. . . .	26 76	5,832.3	120,564	. . . .	. . . .	120,564	4,520	21 21	. . . .	21 21
4	Fresno	578	150 00	13 00	163 00	4,194.1	86,700	5,812	7,514	94,214	578	120 00	10 40	130 40
5	Inyo . . .	6,714	5 01	69 66	74 67	1,627.0	33,633	361,779	467,744	501,377	6,714	3 83	35 62	39 45
6	Lassen	2,079	21 08	63	21 71	*2,120.2	*43,828	*1,009	*1,305	*45,133	2,079	16 71	50	17 21
7	Los Angeles	200	. . . .	160 00	160 00	. . . . .	. . . . .	24,750	32,000	32,000	200	. . . .	147 00	147 00
8	Mariposa . . .	16,660	17 10	. . . .	17 10	13,783.0	284,920	. . . . .	. . . . .	284,920	16,660	10 69	. . . .	10 69
9	Mono	57,211	51 95	10 59	62 54	143,772.9	2,972,050	468,826	606,145	3,578,195	57,108	48 44	8 33	56 77
10	Nevada	58,433	21 91	49	22 40	61,937.6	1,280,364	22,328	28,868	1,309,232	58,433	15 21	33	15 54
11	Placer	3,000	25 00	. . .	25 00	3,628.1	75,000	. . . . .	. . . . .	75,000	3,000	20 00	. . . .	20 00
12	Plumas	113,879	9 03	09	9 12	49,773.6	1,028,912	7,848	10,147	1,039,059	113,879	6 63	06	6 69
13	San Bernardino	489	20 45	170 90	191 35	483.7	9,999	64,640	83,573	93,572	389	. . . .	164 55	164 55
14	San Diego	16,513	22 36	. . . .	22 36	17,862.4	369,249	. . . . .	. . . . .	369,249	16,513	14 40	. . . .	14 40
15	Shasta	8,010	*15 96	*13 48	*29 41	*6,182.3	*127,799	*83,533	*108,000	*235,799	7,880	12 08	*11 34	23 42
16	Siskiyou	22,290	12 20	44	12 64	13,153.9	271,915	7,217	9,331	281,246	22,290	9 11	31	9 42
17	Trinity	800	*35 00	. . . .	*35 00	*1,354.5	*28,000	. . . . .	. . . . .	*28,000	800	27 50	. . .	27 50
18	Tuolumne . . .	10,406	15 11	38	15 49	7,603.9	157,186	*3,004	*4,000	161,186	10,406	12 32	29	12 61
	Total	479,028	18 84	2 84	21 68	436,528.0	9,023,834	1,050,836	1,358,627	10,382,461	470,088	16 10	2 00	18 10
	Additional production estimated from transportation statistics...	*65,213	*18 84	*2 84	*21 68	59,434.1	*1,228,612	143,248	*185,205	*1,413,817	*65,213	*16 10	*2 00	*18 10
	Grand Total . .	544,241	18 84	2 84	21 68	495,962.1	10,252,446	1,104,084	1,543,832	11,796,278	535,301	16 10	2 00	18 10

* Estimated.

ing expert, it was often impracticable to communicate with the only persons able to supply information.

Seventh. The variation in the fiscal year of the incorporated companies makes it a mátter of much difficulty to reduce the returns to a different period from that for which the books are kept.

With means still less adequate than were lately at command, the census authorities in 1870 found it impossible to trace the bullion product of the country at that time. The best results reached by the deputy marshals in certain instances hardly amounted to a moiety of the actual product, as known through other sources of information. In the case of the census of 1880, even with greatly increased facilities, there were many gaps in the testimony which had to be filled out by estimates derived from other data than those collected directly by the experts. Where such estimates have been applied in the tabulation, they have been indicated by an asterisk (*). In all cases a careful scrutiny has been exercised in the selection and comparison of material. It is believed, in view of the more extended and fuller details accessible, as compared with previous researches of the same nature, that the results reached in this compilation are as close an approximation to absolute accuracy as it is possible to attain without a far greater expenditure of money and time than the subject demands. In compiling the material at hand, the following system was adopted: The returns in the individual mine schedules were first abstracted and grouped into aggregates for districts. Information as to the operations of the different establishments being in many cases confidential, publication of the results begins with the district exhibits. These, again, are condensed into tables for counties, and finally into abstracts for whole states and territories. Where a marked discrepancy existed between the schedule returns and other reliable data, the necessary additions were entered and the fact that they were estimates indicated. It is hardly necessary to remark that the schedules would show deficiencies rather than an excess as compared with correlative data. At the same time the schedules of reduction works were examined, and furnished a valuable check upon the figures derived from the mine reports. In some instances the yield was quoted in ounces of fine metal, as is customary in localities where the ore is reduced by smelting; in others, in ounces of crude bullion, as in the case of placer gold; in still others, in dollars calculated from the assay value of the bullion; and more rarely in dollars representing the net proceeds after deducting the discount upon silver and other charges. In order to present the whole in harmonious shape it became necessary to reduce these various denominations to a uniform standard. That adopted is the ounce of fine metal and its assay value in United States money. The terms are interchangeable and appear side by side in the tables of production. As a preliminary step a series of conversion tables was prepared.

Classification of Mines.—Mines of the precious metals are grouped under two comprehensive heads: deep mines and placer mines. The former are workings in primary deposits, in which the ore usually, though not invariably, occurs in a vein, and while the earlier operations in mines of this class may begin at or near the outcrop of the vein, the tendency is always downwards. The leading varieties of deep mines are:

1. Mines of free gold, or gold alloyed with a small proportion of silver.
2. Mines of silver ores, containing only traces of gold.
3. Mines yielding doré bullion from milling ores, containing both gold and silver in appreciable quantities.
4. Mines yielding base bullion from smelting ores in which the precious metals are associated with larger quantities of lead, copper, etc.

All of these divisions shade imperceptibly into each other.

Placer or gravel mines are workings in secondary or fragmentary gold deposits, including gravels and sands, and are either surface or shallow workings. The leading types are:

1. Hydraulic mines.
2. Dry washings.
3. Booming and shovel-sluicing.
4. River mines.
5. Pocket mines.
6. Drift mines.
7. Branch mines.
8. Black sand littoral deposits.

In the tables of production the classification under these two main heads is observed.

Classification of Reduction Works.—In some of the following tables a distinction is made between the production as shown by the different reduction works, which, like the mines, are divided into two principal classes. These are, first, amalgamating mills, including:

1. Gold quartz mills.
2. Mills in which silver ore is treated in the raw state.
3. Mills in which roasting is practiced before amalgamation.

MINES FOR THE YEAR ENDING MAY 31, 1880.

Bullion produced from ore raised and treated during census year.					*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*					*Bullion produced during census year from ore previously raised.*					
Gold.		*Silver.*		*Total.*		*Gold.*		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*	
Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Tons.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	
65,332.7	1,350,547	...	...	1,350,547	6,482	1,251.5	25,871	...	...	25,871	2,733.2	56,500	...	...	56,500	1
16,817.5	347,649	...	...	347,649	2,125	1,312.1	27,134	...	...	27,124	48.4	1,000	...	...	1,000	2
4,686.6	96,881	...	...	96,881	...	...	...	...	...	...	...	...	...	...	...	3
3,355.3	69,360	4,649	6,011	75,371	...	...	...	...	...	...	156.7	3,239	217	281	3,520	4
1,243.4	25,703	184,968	239,145	264,848	...	...	...	...	...	...	...	...	...	...	...	5
1,680.5	34,739	802	1,037	35,776	...	...	...	...	...	...	...	...	...	...	...	6
...	...	22,740	29,400	29,400	...	...	...	...	...	...	...	...	...	...	...	7
9,096.9	188,050	...	...	188,050	...	...	...	...	...	...	6,493.1	134,224	...	...	134,224	8
133,816.6	2,766,235	367,875	475,626	3,241,861	103	138.1	2,855	939	1,214	4,069	...	...	696	900	900	9
43,000.9	888,907	14,737	19,053	907,960	...	...	...	...	...	...	...	...	...	...	...	10
2,902.5	60,000	...	...	60,000	...	...	...	...	...	...	387.0	8,000	...	...	8,000	11
36,536.5	755,276	5,608	7,251	762,527	...	...	...	...	...	...	2,152.6	44,498	21	27	44,525	12
...	...	49,540	64,050	64,050	100	483.7	9,999	6,342	8,200	18,199	...	...	824	1,065	1,065	13
11,506.0	237,850	...	...	237,850	...	...	...	...	...	...	...	...	...	...	...	14
4,605.3	95,200	*69,145	*89,398	184,598	130	628.9	13,001	...	...	13,001	58.1	1,201	6,914	8,939	10,140	15
9,830.0	203,204	5,273	6,818	210,022	...	...	...	...	...	...	...	...	...	...	...	16
1,064.2	22,000	...	...	22,000	...	...	...	...	...	...	...	...	...	...	...	17
6,204.5	128,260	2,320	3,000	131,260	...	...	...	...	...	...	73.1	1,511	146	189	1,700	18
351,679.4	7,269,861	727,657	940,789	8,210,650	8,940	3,814.3	78,850	7,281	9,414	88,264	12,102.2	250,173	8,818	11,401	261,574	
*50,790-1	*1,049,925	100,879	*130,426	*1,180,351	...	...	...	...	...	...	...	...	...	...	...	
402,469.5	8,319,786	828,536	1,071,215	9,391,001	8,940	3,814.3	78,850	7,281	9,414	88,264	12,102.2	250,173	8,818	11,401	261,574	

CALIFORNIA.—PRODUCTION (GOLD) OF HYDRAULIC, PLACER, DRIFT AND RIVER MINES FOR THE YEAR ENDING MAY 31, 1880.

County and district.	Gold. Totals, by districts. Ounces.	Gold. Totals, by districts. Dollars.	Gold. Totals, by counties. Ounces.	Gold. Totals, by counties. Dollars.
BUTTE.				
Centerville and Helltown	725.6	15,000		
Cherokee Flat	13,257.5	274,057		
Magalia or Dog Town	828.1	17,118	15,730.3	325,174
Morris Ravine	435.4	9,000		
Oroville	483.7	9,999		
CALAVERAS.				
Mokelumne Hill	3,069.4	63,450		
Robinson's Ferry	725.6	15,000	4,665.8	96,451
Vallecito	870.8	18,001		
DEL NORTE.				
Scattered	6,208.0	128,331	6,208.0	128,331
EL DORADO.				
Scattered	*24,877.7	*514,268	*24,877.7	*514,268
HUMBOLDT.				
Gold Bluffs	1,306.1	27,000	3,724.9	77,001
Orleans Bar	2,418.8	50,001		
MONO.				
Bodie	1,219.0	25,199	1,219.0	25,199
NEVADA.				
Scattered	2,061.3	42,631	2,062.3	42,631
PLACER.				
Bath	3,144.4	65,000		
Dutch Flat	2,128.5	44,000		
Gold Run	2,612.2	53,999	13,998.2	289,368
Iowa Hill	774.0	16,000		
Michigan Bluffs	5,339.1	110,369		
PLUMAS.				
Claremont	......	......		
Light's Cañon	290.2	5,999		
Moonlight Mountain	290.3	6,001		
North Fork, Feather River	4,081.7	84,376	7,946.0	164,259
Seneca	340.3	7,035		
Scattered	2,943.5	60,848		
SHASTA.				
Buckeye	696.6	14,400		
French Gulch	1,393.8	28,813		
Igo	......	......		
Northern Shasta County	5,201.3	107,520	21,789.7	450,432
Sawmill Flat	182.8	3,779		
Shasta City	1,253.9	25,920		
Southern Shasta County	10,158.8	210,000		
Scattered	2,902.5	60,000		
SISKIYOU.				
Callahan's Ranch	3,984.7	82,371		
Cottonwood	580.5	12,000		
SISKIYOU—Continued.				
Galena Hill	483.8	10,001		
Greenhorn	657.9	13,600		
Humbug	1,879.4	38,851		
Indian Creek	712.4	14,726		
McAdam's Creek	2,419.5	50,015		
Oro Fino	943.5	19,503	23,413.1	483,992
Rattlesnake Creek	314.4	6,500		
Sawyer's Bar	3,628.1	75,000		
Sciad Valley	205.1	4,240		
Scott Valley	725.6	15,000		
South Fork, Salmon River	3,773 3	78,001		
Yreka	3,104.9	64,184		
STANISLAUS.				
La Grange	3,030.7	62,650	3,030.7	62,650
TRINITY.				
Arkansas Bar				
Ballychoop				
Boalt's Hill				
Buckeye Mountain				
Cañon Creek				
Coffee Creek				
Cox's Bar				
Douglas City				
Hay Fork				
Indian Creek	37,635.7	777,999	37,635.7	777,999
Junction City				
Minersville				
New River				
Oregon Gulch				
Red Hill				
South Fork				
Taylor's Flat				
Trinity Center				
Weaver Basin				
TUOLUMNE.				
Big Oak Flat				
Chinese Camp				
Groveland				
Jacksonville	*27,081.7	*559,828	*27,081.7	*a 559,828
Montezuma				
Scattered				
YUBA.				
Scattered	*50,423.6	*1,042,349	*50,423.6	*1,042,349
Total	243,806.7	5,039,932	243,806.7	5,039,932
Additional production estimated from transportation statistics	......	......	*171,298.3	*3,541,050
Grand total	......	......	415,105.0	8,580,982

* Estimated.

a Including $300,000 from "pocket" mines.

4. Concentration works.
5. Chlorination and leaching establishments.
6. Arrastras.

The second class includes the several varieties of smelting works in which the production of base bullion, matte, or speiss, is a preliminary step toward the final extraction of the precious metals. Placer mines, with the exception of pocket mines and branch mines, require no reducing process, and in the two exceptions named, the mill process is not always a necessary concomitant; in the former, in fact, but rarely. Various systems of reduction by chlorination and amalgamation have also been applied to black sand deposits and refractory conglomerates containing placer gold; but not to an extent affecting the general principle of classification here maintained.

[NOTE.—In each of the tables of production and throughout this discussion, the following explanations apply: The short ton of 2,000 pounds is invariably used. The ore tonnage is stated in gross tons; the assay values are of net tons, without allowance for moisture. Mint values are assumed in all cases. The weight of bullion is given in troy ounces of fine metal. The gold ounce is taken at $20.671,834, and the silver ounce at $1.2929. A statement of the estimated market value of the silver is elsewhere appended. No account is taken of the value of the silver alloyed with placer gold in the primary production tables; as, with very few exceptions, no allowance is made for it in selling. This is treated of separately and the proper addition made in the final summary. The bullion yield is given according to the district in which the ore producing it was raised, without regard to the locality where the ore was reduced. This method of stating the product apportions it with reference to the original source, so far as it is practicable to trace it. Were the yield to be credited to the reduction works, Omaha, Chicago, St. Louis, Newark, New York, and other points remote from the mines would appear as large producing centres, Individual estimated amounts are designated by an asterisk (*); and where such estimates form a considerable proportion of the totals, the fact is similarly indicated.]

California.—In production of gold California still holds the first place, The vast deposits of auriferous gravel continue to yield largely, though their final exhaustion, in view of the enormous hydraulic operations now being prosecuted, is to be looked for at no very distant day. Previous to the discovery of the Bodie district, the placer mines furnished more than two-thirds of the total gold output of the state, but the large yield of that district, amounting to over two and three-quarter millions in gold during the year, in addition to the silver product, has placed the deep mines about on a par with the placers in point of productiveness. The amount of silver contributed by California is relatively small, and comes mainly from two adjoining counties, Inyo and Mono. There is a larger number of actively working mines in California than in any other state or territory, as, owing to the settled condition, transportation facilities, and comparative cheapness of labor and supplies, it is possible to mine deposits of lower grade than could be made profitable in localities having less advantages of position. The result is that there are, besides a few large incorporated companies, a great many mining properties worked on the small scale, but still profitably, by individual owners. The collection of accurate statistics regarding these smaller claims is a very tedious and also somewhat uncertain matter. Schedule returns were received from 128 deep mines, 147 placer mines, 57 amalgamating mills, concentration and leaching works, 9 arrastras, and 4 smelting works in this state. These include most of the more important establishments, and are supplemented by general reports covering in some cases whole districts. But, with all the care taken by the census experts to cover thoroughly the ground, the subject was by no means exhausted, and in several cases in the accompanying tabulations resort has been had to information from outside sources. California furnishes 71.47 per cent. of the total placer product of the United States, and 40.09 per cent. of the total gold product of the deep mines, or 51.38 per cent. of the total gold product of the country (from all sources). The yield in silver, however, is only 2.80 per cent. of the total, California standing sixth in rank as a producer of the latter metal. In proportion to its area, again, California leads in production of gold, with an average of $108.30 per square mile; is sixth in its silver yield of $7.27 per square mile; and third as to its output of both metals, $115.57 per square mile. As the population of the state has largely increased, while the mine production has remained nearly at a standstill for some years, the showing in relation to the population is less favorable, the yield of gold being only $19.83, silver $1.33, and that of both the precious metals only $21.16 per capita, placing California fifth as to gold, and eighth as to silver and the total, in the ranks of the states. The prosperity of the state is not, however, dependent upon its mines in the same degree as formerly, agriculture and manufacturing having outstripped the earlier industry.

Nevada.—The production of this state shows a considerable decline, as compared with that of the preceding six years. This is not due to any general falling off in the prosperity of the mining industry of the state, but to the decrease in the yield of the leading source, the Comstock lode. From 1871 to 1879, Nevada had outranked all the other states and territories in its output of the precious metals; but in the present census year it has fallen to the third place, having been passed by both Colorado and California. With the yield of the outside districts maintained at the existing rate of production, an important discovery of ore in the Comstock would perhaps raise Nevada again to the first rank. And even without any striking new developments, there is still a reserve of low-grade ore and tailings remaining unworked, sufficient to give a large and steady product for many years to come. In 1876 the yield of the Comstock, according to Mr. Del Mar's careful analysis, was: gold, $18,002,906; silver, $20,570,078; total, $38,572,984. During the census year the product of the whole Comstock district, including the Virginia, Gold Hill, and Devil's Gate subdistricts, the outlying veins, such as the Occidental, etc., and the yield of tailings worked at various points throughout the entire tract known as the Washoe country, was: gold, $3,109,156; silver, $3,813,174; total, $6,922,330; showing a decline of $31,650,654, or 82.06 per cent., since 1876. The bullion product of Nevada represents an average of $44.16 gold, $112.29 silver, and $156.45 gold and silver for each square mile of its area. In this respect Nevada is surpassed by Colorado, the figures for which are $25.98 gold, $159.24 silver, and $185.22 total. But with reference to its population, Nevada, even with the reduced output, remains the richest of the mining states and territories, as its annual product, if distributed equally per capita, would give $78.51 gold, $199.63 silver, and $278.14 total to every man, woman, and child within its borders. Notwithstanding the large proportion of adult males, it will be seen that this would be a fair income for the actual working population. The Nevada mines, however, are largely owned outside the state, and although they have not, taken as a whole, been profitable during the year, the local disbursements in wages, etc., continue steadily, so that the inhabitants have a direct interest in the prosecution of the work, independent of the question of ownership.

Placer Mines.—The placer yield of Nevada is insignificant. No important gravel deposits having suitable water supply are known to exist. The ground worked is in most cases merely the wash from the croppings of quartz veins. Operations are conducted on a small scale at Tuscarora, Tulé Cañon, points in the neighborhood of the Comstock, and in a few other isolated spots. The aggregate yield for the year is estimated roundly at $50,000.

Correlative Statistics.—There is a state bullion tax in Nevada, but in no other state or territory. The assessor's rolls, prepared in collecting this tax, furnish interesting comparative data, which have been condensed into the following abstracts. The periods selected for comparison correspond with the United States fiscal year (ending June 30th, 1880). The discrepancies between the census figures and those obtained from assessor's rolls are mainly due to the natural undervaluation attending the collection of information for the purpose of taxation, and the escape of many small amounts from enrollment all together; and in a less degree to the fact that the United States fiscal year is one month later than the census year.

Utah.—The bullion product of Utah is remarkably steady, varying latterly but little from year to year. This territory presents facilities for arriving at a true valuation of the product which are wanting in many other mining localities. The mines are more concentrated, the yield coming from a comparatively few but rich claims, and the bulk of the ore is treated by a few large smelting works and mills, where accurate accounts are kept. It is therefore easier to collect full statistics of the product than in regions where the bullion is derived from a vast number of sources, each one of which furnishes only a small quota, as is the case where placer-mining forms an important factor. The census figures for Utah are also the more reliable from the fullness and clearness with which the schedules were prepared by the special expert for the territory. The tabulation of the product is based on returns from 535 deep mines, 1 placer mine, 18 amalgamating mills, 34 smelting works, and 10 miscellaneous metallurgical establishments, consisting of sampling, concentration and leaching works. Many of these sources, were, however, unproductive during the census year. The silver-lead ores sold to the smelters are in many cases transported for reduction out of the district in which they were raised; and as their identity is lost in the mixture of ores from all portions of the territory, and even from other states and territories, it is impossible to segregate the bullion yield by districts.

NEVADA—PRODUCTION BY COUNTIES OF DEEP

	County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.					Ore raised and treated.	Average yield per ton.		
			Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.		Gold.	Silver.	Gold and silver.
		Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.
1	Elko	13,221	11 71	122 82	134 53	7,492.0	154,873	1,255,965	1,623,837	1,778,710	11,721	9 31	99 27	108 58
2	Esmeralda	29,731	5 44	53 49	58 93	7,825.9	161,776	1,229,931	1,590,178	1,751,954	29,361	4 45	44 88	49 33
3	Eureka	82,013	19 23	38 84	58 07	76,304.5	1,577,354	2,464,082	3,185,812	4,763,166	79,392	16 37	34 88	51 25
4	Humboldt	11,458	8 24	34 83	43 07	4,566.5	94,398	308,666	399,074	493,472	10,644	6 14	28 49	34 63
5	Lander	8,166	....	161 22	161 22	.....	...	1,018,315	1,316,579	1,316,579	7,751	....	143 19	143 19
6	Lincoln	14,399	1 31	54 81	56 12	910.9	18,830	610,466	789,271	808,101	10,398	22	48 78	49 00
7	Nye	23,817	1 33	30 75	32 08	1,527.6	31,578	566,431	732,339	763,917	23,817	1 11	26 16	27 27
8	Storey and Lyon	161,700⅓	21 75	26 47	48 22	170,155.1	3,517,418	3,310,015	4,279,518	7,796,936	161,700	16 31	19 85	36 16
9	White Pine	11,547	53	61 00	61 53	294.9	6,096	544,867	704,459	710,555	11,547	42	50 83	51 25
	Total	356,052⅓	15 62	41 06	56 68	269,077.4	5,562,323	11,308,738	14,621,067	20,183,390	346,331	12 35	33 47	45 82

PRODUCTION OF LEADING COMSTOCK MINES.

Month.	Consolidated Virginia mine.		California mine.		* Union Consolidated mine.				† Ophir mine.				‡ Sierra Nevada mine.
	Ore milled.	Bullion produced.	Ore milled.	Bullion produced.	Ore milled.	Bullion produced.			Ore milled.	Bullion produced.			Bullion shipped.
						Gold.	Silver.	Total.		Gold.	Silver.	Total.	
1879.	Tons.	Dollars.	Tons.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.	Dollars.
June	3,466.5	127,007 81	5,193.5	185,963 10	...	...	...	...	1,341.45	30,964 47	42,992 78	73,957 25	60,388 77
July	4,745.5	189,393 08	4,454.5	108,739 63	...	...	...	...	1,529.00	55,711 69	52,879 03	108,590 72	101,860 94
August	4,739.0	160,215 03	4,411.0	101,107 73	...	...	...	...	1,716.00	40,196 29	48,430 40	88,626 69	45,347 76
September	4,072.9	106,020 81	4,228.0	124,605 78	...	...	...	...	1,730.00	41,277 79	55,094 46	96,372 25	...
October	4,113.0	158,476 52	3,573.0	67,840 37	...	...	...	...	1,496.75	49,238 37	66,615 58	115,853 95	...
November	4,859.0	198,359 56	4,141.0	125,772 28	...	...	...	...	1,536.65	41,184 14	61,735 28	102,919 42	...
December	4,674.0	169,503 65	3,526.0	191,205 77	5,200.75	144,965 25	132,318 38	277,283 63	1,346.65	19,633 86	28,812 41	48,446 27	...
1880.													
January	5,209.0	194,222 13	5,391.0	164,106 71	3,336.00	61,223 69	54,493 93	115,717 62	1,658.00	26,343 42	34,323 27	60,666 69	14,545 28
February	4,230.0	128,168 72	2,220.0	39,930 92	4,750.00	98.927 23	98,895 07	197,822 30	1,600.00	27,398 61	31,348 49	58,747 10	31,843 85
March	4,338.0	151,386 01	1,188.0	28,411 80	9,003.15	169,219 89	191,586 91	360,806 80	951.80	7,929 29	10,683 11	18,612 40	...
April	4,607.5	173,642 25	2,498.5	60,004 76	5,015.88	61,125 47	91,166 17	152,291 64	755.20	8,688 19	10,347 98	19,036 17	...
May	5,830.5	205,778 01	2,169.5	55,334 54	2,713.22	31,004 06	39,877 26	70,881 32	228.55	3,950 60	5,028 04	8,978 64	...
Total	54,884.0	1,965,083 58	42,988.0	1,253,023 39	30,019.00	566,465 59	608,337 72	1,174,803 31	15,890.05	352,516 72	448,290 83	800,807 55	253,986 60

* Milled at the Brunswick and Morgan mills. † All treated at the Trench mill. ‡ All ore during census year treated at Mariposa mill.

TAXED PRODUCT OF THE NEVADA MINES.

[From reports of the State Controller, containing abstract statements of the quarterly assessment rolls for the years 1879 and 1880.]

County.		THIRD QUARTER, 1879.				FOURTH QUARTER, 1879.			
		Quantity worked.		Gross yield or value.	Net yield or value on which tax is levied.	Quantity worked.		Gross yield or value.	Net yield or value on which tax is levied.
		Tons.	Pounds.			Tons.	Pounds.		
Elko	Ores	5,872	....	$454,558 96	$288,755 12	3,397	960	$164,462 76	$41,601 99
Esmeralda	do.	5,319	1,138	209,037 00	29,300 81	6,177	1,032	279,666 39	132,047 18
Eureka	do.	25,283	196	902,679 81	304,900 09	23,015	700	822,196 79	278,981 76
Humboldt	do.	2,465	....	58,086 00	18,644 41	4,223	138	134,051 67	55,264 28
Lander	do.	1,766	1,297	178,380 13	69,873 51	1,351	1,653	122,927 18	52,218 92
Lincoln	do.	5,724	1,758	158,277 02	36,366 24	4,455	479	125,579 37	23,883 27
Nye	do.	5,648	94	145,281 18	6,655 00	6,676	1,371	184,597 64	37,816 51
Storey	do.	34,819	1,000	1,139,145 54	376,069 96	41,148	250	1,593,328 30	656,542 12
White Pine	do.	7,020	682	242,565 50	67,306 98	1,197	1,250	60,953 61	7,362 07
Total ores		93,919	165	3,497,011 14	1,197,866 07	91,642	1,833	3,487,763 71	1,285,718 10
Humboldt	Tailings	560	....	3,100 00	600 00	780	....	3,400 00	675 00
Lyon	do.	6,733	....	28,724 69	5,449 87	7,635	....	39,361 90	11,901 80
Ormsby	do.	29,206	....	251,837 11	123,894 66	16,410	....	140,056 78	63,852 33
Storey	do.	15,355	....	126,022 40	37,776 68	6,806	....	34,628 40	8,514 88
White Pine	do.	3,267	....	11,936 02	2,788 42	7,069	....	33,365 68	5,089 68
Total tailings		55,121	....	421,620 22	170,509 63	38,700	....	250,812 76	90,033 69

MINES FOR THE YEAR ENDING MAY 31, 1880.

Bullion produced from ore raised and treated during census year.					*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*					*Bullion produced during census year from ore previously raised.*					
Gold.		*Silver.*		*Total.*		*Gold.*		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*	
Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Tons.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	
5,281.4	109,176	899,928	1,163,517	1,272,693	*1,500	*858.7	*17,751	*135,594	*175,309	*193,000	. . . .	. . . .	. . . .	. . . .	. . . .	1
6,324.3	130,735	1,019,318	1,317,876	1,448,611	370	26.1	540	19,357	25,027	25,567	. . . .	. . . .	1,129	1,460	1,460	2
62,893.4	1,300,122	2,141,621	2,768,902	4,069,024	2,621	1,789.9	37,000	62,689	81,051	118,051	. . . .	. . . .	. . . .	. . . .	. . . .	3
3,160.7	65,337	234,562	303,265	368,602	814	505.5	10,450	14,502	18,750	29,200	. . . .	. . . .	. . . .	. . . .	. . . .	4
. . . .	. . . .	858,439	1,109,876	1,109,876	415	. . . .	. . . .	*76,108	*98,400	*98,400	. . . .	. . . .	. . . .	. . . .	. . . .	5
111.3	2,301	392,355	507,276	509,577	4,001	774.2	16,004	154,730	200,050	216,054	. . . .	. . . .	. . . .	. . . .	. . . .	6
1,284.0	26,543	481,883	623,026	649,569	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	6,932	8,962	8,962	7
127,616.4	2,658,065	2,482,512	3,209,639	5,847,704	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	27,142.6	*561,087	551,886	*713,535	*1,274,622	8
235.9	4,877	453,944	586,905	591,782	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	89,721	116,000	116,000	9
206,907.4	4,277,156	8,964,562	11,590,282	15,867,438	9,721	3,954.4	81,745	462,980	598,587	680,332	27,142.6	*561,087	649,668	*839,957	*1,401,044	

* Estimated.

TAXED PRODUCT OF THE NEVADA MINES.—*Continued.*

County.		FIRST QUARTER, 1880.				SECOND QUARTER, 1880.			
		Quantity worked.		*Gross yield or value.*	*Net yield or value on which tax is levied.*	*Quantity worked.*		*Gross yield or value.*	*Net yield or value on which tax is levied.*
		Tons.	*Pounds.*			*Tons.*	*Pounds.*		
Elko	Ores	1,500	. .	$95,739 75	$22,245 90	1,556	1,500	$51,457 51	$7,683 01
Esmeralda	do.	7,262	607	278,877 05	115,280 06	8,681	. . . . .	277,985 63	80,853 08
Eureka	do.	23,532	1,644	885,768 91	304,197 11	20,944	166	891,492 12	329,038 33
Humboldt	do.	3,411	200	97,408 00	35,724 38	4,111	371	82,343 15	23,678 52
Lander	do.	1,472	1,942	138,433 14	53,923 76	1,251	806	140,188 30	58,971 79
Lincoln	do.	2,321	1,623	64,226 18	7,853 72	1,440	1,510	50,679 26	9,512 22
Nye	do.	6,155	1,430	122,864 72	9,758 67	5,509	270	128,328 82	12,580 05
Storey	do.	49,113	1,350	1,619,820 07	589,987 68	38,846	. . .	1,138,971 16	372,826 33
White Pine	do.	1,101	750	55,059 90	9,628 20	1,351	1,511	61,353 30	6,446 24
Total ores		95,871	1,546	3,358,197 72	1,148,599 48	83,692	134	2,822,799 25	901,589 57
Humboldt	Tailings	560	. . .	2,900 00	840 00	2,496	30	18,629 00	8,565 26
Lincoln	do.	150	. .	1,050 00	105 00	864	225	8,469 79	1,178 79
Lyon	do.	25,754	. . .	101,435 77	17,432 48	22,946	. . . .	134,433 37	38,200 78
Ormsby	do.	7,912	. .	66,732 81	27,693 01	13,185	. .	112,440 38	44,116 19
Storey	do.	. . . . .	. .	. . . .	. . . . . .	6,179	. .	43,341 45	10,311 13
White Pine	do.	5,698	. .	21,585 51	2,158 55	7,030	. .	24,420 22	2,442 00
Total tailings		40,074	. .	193,704 09	48,229 04	52,700	255	341,733 21	104,813 15

Summary of the Taxed Product of the Nevada Mines.

County.		*Quantity worked.*		*Gross yield or value.*	*Net yield or value on which tax is levied.*
		Tons.	*Pounds.*		
Elko	Ores	12,326	460	$766,218 98	$360,286 02
Esmeralda	do.	27.440	777	1,045,566 07	357,481 13
Eureka	do.	92,775	706	3,502,137 63	1,217,117 29
Humboldt	do.	14,210	709	371,888 82	133,311 59
Lander	do.	5,842	1,698	579,928 75	234,987 98
Lincoln	do.	13,942	1,370	398,761 83	77,615 45
Nye	do.	23,989	1,165	581,072 36	66,810 23
Storey	do.	163,927	600	5,482,265 07	1,995,420 09
White Pine	do.	10,671	193	419,932 31	90,743 44
Total ores		365,125	1,678	13,147,771 82	4,533,773 22
Humboldt	Tailings	4,396	30	28,029 00	10,680 26
Lincoln	do.	1,014	225	9,519 79	1,283 79
Lyon	do.	63,068	. . . .	303,954 73	72,984 93
Ormsby	do.	66,713	. . .	571,067 08	259,555 19
Storey	do.	28,340	. . .	203,992 25	56,602 69
White Pine	do.	23,064	. . . .	91,307 43	12,478 65
Total tailings	do.	186,595	255	1,207,870 28	413,585 51

UTAH—PRODUCTION BY COUNTIES OF DEEP

	County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.					Ore raised and treated (in the same counties).	Average yield per ton.		
			Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.		Gold.	Silver.	Gold and silver.
		Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.
1	Beaver	19,665.75	43	45 47	45 90	412.4	8,525	691,708	894,309	902,834	18,015.75	42	87 14	37 56
2	Juab	6,256.00	15 05	38 60	53 65	4,554.3	94,146	186,805	241,520	335,666	3,548.00	16 98	3 15	20 13
3	Piute	130.00	40 72	105 92	146 64	256.1	5,294	10,650	13,770	19,064				
4	Salt Lake	52,506.00	3 09	20 39	23 48	7,865.7	162,598	827,991	1,070,510	1,233,108	12,000.00	9 69	53	10 22
5	Summit	16,918.33		126 12	126 12			1,650,400	2,133,802	2,133,802	12,508.00		97 04	97 04
6	Do.													
7	Tooele	7,319.20		56 99	56 99			322,630	417,128	417,128	250.00		34 00	34 00
8	Utah	1,957.50		31 59	31 59			47,828	61,837	61,837				
9	Washington	49,895.00		26 71	26 71			1,030,744	1,332,649	1,332,649	46,795.00		21 66	21 66
10	Scattered	*180.00		*77 57	*77 57			*10,800	*13,963	*13,963				
	Total (a)	154,827.78	1 75	39 91	41 66	13,088.5	270,563	4,779,556	6,179,488	6,450,051	93,116.75	1 98	31 38	33 36

* Estimated.

In the preceding table, which gives the yield by counties, the ore is stated in gross tons, and the assay value and yield is of net tons, the amount of moisture being noted in the district table where important. The following is an exhibit of the proportionate amounts of ore milled and ore smelted:

UTAH—STATEMENT OF ORE MILLED AND SMELTED.

County.	District.	Ore milled.	Ore smelted.	Total ore treated.	Percentage of ore milled.	Percentage of ore smelted.
		Tons.	Tons.	Tons.		
Beaver	Bradshaw		1,771.75			100
Do.	San Francisco		16,244.00			100
Do.	Star		900.00	18,915.75		100
Juab	Tintic	3,548	2,258.00	5,806.00	61	39
Piute	Mount Baldy		80.00	80.00		100
Salt Lake	Big Cottonwood		1,575.50			100
Do.	Little Cottonwood		6,324.50			100
Do.	West Mountain (gold mines)	12,000			100	
Do.	West Mountain (silver-lead mines)		29,956.00	49,856.00		100
Summit	Uinta	12,508	565.33	13,073.33		100
Tooele	Camp Floyd	200			100	
Do.	Ophir	50	1,837.20		3	97
Do.	Rush Valley		4,032.00	6,119.20		100
Utah	American Fork		1,736.50			100
Do.	Silver Lake		121.00	1,857.50		100
Washington	Harrisburg or Silver Reef	46,795		46,795.00	100	
Scattered			180.00	180.00		100
Total		75,101	67,581.78	142,682.78	53	47

The most noticeable feature shown in the foregoing table is the large proportion of milling ore which Utah furnishes, compared with her base ores, although a territory generally supposed to be dependent upon her smelting works. It should be noted, also, that of the ore smelted there was a considerable amount which might have been treated by amalgamation, but which, because of the absence of proper milling facilities, or because of unusual richness, it was advisable to sell to the smelters. But while the percentage by weight of ore milled was 53 per cent., as against 47 per cent. for ores smelted, the same proportion does not hold with regard to value, the percentage of bullion extracted being only 51.08 per cent. for the product of amalgamating mills, as against 48.92 per cent. for that from the smelting works—a nearly even ratio. This difference is accounted for by the fact, that as a rule, the ores smelted, on account of the greater expense usually involved, are richer than the ores which will bear the milling expense, and also because of the higher proportion of the assay contents of the ore extracted by the smelting process, as compared with the milling results. The following analysis of the total bullion product of the territory shows the relative amounts coming from each source:

MINES FOR THE YEAR ENDING MAY 31, 1880.

Bullion produced from ore raised and treated during census year, as traced by counties.					Ore raised, but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.					Bullion produced during census year from ore previously raised.					Ore sold.	Cash receipts for ore sold. (Bullion accounted for in returns of smelting works.)		
Gold.		Silver.		Total.		Gold.		Silver.		Total.	Gold.		Silver.		Total.		Average price per ton.	Total receipts.	
Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Ozs.	Dolls.	Ounces.	Dollars.	Dollars.	Ozs.	Dolls.	Ounces.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	
369.5	7,638	517,463	669,028	676,666	750	. . .	. . .	30,000	38,787	38,787	74.6	1,542	4,984	6,444	a7,986	900.00	8 00	7,200	1
2,914.0	60,238	8,663	11,200	71,438	450	135.5	2,801	5,260	6,800	9,601	. . .	. . .	. . .	. . .	. . .	2,258.00	45 11	102,860	2
. . .	. . .	. . .	. . .	. . .	50	. . .	. . .	1,547	2,000	2,000	. . .	. . .	. . .	. . .	. . .	80.00	98 06	7,845	3
6,627.4	116,329	4,830	6,309	122,638	2,650	29.0	600	26,500	34,262	34,862	. . .	. . .	. . .	. . .	. . .	37,856.00	22 76	861,789	4
. . .	. . .	938,762	1,213,725	1,213,725	3,845	. . .	. . .	370,269	478,720	478,720	. . .	. . .	107,911	139,518	139,518	565.33	13 13	7,420	5
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	300.00	40 00	b12,000	6
. . .	. . .	6,575	8,501	8,501	1,200	. . .	. . .	12,839	16,600	16,600	. . .	. . .	. . .	. . .	. . .	5,869.20	50 42	295,947	7
. . .	. . .	. . .	. . .	. . .	100	. . .	. . .	3,867	5,000	6,000	. . .	. . .	. . .	. . .	. . .	1,857.50	29 68	55,135	8
. . .	. . .	784,065	1,013,718	1,013,718	3,100	. . .	. . .	57,227	73,989	73,989	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	9
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	*180.00	*60 00	*10,800	10
8,910.9	184,205	2,260,408	2,922,481	3,106,666	12,145	164.5	3,401	507,509	656,158	659,559	74.6	1,542	112,895	145,962	147,504	49,866.03	27 29	1,360,996	

* Estimated. a From 357.5 tons raised prior to census year. b For 300 tons concentrations.

UTAH—ANALYSIS OF PRODUCT.

Classification of source.	Gold.	Silver.	Total.
Amalgamating mills, from ore raised during census year	$175,024	$2,247,009	$2,422,033
Amalgamating mills, from ore raised prior to census year	. . . .	139,518	139,518
Total from mills	175,024	2,386,527	2,561,551
Smelting-works, from ore raised during census year	94,989	2,349,948	2,444,937
Smelting-works, from ore raised prior to census year	1,542	6,444	7,986
Total from smelting-works	96,531	2,356,392	2,452,923
Total from mills and smelting-works	271,555	4,742,919	5,014,474
Placer mines	20,000	. . . .	20,000
Total	291,555	4,742,919	5,034,474

The average product of the Utah milling ores and ores smelted, and the average yield of all the Utah ore reduced by either process during the census year, was as follows:

UTAH—COMPARATIVE RESULTS OF TREATMENT.

Metal.	Average yield of—		
	Ores milled.	Ores smelted.	All ore treated.
Gold, per ton	$2 33	$1 40	$1 90
Silver, per ton	29 92	34 78	33 24
Total	32 25	36 18	35 14

The next table shows the base bullion product of the Utah smelting works, with the precious-metal contents. It includes the yield of ores sent from Idaho, Montana and Nevada to the Utah smelters, and also the product of a small quantity of ore which was raised prior to the census year.

UTAH—BASE BULLION PRODUCTION OF SMELTING WORKS FOR THE YEAR ENDING MAY 31, 1880.

County.	Refined lead.	Crude bullion, including weight of silver and gold contents.	Precious metals contained in base bullion.				
			Gold.		Silver.		Total.
	Pounds.	Pounds.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Beaver	. . . . . .	8,312,957	444.1	9,180	522,447	675,472	684,652
Salt Lake	2,586,370	16,781,778	3,731.4	77,135	1,159,583	1,499,225	1,576,360
Tooele	. . . . . .	3,118,766	335.9	6,944	131,876	170,502	177,446
Total	2,586,370	28,213,501	4.511.4	93,259	1,813,906	2,345,199	2,438,458

Deducting from the crude bullion product 322,170 pounds, produced from Idaho, Montana and Nevada ores smelted in Utah, the remainder, 27,891,331 pounds, is the yield of Utah ores smelted in the territory. To this should be added 865,500 pounds of crude lead bullion, the estimated yield of Utah ores smelted in Chicago and in Omaha. The total crude bullion product of Utah for the census year, is therefore, 28,756,831 pounds.

The gross precious metal product of the Utah smelting works, given in the preceding table, is segregated as follows:

UTAH—PRODUCT OF ORES SMELTED IN UTAH DURING CENSUS YEAR.

Product.			Gold bullion.		Silver bullion.		Total.
			Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Product of smelting works (precious metals contained in base bullion)			4,511.4	93,259	1,813,906	2,345,199	2,438,458
Deduct product of Beaver county smelting works			444.1	9,180	522,447	675,472	684,652
Product of smelting works, less product of Beaver county smelting works			4,067.3	84,079	1,291,459	1,669,727	1,753,606
From this deduct:	Ounces.	Dollars.					
Product of Nevada ores smelted in Utah (a)	14,994	a19,386	. . .	. . .	. . .	. . .	. . .
Product of Idaho ores smelted in Utah (b)	16,916	b21,871	. . .	. . .	. . .	. . .	. . .
Product of Montana ores smelted in Utah (c)	5,116	c6,614	. . .	. . .	. . .	. . .	. . .
Product of Nevada sulphides from leaching works	15,469	20,000	. . .	. . .	. . .	. . .	. . .
Total	52,495	67,871	. . .	. . .	52,495	67,871	67,871
Net product of Utah ores smelted in Utah during census year			4,067.3	84,079	1,238,964	1,601,856	1,685,935

a 359 tons containing 25 per cent. lead. Estimated product, 80.775 tons lead.
b 162 tons containing 45 per cent. lead. Estimated product, 65.610 tons lead.
c 49 tons containing 30 per cent. lead. Estimated product, 14.700 tons lead.

In addition to the bullion product from ores which were treated in the territory, there was also a considerable yield from ores and matte shipped to Chicago and to Omaha and reduced at these points. As nearly as ascertainable, this additional product was as follows:

UTAH—BULLION PRODUCED FROM UTAH ORES AND MATTE, TREATED ELSEWHERE THAN IN THE TERRITORY.

Ores and matte shipped to Chicago and Omaha.	Assay value per ton.			Total assay value.					Estimated yield per ton.			Estimated product to be included in total production of Utah.					Remarks.
	Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.	Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.	
Tons.	Dolls.	Dolls.	Dolls.	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.	Dolls.	Dolls.	Dolls.	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.	
1,180	1 63	54 54	56 07	93	1,922	49,689	64,243	66,165	1 49	49 00	50 49	83.7	1,730	41,720	57,819	59,549	Con. 865,500 lbs. lead.
241	. . .	64 64	64 64	. . .	. . . .	12,050	15,579	15,579	. . .	61 41	61 41	. . .	. . . .	11,448	14,801	14,801	Con. 96,400 lbs. copper
1,421	. . .	. . . .	. . . .	93	1,922	61,739	79,882	81,744	. . .	. . .	. . . .	83.7	1,730	56,168	72,620	74,350	

From the preceding tables the following *résumé* is derived:

RÉSUMÉ.

Classification of product.	*Bullion.*				
	Gold.		*Silver.*		*Total.*
	Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Bullion product traceable by districts from Utah ore raised during census year	8,910.9	184,205	2,260,408	2,922,481	3,106,686
Bullion product traceable by districts from Utah ore raised prior to census year	74.6	1,542	112,895	145,962	147,504
Net bullion product from Utah ores sold to and treated by Utah smelting works during census year	4,067.3	84,079	1,238,964	1,601,857	1,685,936
Estimated bullion product of ores and matte shipped to Chicago and Omaha during census year	83.7	1,730	56,168	72,620	74,350
Product of placer mines (of West mountain district, Salt Lake county) during census year	967.5	20,000	. . . .	. . .	20,000
Total	14,104.0	291,556	3,668,435	4,742,920	5,034,476

Utah Placer Gold.—The small placer product of the territory ($20,000 in the census year) was from West Mountain district, in Salt Lake county.

Market Value of Utah Base Bullion.—The gold and silver contents of the base bullion are sold at a price which allows for the refining charge on each metal, with, of course, the market discount on the silver. Thus the gold contents brought from $19 to $20 per ounce, and the silver an average of $1.10 per ounce during the census year. The average price of refined lead at Salt Lake City during the same period was 4¾ cents per pound, and that of unrefined lead $47.50 per ton.

Market value of 2,586,370 pounds refined lead	$122,853
Market value of 28,756,831 pounds unrefined lead	682,975
Total	$805,828

This represents roughly, the value at the seaboard after deducting freight charges, commissions, etc. There were also $14,160 worth of copper sold, the product of Utah ores worked for the extraction of the precious metals. Adding the market value of the lead and copper, all of it an accessory product of the precious metal industries, to the mint value of the precious metals, the total product of the Utah mines is raised to $5,854,462. This does not include the value of iron ore sold for flux, and some other small items.

Wells, Fargo & Co.'s Estimates of the Utah Bullion Product.—By way of comparison, the following estimates of the Utah bullion product, furnished by J. E. Dooly, agent of Wells, Fargo & Co., at Salt Lake City, are appended. They are for the calendar years 1879 and 1880.

WELLS, FARGO & CO.'S STATEMENT OF THE MINERAL PRODUCT OF UTAH FOR 1879.

Base bullion.	*Lead, refined.*	*Lead, unrefined.*	*Silver.*	*Gold.*
	Pounds.	*Pounds.*	*Ounces.*	*Ounces.*
Chicago smelter	. . . .	1,739,138	90,006	270
Germania smelting and refining works	2,301,276	. . . . . .	344,836	2,202
Horn silver mine (Frisco smelter)	. . . .	4,134,832	248,936	632
Horn silver mine (Horn Silver Mining Company's smelter)	. . . .	5,660,298	347,313	10
Marsac company	. . . .	30,299	54,552	. . . .
Mingo Furnace company	. .	3,925,104	245,330	931
Morgan smelter	. .	2,673,200	257,568	1,480
Old Telegraph company	. . . . . .	6,128,927	153,735	92
Pascoe smelter	. . .	14,248	5,790	24
Waterman smelter	. . . .	235,004	7,285	. . . . .
Total	2,301,276	24,541,050	1,755,360	5,641
Lead, silver and gold, in ores, shipped	. . . . .	1,900,309	42,229	52
Total (ores and base bullion)	2,301,276	26,441,359	1,797,589	5,693
DORÉ BARS AND DUST.				
Germania smelting and refining works			24,680	240
Ontario Silver Mining company			1,165,180	. . . .
Stewart Mining company			. . . .	5,999
Other mills			6,043	3,000
Bingham placers			. . . .	1,000
Leeds district (Silver Reef)			841,555	. . . . .
Total			2,037,458	10,239

RECAPITULATION.

2,301,276 pounds refined lead, at 4½ cents per pound	$103,557 42
26,441,359 pounds unrefined lead, at $45 per ton (average price for 1879)	594,930 57
3,835,047 ounces silver at $1.10 per ounce (average price for 1879)	4,218,551 70
15,932 ounces gold, at $19 per ounce (average price for 1879)	302,708 00
Total	$5,219,747 69

Mr. Dooly states the foregoing exhibit "includes the product of ores received from Idaho, Montana, and Nevada, aggregating 126,000 pounds lead, 102,800 ounces silver, and 200 ounces gold."

WELLS, FARGO & CO.'S STATEMENT OF THE MINERAL PRODUCT OF UTAH FOR 1880.

Base bullion.	Lead, refined.	Lead, unrefined.	Silver.	Gold.
	Pounds.	Pounds.	Ounces.	Ounces.
Chicago smelter		2,990,861	127,382	357
Germania smelting and refining works.	2,892,498	1,722,865	162,909	685
Horn silver mine (Frisco smelter)		2,017,991	125,722	550
Horn silver mine (Horn Silver Mining Company's smelter)		6,646,357	463,552	
Mingo Furnace Company		6,464,382	272,832	675
Morgan smelter		2,733,782	157,374	519
Old Telegraph Company		4,242,608	119,401	159
Other smelters		152,234	4,841	44
Total	2,892,498	26,971,080	1,434,013	2,989
Deduct base bullion purchased for Germania refining works.		1,360,587	54,218	134
Net product base bullion	2,892,498	25,610,493	1,379,795	2,855
Lead, silver and gold, in ores, shipped.		831,600	24,024	23
Total refined lead, ores and base bullion	2,892,498	25,442,093	1,403,819	2,878
DORÉ BARS.				
Germania refining works.			36,422	115
Ontario Silver Mining Company			1,439,542	
Tintic Milling and Mining Company			41,923	58
Other mills			15,793	4,118
Bingham placers.				850
Silver Reef mills.			846,062	
Total doré bars			2,379,747	5,142

RECAPITULATION.

2,892,498	pounds refined lead, at 5 cents per pound	$144,524 90
26,442,093	pounds unrefined lead, at $50 per ton (average price for 1880)	661,052 32
3,783,566	ounces silver, at $1.10 (average price for 1880)	4,161,922 60
8,020	ounces gold, at $20	160,400 00
	Total export value.	$5,127,999 82

In explanation, the agent observes:

The above includes the product of ores received from Idaho, Montana, and Nevada, aggregating 784,450 pounds lead and 120,383 ounces silver. Computing the gold and silver at the mint valuation and lead at its value at the seaboard, it would increase the value of the product to $6,450,953.70.

Arizona.—A marked impulse has been given to the mining industry of Arizona by the fine showing of the new Tombstone district, in Pima county. The bullion production of this district had only begun in the period covered by the census year. A few months later, with increased mining facilities, a considerably higher rate of production was maintained.

The accompanying tables contain a probable error of at least 20 per cent., owing to the fact that no schedule data were available for estimating the production from the following sources: Various districts in Apache county; in Maricopa county, the Vulture mine (a large producer) and Myers district; in Mohave county, Aubrey, Hope, and San Francisco districts; in Pima county, Aztec, De Frees, Huachucha, Patagonia, Santa Catarina, and Tyndall districts, also several important mines in Tombstone district; in Pinal county, Mineral, Pinal, Randolph and Summit districts, also the Silver King mine in Pioneer district and the Silver Era mine in Globe district; in Yavapai county, Agua Fria, Greenwood, Hassayampa, Lynx Creek, Martinez, Pine Grove, and Turkey Creek districts; in Yuma county, Bill Williams' Fork, Eureka, Harcuvar, La Paz, Montezuma, and Weaver districts. The estimates given for the production from the sources mentioned as not included in the schedule data furnished by the experts accordingly have a wide margin of uncertainty in comparison with the statements of the yield of localities from which fuller information was received.

ARIZONA—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

	County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.				
			Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
		Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
1	Maricopa	1,980.00	1 61	114 43	115 94	145.1	2,999	176,039	227,601	230,600
2	Mohave	2,618.50	10 70	84 30	95 00	1,367.1	28,260	170,729	220,736	248,996
3	Pima	25,338.00	9 74	76 82	86 56	11,941.4	246,851	1,505,428	1,946,368	2,193,219
4	Pinal	1,201.00	21 33	31 60	52 03	1,239.3	25,619	29,352	37,949	63,568
5	Yavapai	6,600.00	4 41	123 70	128 11	*1,408.9	*29,125	631,487	816,450	845,575
6	Yuma	1,930.00	3 56	35 49	39 06	332.6	6,875	52,973	68,489	75,364
	Total	39,676.50	8 56	83 61	92 17	16,434.4	339,729	2,566,008	*3,317,593	3,657,322
	*Additional production	*8,576.00	*9 35	*114 99	*124 34	*3,877.9	*80,163	*762,745	*986,153	*1,066,316
	*Total production	*48,252.50	*8 70	*89 19	*97 89	*20,312.3	*419,892	*3,328,753	*4,303,746	*4,723,638

* Estimated.

ARIZONA—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

County.	*Ore raised and treated.*	*Average yield per ton.*			*Bullion produced from ore raised and treated during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Maricopa	264.00	...	376 44	376 44	...	...	76,866	99,380	99,380
Mohave	893.00	10 36	114 49	124 85	447.5	9,251	79,084	102,248	111,499
Pima	12,448.50	9 74	76 82	86 56	4,680.2	96,748	623,499	806,122	902,870
Pinal	119.75	21 09	40 33	61 42	122.2	2,526	3,735	4,829	7,355
Yavapai	3,223.00	3 32	144 79	148 11	517.6	10,700	380,933	466,650	477,350
Yuma	204.00	5 00	...	5 00	49.3	1,019	...	...	1,019
Total	17,152.25	7 01	86 24	93 25	5,816.8	120,244	1,144,117	1,479,229	1,599,473
*Additional production	*8,576.00	*7 01	*86 24	*93 25	*2,908.4	*60,122	*572,059	*739,615	*799,737
*Total production	*25,728.25	*7 01	*86 24	*93 25	8,725.2	*180,366	*1,716,176	*2,218,844	*2,399,210

County.	*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*					*Bullion produced during census year from ore previously raised.*				
		Gold.		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Maricopa	1,725.00	145.1	2,999	82,276	106,375	109,374	...	...	...	...	...
Mohave	1,725.00	709.2	14,660	85,737	110,849	125,509	...	...	10,929	14,130	14,130
Pima	12,889.50	5,848.5	120,899	762,674	986,061	1,106,960	...	...	...	...	...
Pinal	1,081.25	1,163.5	24,052	15,287	19,764	43,816	...	...	...	...	...
Yavapai	3,377.00	*740.2	*15,301	210,525	272,188	287,489	77.4	1,600	71,617	92,594	94,194
Yuma	1,726.00	61.2	1,265	62,973	68,489	69,754	...	...	...	...	...
Total	22,524.25	8,667.7	179,176	1,209,472	1,563,726	1,742,902	77.4	1,600	82,546	106,724	108,324
*Additional production	...	...	...	...	...	...	...	...	...	...	...
*Total production	22,524.25	8,667.7	179,176	1,209,472	1,563,726	1,742,902	77.4	1,600	82,546	106,724	108,324

* Estimated.

ARIZONA—PRODUCTION OF PLACER MINES FOR THE YEAR ENDING MAY 31, 1880.

County and district.	*Gold.*	
	Ounces.	*Dollars.*
YAVAPAI COUNTY.		
Castle Creek	72.5	1,499
Hassayampa	193.5	4,000
Walker	241.9	5,000
Walnut Grove	48.4	1,001
Weaver No. 2	241.9	5,000
Total, as derived from schedule data	798.2	16,500
Additional production, estimated	*653.0	*13,499
Total production, estimated	*1,451.2	*29,999

* Estimated.

Idaho.—The tabulation of the output of this territory is based upon reports of the examining expert on 369 deep mines, 14 placer mines, 18 amalgamating mills, 2 arrastras, and 2 smelting works, besides several general reports on whole districts. From 1876 up to the close of the census year, the product of this territory has been mainly dependent upon the older mining districts, of which the placer mines of Boise basin have contributed a large proportion. The panic in the stock market of San Francisco in 1876 led to a suspension of operations in the principal Owyhee mines, which for some years previous to that period had yielded large returns. This crash was due quite as much to mismanagement of the mines themselves as to causes inherent in the speculative market; but whatever the reason, the result was the closing down of many mines which probably would have been still largely productive if properly worked. As the case now stands, the Owyhee district, which formerly yielded by far the greater part of the total output of the territory, at present furnishes only about one-fifth of the aggregate. It is to be hoped that at no distant time in the future this district may again appear as a large producing centre.

Had the census statistics been collected only a few months later, the new and promising Wood river country would have added largely to the total product. Operations in this district were only seriously begun toward the close of May, 1880; hence the large product from ores shipped to Salt Lake during the fall of the same year does not enter into the tabulation for the census year.

In addition to the developments in the Wood river country, a number of other new localities appear as future important productive sources, prominent among which is the Sawtooth district, which from the absence of local milling facilities was at a standstill pending the erection of reduction works. Another year will witness a considerable bullion production from the mines of this district. The same remark holds good with regard to Smiley's cañon, from which a small amount of ore was shipped at great expense to distant points for reduction. The returns from these shipments were such as to give great hope for a large increase when it becomes possible to treat the ores at greater advantage in mills placed near the mines.

In the Yankee Fork region, a decided impulse—the effect of which was not shown until the opening of the season of 1881—was given by the erection of the fine and well appointed mill of the Custer company. Previous to the building of this mill the ores of the district had either to be worked in arrastras, with a large percentage of loss, or be freighted at a heavy charge to Salt Lake, or elsewhere, for treatment. In spite of these disadvantages two mines were shipping considerable amounts of $900 ore, while a third was developing an immense body of ore which was expected to yield $300 per ton. The smelting works recently constructed at Bay Horse and Kinnikinnick will also add largely to the total product. The period covered by the census year, while one of great promise for the future of the territory, nevertheless showed a comparatively small yield. The probabilities are that within two years the output of Idaho will at least have doubled. The deposits of Idaho bullion (so far as it is possible to segregate them—a very large portion having passed through private refineries and thus losing their identity) up to the close of the fiscal year ending June 30, 1880, are stated by the director of the mint to have been $24,137,417 gold, $727,296 silver, and $24,864,713 total. This amount is considerably within the actual output. Of the total gold product of Idaho, 59.45 per cent. is from the placers, and 40.55 per cent. from the deep mines. Idaho furnishes 7.33 per cent. of the placer output of the United States, 2.81 per cent. of the deep-mine gold, and 4.43 per cent. of the total gold; 1.13 per cent. of the silver, and 2.61 per cent. of the entire product of the precious metals in the whole country. As a gold-producer the territory ranks sixth, and in silver, seventh. The average yield per square mile is $17.45 gold, $5.48 silver, and $22.93 total. In this respect Idaho stands fifth in point of gold, seventh in silver, and sixth in developed richness in gold and silver. The average yield per capita is $45.37 gold, $14.25 silver, and $59.62 in both precious metals, placing the rank as regards product in reference to population, third as to gold, sixth as to silver, and fifth altogether. The comparison with regard to population is probably the most reliable test of the relative prosperity of a mining region.

IDAHO—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Alturas	4,077.75	36 43	40 12	82 55	7,185.4	148,535	145,477	188,087	336,622
Boisé	16,605.00	16 92	6 51	23 43	13,594.3	281,019	83,684	108,195	389,214
Idaho	*500.00	*25 00		*25 00	604.7	*12,500			*12,500
Lemhi	*5,000.00	*60 00	*60 00	*120 00	14,512.5	*300,000	232,036	*299,999	*599,999
Nez Percés	*300.00	*20 00		*20 00	290.3	*6,001			*6,001
Oneida	*500.00	*25 00		*25 00	604.7	*12,500			*12,500
Owyhee (a)	8,342.75	32 35	33 81	66 16	13,057.7	269,927	218,190	282,098	552,025
Washington	500.00	15 00		15 00	362.8	7,500			7,500
Total	35,825.50	28 97	24 52	53 49	50,212.4	1,037,982	679,387	878,379	1,916,361

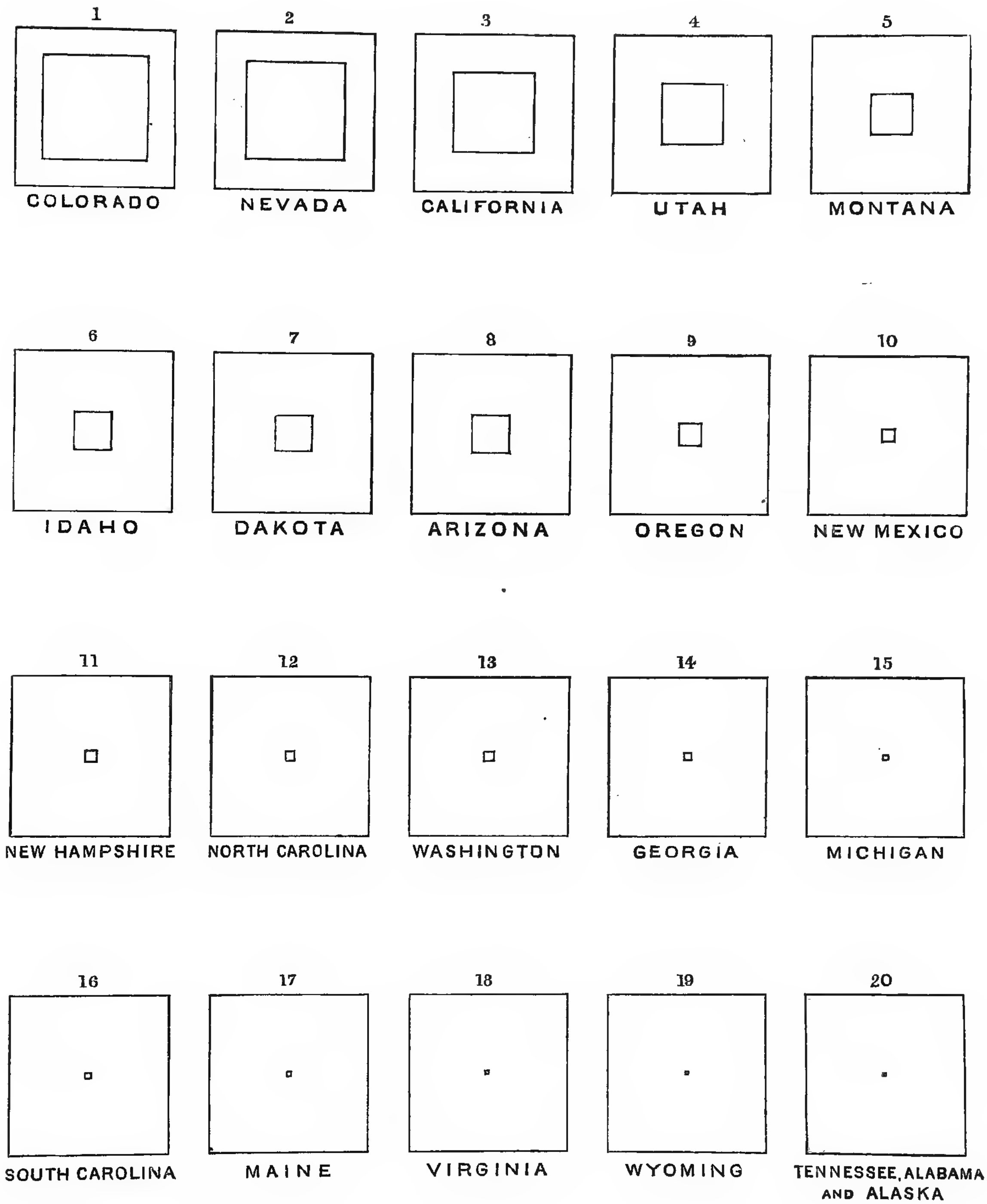
County.	Ore raised and treated.	Average yield per ton.			Bullion produced from ore raised and treated during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Alturas	908.00	53 13	65 45	118 58	2,333.7	48,242	45,971	59,436	107,678
Boisé	15,645.00	13 44	5 39	18 83	10,169.9	210,230	65,330	84,465	294,695
Idaho	*500.00	*20 00		*20 00	483.7	*9,999			*9,999
Lemhi	*2,500.00	*50 00	*50 00	*100 00	6,040 9	*125,001	96,683	*125,001	*250,002
Nez Percés	*300.00	*15 00		*15 00	217.7	*4,500			*4,500
Oneida	*500.00	*20 00		*20 00	483.7	*9,999			9,999
Owyhee (a)	7,176.75	25 09	24 68	49 77	8,712.4	180,101	136,985	177,108	357,209
Washington	500.00	10 00		10 00	241.9	*5,001			*5,001
Total	28,029.75	21 16	15 91	37 07	28,689.9	593,073	344,969	446,010	1,039,083

County.	Ore raised, but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.					Bullion produced during census year from ore previously raised.				
		Gold.		Silver.		Total.	Gold.		Silver.		Total.
	Tons.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Alturas	3,169 75	4,396.7	90,888	95,653	123,670	214,558	169.3	3,500	2,707	3,500	7,000
Boisé	960.00	1,867.0	38,594	13,388	17,309	55,903	166.2	3,436			3,436
Idaho											
Lemhi	*2,500 00	7,256.2	*149,999	116,018	*150,000	*299,999					
Nez Percés											
Oneida											
Owyhee (a)	*1,166,00	2,891.7	59,777	58,563	75,716	135,493					
Washington											
Total	7,795 75	16,411.6	339,258	283,622	366,695	705,953	335.5	6,936	2,707	3,500	10,436

* Estimated.

a Including 300 tons tailings reworked.

BULLION PRODUCT PER SQUARE MILE.



IDAHO—PRODUCTION OF HYDRAULIC, PLACER, DRIFT, AND RIVER MINES FOR THE YEAR ENDING MAY 31, 1880.

County and district.	Gold. Totals, by counties.	
	Ounces.	Dollars.
ADA.		
Various small placers	241.9	5,001
ALTURAS.		
Bane's Diggings, Bear Creek, California Bar, Elk Creek, Middle Boisé, Parsons' Bar, Red Warrior, Stanley Basin, Tuscarora Bar, scattered	1,693.1	34,999
BOISÉ.		
Bear Run, Boston, Bummer Hill, Centerville, Cold Spring Gulch, Elk Creek, Granite, Grayback Bar, Grimes' Creek, Larraway Creek, Last Chance Bar, Moore's Creek, Noble's Gulch, Pioneer, Placerville, Squaw Creek, Willow Creek, scattered	30,120.4	622,644
CASSIA.		
Bonanza Bar, Rock Creek, Salmon Falls, scattered	967.5	20,000
IDAHO.		
Butts' Bar, Copeland Diggings, Elk City, Florence, Gold Fork, Little Salmon River, Mallett's Placers, Meadow Creek, Miller Creek, Salmon River, Sand Creek, South Fork, Warren's, scattered	2,902.5	60,000
LEMHI.		
Anderson Creek, Curly Creek, Dahlonega or Gibbonsville, Jordan Creek, Salmon City, Yankee Fork, scattered	967.5	20,000
NEZ PERCÉS.		
Various small placers	483.8	10,001
ONEIDA.		
Eagle Rock, Iowa Bar, Snake River, Tin Cup, scattered	1,451.2	29,999
OWYHEE.		
Blue Gulch, Bruneau Valley, Jordan Creek, Meadow Creek, Ruby Gulch, scattered	2,515.5	52,000
SHOSHONE.		
Number One, scattered	483.8	10,001
WASHINGTON.		
Various small placers	725.6	14,999
Total	42,552.8	879,044

Oregon.—Oregon is one of the oldest of the western mining states, the discovery of gold within its limits having followed closely upon that in California. Its output has never been very large, in comparison with the yield of its neighbor state, but although the mines have become secondary to its agricultural resources in point of importance, they still furnish occupation and profit to many of its inhabitants. The quartz veins of Baker county, in the eastern portion of the state, adjoining Idaho territory, continue to yield the larger portion of the total deep-mine product of this state. The prevailing type of the Oregon ores is a free gold quartz, though rebellious gold ores, requiring special treatment, are found in some localities, and a small amount of silver is produced in Grant county. The latter county takes the lead in surface mining, while Baker, Jackson, and Josephine counties are also productive of a considerable amount of placer gold. Oregon now ranks seventh on the roll of the mining states in production of gold, eleventh in output of silver, and ninth in its yield of both metals. Its quota toward the total production of the United States is 7.71 per cent. of the placer gold, 0.80 per cent. of the deep-mine gold, 3.29 per cent. of the total gold, and only 0.07 per cent. of the total silver. The percentage of the total combined gold and silver product is 1.51 per cent. The average yield per square mile is $11.43 gold, $0.29 silver, and $11.72 total. The product per capita is $6.28 gold, $0.16 silver, and $6.44 total, giving Oregon a rank of seventh in gold, tenth in silver, and ninth in total bullion output, in point of production as relative to population. The small proportion per capita shows how completely mining has been overshadowed by other industries in this state.

Washington.—Of the small product reported from the deep mines of Washington territory, nearly the whole comes from Peshaston district, in Yakima county, where gold quartz mining is conducted on a small scale.

The Upper Columbia placers furnish over one-half of the total placer yield of the territory. The Skagit mines, in Whatcom county, about which, from time to time, reports glittering with golden promise have been spread, are not yet to be numbered among the important productive deposits of the country. They have attracted much attention from the press, and have been the scene of several incipient "rushes," but the shortness of the season, inaccessibility, and other natural disadvantages have combined to retard operations, and the yield is still very scanty.

OREGON—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay per ton.			Total assay value of ore raised during census year.					Ore raised and treated.	Average yield per ton.		
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.		Gold.	Silver.	Gold and silver.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.
Baker	12,737	11 00	1 59	12 59	6,776.9	140,091	15,713	20,315	160,406	12,607	7 80	34	8 14
Grant	1,200	76 87	45 88	122 75	4,462.1	92,240	42,579	55,051	147,291	1,015	67 21	13 43	80 64
Josephine	150	*34 83	.....	*34 83	*252.7	*5,224	....	....	*5,224	150	31 66	....	31 66
Total	14,087	16 86	5 35	22 21	11,491.7	237,555	58,292	75,366	312,921	13,772	12 44	1 30	13 74

*Estimated.

OREGON—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

County.	Bullion produced from ore raised and treated during census year.					Ore raised but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.					Bullion produced during census year from ore previously raised.				
	Gold.		Silver.		Total.		Gold.		Silver.		Total.	Gold.		Silver.		Total.
	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.	Tons.	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.
Baker	4,755.5	98,305	3,331	4,307	102,612	130	188.7	3,901	3,017	3,901	7,802	4.3	0 89	1,285	1,661	1,750
Grant	3,300.2	68,221	10,549	13,639	81,860	185	894.9	18,499	28,617	36,999	55,498	...	...	...	...	...
Josephine	229.8	4,750	....	....	4,750	...	....	....	....	....	....	...	...	...	...	...
Total	8,285.5	171,276	13,880	17,946	189,222	315	1,083.6	22,400	31,634	40,900	63,300	4.3	0 89	1,285	1,661	1,750

OREGON—PRODUCTION (GOLD) OF HYDRAULIC, PLACER, DRIFT, AND RIVER MINES FOR THE YEAR ENDING MAY 31, 1880.

County and district.	Gold. Total by districts.		Gold. Total by counties.	
	Ounces.	Dollars.	Ounces.	Dollars.
BAKER.				
Amelia	290.2	5,999		
Blue Cañon	333.8	6,900		
Chicken Creek	259.3	5,360		
Humboldt Basin	435.4	9,001		
Mormon Basin	130.6	2,700		
Pocahontas	1,805.2	37,317	7,262.8	150,135
Rye Valley	1,112.6	22,999		
Shasta	747.4	15,450		
Sumter	1,632.6	33,749		
Willow Creek	515.7	10,660		
COOS.				
Black Hawk	3.6	74	3.6	74
CURRY.				
Sixes River	453.5	9,375	453.5	9,375
DOUGLAS.				
Big Bend, Cow Creek	177.6	3,671		
Cañonville	237.7	4,914	620.5	12,827
Green Mountain	205.2	4,242		
GRANT.				
Cañon City	6,482.3	134,001		
Elk Creek	4,837.5	100,000		
Granite	353.1	7,299		
Marysville	774.0	16,000	14,096.5	291,401
Prairie City	967.5	20,000		
Rock Creek	203.2	4,201		
Trail Creek	478.9	9,900		
JACKSON.				
Applegate	261.2	5,400		
Ashland	106.8	2,208		
JACKSON—continued.				
Coyote Creek	322.9	6,675		
Dry Diggings	145.1	3,000		
Farris Gulch	290.1	5,997		
Fort Lane	435.4	9,001		
Forty-Nine	285.9	5,910		
Grass Creek	290.3	6,001		
Jackass Creek	967.5	20,000		
Jacksonville	822.3	16,998	9,132.7	188,790
Rogue River	483.8	10,001		
Sam's Valley	35.6	736		
Sardine Creek	1,161.0	24,000		
Sterling	1,511.3	31,241		
Uniontown	1,088.4	22,499		
Willow Springs	361.8	7,479		
Wolf Creek	563.3	11,644		
JOSEPHINE.				
Althouse	2,418.8	50,001		
Cañon Creek	483.8	10,001		
Grass Creek	192.1	3,971		
Illinois	967.5	20,000		
Josephine	725.6	15,000	9,503.4	196,453
Murphy	27.0	558		
Silver Creek	725.6	15,000		
Waldo	799.5	16,527		
Yank	3,163.5	65,395		
UMATILLA.				
Scattered	3,680.4	76,080	3,680.4	76,080
WASCO.				
Ochoco	58.1	1,201	58.1	1,201
	44,811.5	926,336	44,811.5	926,336

WASHINGTON—PRODUCTION OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.					Ore raised and treated.	Average yield per ton.		
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.		Gold.	Silver.	Gold and silver.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Dolls.	Dolls.	Dolls.
Yakima (Peshaston district)	437	*41 85	Trace.	*41 85	884.6	*18,286	.....	.....	*18,286	437	31 59	Trace.	31 59
Scattered	100	37 50	Trace.	37 50	181.4	3,750	.....	.....	3,750	100	30 00	Trace.	30 00
Total	537	41 04	Trace.	41 04	1,066.0	22,036	.....	.....	22,036	537	31 28	Trace.	31 28

WASHINGTON—PRODUCTION OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

County.	Bullion produced from ore raised and treated during census year.					Ore raised but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.					Bullion produced during census year from ore previously raised.				
	Gold.		Silver.		Total.		Gold.		Silver.		Total.	Gold.		Silver.		Total.
	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.	Tons.	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.	Ozs.	Dolls.	Ozs.	Dolls.	Dolls.
Yakima (Peshaston district)	667.6	13,801	. . .	. . .	13,801	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Scattered	145.1	2,999	. . .	. . .	2,999	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Total	812.7	16,800	. . .	. . .	16,800	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

* Estimated.

WASHINGTON—Production (Gold) of Hydraulic, Placer, Drift, and River Mines for the year ending May 31, 1880.

Locality.	Gold.	
	Ounces.	Dollars.
Whatcom county, Skagit mines	193.5	4,000
Yakima county, Swauk mines	483.7	9,999
Upper Columbia placers	2,902.5	60,000
All other places	2,176.9	45,001
Total	5,756.6	119,000

Alaska.—This vast territory, occupying an area of over half a million square miles, is for the most part still an unexplored region. The small amount of prospecting which has been done has developed the fact that Alaska contains many gold-bearing localities, none of which, however, have yet yielded any considerable output. The climate and remoteness from communications will always be obstacles in the way of mining, but in spite of the natural disadvantages of the country, it is reasonable to look for an increased product in the future. Recent reports, much exaggerated, of fabulous discoveries of mountains of silver ore, have attracted many adventurous miners to Alaska. Thus far only disappointment has resulted. The small amount of placer gold received at the San Francisco mint from Alaska during the census year, $5,951, does not perhaps represent the whole product, as a portion may have found its way to Victoria, and thus have become identified with the product of British Columbia. No means of tracing this small possible balance are at hand. The total was in any event insignificant.

Colorado.—From an average production of only three or four millions, Colorado has suddenly risen to the first rank as a producer of the precious metals among the states and territories for gold and silver combined; as for silver alone it ranks first, while for gold it holds the fourth rank. In the relation of production to area, it holds the first rank, likewise, for gold and silver combined and for silver alone, and the third for gold alone. In the relation of production to population, however, it ranks only third for gold and silver together, second for silver alone, and sixth for gold alone. The total value of its product during the census year in gold and silver, was in round numbers, nineteen and a quarter million dollars, and if we add to this the value of lead and copper in crude metal produced, we have a total value of metallic product of twenty-two and three-quarters million dollars.

The collection of statistics of the precious metals in this state presents certain peculiar difficulties. First, from the fact that there are so many small mines which keep no accurate record of their production; second, because a very large proportion of its ores, being essentially heterogeneous in composition, have to be smelted, and are thus more difficult to trace than milling ores. The smelting ores are sold, it is true, mostly to smelters within the state, but the same mine often sells to different and widely separated works, and the smelters themselves buy ores in small lots from many mines, of which no separate record is kept. Moreover, the check furnished in the more western states over the total production by the express returns is here wanting, since, practically, the whole silver product is shipped east in lead bullion of which the transportation companies keep no record. Nevertheless, owing to the almost uniform willingness which the more important mine-owners, samplers and smelters have shown to afford the data which they possessed,

COLORADO—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Boulder	7,868	58 17	49 46	107 63	22,137.0	457,612	301,025	389,195	846,807
Chaffee	979	20 58	171 64	192 22	975.0	20,155	129,965	168,032	188,187
Clear Creek	37,031	10 15	52 79	62 94	18,191.0	376,041	1,511,754	1,954,547	2,330,588
Custer	16,004	91	37 17	38 08	706.0	14,594	462,721	598,252	612,846
Gilpin	123,668	16 27	5 46	21 73	97,337.0	2,012,134	521,871	674,727	2,686,861
Gunnison	252	36 02	721 03	757 06	439.2	9,079	140,537	181,700	190,779
Hinsdale	2,695	3 07	69 45	72 52	400.0	8,269	144,762	187,163	195,432
Huerfano	35	20 69	96 97	117 66	35.0	724	2,625	3,394	4,118
Lake (c)	152,451	54	90 04	90 58	4,000.0	82,687	10,617,216	13,726,999	13,809,686
La Plata	12	10 00	246 75	256 75	5.8	120	2,290	2,961	3,081
Ouray	1,790	41 41	154 81	196 22	3,585.5	74,119	214,327	277,103	351,222
Park	5,364	1 36	146 21	147 57	352.7	7,291	606,585	784,254	791,545
Rio Grande	550	15 50	. . . .	15 50	412.5	8,527	. . . .	. . . .	8,527
San Juan	2,725	73	121 39	122 12	96.5	1,995	255,847	330,785	332,780
Summit	4,846	3 73	85 88	89 61	875.0	18,088	321,889	416,170	434,258
Scattered	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .
Total	356,360	8 68	55 26	63 94	149,548.2	3,091,435	15,233,414	19,695,282	22,786,717

COLORADO—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

County.	*Ore raised and treated.*	*Average yield per ton.*			*Bullion produced from ore raised and treated during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Boulder	7,558.0	40 28	46 82	87 10	14,728.3	304,461	273,688	353,851	658,312
Chaffee	161.0	6 33	46 65	52 98	*49.3	*1,019	*5,809	*7,510	*8,529
Clear Creek	a35,821.0	6 11	46 73	52 84	*10,582.3	*218,756	*1,294,774	*1,674,013	*1,892,769
Custer	b6,784.0	2 12	10 66	12 78	696.2	14,392	55,927	72,308	86,700
Gilpin	123,645.0	13 08	2 61	15 69	*78,263.4	*1,617,848	*250,074	*323,321	*1,941,169
Gunnison	252.0	18 11	100 00	118 11	*220.3	*4,554	19,507	25,221	29,775
Hinsdale	2,695.0	2 61	13 09	15 70	277.8	5,743	99,958	129,236	134,979
Huerfano	5.5		57 27	57 27			244	315	315
Lake (c)	140,623.0	58	89 34	89 92	3,913.7	80,903	9,717 819	12,564,168	12,645,071
La Plata	12.0	8 58	226 00	234 58	5.0	103	2,098	2,712	2,815
Ouray	1,311.0	12 69	78 55	91 24	*804.5	16,630	*79,651	*102,981	*119,611
Park	5,364.0	18	95 67	95 85	*46.0	*951	*396,921	*513,179	*514,130
Rio Grande	550.0	9 79		9 79	260.5	5,385			5,385
San Juan	1,353.0	1 29	104 31	105 60	*84.0	*1,736	*109,166	*141,141	*142,877
Summit	4,446.0	1 16	79 66	80 82	*250.0	*5,168	*273,915	*354,145	*359,313
Scattered									
Total	330,580.5	6 89	49 20	56 09	110,181.3	2,277,649	12,579,551	16,264,101	18,541,750

County.	*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*					*Bullion produced during census year from ore previously raised.*				
		Gold.		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Boulder	310.0	1,423.0	29,416	21,470	27,759	57,175			9,487	12,266	12,266
Chaffee	818.0	708.4	14,644	107,706	139,253	153,897					
Clear Creek	1,210.0	2,053.5	42,450	133,254	172,284	214,734					
Custer	9,310.0			316,350	409,009	409,009					
Gilpin	23.0	18.1	374	97	125	499	*11,425.7	236,190	*62,322	80,576	316,766
Gunnison											
Hinsdale											
Huerfano	29.5	29.5	610	2,212	2,860	3,470					
Lake (c)	11,828.0	118.3	2,445	823,702	1,064,964	1,067,409					
La Plata											
Ouray	479.0	1,457.1	30,121	87,093	112,603	142,724					
Park											
Rio Grande											
San Juan	1,372.0			112,960	146,046	146,046					
Summit	400.0	200.0	4,134	26,800	34,650	38,784					
Scattered							4,078.7	84,314	147,707	190,970	275,284
Total	25,779.5	6,007.9	124,194	1,631,644	2,109,553	2,233,747	15,504.4	320,504	219,516	283,812	604,316

* Estimated. a 14,384 tons lost by concentration. b 4,684 tons lost by concentration. c Including the Leadville district.

it is believed that the totals attained represent a very close approximation to the actual product of the state, and that the figures given are, on the average, within 5 per cent. of the true amount, although in districts as yet incompletely developed this percentage may be greater.

As it was found impossible to separate with any degree of approximation the amount of "bullion produced," which should be credited to individual districts in several counties, the division into districts has been abandoned in such instances. In the following tables the amount and value of ore raised has been given to districts as far as was possible, the heading "Scattered" including, in general, mines from which no direct information was obtained, but which had sold ore to samplers or smelters. The sign of "estimated" (*) might be appended in many cases to amounts of bullion produced by counties, because these amounts were largely obtained by segregating returns of ore purchased by smelters, and apportioning to each county the corresponding proportion of bullion produced from that ore; thus, while the relative amounts may be considered estimates, the total footings of the columns are determined from comparatively accurate data.

In the foregoing tables the following are the more important items of uncertainty or inadequacy of data:

Arapaho county.—In this county, as well as in Jefferson, and Pueblo counties no mines producing gold and silver are known to exist. In these, however, are located important smelting works, which buy and treat ores from almost every county in the state, as well as from Montana and New Mexico. The bullion production of these counties would therefore be an important fraction of the total bullion yield of the state. It has, however, been considered best to apportion this yield as nearly as possible among the districts or counties in which the ore was raised. This has been done in the following manner: The greater part of the ore treated could be traced back to the county where it was raised, and the total bullion product of each such lot was deduced from the average assay value of such lot, of the total amount treated, and of the total amount of bullion produced, in the case of each individual smelter. A portion of ore treated and bullion produced therefrom, which could not be directly traced back to its source, was distributed on estimated proportions, founded mainly on the relative amounts of ore produced, as determined by schedules and previous estimates. In considering the amount of bullion produced and ore treated, there is this element of uncertainty in some of our calculations, that the larger smelters cannot always say that the bullion produced was from the very lots of ore purchased, as they keep a varying stock of ore on hand. It is probable, however, that, considering the whole, the figures obtained are sufficiently near the truth.

Boulder county.—No reliable data could be obtained in regard to the Niwot mine, which is said to produce about 15,000 tons of ore per year. In general the returns from this county were more incomplete and less satisfactory than from most counties in the state. It was not possible to apportion out by districts even the ore raised. The product, as obtained from smelters, is approximately correct, that from mills less certain and probably incomplete.

Chaffee county contains a number of promising mines, but owing to absence of owners no reliable data of production during census year could be obtained.

Clear Creek county includes a great number of small districts, within a limited region, whose boundaries are not always clearly defined; hence no allotment of ore by districts was attempted. One element of uncertainty in this district is the very common practice of leasing the mine to one or more parties, who pay the owner a royalty, or a portion of the gross product. A second is, that the ores are sampled frequently concentrated, and sometimes treated in Gilpin county. Small lots of rich ore have been also shipped to smelters in the east, of which no record could be obtained. The loss by concentration (14,384 tons) was obtained by actual returns from ore-dressing works in one case only, of a few hundred tons, an estimate being made of the degree of concentration. The proportionately large loss in treatment is due, doubtless, to defective systems of working, but may be less than shown by the figures given above, since the product of rich ores shipped east does not appear here.

Custer county—Its production is relatively low, since the Bassick mine did not produce during a great part of the census year. The loss by concentration (4,684 tons) is an estimate, deducting the sum of tons treated and tons remaining on hand from tons raised.

Gilpin county.—Owing to the system pursued by a large proportion of the mines and mills, viz.: that the miners send their ore to custom mills to be treated, and receive in return the bullion produced, less charges, without any assay control, to determine how much was lost in treatment, or any record being kept by mills of value of bullion returned, it has been necessary to estimate a large proportion of the bullion thus produced. The express returns give for the year ending June 30, 1880, a shipment from Central City of 88,016 ounces of gold bullion, of reported value of $1,320,260. The census figures for the year ending May 31, 1880, are somewhat less, viz.: For the mill production, 54,361.8 ounces fine gold, having a mint value of $1,123,758.11, showing that this estimate is probably somewhat under the truth, although it is not certain that absolutely all bullion shipped from Central City was produced within Gilpin county. The figures in the column of "Bullion from ore raised prior to census year" are an estimate of the yield of tailings from the mills, which were sold to smelters during the year, and which are supposed to come mainly from ore raised during previous years.

Gunnison county.—But few mines were sufficiently developed to be regular producers during the census year, and many small lots shipped out for treatment may have escaped the record.

Hinsdale county.—The principal smelting works of the San Juan region are located here, and its production includes probably some small lots of ore raised in Ouray and San Juan counties, which could not be segregated.

Huerfano county has but few mines. From only a single district were returns made by the expert who had charge of this portion of the state.

Lake county.—Is the largest producer and furnishes the most accurate data, though it has been impossible in every case to actually trace back the bullion produced to the individual mine from which it came. The figures given are known to be under the truth for the following reason: The "American" and "Gage, Hagaman & Co.'s" smelters ran during a portion of the year, but were shut down and changed hands, so that when these statistics were collected no record, or even estimate, could be obtained of the amount of bullion produced by them. A thousand tons of crude bullion, of an average of 300 ounces silver per ton, would probably be an outside figure for the production of the two. This would add 300,000 ounces silver to the total production for the year. No record was obtained of the amount of ore, if any, which was shipped directly from Leadville to the smelting works at Omaha; its influence on the total production would be, at all events, inconsiderable. With these exceptions the figures given present a very accurate estimate of the bullion produced. With regard to the gold production the amount contained in the ores is in general too small to be taken account of, and it is only when concentrated in the lead bullion that it becomes appreciable; moreover a considerable portion of it comes from small lots of auriferous ores purchased by smelters from mines or prospects in outlying districts within the county, and in some cases from Gunnison or Summit counties. The gold contents of ore raised had therefore to be largely determined by estimate.

La Plata county.—From this county reports of only a single district were obtained, as the mines were as yet but little developed in the census year; probably many small lots of ore are unaccounted for.

Ouray county.—Doubtless from this county also the returns are somewhat incomplete, and it is certain that some addition is due to the amount of "bullion produced" which has been credited to it. Unfortunately data are wanting for making an accurate estimate, although it is known that some of this has been credited to Hinsdale county.

Park county.—At the time of collecting these statistics accurate data could be obtained from but few of the producing mines of this county; it has been necessary, therefore, to deduce them largely from information obtained from samplers and smelters, and estimate their proportionate bullion yield.

Rio Grande county.—Here, also, returns were obtained from but a single district.

San Juan county.—To this the same remarks are applicable which were made in regard to Ouray county.

Summit county.—From this county, for various reasons, the returns as regards the census year are rather incomplete, and figures probably below the truth. The bullion produced also had to be largely estimated. The following years will probably show an increased production. To show the data from which the figures given above have been obtained the number of mines from which full schedules were received is subjoined, and the proportion thereof that have been bullion-producers during the census year, as well as those producers of which data have been obtained otherwise than by schedules and visits of census experts:

Total deep mines scheduled	249
Productive mines scheduled	126
Productive mines reported otherwise	249
Total productive mines reported	375
Total all mines reported on	498

COLORADO—Production of Placer Mines for the year ending May 31, 1880.

County.	*Gold.*	
	Ounces.	*Dollars.*
Chaffee	1,275.0	26,357
Clear Creek	410.0	8,475
Lake	835.0	17,261
Park	1,000.0	20,672
Routt	241.9	5,001
Summit	1,160.0	23,979
Total	4,921.9	101,745

The above table gives all the data which were obtained by the experts engaged in this work on placer and hydraulic workings in the state. The inherent difficulty of obtaining complete information with regard to surface mining, in that it is carried on only during a limited portion of the year, and in great part by individuals who keep no accurate account of their gains, renders these returns necessarily incomplete here as elsewhere. In Colorado, moreover, owing to the fact that other gold bullion is produced so largely, it has been impossible to supplement these figures by express or mint returns. While the above figures doubtless very inadequately express the production of placer gold for the state, it is a fact that this production was relatively small during the census year, owing to the unusual activity in prospecting for and working deep mines.

COPPER AND LEAD PRODUCTION IN COLORADO.—Although copper and lead belong rather to the useful than to the precious metals, their importance among the mineral products of Colorado, and their intimate connection with the production of gold and silver, render their consideration here essential. In the table given below, only the crude metal obtained from ores actually smelted within the state is given, no account being taken of the copper or lead contained in ores which were shipped outside of the state for treatment. This amount is, however, of comparatively little importance, forming probably not over 5 per cent. of the total product. The lead product was all in the form of argentiferous lead bullion, which was shipped to various smelters in the East to be refined. The copper product was partly as matte, but largely in the form of copper oxide. Of the actual shipments of the latter a portion has been produced from ores raised in Montana; a proportionate amount of the total product has, however, been credited to that territory in its appropriate place. In calculating the value of these metals the average market value of either for the year has been assumed as 4½ cents per pound for lead, 20 cents per pound for copper.

COLORADO—CRUDE BULLION PRODUCT FOR THE YEAR ENDING MAY 31, 1880.

County.	*Gross tons.*	*Lead.*		*Copper.*		*Gold.*		*Silver.*		*Total.*
		Tons.	*Dollars.*	*Tons.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Arapahoe	1,225	.....	.....	980	392,000	.....	.....	.....	.....	392,000
Hinsdale	800	790.00	71,100	.....	.....	270.0	5,581	96,878	125,254	201,935
Jefferson	1,117	525.75	47,318	598	239,200	10,315.0	213,231	565,020	730,514	1,230,263
Lake	28,383	28,226.00	2,540,340	.....	.....	3,830.2	79,177	8,053,946	10,412,947	13,032,464
Ouray	90	89.00	8,010	.....	.....	.....	.....	24,103	31,163	39,173
Park	57	56.00	5,040	.....	.....	.....	.....	11,996	15,510	20,550
Pueblo	2,191	2,126.50	191,385	.....	.....	1,347.0	27,845	1,557,608	2,013,831	2,233,061
Summit	230	256.00	23,040	.....	.....	.....	.....	10,400	13,446	36,486
Total	34,123	32,069.25	2,886,233	1,578	631,200	15,762.2	325,834	10,319,951	13,342,665	17,185,932

Lead, $90 per ton. Copper, $400 per ton.

COLORADO—PRODUCTION OF SMELTING WORKS AND AMALGAMATING MILLS FOR THE YEAR ENDING MAY 31, 1880.

County.	*Ore raised and smelted.*	*Average yield per ton.*			*Bullion produced from ore smelted during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Boulder	3,412.0	68 52	47 10	115 62	11,309.8	233,794	124,307	160,717	394,511
Chaffee	161.0	*6 33	*46 65	*52 98	*49.3	*1,019	*5,809	*7,510	*8,529
Clear Creek (*a*)	9,701.0	11 93	116 26	128 19	*5,599.3	*115,748	*872,344	*1,127,854	*1,243,602
Custer (*b*)	982.0	14 24	64 65	78 89	676.2	13,978	49,107	63,490	77,468
Gilpin	10,218.0	48 36	28 26	76 62	23,901.5	494,088	223,305	288,711	782,799
Gunnison	252.0	18 11	100 00	118 11	*220.3	*4,554	19,507	25,221	29,775
Hinsdale	2,695.0	2 61	13 09	15 70	277.8	5,743	99,958	129,236	134,979
Huerfano	5.5	.....	57 27	57 27	.....	.....	244	315	315
Lake	140,623.0	58	89 34	89 92	3,913.7	80,903	9,717,819	12,564,168	12,645,071
La Plata	12.0	8 58	226 00	234 58	5.0	103	2,098	2,713	2,816
Ouray	1,015.0	6 66	100 62	107 28	327.0	6,760	78,995	102,133	108,893
Park	5,364.0	*18	*95 67	*95 85	*46.0	*951	*396,921	*513,179	*514,130
Rio Grande	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Juan	1,353.0	*1 29	*104 31	*105 60	*84.0	*1,736	*109,166	*141,141	*142,877
Summit	3,771.0	.....	*93 91	*93 91	.....	.....	*273,915	*354,145	*354,145
Total	179,564.5	5 34	86 21	91 55	46,409.9	959,377	11,973,495	15,480,533	16,439,910

County.	*Ore raised and milled.*	*Average yield per ton.*			*Bullion produced from ore milled during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Boulder	4,146	17 05	46 58	63 63	3,418.5	70,667	149,381	193,135	263,802
Chaffee	.....	.....	.....	.....	.....	.....	.....	.....	.....
Clear Creek (*a*)	11,736	8 78	46 54	55 32	*4,983.0	*103,008	*422,430	*546,160	*649,168
Custer (*b*)	1,118	38	7 88	8 26	20.0	413	6,820	8,818	9,231
Gilpin	113,427	9 91	30	10 21	54,361.9	1,123,760	26,769	34,610	1,158,370
Gunnison	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hinsdale	.....	.....	.....	.....	.....	.....	.....	.....	.....
Huerfano	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lake	.....	.....	.....	.....	.....	.....	.....	.....	.....
La Plata	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ouray	296	33 35	2 86	36 21	477.5	9,871	656	848	10,719
Park	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rio Grande	550	9 79	.....	9 79	260.5	5,385	.....	.....	5,385
San Juan	.....	.....	.....	.....	.....	.....	.....	.....	.....
Summit	675	*7 66	.....	*7 66	*250.0	*5,168	.....	.....	*5,168
Total	131,948	9 99	5 94	15 03	63,771 4	1,318,272	606,056	783,571	2,101,843

* Estimated. *a* 14,384 tons lost by concentration. *b* 4,684 tons lost by concentration.

In the preceding table are shown the relative amounts of ore treated by mill process and by smelting, and their average yield per ton. Its principal value is to show the average character of ore in each county in reference to its adaptation to either process of reduction. It would have been extremely interesting, had the data been such as would yield accurate results, to have given the assay value of the ore treated in either case, and thus compare the relative losses in either process, but the number of cases in which it has been necessary to estimate product from assay value, or *vice versâ*, would seriously impair the value of such comparison. This subject will be found treated at length in another part of the report.

Dakota.—The metallic production of Dakota is derived from the region of the Black Hills, and in greater part from Lawrence county, where free-milling gold-quartz ores of low grade are reduced in amalgamating mills of great size. The perfection to which the milling process has been brought is shown by the large percentage of the assay value extracted. Custer and Pennington counties are opening new mines, but had scarcely become producers during the census year. The following table is a condensation of the preceding, and gives the deep-mine production by counties only:

DAKOTA—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	*Ore raised during census year.*	*Average assay value per ton.*			*Assay value of ore raised during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Custer	2,250	13 89	0 07	13 96	1,511.7	31,250	122	158	31,408
Lawrence	526,998	7 65	34	7 99	195,063.3	4,032,316	136,190	176,080	4,208,396
Pennington	7,500	10 31	09	10 40	3,738.9	77,290	541	699	77,989
Total	536,748	7 71	33	8 04	200,313.9	4,140,856	138,853	176,937	4,317,793

County.	*Ore raised and treated.*	*Average yield per ton.*			*Bullion produced from ore raised and treated during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Custer	...	...	...	...	...	...	...	...	...
Lawrence	495,630	6 33	0 15	6 48	151,759.7	3,137,151	54,577	70,563	3,207,714
Pennington	500	3 20	...	3 20	77.4	1,600	...	...	1,600
Total	496,130	6 33	14	6 47	151,837.1	3,138,751	54,577	70,563	3,209,314

County.	*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*					*Bullion produced during census year from ore previously raised.*				
		Gold.		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Custer	2,250	1,511.7	31,250	122	158	31,408	...	...	...	...	...
Lawrence	31,368	12,621.7	260,914	24,741	31,988	292,902	5,622.7	116,233	...	...	116,233
Pennington	7,000	3,619.9	74,830	541	699	75,529	...	...	...	...	...
Total	40,618	17,753.3	366,994	25,404	32,845	399,839	5,622.7	116,233	...	...	116,233

PLACER AND HYDRAULIC MINES—The following table gives the production of hydraulic and placer mines so far as could be ascertained by the expert in charge of this district. The amount seems very small, compared with the supposed value of the surface deposits in this region. This may be in part accounted for by the fact that several important companies were making ditches, and preparing for work on a large scale, but had not become producers during the census year.

DAKOTA—Production of Hydraulic, Placer, Drift and River Mines for the year ending May 31, 1880.

County.	*Gold.*	*Gold.*
	Ounces.	*Dollars.*
Lawrence	2,307.5	47,700
Pennington	152.8	3,159
Total	2,460.3	50,859

Montana.—Montana has within its boundaries the elements favorable to a lagre production of the precious metals—rich and varied ores and abundant fuel, both coal and wood. As yet, however, owing to lack of development and want of sufficient transportation facilities, it has not taken its proper rank as a producer. Owing to the great extent of territory over which its mines are scattered, and the fact that, from circumstances beyond our control, the collection of statistics was not completed until the winter was far advanced, and travel rendered thereby very difficult, our data leave something to desire in point of completeness. It was evident that the figures of gold production deduced from the schedules were below the truth, since the mint returns report the gold production of Montana as a little over a million dollars in excess. As the mint figures are certainly below the truth, it was proper that this difference should be added, the only question being to what branch of mining it should be credited. Now, the census returns from placer and hydraulic mines were notoriously incomplete, since, owing to the lateness of the season, but few of their owners could be found; but it is well known that they form the most important element in the gold production of Montana. On the other hand, it was thought that returns had been obtained from practically all the mills and smelting works. Under these circumstances it was judged best to discard the census figures for hydraulic and placer mines altogether, and assume as their production the difference between the amount of gold produced, as determined by mill and smelters' returns, and the total product obtained from mint returns. While, therefore, it is possible that a small amount of the gold credited to hydraulic and placer mines may belong to mill production, it is probably not more than that by which the mint returns fall short of giving the total gold production of the territory as gold which, for various reasons, has not passed through the hands of its agents.

The following table gives the production of the deep mines of Montana by districts, and the yield of the ore treated, as far as could be ascertained, though some small lots of ore are known to have been shipped east, which could not be traced:

MONTANA—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay value per ton.			Assay value of ore raised during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Beaver Head	10,936	2 22	96 19	98 41	1,176.2	24,314	813,727	1,052,068	1,076,382
Deer Lodge	81,256	6 34	45 19	51 53	24,910.7	514,950	2,840,198	3,672,092	4,187,042
Jefferson	3,335	54 66	29 70	84 36	8,818.6	182,297	76,616	99,057	281,354
Lewis and Clarke	10,493	16 18	6 33	22 51	8,215.0	169,819	51,379	66,428	236,247
Madison	8,838	28 45	1 40	29 85	*12,166.2	*251,498	9,582	12,389	*263,887
Total	114,858	9 95	42 68	52 63	55,286.7	1,142,878	3,791,502	4,902,034	6,044,912

County.	Ore raised and treated.	Average yield per ton.			Bullion produced from ore raised and treated during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Beaver Head	10,902.0	1 81	66 90	68 71	955.4	19,750	564,110	729,338	749,088
Deer Lodge	57,029.0	5 92	34 83	40 75	16,337.7	337,730	1,536,134	1,986,068	2,323,798
Jefferson	3,038.0	18 49	24 54	43 03	2,717.2	56,169	57,670	74,562	130,731
Lewis and Clarke	10,343.0	12 71	2 44	15 15	6,361.3	131,500	19,554	25,281	156,781
Madison	5,264.5	16 49	07	16 56	4,198.8	86,797	292	378	87,175
Total	86,576.5	7 30	32 52	39 82	30,570.4	631,946	2,177,760	2,815,627	3,447,573

County.	Ore raised but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.					Bullion produced from ore raised prior to census year.				
		Gold.		Silver.		Total.	Gold.		Silver.		Total.
	Tons.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Beaver Head	34.0	....	....	4,208	5,440	5,440	....	....	....	....	....
Deer Lodge	24,227.0	5,867.6	121,294	852,237	1,101,867	1,223,151	203.2	4,200	61,808	79,912	84,112
Jefferson	297.0	3,990.9	82,499	2,700	3,491	85,990	11.3	234	1,029	1,330	1,564
Lewis and Clarke	150.0	119.0	2,460	600	776	3,236	....	....	....	....	....
Madison	3,673.5	2,883.7	59,611	553	721	60,332	313.5	6,481	....	....	6,481
Total	28,281.5	12,861.2	265,864	860,303	1,112,285	1,378,149	528.0	10,915	62,837	81,242	92,157

* Estimated.

The following table shows the relative amounts of ore reduced in stamp-mills and by smelting works, with the average yield per ton, and total contents in gold and silver in each case:

MONTANA—ORE TREATED BY SMELTING WORKS AND AMALGAMATING MILLS.

	Ore treated.	Average yield per ton.			Bullion produced.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Smelted	14,680.0	64	78 36	79 00	454.4	9,393	889,362	1,149,856	1,159,249
Milled	71,896.5	8 65	23 18	31 83	30,116.0	622,553	1,288,398	1,665,770	2,288,323
Total	86,576.5	7 30	32 52	39 82	30,570.4	631,946	2,177,760	2,815,626	3,447,572

Hydraulic and Placer Mines.—The gravel deposits of Montana form an important source of its wealth, and their product is known to be very considerable. The figures for this product, as explained above, have been assumed, in the absence of more reliable data, derived from direct information, and are:

Gold	ounces	56,255.6
Value		$1,162,906

The counties from which hydraulic-mine returns were received are Deer Lodge, Meagher, Beaver Head, and Lewis and Clarke, the relative amount of production reported from each standing in the order in which they are named above. The ores of Montana, like those of Colorado, contain considerable amounts of copper and lead, which cannot be neglected in considering its production of metals. The table below gives the amounts which could be traced, a portion of the copper having been reduced to copper oxide in Colorado. The figures below are for crude bullion which was not reduced to the metallic state within the territory. A certain amount of copper ore was shipped directly east from Montana, but its value or contents could not be ascertained.

MONTANA—CRUDE BULLION PRODUCED FOR THE YEAR ENDING MAY 31, 1880.

County.	Gross tons.	Lead.		Copper.		Gold.		Silver.		Total.
		Tons.	Dollars.	Tons.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Beaver Head	1,568	1,132.5	101,925	186.25	74,500	....	....	562,574	727,352	903,777
Deer Lodge	525	.....	.....	420.00	168,000	343.5	7,101	160,300	207,252	382,353
Jefferson	83	81.5	7,335	....	....	332.0	6,863	30,378	39,276	53,474
Total	2,176	1,214.0	109,260	606.25	242,500	675.5	13,964	753,252	973,880	1,339,604

Lead, $90 per ton. Copper, $400 per ton.

New Mexico.—Although during the census year the mines of New Mexico were attracting much attention, their practical development was awaiting the completion of the railroads which were about to intersect it. Its mining districts were many of them difficult and even dangerous of access, and it was almost impossible to ascertain in advance whether they had actually producing mines. The collection of statistics under these circumstances was peculiarly difficult, and the completeness of the material obtained was seriously impaired by the assassination of Colonel Charles Potter, the expert in charge of this territory. The data presented below do not necessarily give a fair idea of the capabilities of the territory as a mineral producer. It is believed, however, that the amount of ore produced during the census year and not accounted for below is not of very great amount.

The subjoined tables give the production of the deep mines by districts and by counties:

NEW MEXICO—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.					Ore raised and treated.	Average yield per ton.		
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.		Gold.	Silver.	Gold and silver.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Dollars.	Dollars.	Dollars.
Doña Aña	718.5	82 65	....	82 65	2,872.8	59,386	....	....	59,386	718.5	49 50	....	49 59
Grant	9,668.0	2 62	79 78	82 40	1,225.0	25,323	596,567	771,301	796,624	6,734.0	2 04	58 26	60 30
Santa Fé	100.0	20 67	32 32	52 99	100.0	2,067	2,500	3,232	5,299	....	....	....	...
	10,486.5	8 28	73 86	82 14	4,197.8	86,776	599,067	774.533	861,309	7,452.5	6 62	52 65	59 27

Placer Mines.—Considerable rich placer ground is known to exist in New Mexico, but as yet but little gold has been obtained from it, owing to want of water. No record could be obtained of any product from such workings during the census year.

NEW MEXICO—PRODUCTION BY COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

County.	Bullion produced from ore raised during census year.					Ore raised but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.				
	Gold.		Silver.		Total.		Gold.		Silver.		Total.
	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Tons.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Doña Aña	1,723.7	35,632	.....	.....	35,632	....	....	....	.....	.....	.....
Grant	663.8	13,722	303,455	392,337	406,059	2,934	....	....	178,288	230,509	230,509
Santa Fé	....	....	....	.....	.....	100	100	2,067	2,500	3,232	5,299
	2,387.5	49,354	303,455	392,337	441,691	3,034	100	2,067	180,788	233,741	235,808

Wyoming.—Wyoming is surrounded on three sides by important mining regions, but has as yet developed but few mines within its borders. During the census year, as far as could be ascertained, the actual production of gold and silver has been confined to Sweetwater county, of which the production is given below:

WYOMING—PRODUCTION OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Sweetwater	843	*27 42	....	*27 42	1,118.1	*23,113	..	..	*23,113
Total	843	27 42	..	27 42	*1,118.1	*23,113	..	..	*23,113

County.	Ore raised and treated.	Average yield per ton.			Bullion produced from ore raised and treated during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
Sweetwater	843	20 55	...	20 55	837.9	17,321	..	......	17,321
Total	843	20 55	.....	20 55	837.9	17,321	..	......	17,321

* Estimated.

EASTERN DIVISION—PRODUCTION BY STATES AND COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

State and County.	Ore raised during census year.	Average assay value per ton.			Total assay value of ore raised during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
ALABAMA.									
Cleburne (*a*)	100	....	....	..	.....	....	......	......	.....
Talladega (*a*)	24	..	..	..	....	...	.....	....	.....
Total	124	.....	..	..	.....	.....	......	......	......

a No assay values given.

EASTERN DIVISION—PRODUCTION BY STATES AND COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

State and County.	*Ore raised during census year.*	*Average assay value per ton.*			*Total assay value of ore raised during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
GEORGIA.									
Cherokee (*a*)	262	22 00		22 00	151.1	3,124			3,124
Cobb	100								
Forsyth	40								
Hall	150								
Lincoln	550								
McDuffie	100								
Meriwether	1,590								
Total	2,792				151.1	3,124			3,124
MAINE.									
Hancock (*a*)	1,800		30 00	30 00			39,446	51,000	51,000
Penobscot	400	26 87	5 17	32 04	519.9	10,747	1,599	2,067	12,814
York	50	6 75	32 30	39 05	16.3	337	1,249	1,615	1,952
Total	2,250				536.2	11,084	42,294	54,682	65,766
NEW HAMPSHIRE.									
Grafton	2,183								
NORTH CAROLINA.									
Davidson	20,200	17 50	2 50	20 00	16,931.2	*349,999	38,673	*50,000	*399,999
Gaston	1,821								
Guilford	10								
Mecklenburg	11,370								
Moore	625								
Nash	60								
Rowan	1,200	9 00	3 00	12 00	522.4	10,799	2,784	3,599	14,398
Stanley	500								
Total	35,786				17,453.6	360,798	41,457	53,599	414,397
SOUTH CAROLINA.									
Abbeville									
Colleton									
Total									
VIRGINIA.									
Buckingham	74								
Culpepper	90	40 09	1 40	41 49	174.5	3,607	97	125	3,732
Total from schedule data	164								
Additional production shown by mint receipts									
Total	164				174.5	3,607	97	125	3,732

State and County.	*Ore raised and treated.*	*Average yield per ton.*			*Bullion produced from ore raised and treated during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
ALABAMA.									
Cleburne (*a*)	100	10 00		10 00	48.4	1,001			1,001
Talladega (*a*)	24	12 50		12 50	14.5	300			300
Total	124	10 50		10 50	62.9	1,301			1,301

* Estimated.

a No assay values given.

EASTERN DIVISION—PRODUCTION BY STATES AND COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

State and County.	Ore raised during census year.	Average yield per ton.			Bullion produced from ore raised and treated during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
GEORGIA.									
Cherokee (a)	205	11 22		11 22	111.3	2,301			2,301
Cobb	100	4 00		4 00	19.3	399			399
Forsyth	40	5 08		5 08	9.8	203			203
Hall	150	10 00		10 00	72.6	1,501			1,501
Lincoln	550	10 88		10 88	289.5	6,984			5,984
McDuffie	100	6 00		6 00	29.0	599			599
Meriwether	1,590	2 00		2 00	153.8	3,179			3,179
Total	2,735	5 18		5 18	685.3	14,166			14,166
MAINE.									
Hancock (a)	400	7 50	18 00	25 50	145.1	2,999	5,569	7,200	10,199
Penobscot									
York									
Total	400	7 50	18 00	25 50	145.1	2,999	5,569	7,200	10,199
NEW HAMPSHIRE.									
Grafton	2,183	5 04	7 32	12 36	532.1	10,999	12,375	16,000	26,999
NORTH CAROLINA.									
Davidson	200	10 00		10 00	96.8	2,001			2,001
Gaston	1,821	5 00		5 00	440.5	9,106			9,106
Guilford	10	2 87		2 87	13.9	287			287
Mecklenburg	11,370	8 33		8 33	4,584.5	94,770			94,770
Moore	625	7 84	0 16	8 00	237.0	4,899	77	100	4,999
Nash	60	20 07		20 07	58.2	1,203			1,203
Rowan									
Stanley	500	4 00		4 00	96.8	2,001			2,001
Total	14,586	7 83		7 83	5,527.7	114,267	77	100	114,367
SOUTH CAROLINA.									
Abbeville					24.2	500			500
Colleton					290.2	5,999			5,999
Total					314.4	6,499			6,499
VIRGINIA.									
Buckingham	74	5 00		5 00	17.9	370			370
Culpepper	5	35 80		35 80	8.7	180			180
Total from schedule data	79	6 96		6 96	26.6	550			550
Additional production shown by mint receipts					424.3	8,771			8,771
Total					450.9	9,321			9,321

State and County.	Ore raised but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.				
		Gold.		Silver.		Total.
	Tons.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
ALABAMA.						
Cleburne (a)						
Talladega (a)						
Total						

* Estimated.

a No assay values given.

EASTERN DIVISION—PRODUCTION BY STATES AND COUNTIES OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

State and County.	*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*				
		Gold.		*Silver.*		*Total.*
	Tons.	*Ounces.*	*Dollars.*	*Ounces*	*Dollars.*	*Dollars.*
GEORGIA.						
Cherokee (a)	57	60.7	1,255			1,255
Cobb						
Forsyth						
Hall						
Lincoln						
McDuffie						
Meriwether						
Total	57	60.7	1,255			1,255
MAINE.						
Hancock (a)	1,400			32,486	42,001	42,001
Penobscot	400	519.9	10,747	1,599	2,067	12,814
York	50	16.3	337	1,249	1,615	1,952
Total	1,850	536.2	11,084	35,334	45,683	56,767
NEW HAMPSHIRE.						
Grafton						
NORTH CAROLINA.						
Davidson	20,000	16,931.2	*349,999	38,673	*50,000	*399,999
Gaston						
Guilford						
Mecklenburg						
Moore						
Nash						
Rowan	1,200	522.4	10,799	2,784	3,599	14,398
Stanley						
Total	21,200	17,453.6	*360,798	41,557	*53,599	414,397
SOUTH CAROLINA.						
Abbeville						
Colleton						
Total						
VIRGINIA.						
Buckingham						
Culpepper	85	164.8	3,407	94	122	3,529
Total from schedule data	85	164.8	3,407	94	122	3,529
Additional production shown by mint receipts						
Total	85	164.8	3,407	94	122	3,529

* Estimated.

a No assay values given.

EASTERN DIVISION—PRODUCTION OF HYDRAULIC, PLACER, RIVER AND BRANCH MINES FOR THE YEAR ENDING MAY 31, 1880.

SOUTH CAROLINA.

County.	*District.*	*Gold.*			
		Totals by districts.		*Totals by counties.*	
		Ounces.	*Dollars.*	*Ounces.*	*Dollars.*
Chesterfield	Scattered	316.4	6,541	316.4	6,541
Total		316 4	6,541	316.4	6,541

EASTERN DIVISION—PRODUCTION OF HYDRAULIC, PLACER, RIVER, AND BRANCH MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

GEORGIA.

County.	*District.*	*Gold.*			
		Totals by districts.		*Totals by counties.*	
		Ounces.	*Dollars.*	*Ounces.*	*Dollars.*
Cherokee	Fifteenth and second	10.9	225	10.9	225
Hall	810 G. M., 9 and 12 L.	183.2	3,787	183.2	3,787
Lumpkin	Twelfth	1,591.6	32,901	2,838.3	58,673
Do.	Twelfth and first	1,237.9	25,590		
Do.	Thirteenth	8.8	182		
Union	Tenth	72.6	1,501	72.6	1,501
White	Third	81.1	1,676	129.5	2,677
Do.	Fourth	48.4	1,001		
Total		3,234.5	66,863	3,234.5	66,863

NORTH CAROLINA.

County.	*District.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*
Montgomery	El Dorado	34.9	721	207.6	4,291
Do.	Scattered	172.7	3,570		
Pope	Scattered	19.1	395	19.1	395
Total		226.7	4,686	226.7	4,686

SILVER CONTAINED IN PLACER GOLD.—No account is taken by the miners of the silver alloyed with placer gold, unless in the exceptional cases where the value of the former is allowed for in the sale of the product, as in direct sales to the mints or United States assay offices. In the aggregate this silver forms a considerable item, which should be included in the total product, but which has usually been disregarded by statisticians. The schedules of the experts contain data for a close estimate as to the average tenor of the placer product. A statement of the fineness in gold of samples from various localities is appended.

SPECIMEN EXAMPLES OF PLACER GOLD.

CALIFORNIA.

County and locality.	*Fineness in gold.*	*Remarks.*
BUTTE.		
Centerville	0.900	
Cherokee Flat	0.970	
Magalia	0.900	
Morris Ravine	0.905—0.908	
Oroville	0.942	
CALAVERAS.		
Mokelumne Hill	0.850—0.960	
DEL NORTE.		
Bunker Hill Mine	0.887—0.925	
China Creek	0.900	
Happy Camp	0.875—0.935	
Indian Creek	0.900	
Wingate Mine	0.944—0.950	
EL DORADO.		
Placerville	0.980	
HUMBOLDT.		
Gold Bluffs	0.940	
Orleans Bar	0.726	Sold for $13 to $17 per ounce.
PLACER.		
Bath	0.850	
Dutch Flat	0.900—0.910	
Gold Run	0.930	
Iowa Hill	0.784—0.814	
Michigan Bluffs	0.925—0.960	
PLUMAS.		
Black Hawk Mine	0.924	
Cook's Cañon	0.885	
Gopher Hill	0.936	
Hungarian Hill	0.924	
Seneca	0.846	
SHASTA.		
Igo	0.885	
SISKIYOU.		
Callahan's Ranch	0.859	Sold for $17.75 per ounce.
Cottonwood	0.860	
Coyotte Gulch	0.900—0.950	
Galena Hill	0.880—0.930	
Greenhorn	0.850	
Humbug Creek	0.809—0.865	
Indian Creek	0.835—0.900	Sold for $17 per ounce.
McAdams Creek	0.750—0.900	
Oro Fino	0.762	
Rattlesnake Creek	0.827	Sold for $16.50 per ounce.
Sawyer's Bar	0.850	
Sciad Valley	0.887—0.912	
Scott Valley	0.805	Sold for $16 to $16.25 per oz.
South Fork Salmon	0.835	Sold for $16.75 per ounce.
Yreka	0.749—0.863	Sold for $15 to $17.12 per oz.
STANISLAUS.		
La Grange	0.920	
TRINITY.		
Buckeye	0.890—0.900	
Cañon Creek	0.894—0.896	
Chapman's and Fisher's Mines	0.914—0.917	
Douglas	0.912	
Indian Creek	0.920	
Junction City	0.875—0.915	Sold for $18 per ounce.
Red Hill	0.910—0.917	
Trinity Center	0.900	
Trinity Mine	0.887—0.903	
Weaver	0.906—0.927	

SPECIMEN EXAMPLES OF PLACER GOLD.—*Continued.*

COLORADO.

County and locality.	*Fineness in gold.*	*Remarks.*
CHAFFEE.		
Hope	0.850	
CLEAR CREEK.		
Jackson	0.880	
LAKE.		
California	0.850—0.875	
PARK.		
Alma township	0.819	
ROUTT.		
Hahn's Peak	0.666	
SUMMIT.		
Bevan	0.750—0.820	
Spalding	0.850—0.900	

DAKOTA.

County and locality.	*Fineness in gold.*	*Remarks.*
LAWRENCE.		
Bear Gulch	0.940	
Cape Horn	0.870	
PENNINGTON.		
Cañon	0.925	
Confederate	0.925—0.940	
Jenny and Strawberry	0.940	

GEORGIA.

County and locality.	*Fineness in gold.*	*Remarks.*
CHEROKEE.		
Fifteenth District	0.927	Sold for $19.20 per ounce
HALL.		
810 G. M. 9th and 12th districts	0.900—0.916	
LUMPKIN.		
Twelfth District	0.875—0.995	
Thirteenth District	0.962—0.992	
WHITE.		
Fourth District	0.945	
UNION.		
Tenth District	0.981	

IDAHO.

County and locality.	*Fineness in gold.*	*Remarks.*
BOISÉ.		
Boisé Basin and vicinity	0.7806	Average of 413 lots.

MONTANA.

County and locality.	*Fineness in gold.*	*Remarks.*
BEAVER HEAD.		
Bannock	0.935	
DEER LODGE.		
Gold Hill	0.950—0.956	
Henderson Gulch	0.925—0.957	
Independence	0.725—0.730	
McClellan's Gulch	0.860—0.930	Sold for $17.50 per ounce.
DEER LODGE—*continued.*		
Nelson	0.935—0.940	
Summit Valley	0.700	
LEWIS AND CLARKE.		
Last Chance	0.910	
MEAGHER.		
German	0.830—0.835	
Thompson's Gulch	0 945—0.980	

OREGON.

County and locality.	*Fineness in gold.*	*Remarks.*
BAKER.		
Amelia	0.810—0.900	
Blue Cañon	0.840—0.853	Sold for $16.50 per ounce.
Chicken Creek	0.725	Sold for $15 per ounce.
Humboldt Basin	0.789—0.866	Do. Do.
Mormon Basin	0.750	Sold for $16 per ounce.
Pocahontas	0.782—0.851	Sold for $15.50 to $17 per ounce.
Rye Valley	0.756	
Shasta	0.850—0.860	Sold for $16.60 per ounce.
Willow Creek	0.825	
CURRY.		
Sixes River	0.825	Sold for $17 per ounce.
DOUGLAS.		
Big Bend	0.925—0.950	Sold for $17 per ounce.
Cañonville	0.900—0.956	
Green Mountain	0.825—0.830	
GRANT.		
Cañon City	0.850—0.900	Sold for $17.60 per ounce.
Granite	0.750—0.761	
Marysville	0.805—0.887	Sold for $16.25 to $17.60 per ounce.
Rock Creek	0.807	Sold for $16.50 to $16.75 per ounce.
Trail Creek	0.857	
JACKSON.		
Applegate	0.850	
Ashland	0.846	
JACKSON—*continued.*		
Coyote Creek	0.895—0.930	
Dry Diggings	0.975	
Fort Lane	0.870	Sold for $16.25 per ounce.
Forty-Nine	0.837	Sold for $16.50 per ounce.
Grass Creek	0.875—0.900	
Jackass Creek	0.959	
Jacksonville	0.860	
Sam's Valley	0.825	
Sardine Creek	0.810—0.900	Sold for $16.75 per ounce.
Sterling	0.826—0.908	
Uniontown	0.804—0.820	Sold for $16.75 per ounce.
Wolf Creek	0.925	
JOSEPHINE.		
Althouse	0.865—0 875	Sold for $16.50 per ounce.
Cañon Creek	0.900	Sold for $17 per ounce.
Grass Creek	0.909—0.930	
Illinois	0.900	
Josephine	0.900	
Murphy	0.900	
Silver Creek	0.900	
Waldo	0.919—0.927	
Yank	0.967	
UMATILLA.		
Columbia River	0.740	Sold for $15.30 per ounce.
WASCO.		
Ochoco	0.711	

From the same sources the following condensed abstract has been prepared, showing the average fineness in gold and silver of the placer yield of several states and territories, with the number of specimen examples from which these averages are derived. The amount of base metal contained in the crude bullion varies from nothing to 0.020.

Average Tenor of Placer Gold.

State or Territory.	Number of examples.	Average fineness.	
		Gold.	Silver.
California	80	0.8836	0.1124
Colorado	9	0.8205	0.1755
Dakota	7	0.9235	0.0725
Georgia	10	0.9228	0.0732
Idaho	413	0.7806	0.2134
Montana	14	0.8951	0.1009
Oregon	77	0.8727	0.1233
Total	610		

From eighty examples of California placer dust and bullion an average fineness of 0.8836 is derived, a proportion slightly in excess of that stated in Dana's *Mineralogy*, where the fineness is quoted at 0.875 to 0.885, or an average of 0.880. It is possible that the census average is a trifle too high, owing to the natural tendency of producers to overestimate the fineness of their gold; but the slight difference between it and the figures given by Dana would not materially affect the general result. The average for Idaho is of 413 lots of placer gold from Boisl basin, a district producing three-fourths of the total for the territory. This gold is of less fineness than that obtained in several other localities in Idaho, but the average stated will hold as a close approximation for the total. There are three methods of obtaining from these data an average for the United States—neither of which is quite free from defects.

If the sum of the figures representing the average gold fineness for the several states and territories be divided by seven, the number of the states and territories from which reliable data as to fineness are obtainable, the quotient is 0.871257, which may be described as an average of geographical distribution. This, however, does not represent the average fineness of the whole actual amount produced, for by this method each state and territory is taken as an equal member in the calculation, without regard to the large difference in their several products. Thus Georgia, with a product of $66,863, has as much weight in influencing the general average as California with a placer yield of $8,580,989, or 128 times as large.

Another mode is to give each individual example equal weight, disregarding territorial limits. Dividing the sum of fineness in gold of 610 specimen examples, 495,887, by 610, an average of 0.8129 is obtained. This gives a true average for the number of cases in which the fineness is definitely given in the schedules, but represents neither the average according to geographical distribution nor that of the whole product. In this way California, with a placer product nine and three-fourths times greater than that of Idaho, is largely overweighted by the latter, owing to the preponderance of examples furnished by Idaho in the census returns. The result is evidently too low.

The third and preferable method is to multiply the average fineness for each state and territory by the coefficient of the several yields, and then divide the sum of the products so obtained by the sum of the coefficients. This gives each not an equal but a just weight. The result is the average fineness of the total product without reference to the producing source. This principle is thus applied:

State or Territory.	Average fineness in gold.		Yield of placer gold in millions of dollars.		Resultants.
California	0.8836	×	8.581	=	7.5821716
Colorado	0.8205	×	0.102	=	0.0836910
Dakota	0.9235	×	0.051	=	0.0470985
Georgia	0.9228	×	0.067	=	0.0618276
Idaho	0.7806	×	0.880	=	0.6869280
Montana	0.8951	×	1.163	=	1.0410013
Oregon	0.8727	×	0.926	=	0.8081202
			11.770		10.3108382

$$\text{Total average gold fineness} = \frac{10.3108382}{11.770} = 0.87602$$

The proportionate contents in silver and in base metal are similarly ascertained. By using the figures representing the average tenor of the placer gold for each of the states and territories for which reliable data are obtainable, and assuming the general averaged deduced from them for the cases in which the returns are defective, the probable total silver contents may readily be calculated. It is found that the 580,766.6 ounces of fine gold were associated with 80,177.3 ounces of fine silver and 2,753.2 ounces of base metal, making the total weight of the crude placer gold 663,697.1 ounces. In mint value the silver contents were worth only $103,661 as against $12,005,511 for the gold. Thus while the ratio of silver to gold products was 1:7.2437 in weight, it was only 1:115.8153 in assay value. At the market rates the value of this placer silver, if any account were taken of it, would be considerably less, or a ratio of about 1:131. The loss to the miners in the price paid for the actual gold contents of the placer dust, when sold in small quantities to local dealers, is so much greater than the whole value of the silver contents, that the latter does not appear to them a matter of any consequence. The amount of silver alloyed with the placer gold of the several states and territories is shown in the accompanying table:

CONTENTS AND MINT VALUE OF CRUDE PLACER GOLD.

State or Territory.	Contents of placer gold.				Mint value.		
	Fine gold.	Fine silver.	Base metal.	Total crude metal.	Gold.	Silver.	Total.
	Ounces.	Ounces.	Ounces.	Ounces.	Dollars.	Dollars.	Dollars.
Alaska	287.9	*39.4	1.3	328.6	5,951	*51	6,002
Arizona	*1,451.2	*198.8	*6.6	*1,656.6	*29,999	*257	*30,256
California	415,105.0	52,804.2	1,879.1	469,788.3	8,580,982	68,271	8,649,253
Colorado	4,921.9	1,052.8	24.0	5,998.6	101,745	1,361	103,106
Dakota	2,460.3	103.1	0.2	2,653.6	50,859	250	51,109
Georgia	3,234.5	256.6	14.0	3,505.1	66,863	332	67,195
Idaho	42,552.8	11,633.1	327.1	54,512.9	879,644	15,040	894,684
Montana	56,255.6	6,341.4	251.4	62,848.4	1,162,906	8,199	1,171,105
Nevada	*2,418.7	*331.3	*11.0	*2,761.1	*49,999	*428	*50,427
North Carolina	*226.7	*31.0	*1.0	*258.8	*4,686	*40	*4,726
Oregon	44,811.5	6,331.2	205.4	51,348.1	926,336	8,186	934,522
South Carolina	316.4	*43.3	*1.4	*361.2	6,541	*56	*6,597
Utah	967.5	*132.5	*4.4	*1,104.4	20,000	*171	*20,171
Washington	5,756.6	*788.6	*26.3	*6,571.4	119,000	*1,019	*120,019
Total	580,766.6	80,177.3	2,753.2	663,697.1	12,005,511	103,661	12,109,172

*Estimated.

RESUME OF PRODUCTION STATISTICS.—The statements of ore raised, its average assay value per ton and actual assay valuation; ore treated, of that which was raised during the year, its average yield per ton and total bullion product; ore which remained on the dumps at the close of the census year, and its assay value; and bullion produced from ore raised prior to the census year, including old tailings reworked, are grouped in the following comprehensive exhibit of the deep mines:

UNITED STATES—PRODUCTION OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.

State or Territory.	*Ore raised during census year.*	*Average assay value per ton.*			*Total assay value of ore raised during census year.*				
		Gold.	*Silver.*	*Gold and silver.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Dollars.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
	2,216,417.61	*a*12 68	*a*25 64	*a*38 32	1,289,990.5	26,666.468	41,193,494	53,259,070	79,925.538
Alabama (*b*)	124.00								
Alaska									
Arizona	48,252.50	*8 70	*89 19	*97 89	*20,312.3	*419,892	*3,328,753	*4,303,746	*4,723,638
Arkansas									
California	544,241.00	18 84	2 84	21 68	495.962.1	10,252,446	1,194,084	1,543,832	11,796,278
Colorado	356,360.00	8 58	55 26	63 94	149,548.2	3,091,435	15,233,414	19,695,282	22,786,717
Connecticut									
Dakota	536,748.00	7 71	33	8 04	200,313.9	4,140,856	136,853	176,937	4,317,793
Delaware									
District of Columbia									
Florida									
Georgia (*b*)	2,792.00				151.1	3,124			3,124
Idaho	35,825.50	28 97	24 52	53 49	50,212.4	1,037,982	679,387	878,379	1,916,361
Illinois									
Indiana									
Indian Territory									
Iowa									
Kansas									
Kentucky									
Louisiana									
Maine (*b*)	2,250.00				536.2	11,084	42,294	54,682	65,766
Maryland									
Massachusetts									
Michigan (*c*)									
Minnesota									
Mississippi									
Missouri									
Montana	114,858.00	9 95	42 68	52 63	55,286.7	1,142,878	3,791,502	4,902,034	6,044,912
Nebraska									
Nevada	356,052.33	15 62	41 06	56 68	269,077.4	5,562,323	11,308,738	14,621,067	20,183,390
New Hampshire (*b*)	2,183.00								
New Jersey									
New Mexico	10,486.50	8 28	73 86	82 14	4.197.8	86,776	599,067	774,533	861,309
New York									
North Carolina (*b*)	35,786.00				17,453.6	360,798	41,457	53,599	414,397
Ohio									
Oregon	14,087.00	16 86	5 35	22 21	11,491.7	237,555	58,292	75,366	312,921
Pennsylvania									
Rhode Island									
South Carolina (*b*)									
Tennessee									
Texas									
Utah	154,827.78	1 75	39 91	41 66	13,088.5	270,563	4,779,556	6,179,488	6,450,051
Vermont									
Virginia (*b*)	164.00				174.5	3,607	97	125	3,732
Washington	537.00	41 04	Trace.	41 04	1,066.0	22,036			22,036
West Virginia									
Wisconsin									
Wyoming	843.00	*27 42		*27 42	1,118.1	23,113			23,113

* Estimated.
a Average calculated without including partial data from Eastern and Southern States.
b No further schedule data.

It appears that of the ore mined during the census year 91.39 per cent. in tonnage was treated at the reduction works, and 8.61 per cent. was left on the dumps. The average result of working treatment, as compared with assay value, was 81.86 per cent. of the gold contents, 79.68 per cent. of the silver, and 80.40 per cent. in all. Notwithstanding the large number of estimated amounts entering into the calculation, these results are probably a very close approximation to the truth.

The highest average yield was from the Arizona ores, amounting to $7.01 gold, $86.24 silver, and $93.25 total per ton. Of the localities producing any considerable amount of bullion, Dakota, with an average of $6.33 gold, $0.14 silver, and $6.47 total per ton, appears as the region where low-grade gold ores are worked to the best advantage, the percentage of yield to assay value being 82.10 per cent. in gold, 42.42 per cent. in silver, and 80.47 per cent. total. The total product of each state and territory, including the silver contents of placer gold, appears in our Table which shows the aggregate bullion output of the United States for the census year.

The relative quota contributed by each of the three great arbitrary divisions into which the country has been apportioned is indicated in the accompanying abtracts, from which it will be seen that the Pacific division furnishes 75.68 per cent. of the gold, 51.43 per cent. of the silver, and 62.30 per cent. of the total. The division of the Rocky mountains yields 23.60 per cent. of the gold, 48.45 per cent. of the silver, and 37.31 per cent. of the total. The product of the Eastern division represents 0.72 per cent. of the gold, 0.12 per cent. of the silver, and 0.39 per cent. of the total.

UNITED STATES—PRODUCTION OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

State or Territory.	Ore raised and treated.	Average yield per ton.			Bullion produced from ore raised and treated during census year.				
		Gold.	Silver.	Gold and silver.	Gold.		Silver.		Total.
	Tons.	Dollars.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
	1,884,426.25	a10 38	a20 43	a30 81	972,582.9	20,105.073	30,577,025	39,533,037	59,638,110
Alabama (b)	124.00	10 50		10 50	62.9	1,301			1,301
Alaska									
Arizona	*25,728.25	*7 01	*86 24	*93 25	*8,725.2	*180,366	*1,716,176	*2,218,844	*2,399,210
Arkansas									
California	435,301.00	16 10	2 00	18 10	402,469.5	8,319,786	828,536	1,071,215	9,391,001
Colorado	330,580.50	6 89	49 20	56 09	110,181.3	2,277,649	12,579,551	15,264,101	18,541,750
Connecticut									
Dakota	496,130.00	6 33	14	6 47	151,837.1	3,138,751	54,577	70,563	3,209,314
Delaware									
District of Columbia									
Florida									
Georgia (b)	2,735.00	5 18		5 18	685.3	14,166			14,166
Idaho	28,029.75	21 16	15 91	37 07	28,689.9	593,073	344,969	446,010	1,039,083
Illinois									
Indiana									
Indian Territory									
Iowa									
Kansas									
Kentucky									
Louisiana									
Maine (b)	400.00	7 50	18 00	25 50	145.1	2,999	5,569	7,200	10,199
Maryland									
Massachusetts									
Michigan (c)							*20,000	*25,858	*25,858
Minnesota									
Mississippi									
Missouri									
Montana	86,576.50	7 30	32 52	39 82	30,570.4	631,946	2,177,760	2,815,627	3,447,573
Nebraska									
Nevada	346,331.00	12 35	33 47	45 82	206,907.4	4,277,156	8,964,562	11,590,282	15,867,438
New Hampshire (b)	2,183.00	5 04	7 32	12 36	532.1	10,999	12,375	16,000	26,999
New Jersey									
New Mexico	7,452.50	6 62	52 65	59 27	2.387.5	49,354	303,455	392,337	441,691
New York									
North Carolina (b)	14,586.00	7.83	Trace.	7 83	5.527.7	114,267	77	100	114,367
Ohio									
Oregon	13,772.00	12 44	1 30	13 74	8,285.5	171,276	13,880	17,946	189,222
Pennsylvania									
Rhode Island									
South Carolina (b)					314.4	6,499			6,499
Tennessee					d96.7	d1,998			d1,998
Texas									
Utah	93,116.75	1 98	31 38	33 36	13,063.4	270,045	3,555,538	4,596,954	4,866,999
Vermont									
Virginia (b)					d.450.9	d9,321			d9,321
Washington	537.00	31 28	Trace.	31 28	812.7	16,800			16,800
West Virginia									
Wisconsin									
Wyoming	843.00	20 55		20 55	837.9	17,321			17,321

State or Territory.	Ore raised but not treated.	Assay value of ore raised during census year and remaining on hand at close of year.					Bullion produced during census year from ore previously raised.				
		Gold.		Silver.		Total.	Gold.		Silver.		Total.
	Tons.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.	Ounces.	Dollars.	Ounces.	Dollars.	Dollars.
	182,346.00	89,033.8	1,840,493	5,277,522	6,823,308	8,663,801	61,391.7	1,269,079	1,140,272	1,474,259	2,743,338
Alabama (b)											
Alaska											
Arizona	22.524.25	8,667.7	179,176	1,209,472	1,563,726	1,742,902	77.4	1,600	82,546	106,724	108,324
Arkansas											
California	8,940,00	3,814.3	78,850	7,281	9,414	88,264	12,102.2	250,173	8,818	11,401	261,574
Colorado	25,779.59	6,007.9	124,194	1,631,644	2,109,553	2,233,747	15,504.4	320,504	219,516	283,812	604,316
Connecticut											
Dakota	40,618.00	17,753.3	366,994	25,404	32,845	399,839	5,622.7	116,233			116,233
Delaware											
District of Columbia											
Florida											
Georgia (b)	57.00	60.7	1,255			1,255					
Idaho	7,705.75	16.411.6	339,258	283,622	366,695	705,953	335.5	6,936	2,707	3,500	10,436
Illinois											
Indiana											
Indian Territory											
Iowa											
Kansas											
Kentucky											
Louisiana											
Maine (b)	1,850.00	536.2	11,084	35,334	45,683	56,767					
Maryland											
Massachusetts											
Michigan (c)											
Minnesota											

* Estimated. a Average calculated without including partial data from Eastern and Southern States. b No further schedule data. c Estimated from receipts at New York assay office; does not include bullion from Silver Islet (which is in Canada). d Actual receipts at Philadelphia mint and New York assay office.

UNITED STATES—PRODUCTION OF DEEP MINES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

State or Territory	*Ore raised but not treated.*	*Assay value of ore raised during census year and remaining on hand at close of year.*					*Bullion produced during census year from ore previously raised.*				
		Gold.		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*
	Tons.	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Mississippi											
Missouri											
Montana	28,281.50	12,861.2	265,864	860,303	1,112,285	1,378,149	528.0	10,915	62,837	81,242	92,157
Nebraska											
Nevada	9,721.00	3,954.4	81,745	462,980	598,587	680,332	27,142.6	*561,087	649,668	*839,957	*1,401,044
New Hampshire (*b*)											
New Jersey											
New Mexico	3,034.00	100.0	2,067	180,788	233,741	235,808					
New York											
North Carolina (*b*)	21,200.00	17,453.6	*360,798	41,457	*53,599	414,397					
Ohio											
Oregon	315.00	1,083.6	22,400	31,634	40,900	63,300	4.3	89	1,285	1,661	1,750
Pennsylvania											
Rhode Island											
South Carolina (*b*)											
Tennessee											
Texas											
Utah	12,145.00	164.5	3,401	507,509	656,158	659,559	74.6	1,542	112,895	145,962	147,504
Vermont											
Virginia (*b*)	85.00	164.8	3,407	94	122	3,529					
Washington											
West Virginia											
Wisconsin											
Wyoming											

* Estimated.

b No further schedule data.

Of greater interest than the above is the following table where the magnificent totals of American bullion production are gathered in contrast. Sixty-two millions of dollars is a total of considerable importance in the economic forces of the country.

BULLION PRODUCT OF THE UNITED STATES FOR THE YEAR ENDING MAY 31, 1880.

State or Territory.	DEEP MINES.									
	From ore raised and treated during census year.					*From ore raised prior to, but treated during census year.*				
	Gold.		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*
	Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Total	972,582.9	20,105,073	30,577,025	39,533,037	59,638,110	61,391.7	1,269,079	1,140,272	1,474,259	2,743,338
Alabama	62.9	1,301			1,301					
Alaska										
Arizona	8,725.2	180,366	*1,716,176	*2,218,844	*2,399,210	77.4	1,600	82,546	106,724	108,324
California	402,469.5	8,319,786	828,636	1,071,215	9,391,001	12,102.2	250,173	8,818	11,401	261,574
Colorado	110,181.3	2,277,649	12,579,551	16,264,101	18,541,750	15,504.4	320,504	219,516	283,812	604,316
Dakota	151,837.1	3,138,751	54,577	70,567	3,209,314	5,622.7	116,233			116,233
Georgia	685.3	14,166			14,166					
Idaho	28,689.9	593,073	344,969	446,010	1,039,083	335.5	6,936	2,707	3,500	10,436
Maine	145.1	2,999	5,569	7,200	10,199					
Michigan			*20,000	*25,858	*25,858					
Montana	30,570.4	631,946	2,177,760	2,815,627	3,447,573	528.0	10,915	62,837	81,242	92,157
Nevada	206,907.4	4,277,156	8,964,562	11,590,282	15,867,438	27,142.6	561,087	649,668	839,957	1,401,044
New Hampshire	532.1	10,999	12,375	16,000	26,999					
New Mexico	2,387.5	49,354	303,455	392,337	441,691					
North Carolina	5,527.7	114,267	77	100	114,367					
Oregon	8,285.5	171,276	13,880	17,946	189,222	4.3	89	1,285	1,661	1,750
South Carolina	314.4	6,499			6,499					
Tennessee	96.7	1,998			1,998					
Utah	13,063.4	270,045	3,555,538	4,596,954	4,866,999	74.6	1,542	112,895	145,962	147,504
Virginia	450.9	9,321			9,321					
Washington	812.7	16,800			16,800					
Wyoming	837.9	17,321			17,321					

* Estimated.

BULLION PRODUCT OF THE UNITED STATES FOR THE YEAR ENDING MAY 31, 1880.—*Continued.*

State or Territory.	DEEP MINES—*continued.* *Total from deep mines.*					PLACER MINES.				
	Gold.		*Silver.*		*Total.*	*Gold.*		*Silver.*		*Total.*
	Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*	*Ounces.*	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Total	1,033,974.6	21,374,152	31,717,297	41,007,296	62,381,448	580,766.6	12,005,511	80,177.3	103,661	12,109,172
Alabama	62.9	1,301	.....	.....	1,301	.....	.....	.....	.....	.....
Alaska	.....	.....	.....	.....	.....	287.9	5 951	*39.4	*51	6,002
Arizona	* 8,802.6	*181,966	*1,798,722	*2,325,568	*2,507,534	*1,451.2	*29,999	*198.8	*257	*30,256
California	414,571.7	8,569,959	837,354	1,082,616	9,652,575	415,105.0	8,580,982	52,804.2	68,271	8,649,253
Colorado	125,685.7	2,598,153	12,799,067	16,547,913	19,146,066	4,921.9	101,745	1,052.8	1,361	103,106
Dakota	157,459.8	3,254,984	54,577	70,563	3,325,547	2,460.3	50,859	193.1	250	51,109
Georgia	685.3	14,166	.....	.....	14,166	3,234.5	66,863	256.6	332	67,195
Idaho	29,025.4	600,009	347,676	449,510	1,049,519	42,552.8	879,644	11,633.1	15,040	894,684
Maine	145.1	2,999	5,569	7,200	10,199	.....	.....	.....	.....	.....
Michigan	.....	.....	*20,000	*25,858	*25,858	.....	.....	.....	.....	.....
Montana	31,098.4	642,861	2,240,597	2,896,869	3,539,730	56,255.6	1,162,906	6,341.4	8,199	1,171,105
Nevada	234,050.0	4,838,243	9,614,230	12,430,239	17,268,482	*2,418.7	*49,999	*331.3	*428	*50,427
New Hampshire	532.1	10,999	12,375	16,000	26,999	.....	.....	.....	.....	.....
New Mexico	2,387.5	49,354	303,455	392,337	441,691	.....	.....	.....	.....	.....
North Carolina	5,527.5	114,267	77	100	114,367	*226.7	*4,686	*31.0	*40	*4,726
Oregon	8,289.8	171,365	15,165	19,607	190,972	44,811.5	926,336	6,331.2	8,186	934,522
South Carolina	314.5	6,499	.....	.....	6,499	316.4	*6,541	*43.3	*56	*6,597
Tennessee	96.7	1,998	.....	.....	1,998	.....	.....	.....	.....	.....
Utah	13,138.0	271,587	3,668,433	4,742,916	5,014,503	967.5	*20,000	*132.5	*171	*20,171
Virginia	450.9	9,321	.....	.....	9,321	.....	.....	.....	.....	.....
Washington	812.7	16,800	.....	.....	16,800	5,756.6	*119,000	*788.6	*1,019	*120,019
Wyoming	837.9	17,321	.....	.....	17,321	.....	.....	.....	.....	.....

State or Territory.	ALL MINES.				
	Gold.		*Silver.*		*Total.*
	Ounces.	*Dollars.*	*Ounces.*	*Dollars.*	*Dollars.*
Total	1,614,741.2	33,379,663	31,797,474 3	41,110,957	74,490,620
Alabama	62.9	1,301	.....	.....	1,301
Alaska	287.9	5,951	39.4	51	6,002
Arizona	*10,253.8	*211,965	*1,798,920.8	*2,325,825	*2,537,790
California	829,676.7	17,150,941	890,158.2	1,150,887	18,301,828
Colorado	130,607.6	2,699,898	12,800,119.8	16,549,274	19,249,172
Dakota	159,920.1	3,305,843	54,770.1	70,813	3,376,656
Georgia	3,919.8	81,029	256.6	332	81,361
Idaho	71,578.2	1,479,653	359,309.1	464,550	1,944,203
Maine	145.1	2,999	5,569.0	7,200	10,199
Michigan	.....	.....	*20,000.0	*25,858	*25,858
Montana	87,354.0	1,805,767	2,246,938.4	2,905,068	4,710,835
Nevada	236,468.7	4,888,242	9,614,561.3	12,430,667	17,318,909
New Hampshire	532.1	10,999	12,375.0	16,000	26,999
New Mexico	2,387.5	49,354	303,455.0	392,337	441,691
North Carolina	5,754 4	118,953	108.0	140	119,093
Oregon	53,101.3	1,097,701	21,496.2	27,793	1,125,494
South Carolina	630.8	13,040	43.3	56	13,096
Tennessee	96.7	1,998	.....	.....	1,998
Utah	14,105.5	291,587	3,668,665.5	4,743,087	5,034,674
Virginia	450.9	9,321	.....	.....	9,321
Washington	6,569.3	135,800	788.6	1,019	136,819
Wyoming	837.9	17,321	.....	.....	17,321

* Estimated.

PRODUCTION BY GEOGRAPHICAL DIVISIONS.

EASTERN DIVISION.

State or Territory.	*Product.*		
	Gold.	*Silver.*	*Total.*
Alabama	$1,301	.....	$1,301
Georgia	81,029	$332	81,361
Maine	2,999	7,200	10,199
Michigan	.....	25,858	25,858
New Hampshire	10,999	16,000	26,999
North Carolina	118,953	140	119,093
South Carolina	13,040	56	13,096
Tennessee	1,998	.....	1,998
Virginia	9,321	.....	9,321
Total	239,640	49,586	289,226

PACIFIC DIVISION.

State or Territory.	*Product.*		
	Gold.	*Silver.*	*Total.*
Alaska	$5,951	$51	$6,002
Arizona	211,965	2,325,825	2,537,790
California	17,150,941	1,150,887	18,301,828
Idaho	1,479,653	464,550	1,944,203
Nevada	4,888,242	12,430,667	17,318,909
Oregon	1,097,701	27,793	1,125,494
Utah	291,587	4,743,087	5,034,674
Washington	135,800	1,019	136,819
Total	25,261,840	21,143,879	46,405,719

Production by Geographical Divisions.—*Continued.*

DIVISION OF THE ROCKY MOUNTAINS.

State or Territory.	*Product.*		
	Gold.	*Silver.*	*Total.*
Colorado	$2,699,898	$16,549,274	$19,249,172
Dakota	3,305,843	70,813	3,376,656
Montana	1,805,767	2,905,068	4,710,835
New Mexico	49,354	392,337	441,691
Wyoming	17,321	. . . . . .	17,321
Total	7,878,183	19,917,492	27,795,675

SUMMARY.

Pacific Division	$25,261,840	$21,143,879	$46,405,719
Division of the Rocky Mountains	7,878,183	19,917,492	27,795,675
Eastern Division	239,640	49,586	289,226
Total	33,379,663	41,110,957	74,490,620

The bullion product of the deep mines of the United States for the year under review amounted to 35 tons 900 pounds avoirdupois (1,033,974.6 ounces troy) of fine gold, and 1,087 tons 900 pounds avoirdupois (31,717,297 ounces troy) of fine silver. That of the placer mines weighed 19 tons 1,824 pounds avoirdupois (580,766.6 ounces troy) in fine gold, with which were alloyed 2 tons 1,498 pounds avoirdupois (80,177.3 ounces troy) of silver. The total weight of fine bullion was no less than 55 tons 724 pounds avoirdupois (1,614,741.2 ounces troy) of gold, and 1,090 tons 398 pounds avoirdupois (31,797,474.3 ounces troy) of silver. These huge figures may be better grasped, perhaps, by considering that the gold represents five ordinary car-loads, while a train of 109 freight cars of the usual capacity would be required to transport the silver. Historians have stated that during the early Spanish occupation whole galleons were freighted exclusively with silver from the mines of Mexico and Peru. This would hardly seem to be an exaggeration, in view of the fact that the present annual product of the United States would suffice to form the full cargo of a large modern vessel.

COMPARISONS.—The relative proportion of placer gold to that produced by the deep mines; the percentage in each class of product of the precious metals from the several mining regions of the United States; the average yield per square mile and per capita in different localities, and the rank of the states and territories in productiveness, are indicated in the following exhibits:

PERCENTAGE OF PLACER GOLD AND GOLD FROM DEEP MINES IN TOTAL GOLD PRODUCT.

State or Territory.	*Hydraulic, placer, drift and river mines.*	*Deep mines.*	*State or Territory.*	*Hydraulic, placer, drift and river mines.*	*Deep mines.*
Alabama	. . . .	100.00	New Mexico	. . . .	100.00
Alaska	100.00	. . . .	North Carolina	3.94	96.06
Arizona	14.15	85.85	Oregon	84.39	15 61
California	50.03	49.97	South Carolina	50.16	49.84
Colorado	3.77	96.23	Tennessee	. . . .	100.00
Dakota	1.54	98.46	Utah	6.86	93.14
Georgia	82.52	17.48	Virginia	. . . .	100.00
Idaho	59.45	40.55	Washington	87.63	12.37
Maine	. . . .	100.00	Wyoming	. . . .	100 00
Montana	64.40	35.60			
Nevada	1.02	98.98			
New Hampshire	. . . .	100.00	United States (including Alaska)	36.06	64.03

RELATIVE PRODUCTION OF THE STATES AND TERRITORIES.

State or Territory.	*Gold.*			*Silver.*	*Total.*
	Placer mines.	*Deep mines.*	*Total gold.*		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Alabama	. . . .	0.01	0.01	. . . .	. . . .
Alaska	0.05	. . . .	0.02	. . . .	. . . .
Arizona	0.25	0.85	0.63	5.66	3.40
California	71.47	40.09	51.38	2.80	24.57
Colorado	0.85	12.16	8.09	40.25	25.84
Dakota	0.42	15.23	9.90	0.17	4.53
Georgia	0.56	0.07	0.24	. . . .	0.11
Idaho	7.33	2.81	4.43	1.13	2.61
Maine	. . . .	0.01	0.01	0.02	0.01
Michigan	. . . .	. . . .	. . . .	0.06	0.03
Montana	9.69	3.01	5.41	7.07	6.34
Nevada	0.42	22.64	14.64	30.24	23.27
New Hampshire	. . . .	0.05	0.03	0.04	0.04
New Mexico	. . . .	0.23	0.15	0.95	0.59
North Carolina	0.04	0 53	0.36	. . . .	0.16
Oregon	7.71	0.80	3.29	0.07	1.51
South Carolina	0.05	0.03	0.04	. . . .	0.02
Tennessee	. . . .	0.01	0.01	. . . .	. . . .
Utah	0.17	1.27	0.87	11.54	6.76
Virginia	. . . .	0.04	0.03	. . . .	0.01
Washington	0.99	0.08	0.41	. . . .	0 18
Wyoming	. . . .	0.08	0.05	. . . .	0.02
Total	100.00	100.00	100.00	100.00	100.00

AVERAGE PRODUCT OF GOLD AND SILVER PER SQUARE MILE AND PER CAPITA.

States and Territories.	Average product.					
	Per square mile.			Per capita.		
	Gold.	Silver.	Total.	Gold.	Sil	Total
Alabama	$0 02	......	$0.02	$0.001	......	$0.001
Alaska	0.01	......	0.01	0.20	......	0.20
Arizona	1.87	$20.58	22.45	5.24	$57.51	62.75
California	108.30	7.27	115.57	19.83	1.33	21.16
Colorado	25.98	159.24	185.22	13.89	85.16	99.05
Dakota	22.17	0.48	22.65	24.46	0.52	24.98
Georgia	1.36	0.01	1.37	0.05	0.0002	0.05
Idaho	17.45	5.48	22.93	45.37	14.25	59.62
Maine	0.09	0.22	0.31	0.005	0.011	0.016
Michigan	......	0.44	0.44	......	0.02	0.02
Montana	12.36	19.89	32.25	46.11	74.19	120.30
Nevada	44.16	112.29	156.45	78.51	199.63	278.14
New Hampshire	1.18	1.72	2.90	0.03	0.05	0.08
New Mexico	0.40	3.20	3.60	0.41	3.28	3.69
North Carolina	2.28	0.003	2.28	0.08	0.0001	0.08
Oregon	11.43	0.29	11.72	6.28	0.16	6.44
South Carolina	0.43	......	0.43	0.01	......	0.01
Tennessee	0.05	......	0.05	0.001	......	0.001
Utah	3.43	55.82	59.25	2.03	32.24	34.97
Virginia	0.22	......	0.22	0.006	......	0.006
Washington	0.96	0.015	1.98	1.81	......	1.81
Wyoming	0.18	......	0.18	0.83	......	0.83
United States (including Alaska)	9 31	11.44	20.75	0.60	0.82	1.48
United States (not including Alaska)	11.03	13.59	24.62	0.66	0.82	1.48
United Statee (including only tha states and territories producing gold and silver, with Alaska)	14.68	18.02	32.70	2.60	3.20	5.80
United States (including only the states and territories producing gold and silver, and not including Alaska)	19.44	23.94	43.38	2.61	3.21	5.82
Average for Colorado, California, Nevada, Utah, Montana, Dakota, Arizona and Idaho	33.47	42.74	76.21	21.04	26.87	47.91

RANK OF THE STATES AND TERRITORIES IN PRODUCTION OF THE PRECIOUS METALS.

In actual product.			In product per square mile.			In product per capita.		
Gold.	Silver.	Total.	Gold.	Silver.	Total.	Gold.	Silver.	Total.
1. California.	1. Colorado.	1. Colorado.	1. California.	1. Colorado.	1. Colorado.	1. Nevada.	1. Nevada.	1. Nevada.
2. Nevada.	2. Nevada.	2. California.	2. Nevada.	2. Nevada.	2 Nevada.	2. Montana.	2. Colorado.	2. Mnntana.
3. Dakota.	3. Utah.	3. Nevada.	3. Colorado.	3. Utah.	3. California.	3. Idaho.	3. Montana.	3. Colorado.
4. Colorado.	4. Montana.	4. Utah.	4. Dakota.	4. Arizona.	4. Utah.	4. Dakota.	4. Arizona.	4. Arizona.
5. Montana.	5. Arizona.	5. Montana.	5. Idaho.	5. Montana.	5. Montana.	5. California.	5. Utah.	5. Idaho.
6. Idaho.	6. California.	6. Dakota	6. Montana.	6. California.	6. Idaho.	6. Colorado.	6. Idaho.	6. Utah.
7. Oregon.	7. Idaho.	7. Arizona.	7. Oregon.	7. Idaho.	7. Dakota.	7. Oregon.	7. New Mexico.	7. Dakota.
8. Utah.	8. New Mexico.	8. Idaho.	8. Utah.	8. New Mexico.	8. Arizona.	8. Arizona.	8. California.	8. California.
9. Arizona.	9. Dakota.	9. Oregon.	9. N. Carolina.	9. Dakota.	9. Oregon.	9. Utah.	9. Dakota.	9. Oregon.
10. Washington.	10. Michigan.	10. New Mexico.	10. Washington.	10. Michigan.	10. New Mexico.	10. Washington.	10. Oregon	10. New Mexico.
11. N.Carolina.	11. Oregon.	11. Washington.	11. Arizona.	11. Maine.	11. N. Hampshi'e.	11. Wyoming.	11. N. Hampshi'e.	11. Washington.
12. Georgia.	12. N. Hampshi'e.	12. N. Carolina.	12. Georgia.	12. Oregon.	12. N. Carolina.	12. New Mexico.	12. Michigan.	12. Wyoming.
13. New Mexico.	13. Maine.	13. Georgia.	13. N. Hampshi'e.	13. N. Carolina.	13. Washington.	13. Alaska.	13. Maine.	13. Alaska.
14. Wyoming.		14. N. Hampshi'e.	14. S. Carolina.		14. Georgia.	14. N. Carolina.		14. N. Carolina.
15. S. Carolina.		15. Michigan.	15. New Mexico.		15. Michigan.	15. Georgia.		15. N. Hampsh'e.
16. N. Hampshi'e.		16. Wyoming.	16. Virginia.		16. S. Carolina.	16. N. Hampshi'e.		16. Georgia
17. Virginia.		17. S. Carolina.	17. Wyoming.		17. Maine.	17. S. Carolina.		17. Michigan.
18. Alaska.		18. Maine.	18. Maine.		18. Virginia.	18. Virginia.		18. Maine.
19. Maine.		19. Virginia.	19. Tennessee.		19. Wyoming.	19. Maine.		19. S. Carolina.
20. Tennessee.		20. Alaska.	20. Alabama		20. Tennessee.	20. Tennessee.		20. Tennessee.
21. Alabama		21. Tennessee	21. Alaska.		21. Alabama.	21. Alabama.		21. Virginia.
		22. Alabama.			22. Alaska.			22. Alabama.

Production Unaccounted for in the Preceding Tables.—In addition to the returns received directly from the mines, there are several minor points to be included in the total yield. A larger item than it is usually considered to be is the annual hoarding of rich specimens. This is not accounted for in the mine production as reported. While it is impossible to state the actual amount thus absorbed with any degree of precision, a careful estimate would place the value of the gold nuggets and ore annually added to the cabinets of collectors at not less than $150,000, and that of the silver ore at about $50,000. This, in view of the great number of mineral collections maintained throughout the mining territory, is certainly not an overestimate.

There is also quite an extensive manufacture of gold quartz into jewelry and souvenirs, particularly in San Francisco. The value so absorbed probably does not fall short of $50,000 annually. In 1870 the United States mining commissioner estimated the amount of gold hoarded as specimens or worked up by local jewelers at $400,000. The same authority, at that period, estimated the annual loss of gold dust in handling as currency at $100,000. As the practice of using dust for money has almost disappeared, the amount so lost is now very small.

Another indefinite quantity is the value of precious metal lost in melting, in assay grains, etc. Summing up the estimates for these additional items, the following result is reached:

Production Unaccounted for in Tabulation.

	Gold.	Silver.	Total.
Bullion product shown in preceding tables	$33,379,663	$41,110,957	$74,490,620
Estimated value of specimens hoarded	150,000	50,000	200,000
Estimated value of gold quartz made into jewelry and souvenirs	50,000	......	50,000
Estimated value of gold dust lost in handling as currency	10,000	......	10,000
Estimated loss in melting and assaying, assay grains, etc.	20,000	10,000	30,000
Total	33,609,663	41,170,957	74,780,620

SHIPMENTS OF BULLION, DUST, AND AMALGAM THROUGH WELLS, FARGO & CO.'S EXPRESS.

UNITED STATES.

State or Territory.	*Shipments during census year.*			*Shipments in June, 1879.*			*Shipments in June, 1880.*		
	Gold bullion, dust, and amalgam.	*Silver bullion and amalgam*	*Total.*	*Gold bullion, dust, and amalgam.*	*Silver bullion and amalgam*	*Total.*	*Gold bullion, dust, and amalgam.*	*Silver bullion and amalgam*	*Total.*
Arizona	$224,468	$1,402,700	$1,627,168	$17,801	$61,896	$79,697	$11,941	$174,386	$186,327
California	16,829,915	532,286	17,362,201	1,604,716	50,067	1,654,783	1,547,651	29,045	1,576,696
Idaho	1,120,902	631,704	1,752,606	103,182	24,743	127,925	62,071	16,820	78,891
Nevada	167,896	14,113,084	14,280,980	17,695	1,356,530	1,374,225	8,858	901,862	910,720
Oregon	922,381	4,510	926,891	78,002	.....	78,002	69,799	.....	69,799
Utah	773,262	2,237,077	3,010,339	39,222	265,531	304,753	72,702	172,825	245,527
Washington	75,138	.....	75,138	7,016	.....	7,016	6,617	.....	6,617
Total	20,113,962	18,921,361	39,035,323	1,867,634	1,758,767	3,626,401	1,769,639	1,294,938	3.064,577
Messengers	94,807	66,712	161,519	.....	.....	.....	1,382	8,575	9,957
Total	20,208,769	18,988,073	39,196,842	1,867,634	1,758,767	3,626.401	1,771,021	1,303,513	3,074,534
New York	.....	945,355	945,355	.....	146,127	146,127	.....	.....	.
Total	20,208,769	19,933,428	40,142,197	1,867,634	1,904.894	3,772,528	1,771,021	1,303,513	3,074,634

FOREIGN.

British Columbia	$929,260	.....	$929,260	$39,750	.....	$39,750	$37,632	.....	$37,632
Mexico	105,243	$1,258,519	1,363,762	15,882	$140,050	155,932	12,601	$92,707	105,308
Total	1,034,503	1,258,519	2,293,022	55,632	140,050	195,682	50,233	92,707	142,940
Total United States	20,208,769	19,933,428	40,142,197	1,876,634	1,904,894	3,772,528	1,771,021	1,303,513	3,074,534
Grand total	21,243,272	21,191,947	42,435,219	1,923,266	2,044,944	3,968,210	1,821,254	1,396,220	3,217,474

A statement of the bullion shipments during the census year from offices of Wells, Fargo & Co., at points in the neighborhood of the Comstock lode is annexed, and is followed by a comparison between the outflow in June, 1879, and that in June, 1880:

BULLION SHIPMENTS FROM POINTS IN NEIGHBORHOOD OF COMSTOCK LODE, THROUGH WELLS, FARGO & CO.'S EXPRESS, FOR THE YEAR ENDING MAY 31, 1880.

County.	*Office.*	*Shipments during census year.*			*Shipments in June, 1879.*			*Shipments in June, 1880.*		
		Gold bullion, dust, and amalgam.	*Silver bullion and amalgam.*	*Total.*	*Gold bullion, dust, and amalgam.*	*Silver bullion and amalgam.*	*Total.*	*Gold bullion, dust, and amalgam.*	*Silver bullion and amalgam.*	*Total.*
Lyon	Dayton	.....	$86,962	$86,962	.....	$22,370	$22,370	.....	.....	.....
Do.	Silver City	$29,034	33,092	62,126	$5,430	.....	5,430	$1,480	.....	$1,480
Ormsby	Carson	.....	28,516	28,516	.....	1,600	1,600	.....	$2,322	2,322
Storey	Gold Hill	28,340	22,974	51,314	3,375	10,650	14,025	.....	.....	.....
Do.	Virginia City	.....	6,835,712	6,835,712	.....	652,715	652,715	1,500	397,860	399,360
Washoe	Reno	10,080	47,620	57,700	.....	.....	.....	464	.....	464
	Total	67,454	7,054,876	7,122,330	8,805	687,335	696,140	3,444	400,182	403,626

Comparison between bullion shipments in June, 1879, and June, 1880.

	Gold bullion, dust, and amalgam.	*Silver bullion and amalgam.*	*Total.*
Shipments in June, 1879	$8,805	$687,335	$696,140
Shipments in June, 1880	3,444	400,182	403,626
Decrease in June, 1880, from June, 1879	5,361	287,153	292,514

The bullion movement from Utah is partially shown in the following abstract from the returns of the Pacific Express Company:

BULLION SHIPMENTS FROM UTAH, THROUGH PACIFIC EXPRESS COMPANY, DURING YEAR ENDING JUNE 30, 1880.

From—	During six months ending December 31, 1879.			Shipped to—								
				New York.			Omaha.			San Francisco.		
	Gold.	Silver.	Total.	Gold.	Silver.	Total.	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Bingham	$107,500	$7,200	$114,700		$7,200	$7,200				$107,500		$107,500
Germania Station		22,630	22,630								$22,630	22,630
Leeds District		468,451	468,451		218,244	218,244					250,207	250,207
Lewiston												
Park City		650,172	650,172		644,747	644,747		$5,425	$5,425			
Silver Reef												
Tintic District	34,700	1,713	36,413	$34,700		34,700					1,713	1,713
Total	142,200	1,150,166	1,292,366	34,700	870,191	904,891		5,425	5,425	107,500	274,550	382,050

From—	During six months ending June 30, 1880.			Shipped to—						Totals for the year ending June 30, 1880.		
				New York.			San Francisco.					
	Gold.	Silver.	Total.	Gold.	Silver.	Total.	Gold.	Silver.	Total.	Gold.	Silver.	Total.
Bingham	$50,300		$50,300				$50,300		$50,300	$157,800	$7,200	$165,000
Germania Station		$35,340	35,340					$35,340	35,340		57,970	57,970
Leeds District											468,451	468,451
Lewiston		8,150	8,150		$8,150	$8,150					8,150	8,150
Park City		468,374	468,374		468,374	468,374					1,118,546	1,118,546
Silver Reef		529,677	529,677		358,089	358,089		171,588	171,588		529,677	529,677
Tintic District	22,953		22,853	$22,953		22,953				57,653	1,713	59,366
Total	73,253	1,041,541	1,114,794	22,953	834,613	857,566	50,300	206,928	257,228	215,453	2,191,707	2,407,160

FOREIGN MOVEMENT.—The exports and imports of treasure are recorded at the custom-houses of the ports through which the outflow and the inflow pass. Such statistics are compiled with great care, and furnish valuable information from a monetary point of view. Used as a means of determining the bullion production of the country they are often deceptive, as explained on a previous page. The figures for the various offices are published regularly by the Bureau of Statistics, and are therefore not repeated here; but an analysis of the returns of the San Francisco custom-house is appended, to show the character of the movement, and as affording a basis of a comparison between similar periods at the beginning and close of the census year.

TREASURE MOVEMENT THROUGH SAN FRANCISCO CUSTOM-HOUSE.

IMPORTS.

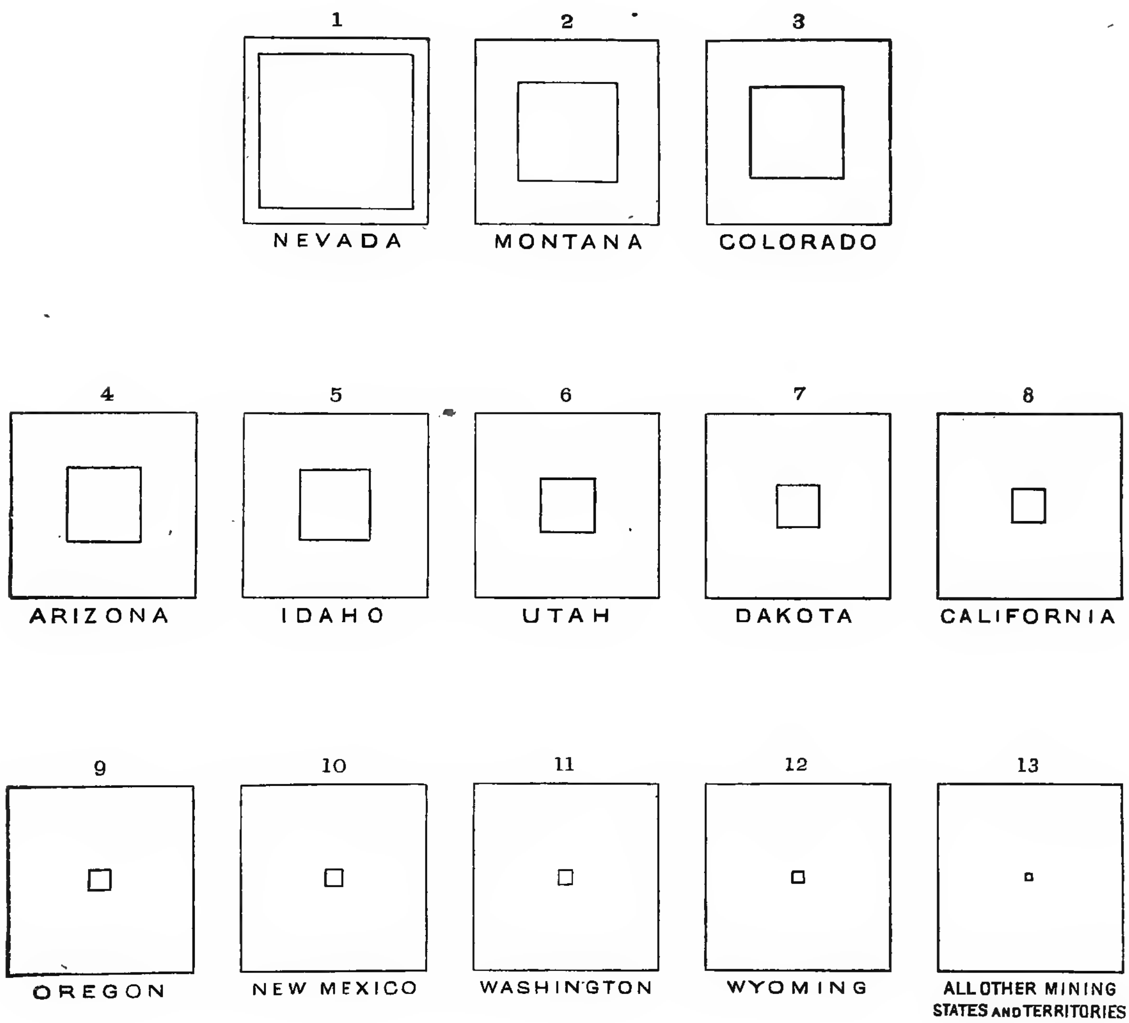
Month.	Gold bullion.	Gold coin.		Total gold.	Silver bullion.	Silver coin.			Total silver.	Total gold and silver
		Foreign.	Domestic.			Foreign.	Domestic.	Trade dollars.		
June, 1879	$40,252	$205	$3,656	$44,113	$74,477	$254,705	$20,950		$350,132	$394,245
July, 1879	80,862		11,994	92,856	123,698	191,721	20,210		335,629	428,485
August, 1879	127,484	1,700	6,467	135,651	122,878	200,592	17,030	$3,420	343,920	479,571
September, 1879	147,125	4,835	10,689	162,649	101,653	159,380	9,896		270,929	433,578
October, 1879	100,222	620	16,601	117,443	153,374	213,579	13,414		380,367	497,810
November, 1879	237,451	71,240	15,257	323,948	86,211	129,873	12,853	25,015	253,952	577,900
December, 1879	83,921	140,555	8,596	233,072	76,698	345,276	15,467	40,500	477,941	711,013
January, 1880	7,054	115,900	9,900	132,854	83,369	251,322	5,853		340,544	473,398
February, 1880	46,650	15,500	3,929	66,079	238,000	93,781	7,517	15,000	354,298	420,377
March, 1880	37,932	32,412	6,809	77,153	120,084	401,751	28,164		549,999	627,152
April, 1880		21,521	35,883	57,404	135,710	354.695	11,509		501,914	559,318
May, 1880	20,601		40,353	69,954	123,370	122,851	116,388		362,609	423,563
Total	929,554	404,488	170,134	1,504,176	1,439,522	2,719,526	279,251	83,935	4,522,234	6,026,410

Comparison between treasure imports in June, 1879, and June, 1880.

Month.	Gold bullion.	Gold coin.		Total gold.	Silver bullion.	Silver coin.			Total silver.	Total gold and silver.
		Foreign.	Domestic.			Foreign.	Domestic.	Trade dollars.		
June, 1879	$40,252	$205	$3,656	$44,113	$74,477	$254,705	$20,950		$350,132	$394,245
June, 1880	52,976		27,926	80,902	107,670	180,489	9,119		279,278	378,180
Increase	12,724		24,270	36,789	33,193					
Decline		205				74,216	11,831		52,854	16,065

Prepared for the MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES, from Plate A, Report on the Precious Metals, by Clarence King, Tenth Census of the United States.

BULLION PRODUCT PER CAPITA.



TREASURE MOVEMENT THROUGH SAN FRANCISCO CUSTOM-HOUSE.—*Continued.*

EXPORTS (DOMESTIC).

Month.	*(a) Gold bullion.*	*Gold coin.*	*Total gold.*	*Silver bullion.*	*Silver coin.*		*Total silver.*	*Total gold and silver.*
					Standard dollars.	*Trade dollars.*		
June, 1879	$100	$80,343	$80,443	$206,843	. . . . . .	$27,888	$234,731	$315,174
July, 1879	1,280	39,360	40,640	155,009	$21,400	7,962	184,371	225,011
August, 1879	3,080	26,788	29,868	804,622	. . . .	7,390	812,012	841,880
September, 1879	2,645	11,393	14,038	529,838	. . . . . .	13,325	543,163	557,201
October, 1879	13,635	40,230	53,865	347,804	240	11,900	359,944	413,809
November, 1879	8,615	53,872	62,487	192,718	. . . . . .	1,406	194,124	256,611
December, 1879	8,801	91,800	100,601	1,154,738	1,000	400	1,156,138	1,256,739
January, 1880	. . . . . .	11,915	11,915	419,665	500	. . . . . .	420,165	432,080
February, 1880	1,367	18,207	19,574	269,125	19,226	1,000	289,351	308,925
March, 1880	286	14,373	14,659	17,700	102,600	. . . . .	120,300	134,959
April, 1880	550	31,042	31,592	72,001	500	. . . . .	72,501	104,093
May, 1880	. . . . . .	48,513	48,513	666,299	9,000	. . . . .	675,299	723,812
Total	40,359	467,836	508,195	4,836,362	154,466	71,271	5,062,099	5,570,294

Comparison between treasure exports (domestic) in June, 1879, and June, 1880.

June, 1870	$100	$80,343	$80,443	$206,843	. . . . . .	$27,888	$234,731	$315,174
June, 1880	1,020	55,534	56,554	34,452	$21,600	.	56,052	112,606
Increase	920	. . . . .	. . .	. . . . .	21,600	. . . . .	. . . .	. . . . .
Decline	. . . .	24,809	23,889	172,391	. . . .	27,888	178,679	202,568

EXPORTS (FOREIGN RE-EXPORTED).

Month.	*Gold bullion.*	*Gold coin.*	*Total gold.*	*Silver bullion.*	*(b) Silver coin.*	*Total silver.*	*Total gold and silver.*
June, 1879	. .	. . . .	. . . .	$45,600	$65,433	$111,033	$111,033
July, 1879	.	$1,990	$1,990	13,900	157,490	171,390	173,380
August, 1879	.	.	.	. . . .	212,421	212,421	212,421
September, 1879	.	. .	. . .	.	149,308	149,308	149,308
October, 1879	.	. .	. . . .	.	324,730	324,730	324,730
November, 1879	.	. . . .	. . .	.	146,205	146,205	146,205
December, 1879	. .	2,452	2,452	.	251,522	251,522	251,522
January, 1880	. .	. . .	.	.	140,214	140,214	140,214
February, 1880	.	. .	.	.	325,913	325,913	325,913
March, 1880	.	.	. . .	.	205,231	205,231	205,231
April, 1880	.	.	.	.	110,300	110,300	110,300
May, 1880	.	.	. . .	.	487,747	487,747	487,747
Total	. . .	4,442	4,442	59,500	2,576,514	2,636,014	2,640,456

Comparison between treasnre exports (foreign re-exported) in June, 1879, and June, 1880.

June, 1879	.	.	.	$45,600	$65,433	$111,033	$111,033
July, 1880	.	.	.	. . . .	102,819	102,819	102,819
Increase	.	.	. . .	. . . .	·37,386	. . . .	. . . .
Decline	.	.	. . .	45,600	. . . . .	8,214	8,214

a Gold bullion includes gold dust.

b The greater part of the silver coin is Mexican dollars.

DR. SOETBEER'S ESTIMATE OF THE PRODUCTION OF THE PRECIOUS METALS IN THE UNITED STATES TO THE CLOSE OF 1875.

Periods.	*Number of years.*	*Gold product.*			*Silver product.*		
		Total.	*Yearly average.*	*Value.*	*Total.*	*Yearly average.*	*Value.*
		Ounces.	*Ounces.*	*Dollars.*	*Ounces.*	*Ounces.*	*Dollars.*
1804–'20	17	1,929	113	39,876	. . . .	. . . . .	. . .
1821–'30	10	35,368	3,537	731,121	. . . . .	. . . . .	. .
1831–'40	10	273,295	27,329	5,649,509	. . .	. . .	. . . .
1841–'50	10	5,658,825	565,883	116,978,291	. . . . . .	. . . .	. . . .
1851–'55	5	14,275,673	2,855,135	295,104,343	1,334,325	266,865	1,725,149
1856–'60	5	12,394,757	2,478,951	256,222,359	996,725	199,345	1,288,666
1861–'65	5	10,722,832	2,144,566	221,660,603	27,972,602	5,594,520	36,165,777
1866–'70	5	12,217,918	2,443,584	252,566,773	48,389,387	9,677,877	62,562,638
1871–'75	5	9,565,344	1,913,069	197,733,203	90,798,425	18,159,685	117,393,284
Total	72	65,145,941	12,432,107	1,346,678,078	169,491,464	33,898,292	219,135,514

ESTIMATE OF THE PRODUCTION OF THE PRECIOUS METALS IN THE UNITED STATES FROM 1848 TO 1880, BY FISCAL YEARS.

[From reports of Hon. Horatio C. Burchard, director of the mint.]

Year.	Gold.	Silver.	Total gold and silver.	Year.	Gold.	Silver.	Total gold and silver.	Year.	Gold.	Silver.	Total gold and silver.
	Dollars.	Dollars.	Dollars.		Dollars.	Dollars.	Dollars.		Dollars.	Dollars.	Dollars.
1848	10,000,000	.....	10,000,000	1860	46,000,000	150,000	46,150,000	1872	36,000,000	28,750,000	64,750,000
1849	40,000,000	50,000	40,050,000	1861	43,000,000	2,000,000	45,000,000	1873	36,000,000	35,750,000	71,750,000
1850	50,000,000	50,000	50,050,000	1862	39,200,000	4,500,000	43,700,000	1874	33,490,902	37,324,594	70,815,496
1851	55,000,000	50,000	55,050,000	1863	40,000,000	8,500,000	48,500,000	1875	33,467,856	31,727,560	65,195,416
1852	60,000,000	50,000	60,050,000	1864	46,000,000	11,000,000	57,000,000	1876	39,929,166	38,783,016	78,712,182
1853	65,000,000	50,000	65,050,000	1865	53,225,000	11,250,000	64,475,000	1877	46,897,390	39,793,573	86,690,963
1854	60,000,000	50,000	60,050,000	1866	53,500,000	10,000,000	63,500,000	1878	51,206,360	45,281,385	96,487,745
1855	65,000,000	50,000	55,050,000	1867	51,725,000	13,500,000	65,225,000	1879	38,899,858	40,812,132	79,711,990
1856	65,000,000	50,000	55,050,000	1868	48,000,000	12,000,000	60,000,000	1880	36,000,000	37,700,000	73,700,000
1857	55,000,000	50,000	55,050,000	1869	49,500,000	12,000,000	61,500,000				
1858	50,000,000	50,000	50,050,000	1870	50,000,000	16,000,000	66,000,000				
1859	50,000,000	100,000	50,100,000	1871	43,000,000	23,000,000	66,000,000	Total	1,520,041,532	460,422,260	1,980,463,792

BULLION PRODUCTION OF THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1879.

[Estimated by Hon. Horatio C. Burchard, director of the mint.]

State or Territory.	Gold.	Silver.	Total.	State or Territory.	Gold.	Silver.	Total.
Arizona	$800,000	$3,550,000	$4,350,000	New Mexico	$125,000	$600,000	$725,000
California	17,600,000	2,400,000	20,000,000	North Carolina	90,000	.....	90,000
Colorado	3,225,000	11,700,000	14,925,000	Oregon	1,150,000	20,000	1,170,000
Dakota	2,420,000	10,000	2,430,000	Utah	575,000	6,250,000	6,825,000
Georgia	90,000	......	90,000	Washington	75,000	20,000	95,000
Idaho	1,200,000	650,000	1,850,000	Other sources	50,000	47,000	97,000
Michigan (Lake Superior) (*a*)	....	780,000	780,000				
Montana	2,500,000	2,225,000	4,725,000				
Nevada	9,000,000	12,560,000	21,560,000	Total	38,900,000	40,812,000	79,712,000

a Including bullion from Silver Islet, which is in Canada.

STATEMENT OF THE AMOUNT OF PRECIOUS METALS PRODUCED IN THE STATES AND TERRITORIES WEST OF THE 100th MERIDIAN FOR THE YEARS 1879 AND 1880.

[Estimated by Mr. John J. Valentine, General Superintendent, Wells, Fargo & Co.'s Express.]

State or Territory.	Gold dust and bullion by express.				Gold dust and bullion by other conveyances.			
	1879.	1880.	Increase.	Decrease.	1879.	1880.	Increase.	Decrease.
California	$16,348,730	$16,900,745	$552,015	.....	$817,436	$845,000	$27,564	.....
Nevada	168,847	236,323	67,476	.....	.....	.....	.....	.....
Oregon	943,601	692,525	.....	$251,076	94,360	346,262	251,902	.....
Washington	77,579	68,911	.....	8,668	7,757	34,500	26,743	.....
Idaho	1,035,804	1,175,115	139,311	.....	207,160	235,023	27,863	.....
Montana	1,907,053	1,115,787	.....	791,266	95,352	55,789	.....	$39,563
Utah	211,640	95,958	.....	115,682	21,164	10,336	.....	10,828
Colorado	3,144,697	2,278,989	.....	865,708	314,469	.....	.....	314,469
New Mexico	19,800	27,300	7,500	.....	.....	.....	.....	.....
Arizona	212,722	159,970	.....	52,752	21,272	80,000	58,728	.....
Dakota	2,674,156	3,749,081	1,074,925	.....	634,831	374,000	.....	160,831
Total	26,744,629	26,500,704	1,841,227	2,085,162	2,113,801	1,980,910	392,800	525,691
Increase	.....	.....	.....	.....	.....	.....	.....	.....
Decrease	.....	.....	.....	243,925	.....	.....	.....	132,891

State or Territory.	Silver bullion by express.				Ores and base bullion by freight.			
	1879.	1880.	Increase.	Decrease.	1879.	1880.	Increase.	Decrease.
California	$739,440	$378,667	.....	$360,873	$285,367	$151,854	.....	$133,513
Nevada	16,622,472	11,071,992	.....	5,550,480	5,206,395	3,723,306	.....	1,483,089
Oregon	.....	20,854	$20,854	.....	.....	.....	.....	.....
Washington	.....	1,763	1,763	.....	.....	.....	.....	.....
Idaho	578,336	332,755	.....	245,581	270,000	151,854	.....	118,146
Montana	1,194,389	919,189	.....	275,200	432,226	1,731,614	$1,299,388	.....
Utah	2,659,042	3,076,775	617,733	.....	2,677,033	3,267,884	590,861	.....
Colorado	1,594,349	1,708,000	111,651	.....	9,360,000	17,300,000	7,940,000	.....
New Mexico	603,000	684,000	81,000	.....	.....	.....	.....	.....
Arizona	1,046,036	2,830,449	1,784,413	.....	662,373	1,402,052	739,679	.....
Dakota	.....	.....	.....	.....	.....	.....	.....	.....
Total	24,937,064	21,022,334	2,517,404	6,432,134	18,893,394	27,728,564	10,569,918	1,734,748
Increase	.....	.....	.....	.....	.....	.....	8,835,170	.....
Decrease	.....	.....	.....	3,914,730	.....	.....	.....	.....

STATEMENT OF THE AMOUNT OF PRECIOUS METALS PRODUCED IN THE STATES AND TERRITORIES WEST OF THE 100th MERIDIAN FOR THE YEARS 1879 AND 1880.—*Continued.*

[Estimated by Mr. John J. Valentine, General Superintendent, Wells, Fargo & Co.'s Express.]

State or Territory.	*Total.* 1879.	1880.	*Increase.*	*Decrease.*
California	$18,190,973	$18,276,166	$85,193	. . . .
Nevada	21,997,714	15,031,621	. . . .	$6,966,093
Oregon	1,037,961	1,059,641	21,680	. . . .
Washington	85,336	105,164	19,828	. . . .
Idaho	2,091,300	1,894,747	. . . .	196,553
Montana	3,629,022	3,822,379	193,359	. . . .
Utah	5,468,879	6,450,953	982,074	. . . .
Colorado	14,413,515	21,284,989	6,871,474	. . . .
New Mexico	622,800	711,300	88,500	. . . .
Arizona	1,942,403	4,472,471	2,530,068	. . . .
Dakota	3,208,987	4,123,081	914,094	. . . .
Total	72,688,888	77,232,512	11,706,270	7,162,646
Increase	. . . .	. . . .	4,543,624	. . . .
Decrease	. . . .	. . . .	. . . .	. . . .

STATEMENT OF THE AMOUNT OF PRECIOUS METALS PRODUCED IN MEXICO (WEST COAST) AND BRITISH COLUMBIA FOR THE YEARS 1879 AND 1880.

[Estimated by Mr. John J. Valentine, General Superintendent, Wells, Fargo and Co.'s Express.]

Country.	*Gold dust and bullion by express.* 1879.	1880.	*Increase.*	*Decrease.*	*Gold dust and bullion by other conveyances.* 1879.	1880.	*Increase.*	*Decrease.*
Mexico (west coast)	$92,916	$118,248	$25,332	. . . .	. . . .	. . . .	. . . .	. . . .
British Columbia	976,742	675,894	. . . .	$300,848	. . . .	$168,973	$168,973	. . . .
Total	1,069,658	794,142	25,332	300,848	. . . .	168,973	168,973	. . . .
Increase	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	168,973	. . . .
Decrease	. . . .	. . . .	. . . .	275,516	. . . .	. . . .	. . . .	. . . .

Country.	*Silver bullion by express.* 1879.	1880.	*Increase.*	*Decrease.*	*Ores and base bullion by freight.* 1879.	1880.	*Increase.*	*Decrease.*	*Total.* 1879.	1880.	*Increase.*	*Decrease.*
Mexico (west coast)	$1,249,955	$1,586,309	$336,354	. . .	$341,000	$386,000	$45,000	. . .	$1,683,871	$2,090,557	$406,686	. . . .
British Columbia	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	976,742	844,867	. . .	$131,875
Total	1,249,955	1,586,309	336,354	.	341,000	386,000	45,000	. . . .	2,660,613	2,936,424	406,686	131,875
Increase	. . . .	. . . .	336,354	. . .	.	.	45,000	. . .	. . .	. . .	274,811	. .
Decrease	. . . .	. . . .	.	. .	.	.	. . . .	. . .	. . .	. . .	. . . .	. . . .

ANNUAL PRODUCTS OF LEAD, SILVER AND GOLD IN THE STATES AND TERRITORIES WEST OF THE 100th MERIDIAN, 1870—1880.

[Estimated by Mr. John J. Valentine, General Superintendent, Wells, Fargo & Co.'s Express.]

Year.	*Products as per W. F. & Co.'s statements, including amounts from British Columbia and west coast of Mexico.*	*Product after deducting amounts from British Columbia and west coast of Mexico.*	*The net product of the states and territories west of the 100th meridian exclusive of British Columbia and west coast of Mexico, divided as follows—* *Lead.*	*Copper.*	*Silver.*	*Gold.*
1870	$54,000,000	$52,150,000	$1,080,000	. . . .	$17,320,000	$33,750,000
1871	58,284,000	55,784,000	2,100,000	. . . .	19,286,000	34,398,000
1872	62,236,959	60,351,824	2,250,000	. . . .	19,924,429	38,177,395
1873	72,258,693	70,139,860	3,450,000	. . . .	27,483,302	39,206,558
1874	74,401,045	71,965,610	3,800,000	. . . .	29,699,122	38,466,488
1875	80,889,057	76,703,433	5,100,000	. . . .	31,635,239	39,968,194
1876	90,875,173	87,219,859	5,040,000	. . . .	39,292,924	42,886,935
1877	98,421,754	95,811,582	5,085,250	. . . .	45,846,109	44,880,223
1878	81,154,622	78,276,167	3,452,000	. . . .	37,248,137	37,576,030
1879	75,349,501	72,688,888	4,185,769	. . . .	37,032,857	31,470,262
1880	80,167,936	77,232,512	5,742,390	$898,000	38,033,055	32,559,067

BULLION PRODUCTION OF THE UNITED STATES—FROM 1868 TO 1875.

[Estimated by Dr. Rossiter W. Raymond, United States mining commissioner.]

State or Territory	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
California	22,000,000	22,500,000	25,000,000	20,000,000	19,049,098	18,025,722	20,300,531	17,753,151
Nevada	14,000,000	14,000,000	16,000,000	22,500,000	25,548,801	35,254,507	35,452,233	40,478,369
Montana	15,000,000	9,000,000	9,100,000	8,050,000	6,068,339	5,187,047	3,844,722	3,573,600
Idaho	7,000,000	7,000,000	6,000,000	5,000,000	2,695,870	2,500,000	1,880,004	1,750,000
Oregon and Washington	4,000,000	3,000,000	3,000,000	2,500,000	2,000,000	1,585,784	763 605	1,246,978
Arizona	500,000	1,000,000	800,000	800,000	625,000	500,000	487,000	750,000
New Mexico	250,000	500,000	500,000	500,000	500,000	500,000	500,000	325,000
Colorado and Wyoming	3,250,000	4,000,000	3,775,000	4,763,000	4,761,465	4,070,263	5,188,510	5,302,810
Utah	. . . . . .	. . . . .	1,300,000	2,300,000	2,445,284	3,778,200	3,911,601	3,137,688
From other parts	1,000,000	500,000	525,000	250,000	250,000	250,000	100,000	500,000
Total	67,000,000	61,500,000	66,000,000	66,663,000	63,943,857	71,651,523	72,428,206	74,817,596

GOLD PRODUCTION OF THE SOUTHERN STATES FROM 1804 TO 1850.

[Estimates of Professor J. D. Whitney.]

Value of gold production by States.

Georgia	$6,048,900
North Carolina	6,842,900
South Carolina	818,100
Tennessee and Alabama	263,800
Virginia	1,198,600
Total	15,172,300

Value of gold production in the respective divisions of time.

1804–'23	$47,000
1824–'30	715,000
1831–'40	6,695,000
1841–'50	7,715,300
Total	15,172,300

EXPORTS OF GOLD FROM SAN FRANCISCO FROM 1848 TO 1863.

[With estimates of Mr. W. P. Blake.]

Year.	*Declared gold export.*	*Estimated actual gold export.*
1848	$60,000,000	$10,000,000
1849		40,000,000
1850		50,000,000
1851 up to May 1	11,497,000	55,000,000
1851	34,960,895	
1852	45,779,000	60,000,000
1853	54,965,000	65,000,060
1854	52,045,633	60,000,000
1855	45,161,731	55,000,000
1856	50,697,434	55,000,000
1857	$48,976,692	$55,000,000
1858	47,548,026	50,000,000
1859	47,640,462	50,000,000
1860	42,325,916	42,325,916
1861	40,676,758	39,176,758
1862	42,561,761	36,061,761
1863	46,071,920	33,071,920
Total	676,908,228	755,630,355

MR. A. DEL MAR'S ESTIMATE OF THE SILVER PRODUCTION FROM 1871 TO 1876.

District.	1871.		1872.		1873.	
	Gold product.	*Silver product.*	*Gold product.*	*Silver product.*	*Gold product.*	*Silver product*
Comstock Lode	$4,077,427	$6,230,587	$6,310,035	$6,612,943	$10,493,756	$11.037,020
Other mines in Nevada	1,485,007	7,880,764	2,142,730	9,953,634	2,678,469	8,094,440
Whole of Nevada	5,562,434	14,111,351	8,452,765	16,566,577	13,172,225	19,131,460
Remainder of the United States		4,000,000		2,000,000		6,000,000
Entire silver product		18,111,351		18,566,577		25,131,460

District.	1874.		1875.		1876.	
	Gold product.	*Silver product.*	*Gold product.*	*Silver product.*	*Gold product.*	*Silver product.*
Comstock Lode	$12,579,825	$11,881,000	$11,739,873	$14,492,350	$18,002,906	$20,570,078
Other mines in Nevada	1,650,202	3,521,382	2 250,618	6,717,636	1,337,798	7,462,752
Whole of Nevada	14,230,027	15,402,382	13 996,491	21,209,986	19,340,704	28,032,830
Remainder of the United States		10,000,000		9,000,000		10,151,520
Entire silver product		25,402,382		30,209,986		38,184,350

The silver product in the United States (with the exception of Nevada) is given for 1876, as follows:

Arizona	$500,000
California	1,800,000
Colorado	3,000,000
Idaho	300,000
Montana	800,000
New Mexico	400,000
Utah	3,351,520
Total, about	10,151,520

Bullion Product of the World.—The world's annual output, so far as ascertainable, is shown in the following tables, which state the sources according to political divisions, and also by continents. The data are for calendar years except for the United States, British Columbia, and Japan. Accurate statistics of the small production of gold and silver in Central America, that of silver in Canada, and gold in Nova Scotia are not available. The totals given are probably slightly under the actual amount. A comparison of the individual figures shows that the United States produce 33.13 per cent. of the gold yield of the whole world, 50.54 per cent. of the silver, and 40.91 per cent. of the total. Of the aggregate supply of the precious metals, North America (including the United States, Mexico, and British Columbia) furnishes 55.78 per cent.

ANNUAL BULLION PRODUCT OF THE WORLD.

Political distribution.				*Continental distribution.*		
Country.	*Gold.*	*Silver.*	*Total.*	*Continent.*	*Total bullion product.*	*Percentage of total product.*
	Dollars.	*Dollars.*	*Dollars.*		*Dollars.*	*Per cent.*
United States (*a*)	33,379,663	41,110,957	74,490,620	North America	101,558,348	55.78
Mexico	989,161	25,167,763	26,156,924	Africa	1,993,800	1.10
British Columbia (*b*)	910,804		910,804	Australia	29,018,223	15.93
Africa (*c*)	1,993,800	......	1,993,800	Europe, including Russia in Asia	39,607,271	21.75
Argentine Republic	78,546	420,225	498,771	Japan	1,382,948	0.76
Colombia	4,000,000	1,000,000	5,000,000	South America	8,531,761	4.68
Rest of South America (*c*)	1,993,800	1,039,190	3,032,990			
Australia (*d*)	29,018,223	....	29,018,223			
Austria	1,062,031	2,002,737	3,064,758			
Germany (*d*)	205,361	6,938,073	7,143,434			
Norway	......	166,270	166,270			
Italy (*d*)	72,375	17,949	90,324			
Russia (*d*)	26,584,000	415,676	26,999,676			
Sweden	1,994	62,435	64,429			
Rest of Europe	....	2,078,380	2,078,380			
Japan	466,548	916,400	1,382,948			
Total	100,756,306	81,336,045	182,092,351	Total	182,092,351	100.00

a Census of 1880. *b* Actual export. *c* From *Dr.* Soetbeer's estimate in 1875. *d* Estimated from production of other years.

Explanation of Charts.—The construction of the diagrams in the charts presented herewith is based upon the figures reached in the preceding compilation, which the plates are designed to exhibit graphically. The plates illustrating the bullion product of the several states and territories per square mile and per capita are founded upon the averages given by our tables in connection with the official measurements of areas by Mr. Henry Gannett, geographer of the tenth census, and the latest count of the population. The inner squares, printed in pink, in each case denote the relative averages of bullion product (gold and silver combined), while the outer gray squares are of an arbitrary, uniform size, and represent in one chart the unit of area, and in the other the unit of population—that is, the square mile and the single individual. The length of the sides of the inner squares is given by the respective square roots of the averages. The plate showing the absolute bullion product of the states and territories, without reference to their size or population, is a repetition in a graphic form of the figures given in our tables, which is the summary of the bullion product of the United States for the census year. It exhibits at a glance three distinct comparisons: that of the gold product, that of the silver, and that of both precious metals. The natural arrangement of the series, according to the totals, is observed. The extreme height of each column is in each case equal to the sum of the height indicating gold, plus that representing the silver. Two essential features are in this manner presented to the eye: first, the wide difference between the product of the three leading mining states, Colorado, California, and Nevada, and that of the remainder of the country; and, second, the remarkable diversity in the proportions of gold and silver in different localities. Colorado and California appear to be anti-types; the one showing a large predominance in the silver yield, the other in that of gold. A similar contrast is shown by another pair, Utah and Dakota. The chart exhibiting the annual fluctuations in the yield of the precious metals since 1848 is in itself a history of the mining industry. The rapid increase in the product following the discovery of the gold fields in California, which reached its highest point in 1853, from which year, owing to the gradual exhaustion of the more accessible and richer deposits, the yield for a time gradually dwindled; the impulse given by the finding of the great Comstock lode, and the addition of the Idaho placers to the productive sources; the effect of the Crown Point and Belcher orebody upon the total product; and, finally, the sudden and vast increase consequent upon the opening of the famous bonanza in the Consolidated Virginia and California mines—these are all pictured. The annals of the silver production, a comparatively recent addition to the national resources, are likewise told. In the same way, if the chart be carried forward beyond the limits of the census year, the rising curves would tell of Leadville and of Tombstone. The figures assumed in this chart are the annual estimates of the director of the mint for fiscal years up to the census year, for which the results reached in this compilation are quoted. It should be remarked that as the fiscal year embraces only the first half of the calendar year of the same designation, the curves in some cases are projected one space to the right of what their position would be were the calendar year to be taken. The two plates illustrating the world's annual product are based on the figures of our table. In one the yield is segregated, so far as possible, according to the political divisions; in the other, according to its continental distribution. The preponderance of the United States as a bullion-producing nation, and of North America as a bullion-producing continent, is in this manner, perhaps, more clearly indicated than by the tabular exhibit.

THE PRODUCTION OF IRON ORE.

MR. RAPHAEL PUMPELLY'S report to the Superintendent of the Tenth Census contains the following, and while these tables do not represent the final results of Mr. Pumpelly's work they summarize it and furnish a fair idea of the iron ore industry of the United States. They are all of the results of his work obtainable up to the time of going to press with this volume. Other statistics in this connection will be found upon other pages which will furnish, in connection with Mr. Pumpelly's figures, a comprehensive view of the iron industry of the country.

Table I.—PRODUCTION OF IRON ORE, BY STATES.

Name of State.	*Number of counties reporting.*	*Number of establishments.*	*Maximum yearly capacity of production, tons, iron ore.*	*Product of establishments, census year (tons).*	*Value of product of establishments.*	*Irregular product, census year (tons).*	*Total product, census year (tons).*	*Value of total product.*	*Value of all materials used in regular industry.*	*Wages paid in establishments of regular industry.*
	1	2	3	4	5	6	7	8	9	10
Total	135	805	13,462,917	7,061,829	$20,470,756	909,877	7,971,706	$23,167,007	$2,896,011	$9,538,117
Alabama	10	17	310,109	184,110	189,108	7,566	191,676	201,865	17,625	123,342
Connecticut	1	4	45,800	35,018	147,799	...	35,018	147,799	20,853	61,167
Delaware	1	2	18,389	2,726	6,553	...	2,726	6,553	941	2,865
Georgia	3	7	101,157	72,705	120,692	18,711	91,416	143,622	8,345	108,796
Kentucky	4	5	105,420	33,522	88,930	31,287	64,809	165,905	8,100	69,319
Indiana	1	...	...	...	...	513	513	1,018	...	...
Maine	1	1	12,000	6,000	9,000	...	6,000	9,000	3,150	9,000
Maryland	5	13	145,296	57,940	118,050	81,688	139,628	421,691	23,726	61,138
Massachusetts	1	9	87,360	62,637	226,130	...	62,637	226,130	43,136	117,158
Michigan	2	43	2,223,365	1,834,712	6,034,648	...	1,834,712	6,034,648	941,711	2,573,857
Missouri	8	48	968,001	386,197	1,674,875	...	386,197	1,674,875	104,955	417,371
New Jersey	6	109	1,487,829	754,872	2,900,442	2,500	757,372	2,910,442	584,229	1,606,257
New York	12	78	2,149,129	1,239,759	3,499,132	22,368	1,262,127	3,654,422	534,395	1,507,395
North Carolina	6	9	11,980	3,276	5,102	42	3,318	5,285	965	4,059
Oregon	1	1	22,400	6,972	4,669	...	6,972	4,669	600	2,210
Ohio	8	30	556,158	198,835	448,000	348,468	547,303	1,269,530	23,806	329,723
Pennsylvania	34	358	3,408,506	1,820,561	4,318,999	365,114	2,185,675	5,517,079	525,165	2,102,167
Tennessee	12	34	218,254	89,933	129,951	14,532	104,465	147,181	8,679	83,529
Texas	1	...	...	...	...	3,600	3,600	8,100	...	...
Vermont	1	1	1,120	560	2,750	...	560	2,750	536	1,500
Virginia	9	23	1,404,524	169,683	384,331	12,643	182,326	439,886	37,783	186,279
West Virginia	6	8	140,529	60,371	88,595	845	61,216	101,557	5,061	63,985
Wisconsin	2	2	45,600	41,440	73,000	...	41,440	73,000	2,250	17,000

Name of State.	*Men employed above ground.*	*Men employed below ground.*	*Boys under 16 employed above ground.*	*Boys employed below ground.*	*Total number of employees in regular establishments.*	*Number of miners.*	*Number of laborers.*	*Number of administrative force.*	*Number of steam-engines.*	*Total horse-power.*
	11	12	13	14	15	16	17	18	19	20
Total	16,345	13,735	1,339	249	31,668	17,923	12,492	1,253	821	24,838
Alabama	590	109	33	6	738	503	216	19	6	192
Connecticut	179	20	1	...	200	100	90	10	5	105
Delaware	36	...	11	...	47	20	25	2	4	40
Georgia	287	50	5	...	342	217	105	20	0	0
Kentucky	255	45	25	...	325	224	88	13	0	0
Indiana	...	...	...	...	...	...	...	...	...	...
Maine	20	...	...	...	20	12	8	...	...	...
Maryland	295	12	22	...	329	119	192	18	11	263
Massachusetts	134	224	24	...	382	216	156	10	8	220
Michigan	2,229	3,120	196	17	5,562	3,163	2,189	210	134	6,574
Missouri	1,435	358	90	10	1,893	1,126	690	77	17	448
New Jersey	1,385	3,264	93	69	4,811	2,931	1,754	126	152	4,486
New York	2,083	2,417	140	35	4,675	2,269	2,216	190	87	3,039
North Carolina	28	19	...	...	47	38	4	5	2	29
Oregon	3	11	...	...	14	11	2	1	1	16
Ohio	1,033	602	43	38	1,716	1,213	459	44	5	130
Pennsylvania	5,196	2,892	583	62	8,733	4,717	3,630	386	380	9,117
Tennessee	443	77	32	...	552	419	109	24	...	...
Texas	...	...	...	...	...	...	...	...	...	...
Vermont	8	7	...	...	15	15	...	...	...	...
Virginia	555	338	36	10	939	412	438	89	8	154
West Virginia	114	150	2	...	266	165	93	8	0	0
Wisconsin	37	20	3	2	62	33	28	1	1	25

PRODUCTION OF IRON ORE, BY STATES—*Continued.*

Name of State.	*Value of all machinery.*	*Cost of explosives used.*	*Number of horses used in regular industry.*	*Number of mules used in regular industry.*	*Amount used as working capital.*	*Value of plant.*	*Value of real estate.*	*Total capital employed and invested in the regular industry.*	*Number of tons on which royalty is paid.*	*Gross amount paid as royalty in census year.*
	21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Total	$2,211,558	$484,432	2,669	1,245	$4,850,763	$8,657,375	$48,274,149	$61,782,287	2,266,510	$981,170
Alabama	17,765	4,240	*9	107	50,900	46,770	438,772	536,442	49,698	6,685
Connecticut	22,225	3,669	98	0	18,500	39,800	368,000	426,300	23,677	42,146
Delaware	4,400	3	6	16	2,000	6,300	40,000	48,300	...	...
Georgia	1,250	4,200	0	68	35,790	33,935	101,200	170,925	...	...
Kentucky	0	1,470	91	26	42,000	59,500	678,329	779,829	21,801	4,427
Indiana	...	...	...	...	...	...	...	...	...	...
Maine	...	2,000	16	0	2,000	2,000	2,500	6,500	...	...
Maryland	17,164	789	37	45	44,450	135,464	310,600	490,614	11,536	6,387
Massachusetts	17,225	6,818	50	2	22,400	70,600	183,000	276,000	3,844	1,277
Michigan	838,558	160,541	390	37	2,254,520	2,789,944	12,452,311	17,496,775	367,610	161,871
Missouri	131,818	28,972	67	241	254,020	678,313	4,666,223	5,598,556	140,597	65,142
New Jersey	519,954	105,130	70	48	562,915	841,226	4,797,620	6,201,761	282,981	156,878
New York	634,906	77,093	323	48	537,950	1,281,740	6,443,449	8,263,139	181,512	71,316
North Carolina	1,850	72	0	2	1,900	2,750	8,650	13,300	...	...
Oregon	1,000	236	0	0	2,225	5,000	9,750	16,975	...	...
Ohio	8,600	7,948	35	55	128,179	263,145	847,401	1,248,725	38,921	6,754
Pennsylvania	934,658	65,288	1,316	305	730,064	2,131,743	14,759,894	17,621,701	1,025,433	437,759
Tennessee	...	1,209	22	84	27,375	36,095	410,450	473,920	51,033	10,129
Texas	...	...	...	...	...	...	...	...	...	...
Vermont	225	138	1	0	500	500	1,000	2,000	...	...
Virginia	37,785	13,165	61	97	106,625	206,000	1,496,500	1,809,125	51,044	11,323
West Virginia	1,500	1,226	67	60	10,450	16,550	88,500	115,500	16,823	1,076
Wisconsin	3,000	225	10	4	16,000	10,000	160,000	186,000	...	...

* 64 oxen are also reported in Alabama.

Remarks on Table I.—Table I contains the principal results thus far compiled from the schedules of the production of iron ore during the census year ending June 1, 1880. The ton of 2,000 pounds is invariably used. The second column of Table I gives the number of mines or establishments which have a regular industrial organization, and from whom it was possible to obtain an account of the capital, wages, and materials employed. The sixth column, headed "irregular product," gives the amount of iron ore raised between the above dates by persons the principal part

Table II.—PRODUCTION OF IRON ORE—GENERAL AVERAGE BY STATES.

Name of State.	*Product of largest mine.*	*Average product per mine.*	*Average number of hands to mine.*	*Average royalty paid per ton (cents).*	*Average yearly income of man.*	*Average monthly net earnings of man.*	*Average number of tons raised per day per man.*	*Average per cent. of year employed in mining.*	*Per cent. of year not employed in mining.*	*Per cent. of year lost in strikes.*	*Average price per ton of ore at mines.*	*Cost of labor per ton of ore mined.*	*Cost of material per ton of ore mined.*
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Total	280,000	8,772	39	43.29	308.94	33.20	0.96	77.56	22.43	0.02	2.90	1.35	0.41
Alabama	23,364	10,830	43	11.44	171.67	24.70	1.43	57.91	42.09	...	1.03	0.67	0.10
Connecticut	14,405	8,754	50	178.00	306.60	27.99	0.64	91.28	8.72	...	4.22	1.75	0.60
Delaware	1,834	1,363	23	...	69.04	31.80	1.06	18.09	81.91	...	2.40	1.05	0.35
Georgia	44,225	10,386	49	...	320.46	33.81	0.90	78.99	21.01	...	1.66	1.50	0.11
Kentucky	17,435	6,704	65	20.31	221.82	27.18	0.50	68.02	30.78	1.20	2.65	2.07	0.24
Maine	6,000	6,000	20	...	450.00	112.51	3.00	33.33	66.67	...	1.50	1.50	0.52
Maryland	17,843	4,457	25	46.70	192.26	29.49	1.08	54.32	45.68	...	2.04	1.06	0.41
Massachusetts	19,079	6,960	42	33.00	316.64	32.04	0.66	82.35	17.65	...	3.61	1.87	0.68
Michigan	224,000	42,668	129	44.00	471.79	43.11	1.20	91.19	8.81	...	3.29	1.40	0.51
Missouri	128,708	8,046	39	46.33	226.46	25.03	0.90	75.41	24.59	...	4.33	1.08	0.27
New Jersey	85,622	6,925	44	55.44	339.59	39.84	0.74	71.03	28.18	0.79	3.84	2.13	0.77
New York	208,416	15,894	60	39.29	328.59	30.64	0.99	89.38	10.62	...	2.62	1.22	0.43
North Carolina	1,686	364	5	...	86.36	17.18	0.55	41.88	58.12	...	1.56	1.24	0.29
Oregon	6,972	6,972	14	...	157.86	25.06	3.16	52.50	47.50	...	0.67	0.32	0.09
Ohio	9,381	6,628	57	17,35	196.79	25.98	0.61	63.13	36.15	0.72	2.25	1.66	0.12
Pennsylvania	280,000	5,085	24	42.69	260.65	28.57	0.91	76.04	23.80	0.16	2.37	1.20	0.29
Tennessee	13,608	2,645	16	19.85	155.84	23.23	0.97	55.91	44.09	...	1.44	0.93	0.10
Vermont	560	560	15	...	100.00	25.00	0.37	33.33	66.67	...	4.91	2.68	0.96
Virginia	28,000	6,526	36	22.18	203.36	28.89	1.03	58.66	41.34	...	2.27	1.10	0.22
West Virginia	29,120	7,546	33	6.40	241.45	28.81	1.08	69.84	29.79	0.37	1.47	1.06	0.08
Wisconsin	39,200	20,720	31	...	285.71	35.71	3.34	66.67	33.33	...	1.76	0.41	0.05

PRODUCTION OF IRON ORE—GENERAL AVERAGE BY STATES.—*Continued.*

Name of State.	*Amount of interest, royalty and profit per ton of ore.*	*Per cent. of value of product paid for labor.*	*Per cent. of value of product paid for material.*	*Per cent. of value of product left for royalty, profit and interest.*	*Average horse-power of engines to mine.*	*Per cent. of miners to total force.*	*Per cent. of laborers in total force.*	*Per cent. of administrative force in total force.*	*Per cent. of capital in real estate.*	*Per cent. of capital in plant.*	*Per cent. of capital used for working capital.*	*Per cent. ratio of value of yearly product to total capital.*	*Per cent. ratio of tonnage produced to maximum capacity of production.*
	14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
Total	1.14	46.59	14.15	39.26	31	56.60	39.45	3.96	78.14	14.01	7.85	33.13	52.45
Alabama	0.27	65.22	9.32	25.46	11	68.16	29.27	2.57	81.80	8.70	9.49	28.00	59.37
Connecticut	1.87	41.38	14.10	44.52	26	50.00	45.00	5.00	86.32	9.30	4.34	34.71	76.46
Delaware	1.00	43.72	14.36	41.92	20	42.55	53 20	4.26	82.82	13.04	4.14	13.78	14.82
Georgia	0.07	90.14	6.91	2.95	....	63.45	30.70	5.85	59.21	19.85	20.94	70.61	71.87
Kentucky	0.35	77.95	9.11	12.94	...	68.92	27.08	4.00	86.98	7.63	5.39	11.40	31.80
Maine	*0.52	100.00	35.00	(*)	....	60.00	40.00	...	38.46	30.77	30.77	72.20	50.00
Maryland	0.57	51.79	20.10	28.11	20	36.17	58.36	5.47	63.32	27.62	9.06	24.07	39.88
Massachusetts	1.06	51.81	19.07	29.12	24	56.54	40.84	2.62	66.30	25.58	8.12	81.93	71.70
Michigan	1.38	42.65	15.60	41.75	153	56.87	39.36	3.77	71.16	15.94	12.89	34.49	82.52
Missouri	2.98	24.92	6.27	68.81	9	59.48	36.45	4.07	83.34	12.11	4.54	30.00	39.90
New Jersey	0.94	55.38	20.14	24.48	41	60.92	36.46	2.62	77.36	13.56	9.08	46.77	50.74
New York	1.17	43.08	15.27	41.65	39	48.53	47.49	4.06	77.98	15.51	6.51	42.34	57.69
North Carolina	0.03	79.56	18.91	1.53	3	80.85	8.51	10.64	65.04	20.67	14.28	38.36	27.35
Oregon	0.26	47.33	12.85	30.82	16	78.57	14.28	7.14	57.44	29.46	13.11	27.51	31.13
Ohio	0.47	73.60	5.31	21.00	4	70.69	26.75	2.56	68.66	21.07	10.26	35.88	35.75
Pennsylvania	0.88	50.76	12.16	37.08	25	54.01	41.57	4.42	83.76	12.10	4.14	24.51	53.41
Tennessee	0.41	64.27	6.68	29.05	...	75.90	19.74	4.35	86.00	7.62	5.78	27.42	41.21
Vermont	1.27	54.54	19.49	25.97	....	100.00	....	....	50.00	25.00	25.00	137.50	50.00
Virginia	0.95	48.47	9.83	41.70	6	43.88	46.65	9.48	82.72	11.39	5.89	21.24	12.08
West Virginia	0.33	72.22	5.72	22.06	....	62.03	34.96	3.01	76.62	14.33	9.05	80.52	42.96
Wisconsin	1.30	23.29	3.08	73.63	13	53.23	45.16	1.60	86.02	5.37	8.60	39.25	90.88

* Loss.

of whose livelihood was obtained in some other occupation, generally farming. In twelve of the states there are localities where soft ore can be obtained from surface diggings. These are worked by farmers during the intervals of agricultural employment, the product drawn by farm teams to the nearest furnace and sold. The quantities of ore so produced by individuals vary from 5 to 500 tons. In some instances, again, furnace companies own the land on which the ore is dug, and hire the farmers of the neighborhood to deliver it at the furnace for a fixed price per ton. This work is done in such an irregular and desultory manner that the only items safely attainable are the amount and value of the product, although the total so produced amounts to over a ninth (11.4 per cent.) of the entire tonnage of the country. An account of purchases of ore was obtained from the furnace companies in these localities, with the name of the producer, the price and technical name of the ore, and the name of the county where the ore was mined, or, more properly, dug. Great care has been taken to avoid duplication of any of the amounts so produced, by comparing the names taken from the books of the smelting establishments with the names on the regular schedules of production received from our agents. It will therefore be observed that no items based on this "irregular product" appear in the columns of employés, wages, materials, capital, etc. The columns of production, both "regular" and "irregular," contain no estimates, but are made up from authentic returns. A small amount of ore raised in Colorado is omitted, as it is used as a flux, and does not, as yet, affect the iron-manufacturing industry. The total production, 7,971,706 tons, exceeds the amount reported as consumed in manufacturing establishments by Mr. Swank (7,709,706 tons) by 232,000 tons. There was imported during the census year at the ports of Buffalo, Boston, Oswego, Philadelphia, New York, and Baltimore, 439,451 tons, from which it would appear that the stocks of ore on hand must have increased during the census year about 701,451 tons, or that only 91.66 per cent. of the ore produced (and imported) was consumed during the period. In view of the fact that there was a scarcity of iron ore in 1879, and that many new mines were opened in consequence, whose stocks failed to reach consumers before the summer of 1880, the two results are easily reconcilable. The value of the ore is taken at the mine, or at the point of delivery to a customer or a transportation company, but always at the point where the expenses of labor and material which come under our consideration, cease. Where the ore is smelted by the same company which mines it, it not unfrequently happens that the cost and value as returned are the same, since the ore is regarded as part of the furnace supplies. This has had the effect of depressing slightly the value returned to us below the market price, and of carrying part of the profits of mining into the manufacture of pig iron. In nearly all of the iron-mining districts of the country, though the systems of labor vary, it is the custom that each miner or underground laborer furnish his oil or candle, and, when working by the ton, his own powder and fuse. The amounts thus expended have, as far as possible, been deducted from the pay of the men and added to the cost of material, in order that the column headed "wages" might more nearly represent the net cash income of the laborer available for his support. "Labor" is classified with regard to age and occupation. In the underground mines the classes of employés are well defined. In the open-cut and quarry mines the distinction between laborers and miners is more indefinite. "Materials used" covers everything consumed in the business, including, among the more important items, feed for animals, timber, fuel, repairs of all kinds, tools, powder, fuse, lights, etc. "Capital" is divided into—First, "working capital," or the sum of money required to run the mine from month to month and to pay wages and buy materials in producing the stock that is ordinarily carried. Taking the broad view of the entire industry, this portion of the capital is represented by marketable product and is not jeopardized.

Second, "plant," which represents the permanent openings, roads, buildings, machinery, etc., which are subject to rapid deterioration, require constant repairs, and are of little value when the mine is exhausted.

Third, "real estate," which means the land as a mineral producer, its value as such being considered apart from its possible value for agricultural or forestry purposes. This value is a fund which is constantly diminished as the ore is withdrawn, and eventually reaches zero; and must be made good by capitalizing the royalties. The lands in question are not wild lands, but such as are attached to a working mine. Their acreage cannot be given, as iron ore deposits are irregular in their occurrence, but their extent is such that for all practical purposes their present annual yield may be regarded as not likely to be diminished for many years.

Remarks on Table II.—Table II contains the averages drawn from the data in Table I. In finding the average net income of a man, the three classes of labor are considered together, and two boys are considered the equivalent of one man in earning capacity. The year, which is divided into percentages of time lost and made, is the working year of twelve months of 25 working days each. The small amount of time lost in strikes, equivalent to the average working lifetime of two men only, shows that no serious conflict between capital and labor arose during the census year in this industry. The low rate of monthly wages must be qualified by the consideration that the miner receives the advantages of low rent and prices of the necessaries of life, and in some cases privileges which cannot be brought into columns of statistics, but which tend to equalize his condition with the higher-paid labor of cities. As stated before, the price of ore in some of the states, notably Georgia, North Carolina, Tennessee, Ohio, Virginia, and West Virginia, is seriously lowered by the fact that it is returned by furnace companies who, in many cases, include, in the price given, no allowance for royalty nor profit, as they charge it to their furnaces at cost. We have not felt at liberty to change the price fixed by a producer without positive information. The product would replace the capital employed and invested in little more than three years, but the profits and royalty would require nearly seven and three-quarter years to effect the same result. It requires an investment of $8.75 on the average to produce a ton of ore yearly. The annual product, as will be observed, is but little in excess of one-half of the maximum capacity. The mines which yield ore fit for the manufacture of Bessemer steel, however, approach much nearer their greatest possible yield. "Maximum capacity" means an estimate of what could be produced from present developments, with present appliances, under the stimulus of a pressing demand. It could be attained with an increase of working capital and labor only. Its excess over real product is partly accounted for by the fact that many new mines went into operation during the latter part of the year. The following table presents some comparisons with the census of 1870:

Table III.—Changes in the iron-ore mining industry in the United States during the decade ending June 1, 1880, expressed in percentages on the returns of the Census of 1870.

	Per cent.
Gain in number of establishments	91.67
Gain in total number of employés	110.81
Gain in total horse-power of steam-engines	189.69
Gain in amount paid as wages	39.48
Gain in amount paid for material	126.33
Gain in total capital	247.61
Loss in value per ton of product	25.45
Gain in value of total product	75.45
Gain in tonnage of total product	135.00
Gain in product of regular establishments	108.00
Loss in yearly income of man	32.13
Loss in per cent. of value of product paid for labor	5.19
Gain in per cent. of value of product paid for materials	4.46
Gain in per cent. of value of product retained for royalty, interest, etc.	0.74

The gain in the total number of mine employés, 110.81 per cent., is slightly more than the gain, 108 per cent., in the product of the establishments to which they belong. This arises from the fact that many new mines were opened in 1879–'80 which were not productive till the latter part of the year. The effectiveness per man has undoubtedly been increased by the increased use of power, as shown in the large per cent., 189.68, and by the introduction of improved drilling machinery and high explosives. The census of 1870, unfortunately, affords no basis for making this important comparison. Proportionately more is expended for material and less for labor than was the case in 1870. This arises partly from the fact that wages are reduced to net wages, as explained before, and partly from a real increase in consumption of supplies as mining becomes more systematic and dependent on mechanical appliances. The average yearly incomes of labor cannot be justly compared, for the same reason that we cannot compare its effectiveness, *i. e.*, because we cannot ascertain the proportion of the year lost in 1870. The number of boys employed has increased at a much more rapid rate than the number of men. They now constitute five per cent. of the entire force, and have increased 348 per cent. in ten years. The large gain in capital, 247.61 per cent., is explained by the fact that all iron-ore producing property was included in the present census, whether it belonged to the mine operator or was leased or worked on a royalty. Viewing the iron lands returned as a whole, they are capable of keeping up the present annual yield for an indefinite time, though parts of them may become rapidly exhausted. Extending the average royalty of 42 cents a ton to the entire product, we would have a yearly income of over three millions of dollars, or rather more than 6.25 per cent. on the returned value of the real estate. In view of the fact that this income, though not likely to be diminished for fifty years to come, is very far from being a perpetual annuity, it will be seen that the present value of the real estate is not overestimated. After taking out the royalty charge, if from the remainder of the annual net receipts we deduct an amount equal to 6 per cent. interest on the working capital, there is left, in round numbers, the sum of $4,690,000. The "plant," consisting of animals, boilers, engines, tools, buildings, cars, tracks, etc., is subject to a deterioration of not far from 30 per cent. yearly. Deducting this, leaves $2,096,000 as the profits and expenses of the general management of the business, or a trifle over 9 per cent. of the value of the annual product, a proportion which cannot be called excessive; for it must be remembered that, though the income of the business, *as a whole*, is a steady and regular addition to our national wealth, each individual mine is subject to interruptions from accidents, and to exhaustion of the mineral deposit. Consequently, the net income of each individual mine cannot be regarded as consisting solely of interest, royalty and profits, but must be charged, for safety, with a certain sum for insurance against unforeseen contingencies, which would not be necessary if one company owned the entire property. The conditions of iron-ore mining are so different in different districts that only the most general analysis can be applied to the totals. The above considerations show that the general relations between capital and production spread over our returns are harmonious, and are given, not so much with a view to prove the healthy condition of the industry, as to justify the assertion that our valuations of capital are very far from extravagant, though the period during which they were made—the summer of 1880—was one of great activity in iron mining. It may be observed, too, that the real estate which furnishes the "irregular product" of 1,015,981 tons is far from worthless as mineral land, though we have not included it in our valuation. Its principal value, however, consists in the fact that it affords its owners a field for moderately remunerative labor. The average price per ton has fallen from $3.89 to $2.90, or 25.45 per cent. As gold averaged about 30 per cent. above the paper dollar in 1870, the true fall in iron ore is only 14 cents a ton. Since the last census was taken the average price per ton has changed in the five great states as follows: In Michigan it has fallen 15 per cent.; in Missouri it has risen 56.32 per cent.; in New Jersey it has fallen 30 per cent.; in New York it has fallen 29 per cent.; in Pennsylvania it has fallen 35 per cent. These irregularities are chiefly due to the increased demand for ores suitable to the manufacture of Bessemer steel.

Table IV.—List of iron-producing States in order of the production of 1880.

States.	*Total product.*	*Per cent. of total product.*	*Per cent. of total value of product.*
	Tons.		
Pennsylvania	2,185,675	27.418	23.8144
Michigan	1,834,712	23.015	26.0485
New York	1,262,127	15.833	15.7743
New Jersey	757,372	9.501	12.5629
Ohio	547,303	6.866	5.4789
Missouri	386,197	4.845	7.2296
Alabama	191,676	2.404	0.8714
Virginia	182,326	2.287	1.8988
Maryland	139,628	1.752	1.8202
Tennessee	104,465	1.311	0.6353
Georgia	91,416	1.147	0.6199

List of iron-producing States in order of the production of 1880.—*Continued.*

States.	Total product.	Per cent. of total product.	Per cent. of total value of product.
	Tons.		
Kentucky	64,809	0.813	0.7161
Massachusetts	62,637	0.786	0.9761
West Virginia	61,216	0.768	0.4384
Wisconsin	41,440	0.520	0.3151
Connecticut	35,018	0.439	0.6380
Oregon	6,972	0.087	0.0202
Maine	6,000	0.075	0.0388
Texas	3,600	0.045	0.0350
North Carolina	3,318	0.042	0.0228
Delaware	2,726	0.034	0.0283
Vermont	560	0.007	0.0119
Indiana	513	0.006	0.0044
The United States	7,971,706		

Table V.—The rank of the sixteen states reported in the census of 1870 as producers of iron ore was as follows:

1. Pennsylvania.	5. Ohio.	9. Massachusetts.	13. Vermont.
2. Michigan.	6. Missouri.	10. Wisconsin.	14. North Carolina.
3. New York.	7. Maryland.	11. Kentucky.	15. Delaware.
4. New Jersey.	8. Tennessee.	12. Virginia.	16. Indiana.

The six great iron states retain in 1880 their former relative rank, and Alabama, a new state, takes the rank next them. Pennsylvania and Michigan yield over one-half the entire product. The six states at the head of the list yield 87.48 per cent. of the total, which is worth 90.91 per cent. of the total value. Sixteen states were reported in 1870 against twenty-three at present. The new iron-producing states are Alabama, Georgia, West Virginia, Connecticut, Oregon, Maine, and Texas. They produce 4.96 per cent. of the product. Virginia has gained four places; Maryland and Tennessee have lost two; Massachusetts four, and Kentucky one.

Table VI.—List of Counties of the first class producing over 100,000 tons.

County.	State.	Tons.
Marquette	Michigan	1,374,812
Essex	New York	630,944
Morris	New Jersey	568,420
Menominee	Michigan	459,900
Lehigh	Pennsylvania	321,322
Lebanon	Do.	285,629
Berks	Do.	252,940
Blair	Do.	154,914
Saint François	Missouri	144,265
Dutchess	New York	125,859
Northampton	Pennsylvania	104,788
Total of 11 counties of the 1st class		4,423,793

The eleven counties (Table VI.) produce 55.49 per cent. of the entire tonnage, of which total Marquette county, Michigan, must be credited with 17.25 per cent. Menominee county, Michigan, is the only one of the above which did not produce iron ore in 1870. The total number of counties from which reports have been received and tabulated is 135, against 71 in 1870, a gain of a little over 90 per cent.

Table VII.—List of Counties of the second class producing less than 100,000 tons and over 50,000 tons.

County.	State.	Tons.
Clinton	New York	92,166
Orange	Do.	88,988
Crawford	Missouri	87,033
Putnam	New York	76,746
Sussex	New Jersey	70,365
Cumberland	Pennsylvania	67,846
Jefferson	New York	64,111
Fayette	Pennsylvania	63,792
York	Do.	63,570
Lancaster	Do.	63,274
Berkshire	Massachusetts	62,637
Lawrence	Ohio	62,599
Dent	Missouri	58,878
Iron	Do.	57,297
Warren	New Jersey	50,214
Total of the 15 counties of the 2d class		1,029,516

The above 15 counties, in 6 states, produce 12.92 per cent. of the entire product. The 26 leading counties produce 68.41 per cent. of the entire product, leaving 31.59 per cent. to be spread over the remaining 109 counties. The following table contains a list of all mines or industrial establishments producing over 50,000 tons during the census year, in the order of their production:

Table VIII.

State.	County.	Name of mine.	Product.	Value of product.	Employés.
			Tons		
Pennsylvania	Lebanon	Cornwall Ore Bank	280,000	$500,000	135
Michigan	Marquette	Republic	224,000	896,000	600
Do.	Do.	Lake Superior Iron Company	215,930	771,180	542
Do.	Menominee	Norway and Cyclops	210,875	527,187	510
New York	Essex	Old Bed	208,416	744,344	321
Do.	Do.	21	187,448	238,525	282
Missouri	Saint François	Iron Mountain	144,153	1,061,801	300
Michigan	Marquette	Jackson	134,585	569,582	252
Do.	Do.	Cleveland Iron Mining Company	125,440	448,000	450
New York	Essex	Crown Point	112,000	500,000	450
Michigan	Marquette	Champion	99,609	355,748	350
New Jersey	Morris	Glendon Hibernia	85,623	382,245	550
Michigan	Menominee	Vulcan	83,394	208,485	200
Do.	Marquette	Michigamme	66,158	212,652	197
Do.	Menominee	Quinisec	63,689	159,220	178
Missouri	Crawford	Merimec Iron Mining Company	60,385	134,788	184
New York	Putnam	Tilly Foster Iron Mines	56,000	131,500	250
Missouri	Iron	Pilot Knob	52,761	115,993	410
New Jersey	Morris	Mount Hope	50,379	264,390	194
			2,460,845	8,222,640	6,355

The preceding 19 mines yielded 34.85 per cent. of the entire tonnage of the "regular mines," the value of which reached 40.16 per cent. of the value of the total. The labor employed by them, however, aggregates only 20.06 per cent. of the entire force, as it is generally worked more continuously and at higher wages. The product of the Cornwall Ore Bank was 3.97 per cent., and of the Republic 3.17 per cent. of the entire product of the regular mines. 174 mines have been opened during the census year, or 21.6 per cent. of the total reported. During the census year the iron-mining industry consumed 6,907,931 linear feet of round timber for props, etc., valued at $114,951; 8,625,463 superficial feet of sawed lumber, valued at $128,110; and 88,443 cords of wood for fuel, valued at $177,309; all of which is included in the gross amount of materials used.

Table No. I.—CENSUS OF 1880—PRODUCTION OF BITUMINOUS COAL BY STATES EAST OF THE 100th MERIDIAN.

Name of State.	*Number of counties.*	*Number of establishments.*	*Maximum capacity of yearly production, tons.*	*Product of establishments census year, tons.*	*Value of product at mines.*	*Irregular product, tons.*	*Total product census year, tons.*	*Value of total product at mines.*	*Value of material used in mines census year.*	*Wages paid to all classes of labor.*
	1	2	3	4	5	6	7	8	9	10
Total	314	2,943	74,154,273	40,311,459	$49,044,498	628,569	40,940,028	$49,733,603	$4,661,662	$30,707,059
Alabama	6	19	451,922	322,934	475,559	1,038	323,972	476,911	48,583	328,788
Arkansas	4	14	57,440	14,778	33,535	...	14,778	33,535	1,135	20,850
Georgia	1	2	165,000	154,644	231,605	...	154,644	231,605	9,500	85,179
Illinois	46	590	13,808,709	6,089,514	8,739,755	25,863	6,115,377	8,779,832	796,149	6,035,919
Indiana	19	216	3,110,983	1,449,496	2,143,093	4,831	1,454,327	2,150,258	158,604	1,405,164
Iowa	25	227	3,896,895	1,442,333	2,473,155	18,783	1,461,116	2,507,453	249,820	1,554,696
Kansas	24	189	1,140,518	763,297	1,497,268	7,845	771,142	1,516,544	47,485	758,980
Kentucky	49	65	2,435,776	935,857	1,123,046	10,431	946,288	1,134,960	95,995	687,474
Maryland	2	32	4,532,832	2,227,844	2,584,455	1,073	2,228,917	2,585,537	194,942	1,370,079
Michigan	2	6	141,800	100,800	224,500	...	100,800	224,500	7,750	146,000
Missouri	35	144	1,120,112	543,990	1,037,100	12,314	556,304	1,061,225	55,756	642,772
Nebraska	1	1	400	200	750	...	200	750	10	200
North Carolina	1	1	700	350	400	...	350	400	50	300
Ohio	30	618	12,093,880	5,932,853	7,629,488	75,742	6,008,595	7,719,767	931,298	5,100,547
Pennsylvania	29	666	26,229,031	18,004,988	18,157,151	420,175	18,425,163	18,567,129	1,754,602	10,863,583
Tennessee	9	20	746,050	494,491	628,954	640	495,131	629,724	47,323	336,765
Virginia	3	4	105,740	40,520	92,837	2,559	43,079	99,802	11,614	71,447
West Virginia	28	120	4,116,485	1,792,570	1,971,847	47,275	1,839,845	2,013,671	251,046	1,298,316

Name of State.	*Men employed above ground.*	*Men employed below ground.*	*Boys under 16 employed above ground.*	*Boys under 16 employed below ground.*	*Total employés.*	*Number of steam engines.*	*Horse-power of steam engines.*	*Value of all machinery, including engines.*	*Value of explosives used census year.*	*Amount employed as working capital.*
	11	12	13	14	15	16	17	18	19	20
Total	13,842	76,512	755	5,366	96,475	812	24,726	$2,403,211	$963,313	$8,191,960
Alabama	625	850	17	21	1,513	12	425	46,400	11,100	111,500
Arkansas	22	98	8	2	130	3	35	...	25	...
Georgia	257	185	...	...	442	...	...	...	3,775	30,745
Illinois	2,152	13,128	71	950	16,301	286	8,294	597,184	267,730	1,162,635
Indiana	570	3,748	7	171	4,496	65	1,717	146,908	56,151	348,665
Iowa	808	3,994	12	210	5,024	57	1,445	126,218	116,970	273,350
Kansas	288	3,142	6	181	8,617	4	120	...	12,125	...
Kentucky	679	1,958	67	122	2,826	18	522	51,150	41,018	276,000
Maryland	505	2,660	37	475	3,677	7	860	129,050	40	901,300
Michigan	51	295	1	65	412	6	235	...	4,700	...
Missouri	253	2,096	12	238	2,599	13	518	...	3,282	...
Nebraska	...	5	...	...	5	...	...	...	5	...
North Carolina	1	2	1	...	4	...	...	25	...	70
Ohio	1,852	13,626	98	755	16,331	131	3,835	386,904	210,453	1,177,328
Pennsylvania	4,489	26,550	268	1,941	33,248	170	5,391	720,189	193,596	3,460,867
Tennessee	242	693	95	62	1,092	6	132	10,750	11,002	65,750
Virginia	124	112	24	1	261	15	793	75,100	1,336	26,500
West Virginia	924	3,370	31	172	4,497	19	404	113,333	30,035	357,250

Remarks on Table No. 1.—Column No. 2 gives the number of separate individual "establishments" from which schedules have been received. As a rule, each schedule received represents what is ordinarily called "a mine," but in some cases one schedule necessarily contains all the data of a company which works one or more shafts not connected underground, and keeps no separate record of the product or labor of each of their mine openings. Such cases—though from the point of view of a mine engineer they might represent two or more mines—we have been obliged to consider as one "industrial establishment." In the anthracite field this question as to what should constitute the industrial unit in the census report cannot arise, since there the word "colliery" has a definite signification, *i. e.*, all the mine openings whose product goes to a single breaker building and is there mixed before delivery. No such absolute distinguishing criterion exists in the iron ore and bituminous coal industry, but the term "industrial establishment" must be taken to mean an organization, the managers of which keep a record in such a manner that the data required for the census can be obtained for it separately. There are, however, not more than five or six cases where any doubt on this point can arise. Column 3, headed "Maximum capacity," represents the number of tons which the operators claim could be raised yearly from the present openings with the present facilities, if the market would take it. It is unexpectedly large, and

Table No. 1.—CENSUS OF 1880—PRODUCTION OF BITUMINOUS COAL BY STATES EAST OF THE 100th MERIDIAN.—*Continued.*

Name of State.	*Value of plant.*	*Value of real estate.*	*Total capital employed and invested in establishments.*	*Tons paying royalty.*	*Amount paid as royalty.*	*Acres coal land worked out*	*Acres coal land unworked, attached to working collieries.*	*Acres coal land unspecified.*	*Grand total of capital, both establishments and irregular workings.*	*Acres available coal lands attached to working establishments.*
	21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Total	$19,435,107	$62,354,034	$89,999,101	13,689,864	$1,964,076	56,101	206,151	204,491	$93,517,464	410,642
Alabama	270,833	323,475	705,808	86,494	14,227	155	2,555	2,440	772,858	4,995
Arkansas								81	15,600	81
Georgia	311,000	100,000	441,745	15,000	1,875	62	16,028		441,745	16,028
Illinois	3,153,457	6,100,460	10,416,552	2,763,857	238,258	19,143	25,502	29,549	10,654,261	55,051
Indiana	773,445	1,146,859	2,268,969	899,356	137,311	2,884	8,000	2,407	2 304,720	10,407
Iowa	860,672	1,644,915	2,778,937	684,754	160,157	594	3,502	16,626	2,778,937	20,128
Kansas								1,600	767,994	1,600
Kentucky	732,252	939,385	1,947,637	213,490	29,017	1,235	30,748	3,887	1,968,537	34,635
Maryland	853,957	11,387,000	13,142,257	412,341	46,658	3,262	14,249	863	13,165,557	15,112
Michigan								107	66,800	107
Missouri								3,715	389,315	3,715
Nebraska								1	500	1
North Carolina	100	40,000	40,170					1,200	40,170	1,200
Ohio	3,258,581	8,529,931	12,965,840	2,630,108	458,468	9,984	33,988	24,651	13,652,484	58,639
Pennsylvania	7,242,524	27,152,403	37,855,794	5,099,817	728,735	17,730	60,814	57,497	38,709,344	118,311
Tennessee	415,371	1,222,847	1,703,968	141,818	35,390			23,743	1,708,968	23,743
Virginia	133,000	169,500	329,000	17,878	2,272			230	329,000	230
West Virginia	1,447,915	3,597,259	5,402,424	724,951	111,708	1,052	10,765	35,894	5,750,674	46,659

possibly in some cases based on too sanguine estimates of capacity. As will be noticed, the average time run was only nine months of the year, which would indicate that the capacity of the mines was at least one-third more than the product. Column 4 gives the production of mines supplying the general market, in tons of 2,000 pounds. It also is larger than was anticipated, but there is no reason to suppose it exaggerated. For instance, the production of Pennsylvania is given in the *Mine Inspectors' Report* (see "Annual Report of the Secretary of Internal Affairs" for 1879–'80, pages 289, 362, and 410) at 18,837,962 tons. This summation is based largely on estimates, and covers the year ending December 1, 1880, thus embracing a period marked by a more active demand for coal and coke than the census year ending June 1, 1880. Our total is 18,004,988, a difference of 4.4 per cent., which is less than the natural increase between the two periods. The 6th column is headed "Irregular product." Under this has been gathered the output of all the small operations where coal is mined in small quantities for local consumption. In many cases, in

Table No. 2.—GENERAL AVERAGES—BITUMINOUS COAL.

Name of State.	*Average price per ton of product of regular mines at mine.*	*Average cost of labor per ton.*	*Average cost of material per ton.*	*Average amount left for royalty, profit, etc., per ton.*	*Per cent. of capital used for working capital.*	*Per cent. of capital in plant.*	*Per cent. of capital in real estate.*	*Average royalty paid per ton, (cents).*	*Average yearly earnings of man, net.*	*Average per cent. of year worked.*	*Average per cent. of year idle, except from strikes.*	*Average per cent. of year lost in strikes.*	*Tons raised per man per day.*	*Tons raised yearly per man.*	*Per cent. ratio of product to maximum capacity.*
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**0**	**10**	**11**	**12**	**13**	**14**	**15**
Total	1.22	0.76	0.12	0.34	9.10	21.61	69.28	0.14	328.72	75.70	17.62	6.68	1.90	431.53	54.36
Alabama	1.47	1.02	0.15	0.30	15.80	38.37	45.83	0.16	220.07	91.54	2.78	5.68	.71	216.15	71.50
Arkansas	2.27	1.51	0.08	0.78					166.80					118.22	25.73
Georgia	1.50	0.55	0.06	0.89	6.96	70.40	22.64	0.125	192.71	100.00	0.00	0.00	1.17	349.87	93.67
Illinois	1.44	0.99	0.13	0.32	11.16	30.27	58.57	0.09	382.25	78.15	17.32	4.53	1.65	385.64	44.10
Indiana	1.48	0.97	0.11	0.40	15.37	34.09	50.54	0.15	318.85	74.34	21.36	4.30	1.47	328.91	46.59
Iowa	1.71	1.08	0.17	0.46	9.84	30.97	59.19	0.23	316.45	69.52	24.14	6.34	1.41	293.57	37.01
Kansas	1.96	0.99	0.06	0.91					215.41					216.63	66.93
Kentucky	1.20	0.73	0.10	0.37	14.17	37.60	48.23	0.14	261.68	62.00	23.60	4.40	1.84	342.61	38.42
Maryland	1.16	0.61	0.09	0.46	6.85	6.50	86.64	0.11	400.49	69.93	17.60	12.47	3.10	651.23	49.15
Michigan	2.23	1.45	0.08	0.70					385.22					265.96	41.08
Missouri	1.91	1.18	0.10	0.63					259.81					219.88	48.57
Nebraska	3.75	1.50	0.05	2.20											
North Carolina	1.14	0.57	0.14	0.43											
Ohio	1.29	0.86	0.16	0.27	9.08	25.13	65.79	0.17	320.69	77.90	13.55	8.55	1.60	373.03	49.06
Pennsylvania	1.01	0.60	0.10	0.31	9.14	19.13	71.73	0.14	337.97	75.73	17.28	6.99	2.47	560.14	68.65
Tennessee	1.27	0.68	0.10	0.49	3.86	24.38	71.76	0.25	332.28	91.15	8.79	0.06	1.78	487.90	66.28
Virginia	2.29	1.76	0.29	0.24	8.05	40.43	51.52	0.13	287.51	61.06	38.94	0 00	0.89	163.05	38.32
West Virginia	1.10	0.72	0.14	0.24	6.61	26.80	66.59	0.15	295.37	69.05	23.57	7.38	1.97	407.82	43.55

some of the bituminous fields, a farmer digs coal from the outcrop on his own farm and supplies his own, and perhaps one or two neighboring families. This industry is analogous to the cutting of wood for domestic fuel, and has no bearing on the mining industry of the country. The whole amount so produced is only 628,569 tons, and it might as well be disregarded hereafter. The iron ore mined in a small way eventually reaches the general market, but the coal does not. No labor is hired and no machinery is used, and the work is carried on when there is nothing else to do on the farm. Strictly speaking, no capital is employed, but the value of the land, as coal land, has been assessed and included in column 29, headed "Grand total of capital." There were over 5,000 of these small operations or "farmers' diggings" reported, and the labor of gathering the statistics from them is entirely disproportioned to the value of the results. They average less than 125 tons yearly. All the other columns, except the 7th, 8th, and the 29th, apply to the regular mines or "establishments" only. In column 5 the value is taken at the "mine's mouth," or rather at the point where the product is delivered for transportation to market. Column 9, "Value of materials," covers mine supplies consumed, including powder, fuse, iron, steel, timber, lumber, wire, rope, etc., whether bought by the miners or by the operators. Column 10 covers wages paid to all classes of labor during the census year, and represents the amount received by the men, less the amount paid by them for material, as powder, fuse, etc., which in many cases are charged to the miners and deducted at the end of the month from their gross wages. The necessity of making this deduction, when not already made on the return, has involved a great deal of extra labor which could not well be avoided, since the average net annual income of the miner available to the support of himself and his family is clearly one of the important items which the census should seek to ascertain with accuracy. The meaning of the columns relating to capital has been sufficiently explained in the former bulletins on anthracite coal, iron ore, and copper, and need not be repeated here. An endeavor was made to ascertain the number of acres of coal lands that were worked out. This has not been altogether successful, as in many cases it was impossible to answer the question with approximate accuracy. In other cases the upper seam only was worked out over a certain area, leaving one or more below untouched. The sum of the three columns of acres is *but a very small fraction of the total available coal land.* The sum in question, 466,743 acres, represents the land attached to working collieries, and averages $133 an acre. The fields are so extensive that only those lands which have special advantages of position, ease of mining, or quality of product, have any present industrial value as mineral lands.

Table No. 2 contains the averages drawn from the data in Table No. 1. In estimating the day's work, yearly earnings, etc., two boys were considered the equivalent, in producing and earning capacity, of one man. The year is taken to consist of twelve months of twenty-five working days each. A very considerable amount of time has been lost in strikes—about twenty days each for every man employed. Although it is not our province to discuss the question of strikes, it may not be out of place to call attention to some of the concomitant facts. First, in the bituminous coal industry there has been an *absolute fall* in the value per ton of the product, whereas iron ore and anthracite coal have not fallen in price since the last census more than gold has, or rather after falling they recovered, which bituminous coal did not. Second, in spite of the time lost in strikes, the average yearly earnings of a man engaged in mining bituminous coal are very nearly the same as those of the iron-ore miner, being in the one $328.72 and in the other $316.08, for the country at large. Third, that in the bituminous industry the percentage of the value of the product obtained by labor has increased nearly 1 per cent., labor obtaining in 1880 62.3 per cent. of the selling price of the product, against 61.6 per cent. in 1870. In other words, the cost of labor per ton has not fallen in quite so large a ratio as the value per ton, though both have fallen more than gold did in the same interval (see Table No. 3). This very small difference represents a gain in favor of labor of one-third of a million of dollars annually, and is the more striking from the fact that wages in the census of 1880 represent net wages, whereas it is possible that the return in the census of 1870, which is used as a basis of comparison, may include a part of what was necessarily expended by the men for mine supplies.

Table 3.—Production of Bituminous Coal during the Census Year ending June 1, 1880, compared with the one ending June 1, 1870, for Mines east of the 100th Meridian.

	Per cent.
1. Gain in number of mines	122.0
2. Gain in yearly tonnage	135.0
3. Gain in value of yearly product	44.0
4. Gain in value of material used	133.0
5. Gain in amount paid as wages	46.0
6. Gain in total number of employés	133.0
7. Gain in total capital	54.0
8. Decrease in value per ton	39.0
9. Gain in tons raised per man per year	3.0
10. Decrease in yearly earnings	36.0
11. Decrease in cost of labor per ton	38.0
12. Decrease in cost of material per ton	1.0
13. Gain in per cent. of value of the product paid for labor	0.7
14. Gain in per cent. of value of the product paid for materials	3.9
15. Decrease in per cent. of value of the product left for royalty, interest, profits, etc.	4.6
16. Gain in number of counties reporting	68.0

NOTE.—The above table illustrates the fact that the fall in price per ton of bituminous coal during the last decade has borne less heavily on labor than on capital. Compare 3, 6, 8, 11 and 13.

As between the bituminous coal industry and the iron-ore mining industry, the former takes from the earth a product worth 140 per cent. more, employs 205 per cent. more hands, and 46 per cent. more capital, uses 161 per cent. more materials, and pays 222 per cent. more wages. These figures are based on the returns from regular mines and would be slightly less if the "irregular product"—more important in the case of coal than in that of iron—were taken into consideration. The increase in the tonnage of the iron ore mined during the census year is 136 per cent., and in that of bituminous coal 135 per cent., as compared with the census year of 1870; showing that these two great divisions of mineral production keep pace with each other, and are advancing nearly twice as fast as the production of anthracite. The reason of this is the obvious one, that in the former cases new fields are laid under contribution, from time to time, as railways are extended, whereas anthracite is restricted to its original area.

Iron is mined in 135 counties and bituminous coal in 314 counties east of the 100th meridian.

Table No. 4.—List of Counties of the first class east of the 100th Meridian, *i. e.*, producing over 500,000 tons per annum.

County.	*State.*	*Tons.*
Total		22,167,999
Allegheny	Pennsylvania	4,426,871
Westmoreland	Do.	3,297,390
Fayette	Do.	2,318,728
Allegheny	Maryland	2,198,073
Clearfield	Pennsylvania	1,722,711
Washington	Do.	968,042
Saint Clair	Illinois	956,265
Tioga	Pennsylvania	938,517
Perry	Ohio	913,974
Clay	Indiana	772,423
Trumbull	Ohio	722,265
La Salle	Illinois	714,787
Will	Do.	611,311
Cambria	Pennsylvania	590,075
Columbiana	Ohio	515,602
Bradford	Pennsylvania	500,965

The sixteen counties of the first class furnish 54.9 per cent., and the twenty counties of the second class 16.6 per cent. of the entire product, leaving 28.5 per cent. to be spread over the remaining two hundred and seventy-eight counties. Allegheny County, Pennsylvania, produces over one-tenth, and the three leading counties of Pennsylvania nearly one-quarter of the entire product,

The three leading states, Pennsylvania, Illinois, and Ohio, produce nearly three-fourths, and the eight leading states nearly nineteen-twentieths of the entire product.

Table No. 5.—List of Counties of the second class east of the 100th Meridian, *i. e.*, producing over 250,000 tons per annum.*

	County.	*State.*	*Total.*
	Total		6,677,306
1.	Mercer	Pennsylvania	485,276
2.	Sangamon	Illinois	427,616
3.	Bourbon	Kansas	403,519
4.	Belmont	Ohio	399,747
5.	Kanawha	West Virginia	368,901
6.	Meigs	Ohio	359,225
7.	Fayette	West Virginia	353,678
8.	Stark	Ohio	347,820
9.	Fulton	Illinois	331,449
10.	Hocking	Ohio	331,170
11.	Jefferson	Do.	324,070
12.	Athens	Do.	310,750
13.	Blair	Pennsylvania	293,834
14.	Clarion	Do.	286,846
15.	Somerset	Do.	286,456
16.	Mahaska	Iowa	283,836
17.	Elk	Pennsylvania	281,151
18.	Peoria	Illinois	273,540
19.	Madison	Do.	272,927
20.	Tuscarawas	Ohio	255,495

The United States, exclusive of the territories, has gained 134.4 per cent. in weight of product. The average price per ton has fallen from $1.99 to $1.22 during the past decade, the price for 1870 being, of course, reckoned in paper dollars.

The production of coal in England was, in 1855, 64,661,401 tons, and in 1877 it was 136,179,968 tons, and in 1880 it was 146,818,122 tons. The English ton, however, is 2,240 pounds. The number of collieries in 1880 was, in England, 3,880, and in the United States, 3,264.

Tables 10 and 11 illustrate, in a general way, the proposition that large mining establishments, which employ power and labor-saving machinery, can pay higher wages and give more steady employment to labor than smaller ones. The mines chosen in the two states were typical ones of their classes. The large amount spent for "materials" by Class 2 is, to a great extent, made up of feed, etc., for the animals used.

As a general rule, too, the mines employing capital most liberally can afford to yield to labor a larger share of the value of the product, since their profits depend on the volume of their business. They also employ more skilled labor. It is believed that these features run through the entire mining industry.

Table No. 6.—RANK OF THE STATES EAST OF THE 100th MERIDIAN PRODUCING BITUMINOUS COAL IN THE CENSUS YEAR ENDING JUNE 1, 1880.

	Name of State.	*Product of regular mines, tons of 2,000 pounds.*	*Percentage of total product.*		*Name of State.*	*Product of regular mines, tons of 2,000 pounds.*	*Percentage of total product.*
	Total	40,311,459	100.00	8.	Kentucky	935,857	2.322
				9.	Kansas	763,297	1.894
				10.	Missouri	543,990	1.349
				11.	Tennessee	494,491	1.227
1.	Pennsylvania	18,004,988	44.665	12.	Alabama	322,934	0.801
2.	Illinois	6,089,514	15.107	13.	Georgia	154,644	0.383
3.	Ohio	5,932,853	14.718	14.	Michigan	100,800	0.250
4.	Maryland	2,227,844	5.527	15.	Virginia	40,520	0.100
5.	West Virginia	1,792,570	4.447	16.	Arkansas	14,778	0.036
6.	Indiana	1,449,496	3.596	17.	Nebraska	200	. . .
7.	Iowa	1,442,333	3.578	18.	North Carolina	250	. . .

Table No. 7.—THE RANK OF STATES EAST OF THE 100th MERIDIAN AS PRODUCERS OF BITUMINOUS COAL, ACCORDING TO THE CENSUS OF 1870, WAS AS FOLLOWS:

	Per cent. gain in 1880.		*Per cent. gain in 1880.*
1. Pennsylvania	131	8. Iowa	447
2. Illinois	132	9. Kentucky	521
3. Ohio	135	10. Tennessee	270
4. Maryland	22	11. Virginia	34*
5. Missouri	13*	12. Kansas	2,217
6. West Virginia	194	13. Michigan	258
7. Indiana	231	14. Alabama	2,836

Table No. 8.—PRODUCTION OF BITUMINOUS COAL AND LIGNITE WEST OF THE 100th MERIDIAN.

Name of State	*Number of counties.*	*Number of establishments.*	*Maximum capacity of yearly production, tons.*	*Total product census year, tons.*	*Value of total product.*	*Value of materials used census year.*	*Wages paid to all classes.*	*Men employed above ground.*	*Men employed below ground.*	*Boys employed above ground.*	*Boys employed below ground.*	*Total employés.*
	1	2	3	4	5	6	7	8	9	10	11	12
Total	20	46	2,001,697	1,477,736	$3,272,470	$189,431	$1,828,401	621	2,812	. . .	8	3,441
California	3	6	239,927	236,950	663,013	44,013	321,950	93	650	. . .	8	751
Colorado	8	25	638,233	462,747	1,041,350	114,576	714,714	301	1,133	. . .	. . .	1,434
Montana Territory	1	1	1,344	224	800	. . . . .	400	. . .	3	. . .	. . .	3
Oregon	1	3	43,205	43,205	97,810	8,567	68,017	13	63	. . .	. . .	76
Washington Territory	3	5	161,708	145,015	389,046	21,203	143,754	65	103	. . .	. . .	168
Wyoming Territory	4	6	917,280	589,595	1,080,451	1,072	579,566	149	860	. . .	. . .	1,009

* Loss.

Table No. 8.—PRODUCTION OF BITUMINOUS COAL, Etc., WEST OF THE 100th MERIDIAN.—*Continued.*

Name of State.	*Number of miners.*	*Number of laborers.*	*Administrative force.*	*Number of steam engines.*	*Horse-power of engines.*	*Value of all machinery.*	*Value of explosives used census year.*	*Amount employed as working capital.*	*Value of plant.*	*Value of real estate.*	*Total capital employed and invested.*	*Acres of coal land.*
	13	14	15	16	17	18	19	29	21	22	23	24
Total	2,599	706	136	42	1,447	$265,650	$26,702	$369,931	$1,251,342	$6,858,300	$8,479,573	33,001
California	478	255	18	8	295	77,500	2,367	107,931	535,500	596,000	1,239,431	2,960
Colorado	1,133	227	74	20	749	100,650	11,673	162,550	328,600	5,448,100	5,939,250	23,592
Montana Territory	3	. . .	. . .	. . .	. . .	. . .	. . .	250	5,100	7,200	12,550	. . .
Oregon	52	21	3	1	60	13,000	1,928	6,500	115,023	105,000	226,523	2,649
Washington Territory	103	44	21	4	115	15,500	10,698	15,700	87,721	232,000	335,421	2,600
Wyoming T rritory	830	159	20	9	228	59,000	36	77,000	179,398	470,000	726,398	1,200

Table No. 9.—PRODUCTION OF COAL IN THE UNITED STATES FOR THE YEAR ENDING JUNE 1, 1880, BY COAL-FIELDS (TONS OF 2,000 POUNDS).

Bituminous:		
Appalachian field	29,842,240	
Western field (Illinois, Indiana, etc.)	8,721,101	
Michigan field	100,800	
Triassic field (Virginia and North Carolina)	46,246	
Iowa and Kansas field	2,232,458	
All fields west of the 100th meridian	1,477,736	
Total bituminous	42,420,581	
Total bituminous brought forward		42,420,581
Anthracite: Pennsylvania	28,640,819	
Rhode Island	6,176	
Total anthracite		28,646,995
*Grand total coal production of the United States for the year ending June 1, 1880		71,067,576
Grand total of hands employed in coal mining		170,585

*NOTE.—2,817 tons of coal returned from Virginia as anthracite included in above as bituminous.

Table No. 10.—187 OHIO COAL MINES CLASSIFIED ON BASIS OF POWER USED.

Class 1. Mines using no power to supplement manual labor.
Class 2. Mines using the power of animals only.
Class 3. Mines using boiler-power not exceeding 100 horse-power.
Class 4. Mines using boiler-power exceeding 100 horse-power.

Class.	*Number of mines in class.*	*Aggregate maximum yearly capacity.*	*Product census year, net tons.*	*Value of census year's product at mines.*	*Average yearly product, net tons per mine.*	*Average value per ton at mine.*	*Average cost of labor per ton mined.*	*Average number of days worked by each man.*	*Average earnings per man, census year.*	*Average per diem wages earned.*	*Average product per man per day worked, net tons.*	*Average horse-power to mine.*	*Tons mined per horse-power yearly.*	*Per cent. of value of product paid for labor.*	*Per cent. of value of product paid for materials.*	*Per cent. of value of product for profits, including interest, repairs, and royalty.*	*Average number of hands to mine, all classes of labor, including superintendence.*
Total	187	7,775,040	4,702,001	$6,062,258	25,145	$1 30	$0 88	229.4	$330 70	$1 44	1.63	26.4	953	68.45	12.58	18.97	67.1
1	12	231,865	99.875	157.218	832	1 57	93	216.4	267 00	1 23	1 33	. . .	. . .	59.1	7.47	33.43	29.0
2	88	3,830,000	2,068,000	2,337,000	23,500	1 13	77	267.5	339 00	1 27	1.64	7.2	3,264	68.42	16.57	15.01	53.6
3	78	3,031,000	2,129,421	2,939,625	27,300	1 38	96	223.6	318 00	1 42	1.49	38.2	715	69.34	10.86	19.80	82.2
4	9	682,175	404,908	628,415	44,990	1 55	1 03	228.0	388 00	1 70	1.66	146.0	3,082	66.13	10.95	22.92	119.0

Table No. 11.—100 INDIANA COAL MINES CLASSIFIED ON THE BASIS OF THE POWER USED.

Class 1. Mines using no power to supplement manual labor.
Class 2. Mines using the power of animals only.
Class 3. Mines using boiler-power not exceeding 100 horse-power.
Class 4. Mines using boiler-power exceeding 100 horse-power.

Class.	*Number of mines in class.*	*Aggregate maximum yearly capacity, net tons.*	*Product census year, net tons.*	*Value of census year's product at mines, in dollars.*	*Average yearly product, net tons per mine.*	*Average value per ton at mine.*	*Average cost of labor per ton mined.*	*Average number of days worked by each man.*	*Average earnings per man, census year.*	*Average per diem wages earned.*	*Average product per man per day worked, net tons.*	*Average horse-power to mine.*	*Tons mined per horse-power yearly.*	*Per cent. of value of product paid for labor.*	*Per cent. of value of product paid for materials.*	*Per cent. of value of product for profits, including interest, repairs and royalty.*	*Average number of hands to mine, all classes of labor, including superintendence.*
Total	100	2,787,710	1,420,324	$2,120,035	14,203	$1 49	$0 97	222	$337 00	$1 52	1.56	28.1	505	65	7.8	27.2	40 9
1	12	42,808	9 807	13,291	817	1 35	87	162	202 00	1 25	1.44	. . .	. . .	64	5.0	31.0	3.5
2	36	430,082	143,657	214,924	3,991	1 50	84	155	244 00	1 57	1.88	2.4	1,663	56	14.6	29.4	13.7
3	48	2,000,000	1,144,243	1,705,166	23,839	1 49	97	230	346 00	1 50	1.55	44.0	592	65	7.0	28.0	67.0
4	4	314,820	122,617	186,704	30,654	1 52	1 11	246	404 00	1 64	1.48	153.0	200	73	7.0	20.0	84.0

THE PRODUCTION OF ANTHRACITE COAL.

MR. PUMPELLY'S report to the Superintendent of the Census has the following: The following exhibit shows the number of establishments, capacity, product, capital, number of employés, and various details under the above head of the "anthracite industry" during the Census year beginning June 1, 1879, and ending June 1, 1880. The net ton of 2,000 pounds is invariably used in this Bulletin.

Establishments.

Number of counties reporting	number	8
Total number of separate establishments or collieries	do.	273
Average yearly capacity of production	tons	149,348
Average actual product in Census year	do.	100,488
Per cent. of maximum capacity attained	per cent	67.28
Average capital, leased, employed and invested	dollars	550,041
Average number of hands employed	number	250
Average amount of wages paid yearly	dollars	79,414
Average value of materials used yearly	do.	23,588
Average number of acres of coal land attached to a colliery	acres	604
Ratio of value of yearly product to total capital	per cent	26.86
Number of company stores	number	69

Two new counties appear as anthracite producers in the present Census, viz., Lackawanna, which was set off from Luzerne, and Susquehanna, in the southern border of which one small colliery was opened.

The number of working collieries has increased during the past ten years from 225 to 273, or 21⅓ per cent. The average horse-power used has, however, increased from 216 to 375, or 73.6 per cent. The average number of hands has increased from 235 to 250, or only 6.4 per cent., while the average product per colliery has increased from 69,320 tons to 100,488 tons, a gain of 45 per cent.

The "capacity of production" referred to means the probable output, with present force and appliances, under a steady demand. The correctness of the figure is presumable from the fact that it bears about the same relation to the actual output that the time run does to the whole year.

Production.

Merchantable product for year ending June 1, 1880	tons	27,433,329
Value of product delivered for transportation	dollars	40,331,981
Average value of same per ton delivered for transportation	do.	1 47
Amount of coal washed	tons	1,396,906
Ratio of value of product to capital	per cent	26.86
Ratio of actual output to capacity	do.	67.28
Tons raised yearly per man	tons	454.4
Tons raised daily per man	do	2.14
Maximum yearly capacity of all collieries reported	do.	40,772,000

The value of the product is taken at the point where the labor we consider ceases to act on it.

A comparison of the Census returns of 1880 and 1870 shows that the output has increased from 15,596,257 tons to 27,433,329 tons, or 11,837,072 tons, a gain of 75.9 per cent., while the gross value has increased only 5.25 per cent. But the value of the product of 1870 was reckoned in paper dollars. The apparent fall of the average price per ton is from $2.49 to $1.47, or $1.02, about 41 per cent., considerably more than the change of standard would account for. The number of tons raised yearly per man—laborers, miners, and administrative force being considered together, and two boys being reckoned the equivalent of one man for this purpose—has, however, risen from 320.5 tons to 454.4, a gain of 41.8 per cent. A portion of this increased output per man is due to more steady labor, a portion to the increased use of steam-power, and a small portion, doubtless, to the increased efficiency of the individual when unharassed by declining prices. In addition to the merchantable product given above, 83 collieries, with a production of 20,295,529 tons, report the production of 7,060,447 tons of impure coal and dust, under the head of "culm." This would be 34.8 per cent. of their product, and would indicate a total production of 9,382,086 tons of unmerchantable coal during Census year, to which no value is assigned. The best procurable estimate would show that 908,250 tons of this was used in making steam at the mines. A small unascertained portion is used in locomotives on the coal roads, and another unascertained portion is sold, for use under boilers, at the cost of transportation. A slight increase in the price of coal, or improvements in the manner of using it, may give this product a commercial value hereafter. At present it is ignored, in accordance with the usage of the trade.

Employes, wages, and time.

Number of men above ground	number	15,564
Number of men below ground	do.	36,952
Number of boys above ground under 16 years of age	do.	11,921
Number of boys below ground under 16 years of age	do.	3,802
Total employés	do.	68,239
Of whom miners number		19,585
Of whom laborers number		47,410
Of whom administrative force number		1,244
Giving the same total		68,239
Per cent. of total force, miners	per cent	28.7
Per cent. of total force, boys	do.	23
Per cent. of total force, laborers and boys	do.	69.5
Per cent. of total force, administrative force	do.	1.8
Total wages paid	dollars	21,680,120
Average yearly income of man	do.	359 08
Average monthly income of man	do.	42 33
Total number of months worked by one man	months	512,204
Total number of months of enforced idleness	do.	207,090
Total number of months lost in strikes	do.	5,234
Per cent. of year worked	per cent	70.69
Per cent. of year lost by stoppages, etc	do.	28.60
Per cent. of year lost in strikes	do.	0.72

As compared with the force reported in the Census year of 1870, the total number has increased from 52,882 to 68,239, or 29.04 per cent. A large proportion of this increase, however, consists of boys who are employed as slate-pickers in the breaker buildings, the number of boys employed in the mine proper remaining almost stationary, and the number of boys employed above ground having increased from 9,051 to 15,723, a gain of 73.7 per cent. The number of adult employés has increased 20 per cent. only. The term "administrative" force includes foremen, mine superintendents, engineers, clerks, etc., employed about the collieries. The total amount returned as wages is $1,218,029 less than in the Census year of 1870, a decrease of 5.62 per cent. Wages, however, in the present returns, are of course reckoned on a specie basis, but, further, they signify net wages, *i. e.*, the pay-roll, less the sum the miner is obliged to expend for powder, oil, etc. The average yearly income of adult employés has contracted only 24.17 per cent., which is less than its purchasing power has increased during the same interval, without taking into account the allowance necessary to reduce the wages of 1870 to net wages. The average monthly income is found by dividing the total sum paid for wages by the total number of months worked by one man. The sum thus arrived at is slightly too high, since miners who work by the ton can find employment during part of the time the colliery is idle. For the same reason the per cent. of the year lost by enforced idleness is slightly too high, and represents in reality the time shipments were suspended. The small proportion of the time lost in strikes, less than one per cent., and the short average duration of the strikes reported, show that the relations between managers and miners are more harmonious than they were ten years ago. The per cent. of the value of the product paid for labor is now 53.75 against 59.75 ten years ago. This loss of advantage to labor is, however, apparent, not real, and is caused by the reduction of gross wages to net wages referred to above. For the same reason the cost of supplies or material consumed, measured in unit of the product, is increased from 9.34 per cent. to 15.96 per cent. The proportion of the value of the product retained for royalty, interest, taxes, profits, etc., is now 30.29 per cent., and was 30.91 per cent. in 1870

Consumption of Material.

Linear feet of unsawed lumber	feet	30,405,658
Value of same	dollars	830,743
Feet sawed lumber (board measure)	feet	39,605,547
Value of same	dollars	644,109
Value of explosives	do.	1,550,680
Total value of all materials consumed	do.	6,439,437
Cost of explosives per ton merchantable product	cents	5.7
Cost of all material per ton merchantable product	do.	23.5

The materials used embrace explosives, oil, candles, lumber and timber, rails, repairs of all kinds, horse and mule feed, etc., but not fuel, to which no value is given. A considerable portion of the material is paid for by the miners, on the sale of which the companies controlling the 69 supply stores referred to doubtless make a profit. The capital invested in these stores is, however, not included, the mining industry alone being considered.

Capital.

Number of acres of coal lands reported	acres		164,852
Mineral value of same, whether owned or leased	dollars		102,614,844
Average value per acre	do.		622 47
Number of tons on which royalty reported	number		14,056,931
Amount paid on above for royalty	dollars		3,256,308
Average amount paid per ton for royalty	do.		23 17
Number of horses	number		409
Value of horses	dollars		48,862
Number of mules	number		7,718
Value of mules	dollars		848,665
Number of steam engines	number		1,604
Value of engines	dollars		3,708,366
Horse-power of engines			102,522
Number of boilers	number		4,007
Value of boilers	dollars		2,332,640
Horse-power of boilers			86,408
Number of mine locomotives	number		80
Value	dollars		243,258
Number of pit cars	number		30,384
Value	dollars		1,643,560
Miles of railroad track underground	miles		1,085
Miles of railroad track outside	do.		258
Total value of machinery, including engines and boilers	dollars		13,295,415
Value of plant		$30,814,309	
Value of working capital		7,731,953	
Value of real estate		102,614,844	
Total capital, real and personal			150,161,196
Ratio of real estate to total capital	per cent.		68.34
Ratio of plant to total capital	do.		26.51
Ratio of working capital to total capital	do.		5.15
Ratio of value of annual product to total capital	do.		26.86

The very large increase in capital reported ($150,161,196) over that returned in 1870 ($50,807,285) would seem to call for some explanation and justification, the more so that the capital in 1870 was reckoned in paper dollars. The increase is over 195 per cent. The "plant" covers machinery, tracks, cars, buildings, animals, shafts and dead work, and is the sum of the several items, and has been kept rather under than above its true value. The largest part of the increase of capital is due to the fact that we have included in our returns the coal lands not owned by the mining companies, but worked on a royalty. Mineral lands are clearly a part of the capital of the mining industry, whether owned or leased or mortgaged. It has been our aim, however, to include only those coal lands which are in immediate connection with a working colliery, and either producing, or, in view of the increasing demand for this fuel, about to produce. The average number of acres reported (604) is not too large in this view; for the area reported would make a block only 16.12 miles square, which the 1,085 miles of underground track would pierce with 67 parallel gangways from side to side, less than ¼ of a mile apart. 53,385 acres of non-producing coal lands, valued at $25,702,500, held in reserve by the great companies, were thrown out altogether as not an element of productive wealth at present. Of the 164,852 acres retained, 13,852 were returned as worked over. As all but a very small portion of this still contains the lower seams, it has all been considered as producing coal lands. The total amount so retained constitutes about 56.68 per cent. of the entire area of anthracite lands, estimated at 290,791 acres. The average value per acre, $622.47, is much less than the ordinary market value of such lands, so far as such property—valuable only in blocks—can be said to have a market value. The price has usually been fixed by the owners. Again, taking the average royalty of 23.17 cents per ton, which is reported as paid on 51¼ per cent. of the product returned, and extending it to the entire output, the anthracite real estate would receive a yearly income of $6,356,302. We are justified in this extension, since the lands owned are returned as equally valuable with those worked on a royalty. Assuming the careful estimate of the total yield of the entire field made by Mr. Joseph B. Harris, based on the very conservative view that only 27 per cent. of the total content could be mined and marketed, the production of anthracite after 1880 would reach 4,009,640,000 net tons before exhaustion. This would indicate that the output of the Census year could be maintained for 146 years. As the lands which we have assumed as a necessary part of the industrial capital to be reported constitute 56.68 per cent. of the entire area, they could continue to earn their present income for 83 years. If we assume that one-tenth of the income would be absorbed in taxes and expenses, the present value of the above income for 83 years would be, with interest at 5 per cent., in round numbers, $112,420,000, and with interest at 5½ per cent., $102,790,000.

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The above valuations would be materially increased if we took into account the probable anticipations of the payments of the income of the later years of the term, owing to the increasing demand and the probable reduction of taxes as the estate approached exhaustion. Finally, the term "working capital" means the sum of money necessarily advanced for wages and supplies during the interval between production and the receipt of returns from sales. It is represented in actual property by the unsold product on hand and in transit. The estimate of this amount was made in nearly all of the collieries by the operators. As the sum is equal to but little more than the value of the product for sixty days, it is evidently not exaggerated. On the whole, the actual value of the anthracite property, as an element of productive wealth, is underestimated, notwithstanding the great apparent rise since 1870. These considerations will apply also to our forthcoming reports on the other mineral industries, in all of which the production has nearly doubled, while the capital has increased in a much greater ratio.

Production by Counties.

		1880.	1870.	*Per cent.*
Luzerne	10,766,360	16,414,725	9,519,298	Gain, 72.4
Lackawanna	5,648,365			
Schuylkill		7,323,174	3,860,144	Gain, 89.7
Northumberland		2,099,966	1,001,200	Gain, 109.7
Carbon		808,373	403,384	Gain, 100.4
Dauphin		450,343	411,355	Gain, 9.5
Columbia		318,573	400,876	Loss, 20.53
Susquehanna		18,173		
Total		27,433,329	15,596,257	Gain, 75.9

Relative production of the Counties, 1880.

Luzerne, per cent. of total output	39.25
Schuylkill, per cent. of total output	26.69
Lackawanna, per cent. of total output	20.59
Northumberland, per cent. of total output	7.65
Carbon, per cent. of total output	2.95
Dauphin, per cent. of total output	1.64
Columbia, per cent. of total output	1.16
Susquehanna, per cent. of total output	0.07

Careful estimates prove that about 50,000 tons, in addition to the above, is raised in a small way for local consumption. As this does not enter into the merchantable product, nor affect the relations of the industry in any way, it has been omitted. The anthracite producers are entitled to the acknowledgments of the Department for the pains they have taken in filling the Census schedules, a task which, in case of the larger companies, involved a great deal of labor. The Census Report of 1870 covered some coal from other fields now classed as semi-anthracite. This amount was deducted before the general comparisons were made.

THE PRODUCTION OF COPPER EAST OF THE 100th MERIDIAN.

MR. PUMPELLY'S Report to the Superintendent of the Census has the following:

All the ratios between production, wages, capital, number of mines, etc., are so controlled by the figures from one exceptionally productive mine in Houghton County, Michigan, that no general results can be drawn from the subjoined table which would not be greatly changed, and in some cases reversed, if that mine were excluded from the consideration.

The product is reduced to metallic copper, and its value is given at the mines or at the point where it is no longer operated on by the labor reported in the schedule. In some cases both smelting and mining are carried on by the same establishment; in others the process of reduction is partly carried on at or near the mine, and the product, in the form of a "matte," is shipped to a distance; in others the ores of copper are mined and shipped without any preliminary reduction. Thus the industry, strictly speaking, embraces both mining and manufacturing, in a manner which renders it impossible to separate them. The only common unit to which these various products can be reduced is evidently metallic copper, the value of which, per pound, to the mine producing varies greatly, depending upon the expense and labor that must be laid out upon it before it reaches the general market in the form of merchantable metal. Under all these various conditions the average price realized by the mines has been 17.46 cents per pound. The small product of the Ducktown mines, of Tennessee, has been excluded, as it did not reach the market at all—the reduction furnaces having been closed—and the amount of copper in the ore reported, probably about 70 tons, being unascertained. The Lake Superior region furnishes 90.48 per cent. of the entire product given in the table. The production of $6,919 worth of native silver is also reported from this region. The 50,655,140 pounds of copper would make a cube whose edge would be 45⅓ feet, or, in other words, would cover 25.75 acres with a sheet one inch thick.

The product is reported as equaling 80.49 per cent. of the "maximum capacity" of the mines. "Maximum capacity," however, represents in many cases rather the hopes and wishes of the manager than the probabilities of the mine. From the nature of the case it has a somewhat different significance from what it has when applied to iron or coal mining, where production from time to time outruns demand. The copper mines are worked continuously during the year, and for the industry as a whole "maximum capacity" may be taken to mean rather the capacity of the machinery than of the mines. We have regarded the return of "capital employed" as one of the most important we had to make, second only to those of wages and labor. It is divided into three items of a totally different nature.

First: The "working capital," which was intended to represent the amount necessary to run the mine between production and sales. As returned it equals nearly four months' expenses, and may be assumed as a low average.

Second: The "plant" means all machinery, improvements, personal property (not supplies), animals, fixtures, etc. An estimate of this should be based on actual values, not cost, and should exclude all antiquated and idle machinery. The footing in the table is believed to be a very conservative estimate.

Third: "Real estate," as explained in the bulletins of iron ore and anthracite coal, means the mine itself as a mineral producer. Its value depends, of course, on the average price of copper during a term of years, and on the reasonable expectation of productive life for each mine.

These three items make up all the substantial actual property of the industry, as it existed June 1, 1880, and an estimate of them for each mine is much more likely to approximate to true values than a mere return of share capital. The market value of the share capital has been, of course, used as a check whenever it was based on ability to pay dividends. The values sought for were not original cost nor selling price, but actual worth based on ability to contribute to the net industrial income of the country at large. Our aim has been to avoid overestimates, and to adopt a system that could be used for future comparisons for the purpose of illustrating industrial progress. The "working capital" of the establishments is represented by copper on hand at the mines or in transit to market. If it is carried after that point by the mines, they assume the character of metal brokers. We wish to restrict our report to industrial production simply. Therefore we assume that what we call "working capital," or that portion which is not invested, but advanced out of production, is not jeopardized except by the inconsiderable fluctuations of price during a period of four months. Consequently it may be assumed that it need not earn more than five per cent. per annum. The "plant," however, like all mining plant, should earn not less than thirty per cent. to make good average expenditures for deterioration and replacement. After deducting the proper sum for these two permanent charges the net income of the copper mines of the eastern district is very nearly two and three-quarter millions of dollars. Assuming this to be paid annually, and taking five per cent. as the ruling rate of interest, the value of the real estate as reported would indicate an average expectation of a productive life of twelve years for the copper mines on it—an expectation which it is believed that their average condition justifies. The fact that the income is paid at intervals shorter than one year shortens the expectation considerably; but, without taking this into consideration, it is evident that we have not fallen into the error of exaggerating the present value of the copper-producing property. It requires, as will be seen by the tables, 62½ cents capital to produce a pound of copper per year. Of this 77.4 per cent. represents the land (though the original outlay may have been much less), 18.39 per cent. of it is invested in the "plant," and 4.21 per cent. of it is required for wages advanced and supplies carried in the ordinary course of business. These averages apply to the industry as a whole, and, of course, vary greatly for different mines. Labor obtains about one-third of the value of the product, and nearly one-sixth is expended in the necessary mine supplies. The value of the yearly product is nearly 28 per cent. of the total capital. The production of the extreme Western States and Territories (Colorado, Arizona, Idaho, and California) is not included in the

PRODUCTION OF COPPER EAST OF THE 100th MERIDIAN.

State.	*County.*	*Number of mines.*	*Maximum capacity of yearly production in pounds of metal.*	*Product census year in tons of ore or rock.*	*Product census year in pounds of ingot copper.*	*Value of product.*	*Value of materials or supplies used.*	*Wages.*	*Men above ground.*	*Men below ground.*	*Boys above.*
Michigan	Houghton	6	41,604,391	794,550	40,389,212	$7,068,111	$1,040,052	$1,971,451	1,840	1,995	105
Do.	Keweenaw	4	7,315,603	79,695	3,764 723	622,826	150,632	392,361	306	447	27
Do.	Isle Royale	1	80,000	2,000	80,000	14,000	2,500	9,221	17	. . .	1
Do.	Ontonagon	8	1,993,766	62,715	1,596,327	274,295	22,022	88,207	74	170	2
Total of Michigan		19	50,993,760	938,960	45,830,262	7,979,232	1,215,206	2,461,243	2,237	2,612	135
Maine	Hancock	3	672,000	12,500	83,080	10,125	9,767	36,500	38	37	. . .
Maryland	Carroll	1	164,640	82	164,640	1,200	100	1,500	1	4	1
Missouri	St. Genevieve	3	3,920,000	1,051	230,717	25,730	2,102	14,059	12	29	. .
North Carolina	Ashe	2	4,080,000	24,680	1,640,000	350,000	61,000	133,631	200	103	25
Pennsylvania	Montgomery	1	218,400	283	40,460	5,630	363	1,400	4	6	. .
Tennessee	Polk	1	205,170	294	. . . . . .	. . . . . .	. . . . . .	1,200	. . .	4	. . .
Vermont	Orange	1	2,647,894	28,037	2,647,894	469,495	102,497	265,231	202	272	37
Wisconsin	Iowa	1	31,007	62	18,087	1,549	84	339	1	2	4
Total		32	62,932,871	1,005,955	50,655,140	8,842,961	1,391,101	2,915,103	2,755	3,069	202

PRODUCTION OF COPPER EAST OF THE 100th MERIDIAN.—*Continued.*

State.	County.	Boys below.	Total employés.	Miners.	Laborers.	Administrative force.	Number of animals: horses, mules and oxen.	Number of steam engines.	Horse-power steam engines.	Value of all machinery.	Value of explosives
Michigan	Houghton	20	3,960	1,513	2,291	156	84	76	9,318	$2,059,000	$159,084
Do.	Keweenaw	...	780	392	369	19	43	28	2,975	445,000	60,413
Do.	Isle Royale	...	18	10	6	2	2	2	80	5,000	25
Do.	Ontonagon	...	246	161	76	9	9	7	342	51,000	4,575
Total of Michigan		20	5,004	2,076	2,742	186	136	113	12,715	2,560,000	224,097
Maine	Hancock	22	97	45	47	5	10	5	215	10,000	2,388
Maryland	Carroll	. .	6	4	2	. . .	1	1	50	7,000	180
Missouri	St. Genevieve	. .	41	31	9	1	. . .	. . .	. .	. . . .	643
North Carolina	Ashe	. .	328	103	219	6	47	11	275	34,000	3,100
Pennsylvania	Montgomery	. .	10	3	6	1	. .	1	6	1,000	16
Tennessee	Polk	. . .	4	4	. . . .	. . .	. . .	. . .	. .	. . . .	. .
Vermont	Orange	48	619	201	406	12	57	3	230	20,800	5,832
Wisconsin	Iowa	. .	7	2	5	. .	. .	. . .	. .	. .	60
Total		90	6,116	2,469	3,436	211	251	134	13,491	2,632,800	236,316

State.	County.	Cords of wood used for fuel.	Value of wood.	Linear feet timber.	Value of timber.	Board-measure feet, sawed lumber.	Value of lumber.	Amount of working capital.	Value of plant.	Value of real estate.	Total capital.
Michigan	Houghton	68,957	$236,322	727,722	$108,172	2,988,000	$48,896	$785,000	$4,387,000	$23,447,000	$28,619,000
Do.	Keweenaw	32,400	81,200	717,726	6,802	323,244	4,244	195,000	803,185	350,825	1,349,010
Do.	Isle Royale	. . . .	. . . . .	2,000	100	1,500	21	4,000	6,000	10,000	20,000
Do.	Ontonagon	3,600	9,250	5,800	260	62,000	572	38,000	79,000	308,541	425,541
Total of Michigan		104,957	326,772	1,453,248	115,334	3,374,744	53,733	1,022,000	5,275,185	24,116,366	30,413,551
Maine	Hancock	1,085	3,000	5,000	25	1,000	100	4,500	71,500	28,000	104,000
Maryland	Carroll	. .	. . . .	. . . .	. .	. . .	. .	800	30,000	5,000	35,800
Missouri	St. Genevieve	. . . .	. . . . .	3,200	32	4,000	56	4,150	6,050	5,280	15,480
North Carolina	Ashe	8,400	21,000	65,000	600	. . . . .	. .	201,000	316,000	76,000	593,000
Pennsylvania	Montgomery	. . . . .	.	5,000	125	4,200	42	500	1,000	7,000	8,500
Tennessee	Polk	. . . .	. . . . .	. . .	. .	. . . . .	. . . .	100	40	. . . .	140
Vermont	Orange	4,700	15,275	. .	. .	500,000	6,000	100,000	125,000	275,000	500,000
Wisconsin	Iowa	. . .	. .	. .	. . . . .	. . .	. . . .	75	50	4,500	4,625
Total		119,142	366,047	1,531,448	116,116	3,883,944	59,931	1,333,125	5,824,825	24,517,146	31,675,096

table. As far as received the production is 6,244,702 pounds, or 12.33 per cent. of the amount produced in the eastern district. Details from them will be given in the final report. Eleven new mines in Maine, Maryland, and New Hampshire report the employment of 162 men, the payment of $31,995 for wages, and $7,650 for material consumed. They have spent $658,470 for machinery, dead work, etc., but have produced no ingot copper. The returns from this class of mines are excluded from the tables, which are restricted to establishments of productive industry. The acknowledgments of the office are due to the agents of the copper mines throughout the country, especially to those of the Lake Superior district, for the promptness and courtesy with which they responded to our calls for information. Had the Census year corresponded with the business year terminating January 1, the questions could have been answered with much greater ease. The preceding tables contain the principal statistics of the copper-mining industry of the United States in the region east of the 100th meridian during the Census year ending June 1, 1880.

MANUFACTURE OF CHEMICALS.

FROM the report of W. L. Rowland we obtain the following figures of the Census year:

ESTABLISHMENTS.		
Total number of establishments in the U. S.		1,349
CAPITAL.		
Capital invested, including buildings and machinery		$85,486,856
HANDS.		
Average number of males 16 years and above		26,751
Do. do below 16 years		1,207
Average number of females 15 years and above		1,493
Do. do. below 15 years		49
Total		29,500
WAGES.		
Total amount paid		$11,820,728
MATERIALS.		
Anthracite coal	tons	273,161
Do. do.	value	$968,432
Bituminous coal	tons	326,398
Do. do.	value	$924,791
All other materials	value	$75,451,058
Total value of all materials		$77,344,281
PRODUCTS.		
Aniline colors	pounds	80,518
Do. do.	value	$107,292
Anthracenes	pounds	344,114
Do.	value	$99,242
Sulphate of Ammonia	pounds	16,575,088
Do. do.	value	$618,485
Alum	pounds	39,217,725
Do.	value	$803,165
Borax	pounds	3,692,443
Do.	value	$277,233
Bromine	pounds	404,690
Do.	value	$114,752
Phosphorus	pounds	56,292
Do.	value	$29,271
Castor oil	gallons	893,802
Do.	value	$790,741
Stearic acid candles	pounds	18,363,066
Do. do.	value	$2,281,600
Oleic acid soap	pounds	33,058,411
Do. do.	value	$1,707,969
Other hard soaps	pounds	378,743,627
Do. do.	value	$18,299,350
Soft soap	pounds	34,494,100
Do.	value	$358,280
Glycerine	pounds	7,117,825
Do.	value	$961,477
Nitroglycerine	pounds	3,039,722
Do.	value	$1,830,417
Manufactured manures	tons	727,453
Do. do.	value	$19,921,400
Dry colors	pounds	67,482,415
Do.	value	$4,086,821
White lead	pounds	123,477,890
Do.	value	$8,770,699
Other salts of lead	pounds	11,375,466
Do. do.	value	$758,680
Ground barytes	tons	19,165
Do. do.	value	$371,829
Zinc oxide	pounds	20,121,761
Do.	value	$766,337
Acetate of lime	pounds	6,593,009
Do. do.	value	$156,892
Potash and pearlash	pounds	4,571,671
Do. do.	value	$232,643
Soda	pounds	40,259,938
Do.	value	$866,560
Sulphur	pounds	1,200,000
Do.	value	$21,000
Sulphuric acid	pounds	308,765,432
Do. do.	value	$3,661,876
Glucose	pounds	151,830,435
Do.	value	$4,551,212
All other products	value	$44,946,831
Total value of all products		$117,407,054

THE MANUFACTURE OF IRON AND STEEL.

THE Tenth Census work, under this head, was intrusted to Mr. James M. Swank, than whom there was none better to handle it. Concerning the method of his work, he says, in his report to the Superintendent: The products of the blast furnaces embrace pig iron and a few furnace castings; the products of the rolling mills embrace all rolled iron, and such other finished iron articles, whether rolled or hammered, as a few of the mills make a specialty of producing; the products of the steel works embrace steel of every description in its crude state, and finished steel in various forms, whether rolled or hammered; the products of the forges embrace blooms made from pig and scrap iron; and the products of the bloomaries embrace blooms and hammered bar iron made directly from the ore. The branches of the American iron and steel industries which are here enumerated may for convenience be termed the *productive* branches of those industries, in contradistinction to such *reproductive* branches as foundries, machine shops, anchor works, chain works, pipe and tube works, nut and bolt works, wire works, tack factories, etc., the collection of the statistics of which branches has been made directly by the Census Office. The productive branches above mentioned include all which produce iron and steel from raw materials, and, with the exception of iron foundries, all which produce iron and steel by what may be termed secondary operations. Iron foundries could not be embraced in the scope of this report because of their close association with machine shops and other reproductive branches, which are so extensive and varied and so infinitely ramified that no statistical machinery other than that of the Census Office itself could justly deal with them.

Some assurance may be desired by the public that the statistics which relate to the blast furnaces, rolling mills, steel works, and forges and bloomaries have been faithfully collected. An explanation of the manner in which these statistics have been obtained will probably satisfy this natural desire. The American Iron and Steel Association has for years compiled at stated intervals a complete directory to all the iron and steel works above mentioned, embodying a detailed description of each establishment, the character of its product, the name and post-office address of its owners, its exact geographical location, etc. Through the co-operation of the Association with the plans of the Census Office a carefully revised edition of this directory was prepared and published a few weeks previous to the beginning of the Census year. Special efforts were made after the publication of this edition to ascertain any changes or additions that might have taken place while it was passing through the press, and this supplementary work was continued until exact information concerning the location, ownership, and character of every establishment existing at the beginning of the Census year is believed to have been obtained. With a complete list in my possession of all the iron and steel works in the country whose statistics I had been requested to collect, the next step was to send, on the 1st day of June, 1880, to each company or firm or individual owning or controlling these works a schedule of interrogatories which had been prepared by the Census Office, accompanied by a circular letter over my signature requesting prompt answers, and explaining the nature and importance of the inquiry which the Census Office had authorized to be made. Special stress was placed in this letter upon the provision in the law authorizing the Tenth Census which specified that any information contained in the schedules returned to the officers of the census should not be disclosed, except to superior officers. The result has been very gratifying. A large majority of the schedules were filled up and returned with reasonable promptness. Others were delayed from various causes, so that a second circular letter and protracted correspondence and personal visits became necessary. In extreme cases the aid of the telegraph was called into requisition. In only one case were coercive measures resorted to, and in only one other case was desired information withheld. That full answers to all interrogatories were not insisted upon in this latter case is due solely to lack of time, the final refusal to furnish information having been made too late to admit of further delay in closing the statistical tables for the country. With this single exception full replies to all the interrogatories were made by the owners, lessees or trustees of all the iron and steel works covered by the schedules, and the results were summarized and presented to the country in my preliminary report, dated April 1, 1881, exactly ten months after the inquiry was undertaken.

In the final report which is herewith submitted the statistics which have been obtained are arranged by states, by counties, by processes, and by products. The tables have been made as compact as was consistent with clearness, comprehensiveness, the gratification of the natural pride of locality, and the object of all true statistical research, which is the accumulation of useful information. To assist those who have not the time or the inclination to study the complete tables, the leading facts established by them have been presented a second time in condensed tables and in connection with explanatory comments. After presenting the results of the census of 1880 I have deemed it best, after careful deliberation, and with your approval, to supplement them with a brief historical sketch of the manufacture of iron and steel in all ages, and with a more elaborate sketch of the growth of the iron and steel industries of our own country from the earliest settlements to the present time. A knowledge of the world's iron history must be regarded as forming part of a useful education in an age like this, which is so proverbially identified with a liberal use of iron and steel; while a knowledge of our own iron history is essential to a full understanding of the causes of our national development. To know what the iron and steel industries have accomplished for our own country is a patriotic duty; to know something of their small beginnings and of the humble circumstances which surrounded the pioneers who planted them and their sons who struggled to sustain and extend them is a matter of patriotic pride. The greatness and the prominence of our country to-day in the production of iron and steel in large quantities and by scientific methods could in no other way be so satisfactorily exhibited as by affording the opportunity for a comparison of these magnificent results with the primitive methods and the meager results which characterized these industries in "good old colony times," or even a few years ago.

Finished steel products.	*Bessemer steel.*	*Open-hearth steel.*
	Tons.	*Tons.*
Rails	741,475	9,105
Bars	76,710	43,296
Rods	49,064	1,134
Shapes	557	80
Sheets	....	1,700
Plates	1,475	11,034
Other forms	20,615	20,794
Total finished products	889,896	93,143

The item of muck bar is an unavoidable duplication, as it reappears as finished iron to be counted a second time.

In the Bessemer and open-hearth steel works of the country the preceding finished products were produced in 1880.

In the Census year 1870 the production of Bessemer steel finished products was only 19,403 tons. No open-hearth steel products are reported for that year. The quantity of Bessemer steel ingots produced in the Census year 1880 was 985,208 tons, and the quantity of open-hearth steel ingots was 84,302 tons. No statistics of ingots produced in 1870 are available for comparison. It will be observed that a larger quantity of finished open-hearth steel products was produced in 1880 than of ingots, which is probably due to the carrying over of ingots from the preceding year and to importations during the Census year. The Bessemer steel ingots produced in 1880 are in excess of the finished products. The increase in the production of crucible steel finished products in the decade between 1870 and 1880 was from 28,069 tons to 70,319 tons, or 151 per cent. The production of crucible steel ingots in 1880 was 76,201 tons. The production of blister steel and of steel made by other minor processes was only 2,285 tons in 1870 and 4,956 tons in 1880, and it is not likely to increase in the future. There was a decrease of 35 per cent. in the production of the forges and bloomaries from 1870 to 1880, or from 110,808 tons to 72,557 tons. This decrease is due to the general substitution of improved processes for the forges and bloomaries of our earlier iron history, and it would have been much greater in the decade mentioned if the improved American bloomary, so largely used in Northern New York, had not contributed its large product to swell the production of 1880.

Raw Materials.—The following table presents the quantities of mineral products used by the iron and steel works in 1880:

Works.	*Iron ore.*	*Limestone.*	*Anthracite Coal.*	*Bituminous Coal.*	*Coke.*
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Blast furnaces	7,256,684	3,169,149	2,615,182	1,051,753	2,128,255
Rolling mills	363,959	...	526,126	3,915,377	14,834
Bessemer and open-hearth steel works	7,327	...	140,458	465,655	104,980
Crucible steel works	2,128	....	40,392	224,657	22,791
Forges and bloomaries	79,610	....	340	1,613	6,695
Total	7,709,703	3,169,149	3,322,498	5,659,055	2,277,555

Of the iron ore and limestone given in the table, at least one-half was purchased from independent producers; of the anthracite coal, nearly all was so purchased; and of the bituminous coal and coke, fully two-thirds was so purchased.

The following table shows the quantities of all other leading raw materials used in 1880 in the manufacture of iron and steel:

Works.	*Charcoal.*	*Mill cinder.*	*Pig iron.*	*Old iron rails.*	*Scrap iron.*	*Ore blooms.*	*Pig or scrap blooms.*	*Muck bar purchased.*
	Bushels.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Blast furnaces	53,909,828	354,048	......	......	......	......	......	......
Rolling mills	2,569,756	...	1,574,693	708,534	422,282	14,147	46,861	53,754
Bessemer and open-hearth steel works	37,552	...	966,603	....	13,911	16,053	250	......
Crucible steel works	60,594	...	17,226	....	1,952	13,211	2,400	......
Forges and bloomaries	13,014,361	.....	38,113	...	8,933	.....	.....	......
Total	69,592,091	354,048	2,596,635	708,534	447,078	43,411	49,511	53,754

Works.	*Spiegeleisen.*	*Old steel rails and crop ends.*	*Bessemer steel ingots and blooms purchased.*	*Open-hearth ingots and blooms purchased.*	*Scrap steel.*	*Swedish billets and bars.*	*Other billets and bars.*	*Oil used as fuel.*
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Barrels.*
Blast furnaces								
Rolling mills								
Bessemer and open-hearth steel works	86,138	85,653	42,939	17,713	90,645			
Crucible steel works					19,726	10,410	16,496	
Forges and bloomaries								853
Total	86,138	85,653	42,939	17,713	110,371	10,410	16,496	853

The large consumption of old iron rails and scrap iron in the rolling mills in 1880 was abnormal, and was the result mainly of the great scarcity of pig iron which followed the sudden revival of a demand for iron and steel products in the summer of 1879.

Relative Rank in Production of the States.—The relative rank in production of all the states and territories which produced iron or iron and steel in 1870 and in 1880 is given in the following table:

States.	*Production, 1880.*	*Rank.*	*States.*	*Production, 1870.*	*Rank.*
	Tons.			*Tons.*	
Pennsylvania	3,616,668	1	Pennsylvania	1,836,808	1
Ohio	930,141	2	Ohio	449,768	2
New York	598,300	3	New York	448,257	3
Illinois	417,967	4	New Jersey	115,262	4
New Jersey	243,860	5	Maryland	95,424	5
Wisconsin	178,935	6	Missouri	94,890	6
West Virginia	147,487	7	Kentucky	86,732	7
Michigan	142,716	8	Michigan	86,679	8
Massachusetts	141,321	9	Massachusetts	86,146	9
Missouri	125,758	10	West Virginia	72,337	10
Kentucky	123,751	11	Indiana	64,148	11
Maryland	110,934	12	Wisconsin	42,234	12
Indiana	96,117	13	Virginia	37,836	13
Tennessee	77,100	14	Tennessee	34,305	14
Alabama	62,986	15	Illinois	25,761	15
Virginia	55,722	16	Connecticut	25,305	16
Connecticut	38,061	17	Maine	17,138	17
Georgia	35,152	18	Georgia	9,634	18
Delaware	33,918	19	Delaware	8,307	19
Kansas	19,055	20	Alabama	7,060	20
California	14,000	21	Rhode Island	4,415	21
Maine	10,866	22	California	3,000	22
Wyoming Territory	9,790	23	North Carolina	1,801	23
Rhode Island	8,134	24	Vermont	1,525	24
New Hampshire	7,978	25	South Carolina	443	25
Vermont	6,620	26	Kansas		
Colorado	4,500	27	Wyoming Territory		
Oregon	3,200	28	New Hampshire		
Nebraska	2,000	29	Colorado		
Texas	1,400	30	Oregon		
North Carolina	439	31	Nebraska		
District of Columbia	264	32	Texas		
South Carolina			District of Columbia		
Total	7,265,140		Total	3,655,215	

Twelve states made over 100,000 tons each in 1880. Pennsylvania, which for more than a hundred years has been the leading iron-producing state in the Union, made in 1870 a fraction over 50 per cent. of the total product, and in 1880 it made a fraction under 50 per cent. At both periods its prominence in the production of iron and steel was virtually the same. From 1870 to 1880 it increased its production 97 per cent., or from 1,836,808 tons to 3,616,668 tons. Ohio was the second state in prominence in 1870, and it held the same rank in 1880. In the former year it produced 449,768 tons, and in 1880 it produced 930,141 tons, an increase of 107 per cent. The third state in prominence in 1870 was New York, and it maintained this rank in 1880, but its growth fell far below that of its two sister states above mentioned. It 1870 it produced 448,257 tons, and in 1880 it produced 598,300 tons, an increase of 33 per cent. New Jersey was fourth in rank in 1870, producing 115,262 tons, but it was fifth in 1880, although in that year it produced 243,860 tons, an increase of 112 per cent. The fourth place in 1880 was taken by Illinois, which produced in 1870 only 25,761 tons, while in 1880 it produced 417,967 tons, an increase of 1,522 per cent.—the most marvelous in the history of the country. Maryland ranked fifth in 1870, producing 95,424 tons in that year, while in 1880 it produced only 110,934 tons, an increase of 16 per cent., causing it to drop to the twelfth place. The sixth state in rank in 1870 was Missouri, with a production of 94,890 tons, which was increased to 125,758 tons in 1880, or 33 per cent., giving it the tenth place in that year. The seventh state in rank in 1870 was Kentucky, but it fell to the eleventh place in 1880, increasing its production from 86,732 tons to 123,751 tons, or 43 per cent. Michigan ranked eighth in 1870, and in 1880 its rank was the same, its production increasing in the ten years from 86,679 tons to 142,716 tons, or 65 per cent. Massachusetts was ninth in rank in 1870, and it held the same rank in 1880, increasing its production from 86,146 tons to 141,321 tons, or 64 per cent. Of the New England states, Massachusetts shows the greatest actual growth in the ten years. West Virginia was tenth in the list in 1870 and seventh in 1880, increasing its production from 72,337 tons to 147,487 tons, or 104 per cent. Wisconsin was twelfth in rank in 1870, but passed to the sixth place in 1880, increasing its production from 42,234 tons to 178,935 tons, or 324 per cent. This state ranks next to Illinois among the western states.

Of the states which made less than 100,000 tons in 1880, several gave promise in that year that they would soon reach an annual production of at least this quantity. Indiana narrowly escaped accomplishing this result, increasing its production from 64,148 tons in 1870 to 96,117 tons in 1880, or 50 per cent. In the ten years from 1870 to 1880 Alabama increased from 7,060 tons to 62,986 tons, or 792 per cent. Georgia increased from 9,634 tons to 35,152 tons, or 265 per cent. Tennessee increased from 34,305 tons to 77,100 tons, or 125 per cent. Delaware increased from 8,307 tons to 33,918 tons, or 308 per cent. Virginia increased from 37,836 tons to 55,722 tons, or 47 per cent. All the states which made iron or steel in 1870 increased their production in 1880, except Maine, North Carolina, and South Carolina. The greatest percentage of increase in the decade was in the western states, beginning with Ohio, and in the southern states, beginning with Delaware, but the greatest actual increase was in Pennsylvania.

Geographical Distribution of all Products.—The whole territory of the United States may be regarded as comprising four grand divisions—the eastern states, the southern states, the western states and territories, and the Pacific states and territories. Assuming that the eastern states comprise all of the states lying north of Delaware and east of Ohio, that the southern states comprise all of the late slaveholding states except Missouri, and that the other divisions require no explanation, we present the following comparative statement of the development of our iron and steel industries in each of the grand divisions in the census year 1880.

Grand divisions.	*Number of establishments.*	*Capital invested.*	*Hands employed.*	*Wages paid.*	*Tons produced.*	*Value of all products.*
Eastern states	556	$149,507,461	82,842	$34,361,660	4,671,808	$192,696,010
Southern states	218	29,145,830	20,595	6,261,344	649,153	25,353,251
Western states and territories	224	50,755,990	36,663	14,542,587	1,912,689	76,933,686
Pacific states and territories	7	1,562,603	878	311,194	31,490	1,574,738
Total United States	1,005	$230,971,884	140,978	$55,476,785	7,265,140	$296,557,685

In the decade between 1870 and 1880 the iron industry was extended into many new states and territories. Twenty-five states were engaged in the manufacture of iron or iron and steel in 1870. Thirty states, the District of Columbia, and Wyoming Territory made iron in 1880, and about the half of these also made steel. South Carolina made iron in 1870, but does not appear in the statistics for 1880. Its total production in 1870 did not, however, aggregate 500 tons. The iron industry in this state has been practically abandoned. Between 1870 and 1880 three states for the first time engaged in the manufacture of iron, namely, Colorado, Kansas, and Nebraska; also two territories, namely, Utah and Wyoming. Utah did not, however, make any iron in 1880. It made a small quantity in each of the years 1874, 1875, and 1876, and will make a larger quantity in the near future. (Since the close of the Census year 1880 Washington Territory has commenced to manufacture pig iron, as have also California and Minnesota. California had previously, since 1868, rolled iron at San Francisco.) Minnesota appears in 1880 among iron-manufacturing states, but its statistics relate only to the preparations that had been made to embark in the business. New Hampshire made iron many years ago, but it does not appear in the statistics for 1870; it re-appears in the tables for 1880. Oregon and Texas each built a blast furnace in the decade preceding the Census year 1870, but they did not make any iron in that year; they appear, however, in the statistics of production for 1880. The District of Columbia once had a blast furnace in operation, but in 1870 it had no iron industry whatever; in 1880 the United States government owned and operated a small rolling mill at the Washington navy-yard. The percentage of total production in 1880 was distributed as follows: Pennsylvania, 50 per cent.; Ohio, 13; New York, 8; Illinois, 6; New Jersey, 3; Wisconsin and West Virginia, each over 2 per cent.; Michigan and Massachusetts, each nearly 2 per cent.; Missouri, Kentucky, and Maryland, each over 1½ per cent.; Indiana over 1 per cent.; Tennessee, about 1 per cent.; and all other states and territories, an aggregate of about 4 per cent.

Centres of Production.—In the following table is presented a view of the principal centres of production of the iron and steel industries of the United States in the Census year 1880. These centres are divided into two classes—the first comprising fifteen counties which produced over 100,000 tons of pig iron, blooms, and finished products, and the second comprising seventeen counties which produced over 60,000 and less than 100,000 tons. Six states are represented in the first class, and eight states in the second class.

The Centre of Total Production.—The geographical centre of total production of the iron and steel industries of the United States is the point at which equilibrium would be established were the country taken as a plane surface, itself without weight but capable of sustaining weight, and loaded with its production of iron and steel, each ton exerting pressure on the pivotal point directly proportioned to its distance therefrom. The centre of production of iron

COUNTIES OF THE FIRST CLASS, PRODUCING OVER 100,000 TONS.

Counties.	*Tons.*
1. Allegheny county, Pa.	848,146
2. Lehigh county, Pa.	324,875
3. Northampton county, Pa.	322,882
4. Cambria county, Pa.	260,140
5. Cook county, Ill.	248,479
6. Dauphin county, Pa.	223,676
7. Mahoning county, Ohio	219,957
8. Berks county, Pa.	213,580
9. Cuyahoga County, Ohio	210,354
10. Mercer county, Pa.	182,881
11. Rensselaer county, N. Y.	177,967
12. Montgomery county, Pa.	168,628
13. Lackawanna county, Pa.	151,273
14. Milwaukee county, Wis.	128,191
15. St. Louis county, Mo.	102,644
Total (15 counties)	3,783,673

COUNTIES OF THE SECOND CLASS, PRODUCING BETWEEN 60,000 AND 100,000 TONS.

Counties.	*Tons.*
1. Lawrence county, Pa.	68,443
2. Lancaster county, Pa.	87,019
3. Ohio county, W. Va.	84,767
4. Will county, Ill.	84,094
5. Montour county, Pa.	79,789
6. Chester county, Pa.	78,363
7. Warren county, N. J.	76,622
8. Trumbull county, Ohio	73,369
9. Lebanon county, Pa.	73,149
10. Lawrence county, Ohio	70,794
11. Schuylkill county, Pa.	70,009
12. Baltimore county, Md.	69,944
13. Blair county, Pa.	68,039
14. Essex county, N. Y.	66,725
15. Philadelphia county, Pa.	65,983
16. Wayne county, Mich.	63,548
17. Dutchess county, N. Y.	61,637
Total (17 counties)	1,262,894

and steel in the United States in the Census year 1880 is found to be at 40° 43′ north latitude, and 79° 20′ longitude west from Greenwich. This point is in Pennsylvania, on the boundary line between Armstrong and Indiana counties, and about 12 miles northeast of Apollo and 12 miles west of Indiana—Laufman & Co.'s rolling mill at Apollo being the nearest iron works. At the centre of production thus ascertained iron has never been manufactured in any form.

Values.—There is a striking disproportion between the values of raw materials and of all products in 1870 and 1880 upon the one hand and the weight of all products in these periods upon the other. The percentage of increase in the values of raw materials and of all products in 1880 over 1870 was 41.13 and 43.12 respectively, while the weight of all products increased 98.76 per cent. The explanation is simple and is twofold. First, the Census year 1870 was a year of high prices, caused partly by an average gold premium throughout the year of about 15 per cent., and partly by other well-known causes. Second, the Census year 1880 was not only a year of lower average prices than 1870, but it may be said to have closed a decade of wonderful mechanical and scientific development in the American iron and steel industries, through which the production of large masses of both crude and finished products was rendered possible.

Geographical Distribution of Special Products.—The various branches of our iron and steel industries have not been equally domesticated in each of the four grand geographical divisions that have been mentioned, and much less can it be said that they are equally at home in any one of the iron-making states or territories. While this statement may embody only a self-evident truth, the full significance of the fact stated is deserving of some consideration. A glance at the statistics for 1880 shows that New England now makes but little pig iron, and that the South makes considerable pig iron and scarcely any rolled iron; that the West has embarked largely in the manufacture of steel by the Bessemer process, while New England cannot boast a single Bessemer establishment, but has preferred the open-hearth process; while New York makes most of the blooms that are made from ore, and Pennsylvania most of the blooms that are made from pig and scrap iron; that Michigan is the leading producer of charcoal pig iron, and now makes no other kind; that West Virginia has developed a remarkably active interest in the manufacture of cut nails; that only five states make Bessemer steel, and two states, Pennsylvania and New Jersey, make nearly all of our crucible steel; and that Pennsylvania has made a greater effort than any other state to manufacture all kinds of iron and steel. A glance, however, at leading geographical characteristics is not sufficient to illustrate the wide diversity of the influences which have affected the local development of our iron and steel industries, and the following details are therefore added.

Pig Iron.—Of 3,781,021 tons of pig iron and direct castings produced in 1880 in 22 states, Pennsylvania made 1,930,311 tons, or 51 per cent.; Ohio, 548,712 tons, or 15 per cent.; New York, 313,368 tons, or 8 per cent.; New Jersey, 157,414 tons, or 4 per cent.; Michigan, 119,586 tons, and Wisconsin, 118,282 tons—each over 3 per cent.; Illinois, 95,468 tons, and Missouri, 95,050 tons—each nearly 3 per cent.; West Virginia, 80,050 tons, or over 2 per cent.; Alabama, 62,336 tons; Maryland, 59,664 tons, and Kentucky, 58,108 tons—each over 1½ per cent.; Tennessee, 47,873 tons, or over 1 per cent.; and all other states and territories, each less than 1 per cent. Anthracite pig iron was produced in Pennsylvania, New York, New Jersey, Massachusetts, and Maryland—the last two states producing but little. Pig iron produced with a mixture of anthracite and coke was made in Pennsylvania, New York, Wisconsin, Illinois, New Jersey, and Maryland. Pig iron produced with bituminous coal and coke was made in Pennsylvania, Ohio, West Virginia, Missouri, Tennessee, Kentucky, Indiana, Illinois, Alabama, Georgia, Virginia, and Maryland. Charcoal pig iron was made in all of the states that made pig iron in 1880, with the exception of Illinois and New Jersey, which used mineral fuel exclusively.

Rolled Iron.—Of 2,353,248 tons of rolled iron of all kinds produced in 29 states and territories in 1880, Pennsylvania made 1,071,098 tons, or 46 per cent.; Ohio, 272,094 tons, or 12 per cent.; New York, 163,538 tons, or 7 per cent.; Illinois, 117,051 tons, and Massachusetts, 109,252 tons—each 5 per cent.; Indiana, 77,880 tons, or over 3 per cent.; West Virginia, 67,437 tons; New Jersey, 66,030 tons; Kentucky, 65,293 tons, and Wisconsin, 60,653 tons—each a little less than 3 per cent.; Maryland, 47,609 tons, or 2 per cent.; Virginia, 35,176 tons, and Delaware, 33,918 tons—each about 1½ per cent.; Tennessee, 25,381 tons, or 1 per cent.; and all other states and territories each less than 1 per cent. Of 466,917 tons of iron rails produced in 1880, Pennsylvania made 34 per cent.; Illinois, 16 per cent.; Ohio, 9 per cent.; Indiana, 8 per cent.; New York, 7 per cent.; Wisconsin, 6 per cent.; Kentucky, 4 per cent.; Kansas and Tennessee, each nearly 3 per cent.; Wyoming Territory, Maryland, and Georgia, each about 2 per cent.; California and Massachusetts, each 1 per cent., and Colorado, West Virginia, and Vermont, each less than 1 per cent. Of the cut nails produced in 1880, Pennsylvania made 30 per cent.; West Virginia, 21 per cent.; Ohio, 14 per cent.; Massachusetts, 10 per cent.; New Jersey and Indiana, each 6 per cent.; Illinois and Kentucky, each 4 per cent., and Tennessee and Virginia, each 2 per cent. New York, Nebraska, and Maine each produced less than 1 per cent., but Nebraska made more nails than New York. The whole number of kegs of cut nails made in the United States in 1880 was 5,056,600, each keg weighing 100 pounds.

Steel Ingots.—The following table shows the states which produced Bessemer, open-hearth, and crucible steel ingots in 1880:

States.	Bessemer steel ingots.	Open-hearth steel ingots.	Crucible steel ingots.
	Tons.	Tons.	Tons.
Connecticut	......	...	2,116
Illinois	253,514	925	130
Kentucky	..	275	75
Massachusetts	......	9,475	140
Missouri	8,409	....	..
New Hampshire	......	4,521	....
New Jersey	....	450	10,492
New York	84,160	.....	2,585
Ohio	82,811	24,712	360
Pennsylvania	556,314	36,944	60,303
Tennessee	..	4,000	..
Vermont	...	3,000	..
Total	985,208	84,302	76,201

Bessemer Steel.—Of the production of 985,208 tons of Bessemer steel ingots in 1880, Pennsylvania made 56 per cent.; Illinois, 26 per cent.; New York, 9 per cent.; Ohio, 8 per cent., and Missouri, less than 1 per cent. Of the production of Bessemer steel rails, Pennsylvania made 55 per cent.; Illinois, 27 per cent.; Ohio, 9 per cent.; New York, 8 per cent., and Missouri and Vermont, each less than 1 per cent. The last-named state had, however, no works for the production of Bessemer steel ingots. At the close of the Census year there were 24 Bessemer converters in the United States, of which six were in Illinois, 2 were in Missouri, 2 were in New York, 2 were in Ohio, and 12 were in Pennsylvania.

Open-hearth Steel.—Of the production of 84,302 tons of open-hearth steel ingots in 1880, Pennsylvania made 44 per cent.; Ohio, 29 per cent.; Massachusetts, 11 per cent.; New Hampshire and Tennessee, each 5 per cent.; Vermont, 4 per cent., and Illinois, New Jersey and Kentucky, each less than 1 per cent. Of the open-hearth steel ingots produced in 1880, only a small quantity was converted into rails, the weight of these being 9,105 tons. At the close of the Census year 1880, there were 37 open-hearth furnaces in the United States, of which 2 were in Illinois, 1 was in Kentucky, 4 were in Massachusetts, 1 was in New Hampshire, 1 was in New Jersey, 10 were in Ohio, 14 were in Pennsylvania, 1 was in Rhode Island, 2 were in Tennessee, and 1 was in Vermont.

Crucible Steel.—Of the production of 76,201 tons of crucible steel ingots in 1880, Pennsylvania made 60,303 tons, or 79 per cent.; New Jersey, 10,492 tons, or 14 per cent.; New

York, 2,585 tons, or over 3 per cent.; Connecticut, 2,116 tons, or under 3 per cent., and Ohio, Massachusetts, Illinois, and Kentucky, an aggregate of less than 1 per cent. Pennsylvania, New Jersey, and Connecticut also unitedly produced 4,956 tons of blister steel and miscellaneous steel products, of which Pennsylvania produced 78 per cent.; New Jersey, 20 per cent., and Connecticut, 2 per cent.

Blooms and Bar Iron from Ore.—The total production of these products in 1880, nearly all of which, however, was in the form of blooms, was 37,633 tons, of which New York produced 84 per cent.; Missouri, 11 per cent.; Tennessee, 2 per cent.; New Jersey and North Carolina, each over 1 per cent., and Pennsylvania, Georgia, and Virginia, an aggregate of less than 1 per cent. Pennsylvania's product was made in a Siemens rotator; that of North Carolina, Georgia, Virginia, and Tennessee, by the old-fashioned Catalan process; that of Missouri, by the Peckham process; while the more considerable product of New York was almost wholly made in American bloomaries—an improvement on the Catalan forge. The very small quantity of bar iron made from ore in 1880 was all made in Virginia, North Carolina, Georgia, and Tennessee bloomaries. It aggregated but little over 1,000 tons.

Blooms from Pig and Scrap Iron.—Of 34,924 tons of blooms of this character made in 1880, Pennsylvania produced 70 per cent.; Maryland and New Jersey, each 10 per cent.; Virginia, 7 per cent.; Georgia, over 1 per cent.; Tennessee, about 1 per cent., and New York and Massachusetts together, less than 1 per cent.

All kinds of Rails.—The production of rails of all kinds in 1880 is given in the following table in connection with the States which produced them. The tonnage of rails produced in 1880 was greater than that of any other rolled product, and was about one-third that of pig iron.

States.	*Iron rails.*	*Bessemer steel rails.*	*Open-hearth steel rails.*	*Total production of all kinds of rails.*
	Tons.	*Tons.*	*Tons.*	*Tons.*
California	6,000			6,000
Colorado	4,500			4,500
Georgia	8,673			8,673
Illinois	72,802	201,186		273,988
Indiana	38,600			38,600
Kansas	13,500			13,500
Kentucky	18,000			18,000
Maryland	9,280			9,280
Massachusetts	5,600			5,600
Missouri		5,100		5,100
New York	34,305	57,870		92,175
Ohio	41,838	66,480		108,318
Pennsylvania	157,213	409,339	3,360	569,912
Tennessee	12,800		2,745	15,545
Vermont	1,500	1,500	3,000	6,000
West Virginia	3,333			3,333
Wisconsin	29,552			29,552
Wyoming Territory	9,421			9,421
Total	466,917	741,475	9,105	1,217,497

Pennsylvania made 47 per cent. of the total production of rails; Illinois, 23 per cent.; Ohio, 9 per cent.; New York, 8 per cent.; Indiana, 3 per cent.; Wisconsin, 2 per cent.; Kentucky, Tennessee, and Kansas, each 1 per cent.; and all other states and Wyoming Territory, each less than 1 per cent.

Labor.—In the following table is presented a summary of the hands employed, hours of labor required, and wages paid in the iron and steel industries of the United States in 1880, compared as far as possible with like statistics for 1870:

United States.	*Males above 16 years.*	*Males below 16 years.*	*Females above 15 years.*	*Females below 15 years.*	*Total hands employed.*	*Average number of hours of labor per week.*	*Average day's wages for a skilled mechanic.*	*Average day's wages for an ordinary laborer.*	*Total amount paid in wages.*
Grand total in 1880	133,203	7,709	45	21	140,978	65	$2 59	$1 24	$55,476,785
Grand total in 1870	75,037	2,436	82		77,555				$40,514,981
Percentage of increase in 1880	77.52	216.46			81.78				36.93
Percentage of decrease in 1880			45.12						

Hands Employed and Wages Paid.—The total number of hands employed in 1880 was 140,978. Of the whole number, 133,203 were men above 16 years old, and 45 were women above 15 years old; 7,709 were boys below 16 years old, and 21 were girls below 15 years old. The remarkably small number of 66 women and girls employed in the manufacture of iron and steel in 1880 will not escape notice, and is exceedingly creditable to our American civilization. The comparatively small number of boys employed is also worthy of notice. The 140,978 persons who were employed in 1880 were paid $55,476,785 as wages, or an average of $393.51 for the year for each person. The average daily wages of skilled labor were $2.59; of unskilled labor, $1.24. The highest average daily wages of skilled labor were paid in Rhode Island, Colorado, and Wyoming Territory—$4; the lowest in North Carolina—$1.25. The highest average daily wages of unskilled labor were paid in Wyoming Territory—$2; the next highest in Colorado and California—$1.75; the lowest in North Carolina—54 cents. It may be remarked of North Carolina that its iron industry in 1880 was wholly confined to the use of the primitive ore bloomary, and that the labor employed was largely that of colored men. The average wages paid in the four grand divisions were as follows: Eastern states—skilled, $2.70; unskilled, $1.21: southern states—skilled, $2.09; unskilled, $1.03: western states—skilled $2.70; unskilled, $1.31: Pacific states and territories—skilled, $3.50; unskilled, $1.75. It is necessary to explain that the figures of "hands employed" and "wages paid" refer to the labor directly employed at the various iron and steel works of the country, and in the mining and other operations conducted in direct connection with these works. They do not include the labor employed in independent and often remote mining operations which supply our iron and steel industries with ore and coal and other raw materials. (The statistics of these operations are being compiled by other hands.) Nor do they include any considerable part of the labor employed in the transportation of raw materials from the sources of production to the places of consumption. If the "hands employed" and "wages paid" in these various contributory channels were added to the figures given in our tables, the total number of persons directly supported by our iron and steel industries in 1880, and the total amount of wages paid to them, would be largely increased and probably doubled.

Hours of Labor.—The average number of hours of labor required per week in the iron and steel works of the United States in 1880 was 65. This gives a little less than 11 hours for each working day of the week. The average is high, in consequence of the general although not universal practice of operating blast furnaces seven days in the week, and in consequence also of the usual practice at blast furnaces, rolling mills, and steel works of working twelve-hour turns or shifts, which practice may require the presence of the workmen for that length of time, although they may not be, and generally are not, so long actually employed. The state which presents the highest average is Vermont—75 hours, while the lowest average in any of the states is found in Delaware and Kansas—56 hours. A still lower average is found in the District of Columbia—54 hours.

A Year of Prosperity.—The Census year 1880, which it may here be stated extended from the 1st of June, 1879, to the 31st of May, 1880, was a year of exceptional prosperity for the iron and steel industries of this country. The coincidence is notable that it exactly covered the period which has been designated as "the boom," during which all iron and steel products were in such great demand by American consumers that the iron and steel works of the country were unable to meet it. The home supply was supplemented by large importations, and even these could not be made with sufficient rapidity to meet the urgent wants of consumers. Prices were high throughout the whole year, but fluctuated violently. Labor was in demand, wages were promptly paid, and disputes between workingmen and their employers were rare and unimportant. The Census year 1880 will long be memorable as a year of general prosperity for our iron and steel industries, and as one which witnessed the beginning and the end of a most exciting epoch in their history.

SUMMARY OF IRON AND STEEL STATISTICS FOR 1880.

THE complete statistical results of the census of the blast furnaces, rolling mills, steel works, forges, and bloomaries in the United States in the Census year 1880 will be found in the accompanying tables. These results are here summarized, and as far as possible compared with results established by the census of 1870. The net ton of 2,000 pounds is invariably used in the tables and summary.

Grand Summary.—In the following table is presented a summary of the more important results established by the census of 1880, compared with similar results established by the census of 1870.

furnaces in 1870 was 574, and in 1880 it was 681, an increase of 18.64 per cent.

The following exhibit shows the number and capacity of the blast furnaces, rolling mills, steel works, forges, and bloomaries at the close of the Census year 1880:

Blast furnace establishments	490
Completed blast furnaces	681
Rolling mill establishments	324
Puddling furnaces, each double furnace counting as two furnaces	4,319
Rotary puddling furnace (Sellers)	1
Danks puddling furnaces	19
Hammers in iron rolling mills	239
Heating furnaces	2,105
Trains of rolls in iron rolling mills	1,206
Nail machines	3,775
Steel works	73
Bessemer steel converters	24
Open-hearth steel furnaces	37
Pot holes for crucible steel	2,691
Trains of rolls in steel works	136
Hammers in steel works	219
Forges and bloomaries	118
Forge and bloomary fires	495
Siemens rotator	1
Hammers in forges and bloomaries	141
Daily capacity of blast furnaces, in tons	19,248
Daily capacity of iron rolling mills, in tons	16,430
Daily capacity of Bessemer steel converters, in tons	4,467
Daily capacity of open-hearth steel furnaces, in tons	827
Daily capacity of Bessemer and open-hearth steel rolling mills, in tons	5,223
Daily capacity of crucible steel works, in tons	445
Daily capacity of forges and bloomaries, in tons	520

Capital.—The whole amount of capital invested in 1880 in the iron and steel industries in the United States which are embraced in this report was $230,971,884; in 1870 it was $121,772,074; increase $109,199,810, or 89.68 per cent. Of the whole amount invested in 1880, Pennsylvania's share was 46 per cent.; that of Ohio was 11 per cent.; that of New York was 9 per cent.; and that of Missouri and New Jersey was each 4 per cent. No one of the other states shows an investment greater than 3 per cent.

Total Production.—The total production of the iron and steel works of the United States in 1880 was 7,265,140 tons; in 1870 it was 3,655,215 tons; increase, 3,609,925 tons, or 98.76 per cent. The phrase "total production" includes the products of all the various processes or operations, although in ascertaining most of these products there

United States.	*Number of establishments.*	*Amount of capital (real and personal) invested.*	*Value of all materials used.*	*Value of all products made.*	*Weight of all products (tons).*	*Total hands employed.*	*Total amount paid in wages.*
Total in 1880	1,005	$230,971,884	$191,271,150	$296,557,685	7,265,140	140,978	$55,476,785
Total in 1870	808	$121,772,074	$135,526,132	$207,208,696	3,655,215	77,555	$40,514,981
Per centage of increase in 1880	24.38	89.68	41.13	43.12	98.76	81.78	36.93

Establishments.—The whole number of establishments that were engaged in the manufacture of iron and steel in 1880, or were built or partly built to engage in their manufacture, was 1,005. In 1870 it was 808. The increase in the ten years was 24.38 per cent. By the term "establishment" is meant a single manufacturing enterprise, or an aggregation of enterprises of like character under one management. Thus one establishment may embrace two rolling mills, and another may embrace four blast furnaces. If, however, a firm or company operates two or more enterprises of different character, each of these enterprises is classed as a separate establishment. A comparison of the number of the various establishments in 1870 and 1880 is given below.

	1870.	1880.
Blast furnace establishments	386	490
Rolling mill establishments	310	324
Steel works	30	73
Forges and bloomaries	82	118
Total	808	1,005

The size and capacity of the establishments were much greater in 1880 than in 1870. As the capacity of blast furnaces only was given in 1870, no complete data are available for a comparison of the capacity of all the works in the two periods. The daily capacity of the blast furnaces in 1870 was 8,357 tons of pig iron, and in 1880 it was 19,248 tons, an increase of 130.32 per cent. The number of blast

is a necessary duplication of the tonnage of raw or comparatively raw materials already stated. Thus rolled iron is mainly produced from pig iron. As the method of stating the production of 1880 is the same that was observed in 1870, a comparison of the results for both periods cannot be open to objection.

Production in Detail.—The following table shows the production of each branch of our iron and steel industries in 1870 and 1880, with the percentage of increase or decrease in the latter year:

Iron and steel products.	*Census year* 1870.	*Census year* 1880.	*Percentage of increase* in 1880.	*Percentage of decrease* in 1880.
	Tons.	*Tons.*		
Pig iron and castings from furnace	2,052,821	3,781,021	84	. . .
All products of iron rolling mills	1,441,829	2,353,248	63	.
Bessemer steel finished products	19,403	889,896	4,486	.
Open-hearth steel finished products	. . . .	93,143	. . .	.
Crucible steel finished products	28,069	70,319	151	.
Blister and other steel	2,285	4,956	117	. . .
Products of forges and bloomaries	110,808	72,557	. . . .	35
Total	3,655,215	7,265,140	98.76	. .

Of the pig iron produced in the census year 1880, there were produced with charcoal and cold blast, 79,613 tons; with charcoal and hot blast, 355,405 tons; with anthracite, 1,112,735 tons; with bituminous coal and coke, 1,515,107 tons; and with mixed anthracite and coke, 713,932 tons. The furnace castings amounted to only 4,229 tons. The total production was 3,781,021 tons, of which 12,875 tons were spiegeleisen. In the following table is presented a comparative statement of iron rolling mill products in 1870 and 1880:

Iron rolling mill products.	1870.	1880.
	Tons.	*Tons.*
Bar iron	488,834	663,211
Rod iron	26,087	145,626
Nail plate iron converted into cut nails	230,225	252,830
Boiler-plate iron	54,477	89,560
All other plate iron		94,749
Sheet iron	74,753	94,992
Iron rails	531,605	466,917
Skelp iron	2,217	128,321
Muck bar made for sale to other works	33,631	64,469
Structural iron	. . .	96,810
Rolled iron axles	. . .	2,630
Hoop iron	. . .	96,843
Fish-plates and miscellaneous forms of rolled iron	. . .	48,345
Railroad spikes, horseshoes, etc., made by iron rolling mills from rolled iron not included above	. . .	82,358
Hammered axles	. . .	21,884
Forgings	. . .	3,703
Total	1,441,829	2,353,248

STATISTICS OF THE AMERICAN IRON TRADE IN 1881.

We are indebted to the valuable compilations of Mr. James M. Swank, in his report to the American Iron and Steel Association, for the following summary of the American iron trade during 1881, and the opening months of 1882:

The prosperity which was restored to the American iron trade in the spring of 1879, and which was continued in 1880, attained its highest development in 1881. This was the most prosperous year American iron and steel manufacturers have ever known. The demand for their products was very active all through the year, production was greatly stimulated, and prices were in the main satisfactory. It was notably a year of *uniform* prosperity; not characterized by spurts and reactions, but by a steady demand at good prices in all branches, except in some pig iron districts in the summer months, when the demand for pig iron weakened slightly in consequence of the large quantities of foreign pig iron that were pressed upon the market. From this local depression there was, however, a complete recovery in the autumn. With this temporary variation in the general situation, the demand for all forms of iron and steel was active and even urgent all through the year. The production was far in advance of that of any previous year, and it all passed into consumption. The stocks on hand at the beginning of the year were also consumed. Never has there been a healthier business done by our iron and steel manufacturers than they did in 1881. The year ended with more orders on their books than were entered when it began, and at prices that were generally higher than were then obtained.

The following table shows the average monthly quotations, for each month of the year 1881, for iron rails per gross ton at the mills in Eastern Pennsylvania; for Bessemer steel rails per gross ton at the works in Pennsylvania; for No. 1 anthracite foundry pig iron per gross ton delivered in Philadelphia; and for best refined roll bar iron per pound at the stores in Philadelphia. The quotations which we give express the average of weekly quotations for the year, but it is fair to add that the latter may have been shaded in actual sales. In all our tables of prices we claim simply to use due caution in giving market quotations, which, as is well known, do not always represent bottom prices.

Months.	*Iron rails. Per ton.*	*Steel rails. Per ton.*	*Pig iron. Per ton.*	*Bar iron. Per lb.*
January	$46.50	$60.00	$25.00	2.5 cts.
February	47.50	62.00	25.50	2.5 cts.
March	47.00	62.50	26.00	2.5 cts.
April	47.00	63.00	25.00	2.5 cts.
May	46.50	63.00	25.00	2.4 cts.
June	46.50	60.00	24.00	2.4 cts.
July	46.75	61.00	24.50	2.45 cts
August	47.00	60.00	24.50	2.55 cts.
September	47.75	60.00	25.25	2.7 cts.
October	47.50	60.00	25.50	2.8 cts.
November	47.75	61.50	25.75	2.9 cts.
December	48.00	60.00	26.00	2.9 cts.

As we have said, and as the above table establishes, prices were generally higher at the close of the year than at its beginning. Yet there were not wanting indications in December that a decreased demand and lower prices might soon be expected. There had been a flurry in railroad stocks, resulting from over-speculation, short crops, a shrinkage in freights, and reduced rates, and clearly pointing to greater caution in the immediate future in railroad investments. This flurry was significant of an early decline in the demand for rails and other railway materials for new roads, while the short crops and the consequent shrinkage in freights and struggle for freight traffic were equally significant of an early spasm of economy in the purchase of rails and other materials for existing roads. These indications of a decreased demand for railway supplies became manifest, too, at the moment when it became generally recognized that the ability of the country to supply itself with steel rails had been greatly increased. The elements of weakness in steel rails were plainly visible, and as steel rails had been largely instrumental in holding up the prices of other iron and steel products it was clearly to be inferred that when they would decline in price the market would weaken at almost every point from this cause alone if from no other.

The indications of last December have been only too fully verified. The demand for most iron and steel products has sensibly slackened, and prices have very generally sympathized with this decline. Steel rails especially have experienced a remarkable fall in price. At the middle of December they were quoted at $60, while the price at the end of the month was $58. At the middle of May orders were easily placed at $50, a decline of $10 in five months. Iron rails were quoted at $48 at the close of December, and in May they had fallen to $44. Pig iron fell about one dollar and a half per ton from December to May, except for best brands of No. 1 anthracite foundry. The prices of bar iron and nails have recently sympathized with the downward tendency in the prices of the other articles above named. In December the prices of bar iron at the stores in Philadelphia was 2.9 cents per pound, and at the middle of May it was 2.6 cents. The quoted price of nails at Pittsburg in December was $3.30 per keg, and at the middle of May it was $3.

Of the demand for all iron and steel products in May, when this report is written, it is certainly correct to say that it is not satisfactory. The situation at the present moment is far from encouraging, and in some respects is discouraging. The heavy importations of iron and steel that have been made since the beginning of the year exercise an unfavorable influence upon the market. Pig iron and iron and steel rails have been brought into the country in large quantities at a time when we are abundantly able to supply the home demand from our own works. The floods in the Mississippi and the cold and wet spring have had an unfavorable effect on all business. The shortness of the harvest last year has increased the cost of the necessaries of life, and labor is consequently unwilling to accept any reduction in its wages; in some instances it even demands higher wages. Through a decline in our exports of agricultural products the balance of trade is being rapidly turned against us, which means less buoyancy and ease in the general financial situation. The whole trade of the country, with which, of course, the iron trade must sympathize, is to-day undergoing a moderate reaction from the remarkable activity of the last three years. Such are the influences that affect unfavorably the American iron trade to-day. We may hope, however, that the prevailing low prices of iron and steel will ere long, especially if we should have a favorable harvest, infuse greater activity than now exists into all branches of our iron and steel industries. But under no circumstances that can possibly happen will this year's business be as prosperous as that of last year. The fact may as well be accepted philosophically, if reluctantly, that we have again entered upon a cycle of low prices for iron and steel. We do not think this result is greatly to be regretted if we consider that some remedy is needed to check our enormous importations of these articles. Were these importations to be continued for a few years longer upon the scale which has existed during the past three years our iron and steel industries would suffer the most serious consequences, which would be felt for a generation. Iron and steel are not consumed like bread or worn out like clothing. Every ton of these metals that is imported stays here and permanently displaces a ton of the same product that might be made at home. Even when iron and steel "wear out" in one form they reappear in another. As a matter of fact, however, the iron and steel rails and some other iron and steel articles that have recently been imported will last a long time in their present forms. Importations of iron and steel had, therefore, to be checked in some way if we would not prevent the future prosperity of the domestic producers of these articles. Low prices may be a distasteful remedy for our manufacturers and their workmen, and for iron ore producers, to apply to the evil mentioned, but no other remedy is available. It is a pity that good use was not made of it a few months ago.

The Production of 1881 Compared with that of 1880.—The production of the leading articles of iron and steel in the United States in 1881 is given in the following table in comparison with the production of the same articles in 1880. With the exception of iron rails our production of every article enumerated was larger in 1881 than in 1880 or in any other year of our history.

Products.	*Net tons.*	
	1880.	1881.
Pig iron	4,295,414	4,641,564
All rolled iron, including nails and excluding rails	1,838,906	2,155,346
Bessemer steel rails	954,460	1,330,302
Open-hearth steel rails	13,615	25,217
Iron and all other rails	493,762	488,581
Kegs of cut nails and spikes, included in all rolled iron	5,370,512	5,794,206
Crucible steel ingots	72,424	89,762
Open-hearth steel ingots	112,953	146,946
Bessemer steel ingots	1,203,173	1,539,157
Blooms from ore and pig iron	74,589	84,606

Our Imports of Iron and Steel from 1871 to 1881.—The foreign value of the imports into the United States from all countries of iron and steel and manufactures thereof, including tin plates, has been as follows in the eleven years from 1871 to 1881.

Years.	*Values.*	*Years.*	*Values.*
1871	$57,866,299	1877	$19,874,399
1872	75,617,677	1878	18,013,010
1873	60,005,538	1879	33,331,569
1874	37,652,192	1880	80,443,362
1875	27,363,101	1881	61,555,078
1876	20,016,603		

The foregoing table of values includes *all* our importations of iron and steel and manufactures thereof, of every description whatever. In the following table we give the quantities of all the *leading* iron and steel products imported into the United States from all countries in the eleven years from 1871 to 1881, except steel in ingots, bars, sheets, and wire, for which statistics of values only are obtainable. To be more specific, the figures below embrace only our importations of pig, bar, boiler, band, hoop, scroll, and sheet iron, iron and steel rails, castings, old and scrap iron, anchors, cables and chains, and tin plates.

Years.	*Net tons.*	*Years.*	*Net tons.*
1871	1,278,965	1877	236,777
1872	1,325,034	1878	236,434
1873	717,761	1879	862,382
1874	337,845	1880	2,112,341
1875	268,477	1881	1,321,767
1876	228,716		

The importations in 1880 were the largest in our history. The decline in 1881 was about $19,000,000 in the value of all iron and steel imports, and about 800,000 net tons in the quantities of the leading articles just enumerated. The following table gives, in net tons, the details of our imports in the last six years of the leading articles above mentioned.

Commodities imported.	1876.	1877.	1878.	1879.	1880.	1881.
Pig iron	83,072	66,861	74,484	340,762	784,968	520,162
Castings	35	53	69	61	114	632
Bar iron	26,653	30,531	33,346	48,840	126,987	47,820
Boiler iron	15	2	1	91	168	290
Band, hoop, etc.	144	150	7	1,031	25,322	827
Railroad bars of iron	287	. .	.	19,090	132,459	137,013
Railroad bars of steel	. . . .	35	10	25,057	158,230	249,309
Sheet iron	1,758	1,184	838	5,459	11,412	8,121
Old and scrap iron	14,149	10,903	6,225	248,429	694,273	151,107
Anchors, cables, etc.	1,863	1,073	646	892	1,393	1,520
Tin plates	100,740	125,976	120,808	172,760	177,015	204,066
Total	228,716	236,777	236,434	862,382	2,112,341	1,321,767

The rapid and unprecedented increase in our iron and steel imports in 1879 and 1880 has been sufficiently explained in preceding annual reports. The same causes which produced this increase may be credited with our large importations of iron and steel rails in 1881. The country could not supply its own pressing need of these articles. The large quantities of pig iron imported in 1881 were not, however, due to a scarcity of domestic pig iron, but to the cheapness, notwithstanding the duty, of the foreign article. There was a noticeable decline in 1881 of importations of old and scrap iron.

Our Imports of Iron and Steel in the First Quarter of 1882.—In the following table we give, in net tons, the imports during the first three months of 1882 of the leading articles of iron and steel above mentioned, with the values added.

Commodities imported.	*Net tons.*	*Values.*
Pig iron	90,333	$1,547,501
Castings	306	19,169
Bar iron	21,338	869,527
Boiler iron	31	1,036
Band, hoop and scroll iron	180	6,779
Railroad bars or rails, of iron	21,150	555,253
Railroad bars or rails, of steel	51,992	1,558,772
Sheet iron	1,949	107,831
Old and scrap iron	65,614	1,094,661
Anchors, cables and chains	481	45,804
Tin plates	57,262	4,410,446
Total	319,636	$10,216,779

The figures given in this table show a larger aggregate importation of the articles mentioned than occur in the corresponding period of 1881, and at first sight indicate no diminution in the volume of imports this year as compared with last year. But the demand for iron and steel has slackened and prices have fallen in this country since the orders were sent abroad for the articles which were imported in the first quarter of this year, and further importations during the year must show a decline.

Our Imports of Iron Ore in 1879, 1880, and 1881.—During the years 1879, 1880, and 1881 our imports of iron ore were derived from the following countries, as we are officially advised by the Chief of the Bureau of Statistics.

Brazil, Denmark, France, French West Indies, French Possessions in Africa and adjacent islands, Germany, England, Scotland, Ireland, Gibraltar, Nova Scotia, New Brunswick and Prince Edward Island, Quebec, Ontario, Manitoba and the Northwest Territory, British Columbia, British Possessions in Africa and adjacent islands, other British Possessions, Italy, Portugal, Russia on the Baltic and White Seas, Spain, Spanish Possessions in Africa and adjacent islands, Turkey in Asia, Turkey in Africa, United States of Colombia, Uruguay, and Venezuela.

The following statement shows the quantity and value of iron ore imported into the United States during the calendar years 1879, 1880, and 1881, by customs districts. Most of the ore was imported from Spanish and Mediterranean ports. Previous to 1879 the quantity of iron ore annually imported was not preserved by the Treasury Department, but in no year did it amount to 100,000 tons.

Districts.	1879.		1880.		1881.	
	Gross tons.	*Dollars.*	*Gross tons.*	*Dollars.*	*Gross tons.*	*Dollars.*
Baltimore	27,090	60,869	170,308	506,560	375,798	1,005,496
Boston	701	2,438	2.155	13,359	716	2,867
Buffalo Creek	5,969	14,251	13,554	36,420	2,492	7,320
Champlain	12	31	. . . .	. . . .	. . . .	. . . .
Cuyahoga	550	1,128	13,858	48,463	10,500	37,675
Detroit	1,287	3,508	456	1,169	617	1,646
Genesee	2,125	4,101	5,390	16,274	8,716	25,961
Huron	. . . .	. . . .	72	258	264	770
Newark, N. J.	. . . .	. . . .	269	798	. . . .	. . . .
New York	109,230	282,060	148,987	432,678	196,419	641,344
Oswegatchie	. . . .	. . . .	7,553	21,052	3,418	10,650
Oswego	884	2,130	4,185	7,860	13,612	44,026
Perth Amboy, N. J.	9,634	29,010	5,444	15,968	13,671	48,323
Philadelphia	126,659	281,941	120,619	335,119	155,564	394,952
Puget's Sound	. . . .	. . . .	400	412	1,100	1,622
Cape Vincent	. . . .	. . . .	158	413	. . . .	. . . .
Total	284,141	681,467	493,408	1,436,809	782,887	2,222,652

Like the statistics of our imports of iron and steel in the last three years, the above table of our imports of iron ore in these years must be an eyesore to every patriotic American. That this country, with all its wealth of iron ore and its splendid transportation facilities, should have imported in these three years over one and a half million tons of foreign iron ore, paying for it over four million dollars, is a remarkable fact upon which the next generation of American iron and steel manufacturers will probably look with amazement. The large importations were mainly caused by the high prices charged for domestic ores, but partly also by a scarcity of ores suitable for the manufacture of Bessemer pig iron. It is, however, gratifying to learn that the imports of iron ore in the present year promise to be quite small as compared with those of last year. In the first three months of 1882 we imported only 43,648 tons, valued at $127,146. We are informed that very few contracts for foreign ore, for delivery this year, have been made by our manufacturers.

Our Domestic Exports of Iron and Steel from 1871 to 1881.—The value of the exports from the United States to all countries of domestic iron and steel and manufactures thereof in the eleven years from 1871 to 1881 was as follows:

Years.	*Values.*	*Years.*	*Values.*	*Years.*	*Values.*
1871	$11,836,137	1875	$16,092,906	1879	$12,470,448
1872	10,030,125	1876	11,798,459	1880	12,690,995
1873	12,129,939	1877	16,659,675	1881	15,782,282
1874	15,389,807	1878	13,260,369		

Our exports of iron and steel and manufactures thereof are made principally to countries on the American Continent, particularly to Canada. Among other countries Australia is a liberal customer for our manufactured articles, England coming next. In 1881 we exported 104 locomotives to foreign countries, a larger number than in any preceding year. The indications are that in this year we will export as many as in last year.

The Production of Pig Iron in 1881.—The total production of pig iron in the United States in 1881 was 4,641,564 net tons, or 4,144,254 gross tons. (A net ton is 2,000 pounds, and a gross ton 2,240 pounds.) The production was less than had been generally anticipated. It was a little more than 8 per cent. greater than that of 1880, which was 4,295,414 net tons, or 3,835,191 gross tons. The production of 1880 was 40 per cent. greater than that of 1879, which was 3,070,875 net tons, or 2,741,853 gross tons. That the production of the last three years may be made still plainer to the eye we present it below in tabular form.

Years.	*Net tons.*	*Gross tons.*
1879	3,070,875	2,741,853
1880	4,295,414	3,835,191
1881	4,641,564	4,144,254

An increase of a little more than 8 per cent. in 1881 makes a poor showing in comparison with the wonderful increase of 40 per cent. in 1880. But the failure of our pig iron industry to maintain in 1881 a rate of increase even approximate to that of 1880 is easily explained. The year 1879 was partly spent before our pig iron manufacturers awakened to the fact that a boom in the iron trade had commenced, and even after this fact was fully realized valuable time was lost in making needful preparations to put idle furnaces in blast. Consequently the production of 1879 was not much larger than that of 1878, which was a year of great depression. But in 1880 our best furnaces were all in operation and were driven to their utmost capacity; hence the remarkable product of that year. In 1881 this activity was generally continued, but a better record than had been made in 1880 could hardly be expected from the furnaces that were running in that year, so that the increased production of 1881, if any, would have to come mainly from new furnaces. There was, however, diminished activity in a few districts and states in 1881 as compared with 1880, owing to the large quantity of foreign pig iron which was sold in our markets during the year, much of which had been carried over at Atlantic ports from 1880. But for these sales of foreign iron during 1881, aggregating over 600,000 gross tons, most of which was of qualities suitable for the manufacture of Bessemer steel and fine castings, our domestic production in that year would have been largely increased over that of 1880, instead of being, as we have stated, only about 8 per cent. greater. Our ability to supply the demand for pig iron in 1881 cannot be doubted, and the chief reason why we did not wholly supply it was the inability of some of our furnace owners to make pig iron profitably at the prices which foreign competition had established. We need not here dwell upon the causes of this inability, but it may be briefly stated that the leading cause was the high price of iron ore.

Twenty-six states and one territory (Washington) made pig iron in 1881. Colorado, California, and Washington territory each made pig iron in that year for the first time, while North Carolina, which had not made pig iron since 1877, resumed its place in the list of pig iron producing states. Minnesota first commenced to make pig iron in 1880, and in 1881 the activity of its solitary furnace was continued. Pig iron was made in Colorado at the furnace of the Colorado Coal and Iron Company, at South Pueblo, which was blown in on September 7; in California at the furnace of the California Iron and Steel Company, at Clipper Gap, (Hotaling post office,) in Placer county, which was blown in on April 24; and in Washington territory at the furnace of the Puget Sound Iron Company, at Irondale, in Jefferson county, which was blown in on January 27. Iron ore of a superior quality and in large quantities is reported to be in course of development about ninety miles from Duluth, in Minnesota, affording the promise of a larger production of pig iron at an early day in that state, and of shipments of ore to other states. A majority of the states which made pig iron in 1881 increased their production in that year over their record in 1880, although in some cases the increase was very small. The largest increase in tons was in Pennsylvania, which produced 107,665 net tons more than in 1880. The most noticeable increase was in Allegheny county. The production of the state in 1881 was 2,190,786 net tons, against 2,083,121 tons in 1880. But the largest percentage of increase was in Virginia, Alabama, Georgia, Tennessee, Illinois, Michigan, Connecticut, Maine, Vermont, Minnesota, and Oregon—the last four states, of course, producing but little pig iron in either year. The increase in Virginia is remarkable, being from 29,934 net tons to 83,711 tons. The increase in Alabama was from 77,190 tons to 98,081 tons; in Georgia it was from 27,321 tons to 37,404 tons; in Tennessee from 70,873 tons to 87,406 tons; in Illinois from 150,556 tons to 251,781 tons; in Michigan from 154,424 tons to 187,043 tons, and in Connecticut from 22,583 tons to 28,483 tons. Ohio increased its production in 1881 very slightly over that of 1880—only 36,339 net tons, or from 674,207 tons to 710,546 tons. Several states made less pig iron in 1881 than in 1880; in some of the states the falling off was quite marked. New York declined from 395,361 tons to 359,519 tons; Maryland from 61,437 tons to 48,756 tons; West Virginia from 70,338 tons to 66,409 tons; Kentucky from 57,708 tons to 45,973 tons, and Indiana from 12,500 tons to 7,300 tons. The states whose production in 1881 did not vary greatly from that of 1880 were Massachusetts, New Jersey, Texas, Wiconsin, and Missouri.

The production of pig iron in 1881 in the pig iron producing states was as follows, in the order of their prominence:

States.	*Net tons.*	*States.*	*Net tons.*
Pennsylvania	2,190,786	Connecticut	28,483
Ohio	710,546	Massachusetts	18,318
New York	359,519	Minnesota	7,442
Illinois	251,781	Indiana	7,300
Michigan	187,043	Colorado	6,396
New Jersey	171,672	Oregon	6,100
Missouri	109,799	California	4,414
Wisconsin	102,029	Maine	4,400
Alabama	98,081	Texas	3,000
Tennessee	87,406	Vermont	2,796
Virginia	83,711	Washington Territory	1,200
West Virginia	66,409	North Carolina	800
Maryland	48,756		
Kentucky	45,973		
Georgia	37,404	Total	4,641,564

The most remarkable fact presented in this table is the prominent place held by Illinois in the production of pig iron. In 1879 her production was 78,143 net tons, and her place in the list of pig iron producing states was eighth; in 1880 her production was 150,556 tons, and she advanced to the sixth place; in 1881 her production was 251,781 tons, and she was fourth in rank. The percentage of production by the four leading states in 1881 was as follows: Pennsylvania, $47\frac{1}{5}$; Ohio, $15\frac{1}{3}$; New York, $7\frac{3}{4}$; Illinois, $5\frac{2}{5}$. No other state made 5 per cent. of the production of the year. Neither Pennsylvania nor Ohio made the same percentage in 1881 that it made in 1880, nor did Pennsylvania make the same percentage in 1880 that it made in 1879. The percentage for these states in the three years mentioned was as follows: Pennsylvania, 1879, $52\frac{1}{3}$; 1880, $48\frac{1}{2}$; 1881, $47\frac{1}{5}$. Ohio, 1879, $14\frac{3}{5}$; 1880, $15\frac{5}{7}$; 1881, $15\frac{1}{3}$.

The following table shows the production of pig iron in Pennsylvania and Ohio, separated according to the varions districts of those states, for the years 1879, 1880, and 1881:

	Districts.	*Net tons of 2,000 pounds.* 1879.	1880.	1881.
Pennsylvania.	Lehigh Valley	456,350	544,987	560,190
	Schuylkill Valley	191,748	306,926	309,049
	Upper Susquehanna	125,971	168,128	125,785
	Lower Susquehanna	165,500	217,889	218,329
	Shenango Valley	150,861	215,313	198,968
	Allegheny County	267,315	300,497	385,453
	Miscellaneous bituminous	214,123	280,007	341,104
	Charcoal	35,895	43,374	51,908
Ohio.	Hanging Rock coke	43,097	60,316	77,500
	Mahoning Valley	147,844	226,877	245,737
	Hocking Valley	51,908	85,719	88,146
	Miscellaneous coke	161,457	232,105	232,994
	Hanging Rock charcoal	43,445	64,854	61,487
	Miscellaneous charcoal	....	4,336	4,682

The increase in the production of pig iron in this country from 1879 to 1881 (covering the production of the two years 1880 and 1881) was 51 per cent. The New England states and New York and New Jersey increased 63 per cent.; Pennsylvania, 36 per cent.; the Southern states, beginning with Maryland and including West Virginia, 64 per cent.; the Western states, beginning with Ohio and including Missouri and Colorado, 70 per cent.; the Pacific Coast, 369 per cent. The percentage of the total production of 1881 in each of these territorial divisions was as follows, in round numbers: Northeast, 13; Pennsylvania, 47; the South, 10; the West, 30; the Pacific Coast, less than 1 per cent. The number of tons of pig iron produced in each of these territorial divisions in 1879, 1880, and 1881 was as follows:

Territorial Divisions.	*Net tons of 2,000 pounds.* 1879.	1880.	1881.
The Northeast	359,992	612,388	585,188
Pennsylvania	1,607,763	2,083,121	2,190 786
The South	287,725	397,301	471,540
The West	812,895	1,197,604	1,382,336
The Pacific Coast	2,500	5,000	11,714
Total	3,070,875	4,295,414	4,641,564

The production of speigeleisen increased slightly in 1881 over previous years, the quantity produced in 1881 being 21,086 net tons. This country makes remarkably slow progress in the production of this essential raw material in the manufacture of Bessemer steel. Both foreign and domestic ores are used in its production in our furnaces. The following table shows the production of this kind of pig iron since 1875:

Years.	*Net tons.*	*Years.*	*Net tons.*
1875	7,832	1879	13,931
1876	6,616	1880	19,603
1877	8,845	1881	21,086
1878	10,674		

Three states made spiegeleisen in 1881—New Jersey, Pennsylvania, and Ohio. Pennsylvania's share of the total production was 16,276 net tons. The spiegeleisen produced in Ohio was made by the Brier Hill Iron and Coal Company, of Youngstown, in a furnace specially built for that purpose and first blown in in 1881. The Lehigh Zinc and Iron Company, of Bethlehem, Pa., erected a small furnace in 1881 to make speigeleisen, but it was not in operation. The product of 1881 was made by the New Jersey Zinc and Iron Company, the Cambria Iron Company, Carnegie Bros. & Co., Limited, and the Brier Hill Iron and Coal Company. The following table shows in net tons the quantity of pig iron produced in each of the years 1879, 1880, and 1881 with bituminous coal, anthracite coal, and charcoal, it being understood that the second of these classifications is not absolutely accurate, as coke is used as a mixture in many anthracite furnaces.

Fuel used.	1879.	1880.	1881.
Bituminous	1,438,978	1,950,205	2,268,264
Anthracite	1,273,024	1,807,651	1,734,462
Charcoal	358,873	537,558	638,838
Total	3,070,875	4,295,414	4,641 564

It will be observed that the use of bituminous coal and charcoal has steadily increased in the years mentioned, but that the use of anthracite coal was less in 1881 than in 1880. The increase in the consumption of bituminous coal was to be expected as the iron industry would be extended in the western and southern sections of the country, where bituminous deposits are abundant and anthracite deposits are practically unknown, but the great increase in the use of charcoal in the last two years is a real surprise. Our production of charcoal pig iron in 1881 was greater than in any previous year in our history, the years of next largest production being 1873 and 1874, in the order named. The following table gives the production of anthracite, charcoal, and bituminous pig iron from 1854 to 1881:

Years.	Net tons of 2,000 pounds.			
	Anthracite.	Charcoal.	Bituminous.	Total.
1854	339,435	342,298	54,485	736,218
1855	381,860	339,922	62,390	784,178
1856	443,113	370,470	69,554	883,137
1857	390,385	330,321	77,451	798,157
1858	361,430	285,313	58,351	705,094
1859	471,745	284,041	84,841	840,627
1860	519,211	278,331	122,228	919,770
1861	409,229	195,278	127,037	731,544
1862	470,315	186,660	130,687	787,662
1863	577,638	212.005	157,961	947,604
1864	684,018	241,853	210,125	1,135,996
1865	479,558	262,342	189,682	931,582
1866	749,367	332,580	268,396	1,350,343
1867	798,638	344,341	318,647	1,461,626
1868	893,000	370,000	340,000	1,603,000
1869	971,150	392,150	553,341	1,916,641
1870	930,000	365,000	570,000	1,865,000
1871	956,608	385,000	570,000	1,911,608
1872	1,369,812	500,587	984,159	2,854,558
1873	1,312,754	577,620	977,904	2,868,278
1874	1,202,144	576.557	910,712	2,689,413
1875	908,046	410,990	947,545	2,266,581
1876	794,578	308,649	990,009	2,093,236
1877	934,797	317,843	1,061,945	2,314,585
1878	1,092,870	293,399	1,191,092	2,577,361
1879	1,273,024	358,873	1,438,978	3,070,875
1880	1,807,651	537,558	1,950,205	4,295,414
1881	1,734,462	638,838	2,268,264	4,641,564

The stocks of pig iron unsold in the hands of makers or their agents on the 31st of December, 1881, amounted to 210,896 net tons, against 456,658 tons at the close of 1880. The following table shows the quantity of each kind of pig iron held in stock by the furnace owners or their agents at the close of these years:

Kind of fuel.	Net tons.	
	Dec. 31, 1880.	Dec. 31, 1881.
Bituminous	184,626	36,495
Anthracite	175,862	90,351
Charcoal	96,170	84,050
Total	456,658	210,896

The consumption of pig iron in the United States in 1881 can be approximately ascertained. We produced 4,144,254 gross tons and imported 464,430 tons. We had in stock at the beginning of the year 407,730 tons of domestic pig iron and 164,404 tons of foreign pig iron. The total supply was 5,180,818 gross tons. At the close of the year we had on hand 188,300 gross tons of domestic pig iron and 9,953 tons of foreign pig iron, which, being deducted from the total supply, gives us 4,982,565 gross tons as the probable consumption of the year. In our Annual Report for the year 1880, published in July, 1881, we estimated the consumption of 1880 at 3,990,415 gross tons—the elements of our calculation being the same for that year that we have taken above for 1881. An increase of 1,000,000 gross tons in one year in our consumption of pig iron is a most remarkable fact.

	Districts.	December 31, 1880.			December 31, 1881.		
		In blast.	Out of blast.	Total.	In blast.	Out of blast.	Total.
Pennsylvania.	Lehigh Valley	41	9	50	45	4	49
	Schuylkill Valley	28	19	47	32	16	48
	Upper Susquehanna Valley	15	10	25	16	7	23
	Lowor Susquehanna Valley	26	10	38	26	11	37
	Shenango Valley	13	17	30	11	20	31
	Allegheny County	11	4	15	12	3	15
	Miscellaneoue bituminous	28	8	36	28	10	38
	Charcoal	27	8	35	25	12	37
Ohio.	Hanging Rock Region	34	12	46	34	11	45
	Mahoning Valley	13	4	17	16	2	18
	Hocking Valley	10	4	14	12	2	14
	Other bituminous and charcoal	19	7	26	17	8	25

About one-third of this vast increase was used in the production of Bessemer steel; the remainder was required to supply the miscellaneous iron and steel works of the country. The preceding table shows the number of furnaces in blast and out of blast at the close of 1880 and 1881 in the pig iron districts of Pennsylvania and Ohio. That so many furnaces should have been out of blast in these states in 1880 and 1881 is a singular fact.

The following table gives the number of completed furnaces in the United States at the close of each of the ten years from 1872 to 1881:

1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
612	657	693	713	712	716	692	697	701	746

Of 701 furnaces in the United States on December 31, 1880, there were 446 in blast and 255 out of blast; of 716 furnaces on December 31, 1881, there were 455 in blast and 261 out of blast. The following table shows the furnaces in blast and out of blast at the close of the years 1880 and 1881:

States and Territories.	December 31, 1880.			December 31, 1881.		
	In blast.	Out of blast.	Total.	In blast.	Out of blast.	Total.
Maine	1	...	1	1	...	1
Vermont	1	...	1	1	...	1
Massachusetts	5	...	5	4	1	5
Connecticut	8	2	10	8	2	10
New York	44	13	57	40	18	58
New Jersey	10	10	20	10	10	20
Pennsylvania	189	85	274	195	83	278
Maryland	10	13	23	12	11	23
Virginia	13	24	37	15	25	40
North Carolina	...	7	7	1	6	7
Georgia	4	6	10	4	6	10
Alabama	13	2	15	13	2	15
West Virginia	7	4	11	5	6	11
Kentucky	8	14	22	8	16	24
Tennessee	13	12	25	11	15	26
Texas	1	...	1	1	...	1
Ohio	76	27	103	79	23	102
Indiana	3	1	4	1	3	4
Illinoie	8	5	13	9	5	14
Missouri	5	11	16	7	10	17
Michigan	14	13	27	17	10	27
Wisconsin	11	3	14	9	6	15
Minnesota	1	...	1	1	...	1
Colorado	...	1	1	1	...	1
Utah Territory	...	2	2	...	2	2
Oregon	1	...	1	1	...	1
California	...	...	...	1	...	1
Washington Territory	...	...	...	...	1	1
Total	446	255	701	455	261	716

The following table shows the number of furnaces in the United States in and out of blast at the close of 1881, as compared with the close of 1880, separated according to the fuel used:

Kind of fuel.	December 31, 1880.			December 31, 1881.		
	In blast.	Out of blast.	Total.	In blast.	Out of blast.	Total.
Bituminous	140	74	214	144	75	219
Anthracite	155	70	225	160	63	223
Charcoal	151	111	262	151	123	274
Total	448	255	701	455	281	718

In 1881 there were built 26 new furnaces in the United States. The building of 25 other furnaces was commenced but not completed. In the same year 12 furnaces were abandoned. Detailed information will be found in the following table:

States and Territories.	*Furnaces built in 1881.*	*Furnaces building in 1881.*	*Furnaces abandoned in 1881.*
New York	1	...	...
Pennsylvania	6	10	5
Maryland	...	1	...
Virginia	5	2	2
Alabama	...	1	...
Kentucky	2	...	...
Tennessee	3	...	1
Ohio	1	5	3
Illinois	2	3	...
Missouri	1	...	...
Michigan	1	...	1
Wisconsin	1	...	...
Colorado	1	1	...
California	1	...	...
Utah Territory	...	2	...
Washington Territory	1	...	...
Total	26	25	12

Production of Iron and Steel Rails in 1881.—Large as was our production of rails in 1880, the production of 1881 was very much larger. We give below, in both net and gross tons, the total rail product of each of the four last years:

	1878.	1879.	1880.	1881.
Net tons	882,685	1,113,273	1,461,837	1,844,100
Gross tons	788,111	993,993	1,305,212	1,646,518

The increase in the rail production of 1880 over 1879 was 348,564 net tons, or 311,219 gross tons, whereas the increase in the rail production of 1881 over 1880 was 382,263 net tons, or 341,306 gross tons. The record of the last three years is really marvelous, and in no other country could it have been possible. In 1881 we more than doubled the rail production of 1878, the product of 1881 being 961,415 net tons, or 858,407 gross tons, larger than that of 1878. The production in 1880 was 31 per cent. greater than that of 1879, and the production of 1881 was 26 per cent. greater than that of 1880. The total rail production of 1881 was as follows, compared with the production of 1879 and 1880, net tons being used:

Kind of rails.	1879. *Net tons.*	1880. *Net tons.*	1881. *Net tons.*
Iron rails	420,160	493,762	488,581
Bessemer steel rails	683,964	954,460	1,330,302
Open-hearth steel rails	9,149	13,615	25 217
Total	1,113,273	1,461,837	1,844,100

The increase in the production of Bessemer steel rails in 1881 over 1880 was 375,842 net tons, or 39⅓ per cent., and the increase in the production of open-hearth steel rails was 11,602 tons, or 85 per cent. In the production of iron rails in 1881 there was a decrease of 5,181 net tons upon the production of 1880, or about one per cent. The production of iron rails in this country must henceforth be annually less than in either of the last two years. Iron rails cannot hereafter be made by our manufacturers in competition with steel rails, except under the favorable circumstances which were explained in our Annual Report for the year 1877, the principal favorable circumstance being the comparative cheapness with which old iron rails may be rerolled at iron rail mills located in sections of the country where there are no steel rail mills. Their manufacture culminated in 1872, from which year it steadily declined until 1879, in which year and in the two following years there was a partial recovery in consequence of the inability of the steel rail manufacturers to supply the demand for their product. This inability no longer exists. The following table gives the production of iron rails in the United States in each of the last twelve years, in net tons:

1870.	1871.	1872.	1873.	1874.	1875.
586,000	737,483	905,930	761,062	584,469	501,649
1876.	1877.	1878.	1879.	1880.	1881.
467,168	332,540	322,890	420,160	493,762	488,581

Included in the production of 1,330,302 net tons of Bessemer steel rails in 1881 were 77,173 net tons which were produced mainly, but not entirely, from imported blooms. Eleven mills in Vermont, New York, Pennsylvania, Ohio, Tennessee, Illinois, and California rolled Bessemer steel rails from purchased blooms. A few other mills have engaged to roll rails from imported blooms in 1882. The business, however, cannot be expected to increase largely, if, indeed, it does not actually decrease from this time forward. Twenty states and one territory (Wyoming) produced rails in 1881. In that year there were in these states and this territory 87 rail mills, of which 57 were active. Of these 87 mills two were burned during the year—one at Topeka, Kansas, which will not be rebuilt, and one at Atlanta, Georgia, which has not yet been rebuilt. The following table shows the production of rails of all kinds, by states, in the order of their prominence, in 1881:

States.	*Net tons.*	*States.*	*Net tons.*
Pennsylvania	891,179	California	6,035
Illinois	433,420	Kentucky	5,005
Ohio	153,596	Georgia	4,000
New York	109,283	West Virginia	3,152
Missouri	64,226	Massachusetts	2,622
Indiana	44,645	Alabama	2,300
Wisconsin	41,165	Maine	2,183
Tennessee	32,660	Colorado	1,643
Kansas	19,016	Virginia	640
Vermont	15,200	New Jersey	244
Wyoming Territory	11,886		
		Total	1,844,100

The capacity of the Bessemer and open-hearth steel rail mills of the country is now much larger than it was a year ago, and is more than equal to the present demand. If necessary we could produce in 1882 not less than 1,500,000 gross tons of steel rails, but it is doubtful whether our product during the year will materially exceed that of 1881. The production of street rails in 1881, which is included in the total production for the year, amounted to 21,544 net tons, of which 12,464 tons were of iron, 7,990 tons were of Bessemer steel, and 1,100 tons were of open-hearth steel. The production of street rails in the eight preceding years was as follows: 1873, 9,430 net tons; 1874, 6,739 tons; 1875, 16,340 tons; 1876, 13,086 tons; 1877, 7,015 tons; 1878, 9,229 tons; 1879, 8,646 tons; 1880, 16,894 tons. The production of iron and steel rails in this country since the beginning of the manufacture of Bessemer steel rails in 1867 has been as follows, in net tons:

Years.	*Net tons of 2,000 pounds.*			
	Open-hearth steel rails.	*Iron rails, all kinds.*	*Bessemer steel rails.*	*Total.*
1867	...	459,558	2,550	462,108
1868	...	499,489	7,225	506,714
1869	...	583,936	9,650	593,586
1870	...	586,000	34,000	620,000
1871	...	737,483	38,250	775,733
1872	...	905,930	94,070	1,000,000
1873	...	761,062	129,015	890,077
1874	...	584,469	144,944	729,413
1875	...	501,649	290,863	792,512
1876	...	467,168	412,461	879,629
1877	...	332,540	432,169	764,709
1878	9,397	322,890	550,398	882,685
1879	9,149	420,160	683,964	1,113,273
1880	13,615	493,762	954,460	1,461,837
1881	25,217	488,581	1,330,302	1,844,100

The production of rails of all kinds in the United States from 1849 to 1881 has been as follows, in net tons:

Years.	*Net tons.*	*Years.*	*Net tons.*	*Years.*	*Net tons.*	*Years.*	*Net tons.*
1849	24,318	1858	163,712	1867	462,108	1876	879,629
1850	44,083	1859	195,454	1868	506,714	1877	764,709
1851	50,603	1860	205,038	1869	593,586	1878	882,685
1852	62,478	1861	189,818	1870	620,000	1879	1,113,273
1853	87,864	1862	213,912	1871	775,733	1880	1,461,837
1854	108,016	1863	275,768	1872	1,000,000	1881	1,844,100
1855	138,674	1864	335,369	1873	890,077	...	...
1856	180,018	1865	356,292	1874	729,413	...	...
1857	161,918	1866	430,778	1875	792,512	...	...

The manufacture of heavy iron rails (other than strap rails) in this country was not commenced until 1844, when they were first made at the Mount Savage Rolling Mill, in Allegheny county, Maryland. In previous reports it has been necessary to state that a few tons of steel-headed rails were annually included in the production of iron rails. In 1881 no rails of this character were reported to us. Pennsylvania's share of the total production of rails in 1881 was 48 per cent.; Illinois came next, with 24 per cent.; Ohio followed, with 8 per cent.; New York, with 6 per cent.; Missouri, with 3 per cent.; Indiana, Wisconsin, and Tennessee, each with 2 per cent.; Kansas, with 1 per cent., and all other states, each with less than 1 per cent. The increased production of the two leading states—Pennsylvania and Illinois—in 1881 over 1880 was at nearly the same rate, the percentage of increase by Pennsylvania being 33 and that of Illinois being 34. For the first time in many years, probably for the first time since rails were first made in this country, Maryland made no rails in 1881. Michigan has made no rails since 1876. Maine made no rails in 1880, and New Jersey made none in 1879 and 1880, but in 1881 both of these states contributed small quantities of rails to the general supply. Two Southern states—Virginia and Alabama—had not made rails for many years prior to 1880, but in that year they again commenced their manufacture, and in 1881 they largely increased their product. Of all the Southern states, Tennessee is the largest producer of rails, its production in 1881 amounting to 32,660 net tons—more than the whole country made in 1849. The following table will show approximately the consumption of all kinds of rails in this country from 1867 to 1881, in net tons:

Years.	*Made in United States.*	*Imported.*		*Approximate consumption.*
		Iron.	*Steel.*	
1867	462,108	163,049		625,157
1868	506,714	250,081		756,795
1869	593,586	313,163		906,749
1870	620,000	399,153		1,019,153
1871	775,733	566,202		1,341,935
1872	1,000,000	381,064	149,786	1,530,850
1873	890,077	99,201	159,571	1,148,849
1874	729,413	7,796	100,515	837,724
1875	792,512	1,174	18,274	811,960
1876	879,629	287	None	879,916
1877	764,709	None	35	764,744
1878	882,685	None	10	882,695
1879	1,113,273	19,090	25,057	1,157,420
1880	1,461,837	132,459	158,230	1,752,526
1881	1,844,100	137,013	249,309	2,230,422

In round numbers we may be said to have consumed 2,000,000 gross tons of rails in 1881. To fully realize how enormous is this consumption, a simple calculation will show that these 2,000,000 tons are sufficient to lay a single track 22,727 miles long with 56-pound rails; or, in default of fuller information, we may compare our consumption of Bessemer steel rails alone in 1881 with that of some other country in the same year. Of the production of 1,023,749 gross tons of Bessemer steel rails by Great Britain in 1881 there were exported 594,419 tons, leaving 429,321 tons for home consumption. The United States, however, imported 222,597 gross tons of steel rails (probably all Bessemer) in addition to the 1,187,770 gross tons of Bessemer steel rails produced at home, thus making its total consumption of these rails 1,410,367 tons. The United States in 1881 therefore used 981,046 tons of these rails more than Great Britain.

Production of Bessemer Steel in 1881.—The total quantity of Bessemer steel ingots produced in the United States in 1881 was 1,539,157 net tons, or 1,374,247 gross tons. The production in 1880 was 1,203,173 net tons; in 1879, 928,972 net tons; in 1878, 732,226 net tons. The increased production of 1881 over 1880 was 335,984 net tons, or 28 per cent.; over 1879 it was 610,185 net tons, or 66 per cent.; and over 1878 it was 806,931 net tons, or 110 per cent. The production of Bessemer steel ingots in this country in the ten years from 1872 to 1881 has been as follows.

Years.	*Net tons.*	*Years.*	*Net tons.*
1872	120,108	1877	560,587
1873	170,652	1878	732,226
1874	191,933	1879	928,972
1875	375,517	1880	1,203,173
1876	525,996	1881	1,539,157

Bessemer steel ingots were produced in 1881 by 13 works, of which 7 are in Pennsylvania. Two new works, both in Pennsylvania, produced Bessemer steel in 1881 for the first time. These works are those of the Pittsburg Bessemer Steel Company, Limited, located at Homestead, near Pittsburg, having two converters, and the Pittsburg Steel Casting Company, of Pittsburg, having but one converter. The Pittsburg Bessemer Steel Company, Limited, made its first blow on March 19, 1881, and the Pittsburg Steel Casting Company made its first blow on August 26, 1881. The latter company, as its name imports, intends to produce Bessemer steel castings, but it also proposes to produce Bessemer steel in other forms, a blooming mill being now in course of erection. Some extensions were made to old works in 1881, one new works has been completed and put into operation since the close of the year, and two new works are now in course of erection. The newly completed works are those of the Colorado Coal and Iron Company, located at South Pueblo, Colorado, which made their first blow on April 11, 1882. New Bessemer steel works at Scranton, in Pennsylvania, and at Chicago, are expected to go into operation this year. The new works at Chicago are owned by the North Chicago Rolling Mill Company, but are located at some distance from the company's old works, and hence virtually form a separate establishment, although not classified as such. A comprehensive exhibit of the fifteen Bessemer steel works of the country which are completed or in progress is as follows:

Names of companies.	*Converters.*	
	Completed.	*Building.*
Albany and Rensselaer Iron and Steel Company, Troy.	two 6¼ ton	......
Bethlehem Iron Company, Bethlehem	four 7-ton	......
Pennsylvania Steel Company, Steelton	two 6½-ton three 8-ton	......
Lackawanna Iron and Coal Company, Scranton	two 7½-ton	......
Cambria Iron Company, Johnstown	two 6-ton	......
Carnegie Bros. & Co., Limited, Bessemer	three 10-ton	......
Pittsburg Bessemer Steel Co., Limited, Homestead	two 4-ton	......
Pittsburg Steel Casting Company, Pittsburg	one 7-ton	......
Cleveland Rolling Mill Company, Cleveland	two 10-ton	......
North Chicago Rolling Mill Co., Chicago (2 plants)	two 6¾-ton	two 10-ton
Union Iron and Steel Company, Chicago	two 5⅓-ton	......
Joliet Steel Company, Joliet	two 5⅓-ton	......
St. Louis Ore and Steel Company, St. Louis	two 6¼-ton	......
Colorado Coal and Iron Company, South Pueblo	two 5-ton	......
Scranton Steel Company, Scranton	......	two 4-ton
Total	33	4

Only 30 converters were in use in 1881, Carnegie Brothers & Co., Limited, having substituted three 10-ton converters since the close of the year for their two 7-ton converters, and the Colorado Coal and Iron Company having put its two converters at work in 1882 for the first time. The Cleveland Rolling Mill Company used two 6¼-ton converters in 1881. The American producers of Bessemer steel rolled 1,253,129 net tons, or 1,118,865 gross tons, of Bessemer steel rails in 1881. But this is not the whole quantity of Bessemer steel rails rolled in the United States in that year, as the iron rail mills of the country rolled 77,173 net tons of these rails, chiefly from imported blooms. The total quantity of Bessemer steel rails rolled in the United States in 1881 was, therefore, 1,330,302 net tons, or 1,187,770 gross tons. The following table shows the production of Bessemer steel rails in the United States and Great Britain in 1880 and 1881, in gross tons:

Countries.	1880. *Tons.*	1881. *Tons.*	*Increase. Tons.*
United States	852,196	1,187,770	335,574
Great Britain	739,910	1,023,740	283,830
Excess of United States over Great Britain	112,286	164,030	51,744

The following table shows the production of Bessemer steel ingots in the United States and Great Britain in 1880 and 1881, in gross tons:

Countries.	1880. *Tons.*	1881. *Tons.*	*Increase. Tons.*
Great Britain	1,044,382	1,441,719	397,337
United States	1,074,262	1,374,247	299,985
Excess of United States over Great Britain	29,880	....	....
Excess of Great Britain over United States	....	67,472	97,352

It will be seen from these tables that in 1880 the production of both Bessemer steel ingots and rails by the United States exceeded that of Great Britain, while in 1881 honors were divided, the United States producing the most rails, and Great Britain producing the most ingots. But how unequal are all other elements of comparison in the Bessemer steel practice of the two countries! The British production of Bessemer steel in 1881 was made by 23 works with 82 converters in operation, while that of the United States was made by only 13 works with 30 converters in operation. The average production of each converter in Great Britain in 1881 was 17,582 gross tons of ingots, while the average production of each converter in the United States in the same year was 45,808 tons. In 1882 seven more converters will probably be in use in the United States, while in Great Britain there will be 41 more converters available than were at work in 1881, of which 14 are new. The production of Bessemer steel rails in this country in the fifteen years since 1867, when they were first made to fill orders, has been as follows, in net tons:

Years.	*Net tons.*	*Years.*	*Net tons.*	*Years.*	*Net tons.*
1867	2,550	1872 . . .	94,070	1877 . .	432,169
1868	7,225	1873	129,015	1878 . .	550,398
1869	9,650	1874 . . .	144,944	1879	683,964
1870	34,000	1875 . .	290,863	1880 . .	954,460
1871	38,250	1876 . . .	412,461	1881 . .	1,330,302

Island and Kentucky each had one open-hearth furnace in 1881 which was not in operation. The total number of open-hearth furnaces in the country in 1881 was 44. The production of blister and puddled steel and of "patented" steel in 1881 was only 3,047 net tons, against 8,465 tons in 1880, and 5,464 tons in 1879. These branches of our steel industry scarcely deserve a separate classification. The following table gives the production of these classes of steel from 1874 to 1881, in net tons:

States.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
New England . .	376	1,500	. . . . .	. . . .	192	950	72	200
New York. . . .	200	. . . .	139	. . . .	220	215	617	. .
New Jersey . . .	. . . .	100	652	. . . .	. . . .	. . . .	. . . .	. . . .
Pennsylvania . .	4,417	7,340	7,601	9,870	8,069	3,004	6,658	2,113
Western States .	1,300	. . . .	1,700	2,034	75	1,000	1,018	734
Southern States .	60	3,667	214	20	. . .	295	100	. .
Total . . .	6,353	12,607	10,306	11,924	8,556	5,464	8,465	3,047

The small quantity of blister, puddled, and miscellaneous steel which was made in this country in 1881 was produced in Massachusetts, Pennsylvania, Kentucky, and Ohio.

Production of all Kinds of Steel in Recent Years.—The following table gives the production in the United States of

States.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
New England . .	1,509	1,620	1,008	1,974	1,602	1,608	660	2,780
New York	2,696	2,300	2,300	2,032	2,800	2,300	3,500	4,961
New Jersey	8,164	7,098	6,806	6,749	7,377	8,651	10,387	14,500
Pennsylvania . .	23,289	26,615	28,217	27,983	30,585	43,614	57,077	66,290
Western States . . .	570	1,500	700	1,400	480	605	800	1,231
Southern States . . .	160	268	261	292	62	2	. . . . . .	. . . . . .
Total	36,328	39,401	39,382	40,430	42,906	56,780	72,424	89,762

Production of Crucible, Open-Hearth, Blister and Miscellaneous Steel in 1881.—The production of crucible steel ingots in the United States in 1881 was 89,762 net tons, against 72,424 tons in 1880, and 56,780 tons in 1879. The preceding table gives the production of crucible steel ingots in various sections of the country from 1874 to 1881, in net tons.

Seven states made crucible steel in 1881—Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, and Illinois. Pennsylvania, as has been the case for many years, made in that year about three-fourths of the total crucible steel ingots, blister steel, and steel made by various minor processes, from 1865 to 1881, in net tons:

Years.	*Net tons.*	*Years.*	*Net tons.*	*Years.*	*Net tons.*
1865	15,262	1871. . . .	37,000	1877.	52,354
1866 . . .	18,973	1872.	37,000	1878.	51,462
1867	19,000	1873. . .	48,500	1879.	62,244
1868	21,500	1874.	42,681	1880.	80,889
1869	23,000	1875.	52,008	1881.	92,809
1870	35,000	1876. . .	49,688	. . . .	. . . . . .

States.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
New England	5,300	3,010	6,085	6,652	8,228	14,660	20,560	24,600
Pennsylvania and New Jersey	1,700	4,240	7,547	7,771	12,231	19,575	50,736	68,363
Western and Southern States	. . .	1,800	7,858	10,608	15,667	22,055	41,657	53,983
Total	7,000	9,050	21,490	25,031	36,126	56,290	112,953	146,946

production. The production of open-hearth steel ingots in the United States in 1881 was 146,946 net tons, against 112,953 tons in 1880, and 56,290 tons in 1879. Our open-hearth steel industry has made a rapid advance in late years. In 1874 our total production of open-hearth steel ingots was only 7,000 net tons. Rapid, however, as our progress in the production of this class of steel has been, we still fall far behind the production of Great Britain. In 1881 that country produced 338,000 gross tons, or 378,560 net tons, of open-hearth steel. The preceding table gives the production of open-hearth steel ingots in the United States from 1874 to 1881, in net tons.

Eight states made open-hearth steel in 1881—New Hampshire, Vermont, Massachusetts, New Jersey, Pennsylvania, Ohio, Tennessee, and Illinois. These states had 38 open-hearth furnaces at work in 1881 and 4 furnaces idle. Rhode

The following table gives the production in the United

Years.	*Net tons.*				
	Bessemer steel ingots.	*Crucible steel ingots.*	*Open-hearth steel ingots.*	*All other steel.*	*Total.*
1872 . .	120,108	29,260	3,000	7,740	160,108
1873 . .	170,652	34,786	3,500	13,714	222,652
1874 . .	191,933	36,328	7,000	6,353	241,614
1875 . .	375,517	39,401	9,050	12,607	436,575
1876 . .	525,996	39,382	21,490	10,306	597,174
1877 . .	560,587	40,430	25,031	11,924	637,972
1878 . .	732,226	42,906	36,126	8,556	819,814
1879 . .	928,972	56,780	56,290	5,464	1,047,506
1880 . .	1,203,173	72,424	112,953	8,465	1,397,015
1881 . .	1,539,157	89,762	146,946	3,047	1,778,912

States of all kinds of steel in the ten years from 1872 to 1881, in net tons.

An increase in our production of steel from 160,108 net tons to 1,778,912 tons in ten years reads like a fable. The figures are, however, reliable. They undoubtedly record the greatest metallurgical achievement ever accomplished by any country.

Production of Bars, Shapes, Plates, Sheets, and other Rolled Iron in 1881.—By the term rolled iron we include (1) cut nails and spikes; (2) bar, shaped, bolt, rod, skelp, and hoop iron; (3) plate and sheet iron; and (4) all sizes of iron rails. Bessemer steel rails are not classed among rolled iron products. The production of all kinds of rolled iron in the United States in 1881, including iron rails, was 2,643,927 net tons, against 2,332,668 tons in 1880, and 2,047,484 tons in 1879. In the following table we give detailed statistics of the production of the different forms of rolled iron in each of the States in 1881, in net tons:

States.	*Bar, rod, bolt, hoop, skelp and shaped iron. Net tons.*	*Plate and sheet iron, except nail plate. Net tons.*	*Cut nails.*		*Iron rails. Net tons.*	*Total. Net tons.*
			Kegs.	*Net tons.*		
Maine	5,433	. . . .	. . . .	. . . .	2,183	7,616
New Hampshire	3,000	. . . .	. . . .	. . . .	. . . .	3,000
Massachusetts	58,524	29,446	525,089	26,254	2,622	116,846
Rhode Island	10,769	. . . .	. . . .	. . . .	. . . .	10,769
Connecticut	17,589	. . . .	. . . .	. . . .	. . . .	17,589
New York	106,372	4,945	2,256	113	11,936	123,366
New Jersey	56,793	1,823	248,521	12,426	244	71,286
Pennsylvania	714,113	251,225	1,914,706	95,735	193,793	1,254,866
Delaware	23,920	10,355	. . . .	. . . .	. . . .	34,275
Maryland	18,517	14,215	. . . .	. . . .	. . . .	32,732
District of Columbia	220	82	. . . .	. . . .	. . . .	302
Virginia	33,984	. . . .	127,566	6,378	640	41,002
Georgia	3,000	. . . .	. . . .	. . . .	4,000	7,000
Alabama	8,772	. . . .	. . . .	. . . .	2,300	11,072
West Virginia	4,106	6,234	1,241,102	62,055	3,152	75,547
Kentucky	15,425	6,035	69,000	3,450	5,005	29,915
Tennessee	5,158	. . . .	94,495	4,725	23,910	33,793
Indiana	20,485	975	326,496	16,325	44,645	82,430
Illinois	52,500	. . . .	352,643	17,632	78,686	148,818
Ohio	229,247	37,327	860,665	43,033	36,120	345,727
Missouri	12,141	4,500	. . . .	. . . .	. . . .	16,641
Michigan	14,685	5,920	. . . .	. . . .	. . . .	20,605
Wisconsin	47,478	. . . .	. . . .	. . . .	41,165	88,643
Kansas	10,528	. . . .	. . . .	. . . .	19,016	29,544
Nebraska	. . . .	. . . .	31,667	1,583	. . . .	1,583
Colorado	2,306	. . . .	. . . .	. . . .	1,643	3,949
Wyoming Territory	3,286	. . . .	. . . .	. . . .	11,886	15,172
California	14,204	. . . .	. . . .	. . . .	5,635	19,839
Total	1,492,555	373,082	5,794,206	289,709	488,581	2,643,927

The following table gives the production of all kinds of rolled iron in 1881 in each of the states, in net tons:

States.	*Net tons.*	*States.*	*Net tons.*
Pennsylvania	1,254,866	Michigan	20,605
Ohio	345,727	California	19,839
Illinois	148,818	Connecticut	17,589
New York	123,366	Missouri	16,641
Massachusetts	116,846	Wyoming Territory	15,172
Wisconsin	88,643	Alabama	11,072
Indiana	82,430	Rhode Island	10,769
West Virginia	75,547	Maine	7,616
New Jersey	71,286	Georgia	7,000
Virginia	41,002	Colorado	3,949
Delaware	34,275	New Hampshire	3,000
Tennessee	33,793	Nebraska	1,583
Maryland	32,732	District of Columbia	302
Kentucky	29,915		
Kansas	29,544	Total	2,643,927

The following table gives the production of bar, rod, bolt, skelp, hoop, and shaped iron in 1881, in each of the states, in net tons:

States.	*Net tons.*	*States.*	*Net tons.*
Pennsylvania	714,113	California	14,204
Ohio	229,247	Missouri	12,141
New York	106,372	Rhode Island	10,769
Massachusetts	58,524	Kansas	10,528
New Jersey	56,793	Alabama	8,772
Illinois	52,500	Maine	5,433
Wisconsin	47,478	Tennessee	5,158
Virginia	33,984	West Virginia	4,106
Delaware	23,920	Wyoming territory	3,286
Indiana	20,485	Georgia	3,000
Maryland	18,517	New Hampshire	3,000
Connecticut	17,589	Colorado	2,306
Kentucky	15,425	District of Columbia	220
Michigan	14,685		
		Total	1,492,555

The following table gives the production of plate and sheet iron, except nail plate, in 1881, in each of the states, in net tons:

States.	*Net tons.*	*States.*	*Net tons.*
Pennsylvania	251,225	Michigan	5,920
Ohio	37,327	New York	4,945
Massachusetts	29,446	Missouri	4,500
Maryland	14,215	New Jersey	1,823
Delaware	10,355	Indiana	975
West Virginia	6,234	District of Columbia	82
Kentucky	6,035		
		Total	373,082

The following table gives the production of cut nails in 1881 in each of the states, in kegs of 100 pounds:

States.	*Kegs of 100 pounds.*	*States.*	*Kegs of 100 pounds.*
Pennsylvania	1,914,706	Virginia	127,566
West Virginia	1,241,102	Tennessee	94,495
Ohio	860,665	Kentucky	69,000
Massachusetts	525,089	Nebraska	31,667
Illinois	352,643	New York	2,256
Indiana	326,496		
New Jersey	248,521		
		Total	5,794,206

Our production of cut nails in 1881 (5,794,206 kegs) was much the largest in our history. Our next largest production was in 1880, when we produced 5,370,512 kegs. It is a noticeable fact that the production of cut nails in this country has not in recent years advanced with the rapidity that has characterized other branches of our iron and steel industries. In 1873 our production was 4,024,704 kegs, and in 1874 it was 4,912,180 kegs. From 1874 to 1879 the annual production fluctuated between 4,000,000 and 5,000,000 kegs, in the latter year amounting to 5,011,021 kegs. The production in 1880 and 1881 has been mentioned above. The following table gives the production of all kinds of rolled iron in the United States from 1864 to 1881, in net tons:

Years.	Net tons of 2,000 pounds.		
	Iron rails.	Other rolled iron.	Total.
1864	835,369	536,958	872,327
1865	356,292	500,048	856,340
1866	430,778	595,311	1,026,089
1867	459,558	579,838	1,039,396
1868	499,489	598,286	1,097,775
1869	583,936	642,420	1,226,356
1870	586,000	705,000	1,291,000
1871	737,483	710,000	1,447,483
1872	905,930	941,992	1,847,922
1873	761,062	1,076,368	1,837,430
1874	584,469	1,110,147	1,694,616
1875	501,649	1,097,867	1,599,516
1876	467,168	1,042,101	1,509,269
1877	332,540	1,144,219	1,476,759
1878	322,890	1,232,686	1,555,576
1879	420,160	1,627,324	2,047,484
1880	493,762	1,838,906	2,332,668
1881	488,581	2,155,346	2,643,927

It has been said that the puddling furnace and the iron rolling mill must soon give way to the Bessemer converter, the open hearth, and the steel rolling mill. The table just given shows that in this country the puddling and rolling of iron are steadily increasing.

Products.	Net tons.								
	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
Blooms and billets from ore	32,863	36,450	24,416	20,784	24,227	24,139	30,282	40,652	45,369
Blooms from pig and scrap iron	29,701	25,220	24,827	23,844	23,073	25,906	32,071	33,937	39,237
Total	62,564	61,670	49,243	44,628	47,300	50,045	62,353	74,589	84,606

As we have heretofore explained, blooms and billets from ore are made chiefly in the Champlain district of New York, and blooms from pig and scrap iron are made chiefly in Pennsylvania. The make of each of these products in the last nine years is given on preceding column, in net tons. The steady increase in their production in the last three years is an interesting fact.

The following table shows the proportion of ore blooms and billets made in New York in the past seven years, and the proportion of pig and scrap blooms made in Pennsylvania, in the same time, in net tons:

Years.	Net tons.			
	Ore blooms and billets made in New York.	Total make of ore blooms and billets.	Pig and scrap blooms made in Pennsylvania.	Total make of pig and scrap blooms.
1875	23,666	24,416	19,032	24,827
1876	20,202	20,784	13,401	23,844
1877	23,466	24,227	16,517	23,073
1878	22,829	24,139	15,121	25,906
1879	27,290	30,282	23,956	32,071
1880	34,351	40,652	24,319	33,937
1881	39,892	45,369	28,342	39,237

The production of both products from 1865 to 1881 has been as follows, in net tons:

Years.	Net tons.	Years.	Net tons.	Years.	Net tons.
1865	63,977	1871	63,000	1877	47,300
1866	73,555	1872	58,000	1878	50,045
1867	73,073	1873	62,564	1879	62,353
1868	75,200	1874	61,670	1880	74,589
1869	69,500	1875	49,243	1881	84,606
1870	62,259	1876	44,628	......	......

Total Production of Iron and Steel in the United States in the last Ten Years.—The annexed table shows the total production of iron and steel in the United States in the ten years from 1872 to 1881, in net tons:

Products.	Net tons of 2,000 pounds.									
	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.
Pig iron	2,854,558	2,868,278	2,689,413	2,266,581	2,093,236	2,314,585	2,577,361	3,070,875	4,295,414	4,641,564
Spiegeleisen, included in pig iron	......	......	......	7,832	6,616	8,845	10,674	13,931	19,603	21,086
All rolled iron, including nails and iron rails	1,847,922	1,837,430	1,694,616	1,599,516	1,509,269	1,476,759	1,555,576	2,047,484	2,332,668	2,643,927
All rolled iron, including nails and excluding rails	941,992	1,076,368	1,110,147	1,097,867	1,042,101	1,144,219	1,232,686	1,627,324	1,838,906	2,155,346
Kegs of cut nails and spikes, included in all rolled iron	4,065,322	4,024,704	4,912,180	4,726,881	4,157,814	4,828,918	4,396,130	5,011,021	5,370,512	5,794,206
Bessemer steel rails	94,070	129,015	144,944	290,863	412,461	432,169	550,398	683,964	954,460	1,330,302
Open-hearth steel rails	......	......	......	......	......	......	9,397	9,149	13,615	25,217
Iron and all other rails	905,930	761,062	584,469	501,649	467,168	332,540	322,890	420,160	493,762	488,581
Rails of all kinds	1,000,000	890,077	729,413	792,512	879,629	764,709	882,685	1,113,273	1,461,837	1,844,110
Crucible steel ingots	29,260	34,786	36,328	39,401	39,382	40,430	42,906	56,780	72,424	89,762
Open-hearth steel ingots	3,000	3,500	7,000	9,050	21,490	25,031	36,126	56,290	112,953	146,946
Bessemer steel ingots	120,108	170,652	191,933	375,517	525,996	560,587	732,226	928,972	1,203,173	1,539,157
Miscellaneous steel	7,740	13,714	6,353	12,607	10,306	11,924	8,556	5,464	8,465	3,047
Steel of all kinds	160,108	222,652	241,614	436,575	597,174	637,972	819,814	1,047,506	1,397,015	1,778,912
Blooms from ore and pig iron	58,000	62,564	61,670	49,243	44,628	47,300	50,045	62,353	74,589	84,606

The Iron and Steel Production of Allegheny County.—The following table gives the production of iron and steel in Pittsburg and the remainder of Allegheny county, Pennsylvania, in 1881 and the seven preceding years, in net tons. We scarcely need to explain that Allegheny county is the leading iron and steel producing county in the United States:

Years.	Number of iron rolling mills.	Product of iron rails, bar, angle, bolt, rod and hoop. Tons.	Product of sheet and plate, except nail plate. Tons.	Product of nails. Kegs of 100 pounds.	Total rolled iron, including nails. Net tons.
1874	31	194,114	52,361	562,995	274,625
1875	31	171,178	45,773	442,359	239,069
1876	31	189,511	31,488	538,874	247,943
1877	31	208,342	30,254	597,806	268,486
1878	31	226,687	33,445	444,013	282,333
1879	82	286,882	52,265	294,942	353,894
1880	30	287,253	80,899	419,098	389,107
1881	30	405,119	75,767	485,916	505,182

Years.	Number of blast furnaces.	Make of pig iron. Net tons.	Number of steel works.	Net tons crucible steel ingots.	Net tons all other steel, including Bessemer ingots.	Total make of steel. Net tons.
1874	11	143,660	11*	17,915	6,000	23,915
1875	11	131,856	14*	22,942	15,498	38,440
1876	11	128,555	14*	25,009	54,467	79,476
1877	12	141,749	14*	24,747	82,401	107,148
1878	12	217,299	14*	27,806	106,948	134,814
1879	13	267,315	18*	40,142	130,781	170,923
1880	15	300,497	17*	52,186	169,819	221,955
1881	15	385,453	17*	61,256	247,345	308,601

* Bessemer steel included. Four of these works are also iron rolling mills.

It will be observed that Allegheny county has in late years largely increased its production of all kinds of iron and steel except cut nails, the production of which was not so large in 1881 as in each of the years 1874, 1876, and 1877 —all years of dull trade. Wheeling and its vicinity have for many years formed a much more important nail-producing district than Allegheny county. The contiguous counties of Plymouth, Bristol, and Norfolk in Massachusetts comprise another nail-making district which usually makes more nails annually than Allegheny county.

Grand summary of United States statistics for 1881.

Production of pig iron in 1881, net tons	4,641,564
Production of Spiegeleisen in 1881 (included in pig iron), net tons	21,086
Production of all rolled iron, including nails and excluding rails, in 1881, net tons	2,155,346
Production of cut nails and spikes in 1881, included in all rolled iron, kegs of 100 pounds	5,794,206
Production of Bessemer steel rails in 1881, net tons	1,330,302
Production of open-hearth steel rails in 1881, net tons	25,217
Production of iron and all other rails in 1881, net tons	488,581
Total production of rails in 1881, net tons	1,844,100
Production of iron and steel street rails in 1881 (included above), net tons	21,554
Production of crucible steel ingots in 1881, net tons	89,762
Production of open-hearth steel ingots in 1881, net tons	146,946
Production of Bessemer steel ingots in 1881, net tons	1,539,157
Production of blister and "patented" steel in 1881, net tons	3,047
Production of all kinds of steel in 1881, net tons	1,778,912
Production of blooms from ore and pig iron in 1881, net tons	84,606
Imports of iron and steel in 1881	$61,555,078
Exports of iron and steel in 1881	$15,782,282
Imports of iron ore in 1881, gross tons	782,887
Production of Lake Superior iron ore in 1881, gross tons	2,336,335
Production of iron ore in New Jersey in 1881, gross tons	737,052
Total production of iron ore in Census year 1880, net tons	7,974,705
Production of anthracite coal in the Census year 1880, net tons	28,646,995
Production of bituminous coal in the Census year 1880, net tons	42,420,581
Production of anthracite coal in 1881, gross tons	28,500,016
Miles of railway completed in 1881	9,650
Miles of railway in the United States December 31, 1861	103,321
Miles of railway track in the United States December 31, 1881, including double track, sidings, etc. (estimated),	130,000
Iron ships built in the United States in the fiscal year ended June 30, 1881	42
Net imports of foreign merchandise into the United States in the ten months ended April 30, 1882	$579,462,510
Exports of domestic merchandise out of the United States in the ten months ended April 30, 1882	$635,867,349
Net imports of specie into the United States in the ten months ended April 30, 1882	$35,875,247
Exports of domestic specie out of the United States in the ten months ended April 30, 1882	$22,708,081
Immigrants into the United States in the calendar year 1881	720,045

MICHIGAN IRON AND COPPER STATISTICS.

FROM Mr. A. P. Swineford's "Annual Review of Lake Superior Mines," we take the following statistics:

Iron Mines.—The following table exhibits the output of the Lake Superior iron mines in 1881, together with the approximate value of the same in the market:

Name of mine.	*Gross tons.*	*Value.*
Argyle	4,584	$43,548.00
Barnum	27,883	264,888.50
Bay State	583	3,166.50
Bessemer	16,718	91,940.00
Boston	14,824	140,828.00
Cambria	19,245	106,122.50
Champion	145,427	1,454,270.00
Chapin	134,521	1,076,168.00
Cheshire	7,449	40,969.50
Chicago	5,531	30,420.50
Cleveland	198,569	1,886,405.50
Columbia	11,158	89,264.00
Commonwealth	97,410	608,812.50
Conrad	355	3,372.50
Cornell	11,816	94,528.00
Curry	17,534	149,038.00
Cyclops	12,644	101,152.00
Dalliba	10,986	60,423.00
East Champion	3,408	27,264.00
Emmet	648	3,564.00
Florence	100,501	552,755.00
Forest City	1,895	10,422.50
Foster	3,011	16,560.50
Goodrich	10,245	69,154.00
Hewitt	4,352	34,816.00
Humboldt	26,302	249,869.00
Jackson	118,939	1,024,500.50
Keel Ridge	19,011	152,088.00
Lake Angeline	18,060	123,720.00
Lake Superior	262,235	2,185,576.50
Ludington	3,374	28,992.00
McComber	28,051	154,280.50
Michigamme	57,272	$544,084.00
Milwaukie	31,635	173,992.50
Mitchell	21,146	116,303.00
National	24,833	235,913.50
New York	50,074	475,702.00
Norway	137,077	891,000.50
Pendill	13,586	74,723.00
Perkins	60,406	483,248.00
Pittsburg and Lake Superior	39,276	333,846.00
Quinnesec	43,711	349,688.00
Republic	233,786	2,337,860.00
Rolling Mill	1,668	9,174.00
Saginaw	30,793	292,534.50
Salisbury	43,690	240,295.00
Section 12	13,243	72,842.00
Spurr	2,746	26,087.00
Stephenson	10,856	86,848.00
Sterling	4,702	44,669.00
Swanzey	7,562	41,591.00
Taylor	9,449	51,969.50
Vulcan	85,274	682,192.50
West Republic	7,354	69,863.00
Wheat	9,040	76,840.00
Winthrop	43,630	239,965.00
Miscellaneous	1,237	6,803.50
Total iron ore	2,321,315	$18,834,923.00
QUARTZ.		
Carp River	8,460	42,300.00
Lake Fairbanks	6,560	32,800.00
Total quartz	15,020	75,100.00
Total ore and quartz	2,336,335	$18,910,023.00

The following table shows the product of the Lake Superior charcoal furnaces in 1881, together with its value in market:

Name of furnace.	*Gross tons.*	*Value.*
Pioneer	17,030	$510,900
Menominee	8,336	250,080
Florence	714	21,420
*Carp River Iron Co.	10,253	307,590
Jackson	4,660	140,400
Deer Lake	7,831	234,930
Martel	4,109	123,270
Total	52,953	$1,588,590

*Three Stacks—Carp River, Pacific and Excelsior.

The following table shows the aggregate product of the working mines of this district, from 1856 to 1881, inclusive —a period of 26 years:

Name of mine.	*Gross tons.*
Argyle	228,091
Barnum	487,906
Bay State	14,799
Bessemer	87,023
Boston	31,302
Cambria	55,703
Champion	975,903
Chapin	169,077
Cheshire	87,179
Chicago	15,510
Cleveland	2,329,064
Columbia	82,033
Commonwealth	107,053
Conrad	4,794
Cornell	42,557
Curry	52,188
Cyclops	79,198
Dalliba	10,986
Emmet	66,003
East Champion	64,264
Florence	114,644
Forest City	1,895
Foster	108,949
Goodrich	41,606
Hewitt	4,352
Humboldt	485,495
Jackson	2,195,162
Keel Ridge	30,507
Lake Angeline	525,697
Lake Superior	2,666,456
Ludington	12,190
McComber	252,345
Michigamme	443,247
Milwaukie	45,718
Mitchell	75,731

Name of mine.	*Gross tons.*
National	91,685
New York	974,489
Norway	416,137
Pendill	34,094
Pittsburg and Lake Superior	237,392
Perkins	123,067
Quinnesec	164,026
Republic	1,425,399
Rolling Mill	221,814
Saginaw	420,774
Salisbury	237,842
Section 12	18,601
Spurr	146,612
Stephenson	34,123
Sterling	5,499
Swanzey	7,562
Taylor	10,559
Vulcan	272,617
West Republic	7,354
Wheat	16,444
Winthrop	256,300
Quartz and mines not now working	525,426
Total	17,642,443

The following table shows the aggregate product of all the furnaces that have been built and put into operation on the upper peninsula:

Name of furnace.	*Gross tons.*
Pioneer (two stacks)	171,592
Northern	15,059
Collins	41,997
Michigan	41,531
Greenwood	40,202
Bancroft	54,618
Morgan	57,573
Champion	31,048
Deer Lake (two stacks)	37,513
Jackson (two stacks)	118,411
Bay (two stacks)	50,706
Munising	28,312
Grace	11,346
Escanaba	8,650
Carp River Iron Co. (three stacks)	75,685
Menominee	45,776
Cliff	8,209
Florence	714
Martel	4,109
Total	843,251

The following is a statement in gross tons of the aggregate product of the mines and furnaces for each year since 1853, together with the value of same:

Years.	*Ore.*	*Pig iron.*	*Ore and pig.*	*Value.*
1856*	86,319	......	86,319	$258,957
1857	25,646	......	25,646	76,938
1858	22,876	1,629	24,505	133,788
1859	68,832	7,258	76,090	575,529
1860	114,401	5,660	120,061	736,496
1861	114,258	7,970	122,228	775,832
1862	124,169	8,590	132,759	984,977
1863	203,055	9,813	212,868	1,416,935
1864	247,059	13,620	260,679	1,867,215
1865	193,758	12,283	206,041	1,590,430
1866	296,713	18,437	315,150	2,405,960
1867	465,504	30,211	495,715	3,475,820
1868	510,522	38,246	548,768	3,992,413
1869	639,097	39,003	678,100	4,968,435
1870	859,507	49,298	908,805	6,300,170
1871	813,984	51,225	865,209	6,115,895
1872	948,553	61,195	1,009,748	9,188,055
1873	1,195,234	70,507	1,265,741	11,395,887
1874	935,488	86,494	1,021,982	7,592,811
1875	910,840	81,753	992,593	5,788,763
1876	993,311	61,911	1,055,222	5,397,785
1877	1,025,129	29,685	1,054,814	5,209,598
1878	1,125,093	17,404	1,142,497	6,884,432
1879	1,414,182	39,583	1,453,765	11,413,114
1880	1,987,598	48,523	2,036,121	19,457,427
1881	2,231,315	52,953	2,374,268	20,498,613
Total	17,642,443	843,251	18,485,694	$138,592,275

*And previous.

Lake Superior Iron in 1882.—The Marquette *Mining Journal* thus continues the figures for the first half of 1882: The following is a statement of lake shipments of iron ore and pig iron for the season up to and including July 5, 1882:

ESCANABA—MARQUETTE DISTRICT.

Name of mine.	*Gross tons.*	*Name of mine.*	*Gross tons.*
Angeline	2,446	Mitchell	8,996
Angeline, hematite	2,100	National	11,315
Barnum	13,086	New York	20,260
Bay State	1,165	New York Hematite	658
Bessemer	13,590	Pittsburg and Lake Superior	15,603
Cambria	13,515	Quartz	927
Cleveland	22,958	Saginaw	4,505
Cleveland, hematite	9,422	Salisbury	12,701
Foster	1,517	Section 12	2,138
Goodrich	3,373	Lake Superior	27,116
Jackson	25,302	Lake Superior, hematite	2,030
Jackson South	7,272	Wheat	3,281
Jackson West	2,057	Swanzey	9,904
Lowthian	2,291	Winthrop	2,551
McComber	10,871		
Michigamme	5,164	Total	245,059

MENOMINEE DISTRICT.

Name of mine.	*Gross tons.*	*Name of mine.*	*Gross tons.*
Chapin	98,096	Lowell	5,029
Commonwealth	58,328	Norway	51,588
Curry	5,282	Perkins	29,532
Cyclops	4,018	Quinnesec	17,231
Eagle	19,521	Vulcan	34,119
Florence	40,907		
Hewitt	4,318	Total	395,212
Keel Ridge	11,433		
Ludington	4,910	Grand total from Escanaba	640,271

MARQUETTE—MARQUETTE DISTRICT.

Name of mine.	*Gross tons.*
Milwaukie	16,094
Cleveland	43,564
Lake Superior	63,330
Lowthian	11,129
Winthrop	7,877
Saginaw	4,602
Mitchell	4,550
Humboldt	12,802
West Republic	7,979
Republic	94,713
Columbia	1,847
Champion	67,584
Boston	3,568
Sterling	1,404
Dalliba	15,431
Argyle	3,635
New Burt	838
East Champion	602
Total from Marquette	361,548

L'ANSE.

Taylor	5,536
Michigamme	8,998
Spurr	1,742
Total from L'Anse	16,276

Name of mine.	*Gross tons.*
Pig iron.	
Carp River Iron Co.'s Furnaces	*345
Pioneer Furnace	839
Deer Lake	85
Total pig iron	1,269

* Does not include shipments from furnace dock.

Ore to local points	20,088
Total ore and pig iron	399,181

ST. IGNACE—IRON ORE.

Lake Superior	8,346
Columbia	584
Total from St. Ignace	8,930
Pig iron.	
Carp River Iron Co.'s furnaces	1,009
Total pig iron	1,009
Quartz.	
Powell Bros. & Co	509
Total ore, pig iron and quartz	10,448

The following table exhibits, in gross tons, the total lake shipments of iron ore from upper peninsula ports the present season up to and including July 5, 1882, together with the amount shipped during a corresponding period last year:

Name of port.	1881.	1882.
Escanaba	437,562	640,271
Marquette	184,045	361,548
L'Anse	15,761	16,276
St. Ignace	.....	8,930
Total	637,368	1,027,025

Showing an increase of 389,657 tons.

Of the 389,657 tons increase in the lake shipments, 220,436 tons comes from the mines of Marquette county, and 169,221 tons from the Menominee range. Of the entire lake output Marquette county has contributed 631,813, and the Menominee range 395,212 gross tons. Increase in shipments from Escanaba, as compared with last year, 202,709 tons, from Marquette 177,503 tons, and from L'Anse 515 tons, the balance of the increase being accounted for by 8,930 tons shipped via St. Ignace. The aggregate shipments up to July 5—less than half the season—were never exceeded in any one year previous to 1878, with the single exception of 1873, in which year the total output was 1,195,234 tons. We very much fear, however, that there may be a gradual falling off during the remainder of the season; an unusual effort has been made to forward shipments in order to take all possible advantage of the prevailing low rates of lake carriage, which are likely to advance immediately after harvest. The strikes among the iron workers, should they continue, will likewise have a bad effect on the ore market, as in that event it is not likely that any new contracts can be made for this season's delivery. Consequently, the *Mining Journal* will not be surprised if, at the end of the year, the figures which now point toward a product of nearly, if not quite, 3,000,000 tons, should show only a slight increase, if any at all, over last year's output.

Copper.—The copper district of Lake Superior embraces the counties of Houghton, Keweenaw, Ontonagon, and Isle Royale. The following table shows a list of the mines wrought in 1881, together with the product (refined copper) of each, and the aggregate market value:

Name of mine.	*Net tons.*	*Pounds.*	*Market value.*
Adventure	3	1,500	$1,368 75
Allonez	736	1,007	268,823 67
Arcadian	1	367	431 97
Ash Bed	6	1,984	2,552 08
Atlantic	1,264	9	461,361 65
Aztec	4	874	1,619 50
Calumet and Hecla	15,680	781	6,723,342 53
Central	709	465	258,869 86
Cliff	39	1,362	14,487 21
Concord	14	849	6,264 95
Conglomerate	193	91	70,461 60
Copper Falls	334	1,121	122,114 58
Evergreen Bluff	.....	968	176 56
Flint Steel River	2	1,402	985 86
Franklin	1,338	1,932	488,722 59
Grand Portage	13	264	4,793 18
Hancock	285	1,897	104,371 20
Huron	127	615	46,448 98
Isle Royal	23	1,308	8,633 71
Madison	.....	1,534	279 95
Mass	233	1,664	85,352 33
Minnesota	12	227	4,421 13
Minong	7	1,397	2,809 95
Nonesuch	69	1,061	21,728 63
Ogima	8	776	3,061 62
Osceola	2,089	1,976	762,845 62
Pewabic	938	244	342,414 63
Phœnix	204	1,357	74,707 65
Quincy	2,753	848	1,004,999 76
Ridge	117	1,606	42,998 10
Shelden-Columbian	5	31	1,830 66
Star	.....	758	138 33
St. Clair	62	1,493	22,902 50
Total	27,274	1,708	$9,955,321 69

The following table shows the product (refined copper) of the Lake Superior copper mines for each year since 1854, together with the average value.

Year.	*Tons.*	*Pounds.*	*Value.*
1854 and previous	6,992	1,727	$3,146,400
1855	2,904	1,334	1,586,160
1856	4,108	1,392	2,218,320
1857	4,765	830	2,382,500
1858	4,579	1,916	2,129,235
1859	4,463	1,995	2,239,591
1860	6,034	375	2,654,960
1861	7,519	837	3,487,995
1862	6,793	328	3,634,255
1863	6,492	1,344	4,415,600
1864	6,245	1,965	5,870,300
1865	7,179	583	6,635,515
1866	6,875	63	4,029,375
1867	8,763	1,607	4,442,841
1868	10,467	124	4,940,624
1869	13,312	1,300	6,230,016
1870	12,311	849	6,096,752
1871	12,873	349	5,728,485
1872	12,276	1,523	7,979,400
1873	15,045	1,505	8,726,100
1874	17,166	1,389	8,009,356
1875	18,019	1,497	8,180,626
1876	19,135	997	7,998,430
1877	19,513	671	7,327,888
1878	20,845	1,266	6,920,540
1879	21,425	1,529	7,327,350
1880	24,869	367	9,947,673
1881	27,274	1,708	9,955,321
Total	328,328	1,370	$152,571,458

These copper tables have been compiled from figures kindly furnished by Mr. Wright, Commissioner of Mineral Statistics.

New Jersey.—Professor George H. Cook, the State Geologist of New Jersey, in his annual report for 1881 places the production of iron ore in that State in the year mentioned at 737,052 gross tons. The production of 1880 was 745,000 tons. Statistics of the production of iron ore in New Jersey during the past decade, and the estimated production at various intervals in preceding years, in gross tons:

Years.	*Gross tons*	*Years.*	*Gross tons.*
1790	10,000	1872	600,000
1830	20,000	1873	665,000
1855	100,000	1874	625,000
1860	164,900	1875	390,000
1864	226,000	1878	409,674
1867	275,067	1879	488,028
1870	382,636	1880	745,000
1871	450,000	1881	737,052

Foreign Tables—Lead Production in Germany.

	1881. *Tons.*	1880. *Tons.*
Mechernich Mining Co	22,409	20,275
Rhenish Nausau Mining Co	7,200	8,611
Stolberg Mining Co	13,996	13,975
Commerner Mining Co	2,362	2,120
A. Poensgen and Sons	3,189	2,900
Rothenbach Smelting Works	55	57
Giesche's Erben	6,480	5,258
Harz Prussian Government Mines	9,852	10,159
Tarnowitz	8,450	7,436
Freiberg Saxon	4,494	6,107
Remy Hoffman	6,772	6,395
Goldschmidt	2,721	2,069
	85,989	85,362

More than one-quarter of the whole production in Germany is produced by the Mechernich Mining Company from their own ores. This company produces only selected lead, and the ready sale and good prices which they obtain for their brand enabled them to pay twelve per cent. dividend last year, a highly satisfactory result considering the dull state of the lead market during last year.—*London Mining Journal.*

Production of the Mines of Great Britain in 1881.—From a report on his district, kindly sent us by Dr. Le Neve Foster, of Llandudno, we take the following figures in statute tons on the production of the mines of Great Britain in 1881:

	1881.
Coal	154,184,300
Ironstone	11,858,766
Iron ore	3,244,657
Iron pyrites	11,764
Arsenic (obtained at the mines)	3,660
Arsenical pyrites	14,322
Banxite	7,732
Copper ore	62,583
Copper precipitate	587
Fluor-spar	373
Ganister	1,201
Lead ore (dressed)	63,445
Lead ore (undressed)	233
Manganese ore	2,737
Rock salt	197,631
Brine salt	1,830,000
Tin ore, dressed (block tin)	11,788
Zinc ore	34,135

The ores enumerated of course are those only which were mined in the country. The vast quantities of foreign ores and products worked in England are not included.—*From Coal.*

Belgium Spelter.—One of the greatest spelter producing districts of the world is that of Liége, Belgium. According to M. Van Scherpenzeel's annual report, the eleven works of the province treated 19,200 tons of Belgian ores and 145,900 tons of foreign ores, of which 40,000 tons came from Greece, 39,000 tons from Italy, 35,000 tons from Spain, 13,000 tons from Sweden, 13,000 tons from Germany, and 3,800 tons from France. Some of our franklinites are also worked in the same district: 375,000 tons of coal were burnt in working them. The product reached the enormous total of 69,800 tons, or about 10,000 tons more than the preceding year. With such heavy supplies weighing down the European markets, and the German works increasing steadily though not as rapidly, it is not surprising that a strong pressure is brought to bear in our Eastern markets, which before the close of this month have been forced to absorb nearly 6,000 tons of foreign metal.—*From Coal.*

THE COAL TRADE IN THE UNITED STATES IN 1881.

FROM *Coal* we take the following review of the coal interests during 1881: *Anthracite—January*—The year opened with a stock of only 500,273 tons in the hands of the companies and an extraordinary large demand caused by very severe weather. Before the end of the month, many dealers and consumers who were in the habit of putting in full supplies before the close of navigation, found that their stocks were becoming exhausted and they were compelled to order shipments by rail. The demand from the West and South was beyond the ability of the railroads to furnish transportation. Water routes were frozen up, and steam power had to be substituted in many instances. Prices strengthened, and the outlook was most favorable. In December, 1880, an arrangement was made to work but three days in the week during the remainder of the month, and up to February 1st. The demand was so great that during the third week of this month the companies were compelled to work full time, to meet the requirements of consumers. It may be stated, however, that the severity of the weather was so great as to bring about an unexpected curtailment, the mines being unable to produce and the railroads to carry the usual quantity of coal. There was at the same time great trouble in moving the coal from the shipping ports, owing to the accumulation of ice. The shipments this month were 1,672,645 tons. Stocks were reduced 82,387 tons, and were, at the end of the month, 417,885 tons.

February.—This month opened with very cold weather and snow-storms, so that the consumption of coal was very large, and the inability to move it great, owing to the railroads being blocked with snow and the harbor almost blocked with ice. Early in the month, however, the weather became milder, and new orders became less abundant, although the companies had orders more than sufficient to take all their coal, and prices were very firm. During the beginning of the month, coal was so scarce in this city that the retailers were enabled to advance their prices 50 cents a ton and the demand was so great that the companies took no action relative to curtailing production. However, the severe weather of the early part of the month and the crippled condition of the motive power of the coal-carrying roads acted as a curtailing influence. The shipments for the month amounted to 2,118,174 tons, making an excess of 729,938 tons for the two months of the year, as compared with the corresponding months of 1880. The stocks were reduced by 22,599 tons to the very small aggregate of 395,286 tons, or but little more than half a week's production.

March.—This month opened with prices slightly lower, and the demand so much reduced that a reduction of output was considered necessary. No action was taken, however, until the 17th, when it was resolved to work but three days a week during the following fortnight. Buyers were making hand-to-mouth purchases in expectation of lower prices and lower rates of freight. The line and Western trade was so great that demoralization was prevented in this market. The delay in action on the part of the companies began to destroy confidence in their settling upon any plan for regulating trade, and as a consequence orders began to be canceled on one pretext or another. At the meeting at which it was decided to curtail production, it was the predominant sentiment that a reduction of prices to induce spring purchases was unnecessary and unwise; but shortly afterward, the Pennsylvania Coal Company issued a circular making a reduction, and all the other companies followed the example by issuing circulars showing a reduction of 10@25 cents in prices. By the end of the month, both demand and supply were better. The shipments of coal this month amounted to 2,225,842 tons, and the total shipments from January 1st exceeded those for the first three months of the previous year by 1,208,903 tons. Stocks aggregated 563,063 tons, an increase during the month of 167,777 tons.

April.—A curtailment of production by working but three days during each of the first three weeks produced a steady improvement; but it was characteristic of the managers that they could not leave well enough alone, but must agree to full time work during the fourth week, with the result of weakening prices once more. On the 15th, the Western Association established prices 55@60 cts. per ton lower than were current immediately previous to its action. The shipments were 1,945,855 tons, making an increase for the first four months of this year, as compared with the like period of 1880, of 1,138,118 tons. The stocks were 528,198 tons, a decrease of 34,865 tons, as compared with the stocks at the end of the previous month.

May.—This month furnishes but little worth recording. During the first week, the mines were worked each day, while during the remaining weeks they produced but three days each week. The production was moved at fairly steady prices, which were not in all cases equal to circular rates. The free-burning coals were a little difficult to sell. The shipments were 2,086,743 tons. For the first five months of the year, they exceed those for the corresponding period of 1880 by 1,573,780 tons. The stocks at the end of the month were 562,719 tons, having increased 34,521 tons.

June.—Some of the companies were so well supplied with orders that they would not consent to more than six days' curtailment. The larger production all around gave trouble to those whose order-books were not well covered, and prices, as a consequence, were a shade weak. The business, however, was a remakarbly good one for the season of the year. The month, and the first half of the year, closed with a scarcity of vessels, and indications of higher prices for coal and freights in the early future. The shipments for the month were 2,418,238 tons; for the first six months, 12,467,496 tons; for the first six months of 1880, 10,312,120 tons; an increase for the first six months of 1881 of 2,155,376 tons. Stock at the end of the month, 598,565 tons, an increase of 35,846 tons for the month, and 180,680 tons for the six months.

July.—During the first half of July, there was a curtailment of three days' work (the last for the year), and prices were steady or improving. During the last, however, too much coal was mined, and prices were weaker. Vessels became scarce and freights higher. The shipments were 2,570,100 tons, making the total production 3,090,680 tons greater than for the first seven months of 1880. Stocks aggregated 674,716 tons, an increase of 76,151 tons for the month.

August.—This was a remarkable month. The production was very large and it was thought that coal was accumulating, but at the end of the month it was found that the coal was all taken and stocks slightly reduced, a misapprehension which caused an irregularity of prices. The demand on the line was very great, while the Western demand was beyond the ability of the companies to secure the necessary transportation to meet it. The movement to the East was greater, owing to an improved supply of vessels; but as this was still small, the rates of freight were high and the movement not so large as it might otherwise have been. The shipments reached the enormous total of 2,733,548 tons, making an increase from January 1st, as compared with the like period of the previous year, of 3,928,712 tons. Stocks at the end of the month aggregated 852,943 tons, a decrease of 21,773 tons.

September.—The production was somewhat curtailed by a scarcity of labor and water at the mines, while the movement of coal was not so great as it might have been, owing to a scarcity of vessels at the seaboard and of cars for meeting the Western demand. Prices were a little irregular, which was largely due to the fact that the Delaware & Hudson Canal Company offered what is called "off colored" coal at a concession. During this month, President Garfield died, and after the long period of suspense business began to improve. The Western Association advanced the prices of egg, stove, and chestnut 25 cents per ton. The shipments aggregated but 2,588,219 tons, reducing the increase over 1880 to 3,677.454 tons. The stocks at the end of the month aggregated 613,958 tons, a decrease of 38,985 tons.

October. —There was no curtailment excepting that which came from a scarcity of water at the mines and a lack of transportation facilities. The demand was constantly ahead of the supply, and prices were well maintained. In fact, for certain sizes and qualities of coal afloat, even more than circular prices were paid. Vessels were in fair supply, but the supply of cars for Western shipment was so meager that coal was shipped to Buffalo via the Erie Canal.

THE ANTHRACITE COAL PRODUCTION OF PENNSYLVANIA, IN TONS OF 2240 POUNDS.

BY RICHARD P. ROTHWELL.

Years.	The Wyoming Region. *Luzerne and Sullivan Counties.*		The Lehigh Region. *Carbon, Columbia, and Luzerne Counties.*		The Schuylkill Region. *Schuylkill, Northumberland, Columbia, Dauphin and Lebanon Counties.*		All The Regions.
	Shipments.	*Total Production.*	*Shipments.*	*Total Production.*	*Shipments.*	*Total Production.*	*Total Production.*
Before 1820	. . . .	10,000	. . . .	3,000	. . . .	5,000	18,000
1820	. . . .	800	365	665	. . . .	500	1,965
1821	. . . .	1,000	1,073	1,473	. . . .	800	3,273
1822	. . . .	1,200	2,240	2,740	. . . .	1,000	4,940
1823	. . . .	1,300	5,823	6,523	. . . .	1,200	9,023
1824	. . . .	1,700	9,541	10,441	. . . .	1,500	13,641
1825	. . . .	2,000	28,393	29,493	5,306	7,006	38,499
1826	. . . .	2,700	31,280	32,760	16,835	19,335	54,815
1827	. . . .	4,000	32,074	34,274	29,493	32,893	71,167
1828	. . . .	6,200	30,233	33,233	47,181	52,481	91,914
1829	7,000	16,800	25,110	29,110	78,293	87,293	133,203
1830	42,000	58,200	41,750	46,850	89,984	104,584	209,634
1831	54,000	78,300	49,966	47,166	81,854	104,854	230,320
1832	84,500	121,700	75,000	82,700	209,271	243,771	448,171
1833	111,777	161,777	123,000	132,100	250.689	298,333	592,210
1834	43,700	53,008	106,241	128,874	226.692	274,977	456,859
1835	90,000	108,900	131,250	158,812	339,508	410,805	678,517
1836	103,861	126,360	148,211	178,891	432,045	521,478	825,729
1837	115,387	139,041	223,902	269,802	523,152	630,398	1,039,241
1838	78,207	94,083	213,615	256,979	433,875	521,951	873,013
1839	124,300	146,760	221,025	265,230	454,538	545,446	957.436
1840	148,470	177,867	225,318	269,932	467,796	560,421	1,008,220
1841	192,270	229,955	143,037	171,072	607,005	725,978	1,127,005
1842	262,699	301,856	272,546	326,692	551,504	659,047	1,286,595
1843	285,606	340,441	267,793	319,209	687,312	819,276	1,478,926
1844	365,911	435,434	397,002	448,638	863,465	1,015,623	1,899,690
1845	451,836	536,329	429,453	509,761	1,093,796	1,298,338	2,344,428
1846	518,389	614,291	517,116	612,783	1.249,154	1,480,247	2,707,321
1847	583,067	689,185	633,507	748,805	1,598,278	1,889,165	3,327,155
1848	685,196	808,531	670,321	790,979	1,672,191	1,973,185	3.572,695
1849	732,910	862,635	781,656	920,000	1,650,101	1,942,168	3,724.812
1850	827.823	972,692	690,456	811,286	1,769,691	2,079,387	3,863,365
1851	1,156,167	1,355,028	964,224	1,130,071	2,308,525	2,705,591	5,190,690
1852	1,284,500	1,502 865	1,072,136	1,254,399	2,536,653	2,967,884	5,725,148
1853	1,475,732	1,723,655	1,054,309	1,231,433	2,556,450	2,984,765	5,939,853
1854	1,603,478	1,868,052	1,207,186	1,406,372	3,066,208	3,572,132	6,846.556
1855	1,771,511	2,060 267	1,284,113	1,493,423	3,551,893	4,130,852	7,684,542
1856	1,972,581	2,288,194	1,351,970	1,568,285	3,571,800	4,143,288	7,999,767
1857	1,952,603	2,261,114	1,318,541	1,526,871	3,373,797	3,906,857	7,694,842
1858	2,186,094	2,527,125	1,380,030	1,695,315	3,236,843	3,741,790	7,864,230
1859	2,731,236	3,151,846	1,626,311	1,879,071	3,448,708	3,979,809	9,010,726
1860	2,941,817	3,388,973	1,821,074	2,098,569	3,749,632	4,319,576	9,807,118
1861	3,055,140	3,513,411	1,738,377	1,999,134	3,160,797	3,654,918	9,147,461
1862	3,145,770	3.608,198	1,351,054	1,549,658	3,432,584	3,937,175	9,095,031
1863	3,759,610	4,304,754	1,894,713	2,169,446	3,911,683	4,478,877	10,953,077
1864	3,960,836	4,526,635	2,054,669	2,348,233	4,161,970	4,756,532	11,631,400
1865	3,255,658	3,720,717	1,822,635	2,082,858	4,356,959	4,979,457	10 783,032
1866	4,736,616	5,413,958	2,128,867	2,433,286	5,464,209	6,245,599	14,092,837
1867	5,328,322	6,089,272	2,062,446	2,356,867	5,161,67[illegible]	5,899,505	14,345,644
1868	5,990,813	6,846,699	2,507,582	2,865,829	5,335,737	6,097,947	15,810,466
1869	6,068,369	7,279,543	1,929,523	2,313,989	5,653,855	6,782,146	16,375,678
1870	7,554,909	8,814,024	1,990,878	3,489,364	4,728,242	5,516,313	17,819,700
1871	6,713,773	7,690,251	2,249,356	2,568,764	6,234,974	7,120,340	17,379,355
1872	9,191,171	10,750,050	3,610,674	4,202,824	6,126,468	7,131,209	22,084,083
1873	10,047,241	11,744,141	3,263,168	3,801,447	6,294,454	7,335,333	22,880,921
1874	9.5[illegible]3,042	10,241,032	3,868,749	4,139,561	6,810,087	7,286,793	21,667,386
1875	10.519,998	11,062,520	2,731,311	2,867,875	6,393,441	6,713,113	20,643,509
1876	8,100,000	8,530,000	3,800,000	3,970,000	6,200,000	6,500,000	19,000,000
1877	7,900,000	8,323,000	4,200,000	4,400,000	8,200,000	8,600,000	21,323,000
1878	7,750,000	8 250,000	3,245,000	3,446,000	6,520,000	6,910,000	18,600,000
1879	12,575,000	13,300,000	4,550,000	4,825,000	9,015,300	9,556,218	27,711,250
1880	11,409,279	12,104,436	4,460,221	4,731,014	7,554,742	8,008,027	24,843,407
1881	13,564.244	14,378,100	5,327,665	7,199,800	9,116,645	8,684,040	30,261,940
	178,847,318	199,426,905	81,571,582	92,618,045	169,652,205	190,934,521	482,979,499

Wyoming includes the Loyalsock Region in Sullivan County, opened in 1871. The production of this region has been as follows: 1871, 23,122 tons; 1872, 51,527 tons; 1873, 32,058 tons; 1874, 36,268 tons; 1875, 16,522 tons; 1876, 30,000 tons; 1877, 23,000 tons; 1878, 37,000 tons; 1879, 50,000 tons; 1880, 59,000; 1881, 64,325 tons.

The shipments amounted to 2,686,054 tons, while for ten months, as compared with the like period of 1880, there was an increase of 3,981,698 tons. The stocks at the end of the month amounted to but 474,904 tons—a reduction of 139,054 tons.

November.—November opened with current prices 15 @25 cents a ton higher than circular rates for stove and chestnut sizes of coal. All through the month, the demand was fully equal to the supply, although some sizes were said to have accumulated to a small extent. Old orders were mostly absorbing all the coal produced, while new orders were not so plenty. Vessels were in moderate supply and freights firmer. The mines worked full time. The shipments amounted to 2,727,871 tons. The stocks at the end of the month aggregated 392,315 tons a decrease of 82,589 tons.

December.—The demand for stove and chestnut sizes continued to be very great during all of this month, although, in anticipation of a slackening in the demand, these sizes were offered at a concession for delivery. The larger sizes were accumulating with some of the companies, and were weak. Vessels were in fair supply and freights reasonable. There was some cold weather, which brought about a fair consumption; but at the close of the year, the winter had been an exceedingly mild one, and it became evident that the falling off in consumption must tell on the business of 1882. The demand at the end of this month was so small as to make the subject of an early curtailment of production one for serious consideration. So ends one of the most remarkable years in the anthracite coal trade of this country. The shipments for this month amounted to 2,724,727 tons, making a total production for the year of 28,500,016 tons, and an increase over 1880 of 5,062,774 tons. The stocks at the end of this month aggregated 497,024 tons, an increase of 104,709 tons for the month. The stocks at the beginning of the year were 500,273 tons, showing a decrease for twelve months of 3249 tons. Mr. John H. Jones furnishes the following statement of anthracite coal shipments for the month of December, 1881, compared with the same period last year.

	December, 1881.	December, 1880.	Increase.	For year 1881.	For year 1880.	Increase.
Philadelphia & Reading Railroad	633,116 13	407,089 04	226,027 09	6,940,283 09	5,933,922 14	1,006,360 15
Lehigh Valley Railroad	595,024 16	369,553 12	225,471 04	5,721,869 12	4,394,532 14	1,327,3[illegible]6 18
Central Railroad of New Jersey	406,837 01	276,888 05	129,948 16	4,085,423 14	3,470,141 02	615,282 12
Delaware, Lackawanna & Western Railroad	425,914 04	310,150 03	115,764 01	4,388,968 19	3,550,348 05	838,620 14
Delaware & Hudson Canal Co	300,730 05	213,009 01	87,721 04	3 211,496 09	2,674,704 18	536,791 11
Pennsylvania Railroad	180,532 08	149,675 09	30,856 19	2,211,363 09	1,864,031 15	347,331 14
Pennsylvania Coal Co	142,163 00	106,018 05	36,144 15	1,475,380 05	1,138,466 05	336,914 00
New York, Lake Erie & Western Railroad	*40,408 09	46,473 17	*6,065 08	465,230 09	411,094 11	54,135 18
Total	2,724,726 16	1,878,857 16	845,869 00	28,500,016 06	23,437,242 04	5,062,774 02

* Decrease.

The stock of coal on hand at tide-water shipping points, December 31st, 1881, was 497,024 tons; on November 30th, 392,315 tons; increase, 104,709 tons. The amount on hand December 31st, 1880, was 500,273 tons. Of the total production in 1881, 13,651,383 tons, or 48.96 per cent. was from the Wyoming Region; 5,204,676 tons, or 18.58 per cent. from the Lehigh Region; and 9,253,958 tons, or 32.46 per cent. from the Schuylkill Region. Competitive tonnage, including all coal which for final consumption or in transit reaches any point on the Hudson River or the Bay of New York, or which passes out of the Capes of the Delaware, except pea and dust:

1880	10,088,159 tons.
1881	2,169 030 "

Of the whole business of 1880 and 1881, the following companies did the percentages set opposite their names:

	1880.	1881.
Phila. & Reading	25·3	24·3
Lehigh Valley RR.	18·3	20.0
Cent. RR. of N. J.	15·0	14·3
Del., Lack. & West. RR	15·1	15·4
Del. & Hud. Canal Co	11·5	11·3
Penna. RR.	8·0	7·8
Penna. Coal Co	5·0	5·2
N. Y., L. E. & W. RR	1·8	1·7
	100·0	100·0

Circular Prices of Lehigh Coals at Amboy, Port Johnson and Elizabethport.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
January	$5.00	$5.00	$4.40	$4.40	$4.45	$4.00
February	5.00	5.00	4.40	4.40	4.45	4.00
March	5.00	5.00	4.40	4.40	4.45	4.00
April	5.00	. .	4.25	4.25	4.25	3.90
May	5.00		4.25	4.25	4.25	3.90
June	5 00		4.25	4.25	4 25	3.90
July	5.00	. .	4 25	4.25	4.25	3.90
August	5.00		4.25	4.25	4.25	3.90
September	5.00	. .	4.25	4.25	4.25	3.90
October	5.00	. .	4.25	4.25	4.25	3.90
November	5.00	.	4.25	4·25	4.25	3.90
December	5.00	. .	4.25	4.25	4.25	3.90

Circular Prices of Wilkes-Barre Coal at Port Johnson.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
January	$4.00	$4.00	$4.00	$4.20	$4.45	$4.40
February	4.00	4.00	4.00	4.20	4.45	4.40
March	4.00	4.00	4.00	4.20	4.45	4.40
April	3.90	3.90	3 90	4.05	4.25	3.39
May	3.90	3.90	3.90	4.05	4.25	3.39
June	3.90	3.90	3.90	4.05	4.25	3.39
July	3.90	3.90	3.90	4.05	4.25	3.39
August	3.90	3.90	3.90	4.05	4.25	3.39
September	3.90	3.90	3.90	4.05	4.25	3.39
October	3.90	3.90	3.90	4.05	4.25	3.39
November	3.90	3.90	3.90	4.05	4.25	3.39
December	3.90	3.90	3.90	4.05	4.25	3.39

Circular Prices of Lackawanna Coal in 1881.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
January	$4.00	$4.00	$4.00	$4.20	$4.45	$4.10
February	4.00	4.00	4.00	4.20	4.45	4.10
March	4.00	4.00	4 00	4.20	4.45	4.10
April	3.90	3.90	3.90	4.05	4.20	4.00
May	3.90	3.90	3.90	4.05	4.20	4.00
June	3.90	3.90	3.90	4.05	4.20	4.00
July	3.90	3.90	3.90	4.05	4.20	4.00
August	3.90	3.90	3.90	4.05	4.20	4.00
September	3.90	3.90	3.90	4.05	4.10	4.10
October	3.90	3.90	3.90	4.05	4.20	4.10
November	3.90	3.90	3.90	4.05	4.20	4.10
December	3.90	3.90	3.90	4.05	4.20	4.10

Circular Prices of Pittston Coal in 1881.

	Lump.	Steamer.	Grate.	Egg.	Stove.	Chestnut.
*January	$3.95	$3.95	$3.95	$3.95	$4.20	$3.95
*February	3.95	3 95	3.95	3.95	4.20	3.95
*March	3.95	3.95	3.95	3.95	4.20	3.95
†April	3.95	3.95	3 85	3.90	4.05	3.90
†May	3.95	3.95	3.85	3.90	4.05	3.90
†June	3.95	3.95	3.85	3.90	4.05	3.90
†July	3.95	3 95	3.85	3.90	4.05	3.90
†August	3 95	3.95	3.85	3.90	4.05	3.90
†September	3.95	3.95	3.85	3.90	4.05	3.90
†October	3.95	3 95	3.85	3.90	4.05	3.90
†November	3.95	3.95	3.85	3.90	4.05	3.90
December	3.95	3.95	3.85	3.90	4.05	3.90

* At Weehawken. † At Newburg.

The Anthracite Coal Production of Pennsylvania.

Years.	The Wyoming Region.		The Lehigh Region.		The Schulkill Region.		Total.
	Gross tons.	Per ct.	Gross tons	Per ct.	Gross tons.	Per ct.	Gross tons.
1820	. . . .	. .	365	. . . .	. .	. . . .	365
1821	. .	. . .	1,073	. . . .	. . . . .	. . . .	1,073
1822	. . . . .	. .	2,240	60 21	1,480	39.79	3,720
1823	. . . .	. .	5,823	83.77	1,128	16.23	6,951
1824	. . . . .	. . .	9,541	85.90	1,567	14.10	11,108
1825	. . . . .	. . .	28,393	81.40	6,500	18.60	34,893
1826	. . . . .	. . .	31,280	65.10	16,767	34.90	48,047
1827	. . . . .	. . .	32,074	50.56	31,360	49.44	63,434
1828	. . . . .	. . .	30,232	39.00	47,284	61.00	77,516
1829	7,000	6.25	26,110	22.40	79,973	71.35	112,083
1830	43,000	24.60	41,750	23.90	89,984	51.50	174,734
1831	54 000	30.54	40,966	23.17	81,854	46.29	176,820
1832	84,000	23.12	70,000	19.27	109,271	57.61	363,271
1833	111,777	22.91	123,001	25.22	252,971	51.87	487,749
1834	43,700	11.60	106,244	28.21	226,692	60.19	376,636
1835	90,000	16.05	131,250	23.41	339,508	60.54	560,758
1836	103,861	15.18	148,211	21.66	432,045	63.16	684,117
1837	115,387	13.27	223,902	25.75	530,152	60.98	869,441
1838	78,207	10.59	213,615	28.92	446,875	60.49	738,697
1839	122,300	14.94	221,025	27.01	475.077	58.05	818,402
1840	148,470	17.18	225,313	26.07	490,596	56.75	864,379
1841	192,270	20.03	143,037	14.90	624,466	65.07	959,773
1842	252,599	22.79	272,540	24.59	583,273	52.62	1,108,412
1843	285,605	22.60	267,793	21.19	710,200	56.21	1,263,598
1844	365,911	22.43	377,002	23.12	887,937	54.45	1,630,850
1845	451,836	22.45	429,453	21.33	1,131,724	56.22	2,013,013
1846	518,389	22.11	517,116	22.07	1,308,500	55.82	2,344,005
1847	583,067	20.23	633,507	21.98	1,665,735	57.79	2,882,309
1848	685,196	22.18	670,321	21.70	1,733,721	56.12	3,089,238
1849	732,910	22.60	781,556	24.10	1,728,500	53.30	3,242,966
1850	827,823	24.64	690,456	20.56	1,840,620	54.80	3,358,899
1851	1,156,167	25.98	964,224	21.68	2,328.525	52.34	4,448,916
1852	1,284,500	25.72	1,072,136	21.47	2,636,835	52.81	4,993,471
1853	1,475,732	28.41	1,054,309	20.29	2,666,110	51.30	5,195,151
1854	1,603,478	26.73	1,207,186	20.13	3,191,670	53.14	6,002,334
1855	1,771,511	26.80	1,284,113	19.43	3,552,943	53.77	6,608,567
1856	1,972,681	28.47	1,361,970	19.52	3,602,999	52.91	6,927,550
1857	1,952,603	29.39	1,318,541	19.84	3,373,797	50.77	6,644,941
1858	2,186,094	31.96	1,380,030	20.18	3,273,245	47.86	6.839,369
1859	2,731,236	34.98	1,628 311	20.80	3,448,708	44.16	7,808,255
1860	2,941,817	34.56	1 821,674	21.40	3,749,632	44.04	8,513,123
1861	3,055,140	38.41	1,738,377	21.86	3,160,747	39.74	7,954,264
1862	3,145,770	39.97	1,351,054	17.17	3,372,583	42.86	7,869,407
1863	3,759,610	39.30	1,894,713	19.80	3,911,683	40.90	9,566,006
1864	3,960,836	38.92	2,054,669	20.19	4,161,970	40.89	10,177,475
1866	3,254,619	33.72	2,040,913	21.14	4,356,959	45.14	9,652,391
1866	4,736,616	37.29	2,179,364	17.15	6,787,902	45.56	12,703,882
1867	5,325,000	40.99	2,502,054	19.27	5,161,671	39.74	12,988,725
1868	5,968,146	43.26	2,502,582	18.13	5,330.737	38.62	13,801,465
1869	6,141,369	44.28	1,949,673	14.06	5,775,138	41.66	13,866,180
1870	6,974,660	49.28	3,239.374	20.02	4,968,167	30.70	16,182,191
1871	6,911,242	44.02	2,235,707	14.24	6,552,772	41.74	15,699,721
1872	9,101,549	46.27	3,873,339	19.70	6,694,890	34.03	19,669,778
1873	10,309,755	48.67	3,705,696	17.46	7,212,601	33.97	21,227,952
1874	9,504,408	47.18	3,773,836	18.73	6,866,877	34.09	20,145,121
1875	10,596,155	53.75	2.834,605	14.38	6,281,712	31.87	19,712,472
1876	8,424,158	45.53	3,854,919	20.84	6,221,934	33.62	18,501,011
1877	8,300,377	39.85	4,332,760	20.80	8,195,042	39.35	20,828,179
1878	8,085,587	45.92	3,237,449	18.40	6,282,226	35.68	17,605,262
1879	12,586,293	48.14	4,595,567	17.58	8,960,829	34.28	26,142,689
1880	11,419,279	48.72	4,463,221	19.05	7,554,742	32.23	23,437,242
1881	13,951,383	48.96	5,294,076	18.58	9,253,958	32.46	28,500,017

Prepared from original and authentic statistics by John H. Jones.

Prices in Dollars of Anthracite Coal from 1826 to 1882.

Prices of Schuylkill White Ash Lump Coal, by the cargo, at Philadelphia. Averaged monthly from mean of weekly quotations. Per ton of 2,240 lbs.

Years.	*January.*	*February.*	*March.*	*April.*	*May.*	*June.*	*July.*	*August.*	*September.*	*October.*	*November.*	*December.*	*Average for year.*
1826	. .	. .	. .	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.50	7.80	. .
1827	7.00	7.00	7.00	7.00	. .	. .	. .	. .	. .	. . .	. . .	. . .	. .
1829	. .	. .	. .	. .	. .	. .	. .	. .	. .	7.50	7.50	7.25	. .
1830	7.25	7.25	6.00	5.75	5.75	5.75	5.75	5.75	5.75	5 75	. . .	. . .	. .
1833	. .	. .	6.00	5.50	5.25	5·25	5.25	5.25	5.17½	4.87½	4.87½	4.87½	. .
1834	4.87	4·87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.87	4.50	4.84
1835	4.56	4.56	4.56	4.56	4.60	4.63	4.63	4.68	4.88	4.90	5.03	6.47	4.84
1836	7.70	7.44	7.31	6.58	5.38	5.50	5.50	6.19	6.41	6.50	7.13	8.05	6.64
1837	8.25	8.25	8.04	6.78	6.50	6.38	6.10	6.00	6.00	6.09	6.13	6.13	6.72
1838	6.13	5.91	5.28	5.25	5.16	5.13	5.13	6.13	5.10	5.00	5.00	5.00	5.27
1839	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	6.00
1840	5.00	5.00	5.00	5.00	5.00	4.63	4.63	4.63	4.66	4.95	5.06	5.34	4.91
1841	6.40	7.00	6.44	5.88	5.69	5.17	5.13	5.27	5.56	5·63	5.63	6.63	5.79
1842	5.63	5.56	5.06	3.38	4.03	3.88	3.83	3.60	3.56	3.51	3.56	3.56	4.18
1843	3.50	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3·25	3.25	3.25	3.27
1844	3 50	3.33	3.10	3.02	3.00	3.03	3.13	3.21	3.26	3.26	3.27	3.26	3.20
1845	3.26	3.26	3.27	3.31	3.31	3.31	3.44	3.44	3.59	3.74	3.76	3.81	3.46
1846	3.81	3.75	3.72	3.84	3.87	3.97	4.00	3.94	3.96	3.88	4.00	4.00	3.90
1847	3.88	3.81	3.81	3.81	3.60	3.63	3.69	3.83	3.95	3.88	3.88	3.88	3.80
1848	3.90	3.90	3.58	3.44	3.37	3.29	3.33	3.56	3.46	3.41	3.39	3.36	3.50
1849	3.36	3.36	3 45	3.62	3.62	3.86	3.88	3.81	3.75	3.69	3.57	3.50	3·62
1850	3.50	3.50	3.40	3.31	3.25	3.25	3.25	3.25	4 25	4.25	4.25	4.25	3·64
1851	4.28	4.13	3 56	3.31	3.10	3.00	3.00	3.05	3.17	3.29	3.25	3.00	3·34
1852	3.18	3 47	3.40	3.44	3.44	3.45	3.45	3.50	3.56	3.56	3.66	3.50	3·46
1853	3.42	3.44	3.45	3.47	3.47	3.47	3.47	3.64	4.03	4.19	4.19	4.10	3.70
1854	4.50	4.50	4.25	4.39	4.81	3.16	5.55	6.00	6.00	5.81	5.68	5.60	5.19
1855	5.60	5.28	4.53	4.50	4.50	4.45	4.28	4.19	4.19	4.19	4.15	4.06	4.49
1856	4.06	4.25	4.25	4.25	4.05	4.00	4.00	4.00	4.12	4.13	4.10	4.08	4.11
1857	3.92	3.92	3.92	3.89	3.85	4.85	3.88	3.87	3.85	3.82	3.82	3.82	3.87
1858	3.83	3.83	3.77	3.47	3.22	3.20	3 35	3.25	3.32	3.32	3.32	3.30	3.43
1859	3.28	3.38	3.34	3.20	3.20	3.24	3.20	3.20	3.19	3.20	3.34	3.29	3·25
1860	3.28	3.29	3.30	3.30	3.23	3.35	3.36	3.39	3.50	3.53	3.62	3.63	3·40
1861	3.63	3.63	3.50	3.24	3.23	3.23	3.37	3.40	3.35	3.33	3.33	3.33	3·39
1862	3.33	3.33	3.11	2.78	2.78	3.64	4.58	4.85	4.98	5.22	5.50	5.63	4·14
1863	5.38	5.25	4.63	4.75	5.50	3.80	6.25	6.50	6.75	7.25	7.50	7.13	6·08
1864	7.10	6.75	6.59	7.20	7.88	5.34	9.78	10.75	10.13	8.00	8.88	8.38	8·39
1865	8.38	8.38	8.63	8.10	6.75	8.25	6.03	6.50	8.32	9.93	8.81	8.25	7·86
1866	7.94	7.75	5.40	5.25	5.13	6.53	5.88	5.68	5.47	5.34	5.25	5.05	6·80
1867	5.06	5.06	4.47	4.50	4.44	5.38	4.28	4.07	4.09	4.01	4.00	4.00	4·37
1868	4.00	3.13	3.13	3.22	3.25	4.25	3.25	3.25	4.10	4.50	5.22	6.00	3·86
1869	5.15	5.01	4.15	3.81	3.90	3.00	6.59	7.17	6.15	6.00	5.87	5.12	5·31
1870	5.07	4.79	4.79	4.50	4.50	5.44	4.31	4.44	4.33	4.19	3.69	3.55	4·39
1871	4.05	. .	. .	. .	. .	4.52	4.45	4.25	4.35	4.68	4.72	4.63	4·46
1872	4.63	3.78	3.50	3.50	3.50	4.50	3.50	3.59	3.71	3.90	3.90	3.90	3·74
1873	3.90	3.90	4.00	4.00	4.10	3.20	4.40	4.40	4.50	4.60	4.60	4.60	4.27
1874	. .	. .	4.05	4.10	4.20	4.30	4.45	4.60	4.75	4.90	5.05	6.05	4.55
1875	. .	. .	4.10	4.10	4.10	4.40	4.50	4.50	4.55	4.55	4.55	4.55	4.39
1876	4.55	4.15	4.25	4.25	4.30	4.15	4.20	4.35	3.20	3.00	3.00	3.00	3.87
1877	3.00	3.00	2.75	2.75	2.75	4.40	2.47	2.40	2.40	2 35	2.35	2.40	2.59
1878	3.25	3.50	3.25	3.25	3.25	2.30	3.30	3.30	3.30	3.30	3.05	2.50	3.22
1879	2.50	2.50	2.25	2.25	2.50	3.50	2.50	2.75	2.75	3.00	3.25	3.65	2.70
1880	3.90	4.25	4.35	4.65	4.65	2.65	4.65	4.65	4.65	4.65	4.65	4.65	4.53
1881	4.65	4.65	4.58	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.53
1882	4.50	4.50	4.50	4.50	4.50	. .	. . .	. .	. . .	. .	. . .	. .	. .

Prices of Lehigh Coal in Philadelphia. (From Grotjan's *Public Sale Report.*) 1822, May to December, $8.40. 1823, January to August, $10; September, $9.50; October to December, $8.40. 1824, January to April, $8.40.

Compiled by The American Iron and Steel Association.

MR. SAWARD'S FIGURES.

Mr. Frederick E. Saward gives the following review of the year 1881 in *The Coal Trade Journal:*

We present herewith, the usual succinct review of the condition of the coal trade during the year 1881. The business of the country was in far better shape than during any preceding year since the war times. Coal was readily taken, and the amount disposed of was largely in excess of any year preceding. In our review of a year ago we said that "the output of Anthracite would be 27,000,000 tons at least, and with proper management it might be greater." We have had a year of proper management, and the result is a grand total of something over 28,000,000 tons. We also remarked referring to the Western trade that "the time may come when the tide-water trade will be a matter of secondary consideration, by reason of the better prices realized for the commodity at points short of tide." That there has been a realization of this point, is felt even at the present date by the dealers along the coast. Without the trade to interior points, is it at all probable that the tonnage would have been what is recorded, or the prices at tide kept up as they have? As year by year goes by, there is more effort made to supply the interior trade, the result netting better prices at the breaker, than that realized from the tide-water coal. When this fact does become more settled in the minds of the dealers on the seaboard, there will be no putting off of purchases in the hope of lower prices. The circular prices hardly varied during the entire year, and the average result must show that card prices were closely realized. At one time in October and November there were sales made at an advance over card rates for prompt deliveries. The Anthracite mines were worked 104 days in the first half of the year, or an average of two-thirds time, and the output to the end of June was 12,467,496 tons. Since that time there has been uninterrupted work and the output now aggregates 28,000,000 tons. It is expected that the year 1882 will show an increase on this quantity as there is a most satisfactory state of affairs in industrial pursuits generally, and the supplies on hand to begin the year with are not great. We append details of the business of the several regions, districts and companies, and to the latest dates available at this moment. Bituminous coals show a largely increased trade and traffic for the year. and at prices that must have been satisfactory to the shipper. There is an improvement in this regard within the past month or so, which if it can be held, will show good balance sheets for the operators another season. Some low prices were made early in the year 1881, and contracts taken at prices delivered at points beyond the tidewater ports. This will gradually be done away with, as the demand continues to keep ahead of the supplies promptly available. The future of the Bituminous coal is exceedingly flattering, and there is no doubt but that this quality of fuel will be relied upon in the East, as the source of steam-raising. Anthracite will sell to better advantage for domestic purposes. There have been no serious interruptions in the several mining districts, and the laborer having been well employed at fair rates, is not disposed to find a pretext for changing this condition of affairs. Our comparative table of the Anthracite output is given herewith. It is subject to some few corrections, and additions to close out the year.

	1881.	1880.
Schuylkill.		
Reading Railroad	6,940,008	5,894,085
Shamokin	1,066.716	911,758
Lykens Valley	411,978	391,840
	8,318,702	7,197,683
Lehigh.		
Lehigh Valley Railroad Company	4,619,907	3,399.226
Central Railroad of New Jersey	2,155,906	2,039,981
	6,695,813	6,439,207
Wyoming.		
Delaware and Hudson Canal Company	3,581,781	3,002,807
Delaware, Lackawanna and Western Railroad	4,271,953	3,479,636
Pennsylvania Coal	1,427,747	1,123,674
Lehigh Valley Railroad	1,155,492	1,033,472
Central Railroad of New Jersey	2,282,160	1,709,850
Pennsylvania and New York Railroad	105,454	39,047
	12,824.587	10,388,466
Grand total	27,839,102	23,025,356
Pennsylvania Canal	457,260	457,269
State Line and Sullivan	62,406	49,945

The Production of Anthracite Coal.

Year.	*Schuylkill.*	*Lehigh.*	*Wyoming.*	*Total.*
1871	6,552,772	2,235,707	6,911,242	15,699,721
1872	6,694,890	3,873,339	9,101,549	19,669,778
1873	7,212,601	3,705,596	10,309,755	21,227,952
1874	6,866,877	2,773,836	9,504,408	20,145,121
1875	6,281,712	2,834,605	10,596,155	19,712,472
1876	6,221,934	3,854,919	8,424,158	18,501,011
1877	8,195,042	4,332,760	8,300,377	20,828,179
1878	6,282,226	3,237,449	8,085,587	17,605,262
1879	8,960,339	4.595,567	12,586,293	26,142,689
1880	7,554,742	4,463,221	11,419,279	23,437.242
1881 (estimated)	8,400,000	6,650,000	13,200,000	28,250,000

The workingmen in the Anthracite coal regions have had on the average, better employment than for several years, and at rates that are fair, being usually based upon the price of coal. The stoppages to restrict production bear heavily upon them, no doubt, but without this, would the prices be fair? We trust that there may be little necessity for this stopping after a season or two. The railroad companies have had a good year, as tolls have borne a proportionate improvement with prices, on a very heavy tonnage.

Lehigh Valley Railroad Company.—This company is rapidly assuming the foremost position in the rank of Anthracite coal carriers, and there is an increase each year in the amount of business done. In the efforts being made to secure a trade to the West, this company is well situated in regard to railway and transfer facilities. The activity prevailing in all the industrial centers along the Lehigh Valley makes a scarcity of coal, when others are complaining of a surfeit. The several branches all show an improvement in the amount of business done; with a line that may be said to extend from the lakes to the Atlantic, is there not opportunity for a vastly increased business in all commodities? We append a detailed statement for the fiscal year ending with November.

The tonage for 1881 was distributed as follows:

Furnaces, etc.	762,042
To connecting railroads between Mauch Chunk and Easton,	300,910
Local trade	88,672
For use of company	237,611
To Morris Canal at Port Delaware	298,951
To Lehigh Canal at Mauch Chunk	66,184
To New Jersey Division at Easton	1,604,203
To P. & N. Y. R. R. at Coxton	712,014
To Belvidere Railroad at Phillipsburg	1,257,176
To M. & E. R. at Phillipsburg	78,213
To Danville, H. & W. R. R. at Hazleton	101,447
To L. & B. R. R. at Lackawanna Junction	245,276
To other connecting railroads	38,575

The tonnage of this line increased during the last year at a greater ratio than has heretofore been recorded. There is an activity along the entire route from the lakes to the Atlantic, that warrants the prophecy that it will always be second in rank of the Anthracite coal carriers. We give details of the traffic:

Received from.	*Tons,* 1878.	*Tons,* 1879.	*Tons,* 1880.	*Tons,* 1881.
Wyoming region	909,712	1,135,587	1,162,706	1,362,706
Hazleton region	1,520,049	1,964,278	2,125,104	2,674,077
Beaver Meadow region,	435,951	474,761	441,591	502,631
Mahanoy region	565,826	786,082	876,860	1,257,933
Miscellaneous	5,076	1,076	243	197
Totals	3,446,615	4,361,785	4.606,415	5,791,376

The distribution was as below:

Year.	*East of Mauch Chunk.*	*Total Coal Tonnage.*
1871	2,210,272	2,889,074
1872	3,009,395	3,850,118
1873	3,189.023	4,144,339
1874	3,016,636	4,150,659
1875	2,417,800	3,277,571
1876	3,129,895	3,951,513
1877	3,453,533	4,362,124
1878	2,758,756	3,446,615
1879	3,531,829	4,361,785
1880	3,774,729	4,606,415
1881	4,498,323	5,791,376

Of the quantity east of Mauch Chunk as noted above, there was 1,604,203 tons delivered to the New Jersey Division for shipment at Perth Amboy, an increase of two hundred thousand tons over the preceding year. There was also 1,258,176 tons delivered to the Belvidere Division of the Pennsylvania Railroad, for shipment at Trenton and South Amboy. The rate of transportation was maintained at $1.40 per ton, for the 101 miles from Mauch Chunk to Perth Amboy, throughout the year. Laterals to Mauch Chunk average fifty cents per ton. Prices of coal remained unchanged throughout the season of 1881, on tide-water deliveries, and the demand was active at all times for Lehigh coal with sales a shade above the circular rates during November. Quotations were:

Lump.	*Broken.*	*Egg.*	*Stove.*	*Chestnut.*
$5 25	$4 45	$4 45	$4 25	$4 00

Prices of coal at Mauch Chunk, for delivery 'on the line,' were evently maintained throughout the season and averaged $3.10 per ton.

The Pennsylvania and New York Railroad.—This line forms the northern connection of the Lehigh Valley Railroad, for its business to the North and West. In addition thereto, it transports a large amount of bituminous coal from what is known as the "Barclay" region. The Loyalsock coal mined in Sullivan county, Pa., is shipped over the State Line and Sullivan Railroad to Towanda and hence to market via this line and its connections. Tonnage has been as below:

	In 1879.	*In* 1880.	*In* 1881.
Anthracite	860,161 tons.	705,464 tons.	1,108,056 tons.
Bitumioous	329,901 tons.	435,516 tons.	419,551 tons.

We append a statement of the business during the fiscal year ending with November.

ANTHRACITE COAL.	
Received from Lehigh Valley Railroad	712,014 02
Received from Lack. & B. Railroad	233,631 06
Received from Pleasant Valley Branch	97,576 18
Received from State Line and Sullivan Railroad	64,834 04
Total	1,108,056 10
Same time last year	705,464 04
BITUMINOUS COAL.	
Barclay Railroad, shipped north from Towanda	370,892 16
Barclay Railroad, shipped south from Towanda	47,644 05
North Central Railroad	1,013 18
Total	419.550 19
Same time last year	435,516 15

Philadelphia and Reading Railroad Company.—The business of this company shows an increase that is very flattering; there was a large increase in the profits as compared with many preceding seasons, and if the company was out of the hands of the receivers, it would be on as good a footing as the other coal carriers and producers. We append details of the distribution of this coal carrier during the eleven months ending with November. The destination of the coal carried is about equally divided between tide-water and Philadelphia and what is termed the "line trade."

Passing over Main Line and Lebanon Valley Branch	4,829,568
For shipment by Schuylkill canal	595,504
Shipped West'd via Cat. & Wpt. Br. & N. C. R. R.	467,863
Shipped East via Lehigh Valley R. R	66,960
Shipped West and South from Pine Grove	129,443
Consumed on Laterals	120,486
Lehigh and Wyomiog coal	976,964
Bituminous	331,376
Coal for Company's use	554,358
Grand total tonoage	8,072,440

Year.	*Tons.*	*Year.*	*Tons.*
1860	1,946,195	1871	6,002.573
1861	1,639,535	1872	6,185,434
1862	2,310,990	1873	6,546,555
1863	3,065,261	1874	6,348,812
1864	3,065,577	1875	5,505,455
1865	3,090,814	1876	5,595,207
1866	3,714,684	1877	7,055,818
1867	3,446,826	1878	5,909,140
1868	4,574,874	1879	8,147,579
1869	4,239.457	1880	7,179,398
1870	4,633,504	1881	8,072,440

The above is the total coal tonnage carried.

Of the coal produced from the lands owned by the company during the years 1873-81, together with the reported average cost of coal in cars at the mines, the following schedule is given:—

	Leases produced.	*P. & R. C. & I. Co. produced.*	*Average cost at mines.*
1873	2.055.565 tons.	1,348,838 tons.	$2.51 per ton.
1874	1,802,370 tons.	1,374,790 tons.	2.45 per ton.
1876	1,594,741 tons.	1,510,572 tons.	1.87 per ton.
1876	1.218,533 tons.	1,[illegible]53,364 tons.	1.35 per ton.
1877	1,389,108 tons.	3,794.528 tons.	1.04 per ton.
1878	1,100,181 tons.	2.727,608 tons.	1.24 per ton.
1879	1,300,822 tons.	4,269,929 tons.	1.14 per ton.
1880	1,235,642 tons.	3,460,464 tons.	1.43 per ton.
1881	1,484,992 tons.	3,937,607 tons.	1.49 per ton.

Philadelphia takes over a million tons of Schnylkill coal, carried by this company; there is a shipping business of two million tons at Port Richmond, and the 'line' deliveries aggregate yearly two millions of tons. This company also sends coal through the tide-water shipping ports of South Amboy and Elizabethport, N. J. The coal tonnage originating at collieries tributary to this railroad company, is stated to have been 6,040,383 tons during the calendar year 1881, thus making it the largest Anthracite coal-carrier.

The ton named is of 2,240 lbs., and the year in all tabular statements ends with November 30th.

Lehigh Coal and Navigation Company.

Year.	*Tons.*	*Year.*	*Tons.*
1872	566,724	1877	550,519
1873	525,623	1878	430,987
1874	572,470	1879	701,761
1875	397,427	1880	617,989
1876	606,773	1881	645,338

Lehigh Coal and Navigation Company.—This company dates back to 1820, as a mining and carrying company. The figures in the schedule above, are the figures of the production at the "Summit Mines."

Coal Cleared Over the New York Canals.

	1879.	1880.	1881.
Anthracite	810,517	762,598	902,214
Bituminous	160,538	186,213	206,935

Delaware, Lackawanna and Western Railroad Company.—The large business that has been done by this company has been cause for surprise with many persons who are not aware of the persistent push that permeates every branch of the management. Westward for Anthracite is one of the cardinal points in their belief; the facilities existing for an increasing business, year by year, are of the most ample description. With the completion of the line from Binghampton to Buffalo, one may naturally expect a greater tonnage in that direction. So far as the tonnage reports are a criterion there must be a profit in this trade that far overshadows the business to tide. In 1878, this company mined and purchased, and transported for others 2.147,000 tons, of which 676,000 went north and west. A comparison with later details is given below.

	Tons 1879.	*Tons* 1880.	*Tons* 1881.
Forwarded North	1,516,458	1,505,843	1,885,350
Forwarded South	2,306,956	2,023,243	2,386,603

Year.	*Tons.*	*Year.*	*Tons.*
1871	1,916,486	1877	2,089,523
1872	2,836,948	1878	2,180,672
1873	3,136,306	1879	3,867,407
1874	2,570,437	1880	3,550,348
1875	3,326,901	1881	4,388,969
1876	2,300,500		

This tonnage includes coal carried, purchased and mined. There are no details of the distribution other than "North" and "South." The tonnage forwarded North includes all the coal sent West, the tonnage forwarded South is the coal brought to Hoboken, and for the line trade in New Jersey. The extension from Binghampton to Buffalo, known as the New York, Lackawanna and Western, will prove of great advantage to this company in developing the trade in Anthracite at the West.

The following is the official statement made at the regular meeting of the Delaware, Lackawanna and Western directors showing the business for the year 1881:

Gross earnings from all sources			$27,396,526
Less expenses, &c			19,632,661
Balance, net earnings			$ 7,763.864
Less interest and rentals of leased lines			3,558,493
Balance profit.			$ 4,205,370

COST OF PROPERTY AND ASSETS.

Construction account			$30,873,356
Materials on hand			1,121,850
Stocks and bonds (cash value, $7,026,800)			6,265,520
Accounts receivable as follows:—			
Cash and demand loans	$ 871,781		
Coal on hand (less than market value)	553,873		
Advances to leased lines	336,645		
Advances on coal to be delivered	608,013		
Coal bills and sundry accounts due	1,519.193		
		$3,804,507	
Less accounts payable:—			
Part due and uncalled for dividends, interest and rentals	$ 93,451		
Dividends, interest and rentals due and payable after January 1	1,576,090		
State taxes payable after January 1	282,179		
Accounts due and payable after January 1	631,673		
Pay rolls for December payable in January	446,641		
		$3.035,037	
			$ 769,469
Total			$39,030,197

CAPITAL STOCK, BONDS AND SURPLUS.

Capital stock	$26,200,000
Bonded debt	4,044,900
Balance due on account of bonds paid and retired March 1, 1881.	1,200,000
Surplus account	7,585,297
Total	$39,030,197

Coal transported in 1881, 4,983,736 tons.

Central Railroad of New Jersey.—We have details of the business of this company to the 24th ultimo, and it will be noticed that there is a largely increased traffic, and the distribution is about equally divided between tide and the interior trade.

Shipped From.			*Gross Tons.*
Wyoming	Region,	L. & W. B. C. Co	1,868,380 14
"	"	Everhart C. Co	59,128 07
"	"	Fairmount	48,824 13
"	"	Susquehanna C. Co.	203,252 16
"	"	D. & Hudson Canal Co	38,725 13
"	"	Red Ash C. Co	90,402 12
"	"	Lehigh-Luzerne C. Co.	12,170 15
Upper Lehigh	"	Upper Lehigh C. Co	462,505 15
"	"	M. S. Kemmerer & Co	124,799 06
"	"	Pond Creek	32,821 19
Beaver Meadow	"	L. & W. B. C. Co	467,944 18
"	"	G. H. Meyer & Co	74,931 06
Mauch Chunk	"	L. C. & Navigation Co.	629,649 10
Cross Creek	"	Coxe, Bros. & Co.	220,770 11
Council Ridge	"	J. Leisenring & Co	135,169 15
Lehigh Valley R. R.		Packerton	12,281 11
R. P. Smith & Co			127,296 04
Total			4,509,056 05

Distribution.	*Year* 1881.	*Year* 1880.
Forwarded East by Rail to Tidal points	2,509.716 16	2,152,961 03
" " " Local "	1,186,756 17	905.073 18
" " " use Central Division	154,604 17	133,817 15
" " " " L. & S. "	18,630 19	15,195 09
Delivered at and above Mauch Chunk	116,950 14	96,647 18
" " Coalport for Canal	318,922 11	369,780 17
" to L. V. R. R. at Packerton	226 15	95 02
" to L. V. R. R. at Sugar Notch	203,252 16	119,537 04
Total	4,509,056 05	3,793,169 06

Coal carried over the Lehigh and Susquehanna Division of the Central Railroad of New Jersey.

1871	1,033,587	1877	2,869,788
1872	2,527,068	1878	2,390,655
1873	3,089,697	1879	4,088,954
1874	2,972,286	1880	4,843,209
1875	2,661,635	1881	4,627,276
1876	2,952,520		

Pennsylvania Coal Company.—The output of coal from the mines of this company is yearly increasing and the figures for 1881 show a larger business than ever before. Tide coal is received at Weehawken, N. J., and at Newburgh, N. Y. by the 'Erie' Railway from Hawley. We append annual business:

1876	1,143,922 tons.	1879	1,372,759 tons.
1877	1,118,011 tons.	1880	1,123,585 tons.
1878	925,995 tons.	1881	1,427,747 tons.

This distribution during 1880 and 1881 was:

	1880.	1881.
West by Erie	131,917	181,494
East by Erie	986,023	1,239,990
East by D. & H. Canal	5,733	6,263

Pennsylvania Railroad—Belvidere Division.—This line connects at the Delaware river with the roads from the Anthracite regions, and we give the amount of Anthracite coal carried to December 24th, 1881:

	1881.	1880.
To South Amboy for shipment	759,703	552,157
For distribution	718,495	503,129
For company's use	113,779	104,906
	1,591,978	1,160,193

This was received from:

Lehigh region	1,327,244	942.427
Wyoming region	264,733	537,756

In the annual report of this company, facts and figures relative to the Anthracite companies controlled by the company are given below:—

SUSQUEHANNA COAL COMPANY.

Receipts from sale of coal, etc		$2,770,958 74
Expenses mining, selling, shipping coal, including taxes and amount charged off for exhaustion of lands, being ten cents a ton on coal mined above certain sizes		2,297,734 97
Net earnings for 1881		$ 473,223 77
From which deduct:		
Interest on funded debt	$120,000 00	
Interest and discount	3,638 68	
		123,638 68
		349.685 09
Add increased value of personal property at mines (as per inventory) as compared with January 1, 1881		23,620 30
		$ 373,205 39
Out of which was paid a dividend of four per cent		85,472 00
Leaving a balance of		$ 287,733 39
Net profit, 1881		$ 373,205 39
Net profit, 1880		209,806 50
Being an increase in profits of		$ 163,398 89

SUMMIT BRANCH RAILROAD COMPANY.

Receipts from sale of coal, rents, &c	$1,107,830 12
Expenses mining, selling, shipping coal, including taxes and amount charged off for exhaustion of lands	993,361 24

Net earnings for year		$ 114,468 88
Add amou t received from Lykens Valley Coal Company on account of advances made to that company in former years		25,875 52
		$ 140,344 40
Interest on funded debt	$70,000 00	
Interest and discount	15,272 31	
		85,272 31
Net profit for 1881		$ 55,072 09
Net profit for 1880		34,809 94
Being an increase in profits in 1881 of		$ 20,362 15

LYKENS VALLEY COAL COMPANY.

Receipts for sale of coal, rents, &c	$ 755,034 04
Expenses mining, selling, shipping coal, taxes, &c	729,158 52
Net earnings for 1881	$ 25,875 52
Net earnings for 1880	48,907 80
Being a decrease in 1881 of	$ 23,032 28

MINERAL RAILROAD AND MINING COMPANY.

Receipts from sale of coal, rents, &c	$1,747,035 25
Expenses mining, selling and shipping coal, taxes, &c	1,147,185 82
	$ 326,849 43
From which deduct:	
Royalty paid on coal to the Pennsylvania Railroad and Northern Central Railway Co's	233,589 31
	$ 93,260 12
Out of which was paid a dividend of	10,000 00
Leaving a balance of	$ 83,260 12
Net profit for 1881	$ 93,260 12
Net profit for 1880	39,858 57
Being an increase in profits in 1881 of	$ 53,401 55

The average price per ton at point of sale, aggregating the results of the four coal companies for 1881, was $3.43 7-10, as against $3.34 6-10 for 1880, showing an increase of 9 1-10 cents per ton.

It will be seen from the foregoing statements, that your companies mined 161,223 more tons of coal in 1881 than in 1880; and that the financial result for the year was a surplus profit of $537,413.12, after paying their interest upon their fixed liabilities, and a royalty by the Mineral Railroad and Mining Company of fifty-three cents per ton on coal mined, amounting to $233,589.31.

Cumberland Coal Trade in 1881.—Shipments of Georges Creek Cumberland coal during the past season have been on a generous scale, and an increased tonnage is recorded. It will be noticed that one company has done a business of nearly three-quarters of a million tons, an amount far ahead of anything previously recorded. A large trade westward has been developed for this coal. The Georges Creek and Cumberland road was opened for business, and all things considered, they have done well. The canal has been dry, or nearly so, unfortunately too, in the busiest time of the year, and there is a decrease in the shipments by that line. The increase in business by the Pennsylvania line is due to the tonnage furnished by G. C. & C. road, and Cumberland coal is now shipped at Georgetown, Baltimore, Philadelphia and South Amboy on the Atlantic sea coast. The development of this coal field south of the B. & O. road, in the Elk Garden country, is likely to increase the shipments of this coal beyond previous calculations. The coal is found there in its purest, with the deepest seam of any portion of the district. Prices have been fairly maintained, and with the conditions of demand of the past month or two continued through 1882, there must be a good financial showing. We quote $3.50 at Georgetown, $3.75 at Baltimore, and $5.00 at New York as a fair average. Contracts, of course, realize less returns. Wages paid for mining are 65 cents per ton. We append details for last two years of the several companies. Those for 1880 are official figures for the calendar year, and 1881 are figures as per tonnage report to the 24th ultimo. If one may judge from the reported improvements being made at the collieries in this district there is likely to be a very much larger tonnage in 1882. The flush times of 1871–'2–'3 induced a heavy tonnage, averaging 2,250,000 tons, and this point has been turned in 1881, in spite of all the coals that have come into market since that time. Is there any doubt, that there is a growing demand for Bituminous coal in view of the points here related?

Shipped by	*Tons* 1880.	*Tons* 1881.
Borden Mining Company	157,533	161,328
Consolidation Coal Company	552,484	730,673
Blæn Avon Coal Company	45,921	25,295
Hampshire and Baltimore Company	98,739	62,121
Georges Creek Coal and Iron Company	235,599	250,102
New Central Coal Company	350,184	296,403
Maryland Coal Company	113,445	121,362
American Coal Company	124,901	113,354
Atlantic and Georges Creek Company	62,802	55,901
Piedmont Coal and Iron Company	14,007	8,157
Swanton Mining Company	41,741	41,144
Potomac Coal Company	77,431	79,294
Maryland Union Coal Company	153,359	169,328
Davis Bros	54,189	67,092
Miscellaneous	367	19
W. Va., C. & P. R. R.	...	10,2[illegible]5
Total	2,189,430	2,197,715

The production was sent to market by the following routes:

	1880.	1881.
B. & O. R. R.	1,319,587	1,415,613
C. & O. Canal	603,125	505,339
P. S. Line	213,460	270,163

The G. C. & C. road carried 207,824 tons of the output in 1881 and the same is included in the coal forwarded to market (83,122 tons) by the C. & O. Canal and (128,102 tons) by the Pennsylvania State Line Railroad, and the local trade of 4,599 tons.

Clearfield Coal Trade in 1881.—Each returning year shows an increasing tonnage from this now well-known source of supply. As remarked in our last review, there must be something in the quality of the commodity that will assert itself in spite of all arguments to the contrary. How were it possible, otherwise for the tonnage to grow from 1,281,861 tons in 1876 to 2,364,169 tons in 1881. Could a supply of cars have been secured, there would have been a still further increase. There was no strike, and wages are at fifty cents per ton. Prices have been remunerative on the average, and $3.75 at Philadelphia, and $4.50 at South Amboy, shows the price realized for good coal. Of course there are many contracts that will not realize these figures, but the lively demand during November and December enabled much better rates to be obtained on very large amounts. It is almost a repetition of our old reports, to state that the business at tide has taken a larger percentage of the traffic in Bituminous coal than in former years. Manufactories, steamships, etc., have all taken more of this coal. We regret not being able to give a detailed statement of the output at each of the forty operations, embraced within this district, but neither the operator nor the railway will give these facts. There are half a dozen concerns that do three-fourths of the business, for much of the coal mined by others is purchased and disposed of by them. There is every prospect of a greater output during the year 1882, and we hope that the operators will realize their anticipations both as to quantity and price. The output is reported at 2,364,169 *net* tons for 1881, as compared with 1,711,098 tons the preceding year. Of course the coal passing over Tyrone and Clearfield road is alone embraced in these figures.

Huntingdon and Broad Top Mountain Railroad.—This is yearly becoming an important coal carrier, not so much of the coal that originates upon its own line, but from the Georges Creek coal that is coming over it for shipment at Philadelphia and South Amboy. Details of the tonnage are given below:

	1879.	1880.	1881.
Broad Top Coal	141,594	174,736	203,000
Georges Creek	174,930	242,593	312,000

An outlet for the coal from the region is afforded by the Huntingdon and Broad Top Mountain Railroad (this was completed in 1856, and during the latter part of that year 42,000 tons were forwarded from this region to various markets.) The line extends from the town of Huntingdon, on the Pennsylvania Railroad, 203 miles west of Philadelphia, to Mt. Dallas, in Bedford county, a distance of 45 miles. At Saxton, 24 miles from Huntingdon, a branch road, 10 miles in length, extends to Broad Top City; at Riddlesburg, 5 miles beyond Saxton, is a branch into Fulton, 5 miles, from the main road. From Mt. Dallas the Bedford and Bridgeport Railroad, 386–10 miles in length, extends to the Maryland State line; from this point to Cumberland, Md., via the Cumberland and Pennsylvania Railroad is 7 miles. At or near Cumberland, connection is made with the Cumberland and Pennsylvania, and the Georges Creek and Cumberland roads. This connection gives an outlet for the Cumberland coal to the interior markets of Pennsylvania, to Philadelphia and South Amboy, N. J. The Bedford and Bridgeport road is leased to the Pennsylvania Railroad, and operated by them.

We append details of the tonnage of the Huntingdon and Broad Top road, during the past ten years.

1872	297,473 tons.	1877	140,143 tons.
1873	350,245 tons.	1878	150,204 tons.
1874	226,693 tons.	1879	141,594 tons.
1875	204,921 tons.	1880	174,736 tons.
1876	159,779 tons.	1881	204,819 tons.

The shipments of Cumberland coal over the Pennsylvania and the Huntingdon and Broad Top Railroads have been as below:

1872	22,021 tons.	1877	187,488 tons.
1873	114,589 tons.	1878	163,598 tons.
1874	67,681 tons.	1879	171,930 tons.
1875	175,154 tons.	1880	242,593 tons.
1876	145,796 tons.	1881	313,600 tons.

The East Broad Top Railroad penetrated this coal field in 1875; there were delivered to the Pennsylvania Railroad at Mt. Union, 53,567 tons of coal during 1875, 66,104 in 1876, 54,738 in 1877, 63,068 in 1878, 67,929 in 1879, 72,450 in 1880, and 91,745 tons in 1881. In addition, some 47,634 tons were last year used in the furnaces, on the line of the E. B. T. road. The coal measures are regular in structure, with gentle undulation dividing the field into several synclinals or basins. The coal is semi-bituminous in its nature, and has been largely used for blacksmithing purposes, for generating steam in locomotives, marine and stationary engines, in rolling mills, puddling furnaces and forge fires; with glass works it is an especial favorite. It gives a white ash, is free burning, and easily ignited. Included in this region, are all the mines in Huntingdon and Bedford counties.

Union Pacific Railroad.—The production and cost of coal mined by the Union Pacific Railroad Company compare as follows:

	Tons.	*Cost.*	*Av. cost.*
In 1881	587,493	$814,613.56	$1.39
In 1880	445,129	547,325.66	1.23
Increase	142,364	$267,287.90	$0.16

The cost of additional machinery and of improvements of all kinds for increasing the capacity of existing mines and for the opening of new mines is included in the above. During the year 1881, there were expended for these purposes:

At Carbon mines	$63,793.52
At Rock Spring mines	17,881.07
At Almy mines	69,926.18
At Grass Creek mines	23,054.84
Making the total	$174,655.61

The annual report says that, although the quantity of coal mined by the company has increased for some years at the rate of 25 per cent. per year, yet the demand for coal on the line of the railroad has increased in a greater proportion. The improvements made the past year have increased the capacity of the mines to double the output of the year 1881, and it is now expected that the additional railroad equipments, under contract to be delivered early this season will enable the company to meet promptly the demand for coal during this year. The company has an interest in fully supplying this demand, not only on account of the direct profit realized from the sale of coal, but also from the development of business that results from an abundant supply of cheap fuel of an excellent quality for domestic and manufacturing purposes. The sales of coal to other railroad companies and to private consumers compare as follows:

	Tons.	*Amt. sales.*
In 1881	193,031	$1,098,863.83
In 1880	137,119	743,087.05
Increase in 1881	55,912	$355,776.78

The production and cost of coal for seven years of the different mines of the company are as follows:

Year.	Carbon.			Rock Springs.		
	Tons.	*Cost.*	*Per Ton.*	*Tons.*	*Cost.*	*Per Ton.*
1875	61,750	$126,716.13	$2.05	104,667	$192,973.09	$1.84
1876	69,062	109,193.02	1.58	134,953	185,844.60	1.38
1877	74,343	92,702.41	1.25	146,494	162,075.07	1.11
1878	62,418	75,026.14	1.20	154,281	152,796 90	.99
1879	75,325	89,541.90	1.19	193,251	190,338.36	.98
1880	100,434	136,040.40	1.35	244,460	303,818.41	1.24
1881	156,820	236,773.03	1.51	279,908	355,978.10	1.27
Total	600,152	$865,993.03	$1.44	1,258.014	1,543,824.53	$1.23

Year.	Almy.			Total.		
	Tons.	*Cost.*	*Per Ton.*	*Tons.*	*Cost.*	*Per Ton.*
1875	41,805	$72,195.88	$1.73	208,222	$391,885.10	$1.88
1876	60,756	80,482.94	1.32	264,771	375,520.56	1.42
1877	54,603	57,353.89	1.05	275,480	312,131.37	1.13
1878	59,096	59,393.81	1.00	275,795	287,216.85	1.04
1879	71,576	83,368.90	1.16	340,152	363,249.16	1.07
1880	100,235	107,466.85	1.07	445,129	547,325.66	1.23
1881	110,157	132,652.38	1.20	587,493	814,613.56	1.39
Total	498 288	$592,914.65	$1.19	2,397,042	$3,091,942.26	$1.29

The total for 1881 includes Grass Creek, 40,608 tons, cost, $89,210.05; average per ton, $2.20. —*From "Coal."*

New York Pennsylvania and Ohio Railroad.—The recent report of the New York, Pennsylvania & Ohio Railroad for the year 1881 contains the following statement of the traffic of coal, ore, and oil during the last seven years:

Year.	*Coal, tons.*	*Ore, tons.*	*Oil, barrels.*
1881	1,359,759	534,159	933,250
1880	1,003,141	494,569	835,556
1879	740,569	375,378	2,385,752
1878	621,743	255,908	2,027,792
1877	747,145	245,199	3,530,188
1876	746,642	204,128	2,158.149
1875	728,967	175,607	2,719,830

—*From "Coal."*

Illinois Central Railroad.—The Illinois Central Railroad carried the following quantities of coal in 1881;

	From Mines along Road.	*From Grand Tower R. R., at Carbondale, Ill.*	*From Crooked Creek R. R., at Judd, Iowa.*
January	27,500	2,375	2,830
February	27,700	5,055	850
March	28,220	7,310	1,390
April	29,960	7,910	1,170
May	21,700	8,585	320
June	20,350	4,130	390
July	23,500	5,210	290
August	41,325	8,135	575
September	38,525	7,070	555
Total for 9 mos.	258,780	55,780	8,370

—*From "Coal."*

COAL IN DIFFERENT STATES.

UNDER this head we gather some further figures of interest from various indicated sources.

Output of the Different States.

	Tons, 1880.	*Tons, 1881.*
Pennsylvania Anthracite	23,437,242	28,500,016
Pennsylvania Bituminous	19,000,000	20,000,000
Illinois	4,000,000	6,000,000
Ohio	7,000,000	8,250,000
Maryland	2,136,160	2,261,918
Missouri	1,500,000	1,750,000
West Virginia	1,400,000	1,500,000
Indiana	1,100,000	1,500,000
Iowa	1,600,000	1,750,000

Kentucky	1,000,000	1,100,000
Tennessee	600,000	750,000
Virginia	100,000	100,000
Kansas	550,000	750,000
Michigan	75,000	100,000
Rhode Island	10,000	10,000
Alabama	340,000	375,000
Washington	175,000	175,000
Wyoming	225,000	225,000
Utah	275,000	275,000
Colorado	575,000	700,000
Georgia	100,000	150,000
Total	65,198,402	76,121,934

—*F. A. Saward, The Coal Trade.*

Government Estimates.—The Department of Internal Affairs of Pennsylvania furnishes the following tabulation of anthracite coal for 1881:

Total number collieries	319
Average number of days worked during year	27.501
Total number employees	75,169
Total amount paid in wages during year	$27,454,781.36
Total production of anthracite for 1881, tons	27,929,128.18
Average amount per ton paid in wages	1.0655
Average amount of coal produced to each employee	373.14

A similar table for the bituminous fields shows:

Total number of collieries	382
Average number of days worked during the year	217.07
Total number of persons employed	35,630
Total amount paid in wages during the year	$14,340,057.50
Total production of bituminous coal for the year ended December 31, 1881, tons	15,692,923.12
Total number of coke ovens	6,640
Total production of coke for the year, tons	2,176,403.08
Average amount per ton paid in wages	$0.92.05
Average amount of coal produced to each employee	442.47

In the bituminous regions the number of days worked in the year is much less than in the anthracite. One reason of this is, probably, that the demand supplied from the bituminous region is more local than that from the anthracite. The number of days' work in a large section of the West Pennsylvania bituminous field depends upon the state of water in the Ohio River, which was not favorable to shipments, and consequently to mining, last year. The greater ease of mining bituminous coal has made the output per man much greater than in the anthracite region.

Accidents.—According to a statement prepared by the engineer of the Philadelphia & Reading Coal and Iron Company, the accidents at the collieries worked by the company during the last nine years, referred to the tonnage of coal extracted, were as follows;

Year.	*Total tonnage.*	*Total serious accidents non-fatal.*	*Number of tons mined per serious accident.*	*Total fatal accidents*	*Number of tons mined per fatal accident.*
1873	1,348,838	132	10,294	44	30,655
1874	1,374,791	96	14,320	36	38,188
1876	1,510,572	80	18,882	30	50,352
1876 (11 mos.)	1,853,364	75	24,711	30	61,778
1877	3,794,529	185	20,511	45	84,323
1878	2,727,608	217	12,570	44	61,991
1879	4,269,929	238	17,941	52	82,114
1880	3,460,464	198	17,477	43	80,476
1881	3,937,608	236	16,685	33	119,321

Referred to the number of employees, the figures stand as follows:

Year.	*Number of employees.*	*Total serious accidents non-fatal.*	*Per cent. serious accidents.*	*Total fatal accidents.*	*Per cent. fatal accidents.*
1873	5,000	132	$2\frac{64}{100}$	44	$0\frac{88}{100}$
1874	8,000	96	$1\frac{20}{100}$	36	$0\frac{45}{100}$
1875	9,000	80	$0\frac{89}{100}$	30	$0\frac{33}{100}$
1876	9,110	75	$0\frac{82}{100}$	30	$0\frac{33}{100}$
1877	11,428	185	$1\frac{61}{100}$	45	$0\frac{39}{100}$
1878	10,630	217	$2\frac{04}{100}$	44	$0\frac{41}{100}$
1879	12,661	238	$1\frac{88}{100}$	52	$0\frac{41}{100}$
1880	13,093	198	$1\frac{51}{100}$	43	$0\frac{33}{100}$
1881	13,509	236	$1\frac{75}{100}$	33	$0\frac{24}{100}$

It will be noted that there was a steady increase.

There were seventy-nine accidents in the Wilkes-Barre district resulting fatally from the following causes.

By Explosions of Carburetted Hydrogen Gas	10
By Falling of Roof and Coal	28
By Falling down Shaft and Slopes	3
Crushed by Mine Cars	10
By Explosions of Powder and Blasts	7
By miscellaneous causes underground	3
By various causes outside around the mines	18
Total	79

One hundred and seventy accidents which were serious but not proving fatal occurred as follows:

By Falling of Roof and Coal	43
By Explosions of Carburetted Hydrogen Gas	24
By Falling down Shafts	1
Crushed by Mine Cars	44
By Explosion of Powder and Blasts	25
From miscellaneous causes inside of the mines	16
By various causes on surface	17
Total	170

Number of persons employed in and around the mines of each company are as follows:

Lehigh Valley Coal Company	1,550
Lehigh and Wilkesbarre Coal Company	4,941
Delaware and Hudson Canal Company	2,699
Susquehanna Coal Company	2,341
Miscellaneous coal companies	5,277
Total	16,808

Miners.—According to returns obtained from the operators by the Pennsylvania Bureau of Statistics, the average daily wages paid to employees in anthracite and bituminous coal mines during the year was as follows:

Anthracite.	*Number.*	1878.	1879.	1880.	1881.
Miners on contract	21,442	$1.97	$2.09	$2.71	2.52
Miners on wages		1.66	1.63	1.88	2.05
Inside laborers	12,550	1.38	1.37	1.62	1.72
Outside laborers	11,241	1.21	1.19	1.30	1.27
Platform men and others	. . . . .	1.21	. .	1.31	1.29
Boss slate picker	. . . .	. .	1.05	1.44	1.37
Slate pickers, boys	15,181	.51	.56	.57	.65
Door and fan boys		.61	.61	.77	.75
Drivers	. . . . .	1.30	1.19	1.26	1.29
Engineers	2,245	1.68	1.65	1.80	1.78
Firemen		1.26	. .	1.44	1.40
Blacksmiths	630	. .	1.65	1.80	1.81
Carpenters	852	.	1.65	1.80	1.83
Other employees	. . . . .	.	1.66	1.66	1.66
Total	75,160				
Bituminous.					
Miners	22,158	1.88	1.74	2.25	2.16
Inside laborers	903	1.47	1.42	1.69	1.81
Outside laborers	4,443	1.47	1.42	1.46	1.63
Mule drivers		1.46	1.41	1.63	1.80
Blacksmiths	307	1.91	1.75	1.96	2.16
Carpenters	238	1.90	1.75	1.84	2.06
Overseers	672	2.64	2.56	2.63	2.60
Clerks		2.38	. .	1.93	2.11
Coke-oven chargers	1,413	1.60	. .	1.46	1.76
Coke-oven drawers		1.60	1.55	1.44	1.74
Boys	1,908	.77	.68	.79	.84
	35,530				

It will be noted that, as a general thing, wages have increased since 1879, when they were very low. Inside, labor, both in the anthracite and bituminous fields, is now better paid, relatively, than in the past, and so it is with many other branches of the labor connected with coal mining. We have added to the table the number of employees named, the difference between the totals given and the sum of the men enumerated being employees not classified. A glance at these figures will show that while the production bore the proportion of about 28,000,000 tons of anthracite to 16,000,000 tons of bituminous, the number of miners is very nearly alike. On the other hand, the inside and outside laborers in the anthracite collieries is 23,791 against only 5346 in the bituminous mines, and the number of boys is about eight times as large. While, therefore, one miner apparently can accomplish more in an anthracite mine, it requires so much other labor that the cost of wages per ton is, according to the returns of the Bureau of $1.065 to $0.92, the latter figures, however, not including the wages paid in coking bituminous coal, so that, strictly speaking, the figures are not directly comparable, on the basis of expenditure or product prepared for market.

The *Commercial Herald* gives the following figures on the imports of coal into San Francisco:

Foreign.	1880. *Tons.*	1881. *Tons.*	*Increase.* *Tons.*	*Decrease.* *Tons.*
Australian	59.872	126,296	66,424	. . .
English	66,860	281,313	214,653	. . . .
Vancouver	169,182	158,629	. . . . .	10,533
Eastern.				
Anthracite	19,829	13,697	. . . . .	5,932
Cumberland	20,616	24,982	4,066	. . . . .
Domestic.				
Mount Diabolo	158,723	103,055	. . . . .	55,668
Coos Bay	35,415	21,246	. . . . .	14,169
Seattle	123,741	152,893	29,152	. . . . .
Tacoma	. . . . .	17,339	17,330	. . . . .
Chile	. . . . .	230	230	. . . . .
Totals	654,118	899,680	331,864	86,302
Increase in 1881	. . . . .	245,562	. . . . .	. . . . .

The San Francisco *Journal of Commerce* reports the following imports for 1881:

	Tons.	
Australian	121,767	
British	270,451	
British Columbia	151,706	—543,814
Eastern		26,743
Seattle	145,173	
Coos Bay	20,621	
Carbon Hill	18,317	
Mount Diabolo (6 months)	66,687	—250,798
Total	821,456	
Corresponding period, 1880	531,745	
Corresponding period, 1879	578,417	

Colorado.—The year 1881 will be remembered as a notable one in the development of the coal and iron interests of the State. Its marked features have been the largely increased output of the coal mines already opened; the developments of the Gunnison coal fields, and especially the anthracite measures at Irwin, near Crested Butte; and pre-eminently the starting of the blast furnace at South Pueblo, with the attendant opening up of iron mines, limestone quarries and other feeders of the furnace. While the coal interests in the northern part of the State have prospered, it is in the southern portion that the greatest strides have been made for which the Colorado Coal and Iron Company, having its general offices in Colorado Springs, must receive the credit. This corporation was organized January 23, 1880, by the consolidation of several of the companies that had been organized to develop different portions of Colorado. It has rapidly grown to be one of the largest and wealthiest corporations of the West, and now owns upwards of 100,000 acres of land in central and southern Colorado, 15,000 acres of which are underlaid with coal, and 12,000 acres containing large deposits of iron ore. To develop these properties, the company has in operation a coke oven at El Moro and Crested Butte, a blast furnace at South Pueblo, with steel works nearly completed, and a rolling mill at Denver.

The following table shows the total output of the Canon City, Walsenburg and El Moro coal mines for the years 1880 and 1881:

Mines.	1880. *Tons.*	1881. *Tons.*	*Increase for* 1881.
Canon City	107,575	120,000	12,425
Walsenburg	32,106	68,000	35,894
El Moro	81,697	140,000	58,303
Totals	221,378	328,000	106,621

From the El Moro mine there were shipped to the coke ovens 51,891 tons in 1880, and 95,000 in 1881. The total coal output of all the company's mines is 332,000 tons in 1881, as against 211,378 tons in 1880.

Canon Coal Fields.—These comprise 3740 acres of land in Fremont county, thirty-eight miles west of South Pueblo. Their product has long been recognized as the best steam, domestic and metallurgical coal in Colorado. It is non-coking and is largely used by the railroad companies, besides supplying a large part of the fuel used in Denver, Pueblo, Colorado Springs, Canon City and Leadville. During the past year the company has increased its facilities for the rapid mining of this popular coal. The annexed analyses were obtained from two specimens of Canon coal.

	No. 1.	*No.* 2.
Water	4.50	6.15
Volatile matter	34.20	36.03
Fixed carbon	56.80	52.82
Ash	4.50	5.00
	100.00	100.00
Sulphur		.65

Cuchara Coal Fields.—These measures, the product of which is known as Walsenburg coal, comprise 2,390 acres of land in Huerfano county, directly on the line of the D. & R. G. Railway. Of the three workable seams, only one has as yet been developed. This like the Canon is a non-coking, steam and domestic coal, largely used by the railroad companies and for household fuel. Analyses are as follows:

	No. 1.	*No.* 2.
Water	3.23	2.97
Volatile matter	40.93	40 08
Fixed carbon	49.54	48.67
Ash	6.30	8.28
	100.00	100.00
Sulphur	.62	.65

El Moro Coal Fields.—In Las Animas county the company owns 8,121 acres of coal lands. The El Moro mine is located in a tract of 1,800 acres lying along the base of Fisher's Peak. The mine is entirely free from water, and the vein of coal is from ten to twelve feet in thickness, lying almost horizontal. It is easily mined, and the average cost of putting the coal on the cars is less than at any other mine west of the Pittsburg, Pa., district. The mine has now a capacity of over 1,000 tons per day which could be readily doubled. The coal is a true Bituminous, producing coke of excellent quality, to which reference will hereafter be made under its appropriate head. It is the best gas and blacksmith's coal in the State, and is used extensively for steam and metallurgical purposes. It is the only coal yet discovered in Colorado east of the mountains which can be profitably used for heating iron in furnaces, and for this use it is equal to the best grades of eastern coal.

Crested Butte Coal Fields.—The company owns 160 acres of coal lands at Crested Butte, and has leased about 1,000 acres of adjoining lands. The coal deposits are of remarkable thickness and of a very superior quality. There are five separate veins, respectively ten, six, five, four, and three feet in thickness, making a total of twenty-eight feet of coal. Three of these veins have already been opened and found to contain good coal. Two of these, the six feet and five feet veins, are coking coal, and the coke made therefrom, in open pits, is much superior in quality and texture to the best product of Pennsylvania ovens. The analysis of coke and coal is as follows:

	Water.	*Vol. Matter.*	*Fixed Carbon.*	*Ash.*
Coke	1.35	. .	92.03	6.62
Coal	.44	24.17	72.30	3.09

The railroad was extended to these mines in November, 1881, and the coking ovens are now well opened by three drifts. The mines are prepared for an output of 400 to 500 tons per day, while the coke pits can be extended to meet any demand.

Unquestionably the most important fact developed during the past year in connection with the coal development of the State, is the determination of the true Anthracite character of certain of the Gunnison coal fields. Near Irwin, nine miles west of Crested Butte, a vein of fine Anthracite coal, three feet four inches in thickness, covers a considerable area of country, and the company have opened a drift on a tract of 240 acres. The railroad has not yet been completed to this mine, and hence no regular shipments have as yet been made. The coal is a true Anthracite, hard, bright, and forming an excellent fuel, as the subjoined analysis testifies:

Water	3.15
Fixed carbon	93.93
Ash	2.92
	100.00

Another extensive Anthracite region has recently been discovered directly north of Crested Butte, with two veins, four and six feet respectively, of the same quality as that found at Irwin. The Anthracite fields of Crested Butte, undoubtedly cover many square miles, and the quality of the coal is believed to be fully equal to the best that Pennsylvania produces. Their development must mark an important era in the history of Colorado.

Until the opening up of the Gunnison coal fields, the El Moro mines and coking ovens furnished all the coke consumed in Colorado. Extensive works were here erected by the Colorado Coal and Iron Company, the present plant of which consists of three steam pumps, a fifty horse-power engine with crushing and washing machinery, and 250 bee-hive coking ovens. The present daily product for 1881 is 50,000 tons, against 25,568 tons in 1880. The quality of this coke has always been regarded as superior. The following will be found an instructive comparison of the analysis of El Moro coke with those of the celebrated Connellsville of Pennsylvania.

COAL.

	Water.	Vol. Matter.	Fixed Carbon.	Ash.	Sulphur.
El Moro	0.25	29.66	65.76	4.32	0.85
Connellsville	1.25	30.11	59.62	8.23	0.78

COKE.

	Fixed Carbon.	Ash.	Sulphur.
El Moro	87.47	10.68	0.85
Connellsville	87.47	11.79	0.75

The supply of coke now furnished by El Moro, may soon be expected to be largely supplemented by the superior product of the Crested Butte ovens, to which reference has been made.

—From the Colorado Gazette.

THE DOMINION OF CANADA.

Nova Scotia exported to the United States—Coal.

Years.	Tons.	Duty.	Years.	Tons.	Duty.
1850	98,173	24 ad val.	1866	404,252	$1.25
1851	116,274	"	1867	338,492	"
1852	87,542	"	1868	228,132	"
1853	120,764	"	1869	257,485	"
1854	139,125	Free.	1870	168,180	"
1855	103,222	"	1871	165,431	"
1856	126,152	"	1872	154,092	.75
1857	123,335	"	1873	264,760	"
1858	186,743	"	1874	138,335	"
1859	122,720	"	1875	89,746	"
1860	149,289	"	1876	71,634	"
1861	204,457	"	1877	118,216	"
1862	192,612	"	1878	88,495	"
1863	282,775	"	1879	51,641	"
1864	347,594	"			
1865	465,194	"			

Nova Scotia Coal Scales from 1875 to 1881 inclusive.

Year.	Sales.	Total.
1785	1,668	
1786	2,000	
1787 } 1788 } 1789 } 1790 }	10,681	14,349
1791	2,670	
1792	2,143	
1793	1,936	
1794	4,405	
1795	5,320	
1796	5,249	
1797	6,039	
1798	5,948	
1799	8,947	
1800	8,401	51,048
1801	5,775	
1802	7,769	
1803	6,601	
1804	5,976	
1805	10,130	
1806	4,938	
1807	5,119	
1808	6,616	
1809	8,919	
1810	8,609	70,452
1811	8,516	
1812	9,570	
1813	9,744	
1814	9,866	
1815	9,339	
1816	8,619	
1817	9,284	
1818	7,920	
1819	8,692	
1820	9,980	91,527
1821	11,388	
1822	7,512	
1823 } 1824 } 1825 }	28,000	
1826	12,600	
1827	12,149	
1828	20,967	
1829	21,935	
1830	27,269	140,820

Year.	Sales.	Total.
1831	37,170	For'd 368,196
1832	50,396	
1833	64,743	
1834	50,813	
1835	56,434	
1836	107,593	
1837	118,942	
1838	106,730	
1839	145,962	
1840	101,198	839 981
1841	148,298	
1842	129,708	
1843	105,161	
1844	108,482	
1845	150,674	
1846	147,506	
1847	201,650	
1848	187,643	
1849	174,592	
1850	180,084	1,533,798
1851	153,499	
1852	189,076	
1853	217,426	
1854	234,312	
1855	238,215	
1856	252,492	
1857	294,198	
1858	226,725	
1859	270,293	
1860	322,593	2,399,829
1861	326,429	
1862	395,637	
1863	429,351	
1864	576,935	
1865	635,586	
1866	558,520	
1867	471,185	
1868	453,624	
1869	511,795	
1870	568,277	4,927.339
1871	596,418	
1872	785,914	
1873	881,106	
1874	749,127	
1875	706,795	
1876	634,207	
1877	697,065	
1878	693,511	
1879	688,626	
1880	954,659	7,377,428
1881	1,035,014	1,035,014
	Total . .	18,482,156

Summary.

1785 to 1790	14,349	1831 to 1840	837,981
1791 " 1800	51,048	1841 " 1850	1,533,798
1801 " 1810	70,452	1851 " 1860	2,399,829
1811 " 1820	91,527	1861 " 1870	4,927,339
1821 " 1830	140,820	1871 " 1880	7,377,428

From the report of Edward S. Gilpin, we obtain the following on the Coal produce of Nova Scotia during the year ended December 31st, 1881:

Nova Scotia.

Collieries.	Seams.	Produce.	Sales.				Colliery Consumption.		
			Paying Royalty.	Free.	Total.	Per Cent.	Engines.	Workmen.	Per Cent.
CUMBERLAND COUNTY.									
Chignecto	North Seam	3,294	1,974	865	2,839	86	400	130	. . . . .
Joggins	Joggins Main	18,880	13,700	2,193	15,873	84	1,500	182	10
Minudie	. . . . . .	400	200	200	400	100	. . . . .	. . . . .	. . . . .
Scotia	North Seam	260	240	50	290	. . . . .	. . . . .	. . . . .	. . . . .
Spring Hill	Black & South	160,485	105,622	46,125	151,747	94	4,507	4,092	5
Styles	Styles	150	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
PICTOU COUNTY.									
Acadia	Acadia	87,582	59,545	21,801	81,346	92	5,422	1,696	8
Albion Mines	Third & McGregor	59,316	26,907	24,738	51,645	87	11,913	2,724	24
Intercolonial	Acadia	135,084	99,521	27,586	127,107	92	5,113	2,449	5
Vale	McBean	90,215	71,600	15,270	86,870	94	10,177	1,168	11
CAPE BRETON COUNTY.									
Block House	Blockhouse	61,108	56,754	95	56,849	93	2,800	1,404	7
Caledonia	Phelan	43,426	32,096	10,837	42,933	98	1,180	698	4
Glace Bay	Harbor	35,012	28,536	3,075	31,611	90	2,870	979	10
Gowrie	McAulay	64,160	50,368	11,001	61,369	95	1,130	1,241	5
International	Harbor	76,860	61,107	15,178	76,285	99	1,415	1,317	3
Lingan	Lingan	34,402	26,909	5,467	32,376	91	1,912	742	7
Ontario	Phelan	15,117	11,460	1,950	13,410	88	569	221	5
Reserve	Phelan	76,727	57,941	10,943	68,884	89	3,136	1,293	5
Sydney	Main	161,577	121,478	11,657	133,135	82	23,177	8,436	19
INVERNESS COUNTY.									
Broad Cove	. . . . . .	45	45	. . . . .	45	. . . . .	. . . . .	. . . . .	. . . . .
VICTORIA COUNTY.									
New Campbellton	. . . . . .	200	. . . . .	. . . . .	. . . . .	. . . . .	340	150	. . . . .
RICHMOND COUNTY.									
Little River	. . . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .
		1,124,270	826,003	209,011	1,035,014	90	78,166	28,922	9

Turning now to the shipments from Cape Breton collieries, we find that there has been a most remarkable increase from every one of them.

Mines.	1880.	1881.	*Increase.*
	Tons.	*Tons.*	*Tons.*
Reserve	31,614	67,000	35,386
Caledonia	22,120	42,600	20,480
L. G. Bay	26,440	31,800	5,360
Ontario	7,852	13,300	5,448
Gowrie	46,204	61,368	15,164
International	59,000	74,000	15,000
Block House	44,000	55,000	11,000
G. M. Association	121,000	131,000	10,000
Lingan	28,000	35,000	7,000

While then Nova Scotia shipped some 70,000 tons less last year than the year previous, Cape Breton has increased her sales by no less than 124.000 tons. The combined shipments from Nova Scotia and Cape Breton this year, as will be gathered from the above figures, are at least 1,031,000 tons. The shipments or sales for 1880 were 954,959 tons, thus showing a net increase of over 76,000 tons in favor of 1881. The parties interested in some of the Cape Breton collieries who last year chartered steam colliers for the transportation of coal to Montreal, are reported to have lost heavily by the undertaking. More steamers were engaged than the mines could load with dispatch, and the result was that a large portion of their time was lost waiting for cargo at Sydney. A steamer of 1500 tons capacity cost the charterer about seven hundred pounds sterling a month, besides the cost of loading, discharging, and all port charges and pilotage. They have, therefore, to be handled very quickly to pay. No doubt the same class of ships will have to be brought out again this year, as transient tonnage will not likely offer sufficient to carry all the coal wanted in Montreal and Quebec. It is hoped that prudence will be displayed in chartering, as losses made in connection with these vessels are very frequently attributed to the unprofitableness of coal mining in Nova Scotia, whereas it is by the mismanagement of chartering agents that the losses are made. Some of the Pictou companies will also re-engage steamers this year.

—From the Trades Journal.

The returns from the various coal mines for the first quarter of 1882 have all been received by the Mines Department and indicate in an unmistakable way the flourishing state of our coal mining industry. The total amount of coal raised during the quarter ending 31st of March last was 196,884 tons, an increase of over 57,000 tons over the same quarter of last year. This shows not only expansion but enterprise, since very much of this increased output has been "banked" for the Spring trade, something which our coal mines heretofore did not care to venture on. The total sales amounted to 111,710 tons, an increase of about seven per cent. over last year's sales during the same time. Comparing the output and sales for the first three months of 1882 with those of the first three months of 1879—the last quarter under jug-handled free trade—we have the following results:

	Output.	*Sales.*
First quarter 1879	101,526 tons.	58,123 tons.
First quarter 1882	169,884 tons.	111,710 tons.

—From the Colonial Standard.

Powder Dividends in 1881.—The consumption of powder, especially blasting descriptions, has always been large in this State. Probably no corresponding number of population use as much. In early years, most of this material was imported. We still receive a good deal of Eastern powder. But we are, nevertheless, manufacturing on a scale as never before. Most of the capital thus employed is paying well. There are several companies that make no announcement of dividends disbursed, and yet they are considered to be more than meeting expenses. The California Powder Works, the pioneer enterprise, keeps its business pretty close, and yet it is understood that the dividends are as regular as the returning months. So far as this office is advised, the dividends of the local powder companies for the past year have been as annexed:

Atlantic Giant Powder Company	$120,000
California Powder Works	180,000
Excelsior Powder Company	10,000
Giant Powder Company	108,000
Vulcan Powder Company	10,000
Total	$428,000

The Vulcan paid for the first eight months. The Excelsior paid one in August.

San Francisco Bulletin.

Comparative Statement of the Salt Industry,

According to the Census Reports of 1880 and 1870, for the principal Salt-producing States,

States.	*Number of Establishments.* 1880	1870	*Capital Employed.* 1880	1870	*Wages Paid.* 1880	1870
United States	264	282	$8,225,740	$6,561,615	$1,256,113	$1,146,910
California	25	8	365,650	66,500	49,120	13,400
Kentucky	3	4	20,500	16,500	8.750	10,070
Massachusetts	6	9	9,000	27,300	1,030	1,875
Michigan	86	65	2,147,209	1,717,500	540,902	331,239
New York	69	93	2,286,081	1,584,211	274,087	[1] 204,226
Ohio	25	40	843,600	1,085,904	105,261	161,420
Pennsylvania	16	27	234,500	171,700	52,047	57,980
Utah	10	1	13,400	650	20,932	300
Virginia and West Virginia	11	20	1,909,500	1,631,300	174,446	290,800
Other States	13	15	407,300	260,050	29,538	75,600

States.	*Total Value of all Materials Used* 1880	1870	*Bushels of Salt Produced.* 1880	1870	*Total Value of Salt Produced.* 1880	1870
United States	2,071,424	1,760,670	29,800,298	17,606,105	4,817,636,	4,818,229
California	18,495	.....	884,443	174,855	121,950	[2] 48,150
Kentucky	9,008	5,520	83,000	64,000	21,950	20,920
Massachusetts	20	250	9,975	22,846	3,950	11,550
Michigan	1,009,723	410,561	12,425,885	3,981,316	2,271,913	1,176,811
New York	507,020	494,854	8,748,203	[1] 4,977,720	1,106,740	925,709
Ohio	202,543	325,922	2,650,301	2,898,649	363,791	773,492
Pennsylvania	74,074	83,203	851,450	579,970	177,415	187,312
Utah	4,000	240	483,800	1,950	66,180	780
Virginia and W. Virginia	231,113	385,255	3,105,333	4,635,813	508,047	1,508,855
Other States	15,445	27,865	557,908	268,986	181,700	164,650

[1] These figures are evidently incorrect, as the New York State Salt Inspector reported 8,662, 237 bushels in 1869 and 8,748,115 bushels in 1870.
[2] Amounts produced, by different processes.

States.	Amount Produced. By Solar Evaporation. *From Sea or Bay Water.*	*From Inland Lakes or Natural Depositories.*	*From Subterranean Brines.*	By Artificial Heat from Subterranean Brines. *By Kettle or Pan Process.*	*By Steam Evaporation Process*
United States	Bushels 886,968	Bushels 944,158	Bushels 2,998,000	Bushels 8,853,821	Bushels. 16,115, 331
California	678,083	6,350	. . .	. . .	. . .
Florida	900	. . .	. . .	. . .	. . .
Kansas	. . .	12,000	. . .	. . .	. . .
Kentucky	. . .	. . .	. . .	50,000	33.000
Louisiana	. . .	312,000	. . .	. . .	. . .
Massachusetts	9,975	. . .	. . .	. . .	. . .
Michigan	. . .	. . .	153,500	*184,270 †1,910,610	10,177,505
Nevada	. . .	114,908	67,500	. . .	. . .
New York	. . .	. . .	2,777,000	5,971,203	. . .
Ohio	. . .	. . .	. . .	276,343	2,373,958
Pennsylvania	. . .	. . .	. . .	. . .	851,450
Texas	. . .	16,600	. . .	34,000	. . .
Utah	. . .	482,300	. . .	1,500	. . .
Virginia	. . .	. . .	. . .	425,895	. . .
West Virginia	. . .	. . .	. . .	. . .	2,679,438

* Kettle. † Pan.

GOLD AND SILVER.

It is proper in taking up the question of gold and silver production in the United States, to begin with quotations from so excellent an authority as the San Francisco *Bulletin*. From the columns of that paper we take the following by way of review. Some tables printed here appear elsewhere also, but we have printed them twice rather than direct the reader to other pages. The *Bulletin* says:

After yielding over $300,000,000 and enriching many thousands, the great Comstock Lode has for the past four years been mainly worked by the contributions of those who still retain an interest in its development. During these four years the bullion product has been gradually growing less. For the fiscal year ending June 30th, 1881, Storey county is credited with a yield of $2,340,000. For the first nine months of the current calendar year the yield was only $972,000, and for the last third of that period the yield was only $173,200. Should the total for the fourth quarter be as large as for the third, the result for the year 1881 would be only $1,145,200. Old friends of the Comstock will note in these figures a strange contrast with the yield a few years ago, when a single mine in a single month, produced more bullion than the whole Comstock lode now produces in a whole year. But for the power to levy and collect assessments, work would have to be abandoned, and the miles of levels and drifts would soon fill with water and *débris*. There are over one hundred claims on the Comstock lode, though on a good many of them no work has been done for some time; and it will depend on the finding of an ore body whether any more work will be done on these temporarily abandoned claims. More or less work has been performed on about fifty Comstock claims during the past year

Many will be surprised at the number of Storey county mines that are being worked mainly by the help of friends. There have been 113 assessments levied this year for account of mines in that county. These assessments aggregate a total of $5,355,800, which has been distributed among 54 mines. There were 24 claims which levied only one assessment each during the year; 12 others levied two; 10 others, three; 5 others, four, and 3, the extreme limit of five assessments. Those in the last named category were the Bullion, Caledonia, Hale and Norcross. The Bullion and Caledonia have been sources of expense to owners for a score of years. Such faith deserves to be rewarded, but faith without the show of ore is dead. Following is a condensed statement of Storey county assessments for 1881:

Mine.	*Assessments.*	*Amount*
Alpha Con	1	$30,000
Alta	3	162,000
Andes	2	75,000
Belcher	3	234,000
Benton Con	2	54,000
Best & Belcher	2	100,800
Bonanza	1	15,000
Bullion	5	370,000
Caledonia	5	125,000
California	1	162,000
Concordia	1	75,000
Confidence	1	12,500
Con. Dorado	1	10,000
Con. Imperial	3	150,000
Con. Virginia	1	162,000
Crown Point	3	175,000
Choller	1	56,000
Exchequer	1	25,000
Flowery	1	10,000
Gold Lead	2	13,000
Gould & Curry,	2	108,000
Hale & Norcross	5	308,000
Iowa	4	21,000
Justice	2	52,500
Julia Con	3	99,000
Kentuck	2	24,000
Lady Washington	1	10,800
Leviathan	1	25,000
Lord of Lorn	2	25,000
Lower Comstock	1	50,000
Mexican	4	302,400
Morning Star	1	20,000
New Wells Fargo	1	5,000
New York	2	20,000
North Gould & Curry	1	25,000
North Sierra Nevada	1	10,000
Ophir	2	201,600
Original Gold Hill	1	3,000
Original Keystone	1	25,000
Overman	4	230,400
Phil Sheridan	1	10,000
Potosi	3	108,000
Prospect	1	10,000
Savage	4	252,000
Segregated Belcher	2	12,800
Sherwood Con	1	5,000
Scorpion	2	35,000
Sierra Nevada	4	400,000
Silver Hill	3	81,000
Trojan	1	10,000
Union Con	3	300,000
Utah	3	120,000
Utah Extension	1	10,000
Yellow Jacket	3	360,000
Totals	113	$5,355,800

The above mines have not only absorbed over $5,000,000 in assessments during the past year, but they have also used up their entire bullion product for the year, estimated at over $1,000,000. The industry has been rather an expensive luxury to those who have had to maintain it. But the contribution has supported many families in Storey county, and has served to keep in existence two Stock Boards in San Francisco, with their numerous attaches. Most of the mines in the above list have been in the assessment business for years, and are considered well up in the art of extracting money from their owners, under the promise of returning it with good interest. There are, however, some new candidates in the field, that deserve to be encouraged. The California mine, after paying $31,320,000 in dividends to stockholders, made its first demand upon them last August. In the following month, Consolidated Virginia made a similar demand upon its stockholders, the first since June, 1873. In the meantime the Consolidated Virginia paid its stockholders the magnificent sum of $42,930,000 in dividends. The assessment levied last spring by the Confidence mine is the first since 1878. The above is the first assessment on the Bonanza, Concordia, Gold Lead, Lorn of Lorn, Lower Comstock, Morning Star, North Gould & Curry, Sherwood Consolidated and Utah Extension. During the year 1880, 61 Storey county mining claims levied $7,989,900.

The last dividend from a Storey county mine was paid by the Consolidated Virginia in August, 1880. In January, 1880, the Ophir paid its last dividend, and in December, 1879, the California paid its last dividend. These are the only three Comstock mines that have paid any dividends since April, 1876, when Belcher paid its last dividend. Crown Point paid its last dividend in January, 1875. The only dividends that have come out of Storey county in the past two years was $100,800 by the Ophir in January, 1880, and $270,000 by the Consolidated Virginia in August, 1880. Against this $370,800, there has been paid into that county during the past two years, through assessments, about $13,-000,000; beside about $3,000,000 of bullion produced by the mines there during this interval. It is a case of patience that has a limit, but whether that limit will be reached before the reward comes, is the one great problem of those interested.

The first break in Consolidated Virginia dividends occurred in January, 1877. That was the forerunner of a changed condition of affairs on the Comstock Lode. It is true Consolidated Virginia has since paid nearly $16,000,000 in dividends and California over $22,000,000, but the reaction in the prosperity of that section fairly dates from the first interruption in these dividends. The only other dividends from the Comstock mines in the past five years are the two by the Ophir in December, 1879, and January, 1880. It is now sixteen months since there was a dividend from any mine in that section. This is a longer interval of non-dividends than has occurred before since the Comstock mines first began making these disbursements. The dividends and assessments of the principal mines there for the past five years are as follows:

	Dividends.	*Assessments.*
1877	$21,600,000	$6,306,200
1878	13,500.000	7,002,000
1879	3,070,800	7,259,500
1880	640,800	6,792,800
1881	....	4,825,200
Totals	$38,811,600	$32,185,800

In this race between what goes in and what goes out of the mines, the dividends still lead, but another year, similar to the past, will bring these two interests nearly neck and neck. The demands of the Comstock mines for the past year have been the most modest for a long time. In 1880, the Sierra Nevada Mining Company was bold enough to ask for $1,000,000 for development purposes. During the past year it has asked for $400,000. It has, however, already put in a claim for $100,000 on account of 1882. Unless some Comstock mine steps to the front soon with dividends, less money will be collected for account of assessments next year than has been collected during the past year. Should 1882 be as barren of dividends as 1881 has been, it is probable that the Comstock mines will be sold at lower figures than at any previous time in their history. The record of dividends and assessments on twenty-nine of these mines for the past five years has been as follows:

	Dividends.	*Assessments.*
Utah	......	$800,000
Sierra Nevada	......	3,150,000
Union Consolidated	......	1,000,000
Mexican	......	1,481,800
Ophir	$201,600	1,159,200
California	22,680,000	162,000
Consolidated Virginia	15,930,000	162.000
Best & Belcher	......	1,008,000
Gould & Curry	......	1,088,000
Savage	......	2,100,000
Hale & Norcross	......	1,512,000
Chollar	......	784,000
Potosi	......	392,000
Julia Consolidated	......	1,259,500
Bullion	......	1,920,000
Exchequer	......	325,000
Alpha Consolidated	......	210.000
Consolidated Imperial	......	2,250,000
Confidence	......	25,000
Yellow Jacket	......	2,400,000
Kentuck	......	63,000
Crown Poiut	......	1,475,000
Belcher	......	1,872,000
Overman	......	1,285,200
Caledonia	......	875,000
Silver Hill	......	982,800
Justice	......	1,732,500
Alta	......	1,404,000
Benton Consolidated	......	307,800
Total	$38,811,600	$32,185,800

Every one of the above mines was in the assessment list during the past year. This has never occurred before. Confidence has levied only two assessments in five years. The promised Sierra Nevada bonanza is found to have had an existence only in the pockets of stockholders.

Comstock Product for Quarter Ending June 30, 1882.

This is reported by the Story county assessor as follows:

Mine or Company.	*Tons Extracted.*	*Gross yie'd or value.*	*Cost Extraction & Reduction.*	*Net yield.*	*Tax.*
Union Con	7,936	$243,335 :8	$217,044 00	$97,334 23	$4,769 37
Belcher	4,000	67,445 03	65,508 25	13,489 00	593 50
Crown Point	11,100	156,702 11	159,700 26	31,340 42	1,378 97
Kentuck	1,150	20,826 50	19,700 00	4,165 30	183 27
Challenge	122	1,695 80	1,830 00	339 16	14 92
Con. Imperial	724	10,063 10	10,760 00	2,012 72	88 56
Confidence	84	1,167 10	1,260 00	233 52	10 27
Total for mines	25,116	$501,235 22	$466,795 51	$148,914 35	$7,038 86
TAILINGS.					
Challenge	78	390 00	300 00	$ 90 00	3 96
Con. Imperial	568	2,840 00	2.272 00	568 00	25 00
Confidence	64	320 00	256 00	64 00	2 81
Cours·r	107	856 00	960 60	85 60	2 48
Mariposa	3,440	15,929 14	12,778 69	3,150 75	154 38
Grand To'als	4,257	$20,33; 14	$16,566 39	$3,958 35	$ 188 63

Lake County, Colorado Product.—By request, the *Herald* publishes the following statement of the product of Lake county since 1860. The figures are those compiled by Commissioner Reed, and are displayed in connection with the Lake county exhibit at the exposition, and are divided into two periods, representing respectively the ante-Leadville and the Leadville eras, the latter dating from the time when the carbonate ores of Leadville began to form a considerable factor in the output:

PRODUCT OF LAKE COUNTY—FIRST PERIOD.

1860–1873, gold from placers	$6,400,000
1874, gold and silver	145,000
1875, " " "	113,000
1876, gold, sil er and lead	852,00
1877, " " " "	555,330
1878, " " " "	3,152,925
Total	$10,451,455

PRODUCT OF LEADVILLE—SECOND PERIOD.

1879, gold, silver and lead	$10,333,740 60
1880, " " " "	14,187,697 00
1881, " " " "	13,170,576 00
1882, " " " " first half	7,817,918 00
Total product of Leadvillc	$45,509,931 69
Product of Lako County	10,451,455 00
Total product, 1860 to July 1, 1862	$55,961,380 69

—*Leadville Herald.*

Nova Scotia.—From the last annual report of the Government Inspector of Mines, M. E. S. Gilpin, we obtain the following:

The following summary shows, so far as I have been able to learn, the extent of the mineral production of Nova Scotia during the year 1881, compared with that of the previous year:

Gold	Ounces	13,234	10,756
Iron Ore	"	51,193	39,843
Manganese Ore	Tons	223	231
*Coal raised	"	1,032,710	1,124,270
†Gypsum	"	128,528	107,133
†Building stone	"	3,540	6,638
†Barytes	"		40
Coke Made	"	13,125	27,871
Fireclay	"	75	401
Grindstones, etc.	"	1,500	1,680

Through the kindness of the Collectors of Customs at the ports specified, I am enabled to give further details under this head at the end of the Report.

Gold.—The total yield of gold during the past year was 10,756 oz. 13 dwt., 2 grs., against 13,234 oz. in 1880. The returns from unproclaimed districts amount to 2,436 oz. 9 dwts. 12 grs., an increase of 1,594 oz. 4 dwts. 23 grs. over the preceding year. The continued decline in the produce of several districts which hitherto yielded uniform returns, has outweighed the increased production of several districts. During the past year the extraction of quartz was more or less suspended in the following Mines, which were sold and being prepared for work on a more extensive scale, viz: Moose River, Satemo, Gallagher and Renfrew. A large number of other mines which have hitherto contributed to the returns, have been idle during part of the year, pending negotiations for their sale; among these may be mentioned, Strawberry Hill, Fifteen Mile Stream, Harrigan's Cove, Moosehead, Symonds, and several Mines at Oldham and Mount Uninacke. That the interest in the Mines has not diminished is shown by the fact that in spite of the suspension of work alluded to above, the returns, not including a large amount of prospecting done at Chezzetcook, Beaver Dam, and other places, show a much larger number of days' work than in the previous year. Under these circumstances the outlook for the year 1882 is of a favorable character, as in it should be reaped the fruits of the large amount of preliminary work performed during the past year.

General Annual Summary.

Year.	*Total ounces of Gold extracted.*	*Stuff Crushed.*	*Yield per ton of 2,000 lbs.*	*Total Days' Labor.*	*Average earnings per man per day and year, at 300 working days, $18 per oz.*	
	Oz. Dwt. Gr.	*Tons.*	*Oz. Dwt. Gr.*		*A day.*	*A year.*
1862	7,275	6,473	1 2 11	156,000	$ 83	$249
1863	14,001 14 17	17,002	16 11	273,624	92	276
1864	20,022 18 13	21,434	18 16	252,720	1 42	426
1865	25,454 4 8	24,423	1 0 20	212,966	2 15	645
1866	25,204 13 2	32,161	15 2	211,796	2 14	642
1867	27,314 11 11	31.386	17 9	218,894	2 24	672
1868	20,541 7 10	32,262	12 17	241,462	1 53	459
1869	17,868 0 19	35.147	10 4	210,938	1 52	456
1870	19,866 5 5	30,829	12 21	173,680	2 05	615
1871	19,227 9 4	30,791	12 11	162,994	2 12	636
1872	13,094 17 6	17,093	15 7	112,476	2 09	627
1873	11,852 7 19	17,708	13 9	93,470	2 28	684
1874	9,140 13 9	13,844	13 5	77,246	2 12	636
1875	11,208 14 19	15,810	15 4	91,698	2 20	660
1876	12,038 13 18	11,490	15 13	111,304	1 94	582
1877	16,882 6 1	17,369	19 10	123,565	2 46	738
1878	12,577 1 22	17,990	13 23	110,422	2 05	615
1879	13,801 8 10	15,936	17 8	92,002	2 34	702
1880	14,234 0 4	14,037	18 20	103,826	2 18	54
1881	10,756 13 2	16,556	12 20	126,308	1 52	456
Total.	321,362 18 7	412,741	......	3,157,191	....	....

* Ton of 2240 pounds.

† Quantities shipped. Amounts used in Nova Scotia unknown. No return sent of plaster shipped from Baddeck.

GENERAL STATEMENT FOR THE YEAR 1881.

Showing the number of Mines at Work, days' labor performed, quantities of Quartz crushed, Yield of Gold, for the year ended December 31st, 1881.

District.	Number of Mines.	Days' Labor.	Mills Employed.	Steam Power.	Water Power.	Quartz, &c. Crushed.	Yield per Ton. Oz.	Dwt.	Gr.	Maximum Yield per Ton. Oz.	Dwt.	Gr.	Total Yield of Gold. Oz.	Dwt.	Gr.	Average yield per man per day for 12 months at $18.00 per oz.
Caribou	3	15,426	3	2	1	1661	0	13	14	6	3	16	1,129	18	13	1.31
Gay's River	1	274	...	...	...	...	...	...	...	...	...	...	12	14	7	.78
Montagu	2	17,982	2	2	...	1165	0	15	10	3	1	15	900	6	17	.90
Oldham	1	2,471	2	1	1	604	0	10	21	1	7	9	329	10	4	.98
Renfrew	2	6.038	1	...	1	583	0	9	5	1	5	19	269	8	13	.96
Sherbrooke	10	29,285	6	4	2	6,279	0	9	18	6	3	0	2,580	2	20	1.58
Stormont	1	4,332	...	...	...	80	2	3	9	2	3	9	173	10	0	.73
Tangier	3	11,721	3	1	2	716	0	11	3	2	6	7	399	9	16	.61
Uniacke	3	10,003	4	3	1	3,094	0	8	23	2	0	0	1,355	8	21	2.28
Waverley	2	5,517	3	1	2	535	0	14	0	1	18	6	374	0	0	1.32
Wine Harbor	1	6,098	1	...	1	652	1	8	20	3	3	0	795	14	0	2.80
Unproclaimed	4	19,161	5	1	4	2,287	1	1	7	2	11	9	2,436	9	12	2.20
	33	126,308	30	15	15	16,556	0	12	20	6	3	16	10,756	13	2	1.52

Gold Product and Coinage of Brazil, 1878–1881.—Our esteemed correspondent, Mr. Alexander Del Mar, now in Brazil, has done us the favor to procure specially for the MINING RECORD the following exhibit of the gold product and coinage of the empire for the three fiscal years ending 30th June, 1881:

	1878–1879.		1879–1880.		1880–1881.	
	Grammes.	*Official Value.*	*Grammes.*	*Official Value.*	*Grammes.*	*Official Value.*
*Dust	402,729	$487,242,130	38,812	$39,200,120	146,456	$147,910,800
*Bars	992,078	1,101,206,120	1,054,370	1,170,350,700	890,300	988,233,800
*Amalgam	...	......	173,963	193,098,930	...	......
Bullion Cast	116,034	127,688,033	79,121	87,824,783	87,880	87,208,000
Coined	67,655	64,314,371	45,693	50,970,447	32,589	36,352,000

BRAZILIAN MINT, RIO DE JANEIRO, July 21, 1882.

DEAR SIR.—I send you these statistics of the annual production of gold such as it was taken at the Rio Custom House and the meagre gold coinage at the mint, during the last three financial years. As for my reports they are not published.

HON. ALEX. DEL MAR. B. J. R. LOBRAGY, Director of Mint.

—*Mining Record.*

A Small Source of Gold.—The Government *Gazette* of Surinam, dated Sept. 7, 1880, notified the export of gold from that colony as follows:

	Guilders.		Guilders.
1876	49 900	First half 1880	390,697
1877	293,880	July	75,922
1878	407,059	Aug	85,343
1879	679,914	Sept	34,074

The total value of the export of gold from 1876 to Sept. 1880 is 2,066,789 guilders, or about $861,160 or 172,232*l.* 8s. 4d. sterling.

Estimated Aggregate Production of the Precious Metals during the Twenty-seven Years from 1849 to 1875 inclusive.

Countries.	*Gold.*	*Silver.*	*Gold and Silver.*
	Million dollars.	Million dollars.	Million dollars.
Entire World	2,761.7	1,573.9	4,335.6
United States	1,351.6	265.55	1,617.15
Other Countries	1,410.1	1,308.35	2,718.45

Annual Average Production of the Precious Metals in the World, also in the United States of America, since 1848, the Year of the Discovery of the Gold-fields of California.

Countries.	*Epochs.*	*No. of Years.*	*Gold.*	*Silver.*	*Gold and Silver.*
			Million dollars.	Million dollars.	Million dollars.
Entire World	1849–'75	27	102.29	68.29	160.68
United States	1849–'75	27	50.06	....	59.89
" "	1859–'75	17	....	15.62	.....
Other Countries	1849–'75	27	52.23	49.94	102.17

*Entered at Custom House for Export.

MINING AND MILL SUPPLIES AND WAGES AT BUTTE, MONT.

WE are indebted to Mr. G. W. Maynard for the following details of the cost of wages and supplies for mine and mill:

Mines.—*Wages, per Day.*—Miners, $3.50; timbermen, $4.00; pumpmen, $4.50; toolpackers, (boys) $2.00; chief engineer, $5.00; assistant engineer, $4.00; fireman, $3.50; woodman, $2.25; topmen, (carmen) $3.50; carpenters, $5.00; carpenter's helper, $3.50; blacksmith, $5.00; blacksmith's helper, $3.50; foremen, $5.00; stablemen, $3.25; ore haulers, $3.00; assayers, $4.00; assayer's helper, $1.66.

Mill.—General foreman, $5.00; foremen, $5.00; crushers, $3.50; batterymen, $4.00; roasters, $4.00; cooling floor, $3.50; wood helpers, $3.00; amalgamators, $4.00; carmen, $3.50; melter, 5.00; assistant melter, $4.00; engineers, $4.00; firemen, $3.50; millwright, $5.00; chief machinist, $6.00; machinists, $5.00; machinist's helper, $4.00; watchman, $3.50; talingsman, $2.50; roustabout, $3.00; saltman, $3.00.

Supplies.—Wood, per cord, $6.00; mine timber, per thousand, $25.00; charcoal, per bushel, 18 cts.; candles, box, $6.50; lagging, each, 12½ cts.; Hercules powder, No. 1, 55 cts.; Hercules powder, No. 2, 40 cts.; fuse, per thousand feet, $9.00; black powder, per keg, $7.50; hammers, per pound, 24 cts.; pickeyes, per dozen, $8.00; pickeye handles, per dozen, $3.50; sledge handles, per dozen, $2.35; shovels, per dozen, $11.50; battery shoes and dies, per pound, 08 cts.; pan shoes and dies, per pound, 08 cts.; mullers, each, $132.00; iron turnings, per pound, 05 cts.; brass screens, per square foot, 42 cts.; rubber belting, 6-inch, 4-ply, 38 cts.; 8-inch, 4-ply, 42 cts.; 10-inch, 4-ply, 54 cts.; 14-inch, 4-ply, $1.00; 20-inch, 4-ply, $1.25; 36-inch, 7-ply, $3.80; leather belting, 8-inch raw hide, $1.40; 10-inch, raw hide, $1.85; cyanide of potassium, per pound, 50 cts.; bluestone, per pound, 13 cts.; coal oil, per gallon, 50 cts.; lard oil, per gallon, extra, $1.30; lard oil, per gallon, No. 1, $1.05; lard oil, per gallon, No. 2, 90 cts.; tallow, 09; lubricating oils, $1.75; heavy lubricators, 65 cts.; cotton waste, per pound, 15 cts.; Packing, 60 cts.; Assay materials: No. 8 crucibles, French, per dozen, $1.40; No. 8 crucibles, French, covers, per dozen, 75 cts.; Black-lead crucible, No. 50, $3.75; litharge, per pound, 13 cts.; bone-ash, per pound, 09 cts.; muffles, each, $1.00; bicarbonate of soda, per pound, 09 cts.; assay, lead, per pound, 12 cts.; argols, per pound, 19 cts.; nitric acid, C. P., 50 cts.; borax, pulverized, per pound, 25 cts.; borax, crystallized, per pound, 17 cts.; quicksilver, per pound, 43 cts.; battery stems, $42.20; hydraulic cement, 06 cts.; steel dies, per pound, 09 cts.; iron dies, per pound, 08 cts.; drill steel (English), per pound, 22 cts.; boiler tubes (3¾), $9.30; gas pipes, per foot, 80 cts.; wire rope, Roebling, 1 inch, 37 cts.; wire rope, Roebling, ⅝ inch, 18 cts.; hemp rope, per pound, 14 cts.; Babbitt metal, per pound, 18 cts.; copper rivets, 42 cts.; salt, per ton, $39.00.

THE PRODUCTION OF PRECIOUS METALS IN 1881—MR. BURCHARD'S REPORT.

THROUGH the courtesy of Hon. H. C. Burchard, Director of the Mint, we are enabled to present herewith the substance of his "Report on the Production of Precious Metals in the United States in 1881," in advance of its publication by the government. In it will be found much that is valuable and pertinent to the history of American Mines and Mining.

TREASURY DEPARTMENT,
BUREAU OF THE MINT,
Washington, D. C., June, 1882.

SIR:—I have the honor to submit herewith my report upon the production of the precious metals in the United States for the calendar year 1881.

To procure the information necessary for preparing and making this report, besides obtaining from depositors in the usual manner the locality of production of the gold and silver brought to the mints and assay offices, the superintendents and assayers in charge of institutions in the mining regions were directed to make special inquiries, and endeavor to ascertain the yield of the mines and the amount of bullion handled by dealers, bankers, and transportation companies, and treated at smelting and refining works in their respective localities.

Information was also gathered for the same purpose by personal visits to the most important mining fields, and by correspondence and special reports from gentlemen concerned in, or familiar with, mining operations, and by the collection and tabulation in my office of such published statements and statistical material as seemed suitable and reliable.

From these sources I am able, with reasonable confidence, to present not only a summary of the yield of the mines of the United States for the year, but also detailed statements or estimates approximately and sufficiently accurate, giving the product of the respective States and Territories, and often, in many cases, of the counties and districts.

The official records of the Mint Bureau show the amount and character of the bullion deposited and purchased during the year, and what portion came from the mines of the United States. They also show the amount of gold and silver used in coinage, and the amount delivered back to depositors in the form of bars.

The Custom-House records give the amount exported, and the reports from manufacturers state approximately the aggregate amount used by them in manufactures and the arts. By ascertaining and adding the domestic gold and silver deposited at the mints and assay offices, and the undeposited domestic bullion exported and used in the arts, the total production of the year can be estimated and stated with sufficient certainty for statistical purposes.

DOMESTIC PRODUCTION OF GOLD IN 1881.

The deposits of gold at the mints and assay offices during the year were $98,763,426.08, of which $34,871,859.46 were reported to be of domestic production.

The export of domestic gold bullion for the year was only $160,766, but wholly in bars, manufactured at private refineries.

The amount of undeposited domestic gold used in the arts must, in part, be estimated. It may safely be placed at half a million of dollars; for while the manufacturers' statements received at this Bureau show that fine gold bars to the value of $6,230,000 were used by them in manufacturing during the fiscal year 1881, the aggregate value of the fine gold bars issued for manufacturing purposes by the New York Assay Office, and of all the fine gold bars made at the mints during the same period, was only $5,960,094.31. The remaining $270,000 of the fine gold bars reported by manufacturers must have been obtained from private refiners and assayers, by whom fine gold bars are also prepared for use in manufactures, consisting principally of domestic bullion received directly from mines or smelting works. The statements of the manufacturers did not include the value of the native gold in the form of grains, ingots, lumps, etc., used for ornamentation and in the arts, which would amount to a considerable sum.

Although this estimation is based upon statements and reports made for the fiscal year, the facts they disclose show that to ascertain the total gold production during the calendar year, an addition to the domestic gold bullion deposited and exported of perhaps half a million dollars should be made for bars manufactured at private establishments, and native gold used in the arts.

From these data, the yield of gold from the mines of the United States in 1881 might be placed, in round numbers, at $35,000,000.

As, however, the imports exceeded the deposits of foreign gold bullion at San Francisco by 348,101, a portion of which refined by the Selby Works in that city may have been reported at the mint as domestic bullion. I have added for undeposited domestic gold only the $270,000 shown by the reports received at my office to have been used in manufactures. This makes the total gold production in the United States, for the calendar year 1881, to have been:

Deposited at Mints and Assay Offices	$34,270,000
Undeposited exports	160,000
" " used in the arts	270,000
Total	$34,700,000

This is over four millions higher than the estimated gold production west of the Missouri river, published by Mr. Valentine, who, from the amount of bullion carried in various forms by express and other conveyances, and the estimated proportions of gold and silver contained, puts the gold domestic production for the calendar year 1881 at $30,653,959.

In my former report, I estimated the gold production for the calendar year 1880 at $36,000,000, from which the production of 1881 has declined over one and a quarter million of dollars.

SILVER PRODUCTION.

The mines of the United States produced of silver bullion during the year 1881, as indicated by the receipts at the mints and customs and manufacturers' returns, $43,000,000, if computed at its standard dollar coining value, or about $37,000,000 at its commercial value.

The purchases for coinage and deposits for bars at the mints and assay offices amounted to $30,326,848.24, of which $27,899,213.13 were of domestic production.

The exports of domestic silver bullion at all the ports of the United States were valued at $12,796,280, worth at the coinage rate about $14,500,000.

Of the $30,326,848.24 silver bullion received at the mints and assay offices, $25,008,268.55 was purchased for coinage, leaving a balance of $5,300,000 deposited for bars. These deposits were $700,000 less than the estimated annual consumption of silver bullion in the United States for manufactures, which deficiency, while undoubtedly containing some foreign coin and bullion, was composed principally of domestic bullion received from private refineries.

I therefore add to the deposits and exports of domestic bullion $600,000 for undeposited domestic bullion used by manufacturers during the calendar year, making the total production of silver bullion deposited at the mints and assay offices $27,900,000, exported $14,500,000, undeposited used in manufacturing $600,000—Total, $43,000,000.

This gain of nearly $4,000,000 over my estimate for the silver production in 1880, resulted from the opening of new mines in portions of Colorado, which fully compensated for the decline in the yield of the Leadville region, and from greater silver production in Arizona, Utah, Montana, and Idaho, notwithstanding the heavy falling off in the yield of the silver mines of Nevada.

It is impossible to determine with exactness the amount of gold and silver supplied from the mines of each State and Territory; but a comparison of the various data received at my office justifies this statement as an approximate estimate.

Production of Gold and Silver in the United States during the calendar year 1881, by States and Territories.

	Gold.	*Silver.*	*Total.*
Alaska	$15,000	$ . . .	$15,000
Arizona	1,060,000	7,300,000	8,360,000
California	18,200,000	750,000	18,950,000
Colorado	3,300,000	17,160,000	20,460,000
Dakota	4,000,000	70,000	4,070,000
Georgia	125,000	. . .	125,000
Idaho	1,700,000	1,300,000	3,000,000
Maine	. . .	5,000	5,000
Montana	2,330,000	2,630,000	4,960,000
Nevada	2,250,000	7,060,000	9,310,000
New Mexico	185,000	275,000	460,000
North Carolina	115,000	. . .	115,000
Oregon	1,100,000	50,000	1,150,000
South Carolina	35,000	. . .	35,000
Tennessee	5,000	. . .	5,000
Utah	145,000	6,400,000	6,545,000
Virginia	10,000	. . .	10,000
Washington	120,000	. . .	120,000
Wyoming	5,000	. . .	5,000
Total	$34,700,000	$43,000,000	$77,700,000

Of the gold production (about $26,000,000), nearly four-fifths of the whole came from the mines of the Pacific coast, including Nevada, Idaho, and Arizona, and was deposited with the San Francisco and Carson mints, while nearly eight millions were received at Philadelphia and New York from Colorado, Dakota, and Montana.

Colorado was again the largest producer of silver, although the yield of the Leadville mines has greatly diminished.

The production of the Tombstone mines brought Arizona to the second rank, and Nevada, once the first, now stands third, her production only exceeding that of Utah by a few thousand dollars.

Besides the material and contributions furnished for this report, for which credit is given in the appropriate place, I have received valuable information and assistance from other officers and gentlemen connected with the mint service or interested in the production of the precious metals, to whom special acknowledgments are due. The superintendents and officers of mines, mills, smelters, and reduction works have furnished me liberally with details showing the character, source, and amount of bullion produced in their business. Bankers and bullion dealers have supplied me with information as to the amount and locality of production of the bullion handled by them, and express and railroad agents and officers have forwarded tabulated statements of the shipments of ore and bullion during the year by their respective companies.

In reviewing the condition of the mining industry in Colorada, Montana, Utah, and Idaho, credit is given to the gentlemen to whom had been assigned the collection of statistics, or who had furnished information from those localities. Their contributions, however, from fuller information received at my office, have been revised, modified, and in some cases rewritten.

A considerable portion of the statistics and materials relating to the mines of California, Oregon, and Nevada, with some information in regard to Idaho and Arizona, was procured by Mr. A. M. Lawver, Superintendent of the Mint at San Francisco, to whom I gave special charge of the collection of statistics on the Pacific coast.

The report upon the mines of New Mexico was prepared by Mr. F. P. Gross, of my office, who personally visited that Territory, and who also compiled and arranged the information received from all sources in relation to mining in Arizona.

While acknowledging my indebtedness to these and many other gentlemen who have to a greater or less extent contributed statistical and other information, special mention should be made of the valuable assistance of Mr. Frederick Eckfeldt, of my office, who has had the general charge of this work, and has ably assisted me in preparing, classifying, and arranging material for this report.

I have the honor to be,
Very respectfully,

Director of the Mint.

HON. CHARLES J. FOLGER,
Secretary of the Treasury.

ARIZONA.

THE mineral bearing sections of Arizona are not local, but are found in all parts of the Territory, except the single county of Apache, in which are rugged, unexplored mountain ranges, that, as is confidently believed by many intelligent people, may also, upon being properly prospected, be found to contain rich mines of silver. In fact there are rumors of such discoveries, which could not, however, be traced to a reliable source, and no mention will be made of them. For more than twenty years the existence of the precious metals in certain portions of the Territory was well known, and mining was commenced in a few of the western counties by adventurous miners from California. Rich prospects were found, and some mines opened, that, under favorable circumstances, would have become profitable. The first considerable ventures of this nature were made in Mohave county, but great distance from sources of supplies, indifferent roads, and inadequate means of transportation caused them to be attended by such enormous expense, that many were necessarily abandoned. The richness of the ores, however, permitted their profitable shipment to San Francisco for reduction, and supported a considerable mining population. Mills and smelters have since been erected, but the industry is barely prosperous. This is true not only of Mohave, but applies to the entire Territory, except that portion opened up by the completion of the Southern Pacific Railroad, which has greatly stimulated the mining industries of the southern half of the Territory. In addition to its inaccessibility, the prosperity of the Territory has been greatly retarded by Indian troubles. For many years it was the stronghold of the Apache, the most warlike and rapacious tribe of Indians of our frontier, who have stubbornly resisted the advancement of civilization. There is scarcely a settlement or mining camp in any portion of the Territory that is not marked by the graves of numerous victims of their cruelty, and the road-sides and cañons on every hand show, by rude crosses or heaps of stone, the last resting-places of hundreds who have been murdered by them. The mineral belt of the Territory, as now defined by actual exploration and valuable discoveries, embraces all that portion south of the thirty-fourth parallel and the southern portions of Mohave and Yavapai counties. Gold and silver lodes have been found in almost every mountain range and isolated peak of this section, and actual developments already made in many places, demonstrate their richness and apparent permanency. Gold placers have also been found in many portions of the Territory, which, after yielding large amounts in nuggets and dust, were abandoned on account of the scarcity of sufficient water to conduct operations upon a scale extensive enough to be profitable. Considerable quantities of gold are, however, still obtained from them by individual enterprise, Mexicans principally, who transport the pay-dirt to the nearest water during the dry season. Many gulches and dry beds of creeks are thus worked by individual effort, and good wages are made generally by those engaged. Arrangements are being made to wash the gravel of some of the streams, notably the San Francisco river, by the hydraulic process, and to this end water is being piped long distances, and expensive plants have been put in place. The most important mining region in the Territory, in point of development at least, is that of Tombstone, in Cachise county, in which the first location was made in 1878 with a single exception, the Bronkow, which is noted in the body of this report. Active development was, however, not commenced until upwards of a year later, when the first stamp-mill was erected. Now a dozen or more, with a capacity of over 200 stamps, are in active operation, and the monthly yield of bullion is doubtless in excess of half a million in gold and silver. The southeastern portion of Pima county and the northern portions of Pinal and Gila counties are also practically demonstrated to be prolific bullion producers. When it is remembered that railroad communication with this section has only been established a year and a half, the result will be found to be truly marvelous. Railroad enterprises are now under way, which will at an early day bring all the important mining centres in direct communication with points on the Southern Pacific; and in addition to this, the northern half of the Territory will be opened by the extension of the Atlantic and Pacific, which, as now marked by the preliminary surveys, will pass through a portion of the mineral belt of Mohave county; and a road north from Prescott to intersect this will give the many mines of that section the advantage of outside railroad communication. A road will also be completed at an early day from Prescott southward, which will traverse the richest portion of the mineral belt south of that city in Yavapai, and north of Phœnix in Maricopa, county. Perhaps no other mining section in the country possesses as favorable facilities for the mining and reduction of ores as the Territory of Arizona. Wood and water are abundant in nearly every locality for necessary mining purposes, and when the supply of wood for fuel becomes exhausted, the coal beds, which underlie at least one-half of the Territory, can be relied upon for centuries to come. The ores generally are easy mined, and can be reduced at the minimum of expense. The smelting varieties are reported to be unusually tractable. In the richness and variety of its ores it differs materially from any other mining section of the country. Pure native silver, in leaf and wire form, chlorides, carbonates, sulphurets, ruby silver, silver glance, bromides and sulphides, are some of these, and those most generally found. It is especially noted for its yield of wonderful masses of pure native silver, *planchos de plata*, the largest of which weighed almost two tons avoirdupois. It was at any rate sufficient in quantity to tempt the cupidity of the Spanish king, who confiscated the production of the mine to his own use. Arizona possesses also the advantage of an equable climate, and work can be prosecuted at all seasons of the year. Snow, except in the mountains, is scarcely known, and the heat in the mining localities is not excessive except in a few districts of Yuma county, where the thermometer sometimes records a very high temperature. The following is my estimate of the production of Arizona, by counties, for the calendar year 1882: The production of Arizona during the calendar year 1881 was $1,060,000 in gold, and $7,300,000 in silver, which I estimate was produced, by counties, as follows:

Counties.	*Gold.*	*Silver.*	*Total.*
Cochise	$645,000	$4,065,000	$4,710,000
Pima	15,000	750,000	765,000
Pinal	25,000	1,250,000	1,275,000
Gila	30,000	530,000	560,000
Yavapai	50,000	450,000	600,000
Maricopa	240,000	75,000	315,000
Mohave	25,000	75,000	100,000
Yuma	30,000	105,000	135,000
Total	$1,060,000	$7,300,000	$8,360,000

Mohave County.—This county lies in the northwestern corner of the Territory. The Colorado river skirts the western boundary for fully two-thirds of its length, otherwise it is bounded by Nevada on the northwest, Utah on the north, Yavapai county on the east, and by Yuma county on the south. The most important portion of the county lies south of the Colorado, and is traversed by extensive mountain ranges and wide valleys, abounding in nutritious grasses, and admirably adapted for stock raising. The valleys of the Colorado and Big Sandy, by the aid of irrigation, are rendered exceedingly productive, and the settlers in those regions devote themselves exclusively to agricultural pursuits. The northern portion, that cut off by the Colorado, has been but little explored, and is generally believed to be a rugged, bleak, and barren waste. Evidently the future prosperity of this county must depend largely upon its promising mineral resources, although there was a decided falling off in the silver bullion production during the calendar year 1881; the gold production was about the same as that of 1880. The people of this county believe the decline is due to inaccessibility rather than a failure in productiveness, and anxiously look forward to the completion of the Atlantic and Pacific Railroad, confident that improved facilities of communication will insure their future prosperity. They have easily succeeded in persuading themselves that every prospect is a bonanza, and that the marvelous richness of their mines, as soon as known, will insure the influx of capital, if improved means of communication are afforded. This confidence is not without reason, for hitherto the revenue derived from higher-grade ores only—none less than $200 in value being profitably mined and shipped—has been sufficient to support the population. The railroad has been completed to a point in Eastern Arizona, over two hundred miles west from Albuquerque, and its construction westward is being pushed forward as rapidly as possible. It will most likely penetrate the mineral section of the county about June or July, 1883, and test the reality of the dreams of the prospector and miner. The Aubrey, Cedar Valley, Greenwood, Hualapai, Maynard, and San Francisco are the most important and best known mining districts of Mohave county. The first three are in the extreme south. Hualapai and Maynard are located near the center, south of the Colorado river, and the San Francisco district is in the western portion, skirting the river. These districts embrace the major portion of the known mineral-bearing area, and contain many valuable mines and locations in which ore bodies of gold, silver, argentiferous galena, and copper, carrying both gold and silver, are found. The Hualapai district is formed by the sub-districts or camps of Cerbat, Todd Basin, Chloride, Stockton, and Gold Basin, the last of which is in the extreme northern portion of the district. Reports from this county are somewhat meagre; the following, however, from the Stockton camp on the east side of the Cerbat range is of interest: The average mill runs of ores from the mines of this camp are above $300 silver per ton. The general strike of the principal veins is northwest, although many small seams or feeders of high-grade ore run into them at various angles. The veins are usually found in a granite formation, frequently with one wall of porphyry. Among the most important mines of the camp now worked are the Franklin, Little Chief, Cupel, Silver Monster, Cincinnati, Miner's Hope, Blue Bell, Fremont, Fountain Head, Pure Metal, and Tigress.

The production of Mohave county during the census year 1880 was reported by the Census Bureau to be (by districts) as follows:

District.	*Gold.*	*Silver.*	*Total.*
Cedar Valley		$7,430	$ 7,430
Hualapai	$9,251	65,134	74,385
Maynard		18,944	18,944
Owens		16,800	15,800
Scattered		9,070	9,070
Total	$9,251	$116,378	$125,629

I have estimated the production for the calendar year 1881 to have been $25,000 in gold and $75,000 in silver.

Yavapai County.—This extensive county covers fully one-fourth of the entire area of the Territory. It is bounded on the north by Utah Territory, on the east by Apache county, on the south by Gila and Maricopa counties, and by Mohave on the west. About one-third of the northern portion of the county is cut off from the remainder by the Colorado and Little Colorado rivers. Like Mohave, but little is known of this region except that it is extremely rugged and mountainous. Whether the mountains contain, as is generally believed, mineral deposits, is yet to be proven by the prospector. The more favored portions of the county even are difficult to penetrate, but the discovery of valuable gold and silver mines by adventurous prospectors, has stimulated enterprise and brought a considerable influx of population to that part of the county west of the Verde river, and especially in the vicinity and south of Prescott. The county generally is an elevated plain traversed by mountain ranges, with occasional isolated peaks. The plains and valleys are covered with a luxuriant growth of grass, upon which cattle thrive during the entire year, as the snow-falls are not excessive and generally melt rapidly. Its agricultural resources are unfavorable, although the soil of the valleys and plains is fertile, for the seasons are irregular and rains uncertain. Tillage must therefore be confined to low meadow lands susceptible of irrigation, and as those are of limited extent, the prosperity of the people must depend upon the mineral resources and stock raising. As yet the production of the precious metals has been only in that portion of the county extending about fifty miles north from its southern boundary, and lying between Mohave county and the Verde river. Within the past few years more favorable localities, opened to the prospector and miner by the completion of the Southern Pacific Railroad, have attracted capital and enterprise from the mines of this county. The prosperity of Yavapai has, like that of Mohave, been greatly retarded by its remoteness from lines of communication, and the expense of transporting ores and concentrations and the necessary mining machinery and supplies. Only the richer ores of the mines could be profitably mined and treated, and some idea may be formed of their value from the fact that the entire community for many years has been supported from their product without external aid, to say nothing of the large fortunes that have been accumulated. The placer mines of this section first attracted attention about twenty years ago, and soon thereafter discoveries of lodes, of both gold and silver, were made at various points. The placers were found to be of great value, were profitably worked for some years, and abandoned only by reason of the scarcity of water and the discovery of mineral lodes. By the term "abandoned" it is not intended to convey the idea that the placers were entirely deserted, as they have been constantly worked to the present time, and are represented still to give good returns for labor employed upon them. Notwithstanding these disadvantages, the reports of the production of both gold and silver during the year 1881 show a large increase over that of the previous calendar year. The following are the estimates, as carefully compiled from the most reliable returns received: Gold $19,124 as against $5,000 for 1880, and silver $716,389 to $265,000 for the same time. This increase is in a measure due to the stimulus given to mining industry throughout the Territory by the completion of the Southern Pacific Railroad, but it may be safely predicted that within a year or so even this production will be largely enhanced by the construction of the Atlantic and Pacific, and a new railroad which is to run from Prescott, the capital of the Territory, southward, to intersect the Southern Pacific at Maricopa. The mineral bearing section of Yavapai county is divided into the following districts, viz.: Agua Fria, Big Bug, Black Cañon, Black Hills, Bradshaw, Cherry Creek, Green Valley, Greenwood, Hassayampa, Humbug, Martinez, Peck, Silver Mountain, Tiger, Trinity, Turkey Creek, Walker, Walnut Grove, Weaver, Verde, Tip Top, Pine Grove, Groom Creek, Crook Cañon, and Lynx Creek. While this list may not embrace all the districts of the county, it comprises all that have thus far reported. Of these the most important are the Peck and Tip Top districts. The former is located about thirty miles southeast from Prescott in the northern foothills of the Bradshaw mountains. Although possessing mines of unusual richness, the prosperity of the district has been seriously retarded since 1878 by continuous litigation in respect to the legal ownership of certain mines. This is especially the case in regard to the Peck, the most valuable mine yet developed. This mine was discovered in 1875, and worked with great success until 1878, when operations ceased, owing to legal controversies. Its production during the three years was about $1,200,000. The ore occurs in the form of chlorides and carbonates in a strong vein, the pay-streak of which is eighteen inches in width. The mine was developed by a shaft 400 feet in depth and by four levels amounting to 1,300 feet, but since the commencement of its legal difficulties has lain idle, as has also the ten-stamp mill with which it is provided.

The production of Yavapai county during the census year 1880 was reported by districts, by the Census Bureau, as follows:

District.	*Gold.*	*Silver.*	*Total.*
Big Bug	. .	$71,250	$71,250
Cave Creek	$4,000	. . .	4,000
Castle Creek	1,499	. . .	1,499
Cherry Creek	600	. . .	600
Humbug	. .	237,847	237,847
Hassayampa	4,000	. . .	4,000
Peck	. .	64,959	64,959
Tiger	3,200	185,188	188,388
Walker	5,500	. . .	5,500
Walnut Grove	1,001	. . .	1,001
Weaver No 2	9,000	. . .	9,000
Estimate (additional)	13,499	. . .	13,499
Total	$42,299	$559,244	$601,543

I have estimated the production of this county during the calendar year 1881 to have been $50,000 in gold and $450,000 in silver.

Apache County.—This county may almost be regarded as a veritable *terra incognita*, especially so far as any development of its mineral resources is concerned. It occupies the northeast portion of the Territory, and next to Yavapai is the largest county in it, being over two hundred miles in length, from north to south, by one hundred in width. The county is exceedingly mountainous, but abounds in fertile, well-watered valleys, that by irrigation can be made to produce grain, though at present they are only valuable for grazing purposes, being covered with a luxuriant growth of nutritious grasses. Large forests of fine timber are found in the central and northern part of the county, and the mountain ranges are also well covered with a variety of trees well adapted for building purposes, fuel, etc. Every portion of the county may be said to be plentifully supplied with water. A large tributary of the San Juan flows through a hundred miles of the northern portion of the county, and the Rio Puerco, with its branches and other tributaries of the Little Colorado, drain and water the central and southern portions. Up to the present time no discoveries of consequence, of either gold or silver, have been made in Apache county, but its physical conformation would indicate it to be an admirable field for the prospector. It, however, must await the suppression of attacks from the fierce Apaches, for there will be no extensive prospecting while the region is liable to their incursions. It will doubtless yet be shown that the cañons of the numerous watercourses of the southern half of the county are rich in placer gold, and the adjacent mountain ranges will also probably prove rich depositories of the precious metals. Should it eventually prove to be as rich in minerals as the older and more thickly settled and thoroughly prospected counties of the Territory, the profusion of timber for all purposes and the plentiful supply of water afforded by its many streams will greatly enhance its value as a mining section, as the scarcity of wood and water has ever been among the most serious obstacles to profitable and extensive mining. The Atlantic and Pacific Railroad from Albuquerque westward is completed to a point on the Rio Puerco in this county, and before the end of the summer it will probably be finished a considerable distance beyond its western border. The road crosses the county in the vicinity of the thirty-fifth parallel. Its completion will, without doubt, hasten the settlement of the central portion, and, despite the presence of hostile Apaches, attract prospectors and capitalists to discover and develop its mineral resources.

Graham County.—This is a county of recent organization, and was formed from portions of Pima and Apache. It lies due south of the latter, west of the boundary of New Mexico, north of Cochise, and east of Pinal. Its principal river is the Gila, which flows through the center of the county from east to west. The San Francisco river and other smaller streams are northern tributaries of the Gila, and water that portion of the county lying north of that stream. These watercourses, especially the Gila, form extensive valleys, which are exceedingly fertile and already are largely taken up by settlers and extensively cultivated. The county has some five or six distinct mountain ranges, besides numerous isolated peaks, between which stretch magnificent plains covered with the rich, nutritious grasses peculiar to the climate. The county has not yet been sufficiently prospected to prove the extent of its mineral resources except in the matter of its copper mines. These are located near Clifton, on the San Francisco river, about fifteen miles above its confluence with the Gila, and are marvelous in extent and richness. The mountains have been tunneled and drifted in various directions without discovering walls, so that the deposits would seem to be vast masses of ore, rather than veins or leads. These mines have been successfully and profitably worked for a number of years past, even when their product had to be transported overland some seven hundred or eight hundred miles by ox teams. From Clifton northward, some fifteen miles, the sand and gravel of both banks of the San Francisco river are found to be gold-bearing. These gravel beds give good surface assays, and shaft and tunnel excavations show that every portion contains placer gold in paying quantities. They were discovered some ten years ago by a Mr. Greenler, who for a time worked them profitably by the cradle and rocker process. Afterwards they passed into the hands of a company of gentlemen from St. Louis, who continued to work in the same crude way until within a year or so past, when a New York company secured by purchase some 10,000 acres of those beds lying along both sides of the river, with a view to washing the gravel by improved hydraulic process. This company is a responsible one and under enterprising management. It is proposed to bring the water some fifteen miles in pipes and flumes. About ten miles of the pipe are already on the ground and will be laid as rapidly as possible. Improved hydraulic machinery is also being erected, and everything will be in readiness to commence work within a very short time. The capacity of these works will be about 5,000 miner's inches per diem. Aside from these extensive placers, alluvial deposits are found in other streams and cañons of the county, especially in the Sierra Blanco range, where the supply of water is abundant, and some of the mountains are known to contain gold quartz ledges as well as extensive silver lodes. Whether these will develop into rich, paying mines remains yet to be determined, except in what is known as the De Frees district, in the western portion of the county, where some work has been done and several fine prospects have been located. Notwithstanding the production of the precious metals in this county up to the present time has not been large, it is confidently predicted by well-informed persons, thoroughly acquainted with the country, that it will eventually prove a rich mining section. The county is liable to incursions by raiding bands of Indians, but the population is increasing so rapidly that but little further trouble from this source is apprehended. Even now the more thickly settled portions are capable of self-protection from the ordinary dangers incident to an exposed frontier.

Gila County.—This is a new and comparatively small county, of irregular shape, formed from the eastern portion of Maricopa and a section of the northeast corner of Pinal county. It is bounded by Apache and Graham counties on the east, Graham and Pinal on the south, Maricopa on the west, and by Yavapai and Apache on the north. The northern half of the county is admirably watered by the Salt, or, as sometimes called, the Black river, and its numerous tributaries. The county is rough and mountainous, possessing little arable land outside the Gila river bottom, and the narrow strips bordering the Black and San Carlos rivers and other smaller streams. An abundance of timber is found in the mountain ranges, and the valleys afford ample pasturage. The entire county is mineral-bearing, but the principal discoveries and richest developments have been made in that portion south of the Apache range, taken from Pinal county, and known as the Apache range. The formation is generally granite and porphyry, though syenite and quartzite are also found, as well as limestone and micaceous slate. The ores of the Apache range, and in fact of the districts generally, are usually high grade and free milling, occasionally carrying copper and iron, while those of the Pinal Mountains in the south are sulphurets requiring the roasting process to precede mining. Wood, and in most places water also, is abundant for all necessary mining purposes. This is especially the case in the Pinal Mountains, where large tracts of fine pine timber guarantee a supply for many years to come. In other sections the oak and juniper afford an ample supply. This county, as yet, has no railroad facilities, though a branch from the Southern Pacific to intersect the mineral sections of Pinal and Gila is under contemplation and will likely be commenced, if not completed, during the coming summer. Improved means of communication with business centers and for obtaining supplies will insure a prosperous future to mining industries in Gila county. Hostile Indians have occasioned considerable alarm and some interruption, but a railroad through the mineral section will lessen the frequency of, if not altogether prevent, their incursions.

I have estimated the production of Gila county, during the calendar year 1881, to have been $30,000 in gold and $530,000 in silver.

Pinal County.—This county lies in the center of the southern portion of the Territory, and is bounded on the south by Pima county, west by Maricopa, north by Maricopa and Gila, and by Gila and Graham on the east. The Gila river flows through the county from east to west, receiving as a principal tributary the San Pedro, which, flowing northward, empties into it near the eastern boundary of the county. The valleys of these streams form the principal portion of the productive soil of the county, and these can only be cultivated by irrigation. Aside from these streams there are but few watercourses, other than small creeks, which do not constantly contain running water, and yet the mining districts are comparatively well supplied by these and local springs, which afford enough water for all purposes except hydraulicing. The principal mineral discoveries yet made are found in that part of the county lying north of the Gila river, which, like the same portion of Gila county, is very rugged and mountainous. Other and later discoveries in different parts of the county, however, indicate that the mineral deposits are not confined to this locality, but are general throughout the county. The geological formation of the county rock is usually granite and porphyrite, but basalt and quartzite are also found in some places. Pioneer district is the most important mineral subdivision of this county. It adjoins Globe district, of Gila county, on the west, and extends northward into Gila and Maricopa, in which, however, no discoveries of importance are reported.

The production of Pinal county, during the census year 1880, was reported to the Census Bureau as follows (by districts):

District.	*Gold.*	*Silver.*	*Total.*
Globe	$2,526	$829	$3,355
Pioneer	....	4,000	4,000
Total	$2,526	$4,829	$7,355

I estimate the production during the calendar year 1881 to have been $25,000 in gold and $1,275,000 in silver.

Maricopa County.—This county lies in the southwestern portion of the Territory, and is bounded on the west by Yuma, north by Yavapai, east by Gila and Pinal, and on the south by Pinal and Pima counties. The Salt and Gila rivers flow through the county in their westward course; the former emptying into the Gila some fifteen miles west of Phœnix, the county seat. The northern portion is, in addition, watered by the Rio Verde and Agna Fria, and Hassayampa creeks. In an agricultural point of view the county is regarded as ranking first in the Territory. It is also rich in its mineral resources, as almost every mountain range is known to be seamed with lodes of gold and silver. The county has not been as yet thoroughly prospected, and all the development in its mining districts, except in a few instances, has been of recent date. The oldest and most important mine of the county is the Vulture, in the northwest portion. This mine was discovered in 1863, and steadily operated for about ten years, when it was abandoned on account of the expense attending the hauling of the ore to the mill, some ten miles distant. Some time after it was relocated and operated successfully for several years by a company which erected a ten-stamp mill on the Hassayampa, twelve miles distant. In 1878 the mine became the property of the Central Arizona Mining Company, under whose management it has been systematically opened and worked. The main shaft has attained a depth of nearly four hundred feet, and it is otherwise opened by working levels and cross-cuts. The ledge is gold quartz, from fifty to one hundred feet in width, between well-defined walls of porphyry and talcose slate, the hanging wall being of the former formation. The ores are not even medium as to grade, but the facilities for treatment are such that the company can handle them at an expense of about $2.25 per ton. An eighty-stamp mill has been erected convenient to the mine, and the necessary water is piped from the Hassayampa, a distance of some fifteen miles. The mill is kept constantly running (barring accidents), and the bullion production amounts to about $20,000 monthly in value, as shown by the following detailed statement of the company for the month of December, 1881, taken from the *Mining Record:*

General expenses	$341 23
Exchange	305 30
Water service	1,575 52
Mine, labor, and supplies	7,308 57
Mill supplies	6,617 82
Dead work	1,400 00
Pipe repairs	192 91
Territorial and county tax	1,064 85
Total expenditure	$18,806 20
Gross product 1124 ounces bullion	$17,971 22
Deficit	$834 98

The mill was operated twenty-seven days, fourteen hours, crushed 6,676 tons ore and waste. Stopped eight hours to repair boilers.

	Per ton.
Average product of ore and waste milled	$269¼
Average cost of operating	241½
Average total expenses	281⅝

The assay of tailings for the month showed an average loss of $1.31 per ton, of which the amalgam loss was fifty-three cents; balance sulphuret. Average production of mine $20,000 monthly; for 1881, $240,000. During the census year 1880 the production of Maricopa county was reported to the Census Bureau as follows: District, Globe: Silver, $99,380. I estimated the production during the calendar year 1881 to have been $240,000 in gold and $75,000 in silver.

Yuma County.—This county lies in the southwestern portion of the Territory, and is bounded north by Mohave, east by Yavapai, Mariposa, and Pima counties, south by Mexico, and west by the Colorado river. The Gila river flows for about one hundred miles through its southern portion, enriching in its course a narrow strip of valley. The western part, bordering the Colorado river, is traversed north and south by parallel ranges of mountains. These and other peaks are known to be rich in precious metals of various kinds. The eastern part is crossed in all directions by rugged mountains, the valleys of which, together with the high table-lands, abound with water and afford good pasturage. Many of these mountain-ranges contain rich lodes of precious minerals. The valleys along the Colorado and Gila rivers are productive farming lands. As far back as 1858 rich placers were discovered on the Gila river, and even now placer mining is carried on to a considerable extent in the region of the Gila, which is rich in alluvial gold. The most noteworthy discovery of placer gold was, however, made in 1862, in the La Paz district, about twenty miles northeast of Ehrenberg. It is estimated that this region has produced over a million a half of dollars' worth of gold. Placer mining declined on account of scarcity of water, which compelled the miners to extract the gold by dry washing. Valuable discoveries of silver in the mountain-ranges along the Colorado have again brought the section to the notice of the public. Castle Dome district lies in the Castle Dome Mountains, about twenty miles northeast of Yuma City. The southern and western boundaries are washed by the waters of the Gila and the Colorado. Owing to Indian hostilities, mining operations in this district were not actively commenced until 1869, although discoveries of its hidden treasures were made six years earlier. The mines owned by the Castle Dome Mining and Smelting Company are the most productive and profitable in the district, and comprise the Rail Road, Flora Temple, William Penn, Pocahontas, and Caledonia. The William Penn has a strong vein of good ore. It is opened by two shafts, each of which is over two hundred feet in depth. It also has necessary working-levels, drifts, etc., and the two shafts are connected by a four hundred-foot tunnel. About $2,000,000 have so far been produced from these mines.

According to a statement of the *Star*, dated Yuma, 31st December, 1881, the bullion output of this county for the year 1881 amounted to $103,000 in silver and $64,000 in gold. The production of gold during the census year ending May 31, 1880, for Yuma county, as given by the census report, is $1,019 in gold, from Ellsworth, Plumas, and Centennial districts. I estimate the production during the calendar year 1881 to have been $30,000 in gold and $105,000 in silver.

Pima County.—This is one of the oldest counties in the Territory, and originally embraced that portion which has lately been organized into Cachise county. It is bounded on the east by the latter, south and southwest by Old Mexico, west by Yuma, and on the north by Maricopa and Pinal counties. The Santa Cruz, the principal watercourse of this county, is formed by several creeks that have their source in Sonora. It flows northward for a distance of nearly eighty miles, to a point some ten miles northwest of Tucson, where it is absorbed by the sands and lost. The valley and the mountains bordering it on either side are an excellent grazing region, and where the land is sufficiently low to be susceptible of irrigation it is an excellent agricultural section. This stream is in the eastern part of the county, which is green and fruitful, while all that portion west of it, and beyond its fructifying influence, is a barren and sandy waste, alternating between sandy plains and rugged mountain ranges, and elevated table lands. As is the case generally in the southern half of Arizona, almost every portion of the county can be considered mineral-bearing, mining districts being found throughout its entire extent. Next to the mining section south of Santa Fé, N. Mex., this is believed to be the oldest in the United States. It is not known at precisely what time the mines were first worked by Americans; but it is pretty generally believed, from the best evidence attainable, that the Jesuits commenced mining operations in this county about the year 1650, and as early as 1700 many valuable mines were discovered, and opened in what are now known as the Oro Blanco, Patagonia, Santa Rita, and Arivaca districts, in all of which localities old shafts, tunnels, and other evidences, showing ancient and extensive workings, abound, while, in some instances, rich mines that are known to have been operated by these enterprising people have never been found, notwithstanding the most diligent and patient search. This is supposed to be the section from which came the Planchas de Plata, which contained about five tons of prime silver, accounts of which are given in Mexican chronicles. These districts were worked until the year 1828, when the missions were finally abandoned by reason of incursions of hostile Apaches, and but little mining was done until the Territory came into the possession of the United States, and then only fitfully until some eight or nine years ago, when the industry was permanently revived. The completion of the Southern Pacific Railroad, a few years ago, stimulated enterprise in this and the adjoining county of Cachise, and the development of mining properties has become general, and in many instances successful. Harshaw district is the most important of the mining subdivisions of Pima county. It is located in the Patagonia Mountains, about seventy miles southeast of Tuscon. Wood and water for all necessary purposes can be conveniently procured, although there is not a superabundance of either. The Hermosa is the principal mine of this district. The vein of this mine varies in width from eight to twelve feet of chloride, mixed with large quantities of horn silver. It is opened by a tunnel upwards of 700 feet in length, cutting the vein some 300 feet below the croppings, by shaft 100 feet below the tunnel level, and by necessary working levels, drifts, and cross-cuts. The ores of this mine are free-milling in character, and are more than sufficient in quantity to keep a twenty-stamp mill, owned by the company, constantly employed. This mill has a capacity for the reduction of about eighty tons ore per day, and its bullion output for the year is reported to be $412,000. During the first twenty-seven days of August last, the output of this mill was $42,000. Ten stamps only were in operation for a portion of this time, owing to scarcity of water, and the mill was stopped entirely for six days by reason of floods washing away the road, besides doing other damage.

The great discoveries in the neighboring county of Cachise, and the success attending the mining ventures in that county have not retarded, but, on the contrary, have stimulated the advancement of Pima county. The following was the production by districts, during the census year 1880, as reported by the Census Bureau.

District.	*Gold.*	*Silver.*	*Total.*
Oro Blanco	. .	$3,672	$3,672
Tombstone	$96,748	802,450	899,198
Total	$96,748	$806,122	$902,870

I estimate the production during the year 1881 to have been $15,000 in gold and $750,000 in silver.

Cachise County.—This county is at present the richest mining section of Arizona. It is situated in the southeast corner of the Territory, and was erected into a county in 1881, from a portion of Pima. It is bounded on the east by New Mexico, south by Sonora, west by Pima, and north by Graham, counties. The San Pedro river, flowing from the south, skirts the entire western portion of the county, and affords admirable water facilities for the richest mining sections. The eastern half of the county is traversed by small creeks, which afford an ample water supply for stock and mining purposes. The entire county is a rugged, mountainous region, and outside the San Pedro bottoms contains little if any arable land. Fine grasses, however, abound in the valley, and on the mountain slopes. The Sulphur Spring Valley is an extensive basin-like scope of country, between the Chericahua and Dragoon mountain ranges, some fifty miles in length by twenty-five in width, which may in time become valuable as a cattle range, as the mountains now are for their mineral deposits. Wood for all purposes is found in almost every portion of the county; especially is this the case in every mining section, where it is a most important consideration. Less than three years ago but little was known of this county as a mining section. Now Tombstone is perhaps the most important bullion-producing district in the United States, which is truly wonderful, when it is remembered that it had no railroad facilities one year ago. The most important property of the county is that of the Contention Consolidated Mining Company of Tombstone district, which consists of the Contention, formerly the Western, the Flora Morrison, and the southeast half of the Sulphuret. The consolidation of these properties was effected during the past summer. The Contention has long been known as one of the principal mines of this district. It has been opened by several shafts, the deepest of which has attained a depth of upwards of 700 feet, and by working levels, drifts, winzes, cross-cuts, etc., aggregating many thousands of feet. The first level is at a depth of 112 feet, where the vein is seven feet in width. This has been opened south to the northern boundary of the Grand Central 290 feet, and north 190 feet. The walls are smooth and well defined, and the width of the ledge throughout this level averages six feet. The ore assays range about $150 to the ton. Some lateral cross drifting indicates a rich mineralized formation outside the main vein, both to the east and west. But little stoping or upraising has been done in this level. The vein is reached from the new level, at a depth of 162 feet, by a west cross-cut thirty-two feet in length. The drift to the north on this level extends 300 feet, and south to the limit of the claim. As in the case of the first, but little stoping has been done. The formation at this depth is porphyritic, and the lateral mineralization is found by cross-cuts about 100 feet in width, while still lower down it extends about 100 feet on either side of the vein. On the 212-foot level, the ledge is reached by a west cross-cut at a distance of ninety-three feet, and is found to be eight feet in width, with good strong walls, and increasing richness of ore body. The south development extends to the limits of the claim, and north a distance of 520 feet. The north and south winzes of this level have been sunk to intersect the fourth. Assays of the ore of this level run up to $160 per ton. In driving west cross-cuts, a six-inch seam of ore was encountered, fifty feet from shaft, or forty-three feet from the ledge, from which ore that ran $2,400 to the ton was extracted. Considerable stoping has been done in this level, especially south from point of contact with shaft where the ore has been taken out the entire 290 feet, to a height of twenty-four feet. About fifty feet north of the cross-cut, the vein was found to contract to one foot in width, which continued a distance of some sixty feet, beyond which point it again widened to its natural proportions, which it retained to the point of exploration; 390 feet north of shaft, a winze has been sunk to fourth level in ore, which gives assays of $200 to the ton. A few upraises are seen in the north end of this level; otherwise the ore remains untouched. At a point in the north drift, 450 feet north of the west cross-cut intersection, a drift has been run east to the new shaft, which thus makes its first connection with these workings. In reaching the 262-foot level, the cross-cut west, at a distance of sixty-five feet from shaft, enters first inside ledge, and ninety feet further cuts the second or outside. The cross-cut was extended still forty feet further in this ledge, all in highly mineralized matter, without reaching its limit. Indeed, the ledge formation at this depth is over 200 feet wide, and seamed with ore throughout. This level is in all respects similar to the last above described, and the outside ledge first encountered from this level differs from the first only in size, as it shows a width of from five to eighteen feet, bearing ore that is said to average $100 to the ton. Very little stoping and upraising have been done, the highest point of the former, fifty feet in a few places. Winzes have been sunk in vein from both ends of drift to the fifth level. The drifting in the outside ledge aggregates 530 feet, inside 480. The 312-foot level is connected with inside ledge by west cross-cut, at a distance of ninety-five, and with outside ledge at 150, feet. The drifting on this level is about 750 feet on each ledge. The lateral drifting shows the same high mineralized formation, both east and west, as far as followed. Exploiting the south end of the outside ledge proves it to be the same that forms the west ledge of the Grand Central. From the extreme north end of the drift, a second cross-cut has been run east to connect with the new working shaft. North and south winzes from this have been driven to the 400-foot level. On the 400-foot level the drift is 115 feet, and connection has been made northward with the shaft. The vein is shown to be eight feet in width. On the 500-foot level the south drift has been run 250 feet, and the connecting cross-cut is said to look promising. The north and south winzes from the upper level have also formed connection with this one. On the 600-foot level the cross-cut west is completed, and the south drift is in about eighty feet. The east drift on this level has been run a distance of 280 feet, and ore breasts, stopes, etc., are said to be very promising. The 700-foot level has not been extensively opened, though some rich ore developments have been made in the north drift, which demonstrate that large ore bodies exist at this depth, and are likely to continue. But little work has latterly been done in this mine, every energy being bent to connect the lower levels of the Flora Morrison with the 500 and 600 levels of the Contention, with a view to concentrating future operations. The shaft of the Flora Morrison, and the new working-shaft of this mine, will hereafter be used by the company, and to this end the works of the old shaft are being dismantled. In all these extensive improvements the new company is extracting sufficient ore to keep its teams employed, and the mill at Contention City, ten miles distant, constantly running, as is shown by the reported product for the month of December, upwards of $136,000 in value. In addition to this mill it is represented that a new one of forty-stamp capacity will be built near the mine during the coming summer. Many thousands of tons of low-grade ore, ranging from ten to thirty ounces of silver to the ton, are now on the dumps of this property, all of which can be profitably operated if the expense attending the transportation of ores can be avoided. The production of this company for the year 1881 amounts, in round numbers, to about $1,500,000, as shown by tables published by the Tombstone *Epitaph*, December 4—last month estimated. The Flora Morrison is a small irregular claim immediately west of the Contention. This is the second of the company's mines. Its working shaft is below the 500-foot level, and, as before remarked, the company is bending every energy to the task of bringing it in with the 500- and 600-foot levels of the Contention. It is regarded as a very valuable property, but its production is included in that given as the bullion yield of the company, and cannot in consequence be given separately.

I estimate the production of Cachise county during the calendar year 1881 to have been $645,000 in gold and $4,065,000 in silver.

Estimate of Mr. A. M. Lawver of the Bullion Production in Arizona during the calendar year 1881, *classified by counties.*

County.	*Gold.*	*Silver.*	*Total.*
Cachise	$490,000	$3,896,210	$3,886,210
Gila	21,334	406,799	428,133
Maricopa	280,044	90,000	370,044
Mohave	20,000	71,000	91,000
Pima	195,000	1,600,155	1,795,155
Piond	1,480	983,373	984,853
Yavapai	19,124	716,389	735,513
Yuma	35,699	114,168	149,867
Total	$1,062,681	$7,378,094	$8,440,775

List of Quartz Mills in Arizona.

Name of Mill.	*Location.*	*Number of Stamps.*	*Gold or Silver.*	*Owners.*
	CACHISE COUNTY.			
Corbin	Charleston	20	Silver	Tombstone Mill and Mining Company.
Gird	do	15	do	do.
Contention	Contention City	25	do	Western Mining Company.
Grand Central	do	30	do	Grand Central Mining Company.
Head Center	do	10	do	Head Center Mining Company.
Pioneer	Dos Cabezas	10	Gold	Pioneer Mining Company.
Boston	Emery City	25	Silver	Boston and Arizona Smelting and Reduction Company.
Perini's	Huachuca Mountains	5		V. Perini & Co.
Hopkins	Watervale	5	Silver	Hopkins Mill Company.

List of Quartz Mills in Arizona—(*Continued*).

Name of Mill.	*Location.*	*Number of Stamps.*	*Gold or Silver.*	*Owners.*
	GILA COUNTY.			
Champion	Globe	2	Silver	Champion Mill and Mining Company.
Globe City	...do	5	...do	Globe City Mill and Mining Company.
Golden Eagle	...do	10	Gold	Golden Eagle Mining Company.
Irene	...do	10	Silver	Irene Mining Company.
Silver Era	...do	5	...do	Silver Era Mining Company.
Townsend	...do	5	...do	Townsend Mining Company.
Stonewall Jackson	McMillen	10	...do	McMillen Silver Mining Company.
Miami	Miami	10	...do	Estate of Jos. Bateman.
Mineral Creek	Mineral Creek	5	...do	Mineral Creek Mining Company.
Silver Nugget	Richmond Basin	5	...do	Silver Nugget Mining Company.
Mack Morris	Stanton	10	...do	Mack Morris Mining Company.
Mazatzal	Tonto Basin	2	...do	Mazatzal Mining Company.
	MARICOPA COUNTY.			
Golden Star	Cave Creek	10	Gold	Golden Star Mining Company.
Grand Canal	Phœnix	5	...do	Jett & Powell.
Vulture	Vulture Mine	80	...do	Central Arizona Mining Company.
	MOHAVE COUNTY.			
Cedar Valley	Cedar Valley	10		
Barry	Cerbat	5	Silver	John Barry.
Lincoln	El Dorado Cañon	5	...do	Lincoln Silver Mining Company.
Hackberry	Hackberry	10	...do	Hackberry Mill and Mining Company.
Breon & Spear	Mineral Park	5	...do	Breon & Spear.
Welcome	...do	5	...do	L. S. Welcome.
McCracken	Signal	20	...do	Peabody Mining Company.
	PIMA COUNTY.			
Arivaca	Arivaca	10	G. & S.	Arivaca Mill Company.
Consolidated Arizona	...do	10	...do	Consolidated Arizona Gold and Silver Mining Company.
Derre & Townsend	...do	10	...do	
Hermosa	Harshaw	20	Silver	Hermosa Silver Mining Company.
Imperial	Old Hat	2	...do	Imperial Mining Company.
	PINAL COUNTY.			
Seventy-six	Pinal City	5	Silver	Windsor Mining Company.
Silver King	...do	20	...do	Silver King Mining Company.
Gem	Queen Creek	10	...do	Wide Awake Silver Mining Company.
Wheeler & Doran	...do	2	...do	Wheeler & Doran.
	YAVAPAI COUNTY.			
Peck	Alexandra	10	Silver	Peck Mining Company.
Hoefler	Arastra Creek	5	Gold	Prescott Mining Company.
Big Bug	Big Bug	10		William Van Name.
Bradshaw	Bradshaw Basin	10	Silver	Bradshaw Mining Company.
Golden Era	Cherry Creek	10	Gold	Golden Era Mining Company.
Buffum's	Crook's Cañon	10	...do	W. M. Buffum.
Tip Top	Gillette	10	Silver	Tip Top Silver Mining Company.
Aztlan	Groom Creek	10	Gold	Prescott Mining Company.
Tuscumbia	Gus Springs	8	Silver	
Senator	Hassayampa	10	Gold	Bowers & Richards.
Bed Rock	People's Valley	5	...do	Bed Rock Mining Company.
Model	...do	2	...do	R. C. Powers.
Tiger	Tiger District	10	Silver	Tiger Mill and Mining Company.
Heneszy	Turkey Creek	5	Gold	
Masterson	...do	2	...do	
	YUMA COUNTY.			
Ellsworth	Ellsworth District	5	Silver	

SMELTERS.

		Tons.		
Lynx Creek	Lynx Creek district	30	Silver	
Texas	Galeyville	30	...do	
Melrose	Melrose	30	...do	
Holland	Patagonia district	30	...do	

CALIFORNIA.

THE principal gold belt of California lies along the lower slopes and foothills of the Sierra Nevada Mountains, and extends from San Diego county, in the south, to Siskiyou, in the north, a distance of over seven hundred miles, and varies from twenty to sixty miles in width.

Of the fifty-two counties in the State, nearly every one, excepting those bordering on San Francisco bay, has at some time or other been the scene of mining industry, and at the present time reports of production from thirty-five have been received at the Mint Bureau. Mining is the chief industry in eighteen of these counties, in some of which, if it did not exist, the other industries would decline proportionally to their loss in mining population. Throughout this immense auriferous area, the gold occurs under widely varied conditions. It is found in the numberless quartz veins scattered throughout all parts of the gold fields; in the channels of ancient rivers, buried in some instances under hundreds of feet of lava and the products of the erosion of lofty mountains for countless ages; in the banks, bars, and beds of the modern river system, constituting the placer diggings; in seams and pockets, and in the bluffs and beaches of the northern coast.

More varied even than the sources of gold, are the means that have been employed for securing it, and the inventive genius of the miner and mechanician have been taxed to overcome the obstacles which have arisen at every step of the process. In the early days of mining in California, nearly all of the gold produced was from the superficial and easily worked placers, but they, for the most part, have been exhausted, and the rocker, tom, and sluice are now things of the past, or used only by individual operators of small means, or Chinamen content to re-work old claims and secure what was lost or disregarded in the flush of fortune by the first claimants. The amount produced in this manner throughout the whole State is not inconsiderable in the aggregate, and as the bulk is taken out by Chinamen, from whom no reports are received, it can be estimated only from returns of express companies. More than half the production of the State to-day is from the gravel of the ancient river channels, and this is obtained either by drift or hydraulic mining. In the first, the pay-gravel is extracted by drifting or tunneling under the superincumbent lava, while by the hydraulic method the whole deposit is disintegrated by a large stream of water thrown under high pressure from the nozzle of a pipe and washed down the sluices and flumes to the valleys below. The quartz lodes of the State have also produced largely. The ores for the most part are easily treated, and under a better system of mining and more intelligent understanding of methods of treatment of ores than formerly prevailed, this branch of the industry is acquiring a permanency that promises for many years to come to add a large share to the wealth of the State. During the past year, mining in California, and particularly hydraulic mining, has been retarded by litigation between farmers and miners. The detritus from the mines first fouling the streams and rivers, filled their channels, caused their banks to overflow, and gradually encroached upou the arable lands of the lower valleys, until thousands of acres were covered and their capacity for culture and value were destroyed. It is still an open question as to what will be the best method for securing the agricultural lands from injury, while permitting the development of the gravel claims. Mining streams usually cannot carry all the *dêbris* washed into them, and when inclosed by high banks, their channels are rising year by year. This accumulation of millions of cubic yards is gradually making its way further and further towards the valleys, and means must be adopted to check its progress as well as to provide for the bowlders, gravel, and sand constantly being added. Mining will not cease so long as gold exists in sufficient quantities to pay for its extraction, but the cost of building and maintaining large and costly dams to restrain the tailings, may cause a permanent suspension of work in some of the least profitable of the mines. The total production of California during the calendar year 1881, as nearly as can be ascertained from all the sources of information at the command of the Mint Bureau, was $18,950,000, of which $18,200,000 was gold and $750,000 silver.

It is as difficult to ascertain the profit of mining as the expenses. Only fourteen companies paid dividends, aggregating $1,808,722. These were the Black Bear, Bulwer, Gold Stripe, Green Mountain, Idaho, Inyo, Magalia, New York Hill, Plumas Eureka, Plumas Mining and Water, Rising Star, Sierra Buttes, Spring Valley Hydraulic, and Standard Consolidated. In addition to this, much was undoubtedly divided without publicity, but in the majority of cases, the profit resulted only to those who did the manual labor. Notwithstanding the large aggregate production and the amount of profits that have been divided, the expense of working the mines has been very great. The output of many of the mines is swallowed up in their development, and where there has been no metal-bearing ore to defray expenses, assessments have been levied. During the year 1881, one hundred and fifty-five assessments were made upon ninety-seven mines in the State, amounting to $2,288,250. The principal appeals for aid came from Mono county. The following shows the number of mines and assessments made, and the aggregate amount for each county:

County.	*No. of mines.*	*No. of assessments.*	*Amount.*
Amador	5	7	$105,500
Butte	5	5	22,000
Calaveras	4	4	18,000
El Dorado	1	1	7,500
Fresno	2	2	16,500
Inyo	3	4	105,000
Los Angeles	4	1	2,500
Mariposa	4	6	81,000
Mono	36	64	1,201,000
Nevada	17	28	220,250
Placer	8	20	220,500
San Diego	1	1	5,000
San Bernardino	1	1	10,000
Shasta	1	1	6,000
Sierra	1	1	15,000
Tehama	1	3	14,000
Trinity	1	1	5,000
Tulare	1	2	16,000
Tuolumne	2	2	17,500
Yuba	2	3	200,000
Totals	97	155	$2,288,250

Two of the principal gravel mines in the State which heretofore have been paying dividends now appear for the first time for years among those that levied assessments. They were obliged to suspend operations during most of the year, not from any diminution in the value of their property, but from litigation consequent upon the conflict between the agricultural and mining interests. Taken as a whole, the past year has not been an unsuccessful one for mining in California. The output has been fully as large as that of the preceding year. The yield from new mines and an increase from those in which the development has been systematically conducted has compensated for decreased production of others on account of litigation. The outlook for the future is equally as good. Mining for the precious metals is becoming year by year more of a legitimate business. Necessarily it involves many uncertainties, but these uncertainties create a need for knowledge, energy, and prudence, which the established companies have acquired, and this fact insures their permanency. During the coming year the pending *dêbris* question will be solved, and hydraulic and drift mining will probably be pursued with renewed energy, and it is not likely that there will be a less yield than the average annual production of the past ten years. The following is my estimate of the production of the State by counties:

County.	*Gold.*	*Silver.*	*Total.*
Alpine	$2,000	$2,100	$4,100
Amador	1,450,000	1,500	451,500
Butte	650,000	1,000	651,000
Calaveras	800,000	1,200	801,200
Colusa	3,500	....	3,500
Del Norte	60,000	....	60,000
El Dorado	550,000	900	550,000
Fresno	90,000	....	90,000
Humboldt	75,000	300	75,300
Inyo	170,000	140,000	310,000
Kern	190,000	14,000	204,000
Lassen	71,000	1,000	72,000
Los Angeles	13,000	39,000	52,000
Mariposa	200,000	1,200	201,200
Mendocino	1,000	....	1,000
Merced	1,500	....	1,500
Modoc	20,000	1,500	21,500
Mono	3,385,000	300,000	3,685,000
Nevada	3,700,000	9,500	3,709,500
Placer	850,000	6,500	856,500
Plumas	1,350,000	2,000	1,352,000
Sacramento	425,000	1,000	426,000
San Bernardino	9,000	100,000	109,000
San Diego	60,000	....	60,000
Santa Barbara	2,000	....	2,000
Shasta	350,000	85,000	435,000
Sierra	950,000	6,000	956,000
Siskiyou	850,000	1,500	851,500
Stanislaus	63,000	31,000	94,000
Tehama	500	....	500
Trinity	550,000	1,500	551,500
Tulare	8,000	....	8,000
Tuolumne	500,000	1,000	501,000
Ventura	500	....	500
Yuba	800,000	1,300	801,300
Total	$18,200,000	$750,000	$18,950,000

The foregoing exceeds by a little over $1,000,000 the estimate prepared at the San Francisco Mint, and varies in several instances in the estimate as to counties. It also exceeds the total estimate of $18,020,679 of Mr. Valentine, based on shipments by express, by upwards of $900,000. I am inclined to believe, however, that the gold production was greater rather than less than the figures I have given. The deposits of gold of domestic production at the San Francisco and Carson mints during 1881 were $26,161,782, not including a deposit of $5,657,677 of foreign gold. The production of all the Pacific States and Territories, except California, which deposit their gold production at the Western mints, is estimated at $6,140,000, which would make the production of California more than $19,000,000. Some foreign gold may have been melted at private refineries on the Pacific coast and deposited at the mint as domestic bullion, but, after making all proper allowance and deduction on this account, I am satisfied that the gold production of the State could not have been less than the amount I have stated—$18,200,000.

Alpine County.—Alpine county is in the eastern part of California, on the border-line of Nevada. It is on the summit and eastern slope of the Sierra Nevada Mountains, and is essentially a mountainous region, having an altitude of from 5,000 to 11,000 feet above sea level. The mines in this county are chiefly in quartz, carrying gold, silver, and copper, but from the rugged nature of the country, the sparse population, and want of capital, they have not been developed to any considerable extent. So far as has been ascertained, the production for the last year has been less than that of 1880.

One mine in Alpine county reports for the fiscal year ending June 30, 1881, a production of $1,643 gold and $2,096 silver. The production of the county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Mint Bureau, fiscal year 1880	$17,113	$24,146
Mint Bureau, fiscal year 1881	1,643	2,096
Mint Bureau, calendar year 1881	1,643	2,096

I estimate the production during 1881 to have been $2,000 in gold and $2,100 in silver.

Amador County.—This county, wedged in between El Dorado, Alpine, Calaveras, San Joaquin, and Sacramento counties, possesses a diversity of wealth-producing resources, not the least of which are gold, copper, and coal. Gold is almost universally disseminated over its whole area in greater or less quantities, although the quartz-mining region in which the greatest developments have been made surrounds the towns of Jackson, Sutter Creek, Plymouth, Amador, and Volcano. The work, however, compared with that done in other mining sections of the State, has been but superficial, but it has been sufficient to warrant more vigorous prosecution and a larger investment of capital. The mining interests of Jackson are not in as flourishing condition to-day as in times past. The Zeile mine is the principal one in operation. It employs about 100 men, has fine hoisting machinery, a forty-stamp mill, and chlorination works; upwards of 100 tons of ore are crushed daily; it is rich in sulphurets, and pays fairly. The water-power, however, is only sufficient to run thirty or thirty-five stamps of the mill. A larger pipe to carry water from the ditch to the mill will be substituted, the prospects of the mine justifying this improvement. This will allow the full number of stamps to be run, and produce sufficient sulphurets to keep the chlorination works running to their utmost capacity. The Kennedy mine, north of the town, is again running, a good character of ore being taken out; at a depth of 400 feet a drift was run north forty feet, encountering a body of ore averaging four feet in width.

The production of Amador county during the census year ended May 31, 1880, was reported as follows by the Census Bureau:

District of	*Gold.*
Amador City	$645,399
Drytown	9,879
Jackson	163,401
Pine Grove	567
Pioneer	....
Plymouth	476,901
Sutter Creek	60,040
Volcano	45,860
Total	$1,407,047

Reports of the production for the fiscal year ending June 30, 1881, were sent by the owners and officers of the following mines: Bunker Hill, Consolidated Amador, De Witt, Empire Gold, Franklin Consolidated, Golden Gate, Griggs, Keystone Consolidated, McQuade, Mahoney, Modoc, Oneida, Pacific, Flood and O'Brien, Lincoln, Madina Milling, Mason, Telegraph Hill, Tellurium, Whitney and Babcock, Pacific Gold, Soto, Telegraph Hill, Volcano Mill, Yuille, Chinese at Laucha Plana, at Volcano, at Jackson, at Alta, at Ione, and small mines at Sutter, Volcano, Jackson, and Ione. The estimated production of the calendar year 1881 is $1,450,000 gold and $1,500 silver. Assessments were made on five mines aggregating $105,000.

The production of Amador county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$1,407,047	
Mint Bureau, fiscal year 1880	1,495,053	$1,953
Mint Bureau, fiscal year 1881	1,561,668	1,172
Mint Bureau, calendar year 1881	1,401,310	1,172

Butte County.—Butte county, on the eastern side of the Sacramento Valley, is between Tehama and Yuba counties on the north and south, and Plumas and Colusa on the east and west, respectively. The western half of the county, bordering on the Sacramento river, is devoted to agricultural purposes, but the eastern portion, lying along the foot-hills of the Sierras, contains the principal mines of the county. This section is drained by the Feather river and its tributaries. The principal mining localities are Bangor, Wyandotte, Forbestown, Cherokee, Mountain House, Dogtown or Magalia, Lovelocks, and Inskip.

Several important projects have been started to mine the bed of the Feather river above Oroville. It is a well-known fact that the river bed is very rich. In 1857 two dams were built across the river, about 1,000 yards apart; the one above to turn the stream, another below to keep out the back-water, with a flume connecting the two. Into this flume the river was turned, and after many weary months' work the intervening space was pumped out and the bed of the river appeared. Along the bed-rock was found gravel, varying in depth from three to ten feet. In some places were found large bowlders. It was late in the season when the work on the wing dams was completed, and every effort was made to clean up as much of the bed of the river as was possible. Less than sixty days were allowed them before the storms came, and every vestige of work disappeared in a day. Yet in that short time nearly one million of dollars' worth of gold dust was taken out. In many places fortunes would be taken out in a space of a few square feet. Since then other attempts to flume or wing-dam the river have been only partially successful. It is now proposed to get at these riches in a systematic way, and to overcome the existing obstacles by engineering science, and a company has been formed to turn the waters of the north fork of the Feather river, known as Big Bend, a little above Whisky Bar, by means of a tunnel, into a tributary of the west branch, called Dark Canyon, which empties into it a few hundred feet above the confluence of the west branch and north fork of Feather river, about ten miles above Oroville. Many have thought something of this kind could be done, but only within a year has the project begun to assume shape. The north fork of Feather river rises at Lassen's Peak, where the melted snow percolates through the fissures in the lava below the cap and gush forth in one immense body, creating, as it were, a river instantaneously at the head of Big Meadows. From this place it continues its course through Lassen, Plumas, and Butte counties, a distance of one hundred miles, until it reaches the point selected for the head of the tunnel. The peninsula of Big Bend is composed of high mountain land with precipitous banks to the river. The area is about eleven square miles, and length of the river to be drained is twelve miles. The tunnel begins nearly half a mile above Whisky Bar, at a place where the river is deeply encaved between the banks, and where the stream has very little fall. It is proposed to establish the bottom of the tunnel four feet below the lowest portion of the stream, in order to give the impetus to the waters, taking a greater velocity than they had in the stream, and in order to obtain at once the required depth of water in the tunnel which it is provided to carry on its whole course. It will be 11,600 feet long, twenty-five and one-half feet wide, twenty-one and one-fourth feet high, and the excavations will cost about $4 per cubic yard. At the entrance of the tunnel will be a permanent dam across and up to the level of the bed of the stream. The tunnel would be large enough to carry all the water of the river, under ordinary circumstances, for enough months in the year to allow of very profitable work. Preliminary work has commenced, roads and houses are being built, and it is intended to begin work on the two faces of the tunnel in April, 1882. The owners of the Greek claim believe they can successfully mine it by sinking a shaft on the bank above high-water mark to several feet below the bed of the river, and then run up a tunnel from the bottom of the shaft to the bed of the river. This experiment could be made at a cost less than $10,000. If successful, it would open up a rich bed of gold dust. Whoever enters upon this enterprise will start in with the knowledge that the gold is on the river bed; on this point there can be no mistake.

The production of Butte county for the census year 1880 was reported by districts as follows:

District of	*Placer Gold.*
Centreville and Helltown	$15,000
Cherokee Flat	274,057
Magalia, or Dogtown	17.118
Morris Ravine	9,000
Oroville	9,999
Total	$325,174

The production reported by the following mines for the fiscal year, 1881, was: Gold, $350,787; silver, $19, viz.: Big Kenshew, Billingsly & Halsey, Black Leg, Brush Creek, Dodson, Hedges & Co., Lott's Gravel Range, Magalia Gold, McIntyre & Co., March & Gwyn, production of Granite Basin, President Langley, Robert & Kendall, Sam Davis, Booming Dutch Gravel, Butte Creek Hydraulic, French Creek, Fulton & Co., Little Kimshaw, McBride, Nichol & Langley, Oroville Irrigating, Reece, Williams & Vinton, Wyandotte Hydraulic, Spring Hill Hydraulic, Thos. H. Williams & Co., Woodson, Garland & Wilcox, small mines at Forbestown and Yankee Hill, and Chinese at Yankee Hill, and at Chico. The production of Butte county for recent periods as reported by the mines has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$325,174	
Mint Bureau, fiscal year 1880	430,501	$1,247
Mint Bureau, fiscal year 1881	350,787	19
Mint Bureau, calendar year 1881	646,790	46

I estimate the total production for the calendar year 1881 to have been $650,000 gold, $1,000 silver.

Calaveras County.—Calaveras county is one of the oldest settled, as well as one of the most celebrated, of the gold-producing counties of the State, and lies southeast of and adjoining Amador county. During the last year there has been no abatement in the mining industry; on the contrary, prospecting has been active, and new mines have been discovered, old ones have been reopened, and in the steadily producing mines, improvements in machinery and appliances for reducing ores or saving gold have been introduced, and work has been prosecuted with an earnestness that insures success.

The Eureka Hydraulic Mining Company, on Calaveras river, have steadily prosecuted work on their claims. The ground was worked in the early mining days, and abandoned until taken in hand by the present owners, who, by a system of ditches miles in length, brought sufficient water to keep two pipes playing continually against the bank. About 6,000 feet of pipe are used, and a flume, upwards of 1,500 feet in length, conveys the tailings into the Calaveras river. During the last season, about four acres of surface, averaging sixty feet in depth, were washed and yielded about $40,000. The main Eureka ditch was extended to Esperanza creek, a total distance of twelve miles. A second ditch, the Calaveras, conveys water from Jesu Maria creek to the claim. The Calaveras Mining Company has from 1,800 to 2,000 acres of mining land, embracing both cement and gravel. Its principal place of operation is three and a half miles north of Milton. A ditch carrying 15,000 inches of water was constructed at an expense of nearly $30,000. The main ditch is twelve miles long, but with its feeders amounts to twenty-one miles. The supply of water is scarcely sufficient, but is aided by a system of reservoirs. The Sand Hill claim, across the Calaveras river, contains 640 acres of gravel. It has not heretofore been worked on account of the difficulty in obtaining water, but this is now obviated, as water can be taken from the reservoir across the river in pipes. Electric lights will be used, so that the work will progress night and day.

The Census Bureau reports for the census year 1880 the following production by districts, viz.:

District.	*Gold-quartz Mines.*	*Gold-placer.*
Angel's Camp	$21,499	
Carson Hill	20,000	
Independence	126,150	
Mesquite		
Mokelumne Hill	181,000	$63,450
Robinson's Ferry	....	15,000
Vallecito	....	18,001
Washington		
Total	$348,649	$96,451
Aggregate	....	445,100

For the fiscal year 1881 reports were received from the following mines, viz.: Adelaide, Brown & McSorley, Bragg & Co., Bully Bully, Ballards Hydraulic, Bonanza Hydraulic, Chong Kee Company, Concentrated de Santo Hydraulic, Champion, Dolan & Cogswell, Duryea Hydraulic, Eureka Hydraulic, Emerson Hydraulic, Grey Hill, Gwin, Gopher, Jupiter, John Rothgeib, J. W. Taylor, Knox & Osborn, Lewis & Fairchild, Lone Star, Morse & Stone, Oro Plata, Red Wheel, River Side, Sheep Ranch, Shawmut, T. T. Collins, Veith & Co., Amelia, Collier, Confidence, German, Kendall & Gunnison, McElroy, Gravel and Safe Deposit Tunnel. These mines shipped a production of $815,724 gold and $22 silver. The production of the year 1881 is estimated at $800,000 gold and $1,200 silver. The production of Calaveras county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$145,100	
Mint Bureau, fiscal year 1880	320,865	$643
Mint Bureau, fiscal year 1881	815,724	22
Mint Bureau, calendar year 1881	793,113	49

Colusa County.—Colusa county lies between the Sacramento river on the east and the Coast Range on the west, and is about eighty miles north of San Francisco. Iron and copper ores exist in considerable abundance, but with the exception of the Manzanita mine, on Sulphur creek, no gold mines are worked in the county. The ore was formerly worked in a stamp-mill and collected with amalgamated copper plates, but from its refractory nature the amalgamating process was abandoned and one of concentration has been adopted. The production of Colusa county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Mint Bureau, fiscal year 1880	$4,830	$78
Mint Bureau, fiscal year 1881	1,251	23
Mint Bureau, calendar year 1881	3,221	23

I estimate the total production for the calendar year 1881 to have been $3,500 gold.

Del Norte County.—Del Norte county is the extreme northwestern county of California. The principal gold mining operations have been conducted in the vicinity of Happy Camp, in the southeastern part of the county, on Klamath river. Here there are large areas of auriferous gravel, ample supply of water for hydraulic operations, and every element essential to large and profitable operations, the only drawbacks being the isolated condition of this section of country and the shortness of the mining season. The Happy Camp Hydraulic Mining Company are running their mine night and day with two pipes. Considerable river-bed mining has been done with profit during the past season along both the Klamath and Smith rivers by means of wing damming; a dam is constructed half-way across the river and then continued down the stream to any desired distance, thus turning the whole body of water into one-half of its channel. The water inclosed by the dam is then pumped out by the force of the current acting on wheels attached to shafts projecting beyond the dam, and the gravel on the portion of the river-bed laid bare is raised with derricks and emptied into sluice-boxes for washing. There appears to be numerous good openings in this county for hydraulic mining. In the vicinity of Crescent City, the county-seat, situated on a little bay on the Pacific, beach or black sand mining has been carried on for several years. A new company was organized and commenced operations with favorable prospects, and, if successful, will no doubt induce others to engage in similar enterprises. The production of Del Norte county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$128,331	
Mint Bureau, fiscal year 1880	215,403	$300
Mint Bureau, fiscal year 1881	45,885	

I estimate the total production for the calendar year 1881 to have been $60,000 gold.

El Dorado County.—This county lies bordering on the State of Nevada, and is about one hundred and twenty-five miles northeast of San Francisco. Throughout the county there are a number of good paying quartz mines, while placer mining is prosecuted mainly by Chinamen.

At Hoosier Bar, a new invention for elevating gravel by hydraulic process has been adopted, of such power that a column of gravel and water can be driven upward twenty feet for every 100 feet of pressure in the driving current. Some very rich ground has been opened up by this elevator, one pan of bed-rock gravel yielding over $25.

Reports of production were received from the Rosecranz, Modoc, Inez, Faber, Mount Pleasant, Seller's Ranch, Fowler & Granger, Gignac, Weber, Hosking, Mason, North Star, Park Canal, Chapparal, Walker, Blue Rock, Roach, Cornwell, Mameluke, Bryant, Toombs, Oro Fino, Grit, Loomis, Beattie, American Cañon, Spanish, Mike Muntz, Von Bremen, Pelton, Kay, Gregory, Blakeley, El Dorado, Friedman, Cumberland, Monteverde, Snow, Iowaville, Verza, Lone

Jack, Vaughn, Pie Pie, Lyon, Grand Victory, Church Union, Tingman, and Pacific. The production of El Dorado county for the census year 1880 was reported by districts as follows:

	Gold.
Scattered	$514,268*
Mud Spring or Springfield	74,601
Placerville	22,280
Total	$611,149

*Placer.

The production of the county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$611,149	
Mint Bureau, fiscal year 1880	389,383	$208
Mint Bureau, fiscal year 1881	710,230	711
Mint Bureau, calendar year 1881	540,173	316

I estimate the total production for the calendar year 1881 to have been $550,000 gold and $900 silver.

Fresno County.—Fresno is one of the largest counties in California, and crosses the great San Joaquin Valley, extending from the Sierra Nevadas on the east to the Coast Range on the west. The mineral resources of Fresno county have not been thoroughly prospected, neither have the mines that have been discovered been developed to a producing point, with very few exceptions. Many that have been long known to be valuable, can be made to produce bullion in paying quantities, when appliances for properly working the ores have been introduced. There are hundreds of ledges through the hills and mountains of Fresno county, carrying large bodies of ore worth from $8 to $10 per ton to much of more valuable quality; the cost of working this low grade ore has hitherto been so great as to practically render it valueless. There is only one river mine of importance east of Millerton, and that is of recent discovery. A number of parties have attempted to prospect a claim twenty miles east of Fresno Flat on the north fork of the San Joaquin. The reported prospects are sufficient to warrant more extensive operations. Rich gravel deposits are reported along the banks of Keyser Gulch. The bed of the creek was rich and was mined out years ago, but the banks were never extensively prospected. The deposits now being opened are said to indicate an ancient river channel, which has not hitherto been discovered in this county.

The production of Fresno county, all from the deep mines in the Potter Ridge district, as reported to the Census Bureau for 1880, was $72,599, gold; $6,291, silver. Reports were received from the Deadwood and a few small mines. The estimated production in Fresno county for the calendar year 1881 is $90,000, gold. The production of this county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$72,599	$6,292
Mint Bureau, fiscal year 1880	143,433	
Mint Bureau, fiscal year 1881	114,307	
Mint Bureau, calendar year 1881	83,513	27

Humboldt County.—Humboldt county is on the coast, in the northwestern part of the State, and immediately south of Del Norte county. There are no quartz mines in this locality, at least none are in operation. The chief placer mining is upon the Trinity and Klamath rivers. It is, however, subordinate to the agricultural and lumber interests. The gravel deposits are neither as extensive nor rich as in other sections of the State, but they have not been vigorously worked, and opportunities exist for enterprise and capital; water is plentiful and can generally be brought upon the mines at but little cost, and as it comes from high mountains a good pressure for hydraulic operations is easily obtained. The mining season is usually short. Of late years considerable attention has been paid to the working of beach sands at Gold Bluff. The presence of gold in the sands thrown up by the surf has been known almost from the time of the first discovery of gold in the State, and at various times projects were formed for washing these deposits and securing the gold; but the fact that the gold existed in infinitesimal particles, and that a rich deposit brought up or exposed at one time was liable to be swept away or covered with barren sand at another, rendered working beach sands too precarious mining to be followed for any length of time, and it was almost abandoned. The whole beach lying in front of Gold Bluff is now owned by two parties, Adson Adams and the Greenbaum Company, who have pursued systematic operations that have not been without success. Mr. Yale, of San Francisco, describes the manner of conducting the business of gold gathering at this point as follows: After a heavy surf, the superintendent of the mine rides along the beach, as the tide begins to ebb, and carefully notes the condition of the sand, watching for evidence of gold having been thrown up by the waves. If he discovers that fresh deposits have been made, he signals the muleteers to that effect, who then rush down their animals and pack out as much of the auriferous sand as possible before the tide again comes in and puts a stop to their work, covering up, perhaps, the rich streak with a heavy layer of barren sand, or possibly sweeping it away altogether.

It is a singular circumstance that when the surf comes square on the beach the gold brought up by it is covered under several feet of this barren sand, and that only when the surf strikes the beach at some other angle is the gold left on the surface, where it can be seen and readily gathered. After being so collected, the rich sand is washed in sluices, small streams of water having been brought in for the purpose. For saving the gold only copper-silver plates are used in the sluices, which are usually run with a light head of water. On the border of a small lagoon on the Greenbaum ground, a short distance back from the beach, occurs a large body of low-grade sand. This is run out on cars and washed in an old-fashioned "Jenny Lind" tom, being a sluice of one box widened out and supplied with a screen at the lower end. At one time it was thought that this gold was brought up out of the ocean, an opinion that some people still entertain. But this is clearly a mistake. It came from the bluff in the rear, which is made up of alternating strata of clay, gravel, and sandstone, the gravel strata, three or four in number, being all more or less auriferous. The action of the waves has broken down this bluff, which varies from 100 to 500 feet in height, and released the gold, the latter having afterwards been by the same agency carried seaward at least as far as low-water mark. After a very heavy surf breaking down, as sometimes happens, a portion of the bluff, the beach below is sensibly enriched, the gold by this new addition being rendered somewhat coarser than before. This fact has suggested the utility of employing powder for breaking down and disintegrating these banks, an agent that will, no doubt, some day be used for that purpose. While the sand along this beach must, under such steady and long-continued working, necessarily suffer a gradual impoverishment, this latter has not as yet proceeded far enough here to sensibly affect practical results; a fact due, it may be presumed, to the great width of the beach at this point and to the replenishment which the stock of workable material is constantly receiving from the caving down of the banks above. Farther north, where these favorable conditions do not exist, the gold-bearing beaches have been so nearly exhausted that hardly any work is now being done, where from fifteen to twenty-five years ago thousands of men made good wages. That the sand, which is constantly covered by the sea, is not very rich has been proven by the trials made on it some years ago with steam-dredges, none of which found gold enough in it to warrant a continuance of these operations. Each of the companies above mentioned employs from ten to twelve men and about eighteen pack-animals the year round. Operations are kept up with but little interruption, the men being engaged a good part of the time either in gathering sand or washing it. It is reported that each of the claims yields about $40,000 per annum; the expenses are about $14,000, leaving $26,000 as net profit. The production of Humboldt county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$77,001	
Mint Bureau, fiscal year 1880	153,940	$80
Mint Bureau, fiscal year 1881	32,679	3,345
Mint Bureau, calendar year 1881	19,115	27

I estimate the total production for the calendar year 1881 to have been $75,000 gold and $300 silver. For the year 1880 the Census Bureau reports by districts as follows:

	Gold.
Gold Bluffs	$27,000
Orleans Bar	50,001
Total	$77,001

Inyo County.—Inyo county comprises the section of country formerly known only as the Owens river and Panamint valleys, lying in the southeastern part of California between the Sierra Nevada Mountains and the State line. In the early history of this county almost a continual warfare was kept up between the settlers, prospectors and miners, and the Indians; but notwithstanding this the reputed richness of the mineral deposits caused a steady influx not only of adventurers but of miners, who came prepared with mills and other machinery to work the mines and secure the precious metals, and the Indians were finally subdued. At Bishop's creek, in the northwestern part of the county, the Poleta, or, as it was formerly called, the Pajaro, is the principal mine in the district. The main incline is 360 feet in depth, all in first-class milling ore, of which about 1,000 tons are on the dump. Two drifts have been started. The west drift, at a depth of 230 feet, and running on the ledge, is in a distance of forty-five feet, and the ledge is looking well; the east drift, at a depth of 126 feet, also running on the ledge, is in fifty feet, the face being in the same character of ore as that encountered in the main incline. Besides these two drifts a tunnel has been started in the ravine west of the mine to connect with the main incline at the depth of 200 feet; it is now in a distance of seventy feet, and about 150 more will have to be run before the connection is made. The work on the main incline has been suspended, as it could not be advantageously continued with a windlass, and until suitable hoisting machinery is erected operations will be confined principally to prospecting the ledge by drifts. It is in contemplation to erect a mill in the course of the coming season. Water is brought to the mine by pipes from the head of Redding's cañon, about two and a half miles.

The production of Inyo county during the census year ended May 31, 1880, was reported as follows:

District.	Gold.	Silver.
Alabama		
Beveridge	$17,000	
Cerro Gordo	3,307	$140,517
Coso	939	17,622
Deep Spring Valley		
Fish Springs		
Kearsarge	....	9,400
Lee	....	6,500
Lookout	633	18,499
Pajaro		
Panamint		37,140
Russ	2,925	2,600
Snow's Cañon	200	1,300
Swansea		5,567
Tarrytown		
Ubehebe		
Union		
Waucoba		
Wild Rose		
Total	$25,004	$239,145

The following mines returned reports of production: Phœnix, Los Angeles, Maggie, Del Norte, Key Note, Juarez, Hippolyte Galeron, Freeborn, American Union, Del Monte, Panamint, Ygnacio, and Modoc.

The production of the county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$25,004	$239,145
Mint Bureau, fiscal year 1880	48,648	173,916
Mint Bureau, fiscal year 1881	90,710	180,077
Mint Bureau, calendar year 1881	168,093	59,020

I estimate the total production for the calendar year 1881 to have been $170,000 gold and $140,000 silver.

Kern County.—Kern county, in the southern part of the State, and lying east of the Coast Range, has some excellent quartz mines, the chief of which is the Sumner, at Kernville, in the northwestern part of the county, on the headwaters of the Kern river. This mine has an 80-stamp mill, one of the best and most costly in the State. Mr. Charles E. Sherman, of Havilah, has furnished the following approximate estimate of the yield of Kern county by districts during the six months ended December 31, 1881. The mills are all wet crushing mills on gold-bearing quartz.

District.	Mills.	Stamps.	Yield.	Placer yield.	Total.
Sageland	1	10	$6,000	$2,000	$8,000
Pah Ute	2	23	2,500	} 3,000	10,500
Claraville	1	10	5,000		
Erskine Creek	1	10	1,000	....	1,000
Washington	1	10	10,000	3,500	13,500
Kernville	1	80	125,000	....	125,000
Bull Run	1	20	6,000	....	6,000
Greenhorn	Arrastras	....	2,500	1,500	4,000
Agua Caliente	1	5	5,000	....	5,000
Lower Caliente	1	5	1,200	....	1,200
Havilah	4	50	11,000	....	11,000
Total	14	223	$175,200	$10,000	$185,200

The production of Kern county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Mint Bureau, fiscal year 1880	$94,214	$390
Mint Bureau, fiscal year 1881	139,287	450
Mint Bureau, calendar year 1881	187,155	14,306

The following mines of Kern county returned reports of production: Bronaugh, Tom Lane, Anthrum, Harding, Oriental, Hailey.

The production during 1881 I estimate to have been $190,000 in gold and $14,000 in silver.

Lassen County.—Lassen county, in the northeastern part of the State, and south of Modoc county, has hitherto had but little reputation as a gold producing county, but discoveries made in late years of quartz ledges carrying varying proportions of gold indicate that with a wise expenditure of capital in their development the county may become a future producer to a considerable extent.

The total production of Hayden Hill district, in this county, is reported as $34,739 gold, $1,307 silver. The production of Lassen county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$34,739	$1,037
Mint Bureau, fiscal year 1880	25,900	
Mint Bureau, fiscal year 1881	42,905	1,406
Mint Bureau, calendar year 1881	70,590	

I estimate the total production for the calendar year 1881 to have been: gold, $71,000; silver, $1,000.

Reports of production were received from the following mines: Hopkins' Consolidated, Don't Care, New Hope, Fairfield & Co., Golden Eagle, and Juniper.

Los Angeles County.—This county, in the southern part of California, and lying on the Pacific Ocean, has lately attracted some attention from the discoveries of both gold and silver bearing ores in the mountains east of Anaheim.

Los Angeles county reported for the census year the production, by districts, as follows: Silverado, $29,400 silver. The following list of mines reported a production during the fiscal year 1881 of $3,978 gold, $3,368 silver: Arams, Stonewall, Santiago, Gold and Silver, Dunlap, Union, and small enterprises at Ravenna. The county's gold and silver production for the calendar year was, gold, $13,000; silver, $39,000. The production of the county for recent periods, as reported by the miners, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	......	$29,400
Mint Bureau, fiscal year 1880	$7,700	66,300
Mint Bureau, fiscal year 1881	3,978	3,368
Mint Bureau, calendar year 1881	13,046	38,166

Mariposa County.—Mariposa county, in Central California, is essentially a mining region, and possesses a large number of rich and valuable gold-bearing quartz veins. Many of the best mines are situated on the Fremont grant, a portion of which is the property of the Mariposa Land and Mining Company. This estate has been involved in prolonged litigation, and at present the company is doing little or nothing in mining, and their mines for the most part are lying idle. The Washington mine, 2 miles north of the town, is perhaps the best developed in the district. It has been exploited to the depth of 1,600 feet, and the ore, which is low-grade, has, under careful and economical management, been made to pay a profit. The depth to which the mine has been worked has, however, caused a proportionate increase in expense over former working, when a greater amount of ore could be extracted with less machinery and at less cost, and this has been gradually reducing the profits until they have reached a point at which the company has been compelled to suspend operations. This is a matter of regret, as the large number of miners employed depended upon the successful working of the mine for support. The machinery at the mine is of the most complete character, an excellent 20-stamp mill, chlorination works, hoisting apparatus, air-compressors, etc. It is in contemplation to remove and work the pillars of ore in the mine, after which the machinery will be sold or shipped to some other mine.

The production of Mariposa county during the census year 1881, by districts, was reported as follows:

	Gold.
Coulterville	$11,250
Hornitos	108,525
Mariposa estate	202,499
Total	$322,274

The production of Mariposa county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$392,274	
Mint Bureau, fiscal year 1880	150,017	$1,300
Mint Bureau, fiscal year 1881	141,449	520
Mint Bureau, calendar year 1881	194,694	1,230

I estimate the total production for the calendar year 1881 to have been $200,000 gold and $1,200 silver. The following mines reported production: Yosemite, Josephine, Burnwell, Piney Hill.

Mendocino County.—Mendocino county, on the Pacific Ocean, south of, and adjoining, Humboldt county, is an extremely mountainous region, the Coast Range occupying its whole extent. It cannot, however, be called a mining county, although gold in paying quantities is known to exist in various sections, and mining is carried on to some slight extent. The chief mining enterprise in the county is the Mendocino Flume and Mining Company of Boston. The mines of this company consist of 300 acres of placer claims near Calpella, which will be worked as soon as the flume is completed. The soil is a light sandy, washed gravel, easily worked, with no clay known. It has never been worked except a little during the rainy season with rocker or tom, when from $2.50 to $4.00 per day were made. The company only began work in the latter part of July, and are now engaged in building a temporary reservoir and the permanent flume for taking lumber and water to their mining ground and Calpella, twelve miles distant. Three tunnels will be necessary. The dam across Mill creek ravine is progressing as fast as possible. It will be 150 feet long and eight feet high, built of logs, brush, and earth, and faced with heavy planks, which will be sunk to their places with a pile-driver. The head dam will be eighty feet long and eight feet high. Flume work is proceeding briskly. A mile of trestle is in place, and water is flowing through three-quarters of a mile of thirty-six-inch flume, carrying material for its extension. Gold has been discovered lately in the hills east of Ukiah, on the Russian river, in fine particles in black sand, which appears to predominate in the formation in that section. The gold-bearing deposit is reported to be quite extensive. The estimated production for the calendar year 1881 is $1,000 gold. The production of Mendocino county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Mint Bureau, fiscal year 1880	$733	
Mint Bureau, fiscal year 1881	650	$125
Mint Bureau, calendar year, 1881	650	

Merced County.—Merced county embraces a large portion of the San Joaquin Valley, and extends from the foothills of the Sierra Nevadas on the east to the Coast Range on the west. The county is nearly all level prairie, and no quartz mines are known to exist. The surface gravel deposits were exhausted long since, and no gold is now extracted except on the Upper Merced river, near Snelling, where a little work is still done by Chinamen. The production of Merced for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.
Mint Bureau, fiscal year 1880	$17,515
Mint Bureau, fiscal year 1881	1,230
Mint Bureau, calendar year 1881	1,284

I estimate the total production for the calendar year 1881 to have been, gold, $1,500.

Mono County.—Mono county is in the eastern part of California, bordering upon the State of Nevada; the western portion lies among the Sierra Nevada Mountains, while the eastern part is principally deserts and volcanic tablelands. The wealth of the county is in its mines of both gold and silver. During the last year it ranked second among the counties of the State in its production of the precious metals. The principal mining district is at Bodie, although there are numbers of mines in other districts which, when developed to the same extent as those at Bodie, will render them equally famous. The Standard Consolidated is the largest bullion producer. It is employing about 150 men, half of whom are underground miners. The east cross-cut on the 1,000-foot level is in 570 feet. A few weeks' more work should cut the west vein of the Summit Mine, which is under control of the Standard. The west cross-cut 700-foot level is in 407 feet, and ought to be in the Bulwer ground, which is also under the Standard control. Most all the ore extracted has been from and above the 500-foot level, which is below the incline 550-foot level. But little work has yet been performed on the 700-foot level, and yet that little reveals the fact that the two great ore veins of the mine are fully as large, if not larger on that, as on the upper levels, and equally as rich. These veins, where cut by the shaft, reveal a tendency to a change of dip from the west to the east. It is reported that a cross-cut will be run west to cut the two immense veins that now lie west of the shaft on the 1,000-foot level, and when these are developed the company will require probably not less than 100 additional stamps. It is contemplated also to open the 1,200-foot level during the coming spring. This mine has been worked continuously for nearly five years, and is far from being worked out. It has rather improved as the years have gone by. It is producing more bullion this year than in any previous year in its history. In 1878 it was considered to be in a good state of development, and the product for that year was a little over $1,000,000. In 1879 and 1880 it did still better. The product for 1881 will exceed $2,000,000. The official figures of product for the first eleven months of 1881 are annexed, together with the actual cash balance on the first of each month:

Months.	Bullion.	Months.	Cash Balance.
January	$207,960	January	$41,315
February	184,342	February	58,148
March	168,175	March	144,004
April	166,376	April	201,362
May	158,835	May	212,273
June	167,651	June	224,390
July	167,360	July	242,354
August	161,384	August	243,886
September	170,230	September	289,971
October	164,632	October	326,709
November	222,793	November	349,914
December		December	397,086
Total	$1,939,738	Total	$2,731,412

Commencing with a cash balance of $41,315 on the 1st of January, 1881, the Standard has kept up its regular dividends of $75,000 per month, and reports a cash balance on the 1st of December of $397,086. In September, 1877, this mine paid its first dividend of $50,000, and continued to pay the same amount monthly until March, 1880, when it paid $75,000, which amount it has paid each month since that time. In addition to this, in December, 1880, and 1881, it declared extra dividends of $75,000, making the total amount paid to the close of the year 1881, $3,300,000.

At the Mono-Bodie or Lent shaft the tank and bob stations are rapidly nearing completion. The excavation for the tank station at the 810-foot level has been completed. The inflow of water remains very constant, the pumps running at seven and a half strokes per minute. At 705 level, north drift is now 266 feet long. In face the rock is firmer and there is less water, showing that it is getting beyond (north of) the great faulting breccia. The Noonday mine is looking well, but they cannot go below the 512-foot level until the Red Cloud shaft takes the water from them, and that may involve a cross-cut 1,000 feet in length, even after the Red Cloud attains sufficient depth; and it is not likely that another cross-cut will be run west short of the 800-foot level. They have substituted a 350-horse-power engine in their mill for the 96 horse-power formerly in use, and have added 10 stamps, making 49 in all. They have drifts running on the 200, 300, 400, and 500 foot levels, and enough ore in sight opened to a depth of 500 feet to keep their 40-stamp mill running for months; but from the fact that the rich ore in the lower levels cannot at present be extracted on account of a large amount of water, their mill is now running on Bechtel Consolidated ore. The rich ore recently struck in this mine is being followed downward and southward, and is holding its own in both directions. The south drift 500-foot level, which led through fair milling ore to the point where rich ore was encountered, is now in 330 feet south of the main east cross-cut. At or near this point a winze has been started and is now down ten feet. The ledge in the winze is five feet wide of clean ore, three assays from which gave the following results: No. 1, $50.23 in gold, and $348.73 in silver; total, $398.96. No. 2, $46.44 in gold, and $659.78 in silver; total, $706.21. No. 3, $46.44 in gold (precisely the same as No. 2), and $342.43 in silver; total, $388.87. The vein in the winze, as before stated, is five feet wide, of clean ore of the quality indicated by the above assays; but this is between smooth clay walls, outside of which is a harder quality of quartz of lower grade, so that really the width of the ore vein is unknown. In the North Noonday the No. 2 north drift on the 412-foot level is in good milling ore, the vein generally being about two feet wide. Work has been renewed in the No. 2 north drift 512-foot level, and shortly they should reach the body of ore which the same drift on the 412-foot level has recently encountered, as all indications point to its pitching north. An upraise has been started from the 512 to the 412 foot level. The No. 2 vein is larger and giving good assays. Ore for the mill is being stoped from the 212, 312, and 412 foot levels.

The Red Cloud great shaft is still being sunk, and has already cost several hundred thousand dollars. It has three compartments; its present depth is about 700 feet, and is intended to be sunk to a depth of 1,000 feet. The machinery, comprising double compound engines, pumps, etc., is simply immense, all of which suggests that the owners who are investing their money in this enterprise have great confidence in the mines. They are now cross-cutting at the 600-foot level and are in 51 feet. The Concordia vein will probably be cut at a distance of about 300 feet. The appearance of this vein on the 400-foot level above would render the discovery of a silver mine on this level a matter not at all surprising.

The United States Government has issued patents to the Bechtel Consolidated, and Tioga Consolidated of Bodie, thus setting all disputes as to titles in their favor.

The bullion shipments from Bodie during the year just closed were the largest of any year since the revival of the district. They amounted to $3,173,000. This is an increase of more than $100,000 over those of 1880, of more than $600,000 over those of 1879, and of more than a million over those of 1878, which was the year of greatest excitement in Bodie mines. The shipments for the five years ending December 31, 1881, have been as follows:

1877	$979,922 80
1878	2,129,732 58
1879	2,556,847 58
1880	3,063,699 13
1881	3,173,000 00
	$11,902,302 09

Notwithstanding this large yield of bullion, only three Bodie mines have ever paid any dividends. The total amount paid by the Standard to date is $3,300,000. The Bodie commenced paying dividends in August, 1878. It paid three that month, first, $1 per share, then $2, then $5 per share. After paying eight dividends, the disbursements were stopped until August, 1879, when eight more monthly dividends followed. From August, 1878, to March, 1880, the mine paid $1,200,000 in dividends. It has paid nothing since, but has levied some assessments. The Standard never levied an assessment. The Bulwer Consolidated mine has produced some bullion, but its main revenue for the past year has been from the rent of its fine mill. On the 1st of December, the company reported a cash balance of $100,000, and out of that a dividend of $10,000 was paid, the first one disbursed.

During the year 1881, Mono county mines have levied the following assessments:

Mine.	*Assessments.*	*Amount.*
Addenda	1	$10,000
Bechtel Consolidated	1	15,000
Belvidere	4	75,000
Black Hawk	3	15,000
Bodie Tunnel	1	50,000
Boston Consolidated	2	50,000
Brooklyn Consolidated	1	5,000
California	1	10,000
Champion	1	25,000
Consolidated Pacific	1	24,000
Defiance	1	25,000
Double Standard	1	12,500
Dudley	1	6,400
East Noonday	2	15,000
Glynn Dale	1	25,000
Goodshaw	2	30,000
Harrington	1	5,000
Headlight	1	10,000
Homer	1	30,000
Jupiter	2	41,000
Maybelle Consolidated	4	36,000
Mammoth	2	50,000
McClinton	1	3,000
Mono	5	150,000
Mount Cristo Consolidated	1	10,000
Noonday	2	75,000
North Noonday	2	75,000
Northern Standard	1	25,000
Oro	4	90,600
Paris	1	25,000
Red Cloud Consolidated	2	17,500
South Bulwer	2	50,000
Spaulding	2	20,000
Syndicate	1	25,000
Tioga Consolidated	3	50,000
University	2	20,000
Total	64	$1,201,000

The above list contains thirty-six mines, some of which are producing bullion. All these mines, it is hoped, will some day become self-supporting, if they do not pay dividends. But while this is the hope, no one has faith enough to believe that such will be the result.

On Mill Creek Cañon the Mono Lake Hydraulic Company have secured a large tract of auriferous gravel, and are making preparations for its systematic mining. The hydraulic mines on Mill creek cover 20,080 acres, secured by patent, of gold-bearing gravel, some three miles in length by one in width, commencing a little above the mouth of Mill Creek Cañon and extending down the creek in a southeasterly direction to within a half mile of Mono Lake. Work was commenced on the 10th day of October last on the big ditch, whose proposed dimensions were five feet wide on top, three feet on the bottom, four feet deep, and having a carrying capacity of 2,500 inches. Up to date it has been completed one mile from where it taps the creek to its present point of connection with the penstock. The latter is fifty feet long, four feet wide by three feet deep. There are now in use 300 feet of Norway iron pipe, twenty-four inches in diameter at the penstock, and tapering down to eleven inches at the giant. The largest sized monitors with patent deflectors are used. The nozzles are four and a half and six inches in diameter, and under an eight-foot pressure, the former is capable of throwing 500 inches, the latter 800. There is now only about 1,500 inches of water in the channel bed, and it is all required. The flume is 700 feet long, and it is being extended at the rate of fourteen feet per day. Its width in the clear is forty-eight by thirty-six inches in depth. The bottom blocks are ten inches by thirty-six inches in diameter; lining blocks four by eighteen with six sets of riffles; dip four inches in twelve feet, while its gravel capacity is 4,000 tons every twenty-four hours, with 2,000 inches of water. Seventy thousand feet of lumber have thus far been consumed in its construction. The bank is fifty-three feet high, and in six days' work of ten hours each, with a four-inch nozzle under an eighty-foot head, 20,000 tons of gravel have been washed down and flumed away. The buildings consist of a boarding-house, lodging-house, office and blacksmith shop. The creek, on leaving the cañon, makes a sweep from east to south about three miles to the lake. The company is now getting ready to lay its pipes from its present workings directly south to the lake, instead of following the old creek channel and commence cutting back on bed-rock to the extreme northern boundary of its property. This manner of procedure will give it a fine tailing off or dumping place, save one and one-fourth miles of flume and pierce the center of the claims, whose highest point is 900 feet. Ample fall will thus be secured. There is now enough pine timber of the best quality standing on the claims along the creek to furnish blocks for two miles of flume. All the water coming from the cañon has been secured by purchase and pre-emption. They can also increase the number of inches to 5,000 when necessary. All that is required is five more miles of ditch, which can be easily constructed, as the soil is good picking ground. There are two to five colors, and sometimes a dozen can be found in every pan of dirt prospected on any part of the creek, or in its vicinity.

The report of the Census Bureau for 1880 gives the following as the production of Mono county by districts:

District.	*Gold.*	*Silver.*
Bishop Creek		
Blind Spring	$308	$43,233
Bodie	*25,199 2,765,927	341,375
Clover Patch		
Homer		
Indian	....	80,317
Montgomery or White Peak	....	5,000
Piute		
Scattered	....	6,601
Total	$2,791,434	$476,526

*Placer mines.

The production of this county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$2,791,434	$476,526
Mint Bureau, fiscal year 1880	2,407,236	582,905
Mint Bureau, fiscal year 1881	2,749,712	517,866
Mint Bureau, calendar year 1881	3,380,751	170,457

The following mines of Mono county reported production for the fiscal year: Josie Green, Delaware, Snow Flake, Honeymoon, Hudson, Babylon, Diana, Lisbon, Standard Consolidated, Bodie Consolidated, Noonday, North Noonday, Bulwer Consolidated, Syndicate, Golden Prince, May Lundy, and Bodie Tunnel. The production during the calendar year 1881 I estimate to have been $3,385,000 in gold, and $300,000 in silver, a total of $3,685,000.

Nevada County.—Nevada county takes the lead among all the counties of California as a producer of gold. Its yield in 1881, as reported by the mines, exceeded by $300,000 that of Mono county, the second in point of production. It lies in the heart of a group of the richest gold-producing counties of the State with Plumas, Sierra, and Yuba on the north, and Placer and El Dorado on the south. Ever since its organization in 1851 the chief industry has been mining. For a number of years succeeding the first discovery of gold in 1849, the river-bars, banks, and shallow placers yielded a golden stream by easy and simple mining processes. The discovery of the ancient river-bed opened a new class of mines involving greater risk and a large outlay of capital for their successful development. An almost continuous deposit of gravel varying from 100 to 300 feet in depth extends along the ridge between the middle and south forks of the Yuba river from Smartsville to the summit of the mountains. To work this in a systematic and profitable manner can be done only by the use of a large supply of water, which is obtained by a system of ditches aggregating hundreds of miles in length and of reservoirs for storing water during the winter months. The reservoirs of the Bloomfield Mining Company, Nevada county, have a capacity of 1,050,000,000 cubic feet; the Milton Company's reservoir has a capacity of 650,000,000 cubic feet; the Eureka Lake Company, 1,130,000,000 cubic feet; the Fordyce and the many other reservoirs of the South Yuba Company contain about 1,800,000,000 cubic feet; the Omega and the Plue Point United, 300,000,000 cubic feet; the Spring Valley, 300,000,000 cubic feet; the California Water Company have nearly 600,000,000 cubic feet; the El Dorado Company's reservoirs have a capacity of 1,070,000,000 cubic feet. There are also a number of small reservoirs on the Feather, Yuba, Bear, and American rivers, whose collected capacity is 700,000,000 cubic feet, making a total of 7,600,000,000 cubic feet of storage capacity of water.

The quartz mines of Nevada county have also been singularly productive. The gold-bearing rocks are chiefly volcanic schisto slates and greenstones. The veins are not generally large, seldom exceeding two feet, while the most productive are rarely over one foot in width. Their peculiarity lies in their uniformity and persistency. The ore is free milling, the sulphurets constituting not over two per cent., and can be readily concentrated; the free gold is in large angular particles and is easily saved, yielding an average of from $25 to $30 to the ton. The concentrates will yield $100 per ton. The chief obstacle to quartz mining is the amount of water, not so much from the bottom of the mines as from the surface. A deep alluvial deposit covers the country rock, and during the rainy season it absorbs an immense quantity of water which percolates through the underlying strata. To keep the deep shafts and lower levels of the mines free from this is a costly operation, requiring ponderous machinery, and frequently taxes the resources of the miners to the utmost. The situation throughout the county, so far as hydraulic and quartz mining is concerned, is encouraging, although the *débris* question and consequent legal proceedings have materially checked the former. Quartz mining, however, is a steady interest, as there are a number of dividend-paying mines that are worked for profit and not for stock purposes, and the number is increasing. Nevada county also possesses some advantages over other mining sections; prominent among which are its railroad communication over a paying road at reasonable rates for freight, long established foundries and machine shops capable of performing any work required upon milling machinery, and a permanent population of skilled laborers in mines, mills, machine shops, etc. In addition to this, its situation is at a sufficient altitude to give exemption from the fierce summer heats of the valley, and it is below the deep winter snows of the mountains. The production of gold in Nevada county from placer mining has been much reduced by the injunction suits instituted by farmers in the Sacramento valley to restrain the working of those mines by hydraulic process and the consequent deposit of the *débris* upon the agricultural lands below. The shipments of gold, most of which was obtained from the quartz mines, none from the mines enjoined, was, in November, $90,536. Work was resumed in several hydraulic mines about the beginning of October, giving employment to hundreds of men who had been idle in consequence of the suits. Nearly all the hydraulic mines in the vicinity of Nevada City were idle in August, and only about $50,000 was taken out, and the product of these mines for the period from June to November was less than $500,000. The most productive quartz mines of the county are found in Grass Valley district, the chief veins being the Idaho, Pittsburg, Empire, Gold Hill, Massachusetts Hill, New York Hill, Eureka, Rocky Bar, and Allison's Ranch.

The Idaho is the principal mine, not only in this district but in the county. The ore is mostly taken from the deepest workings of the mine, the eleventh and twelfth levels, where the vein is strong and uniform in its paying character. Two years ago there were apprehensions that the profitable days of the mine were drawing to a close, as the tenth level east ran into comparatively barren ground, in which the vein did not live. Since then the No. 11 level has been opened and the drift carried under the barren ground spoken of, and a good paying and well defined vein found all the way. The No. 12 level has not been extended as far east as the No. 11, but it carries good ore in its stopes. The No. 13 level is now being opened, a drift having been run about 125 feet. The appearance of the mine is entirely satisfactory, and there is all encouragement to believe that it can be worked profitably to a much greater depth than has yet been reached. Masons are laying the foundation for the engine. The ground has been excavated to the depth of twenty-eight feet down to solid rock, and on this a solid bed of granite is being laid in Portland cement for engine foundation and bob-pit. This foundation will be sixty-three feet in length, twenty-eight feet in depth, and in width a portion sixteen feet, and the remainder thirty-three feet. The cap-stones for the engine will be dressed granite from the quarries of Penryn, amounting to 260 cubic feet. The entire amount of excavating, to receive the stone work, has been 38,000 cubic feet. The entire plant, when ready for use, will be the best pumping-rig in California. The building covering the machinery will be forty-seven feet span in length, twenty feet posts, and supported by a truss roof. The new works will pump the water from the bottom of the mine up to the 800-foot level, a six-inch pump being used for that purpose. From the 800-foot level the engine now in use in the fire-proof pump-house will raise the water to the surface. With the new works it is anticipated that every power requisite for the future drainage of the mine will have been provided for, as it is expected that they will be ready for service about the middle of December, and that the cost of the same will be from $25,000 to $30,000. The mill has fifty stamps, crushing about two tons to the stamp-head. They are fed by hand. The pulp first flows over blankets. The blanket concentrates are passed with a minimum of water through riffles filled with mercury, and thence join the bulk of the battery pulp, which now enters boxes, in which amalgamated, corrugated plates are made to oscillate with sufficient rapidity to agitate the sands. From these boxes they flow over long, narrow amalgamated plates, and are then concentrated in sluices, lined with gunny cloth, through which the water flows in intermitting waves. The concentration is partly done on shares. The concentrates are amalgamated raw in pans before being sold to the chlorination works. This mine was first opened in 1869, since which time the receipts from all sources have been as follows:

1869	$306,038 75	1876	$573,928 31
1870	183,450 23	1877	525,435 18
1871	407,301 16	1878	609,449 18
1872	404,035 52	1879	501,038 15
1873	1,010,612 20	1880	440,445 59
1874	669,023 03	1881	640,107 58
1875	509,430 72		
Total receipts for 13 years			$6,780,295 60

Of this amount there have been paid in dividends the following amounts:

Year.	*Dividend.*	*Per Cent.*	*Amount.*
1869	11	55½	$170,500
1870	7	12	37,200
1871	12	75	232,500
1872	11	52½	162,750
1873	12	220	682,000
1874	12	102½	317,750
1875	11	55½	172,050
1876	12	82½	255,750
1877	12	77½	240,250
1878	12	85	263,500
1879	12	54½	168,950
1880	12	41	127,100
1881	12	87½	271,250

Being for thirteen years 148 dividends, amounting to $3,101,550. The success attendant upon the working of the mine has been due as much to wise and judicious management as to the quantity and quality of the ore.

The superintendent, Edward Cole, reports the monthly dividends paid during 1881:

Date.	*Per Cent.*	*Amount.*
January 3	5	$15,500
February 7	7½	23,250
March 7	7½	23,250
April 4	7½	23,250
May 2	7½	23,250
June 6	7½	23,250
July 4	7½	23,250
August 1	7½	23,250
September 5	7½	23,250
October 3	7½	23,250
November 7	7½	23,250
December 5	7½	23,250
Total		$271,250

Of the operations of the mine, he says:

"The work connected with the company's property has also been kept in as favorable a condition as circumstances would permit; and it is considered that there is fully as much pay ore in sight underground now as there was one year ago; and as was expected the yield has been more satisfactory than it was last year. This also has brought an increase of profits, which have been disbursed to the stockholders by increased monthly dividends.

"In several of my reports I have stated that our machinery was of adequate power to do all the work required, but each year seems to require an addition, and while we may congratulate ourselves on the apparent permanency of the mine, we should also bear in mind that as we attain greater depth, it brings with it the need of larger and heavier machinery. We have been troubled considerably in the past to adjust the pumps for both winter and summer use. In the winter the surface water is very fast, requiring fourteen-inch pumps to keep it at about eight strokes per minute. This water is caught at the 800 level, and below that point a six-inch pump will answer at any time in the year. In the summer months the fourteen-inch pumps are too large, and have to be run so slow that the six-inch are too small to do the required work below the 800 level, and in view of this difficulty, and in order to do away with some of the flat rods, it was deemed advisable to erect another engine to connect with the lower pumps and have them entirely independent of the large pumps. This engine is of twenty-inch diameter and forty-eight-inch stroke, and all its parts are of sufficient strength to work the engine up to its full capacity. As it is impossible to form an idea of the work this engine may have to do in the future, it was deemed best to make a good job in every particular, and when completed it will be second to none on the coast.

"The sump at the 800 station has been enlarged. This was necessary from the fact that if from any cause the large pumps were stopped only a short time, the water ran to the bottom of the mine, and with six-inch pumps running so slow it required a long time to pump it out. The sump is now sixteen feet by fourteen feet and sixty feet long.

"The underground workings are all in good condition. The 1,100 drift is in 850 feet from the incline. The ledge has been of an average quality and size until recently. It now shows indications of breaking up, and I fear we have about exhausted the pay chute in this drift. The stopes connected with this drift are of good size and of an average quality.

"The 1,200 level is in 512 feet from the incline. The ore in the drift is of low-grade all the way from the incline, and it has been broken up badly for the last 100 feet. I think, however, it is only local, and that it will form again only a little below the bottom of the drift. It certainly extends only a short distance up, and the ore is of good quality and the ledge of good size all through the 1,200 stopes.

"The 1,300 drift is in 124 feet from the incline. As we wish to make a connection with the 1,200 as soon as possible, we have not taken the ledge down in this drift. We are now putting up a raise to the 1,200, which will be through in about three weeks.

"Preparations are now being made to commence sinking the incline for the 1,400 level. In the last 100 feet of sinking, the incline ran into the hanging wall. This made it quite expensive, and it is now thought best to make a turn toward the foot-wall, and thus avoid working in the hard hanging wall rock.

"During the year we have crushed 27,945 tons of rock. Of this amount 346½ tons came from the 1,000 level and stopes; 9,753½ from the 1,100; 15,527½ from the 1,200; 1,977¾ from the 800, and 340 tons from the incline; yielding an average of $22.95¾ per ton. Average cost of mining and milling per ton, $9.51⅓."

A company of Chinese miners are working in the bed of Bear river a short distance below the mouth of Greenhorn creek. They have diverted the water in the streams by means of embankments, so that it runs close to the Nevada side, leaving a large area of ground dry. They have sunk a large pit into this, which is compact sand and gravel, the washings from the mines, down to the original bed of the river. The depth is 16 or 18 feet, which makes heavy stripping, as all the top dirt has to be wheeled out in barrows. The pit is kept dry by the usual water-wheel used in river mining, in the erection of which the Chinese always show as much ingenuity as the white men. The Chinese are always reticent as to their success in mining, but from the fact that the same company has worked that part of the river for several years in succession, the inference is that they have paying ground. In September, at the Blue Point mine, on Morris Flat, a slide occurred causing a suspension of operations and over 50 men were temporarily thrown out of employment. A number of men were set to work by the manager drifting a tunnel, and over a month and a half was consumed in restoring the mine to its former condition. The Knickerbocker hydraulic mine, located at Quaker Hill, had a clean-up from a 20 days' run, and took out $2,000 at an expense of $350. The gold found was of unusual purity, assaying $19.41 per ounce.

The production of Nevada county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$931,538	$19,053
Mint Bureau, fiscal year 1880	2,702,362	70,144
Mint Bureau, fiscal year 1881	4,129,325	7,470
Mint Bureau, calendar year 1881	3,645,525	9,358

The Census Bureau reports the production for the year 1880, by districts, as follows:

District.	Quartz. Gold.	Quartz. Silver.	Placer Gold.	Total. Gold.	Total. Silver.
Grass Valley	$440,445	....	....	$440,445	$19,053
Nevada City	396,303	$19,053	....	396,303	
Scattered	....	....	$42,631	42,631	
Willow Valley	52,159	....	....	52,159	
Total	$888,907	$19,053	$42,631	$931,538	$19,053

The following mines of Nevada county reported production during the fiscal year: Mayflower, Red Hill, Charonnat & Sons, Deadwood, California, Gold Tunnel, Lincoln, Spargo, Murchie, El Capitan, Knickerbocker, New York Hill, Idaho, Golden Gate, Centennial, Orleans, Godfrey Gravel, Champion, Walkenshaw, Portuguese, Derbec Blue Gravel, Black Gillespie, Lone Ridge, American, Hathaway, Illinois, Conger, Badger Hill, Sailor Flat, Blue Tent, Mount Vernon, Hawley, Ashburn, Gowell, Lecompton, McDonald, Hall, North Bloomfield, Miller, Consolidated Wyoming, Eureka Consolidated, Round Mount, Pittsburg, Mohigan, Swamp Angel, Deadwood, Quaker Hill, Erskine & Craig, Alpha, Rocky Bar, Place Grand, East New York, Brockmeyer & Hainer, Perkenpine, Bartlett, Tiernan & Co., Wiseman & Co., Corinth, Garden Lodge, Canada Hill, Nevada City, Turner, L. Wheeler & Co., Milton Company, Steep Hollow, Dean Culbertson, Poor & Co., J. W. Hart, Manzanita, Omega, Yuba, Providence, Ford & Mullin, Empire, Rose Hill, and Merrifield.

I estimate the production during the calendar year 1881 to have been $3,700,000 in gold and $9,500 in silver.

Placer County.—Placer county is situated in about the middle of the gold-mining counties of the State. Its western boundry is in the valley plains about fifteen miles from the base of the foot-hills. From there it extends in a northeasterly and easterly direction, nearly 100 miles to the eastern boundary of the State. In width it varies from ten to thirty miles. The northern boundary is in part Bear river, the southern the Middle Fork of the American river, the greater portion of the drainage being into the latter stream through its numerous tributaries. The western portion of the county lying between these two rivers is drained by several small streams, of which Auburn and Doty's ravines and Rock and Coon creeks are the most important. The eastern portion of the county is mountainous and contains but a few mines, which as yet have only been prospected. In the western section, consisting of the lower foot-hills, are the great auriferous channel gravel deposits, which are worked by hydraulicing and drifting. The surface placers have been for the most part long since worked out and abandoned, but a few gravel mines are being now worked on a small scale. There are also numerous auriferous quartz ledges being developed, the Rising Sun, at Colfax, having been the most permanently worked.

At the Daniel Webster mine the owners are now running a tunnel to tap the lode about seventy feet below the present surface. It was prospected over twenty years ago, and was then known as the "Old Man Mason's Lode." It was abandoned, and for several years deemed unworthy of notice. About ten years ago a San Francisco company did some work upon the claim, but they failed to find the vein, and the ground was again abandoned. It has been located several times since, but no work done until located by the present owners, D. W. Malby and P. W. McCarthy, who went to work and stripped the lode for over 100 feet on the surface, and are now opening it in good shape. They found the true vein within thirty feet of the old works.

The gold production of some of the mines in that vicinity has been as follows: North Star and Weisler claim at Iowa Hill proper, $2,000,000; Wolverine mine at Roach Hill, $800,000; Shelby, $105,000; Columbus, $100,000; Dayton, $156,000; Phillips, $80,000; Morning Star mine at Morning Star Hill, $250,000; Bird's Flat mines, $200,000; Strawberry Flat, $100,000; Wisconsin Hill, $550,000; Grizzly Flat mines, $350,000; Sucker Flat, $250,000; total from the Independence Hill mines, $100,000; and Mountain Gate at Damascus, $1,500,000; total, $6,541,000.

The production of Placer county for the census year 1880 was reported by districts as follows:

	Gold.
Bath	$65,000
Colfax	*68,000
Dutch Flat	44,000
Gold Run	53,999
Iowa Hill	16,000
Michigan Bluffs	110,369
Total	$357,368

* Quartz mines.

The production of the county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$357,368	
Mint Bureau, fiscal year 1880	838,133	$640
Mint Bureau, fiscal year 1881	1,236,252	577
Mint Bureau, calendar year 1881	830,126	6,099

I estimate the total production for the calendar year 1881 to have been $850,000 gold and $6,500 silver.

The following mines of Placer county reported production for the fiscal year: Crater, Washington, Yankee Jim's, Sacramento Gold, Laird, Strawberry, Indian Cañon, Wolverine, Mountain Gate, Big Gun, Hidden Treasure, Mayflower, Davis, Loyd & Co., East New York, Blue Bluff, Cañon Creek, Almatah Quartz, Gosling Ravine, U. S. Grant, Boles & McBride, Rockey Point, Zentgraf, Southern Cross, Nevada Hydraulic, Polar Star, Gold Run Ditch, Excelsior Deep Gravel, Hoffman, Julian Gold, Moodey, Paragon, Lowell Hill, Baltimore, James Butts, John Vabmeir, Indian Hill Mill, Trio, Independence Hill Hydraulic, Hope, Morning Star, Homeward Bound, Lost Camp, Cranage Hydraulic, Cedar Creek, Mammoth Bar Placer, Rising Sun, Shipley, Belleview, Succor Flat, St. Patrick, Pie Pie Hill, New Gold Run Hydraulic.

Plumas County.—Plumas county lies high up in the Sierra Nevadas, with Lassen county on the north and Sierra county on the south. The mines constitute the chief source of wealth, both gravel and quartz mines existing in all parts of the county. The auriferous gravel is often found incorporated with volcanic products or hardened cement, rendering blasting and crushing necessary, in many instances, before it can be washed. On this account, mining in some sections had been almost abandoned, but these mines are again coming into notice rapidly and capital is being brought from all quarters for investment. Sometimes, however, the gravel is found loose and is readily washed, and these placers always richly repay the time and labor expended. The old established quartz mines are mostly on a sound paying basis, and new ledges are constantly being discovered and developed to a greater or less extent. The Green Mountain mine near Greenfield, in Indian Valley, is one of the principal quartz mines of the county. The mine is situated on the point of a high range of hills which rise on the southwest side of the valley. The average width of the lode is about fourteen feet, although it widens in places to thirty or forty feet. The country rock is granite, but at some points on the line of the lode it changes to porphyry, and at others to a stratified slaty material; the granite dike which contains the lode lies between the Jurassic slates on the east and west, and the stratified condition of the rock is due to the fact that different strata have mingled in the formation where it passes from granite to slate, and from slate to granite. The main tunnel is in upwards of 3,000 feet, and over 1,000 feet of pay ore has been penetrated. The lode crops at various places along the line, but has not been stoped to the surface. The west hanging-wall of the lode is found, carrying a gouge, but the east foot-wall has not been found. A cross-cut is to be run to cut the same, if possible. The ore is free milling and is worked by the ordinary stamp process, no concentrators nor pans being necessary. The reduction works consist of two mills run by water-power, one of sixty stamps situated at the foot of the hill and one of thirty-two stamps on the top of the first bench. The ore for the latter is run directly from the mine to the mill, while that for the sixty-stamp mill is taken from the tunnel to the dump-house, and from thence by double tramway to the mill. The larger mill is in excellent order, and is supplied with an ore-breaker and automatic ore-feeders. The output of the mine is 150 tons per twenty-four hours. The mills crush the same. The cost of reduction and mining is inside $2.50 per ton. The quality of ore now taken from the shaft that is being sunk on the White ledge is superior to any milled for some time, and it is confidently expected that good results will be given. The mine shows a strong and permanent ledge, and when the lower Bidwell tunnel reaches the ledge it will give good reserves of ore to last for many years to come.

This county reported for the census year the production by districts as follows:

District.	Quartz.		Placer Gold.	Total.	
	Gold.	Silver.		Gold.	Silver.
Claremont					
Genesee Valley	$2,799	$20	....	$2,799	$20
Indian Valley	232,614	2,859	....	232,614	2,859
Lights Cañon	....	....	$5,999	5,999	
Moonlight Mountain	....	....	6,001	6,001	
North Forks, Feather River	....	....	84,376	84,376	
Quartz Township	518,588	4,359	....	518,588	4,359
Seneca	45,773	40	7,035	52,808	40
Scattered	....	....	60,848	60,848	
Total	$799,774	$7,278	$164,259	$964,033	$7,278

The accompanying list of mines reported a production during the fiscal year of gold, $1,251,917; silver, $419: Yankee Hill, Fall River and Ditch, Franklin Hill, Twelve Mill Bar, Badger Hill, Taylor Hill, Grub Flat, Rush Creek Flat, Halstead, Silver Star, Plumas National Gold, New York, Morton, Jolly, Smith & Davis, Harris, Plumas Eureka, Genesee Valley, Diamond, Brown Bear, Hungarian, Scad's Point, Plumas Water, Winters, Empire, English Bar, Diadem, East Branch, Lee & Jolly, Orr & Co., Queensabe, Monte Christo, Centennial, Cunningham Bros., Jos. Dodson, Vermont, Sunnyside, D. Bushman, Granite Basin, Reynolds & Co., Buckeye and Low Pit Gravel, W. W. Wiseman, Western Gravel, Gold Stripe, Green Mountain, Cherokee, Crescent Mills, Loring & Leavitt; Chinese at Spanish Ranch, at La Porte, at Quincy, at Crescent Mills, and small enterprises at Eureka Mills, at Spanish Ranch, and at La Porte.

The production of Plumas county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$964,033	$7,278
Mint Bureau, fiscal year 1880	857,124	181
Mint Bureau, fiscal year 1881	1,251,917	419
Mint Bureau, calendar year 1881	1,354,685	163

I estimate the total production for the calendar year 1881 to have been, gold, $1,350,000; silver, $2,000.

Sacramento County.—Sacramento county is situated in Central California, and was one of the first organized counties. The mining interests are now but secondary to the commercial and agricultural, as the placers have been worked and reworked until but little new ground remains, and the principal production of gold is by the Chinese. Folsom, in the northeastern part of the county, is near the border of a former ocean deposit, adjoining slate and granite bed-rock, with gravel drifts ranging from twenty to sixty feet in depth, and extending across the Sacramento Valley some sixty miles in width, but paying in a belt about five miles in width near the foot-hills. This drift deposit pays chiefly at the junction with the underlying ocean deposit, and is being rapidly washed out. The ocean deposit has been bored to a depth of 120 feet, and gold in paying quantities found on the granite beneath, but it cannot be profitably worked owing to the great amount of water, which requires heavy and expensive pumping apparatus to handle. A field is open here to enterprise, aided by capital, to develop what may prove to be as rich and extensive mines as any heretofore discovered.

The production of Sacramento county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.
Mint Bureau for fiscal year 1880	$342,514
Mint Bureau for fiscal year 1881	306,058
Mint Bureau for calendar year 1881	425,631

I estimate the total production for the calendar year 1881 to have been $425,000 gold and $1,000 silver.

The following mines of Sacramento county reported production for the fiscal year: Humphrey, Gullett & Co., Milgate, Donovan, Amador and Sacramento Canal, Hartford Anderson, James Jordan.

San Bernardino County.—San Bernardino is the largest county in California, and is located in the southeastern portion of the State, bordering on Arizona and Southern Nevada. The mining interests of this county, which have been gradually winning the attention of the public during the last two years, have received a new impetus in the recent discoveries about Calico Mountain. These are attracting miners from adjacent States and Territories, and the building of the California Southern Railroad, which taps some of the most valuable districts, offers encouragement of convenient transport. The town of San Bernardino is the nucleus of the activity, and is showing signs of material advancement.

The Census Bureau reports the production of San Bernardino county for the census year 1880 as follows:

District of	Silver.
Clark	$65,115
Dry Lake	
Silver Mountain	
Total	$65,115

The estimated production of the county for the calendar year is $9,000 gold and $100,000 silver.

San Diego County.—San Diego county is in the extreme southern portion of California. The chief mining done is at Julian, Banner, and Pinacate mining districts. *Pinacate mining district* lies immediately north of the Temescal range, in the region of the county known as the San Jacinto, distant from San Diego seventy-five miles. A good wagon-road connects it with Colton, thirty miles distant, which is the nearest depot of the Southern Pacific Railroad. The district is comparatively a new one, but the developments now making evidence mines of considerable importance. The veins contain free milling ore, and run north and south in decomposed granite.

During the past year there has been a resumption of excitement relative to mineral deposits in the country lying along the foot-hills and mountains skirting the desert, and several discoveries of more or less importance have been made in gold, silver, and copper, prominent among which is the Copper Chief, Silver Dime, and Lucky Strike. The ledge upon which these claims lie runs through the country for miles. It has been exposed in a number of places, and shows a uniform width of about seven feet, lying between two plainly-defined walls. The ore assays rich in gold, silver, and copper, the returns in some instances showing $25 in gold and 20 per cent. copper. Others show very rich in silver.

The production of San Diego county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$237,850	
Mint Bureau, fiscal year 1880	81,558	
Mint Bureau, fiscal year 1881	68,192	$14.00
Mint Bureau, calendar year 1881	34,631	

I estimate the total production for the calendar year 1881 to have been $60,000 gold.

Reports for the fiscal year were received from the Cable, Hubbard, Gardner, and Yuma.

The production by districts has been reported by the Census Bureau thus:

	Gold.
Banner	$9,000
Cargo Muchacho	154,000
Julian	8,850
Pecacho	66,000
Pinnecate	
Total	$237,850

Shasta County.—Shasta county, in the northern part of the State, produced, in the early mining days of California, a large amount of gold, but the gravel deposits were worked over and over again until their poverty led to more attention being paid to quartz mining, and many locations have been made and developments prosecuted of a highly encouraging character.

The production of Shasta county, by districts, for the year 1880 was reported as follows:

District.	Quartz.		Placer Gold.	Total.	
	Gold.	Silver.		Gold.	Silver.
Buck Eye	....	....	$14,400	$14,400	
French Gulch	$38,500	....	28,313	67,313	
Igo					
Iron Mountain					
Northern Shasta County	....	....	107,520	107,520	
Pittsburgh	13,201	$98,337	....	13,201	$98,337
Sawmill Flat	....	....	3,379	3,379	
Shasta City	....	....	25,920	25,920	
Southern Shasta County	....	....	210,000	210,000	
Scattered	4,000	....	60,000	64,000	
Whisky Creek	40,700	....	....	40,700	
Total	$96,401	$98,337	$450,032	$546,433	$98,337

The production of this county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Census Bureau, census year 1880	$546,433	$98,337
Mint Bureau, fiscal year 1880	140,455	117,907
Mint Bureau, fiscal year 1881	233,007	19,805
Mint Bureau, calendar year 1881	347,888	85,107

I estimate the total production for the calendar year 1881 to have been: gold, $350,000; silver, $85,000.

The following mines of Shasta county reported their production during the fiscal year 1881: Aftermath, Rios, Williams, Dunkham Gravel, White, Summit, Thafter Quartz, Chicago, Jennie June, Scorpion, Dry Creek, Fluming Tunnel, Brown Bear, Spring Creek, Dixon & Cooper, Vermont, Washington, Frich & Davis, Dardanells.

Sierra County.—Sierra county, located between Plumas and Nevada counties, in the heart of the Sierra Nevada Mountains, which cross it from north to south, has yielded an immense amount of gold in the past. The hydraulic and drift mines during the last year have produced large sums, and the quartz mines are becoming more and more a leading industry. At Sierra City the Sierra Buttes continues to be the principal producer. The mine is opened by tunnels, and no sinking or pumping is required. The ore is low grade, and consequently a large quantity must be reduced to render it remunerative. It has been found here, as in Dakota, that low-grade ores can be more profitably worked by means of mills having a large number of stamps than in any other manner; the expense of running 100 stamps being but little more than for half that number. This company have ninety-six stamps, which are run by water-power, and employ about 250 men. Eight levels have opened the ledge, and a ninth has been started and is now in about 250 feet. During the year ended June 30, 1881, 48,000 tons of ore were extracted. The mine is owned by an English company.

The Bonanza gravel claim, Howland Flat, was worked during the whole season, and the channel was found to widen and improve in quality. In January, 1881, eleven car-loads from the mine yielded $190. The highest yield at any time reached was $200. During the summer the mine changed hands, being purchased by Cornish capitalists, who paid for it $300,000, and added $100,000 more for working expenses. For the first two months and a half the returns were $12,000 above expenses; but afterwards the main channel was lost, and the new owners ran behind $7,000. The pay channel was, however, again found, and in September gravel was taken from the mine at the rate of one hundred and fifty car-loads per day, worth $5.50 each load. The main tunnel is 4,000 feet in length, the air tunnel 1,600 feet, and the air shaft 375 feet in depth; seventy-five men are employed inside and outside of the mine.

The production of Sierra county for recent periods, as reported by the mines, has been as follows:

Reported to	Gold.	Silver.
Mint Bureau, fiscal year 1880	$974,332	$576
Mint Bureau, fiscal year 1881	1,158,286	1,039
Mint Bureau, calendar year 1881	925,342	6,043

I estimate the total production for the calendar year 1881 to have been: Gold, $950,000; silver, $6,000.

The following mines of Sierra county reported their production during the fiscal year: Grizetz, Richards, Frank, Brennan, Buckeye, Branch and Mammoth, Union Consolidated, Williams, Arnott & Bird, Egleston & Mowrey, Keystone, Hill Placer, Gold Bluff Quartz, Limperick, American Hill Hydraulic, Bonanza Gold, Perry, Sierra Buttes, New York Gravel, Doherty, Havens, California Consolidated, Gardner's Point, Donahue, Caledonia, Indian Queen, Kendall & Noble, Fair Play, Union, Union Hill, Lewis, Baird, Filliput, Martinetti, Golden Star, Highland and Masonic, Truckee, Rising Sun, Bald Mountain, Rainbow Quartz, Virginia, Hill & Co., Troxel & Co., Bald Mountain Extension, Peter Wanemacher, Fur Cap and Live Yankee, Cleveland, J. Winans, Gold Lake, F. Buckerman & Co., W. A. Morse, Cox & Gourley, Dutch, B. F. Folsom & Co., Pioneer Hydraulic, Sierra Yuba Gold Quartz.

Siskiyou County.—Siskiyou is one of the northernmost counties in the State, and borders on Oregon. Two ranges of mountains, the Sierra Nevada and the Coast Range, the latter known locally as the Siskiyou and the Salmon Mountains, meet here, and on the numerous streams which arise in their cañons and ravines, and are tributary to the Klamath and Sacramento rivers, gold-mining of placers first attracted settlers to the county. Although gravel-mining is not so actively pursued as in the early days, it has been by no means abandoned, and is still the chief industry of the county. In addition to this, the quartz-mining interest is gradually assuming an importance which which will in the near future attract capital to profitable investment.

Mr. John Daggett, of Klamath mills, Siskiyou county, furnishes the following interesting and valuable communication in regard to mining for the precious metals in that county. The mining field in Siskiyou county extends from the Oregon line on the north to the line of Humboldt county on the south, and is formed by the Klamath river and its tributaries, the largest being the Salmon and Scott rivers, which have been worked since early in 1850, and although the yield has been large, the diggings are in a much less exhausted condition than in the southern part of the State, affording many opportunities for capital to apply improvements now unused here, but found profitable elsewhere, as the region is well watered and dumpage good. River mining has received a new impetus by the success of wing damming companies on the Klamath for the last three years. The yield for the past season was very profitable, and as the Klamath is fed by auriferous streams from Cottonwood creek, through Siskiyou, Del Norte, and Humboldt counties, to the ocean, a distance of nearly two hundred miles, this branch of mining, is destined to become an important factor in the future production of gold in this part of the State. Quartz mining, although inaugurated as early as 1859 on Humbug and Indian creeks, was only partially successful, until at a later day the mines of the North Fork of Salmon were opened about the head of Eddy's and Black Bear Gulches, where the so-called Mother Lode of California appears with all the characteristics of its occurrence in the southern part of the State, black slate and large veins.

The total yield of Siskiyou county for 1881 from both white and Chinese is:

Quartz mining companies	$200 000 00
Placer mining companies	837,350 00
	$1,037,350 00

I have placed the production of Siskiyou county for the calendar year at $850,000 gold and $1,500 silver, which is $185,850 below Mr. Daggett's estimates. Messrs. Wells & Fargo carried out of Siskiyou county, during the calendar year, $507,000.

For the fiscal year 1881 the production was reported by the following mines, viz.: Thomas Hikey, Black Bear, Last Chance, Johnson Quartz, Boulder Creek, Yreka Creek, Pacific, Steamboat, Matthewson, Oak Grove, Tompkins, Williams, Cameron, Selle Claim, Burnett & Miller, Allen Brothers, Burns Brothers, Pierson & McMahar, Grizzly Quartz, Kanaker, Grizzly Bear, Blind Lode, Klamath Quartz, Knokenback & Myers, Centennial, Empire Quartz, Yreka Creek, Fortune, A. B. C., Wright & Fletcher, G. A. Mohr & Co., Columbia, Grattan, Burns Placer, General McNeal, Chinese, and small enterprises.

The production of Siskiyou county by districts, for the census year 1880, was reported by the Census Bureau as follows:

District.	*Quartz.*		*Placer Gold.*	*Total.*	
	Gold.	*Silver.*		*Gold.*	*Silver.*
Callahan's Ranch	....	....	$82,371	$82,371	
Cottonwood	....	....	12,000	12,000	
Galena Hill	....	....	10,001	10,001	
Greenhorn	....	....	13,600	13,600	
Humbug	....	....	38,851	38,851	
Indian Creek	....	....	14,726	14,726	
McAdams Creek	....	....	50,015	50,015	
Oro Fino	....	....	19,503	19,503	
Quartz Valley	$9.798	$4,396	....	9,798	4,396
Rattlesnake Creek	....	....	6,500	6,500	
Sawyer's Bar	32,550	228	75,000	107,550	228
Sciad Valley	....	....	4,240	4,240	
Scott Valley	....	....	15,000	15,000	
South Fork, Salmon River	160,856	2,134	78,001	238,857	2,134
Yreka	....	....	64,184	64,184	
Total	$203,204	$6,758	$483,992	$687,196	$6,758

The production of the county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$687,196	$6,818
Mint Bureau, fiscal year 1880	440,735	95,340
Mint Bureau, fiscal year 1881	567,519	100
Mint Bureau, calendar year 1881	547,524	

Stanislaus County.—Stanislaus county, forming a part of the San Joaquin Valley, is now more noted as an agricultural than as a mining district. The rich placers of early California days have been long since worked out, and but little attention is now paid to this branch of industry. La Grange, in the eastern part of the county, and formerly known as French Bar, is the seat of the chief gravel mining. The La Grange Ditch and Hydraulic Company is the principal producer. A little work is also done on the Tuolumne river a few miles above the town. From the La Grange district there was reported for the census year 1880, gold, $62,650.

The production of the county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$62,650	
Mint Bureau, fiscal year 1880	73,271	
Mint Bureau, fiscal year 1881	61,553	$4,200
Mint Bureau, calendar year 1881	62,614	31,735

I estimate the total production for the calendar year 1881 to have been $63,000 gold and $31,000 silver.

Trinity County.—Trinity county is in the northern part of California, and is a long and comparatively narrow county, drained by Trinity river and its tributaries. Although gold was discovered in this county in the earliest days of the mining excitement in the State, yet from its inaccessibility and from the distance which mining supplies had to be transported, the mines were never worked to an extent proportionate to their magnitude and richness, and the result is that there are openings here for successful operations, if conducted in a systematic manner, that would not exist had the country been more conveniently located and in the more direct line of travel. At Weaverville, the county seat, but little sluicing is now done except by Chinamen, the principal large companies employing the hydraulic method. The town is situated in a bowl-like depression, four or five miles in diameter, known as Weaver Basin, and hydraulic washing clears the gravel only to the false bed-rock. Beneath this the true bed-rock has been ascertained to be about 600 feet deep, and a project has lately been set on foot and is now being matured for working this deposit to as great a depth as possible, though it is not expected that the true bed-rock will be reached. The consummation of this scheme involves the construction of a large tunnel through a peninsular ridge formed by a long bend in the Trinity river, whereby fall enough will be obtained to run off a large amount of surface gravel in this basin. To mine to the deep bed-rock can only be effected by means of another and much longer tunnel, the construction of which it is believed will some day be undertaken, as a work of this kind would be entirely feasible and very likely accomplish the end proposed. Conjoined with the first of these schemes will probably be the extension to Weaver Basin of the large ditch now being built by Thomas H. Blythe for conducting the water of Coffee Creek and other large branches of the Upper Trinity upon the mining grounds of the proprietor and others adjacent. Viewed as a whole, this enterprise may be considered one of great magnitude, as well as one likely to lead to a successful issue.

The production of Trinity county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$799,999	
Mint Bureau, fiscal year 1880	326.693	$142
Mint Bureau, fiscal year 1881	330,732	643
Mint Bureau, calendar 1881	494,666	

The production by districts, as estimated for the census year 1881, was as follows:

	Gold.
Aggregate of the placer mines	$777,999
Bully Choop, small mines (quartz)	10,000
Deadwood, small mines	12,000
	$799,999

The following mines reported their productions for the fiscal year 1881: Vance's Bar, Price, McKenney, Keno, Weaver Creek, Shoo Fly, Lowden & Bates, Chapman, Julian Creek, Buckeye Water and Hydraulic, Black Bear, Ella May, Smith's Flat, Laws & Co., Lorenz, A. J. Sturdivant, R. M. Holman, McMurray & Hupp, Garden Gulch, Rule Brothers, Trinity Hydraulic Gold, Slattery, A. Pitreau & Co., Wilshire Hydraulic Gold, Portuguese, Cunningham Gravel.

The production for the calendar year 1881 I have estimated at $550,000 gold and $1,500 silver.

Tulare County.—Tulare county is situated in the San Joaquin Valley, between Fresno and Kern counties, and a little south of the center of the State. In the eastern and northeastern part of the county, among the Sierra Nevada Mountains, large deposits of silver-bearing ores, as well as gold quartz, have been discovered.

At White River, in the southern part of the county, White River, East Prong, Coarse Gold, Grizzly, Gordon, and Rag Gulches, are the principal streams which have yielded placer gold in the district. Lack of water has prevented a proper and thorough working of the placers. Many small tributaries of the streams spoken of remain untouched. When the main stream is abandoned the freshet water could be turned into one of these small gulches and the whole worked out. When such an enterprise has been undertaken it has generally paid well. Throughout this section there are an immense number of small veins of gold-bearing quartz. The formation in which these small veins occur is syenitic granite, which generally carries a large percentage of hornblende, which in some cases is so great as to give the rock the constituent properties of greenstone. The country rock is very much decomposed. Tunnels have traversed this rock 100 or 200 feet without exploding a blast. The veins which outcropped were mainly all discovered many years ago, and have been worked in many places five or ten feet deep. In some places they have been worked twenty or thirty feet deep, two or three have approximated 100 feet, and one shaft has reached 112 feet. In many cases the lodes are so flat as to partake of the character of "blanket lodes." Williams and Popple, after following a narrow stream for about thirty feet in soft granite, struck a vein of twenty inches lying nearly flat, and have developed it by about 300 feet of drifts into pay rock, which will probably yield more than $100 per ton on the average. There are some of the sulphurets, however, which do not yield to the simple process of the arrastra, and it is doubtful whether mere milling would save more than $50 per ton.

The production of Tulare county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Mint Bureau for fiscal year 1880	$1,125	$526
Mint Bureau for fiscal year 1881	3,847	36
Mint Bureau for calendar year 1881	8,181	

Reports of production for the fiscal year 1881 were received from Briggs & Garvison, Mahurin, Stone Hydraulic, and Williams & Popple.

The production during the calendar year 1881 I have placed at $8,000 in gold.

Tuolumne County.—Tuolumne is an irregularly shaped county situated on the western slope of the Sierra Nevada Mountains, and about 150 miles due east of San Francisco. Surface mining in this county is nearly exhausted, and the present production of gold is from quartz lodes and the ancient river beds, the channels of which were filled up with volcanic deposits to the depth of from 200 to 400 feet during the period of volcanic disturbances.

Of these ancient rivers there are a number of parallel claims which traverse the county from northeast to southwest. Some portions of these channels which have been opened up have proved to be extremely rich, but there is an extensive field for future enterprise. The great drawback to rapid and successful development has been a want of capital, as the opening of deep gravel mines necessitates a large outlay before any returns may be expected.

The production of Tuolumne county for the census year 1880 was reported by districts as follows:

District.	*Gold.*	*Silver.*
Confidence	$31,260	
Jamestown	44,000	
Riverside	2,000	
Sonora	24,000	
Soulsbyville	28,511	$3,189
	$129,771	$3,189
Placer mines	$559,828	
	$689,599	$3,189

The production reported by the following mines for the fiscal year 1881 was: Gold, $372,454; silver, $375: Mount Zion, Louisiana, Stewart Placer, Keith, Quartz Mountain, T. G. Evans, Golden Treasure, Raw Hide Quartz, Republican Quartz, Philadelphia, Hawes Gold, Tiger, Osgood & Slayton, Mohrman Quartz, Chinese at Big Oak Flat, at Columbia, at Jamestown, at Chinese Camp, at Sonora, small enterprises at Big Oak Flat, at Columbia, at Jamestown, at Sonora, Ogden & Nash, Never Sweat, New Albany, Soulsby, Confidence, Devall & Co., Riverside, Portland, Peterson & Co., Newbaumer & Co., Alto.

The estimated production of Tuolumne county for the calendar year 1881 was $500,000 in gold and $1,500 in silver. The production of Tuolumne county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$689,599	$3,189
Mint Bureau, fiscal year 1880	461,861	1,071
Mint Bureau, fiscal year 1881	372,454	375
Mint Bureau, calendar year 1881	444,684	

Yuba County.—Yuba county lies in the Sacramento Valley, west of and adjoining Sierra and Nevada counties. Its reputation as a mining county, gained from the exceeding richness of its bars, gulches, creeks and ravines, was widespread, but at present, with the exception of a few large hydraulic companies, not over 100 white men are engaged in placer mining, the worked-out claims being now in the hands of Chinamen. Some of the most extensive hydraulic mining in the State has been conducted in Yuba county. When this system was first introduced, an inch nozzle on a two-inch canvas hose was employed, but this was superseded by pipes of boiler-iron eighteen inches in diameter, propelling streams of from five to nine inches against the gravel banks, which in some instances were 200 feet high. At Smartsville, eighteen miles above Marysville, the county seat, is the Excelsior Water and Mining Company, the largest mining enterprise in the county, producing annually nearly three-fourths of all the gold taken out. The property of the company consists of a surface area of 525 acres of gold-bearing gravel, together with a farm of 2,300 acres, 300 of which are irrigated, and all well equipped and stocked. The improvements and appliances embrace six tunnels, the construction of which, before the acquisition of the property, had cost $441,000; 23,000 feet of the rock-paved flumes and under-currents that had cost $50,000; one hundred and fifteen miles of ditches, which, with their strong, well-placed head dams, had cost originally $1,000,000; two distributing reservoirs, having the capacity to store 13,000 inches of water over night; a complete hydraulic equipment, with all the buildings necessary for the most advantageous exploitation of so extensive a property. About 350 men are constantly employed.

The Nevada Reservoir and Ditch Company, at Smartsville, reports the second largest production in the county. This company is associated with the Golden Gate Company. The gravel of this mine can all be worked from the bed-rock to the surface and pay an average of forty-two cents to the cubic yard. The Golden Gate claim has, during about ten years' work, washed away some seven acres of land, which has produced $1,250,000. The Massachusetts Mining Company are opening Garden Valley claim, on Willow Creek, between Comptonville and Bullard's Bar. This property was mined to some extent in the early days, but the tailings from the mines above, drove out the miners and covered the pay gravel up from twelve to twenty feet deep. It is now proposed to rework the whole deposit. As there is no dump to permit of this vast mass of tailings and gravel being washed down and out of the lower end of the valley, it must be raised up out of the sink and carried away through flumes thirty or forty feet above. For this purpose, an improved elevator will be used. It consists of pipe inclined at an angle of 35°, the lower end resting in the claim. Into this a stream of water having a pressure of 400 feet will be turned, and a little giant will be used to drive the tailings in front of the bottom orifice, where the stream will force it up through the pipe and into the sluices. After the work is once fairly inaugurated, six or eight men will be sufficient to do all the work around the claim. The projectors estimate that all of the dirt, including the wash from the mines above, will pay for working.

The production of Yuba county for recent periods, as reported by the mines, has been as follows:

Reported to	*Gold.*	*Silver.*
Census Bureau, census year 1880	$1,042,349	
Mint Bureau, fiscal year 1880	943,860	$438
Mint Bureau, fiscal year 1881	950,203	5,772
Mint Bureau, calendar year 1881	600,101	

I estimate the total production for the calendar year 1881 to have been $800,000 gold and $1,300 silver.

The following was reported by districts for the census year 1880:

	Placer Gold.
Scattered	$1,042,349

The following mines reported production during the fiscal year:

Foster Bar, Purdy Creek Flume, Drake & Blanchard, Boyce, Gorne, Melody, McChesney, Florence, Sharon Valley, Indian Ranch Quartz, Young's Hill, Weed's Point, Humphrey, Brandy City, Pittsburg, Alexanderson, Brown & Purington, Templar Ledge No. 3, Merrill, California, Brownsville, Baxter, Nevada Reservoir Ditch, South Featherwater, Solo Mill, Joubert, Eagle Mill, Forlorn Hope, Gold Quartz, G. B. Pepper, Watson, Resler & Co., J. S. Stevens, Union, Washington Mill, Sparks & Burn, Safford, James Fagin, Bridger Creek, Excelsior Water, John Tolen.

General Statistics.—*California half-year product.* Mr. J. J. Valentine's estimate, which appeared in the San Francisco papers, of the product of gold and silver of the mines of California for the six months of the year ending July 1, 1881, gave:

Gold	$9,418,378
Silver	298,264
Total	$9,716,642

Mr. Valentine's estimates for the previous ten years are:

Year.	*Gold.*	*Silver.*	*Total.*
1871	$19,447,354	$231,270	$19,679,224
1872	18,143,314	906,784	19,050,098
1873	17,289,951	744,771	18,025,722
1874	17,616,124	2,683,407	20,300,531
1875	16,326,211	1,426,940	17,753,151
1876	16,099,559	2,516,248	18,615,807
1877	15,237,729	2,936,987	18,174,716
1878	17,306,508	1,613,953	18,920,461
1879	17,166,166	1,014,807	18,190,973
1880	17,745,745	530,421	18,276,166
Total	$172,370,661	$14,616,188	$186,986,849

Silver Shipments from San Francisco to Hong-Kong and China.

The following shows the shipments of silver in 1881 to Hong-Kong and China:

Months.	*Refined.*	*Mexican Dollars.*
January	....	$70,244
February	$330,000	292,380
March	....	57,230
April	467,630	285,505
May	126,800	266,587
June	1,500	121,417
July	249,590	123,409
August	....	146,239
September	....	154,092
October	....	279,236
November	56,987	148,775
December	....	173,940
Totals	$1,232,507	$2,119,063
1880	1,156,279	2,154,082
Increase	$76,228	
Decrease	....	$35,119

The shipment of trade and Mexican dollars in each of the years named compare as follows:

Years.	*Trades.*	*Mexicans.*
1876	$5,752,079	$2,610,043
1877	7,925,955	2,454,900
1878	1,489,148	2,372,036
1879	546,403	2,340,796
1880	1,000	2,154,182
1881	....	2,119,063
Six years	$15,714,585	$14,057,020

Production of Gold and Silver in California, by counties, during the fiscal year ended June 30, 1881, as reported by the mines to the Superintendent of the San Francisco Mint.

Counties.	*Gold.*	*Silver.*	*Total.*
Alpine	$1,643	$2,096	$3,739
Almador	1,561,668	1,172	1,562,840
Butte	350,787	19	350,806
Calaveras	805,724	22	805,746
Colusa	1,251	23	1,274
Del Norte	45,885	....	45,885
El Dorado	710,230	711	710,941
Fresno	114,307	....	114,307
Humboldt	32,679	....	32,679
Inyo	90,710	180,077	270,787
Kern	139,287	450	139,737
Lassen	42,995	1,406	44,401
Los Angeles	3,978	3,368	7,346
Mariposa	141,449	520	141,969
Mendocino	650	....	650
Merced	1,230	....	1,230
Modoc	29,000	1,500	30,500
Mono	2,749,712	517,866	3,267,578
Nevada	4,129,325	7,470	4,136,795
Placer	1,236,252	577	1,236,829
Plumas	1,251,917	419	1,252,336
Sacramento	306,058	....	306,058
San Bernardino	1,100	7,785	8,885
San Diego	68,192	14	68,206
Santa Barbara	2,000	....	2,000
Shasta	233,007	19,805	252,812
Sierra	1,158,286	1,039	1,159,325
Siskiyou	567,519	100	567,619
Stanislaus	61,553	4,200	65,753
Tehama	91	....	91
Trinity	330,732	643	331,375
Tulare	3,847	36	3,883
Tuolumne	372,454	375	372,829
Ventura	600	....	600
Yuba	950,203	5,772	955,975
	$17,496,321	$757,465	$18,253,786

Estimate of Mr. A. M. Lawver of the bullion production in California during the calendar year 1881, classified by counties.

Counties.	*Gold.*	*Silver.*	*Total.*
Alpine	$1,643	$2,096	$3,739
Amador	1,401,310	1,172	1,402,482
Butte	646,790	46	646,836
Calaveras	793,113	49	793,162
Colusa	3,251	23	3,784
Del Norte	10,050	....	10,050
El Dorado	540,173	316	540,489
Fresno	83,513	27	83,540
Humboldt	19,115	3,345	22,460
Inyo	168,093	59,020	227,113
Kern	187,155	14,306	201,461
Los Angeles	13,046	38,166	51,212
Lassen	70,592	....	70,592
Mendocino	650	....	650
Mono	3,380,751	170,457	3,551,208
Mariposa	194,694	1,230	195,924
Modoc	121,067	1,500	122,567
Merced	1,284	....	1,284
Nevada	3,645,525	9,358	3,654,883
Placer	830,126	6,699	836,825
Plumas	1,354,685	163	1,354,848
Shasta	347,888	85,107	432,995
Stanislaus	62,614	31,735	94,349
San Diego	34,631	....	34,631
San Bernardino	8,891	120,000	128,891
Santa Barbara	1,740	....	1,740
Sacramento	425,631	....	425,631
Siskiyou	547,254	....	547,254
Sierra	925,342	6,043	931,385
Tuolumne	444,684	....	444,684
Trinity	$494,666	....	$494,666
Tulare	8,181	....	8,181
Tehama	278	....	278
Ventura	224	....	224
Yuba	600,101	....	600,101
Total	$17,368,751	$550,858	$17,919,609

NEVADA.

THIS State, which at one time produced more bullion annually than any other State in the country, now ranks as third, Colorado and California both having exceeded it during the last year. The decrease in productiou has not been general throughout the State, but mainly in Storey county. Mines outside of the Comstock have not fallen off in their yield, but in many instances have increased in gross yield and net profit. Nearly the whole extent of territory in Nevada is mineral-bearing, though much of the ore found is refractory and of low grade. The great needs of the country are an economical process for working low-grade ores and better and cheaper railway facilities. The latter are being secured by the extension of the Carson and Colorado Railroad through Esmeralda county, and the construction of a new railway from Eureka to Salt Lake, at which point it will become a part of one of the projected transcontinental trunk lines. During the year, eighty-seven mines in the State called for help in the way of assessments, aggregating $6,509,110, as follows:

Counties.	*Mines.*	*Assessments.*	*Amount.*
Elko	8	17	$320,000
Esmeralda	9	12	179,500
Eureka	2	6	207,500
Humboldt	1	1	7,000
Lander	1	2	75,000
Lincoln	3	4	148,000
Lyon	1	1	6,310
Nye	4	7	105,000
Storey	54	113	5,355,800
White Pine	3	8	105,000
Total	87	171	$6,509,110

During the same time but eight mines declared dividends, amounting to $1,397,500; these were:

Mines.	*Dividends.*	*Amount.*
Eureka Consolidated	9	$225,000
Exchange	5	15,000
Indian Queen	10	57,500
Navajo	1	25,000
North Belle Isle	1	15,000
Northern Belle	20	400,000
Richmond Consolidated	4	540,000
Starr Grove	6	120,000
	56	$1,397,500

This State, according to the recently published report of A. J. Hatch, Surveyor-General, contains at the present time 108 ore-crushing mills and twenty-six smelting furnaces, by which latter there were last year smelted 98,825 tons of ore; 1,168,465 tons of ore having been milled meantime. Seven pan mills worked over 119,523 tons of tailings. These reduction works are of very variable capacity, each being able to put through from two or three to forty or fifty tons every twenty-four hours. There are ten mining ditches in the State, having an aggregate length of fifty-one and a half miles, and a carrying capacity of 20,413 inches of water.

The following is my estimate of the production of gold and silver in Nevada during the calendar year 1881 by counties:

Counties.	*Gold.*	*Silver.*	*Total.*
Elko	$30,000	$500,000	$530,000
Esmeralda	35,000	1,620,000	1,655,000
Eureka	980,000	1,980,000	2,960,000
Humboldt	70,000	230,000	300,000
Lander	5,000	930,000	935,000
Lincoln	20,000	280,000	300,000
Nye	15,000	500,000	515,000
Storey (including Lyon)	1,050,000	660,000	1,710,000
Washoe	5,000	35,000	40,000
White Pine	40,000	325,000	365,000
Total	$2,250,000	$7,060,000	$9,310,000

Elko County.—The principal locality where mining is successfully carried on in Elko is in Tuscarora district, in the northwestern part of the county. Less bullion was produced here during the last than in previous years, and did not exceed in value $600,000. The principal mines in the Tuscarora district are the Argenta, Belle Isle, Grand Prize, and Independence.

The *Times Review* publishes the following as the shipments of Tuscarora bullion for eleven months in 1881, as furnished by the books of Wells, Fargo & Co.:

January	$25,025 04
February	39,224 76
March	97,590 06
April	31,276 13
May	20,745 43
June	24,028 28
July	16,888 63
August	69,972 96
September	14,091 00
October	9,146 01
November	37,207 14
Total	$385,195 44

The gross yield of the mines of Elko county for the calendar year 1881, as reported to the assessor, was 2,665 tons—value $156,349.61. According to the San Francisco *Bulletin*, the assessments of the mines of Elko county for the calendar year 1881 were:

Mines.	*Assessments.*	*Amount.*
Argenta	3	$40,000
Belle Isle	2	25,000
Blue Belle Consolidated	1	20,000
Grand Prize	4	115,000
Howe	1	10,000
Independence	2	35,000
Navajo	2	45,000
Tuscarora	2	30,000
Totals	17	$320,000

The following table shows the production of gold and silver in Elko county, for the year 1880, as reported to the Census Bureau by districts:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Blue Jacket			
Columbia	$1,639	$106,600	$108,239
Good Hope			
Rock Creek			
Tuscarora	105,697	1,006,917	1,112,614
White Rock			
Scattered	1,840	50,000	51,840
Total.	$109,176	$1,163,517	$1,272,693

I estimate the production of the county for the calendar year 1881 to be gold, $30,000; silver, $500,000.

Esmeralda County.—This county, situated on the western border of the State, adjoins Mono county, in California, and like the latter has attracted much attention on account of the increasing importance of its mines. While the yield of the precious metals has been gradually decreasing in many other counties, it has increased in Esmeralda, until in 1881 the county ranked second in the State. There is a well-grounded feeling that it is better and more profitable to open new mines than to continue the search for new ore bodies in the deep workings of such mines as are on the Comstock ledge, and the building of the Carson and Colorado Railroad through the heart of the county has induced and aided the search of mineral-bearing ledges in sections of country tributary to the road, and imparted an interest and prospective consequence greater than has heretofore been attached to this county.

The gross yield of the mines of Esmeralda county for the calendar year 1881, as reported to the assessor, was 36,509 tons, and the value $1,372,828.53.

The gold and silver production of Esmeralda county, as reported by districts to the Census Bureau for the year 1880, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Alum Creek			
Black Mountain	....	$48,841	$48,841
Cambridge	$7,675	75	7,750
Columbus	18,000	1,171,028	1,189,028
Dutchman Creek			
Esmeralda	15,000	5,000	20,000
Gold Mountain			
Lake			
Lida Valley	1,500	13,500	15,000
Montezuma	....	16,575	16,575
Mount Grant			
Oneota	....	49,718	49,718
Palmetto			
Santa Fé			
Silver Peak	$13,614	$13,955	$27,569
Volcano			
Washington			
Wilson	74,946	644	75,590
Total	$130,735	$1,319,336	$1,450,071

The San Francisco *Bulletin* gives the following as the assessments of the mines of Esmeralda county for the calendar year 1881:

Mines.	*Assessments.*	*Amount.*
Equator	1	$25,000
Holmes	2	20,000
Juniata Consolidated	1	2,000
Lodi	2	15,000
Metallic	1	12,500
Mt. Potosi Consolidated	1	10,000
Real del Monte	2	75,000
Tilden	1	10,000
Vanderbilt	1	10,000
Total	12	$179,500

The production for the year 1881 I estimate at $35,000 gold, and $1,620,000 silver. The following mines reported their production during the fiscal year 1881: Rothschild, McIntosh & Bauer, Hawkeye, Black Hawk, Northern Belle, Grand Trunk, Shawamut, Consolidated, North Star, Wilson, Mt. Diablo, A. W. Simonson, and Thos. Taylor.

Eureka County.—Eureka stands foremost in production of all the counties of Nevada. This is largely due to the yield of two great mines, the Richmond, and Eureka Consolidated, both situated in the southern part of the county, in Eureka district. Through this district a great ore-channel extends along the eastern base of Prospect Mountain from north of Ruby Hill to Secret Cañon in the south, a distance of about twelve miles. This is a contact lode in a formation of limestone, quartzite, and shale, and from the various mines scattered along the main lode and its branches and spurs more than $50,000,000 have been taken.

The Richmond mine is owned by a London company, and by careful, economical, and systematic management has been made, probably, the best paying mine in Nevada. The ore yields about twenty per cent. of base bullion, and of the value of the precious metals one-third is gold and two-thirds silver. The company have their own smelting works two and a half miles from the mine, the ore being transported by rail. Four furnaces are in constant operation, and until the summer of 1881 had been running for two and a half years without stopping. They also have their own foundry and machine-shops, making their own castings. The following in relation to this mine is from the report of the directors for the last year:

"The smelting and refining works (which had been in continuous operation since December, 1878) were shut down on May 30, and were, together with the whole machinery, thoroughly repaired and put in order, the furnaces rebuilt, a new steam-engine, a new 'Baker' blower, and other machinery erected. This necessitated, of course, the stoppage of the works for some time (seven weeks), the repairs required after such a long run being very heavy. Smelting was resumed on July 18, and from that date to the present everything at the works has been running smoothly and well. Extensive explorations have been made in the mine during the half year; 3,586 feet of drifts and winzes have been run and sunk, low-grade ore and bunches of galena have been found in the 200, and favorable indications for ore in several other places."

On November 1st the directors received telegram from Mr. Probert: "Indication favorable for fourteenth chamber continuing downward northerly; followed ore streak thirty feet below 600 level; only prospect yet, take month to develop." After giving other telegrams showing the value to be maintained, the report continues: "This strike or find is by far the most important that has taken place in the mine for a long time, and it is impossible to estimate its value or foresee its results. The shareholders must remember that up to this time no ore has been discovered in the mine below the 600. The cave was struck at a depth of thirty-five feet below the 600, and good ore found in the bottom; a winze has been sunk fifty feet from the bottom of this cave, all the way in ore, and the ore body is now flattening and extending northward, looking strong, and promising well for a chamber with a flat floor, which has always been the most profitable sort of ore body."

Mr. Rickard, writing on this subject, says: "This is undoubtedly the continuation in depth of the large ore chambers found above the 600; and the fact of it (the ore body) making below the 600 is of great importance, and cannot be too highly appreciated." With the view of further proving the mine at deep levels the main or Richmond shaft has been sunk 330 feet below the 900, and is now down 1,230 feet from the surface. The shaft itself being in the quartzite, a drift has been started at the 1,200 in a northerly direction in order to cut the ore-bearing ground (the limestone); this drift has been run 212 feet, and it is expected that the limestone will be reached with about 100 feet further driving.

During the nineteen weeks of the half year that the furnaces have been running they have reduced 15,200 tons of Richmond ore and 821 tons of purchased ore, together 16,041 tons; the average yield per ton being $57.08 (Eureka assay value). No. 4 furnace, which smelts principally low-grade Richmond and purchased ore mixed with the drosses from the refinery, has smelted 3,606 tons of Richmond and 178 tons of purchased ore. The total quantity smelted by the three furnaces being 19,825 tons, yielding 3,453 tons of lead, 395,578 ounces of silver, and 13,012 ounces of gold. The purchased ore is less than six per cent. of the total quantity smelted, whereas in the corresponding half year it was as much as twenty-seven per cent. Then follows a table showing 15,790 tons to be the quantity of ore smelted by the two large furnaces as cabled weekly, and the gross estimated value of the bullion (gold, silver, and lead), at Eureka assay value, to be $907,000.

The refinery was shut down on June 7th, and started again on August 2d, since which time it has been working continuously, and well treating all the ore produced at the works, as well as 319 tons of purchased bullion. The returns of the refinery (closed down eight weeks) show the gross estimated value of the doré bars (gold and silver), also at Eureka assay value, to be $850,000. After charging revenue with all the costs and expenses of rebuilding the furnaces, providing new machinery, and putting the works in a thorough state of repair, the profits for the half year, although the works were shut down so long, will probably be between £50,000 and £60,000. The price of lead has improved, and the company is sending it forward for sale as quickly as possible; the latest quotation at New York for small parcels is five cents per pound (£20 per ton). The Richmond furnaces have the reputation of being the largest smelters in the world. The accumulation of lead in that company's premises is something wonderful. There must have been in July the vicinity of 50,000 tons of market metal lying outside the refinery. There is an acre of ground piled solidly five feet high with pigs of lead. Writing from Eureka, Nev., a correspondent of the San Jose *Mercury*, says of the Richmond mine: "The stock of this company is owned entirely in London. It is reputed to be the best paying mine in the world. It has already produced $61,000,000 of the precious metal without a single assessment of the stockholders in the nine years of its existence. They have their own smelting works, which are located in the south end of the town, about two and one-half miles from the mine, and their ore is transported by rail. This is probably the largest and most perfect work of the kind in the world, connected directly with their own mine, having their own refinery and machine-shops, and making their own castings, etc., on the premises. They run four furnaces night and day, smelting 200 tons of ore per diem. Of the yield of the ore thirty-three per cent. is gold and sixty-six per cent. silver, and one ton of lead to five tons of ore. The quality of the ore in the two mines is about the same. The Richmond employs 500 men at mine and furnace, and as many more outside in furnishing wood and coal. They consume 5,000 bushels of clear coal per day, and 1,000 cords of wood per month; coal costing twenty-five cents per bushel and wood $7 per cord, delivered at the works. The smelting works were shut down for repair last week, and will remain closed for one month. They have been running constantly for two and a half years without stopping. They have now piled up in their yards 12,000 tons of lead ready for shipping, which will cost at present rates $100,000 to pay freight."

The shipment of the Richmond during the calendar year, reported in the *Engineering and Mining Journal* of bullion for the quarter, was $672,135.

The Eureka Consolidated has had from the time it was first opened a prosperous existence. The company was organized a dozen years since, with a nominal capital of $5,000,000 in 50,000 shares, only $100,000 of which was actually paid up and used in developing the mine and placing it on a self-sustaining basis. The mine commenced to pay dividends in 1871, and has paid seventy-two, ranging from thirty cents to $3 per share. The dividends were as follows:

	Number.	*Amount.*
1871	6	$275,000
1873	4	200,000
1874	4	175,000
1875	8	300,000
1877	4	600,000
1878	12	1,800,000
1879	12	825,000
1880	12	280,000
1881	10	250,000
Totals	72	$4,705,000

The payment of dividends was suspended in November, 1881, and the surplus funds on hand retained to pay for improvements that were being made, the sinking of a new shaft and the erection of extensive works. The mine is explored to the fourteenth level, but the water is too heavy to allow much work to be done until after the new pumping machinery is in operation. The principal extraction of ore was from the eighth and ninth levels. The new machinery consists of six large boilers, two engines for working the hydraulic rams, hoisting engines, and other appliances connected with the hydraulic work. The pumping capacity is estimated at 30,000 gallons per minute on a rise of 3,000 feet. Besides the company's regular force, considerable work has been done by tributers and ore taken out from the twelfth level up. Taken as a whole, the mine is looking well and a large amount of ore in sight. The indications are favorable for the continuation of the ore channel to a great depth. On the twelfth level the ledge narrowed until the hanging and foot walls were scarcely a foot apart, but they rapidly diverged, and the thirteenth level shows an ore body thirty-five feet wide, and the fourteenth one of 109 feet in width. The following from the secretary's annual report shows the condition of the company's account:

From 5,396 tons base bullion	$1,720,313
Sales of candles	1,260
Sales of powder, fuse, and caps	3,384
Sale of boiler	500
Sales of lumber, hardware, etc	99
Discount on coal receipts	444
Assaying	3
Total receipts, 1880–81	$1,726,003
Superintendent's drafts	19,902
Cash in hands superintendent, October 9, 1880	97
Cash on hand, October, 9, 1880	24,521
Total resources	$1,770,523

The output of the Eureka Consolidated for the quarter ending September 30, 1881, as reported to the county assessor, was $305,074.90, its mining expenses $248,277.05, and, according to statements published in the *Mining Record*, bullion to the value of $1,396,618 was shipped during the year.

The *Header*, in publishing the assessor's statement of the proceeds of the mines of the district for the first quarter of the year, said:

"Assessor Wallace's statement of the proceeds of mines for quarter ending March 31, 1881, makes most gratifying showing for district, and shows most decided increase in output of mines. Gross yield for quarter, according to his account, is $916,524.37. Compared with the yield of the previous quarter, it shows an advance of $60,830.33, and makes encouraging increase of $114,153 in the two quarters last past. As compared with preceding quarter, the last shows the total cost of extraction, transportation, reduction, etc., to be $47,629.23 less, and tax derived from mines $3,283.70 more. There were also 769½ tons more ore extracted, the average assay of which was $41.82 per ton for yield of entire district. This marked increase in yield of district is most encouraging, and it demonstrates that mining in Eureka, instead of dying out, is steadily growing in importance. Mines throughout were never in a healthier or more prosperous condition. The Richmond Company produced past quarter $447,286.86—an increase over preceding quarter of

$40,155.44, and Eureka Consolidated produced $344,550.50—an increase of $5,050.50. Not alone on these two important properties is advance noticeable, but along entire line. Present mining outlook of the camp, we can candidly say, is better now than ever has been. Capital is seeking investment in Eureka from all directions, both at home and abroad, and prospects are that more money will be expended in developing mines this season than ever before. With present outlook, and judging from returns of first quarter, 1881 will bring a yield to Eureka of at least four and a half or five millions. Idaho, Colorado, New Mexico, and other great mining centers may boast of richer mines, but we defy them to produce a steadier or more reliable camp than Eureka, or one with more promising prospects."

The *Sentinel*, of November last, published the following condensed statement of the bullion production of the mines of Eureka district for the quarter ending September 30, 1881, condensed from the assessor's statement: "The following Eureka mines produced ore during the quarter: Eureka Consolidated, Garrison, Jackson, Richmond, Williamsburg, Altoona, Alexandria, Antelope, Apex, Bully Boy, Banner, Bowman, California, Cumberland, Connelly, Dead Broke, Eureka Tunnel, El Dorado No. 2, Elise, Excelsior, Geddes and Bertrand, Good Hope, Giant, Helena, Montana, Herculean, Idaho, Kit Carson, Lone Pine, Maid Queen, May Queen, May Flower, Mountain Boy, Macon City, Members, North Macon City, Orange, Oriental, Probert, Phœnix, Piute, Ruby-Dunderberg Consolidated, Reindeer, Rocky Point, Silver Lick, Silver West, Swallow, and Silver Connor. The Richmond leads in production for the time named, the gross yield having been $315,620.48. Eureka Consolidated comes next, with an output of $305,074.90. The Richmond deducted for working expenses $229,255.35, and the Eureka Consolidated $248,277.05. The former paid taxes on $86,355.09, and the latter $56,707.47. The Garrison of Cortez paid $7,821.98; the Jackson of this district on $660.77, and the Williamsburg on $780.17. The Ruby-Dunderberg returned a total yield of $68,606.73, and was allowed the whole amount to offset expenses. The other mines produced from a few tons to several hundred, but were exempt from the quarterly tax under the law. The gross yield of the district was $758,356.72, and the net yield $152,425.50. The amount of tax collected was $3,810 63. The showing falls short of the preceding quarter, but for what reason we do not know."

The following statement from the books of the county assessor shows the product of Eureka county for a series of nine years:

	Tons.	Value.
1873.		
First quarter...	5,612	$191,530.87
Second " ...	18,429	713,521.95
Third " ...	26,532	995,603 44
Fourth " ...	26,034	914,911.96
Totals.....	76,637	$2,815,568.22
1874.		
First quarter...	11,316	424,142.83
Second " ...	13,570	489,396.15
Third " ...	23,173	781,297.32
Fourth " ...	26,306	842,146.73
Totals.....	71,365	$2,536,983.03
1875.		
First quarter...	18,851	729,931.31
Second " ...	26,838	984,931.69
Third " ...	24,878	910,798.70
Fourth " ...	13,764	561,419.43
Totals.....	84,331	$3,187,071.13
1876.		
First quarter...	9,630	370,073.79
Second " ...	8,051	355,324.10
Third " ...	18,886	830,704.47
Fourth " ...	16,860	551,499.22
Totals.....	53,427	$2,117,601.58
1877.		
First quarter...	20,392	828,075.12
Second " ...	10,746	401,590.17
Third quarter..	16,001	817,456.67
Fourth " ..	35,033	730,803.80
Totals.....	112,172	$2,796,826.36
1878.		
First quarter...	31,254	1,600,523.41
Second " ...	32,850	1,667,152.88
Third " ...	27,822	1,162,043.23
Fourth " ...	28,266	1,026,631.60
Totals.....	120,162	$5,456,351.12
1879.		
First quarter...	34,895	1,142,586.57
Second " ...	26,862	876,825.45
Third " ...	25,283	902,679.81
Fourth " ...	23,015	822,196.79
Totals.....	110,055	$3,744,288.62
1880.		
First quarter....	23,532	$885,768.91
Second "	20,944	891,482.12
Third "	21,799	802,370.49
Fourth "	21,014	849,091.93
Totals.........	87,289	$3,428,723.45
1881.	Tons.	Value.
First quarter. ..	21,913	$916,524.37
Second "	18,435	738,104.54
Third "	18.938	758,356.72
Fourth "	17,732	703,849.55
Totals.........	77,018	$3,116,835.18

The number of tons worked during the nine years, 774,724; amount realized, $28,496,499.14. To this sum should be added twenty-five per cent. discount on bullion, etc., which would swell the total to a much higher figure.

During the year 1881, Wells, Fargo & Co. shipped the following amounts of refined bullion, as reported by the Eureka *Sentinel:*

January	$336,084 00
February	161,663 00
March	175,228 00
April	174,259 00
May	184,080 00
June	52,157 00
July	
August	168,612 00
September	160.722 00
October	171,803 00
November	141,397 00
December	146,000 00
Total shipments	$1,872,000 00

Reports of production have been received from the following mines: Wilson, Connolly, Richmond, Ruby-Dunderberg, California, Emma, Albion, Banner, Lone Pine, Wenham, Silver Lick, and Eureka Consolidated.

The gross yield of the mines of Eureka county for the calendar year 1881, as reported to the assessor, was 75,495 tons; value, $3,074,980.

According to the San Francisco *Bulletin*, the assessments of the mines of the county for the calendar year 1881 were:

Mines.	*Assessments.*	*Amount.*
Albion Consolidated	5	$202,500
Phœnix	1	5,000
Total	6	$207,000

The following table shows the production of gold and silver in Eureka county, as reported to the Census Bureau by districts, for the year 1880:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Cortez	....	$123,053	$123,053
Eureka	$1,300,122	2,634,499	3,934,621
Secret Cañon	....	11,350	11,350
Total	$1,300,122	$2,768,902	$4,069,024

My estimate for the production of the calendar year 1881 is $980,000 gold and $1,980,000 silver.

Humboldt County.—Humboldt county, situated in the northwestern part of the State, possesses a vast extent of desert country interspersed with mountain ranges in which are found numerous ledges rich in the precious metals; but few of which, however, have been developed into mines of permanency and acknowledged value.

The following mines of Humboldt county reported production during the year: Lang Syne, Ohio, Iowa Consolidated, Mary Wilder, Bullion, Arizona Silver, Paradise Valley, and De Soto. The amount reported was $237,000 gold and $70,000 silver. The gross yield of the mines of Humboldt county for the calendar year 1881, as reported to the assessor, was 8,910 tons; value, $76,298.71. The assessment upon Paradise mine in this county, according to the San Francisco *Bulletin*, for the same period was $7,000. The gold and silver production of Humboldt county for the year 1880, as reported to the Census Bureau by districts, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Bradshaw			
Buckskin			
Buena Vista	$4,500	$26,000	$30,500
Congo	....	63	63
Mount Rose	26,259	272,702	298,961
Rebel Creek	500	4,500	5,000
Richmond			
Sierra	34,078	....	34,078
Silver State			
Winnemucca			
Total	$65,337	$303,265	$368,602

My estimate of the production of the county for the calendar year 1881 is $70,000 gold and $230,000 silver.

Lander County.—Lander county is near the center of Nevada and adjoins Eureka on the west. It was formerly the largest in the State, comprising what are now Eureka, White Pine, Elko, and Lander, about one-fourth of the whole area. The well-known Reese river country is included in its present limits.

The following mines of Lander county have reported their production during the year: Manhattan, Defiance, and Starr-Grove.

The amount of gold and silver produced in Lander county by districts, as reported by the Census Bureau for the year 1880, was as follows:

District.	Quartz. Gold.	Quartz. Silver.	Total Gold and Silver.
Lewis	....	$170,000	$170,000
Reese River	....	939,876	939,876
Total	....	$1,109,876	$1,109,876

The gross yield of the mines in this county for the calendar year 1881, as reported to the assessor, was 6,959 tons; value, $929,795.89. According to the San Francisco *Bulletin*, there were two assessments upon the Betty O'Neal mine of the amount of $75,000. My estimate for the calendar year 1881, of the production of gold and silver in Lander county, is $5,000 gold and $930,000 silver.

Lincoln County.—Lincoln county is situated in the southeastern part of Nevada, and comprises a large extent of territory over which the various mining camps are widely scattered.

The following mines reported their production during the last year: Bristol, Mayflower, Ohio, Day, Southwestern, and Bullionville Smelting Company.

The gross yield of the mines of Lincoln county for the calendar year 1881, as reported to the assessor, was 14,465 tons; value, $301,808.89. The San Francisco *Bulletin* states the assessments of the mines of the county for the calendar year 1881 as follows:

Mines.	Assessments.	Amount.
Day	2	$30,000
Hillside	1	100,000
Meadow Valley	1	18,000
Totals	4	$148,000

The following table shows the production of gold and silver in Lincoln county for the year 1880, as reported to the Census Bureau by districts:

District.	Gold Quartz.	Silver.	Gold and Silver.
Bristol	....	$324,401	$324,401
Eldorado	$1,739	12,753	14,492
Ely	562	170,122	170,684
Total	$2,301	$507,276	$509,577

My estimate of the production of the county for the calendar year 1881 is gold, $20,000; silver, $280,000.

Nye County.—This county is in Southern Nevada, with Esmeralda county on the west and Lincoln on the east. The principal mines are situated in the northern and northwestern portions of the county.

The following mines made reports of production during the year: La Salle, Fisherman, Liberty, Barcelona, Forlorn, Alexander, Good Hope, Tybo Consolidated, and Continental. The gross yield of the mines of Nye county for the calendar year 1881, as reported to the assessor, was 12,148 tons; value, $362,431.54.

According to the San Francisco *Bulletin*, the assessments of the mines of this county for the calendar year 1881 were as follows:

Mines.	Assessments.	Amount.
Alexander	1	$30,000
Belmont	4	25,000
Gila	1	25,000
Liguria	1	25,000
Total	7	$105,000

The amount of gold and silver produced in the county of Nye by districts, as reported by the Census Bureau for the year 1881, was as follows:

District.	Quartz. Gold.	Quartz. Silver.	Total Gold and Silver.
Ione			
Jet			
Lodi			
Lone Mountain			
Mammoth or Ellsworth			
Morey	....	$14,400	$14,400
Philadelphia	....	40,322	40,322
San Antonio			
Silver Star	....	30,000	30,000
Sunnyside			
Tybo	$26,208	183,792	210,000
Union	335	363,474	363,809
Total	$26,543	$631,988	$658,531

My estimate of the production for the calendar year 1881 is: gold, $15,000; silver, $500,000.

Storey County.—Storey county, which for years produced more bullion than any equal extent of territory in the United States, has been decreasing in production for the past four years. This may be shown by a comparison of the yield by six months' periods:

From January 1 to June 30, 1880	$2,802,133
From July 1 to December 31, 1880	1,478,774
From January 1 to June 30, 1881	861,731
From July 1 to December 31, 1881	607,187

This decrease has been due to the falling off in production of the Comstock Lode, and mainly in that of two mines, the California and Consolidated Virginia. These two mines made a shipment on December 29, 1877, of the following amounts as the result of eight days' run: The California, 129 bars, weighing 16,130 pounds, valued at $558,904; the Consolidated Virginia, 133 bars, weighing 16,668 pounds, and worth $540,196, or a total for the two mines of 16 tons 798 pounds of bullion, of a value of $1,099,100. The total production of all the mines on the Comstock during the year 1881 was only about $1,100,000, but little more than the one shipment above mentioned. During the year no extensive or rich ore-bodies were discovered, although vigorous prospecting was carried on in all the prominent mines. The Yellow Jacket mine has been worked to the 3,000-foot level, and others to the 2,500 and 2,800 foot, and this deep exploitation has not been done in extracting ore, or following rich mineral-bearing veins; on the contrary, but little ore has been raised compared to the magnitude of the workings, and of a low grade only. The hope of striking large bodies of rich ore such as rendered the Bonanza mines famous, has been the stimulus for the further sinking of shafts and driving of levels. The Yellow Jacket, previous to 1871, paid in dividends $2,184,000, but, although it has been a steady assessor of its stockholders for the greater part of the last ten years, it has continued the work of exploration until its deepest shaft, on the 1st of July last, had cost $1,674,203.53 without finding ore, while its total assessments have amounted to $4,098,000. Its expenditures during the year ending June 30, 1881, were $549,740, of which were paid $27,230 for drifting 743 feet of the Sutro Tunnel. These expenses were chiefly incurred for pumping and repairs. While 1,055 feet of drifts were run, and 980 feet were sunk with the diamond drill.

The Superintendent says: "From April 16, when connection was made with the Sutro Tunnel, to June 20, or in a little more than two months, we pumped and hoisted 6,000,000 gallons, or 360,000 tons of water. We have had since that time a steady flow of sixty miners' inches, or 720 gallons per minute. The cost of raising this weight of water, 3,900 tons a day, from the 3,000-foot level to the Sutro Tunnel, about 1,500 feet, is greater than that required to work some of the largest and most profitable mines in the country. The Yellow Jacket, at the present time, is simply a prospect, and cannot be called a productive mine."

No very considerable amount of high-grade ore has been developed below the 1,600-foot level in any of the mines, except in the Union Consolidated, which had ore from the 2,100 to the 2,400 foot levels. The Utah mine is now down to the 2,500 level, and no ore has been developed in any portion of the mine. Cross-cuts and drifts have been run from the vertical shaft and inclines. A cross-drift is now being run east from the bottom of the incline (2,500), and no ore has as yet been found. The Sierra Nevada has no developed ore of any value on the 2,500 level, although a large amount of exploitation has been done. The joint Sierra Nevada and Union Consolidated winze is down to the 2,800 level, and but little ore has been found. It is hoped that the Union Consolidated may develop ore on the 2,700 level; but the chances are that it will not pay the expense of extracting and milling. The Ophir and Mexican have a joint winze that has been sunk from the 2,500 level to the 2,910 level, and a cross-drift has been run east from the 2,900 level of the winze several hundred feet, and no ore has been encountered, although a large amount of promising vein material has been passed through. The California and Consolidated Virginia have gone at some depth below the 2,500 level, and have made no development of ore. The Best & Belcher and Gould & Curry have extended their exploration to a depth of 2,118 feet and have not succeeded in finding ore. As yet the Savage, Hale & Norcross, Chollar, and Potosi have found no ore on the 2,400 level, although there has been no search for it beyond running a drift from the combination shaft (a drain shaft for those mines). What little ore the above mines have had below the 1,600 level has been of low grade. The Julia and Bullion that have been sunk on to the depth of about 2,500 feet, have had no ore in any of their levels from the surface. The Crown Point and Belcher have carried their workings down to the 3,000-foot level and no ore of value has been developed. This continued work of underground exploration has been carried on at an immense expenditure of capital and labor, and probably nowhere in the world has the science of deep mining been carried to greater perfection than in Storey county. One great problem that has severely taxed the patience and ingenuity of the mining engineer has been the handling of the water. In some cases assessments have been made and expended in keeping pumps running at great expense without anything further being accomplished. During the year the hydraulic pump at the combination shaft was set to work raising water to the level of the Sutro Tunnel, through which it is discharged, and this has permitted much work which otherwise could not have been done if each mine unaided had attempted to keep its own workings free from water. No dividends have been declared by any Storey county mine during the year; on the contrary, not only has the entire bullion product been consumed in further exploration, but 113 assessments were levied, aggregating $5,355,800. The following is a condensed statement of the assesments in Storey county for 1881:

Mine.	*Assessment.*	*Amount.*
Alpha	1	$30,000
Alta	3	162,000
Andes	2	75,000
Belcher	3	234,000
Benton	2	54,000
Best & Belcher	2	100,800
Bonanza	1	15,000
Bullion	5	370.000
Caledonia	5	125,000
California	1	162,000
Concordia	1	75,000
Confidence	1	12,500
Consolidated Dorado	1	10,000
Consolidated Imperial	3	150,000
Consolidated Virginia	1	162,000
Crown Point	3	175,000
Chollar	1	56,000
Exchequer	1	25,000
Flowery	1	10,000
Gold Lead	2	13,000
Gould & Curry	2	108,000
Hale & Norcross	5	308,000
Iowa	4	21,000
Justice	2	52.500
Julia Consolidated	3	99,000
Kentuck	2	24,000
Lady Washington	1	10,800
Leviathan	1	25,000
Lord of Lorn	2	25,000
Lower Comstock	1	50,000
Mexican	4	302,000
Morning Star	1	20,000
New Wells Fargo	1	5,000
New York	2	20,000
North Gould & Curry	1	25,000
North Sierra Nevada	1	10,000
Ophir	2	201,600
Original Gold Hill	1	3,000
Original Keystone	1	25,000
Overman	4	230,000
Phil Sheridan	1	10,000
Potosi	3	168,000
Prospect	1	10,000
Sarave	4	252,000
Segregated Belcher	2	12,800
Sherwood Consolidated	1	5,000
Scorpion	2	35,000
Sierra Nevada	4	400,000
Silver Hill	3	81,000
Trojan	1	10,000
Union Consolidated	3	300,000
Utah	3	120,000
Utah Extension	1	10,000
Yellow Jacket	3	360,000
Total	113	$5,355,800

That more work was not accomplished than has been, by the expenditure of this large sum of money, is not surprising when the great depth at which the operations are conducted is considered. As an illustration of the cost of sinking deep shafts, the following is a statement of the disbursements for the C. and C. shaft during the year:

Office supplies and repairs	$1,418 19
Miscellaneous supplies	28,460 38
Candles	$5,736 70
Powder, caps, and fuse	18,977 50
Timber	19,890 24
Wood	106,671 99
Oils	4,364 68
Ice	24,724 35
Water	9,600 00
Wire cable	2,373 44
Salaries	1,800 00
Wages	112,125 34
Real Estate	750 00
Team expense	77 00
Contribution account	90 00
Interest and exchange	333 86
Taxes	4,073 58
Pumping	10,037 50
Surveying	1,800 00
Legal expenses	20,410 50
Transportation and hauling	3,027 10
Balance, cash on hand	457 70
Total	$377,200 05

This shaft in January was 2,494 feet deep, and was sunk thirty-three feet below the 2,500-foot level. A sump drift was run out fifty feet from the bottom and stationary double plunger pumps, with the requisite balance bobs and tanks put in at the 2,400 and 2,500 foot levels. The Sierra Nevada, Mexican, and Union Combination shaft was sunk 130 feet lower than the 2,600-foot level, and the necessary sump drift, stations, etc., excavated, and the main line of pumps extended, at a total cost of $301,689.93, or $2,320.68 per foot. A description of the underground workings of the well-known mines of Storey county would be imperfect and unimportant. They have the same general character and history, induced by a vigorous and persistent search for large bodies of pay ore. In the lower levels the same vein material is found as was met with above, but it is of so low grade as, in most cases, not to pay the expenses of its extraction and reduction. The expensive nature of the work performed may be gathered from the reports of two or three of the representative companies. The California mine raised 6,175 tons of ore and 13,299 tons of waste. The ore milled seventy-nine per cent. of its assay value and yielded an average of $19.77 per ton, or $82,146.10 gold, and $39,961.16 silver—a total of $122,107.26. The receipts and expenditures of the mine were as follows:

Receipts.

Bullion on hand at last annual statement	$34,359 03
Cash on hand at last annual statement	903 42
Samples on hand at last annual statement	65 91
Gross product of mine for 1881	122 182 32
Assessment No. 1	162,000 00
Overdraft, January 18, 1882, at Nevada Bank	74,630 25
Total	$394,140 93

Disbursements.

Overdraft, last annual statement	$9,804 50
Salaries and wages	55,580 76
Supplies	30,381 47
Hoisting	16,006 63
Compressed air	6,097 50
Sutro Tunnel royalty	3,058 30
Suction fan	3,706 11
Assaying account	745 58
Team account	148 75
Taxes	2,856 14
Pumping expenses	755 00
Bullion freight	465 20
Virginia City expense	1,330 08
C. and C. joint shaft	126,200 00
Real estate, Virginia City	1,325 00
Interest and exchange	6,027 02
Legal expense	11,923 80
Advertising	4,657 25
Discount on bullion	10,104 91
Refining charges on bullion	997 74
San Francisco office expenses	3,757 95
Books and stationery	580 20
Cash on hand	1,174 52
Samples on hand	14 36
Total	$394,140 93

From the Consolidated Virginia 6,435 tons of ore and 8,307 tons of waste rock were raised. The total bullion yield was $144,064.10, or $21.13 per ton. The receipts and expenditures were as follows:

Receipts.

December 81, 1880, cash on hand	$1,569 50
Samples on hand	154 40
Assaying	6,284 19
Supplies	11,382 33
Best & Belcher, joint work	14,029 94
Drafts on secretary	320,365 05
Samples produced	104 47
Suction fans	13,903 10
Total	$367,792 98

Disbursements.

Salaries	$6,000 00
Wages	83,079 50
Timber	7,793 72
Ice	6,547 82
Candles	2,240 35
Powder, fuse, and caps	5,966 04
Miscellaneous supplies	6,441 01
Office expenses	707 84
Assay office wages	6,906 51
Assay office supplies	3,588 05
Team expense	284 75
Legal expense	3,517 05
Tax on real estate	1,443 05
Tax on proceeds of bullion	3,576 48
Hoisting	15,466 20
Reduction	61,351 20
One-half expense of C. and C. shaft	126,200 00
One-half royalty to Sutro Tunnel Company	3,134 00
Interest and exchange	1,373 56
Transportation and hauling	1,458 85
Best & Belcher joint winze	777 35
Suction fans	15,675 41
Samples shipped	258 87
Compressed air	2,069 50
Cash on hand, December 31, 1881	1,980 87
Total	$367,792.98

The Superintendent of the Sierra Nevada reports:

"We have extracted 6,077 tons 1,400 pounds of low-grade ore between the 2,300 and 2,500 foot levels, which have been milled, yielding bullion to the value of $195,213.53, or an average of $32.11 per ton, the yield being about sixty-nine per cent. of the assay value of the ore, no allowance being made for moisture. The value of the gold in the bullion was $141,670.02, and of the silver $53,543.51. We have also raised from the mine 42,130 tons of waste rock. No work has been done in the mine above the 2,300-foot level, with the exception of keeping the winzes and drifts connecting with the main incline below the 1,700-foot level in good repair, for purposes of ventilation."

The receipts and expenditures for the year were:

Receipts.

From other mines for supplies, labor, etc	$27,276 30
From San Francisco office, sundry drafts on president	583,157 57
Total	$610,433 87

Disbursements.

Salaries and wages	$255,234 98
Mining supplies	45,799 97
Miscellaneous expenses	1,360 86
Office expenses	457 27
Timber	22,922 79
Wood	29,280 75
Water and ice	26,694 87
Hoisting	48,732 50
Union shaft, one-third net expenses	100,563 31
Hauling	7,157 37
Legal expenses	1,542 15
Taxes	5,960 99
Milling	51,699 30
Assaying	1,706 73
Surveying	600 00
Eureka mill	4,918 57
Discount and interest	2,801 46
Total	$610,433 87

In regard to the condition of the mine the Superintendent says:

"At no time during the last two years have the prospects of the Sierra Nevada mine looked more promising than they do at the present. In all of the cross-cuts on the 2,500-foot level, both east and west, stringers of ore have been cut giving fair assays showing great strength of formation, and also a strong tendency toward concentration at a greater depth. Soft vein-matter has been cut in all of the drill holes run in from the face of the cross-cuts on this level, and at times giving low assays. We are now nearly ready to open up and develop the 2,700-foot level, and, as before mentioned, will start a north lateral drift in a few days, which, when connected with No. 2 winze down from the 2,100-foot level at a point 1,000 feet north of our south line, will place the workings of the mine in a very interesting position, enabling us to thoroughly prospect the vein on both sides of the drift. Another very interesting point in the mine is the main north lateral drift on the 2,500-foot level running to a connection with the Utah mine. This drift will pass through a new and undeveloped country for a distance of 2,000 feet. The face is now in soft porphyry, showing heavy strata of clay. Cross-cuts will be run on both sides of this drift at most convenient points. The mine is fully equipped with all necessary machinery for use under ground and on the surface, which is now in first-class working order."

The employment directly furnished at present by the operations in the leading Comstock mines is shown by statements taken from Virginia City papers of the number of persons working at each mine.

North End Comstock Employés.—Are reported in Virginia City *Chronicle* of 21st ultimo for the following mines, from the Consolidated Virginia, on the south, to the Utah, on the north:

Utah.—Miners, 24; surface men, 18; total 42.

Sierra Nevada.—Miners, 76; surface men, 14; total 90.

Union Shaft.—Miners, 45; surface men, 61; total 106.

Mexican.—Miners, 39.

Union Consolidated.—Miners, 63.

Ophir.—Miners, 70; surface men, 19; total 89.

California.—Miners, 28; surface men, 1; total 29.

C. and C. Shaft.—Surface men, 43.

Consolidated Virginia.—Miners, 17; surface men, 3; total 20.

Total.—Miners, 362; surface laborers, carpenters, machinists, clerks, etc., 176; grand total, 538.

Number of Employés in the Comstock Mines.—As we have been repeatedly asked to report the number of miners employed in these mines, we reprint the following answer from the Gold Hill *News* of December 24, 1881: "The Gould & Curry and Best & Belcher shaft employs a total of 68 men, Savage 115, Hale & Norcross 59, Andes 10, Yellow Jacket 145, Imperial and Alpha 38, Kentuck 15, Overman and Caledonia 65, Forman shaft 66, Alta 74; total in these mines, 657. The reporter has been unable to see Superintendent Jones, and therefore the number of men employed in the Crown Point and Belcher have not been obtained. Of the number given above, 405 are employed in Gold Hill mines. Add to these the number employed in the Crown Point and Belcher, and the men at work on claims not listed in the San Francisco Boards, the total number employed in Gold Hill district will not fall short of 750 men." (New York *Mining Record*, January 7, 1882.) The amount of money disbursed by these mines for labor is shown by the monthly pay-rolls, two of which have been published for some of these mines.

Comstock Pay-rolls.—Following are some of the pay-rolls for August:

Consolidated Virginia, California, and C. & C. shaft	$20,676 00
Union shaft	20,345 75
Sierra Nevada, Ophir, Mexican, and Union Consolidated	33,567 50
Utah	5,440 75
Gould & Curry and Best & Belcher shaft	8,954 00
Hale & Norcross	8,585 75
Chollar, Potosi, and C. N. S. shaft	11,777 62
Consolidated Imperial	5,777 50
Alpha	150 00
Exchequer	150 00
Yellow Jacket	15,583 00
Overman	4,175 75
Caledonia	958 50
Forman shaft	9,041 19

Following are additional pay-rolls for October work:

Alta	$6,090 00
Benton	3,130 00
Consolidated Imperial	3,780 00
Alpha	150 00
Exchequer	150 00
Forman shaft	8,916 37
Overman	5,587 50
Caledonia	2,185 50
Belcher	11,943 00
Crown Point	9,277 50
Crown Point and Belcher joint shaft	5,211 50
Hale & Norcross	8,403 00
Savage	6,620 55
Savage drift from C. N. S. shaft	1,524 20
Scorpion	1,205 00
Consolidated Virginia, California, and C. & C. shaft	14,179 50
Union shaft	14,109 05
Utah	5,685 70

The great depth and consequent heat seriously interfere with the efficiency of labor in the lower levels of the Comstock lode. Eight men are employed on a shift, four of whom work at the same time. The heat at the face of the drift is so great, the men could not work unless sprinkled continuously with cold water, which, by means of a hose attached to a barrel placed at some height above, is forced through a fine sprinkler and falls upon them in a spray. The men can work in the drifts but a short time, and, after a little labor, must go to the cooling-off station, their places being filled by others. They remain in the drift but six hours, and then are relieved, so that actually the miners work only three hours in the drift, but the labor for that length of time is more wearing and severe than eight hours' work on the surface.

In the Virginia City *Chronicle* of the 31st October we find the following details as to work being done by the quartz mills in that quarter:

"The Brunswick mill is running on tailings, of which there is an almost inexhaustible supply near the mill. About 120 tons a day are being reduced, which pays the expenses of working and a small margin of profit. The Morgan mill, near Empire, has been working on tailings for some time, but is now temporarily laid up, owing to a breaking of a part of the gear. Two teeth broke out and have been patched up several times, but without success. Whenever an attempt was made to start the mill the teeth broke where bolted on. If new gearing is got, the cost will be over $1,000. The Mexican mill, at Empire, one of the largest and finest mills on the river, is running on low-grade ore from the Crown Point mine. The daily shipments of ore from that mine are but about fifty tons, yet the mill is able at present to reduce as much as 120 tons per day, owing to a surplus lot of ore on hand, now aggregating about 1,200 tons. The Vivian mill, located about four miles beyond the Mound House, is running on low-grade ore from the Belcher. The Santiago mill, beautifully located on the river a little north of the Vivian, once had a large and steady business under the superintendency of Donald McKay, now in San Francisco. It is owned by the Union Mill and Mining Company, which once did a land-office business in ore crushing, but whose glory has long since departed. There is some talk of the Santiago being bought or leased by the Savage Mining Company for the purpose of reducing ore from their mine, now forging slowly ahead as a bullion producer. If it is again utilized, much will have to be done in the way of repairs. The batteries are in good order and but little else. New pans will have to be put in and a general overhauling made.

"The Eureka mill, one of the largest and most complete in the State, has been 'hung up' for a long time. It is located out of sight from the railroad track, at the end of a winding ravine a mile east of the Virginia and Truckee main track and two miles south of the Mound House. The clatter of its stamps will not likely be heard again until another bonanza revives the dimmed glories of the Comstock." The county assessor's statement for the quarter ending September 30, 1881, by mines, gives some idea of the amount in value of the ore produced by each of the principal mines, which is as follows:

Mine or Company.	*Tons extracted.*	*Gross value.*	*Net yield.*	*Tax.*
Ophir	12½	$2,098 50	$1,049 27	$51 51
Sierra Nevada	330¼	5,364 07	1,072 58	52 53
Savage	42	1,128 96	339 29	16 63
Belcher	3,155	48,429 25	9,688 74	402 09
Consolidated Imperial	1,698	22,080 50	4,416 10	183 57
Confidence	153½	1,989 00	397 80	16 50
Challenge	168½	2,190 50	438 12	18 19
Crown Point	5,405	80,263 21	16,053 57	666 23
Kentuck	500	4,615 00	461 30	19 14
Monte Christo	500	5,000 00	500 00	14 40
Total	11,964¼	$173,158 99	$34,416 75	$1,440 42

The amount of tailings reduced during the quarter was as follows:

Tailings Mills.	*Tons reduced.*	*Gross value.*	*Net proceeds.*	*Tax.*
C. C. Stevenson	2,442	$12,210 00	$2,442 00	$101 25
Mariposa Mill	5,545	26,006 05	3,351 32	164 21
Omega Mill	8,823	33,439 17	3,350 57	97 17
Courser Mill	286	2,431 00	243 10	7 05
Hitchcock Mill	300	1,200 00	120 00	3 48
Johannsen Mill	47	185 18	18 53	44
Jennings Mill	160	1,265 60	126 50	3 67
Pfeifer Mill	150	600 00	60 00	1 74
Secora Mill	47	160 00	16 00	46
Besel Mill	105	840 00	84 00	2 44
Total	17,898	$78,337 00	$9,812 22	$382 01

SUMMARY.

"Total tons of ore and tailings, 29,862, and 1,460 pounds. Total gross yield, $251,425.99. Total net yield, $44,228.97. Total tax, $1,822.43. Average gross value of ore per ton, $2.87. Average tax on ore per ton, about 12 cents. Average gross value of tailings per ton, $4.37. Net yield of tailings per ton, 55 cents nearly. Average tax per ton on tailings, 2.134 cents.

"The figures for the preceding quarter, that ending June 30, are as follows: Total tons of ore extracted, 21,744. Tons of tailing reduced, 4,645. Gross value of tailings, $22,734.38. Net yield of ore, $74,148.92. Net yield of tailings, $2,273.43. Tax on ore, $3,337.66. Tax on tailings, $96.57. Total tax on ore and tailings, $3,434.23. A comparison of the returns for the last two quarters gives the following result: Decrease in ore extracted during the last quarter, 9,780 tons. Decrease in gross value of ore, $199,269.28. Decrease in net yield of ore, $39,732.17. Decrease in tax on ore, $1,797.24. Increase in tailings reduced during the last quarter, 13,253 tons. Increase in gross value of tailings, $55,602.62. Increase in net yield of tailings, $7,538.79. Increase in tax on tailings, $285.46. Total decrease in tax on the net proceeds of ore and tailings extracted and reduced for the past quarter over that ending June 30, $1,611.80." The great need of Storey county, and, indeed, of the whole of the State, may be said to be a means of working low-grade ores at a low price. If this could be accomplished a new lease of life would be granted to the Comstock. Not only are the deeper workings in low-grade ore, but in many of the mines considerable reserves of the same exist in the upper workings; and could this be extracted and reduced at a fair profit, it might not be that dividends would be declared, but it would furnish means for prosecuting exploration to still greater depths without making a constant drain upon the stockholders. Unless some process for working low-grade ores should be introduced, or new, large, and rich ore bodies be shortly encountered, the prospect for continued exploration in the lower workings is not favorable; and the attention of the companies will sooner or later be turned to further exploring and working the upper levels and storing the waste rock in the deep excavations instead of raising it to the surface.

The following statement shows the assessments and dividends upon the Comstock mines from their discovery to the close of the year 1881:

Mine.	*No. of Assessments.*	*Amount of Assessments.*	*No. of Dividends.*	*Amount of Dividends.*
Alpha Consolidated	14	$390,000	None.	
Alta	22	1,587,600	do.	
Andes	17	562,500	do.	
Baltimore Consolidated	19	1,037,600	do.	
Belcher	28	2,502,400	38	$15,397,200
Best & Belcher	27	1,143,390	None.	
Bullion	65	4,220,000	do	
Cabinet	1	4,000	do.	
Caledonia	38	2,710,000	do.	
California	2	216,000	34	31,510,000
Chollar	6	330,000	44	3,080,000
Consolidated Imperial	16	1,327,000	None.	
Consolidated Virginia	16	573,200	53	42,930,000
Confidence	16	268,800	6	78,000
Cosmopolitan	5	125,000	None.	
Crown Point	46	2,648,370	50	11,688,000
Exchequer	11	655,000	None.	
Fairfax	2	35,000	do.	
Gould & Curry	40	3,314,000	36	3,825,800
Hale & Norcross	71	3,754,000	36	1,598,000
Julia Consolidated	16	1,435,500	None.	
Justice	35	3,335,000	do.	
Kentuck	17	342,000	32	1,252,000
Leviathan	12	355,000	None.	
Mexican	17	17,708,004	do.	
Mint	24	165,000	do.	
New York	26	950,000	do.	
Niagara	...	99,000	do.	
North Bonanza	6	200,000	do.	
Occidental	6	112,500	do.	
Ophir	40	3,193,400	28	1,596,400
Overman	51	3,513,300	None.	
Phil Sheridan	10	170,000	do.	
Potosi	7	392,000	do.	
Rock Island	13	365,000	do.	
Savage	48	5,176,000	52	4,560,000
Segregated Belcher	20	289,600	None.	
Segregated Silver	...	12,000	do.	
Sierra Nevada	70	4,700,000	11	102,500
Silver City	2	6,310	None.	
Silver Hill	16	1,792,800	do.	
South Comstock	6	79,000	do.	
South California	1	10,000	do.	
Succor	24	763,800	2	22,800
Union Consolidated	18	1,260,000	None.	
Utah	36	1,230,000	do.	
Ward	5	198,000	do.	
West Comstock	...	25,000	do.	
Woodville	6	3,030,000	do.	
Yellow Jacket	42	5,238,000	25	2,184,000
Total	1,036	$67,555,074	447	$119,824,700

From this table it will be seen that, taken as a whole, the Comstock lode has not been unprofitable. Fifty mines have been asssessed in the aggregate $67,555,074, and fourteen have paid dividends amounting to $119,824,700, leaving a balance in favor of the dividends of $52,269,626. Of the total amount of dividends paid, two mines alone, the California and Consolidated Virginia, paid $74,440,000.

The following is the assessed valuation of the mines and mills, with the amount of taxes paid by each in 1881:

VIRGINIA DISTRICT.

Mine or Mill.	*Valuation.*	*Tax.*
Best & Belcher	$4,200 00	$205 80
California	800 00	31 85
C. & C. joint shaft	82,820 00	4,058 18
C. N. S. shaft	112,000 00	5,488 00
Chollar and Potosi	16,310 00	799 19
Columbia	200 00	9 80
Consolidated Virginia	29,250 00	1,443 25
Concordia	150 00	7 35
Fairfax	2,600 00	127 40
Gould & Curry	17,950 00	87 95
Hale & Norcross	51,913 00	2,543 73
Iowa	700 00	34 30
Julia	11,800 00	572 48
Mint	4,000 00	196 00
Mountain View	100 00	4 90
North Comstock	100 00	4 90
North Milton	100 00	4 90
Original Keystone	5,175 00	253 27
Ophir	79,800 30	3,910 21
Phil Sheridan	700 00	34 30
Pioneer	100 00	4 90
Red and White Cross	200 00	9 80
Roman Capitol	780 00	38 46
Savage	70,000 00	3,430 00
Scorpion	4,000 00	196 00
Jo Scates	595 00	29 15
Senator	920 00	45 08
Sierra Nevada	60,000 00	2,940 00
Sutro Mining Company	500 00	24 50
Sutro Tunnel Company	17,950 00	879 55
Troy	2,200 00	107 80
Union Consolidated	1,245 00	61 00
Utah	24,565 00	1,203 68
Vermont Consolidated	3,450 00	169 05
New Wells-Fargo	1,500 00	73 50
S. N. M. & Union Shaft Company	161,875 00	7,931 87
G. & C. and B. & B. joint shaft	53,173 14	2,605 48
Union Mining and Milling Company	28,700 00	1,348 17
Pacific Mining and Milling Company	226,000 00	11,089 68

GOLD HILL DISTRICT.

Mine or Mill.	*Valuation.*	*Tax.*
Atlas Mill	$4,900 00	$203 35
Sapphire Mill	1,000 00	41 50
Petaluma Mill	4,000 00	166 00
Alta	40,900 00	1,697 35
Alpha Consolidated	325 00	13 48
Belcher	27,665 74	1,148 76
B. & C. P. pump shaft	51,777 50	2,148 77
Bullion mine	4,575 90	196 06
Bullion Con. Shaft	23,250 00	964 87
Caledonia	21,900 00	923 37
Charta	150 00	6 22
Challenge	300 00	12 45
Consolidated Dorado	700 00	29 05
Confidence	150 00	6 22
Crown Point	41,981 92	1,742 25
Crown Point Ravine	200 00	8 30
Consolidated Imperial	39,872 12	1,654 69
Dardanelles	500 00	20 79
Exchequer	400 00	16 00
Europa	1,650 00	68 47
Forman shaft	60,500 00	2,510 75
Golden Standard	900 00	37 35
Gold Hill Tunnel	450 00	18 67
Justice	22,500 00	833 75
Kentuck	1,655 00	68 67
Keystone	225 00	9 33
Knickerbocker	7,700 00	319 55
Lady Washington	500 00	20 75
Leo	75 00	3 11
Leviathan	3,150 00	130 72
Mitchell	50 00	2 07
New York	18,000 00	747 00
Niagara	2,850 00	118 27
Occidental	785 79	32 61
Original Gold Hill	1,450 00	47 72
Overman	23,400 00	971 25
Prospect	8,000 00	382 000
Rock Island	4,500 00	186 75
Segregated Belcher	1,000 00	41 50
Sierra	850 00	35 27
Silver Hill	26,650 00	1,105 97
St. Louis	125 00	5 18
Sullivan	100 00	4 15
South Comstock	1,050 00	43 57
Trojan	3,750 00	155 62
Twin Peaks	75 00	3 11
Vivian Mine	100 00	4 15
Woodville	5,800 00	247 00
Yellow Jacket	152,535 00	6,330 22

The following mines of Storey county reported production during the fiscal year 1881: Union Consolidated, Belcher, Sierra Nevada, California, Consolidated Virginia, Monte Christo, Ophir, Hale & Norcross. The gross yield of the mines of Storey county for the calendar year 1881, as reported to the assessor, was 108,976 tons; value, $1,468,918.44. The gold and silver production of Storey and Lyon counties, for the year 1880, as reported to the Census Bureau, by districts, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
The Comstock	$3,109,151	$3,813,174	$6,922,325
Scattered	90,001	110,000	200,001
Total	$3,199,152	$3,923,174	$7,122,326

My estimate for the calendar year 1881, of the production of these counties, is: gold, $1,050,000; silver, $660,000.

Washoe County.—This county, in Western Nevada, is the oldest mining locality in the State; it was here that the first discoveries were made that have since rendered Nevada famous. The work done during the year has been chiefly for the purpose of development; but little ore was raised, the principal yield of the county being from the re-working of tailings. Reports were received from the Mansalond, Unit, Copper King, Consolidated Esmeralda, Antelope, Jones & Kinkead, and Ophir City (tailings).

The production of Washoe county during 1881, I estimate at $5,000 in gold and $35,000 in silver.

White Pine County.—White Pine county is in Eastern Nevada, bordering upon Utah. In *Cherry Creek district*, in the northern part of the county, and in *Ward district*, in the south, the most productive mines are found.

At the Star mine, considerable ore has been extracted above the 540-foot level. The mill has been kept constantly running, and the ore is accumulating on the dump. This mine is destined to become one of the most valuable properties in Eastern Nevada.

Although the Star Mining Company was reported to have produced, in 1880, bullion amounting to $307,235, in December it levied an assessment of $10,000. During the year 1881 it was a regular producer, shipping bullion in some months to the amount of from $30,000 to $40,000. The pay-roll averaged about $14,000, and the monthly expenses of the mill and mine $20,000. The mill has run as high as 600 tons each month, the ore yielding from $60 to $70 per ton. The total shipments of this mine, as reported by the *Engineering and Mining Journal* for 1881, were $294,743.

The financial condition of the company at the close of the year was reported as follows:

Receipts.	
Assessments	$106,146 88
Mine cost	100 00
Stores account	5,691 26
Draft account	2,383 28
Real estate account	118 59
Construction account	1,725 00
Lumber account	700 00
Wood account	648 39
J. Henry account	163 93
Coal account	75 00
Cash on hand August 1, 1880	7,740 06
Total	$125,392 39
Disbursements.	
Liabilities August 1, 1880	$10,214 37
Legal expenses	100 00
Taxes	100 00
Interest	2,649 68
Assessment work	400 00
Tunnel account	63,647 15
Timber account	578 78
Office expenses	4,658 65
General expenses	10,750 11
Company's stock	25,512 00
Cash on hand	6,504 91
Total	$125,392 39
Liabilities, drafts outstanding	$2,383 28

In the Bohemian Girl, a rich strike was made assaying from $80 to $400 per ton. The express shipments from Cherry Creek during 1881 were as follows:

January	$23,020
February	33,072
March	23,040
April	39,490
May	41,685
June	39,757
July	32,700
August	27,150
September	25,465
October	21,950
November	31,367
December	33,000
Total	$375,680

The gross yield of the mines of White Pine county for the calendar year 1881, as reported to the assessor, was: 8,991 tons; value, $364,784.37. According to the San Francisco *Bulletin*, the assessments of the mines of White Pine county were:

Mines.	*Assessments.*	*Amount.*
Martin White	3	$45,000
Star	4	40,000
Ward Beecher	1	20,000
Total	8	$105,000

Surveyor-General Hatch, in his report for 1880, says that from the Osceola placer mines $30,000 in gold dust was collected.

The amount of gold and silver produced in White Pine county by districts, as reported by the Census Bureau for the year 1880, was as follows:

District.	*Quartz.*		*Total Gold and Silver.*
	Gold.	*Silver.*	
Cherry Creek	$4,877	$344,199	$349,076
Ward	....	229,418	229,418
White Pine	....	129,288	129,288
Total	$4,877	$702,995	$707,782

My estimate of the production of this county for the calendar year 1881, is: gold, $40,000; silver, $325,000.

Summary of bullion production by counties in Nevada, as reported by Mines to the Superintendent of the Mint at San Francisco, during the fiscal year 1881.

Counties.	*Gold.*	*Silver.*	*Total.*
Elko	$44,846	$582,117	$626,963
Esmeralda	30,855	1,649,288	1,680,143
Eureka	1,258,805	2,300,999	3,559,804
Humboldt	28,304	118,394	146,698
Lander	1,200	1,330,966	1,332,166
Lincoln	7,779	117,048	124,827
Lyon	60,291	146,107	206,398
Nye	11,000	491,875	502,875
Storey	1,053,394	649,874	1,703,268
White Pine	33,046	301,284	334,330
Washoe	5,272	88,866	94,138
Total	$2,534,792	$7,776,818	$10,311,610

The following is the estimate furnished by Mr. A. M. Lawver of the production of Nevada during 1881:

Counties.	*Gold.*	*Silver.*	*Total.*
Elko	$30,183	$580,812	$610,995
Esmeralda	35,474	1,639,275	1,674,749
Eureka	990,661	2,680,860	3,671,521
Humboldt	237,000	70,000	307,000
Lander	2,050	1,524,291	1,526 341
Lincoln	70,333	346,139	416,472
Lyon	46,080	222,627	268,707
Nye	14,857	600,239	615,096
Storey	391,974	411,817	803,791
Washoe	5,000	100,000	105,000
White Pine	10,046	335,000	345,046
Total	$1,833,658	$8,511,060	$10,344,718

This estimate varies nearly $400,000 in gold, and $2,000,000 in silver, from mine, and is probably due to the value of the base metal in the bullion having been included.

Gross yield of the Mines of Nevada, by counties, during six months, periods, and for the calendar years 1880 and 1881.

[From reports of the State Comptroller.]

FOR THE SIX MONTHS ENDING JUNE 30.

Counties.	*1880.*			*1881.*		
	Quantity Worked.		*Gross Yield or Value.*	*Quantity Worked.*		*Gross Yield or Value.*
	Tons.	*Pounds.*		*Tons.*	*Pounds.*	
Elko	3,056	1,500	$147,197 26	2,488	1,825	$122,193 21
Esmeralda	17,943	607	556,862 68	19,436	1,666	749,521 83
Eureka	44,476	1,810	1,777,261 03	38,824	1,656	1,612,774 51
Humboldt	10,578	601	201,280 15	5,017	866	45,611 16
Lander	2,724	748	278,621 44	3,976	596	491,235 97
Lincoln	4,776	1,358	124,425 23	6,625	1,925	80,559 61
Lyon	48,700	....	235,868 14	39,760	....	146,778 61
Nye	11,664	1,700	251,193 54	6,551	583	188,908 45
Ormsby	21,097	....	179,173 19	7,075	....	35,321 07
Storey	94,138	1,350	2,802,132 68	48,887	539	861,731 10
Washoe	....	.....	....	2,640	....	18,588 87
White Pine	15,181	261	162,418 93	5,056	....	189,283 28
Total	274,337	1,935	$6,716,431 27	186,339	1,656	$4,542,507 67

FOR THE SIX MONTHS ENDING DECEMBER 31,

Counties.	*1880.*			*1881.*		
	Quantity Worked.		*Gross Yield or Value.*	*Quantity Worked.*		*Gross Yield or Value.*
	Tons.	*Pounds.*		*Tons.*	*Pounds.*	
Elko	5,224	1,218	$291,180 83	175	1,800	$34,156 40
Esmeralda	19,178	280	818,957 50	17,072	392	623,306 70
Eureka	41,040	669	1,600,783 17	36,670	1,167	1,462,206 27
Humboldt	10,753	934	110,338 15	3,892	666	30,687 55
Lander	2,884	196	349,187 53	2,982	481	438,559 92
Lincoln	5,888	1,358	98,123 38	7,838	1,298	221,249 28
Lyon	29,612	....	175,286 79	47,294	....	248,372 86
Nye	12,151	554	273,881 37	5,596	1,834	173,523 09
Ormsby	43,404	....	234,913 11	19,001	....	75,076 81
Storey	92,863	435	1,478,774 34	60,088	1,560	607,187 34
Washoe	....	....	....	2,616	....	20,944 55
White Pine	26,578	875	257,897 08	3,934	1,205	175,501 09
Total	289,578	591	$5,689,323 25	207,163	343	$4,110,771 86

FOR THE CALENDAR YEARS

Counties.	*1880.*			*1881.*		
	Quantity Worked.		*Gross Yield or Value.*	*Quantity Worked.*		*Gross Yield or Value.*
	Tons.	*Pounds.*		*Tons.*	*Pounds.*	
Elko	8,281	718	$438,378 09	2,664	1,625	$156,349 61
Esmeralda	37,121	887	1,375,820 18	36,509	58	1 372,828 53
Eureka	85,517	479	3,378,044 20	75,495	823	3,074,980 78
Humboldt	21,331	1,535	311,618 30	8,909	1,472	76,298 71
Lander	5,608	944	627,808 97	6,958	1,077	929,795 89
Lincoln	10,665	716	222,548 61	14,464	1,223	301,808 89
Lyon	78,312	......	411,154 93	87,054	......	395,151 47
Nye	23,816	254	525,074 91	12,148	417	362,431 54
Ormsby	64,501	......	414,086 30	26,076	......	110,397 88
Storey	187,001	1,785	4,280,907 02	108,976	99	1,468,918 44
Washoe	....	......	....	5,256	......	39,533 42
White Pine	41,759	1,136	420,316 01	8,990	1,205	364,784 37
Total	563,916	454	$12,405,757 52	393,502	1,999	$8,653,279 53

OREGON.

GOLD was discovered in Oregon but a little later than in California, but the extraordinary richness of the gold fields in the latter State and the magnitude of its mining operations have attracted attention away from the progress and extent of the mining industry in Oregon. The production of the State, though steady but not large, has heretofore been principally from the placer mines, but recently the quartz lodes in Eastern Oregon, found in the counties of Union, Grant, and Baker, have been worked. In these counties, as well as in South Oregon, the gravel mining has been chiefly in shallow placers, but in Eastern Oregon a large amount of deep gravel or ancient river channels exist, varying from sixty to 200 feet in depth, which have been but little worked. Considerable capital is required to properly open and work the deep deposits, but when sufficient water is introduced the gold product will be greater than ever before. The production of gold and silver in Oregon during 1881 is estimated by counties to have been as follows:

Counties.	*Gold.*	*Silver.*	*Total.*
Baker	$250,000	$10,000	$260,000
Grant	280,000	20,000	300,000
Jackson	250,000	....	250,000
Josephine	200 000	....	200,000
Umatilla	50,000	....	50,000
Union	40,000	....	40,000
All others	30,000	10,000	40,000
Total	$1,100,000	$40,000	$1,140,000

Estimate of Mr. A. M. Lawver, of the bullion production in Oregon during the calendar year 1881, classified by counties.

Counties.	*Gold.*	*Silver.*	*Total.*
Baker	$265,414	$10,231	$275,645
Benton	2,260	16	2,276
Coos	8,634	12	8,646
Clatsop	1,514	36,135	37,649
Douglas	8,000	....	8,000
Jackson	199,406	....	199,406
Josephine	81,109	....	81,109
Lane	3,750	....	3,750
Polk	18,337	....	18,337
Union	80,000	....	80,000
Umatilla	30,995	8,223	39,218
Total	$699,419	$54,617	$754,036

Baker County.—Baker county comprises nearly the whole eastern border of the State adjoining Idaho. On Powder river and its tributaries there are a number of good placer mines, the principal being on Auburn creek. On Sutton creek the mines have been successfully worked, yielding better than was anticipated by the owners. No hydraulicing has been done, but only ground sluicing. There are a number of quartz ledges in this vicinity, but no reports of their condition have been received. The following is a list of the stamp mills of Baker county, with number of stamps of each:

	Stamps.
Connor Creek	20
Gold Hill	10
Moore & Estabrook	2
New England and Oregon	5
Virtue	20
Mammoth	5
Tom Paine	2
Total	64

The production of Baker county, as ascertained during the last census year, 1880, was $248,528 in gold and $5,968 in silver. I estimate that the total production during the year 1881 was $260,000.

Grant County.—Grant county is west of and adjoining Baker, and contains a great diversity of minerals. Upwards of 300 quartz mines are under process of development, prominent among which are the Cable Cove, Buffalo, Hazard, Silver King, California, Granite, and Silver Peak. Near Granite creek ledges of antimonial silver occur, the principal of which are the Monumental and Beagle. The ledges are small, but the ore is of high grade.

The chief placer mines are on Cañon creek and Prairie creek, which have been worked for a number of years and paid largely. The production of this county during 1880, as reported by the last census, was $359,622 gold and $13,639 silver. I estimate the total production during 1881 to have been $300,000.

Jackson County.—Jackson county is in the southwestern part of the State, east of and adjoining Josephine county. A few quartz ledges have been found, but no mills have been erected, and the mines are pretty much undeveloped. The whole gold production of the county is from its placers, which have been continuously worked for twenty-nine years, and are still far from being exhausted. Every process for gravel-mining, from the primitive rocker to the most improved hydraulic process, is in use, although the latter has been introduced only during the last few years. The mines are located on Rogue river and its numerous tributaries, and the mining season commences in November and lasts till May. Fully half of the men engaged in mining are Chinamen. It is difficult to ascertain the annual production, as gold dust is used as a circulating medium, and also finds its way out of the county by mail, express, and by private hands. The production during the census year 1880 was reported to have been $188,790. I estimate the production during 1881 to have been $250,000.

Josephine County.—Josephine county is west of Jackson, and, as in the latter, mining is almost the sole industry. The season was quite successful, although shorter than usual from a less amount of water. Very few large companies operate here, but the larger part of the gold extracted is by small operators and Chinamen. The yield of the county during the last census year was reported as $201,203. I estimate that during 1881 it was $200,000.

Union County.—This is the extreme northeastern county of the State, and mining is not extensively carried on. Near the head of Grand Ronde river are the Camp Carson mines, which cover a large area of placer ground. They are in charge of an experienced Chinese miner, who works about fifteen men. I estimate the total production of the county during 1881 to have been $50,000.

Wasco County.—In Wasco county, which is central in the State, the chief mines are located in the Ochoco Mountains, where the Ochoco Gold and Silver Mining Company are operating. A tunnel is being run to strike the ledge, which is in a distance of 200 feet. It is only within the past year that attention has been directed to this county, and from reports it would appear that the quartz lodes are worthy of a more extended prospecting than they have hitherto received.

WASHINGTON TERRITORY.

THE production of gold in Washington Territory has not increased during the year. There is reason to believe that heretofore the production has been overestimated, owing to the difficulty experienced in ascertaining the amount mined by Chinamen, and also on account of a portion of the gold yield of British Columbia being credited to Washington. The mining camps are widely scattered, the season is short, and although mineral-bearing lodes undoubtedly exist in various sections of the country, which, if properly opened, would make good paying mines, little or nothing has been done looking to their development. The chief mining operations are confined to Yakima and Spokane counties, and to Snake river flowing through Columbia, Garfield, and Whitman counties. The placer grounds on the latter are almost exclusively in the hands of Chinamen, and their production finds an outlet at Walla Walla. In Yakima county is *Peshastin district*, about forty miles north of Ellensburg. The ores of this district are low-grade but free-milling; some work has been done in a desultory manner, extracting ore and working it in arastras. Swauk mining district is located twenty-five miles north of Ellensburg, and is reported to have done moderately well. In the northeastern part of the Territory, in Stevens county, are the Mount Chopaco mines, or, as sometimes known, "the Smilkameen," situated near the line of British Columbia. They are reported to be silver-bearing ledges, which have been prospected to some little extent. The production of gold in the Territory during the last census year, 1880, was reported to have been $119,000. I estimate, from express returns and other sources of information, that the yield during 1881 was about $120,000.

Estimate of Mr. A. M. Lawver of the bullion production in Washington Territory during the calendar year 1881, classified by counties.

	Gold.
Columbia	960
Jefferson	1,845
King	3,539
Klikitat	2,000
Pierce	1,806
Spokane	23,656
Walla Walla	60,000
Whitman	47,941
Total	$98,747

ALASKA.

DURING the year 1881 there was deposited at the United States mint $13,374.70 in gold and $144.36 in silver produced in Alaska. This was placer gold from the Harrisburg settlement in Southeast Alaska. The following information, taken from the *Puget Sound Argus*, in regard to this but little-known region, will doubtless be of interest:

"At last the gold and silver mines of Alaska are becoming more known and their value demonstrated. We have always contended that in this unknown land would be found some of the richest mineral deposits on this continent; and if half the news is true which was brought by the last steamer from Sitka, our prophecy is already more than fulfilled. It is stated that rich placer diggings have been discovered at Takou, twenty miles long by eight wide, and that good pay-dirt is the result. No sufficient prospect has been made to speak definitely of their value, but those who are there are fully satisfied with results, and it is expected there will be a great rush there during the coming spring.

"On the mainland, outside the Coast Range, between Auk and Schuck, the most extraordinary and wonderful discovery has been made of gold, silver, and galena. The assays go into the thousands—one lot of ore showing $3,000 to the ton. The gold can be seen with the naked eye, and can be felt by a blind man. A new mining district has been formed and named after Harris, the discoverer. He has taken up a town site of 160 acres of land, situated on the coast. If these stories are true, next summer will behold there one of the most flourishing mining camps on the Pacific coast. A few men are now there at work—old Alaska mountaineers, inured to the hardships and cold of that peculiar climate.

"Our source of information is from the most undoubted authority. The steamer Favorite has gone to the new diggings, with George E. Pitz, the assayer and mining engineer, whose party of prospectors are amongst the first locators of the new mines. Several of the most experienced miners who are wintering at Sitka have also gone in the Favorite to ascertain the truth of the report. We have, ourselves, seen some of the rock, and it is fabulously rich in appearance. Still, until further advices are received, we would caution the public against putting too much reliance in the statements made. There will be plenty of time between this and spring to ascertain the truth. The season of the year is inclement; the winter even here has set in with unusual severity, and at Takou it is rigorous, boisterous, and very cold. An unprecedented rush at this season might result in untold hardships and disasters. It is better to wait until the spring opens, when, if these marvelous stories are substantiated, we shall look for an exodus equal to the Fraser river excitement in 1857.

"A number of valuable lodes of silver and argentiferous galena have also been discovered, located, and secured, north of Cross Sound, and merged into a company composed of experienced and go-ahead men. Some of the rock—an average lot—has been assayed, and realizes $180 in silver and $40 in lead to the ton. Specimens of this ore can be seen at the office of Major Morris, special agent. Samples have also been sent to the mining magnates of Boreel's building, New York. One mine of this kind only is needed to make all parties connected therewith independently rich. Major M. P. Berry, late collector at Sitka, is president of the company. He is an old miner, and a man of great caution and experience.

"We take pleasure in noticing the remarks contained in the recent report of the Secretary of the Navy regarding the establishment of some form of civil government in Alaska, and also congratulating our neighbors on the decided stand taken by the President in his last message, wherein he recommends this to Congress, fully indorsing the report of Secretary Thompson in every particular. Once establish the fact of productive mines in Alaska, and the question of population is settled. It will not be long before she will have as many white people there as there are in the State of Nevada. We shall keep our readers advised as we hear from that section."

Of Fish river mining district, the San Francisco *Scientific Press* says:

"This district was discovered in June of last year. It is situated in the 'Omiluk' range of mountains thirty miles north of Golowin Bay, on the north side of Norton Sound, and about ninety miles northwest from Saint Michael's, a trading station of the Alaska Commercial Company, and also of the Western Fur Company. Two locations were made by the discoverers of the district in the interest of the Alaska Mining Company, now incorporated as the 'Alaska Gold and Silver Mining, Milling, and Trading Company.' These locations or claims are 1,500 feet in length each by 600 feet in width, and join on the summit of the ridge, one being the Pioneer, on which a shaft was put down twenty-two and a half feet in ore, and a cut made some 600 feet below the shaft, finding the same character of ore as thus taken from the shaft. The other claim, the Omiluk, is situated on the opposite side of the mountain. On this claim a shaft was put down twelve feet in ore also, and of same general character as that in the first shaft. The ore is argentiferous galena, with some iron croppings. Limestone forms one wall and micaceous slate the other, and these walls seem to be separated about 200 feet where the ore body crosses the mountains, leaving no doubt that there is an immense body of ore at this point. Some fifteen tons of ore are now on the dump of the shafts.

"The ore carries a very high percentage in lead, as is evidenced by the following assays:

	Silver.	Lead. Per cent.
By Prof. Thos. Price, trace of gold	$121 28	83
Do	161 86	85
By Selby Smelting Works	143 51	80
By E. M. Cram, trace of gold	135 75	Not given.
Do	122 83	Not given.
Do	155 78	Not given.

"Giving an average of $140.16 in silver per ton; add value of lead, say $70, and we have over $210 per ton of 2,000 pounds.

"From the foregoing statement (and these assays were not made from selected specimens, for the entire body of ore taken out would give the same results) the percentage of lead is so great that no reduction works will be required at the mine. Should this ever become necessary, however, there is an abundance of timber near the mine for all practical purposes.

"The company propose to send up to the mine, in the spring, a working force, to remain a year or more and explore the mine to greater depth.

"The mine is about twelve or fifteen miles from a point on Fish river, whence scows or barges will take the ore to the vessel-landing. The river transportation is about fifty miles. A light-draught stern-wheel steamer will be used to tow the barges up and down the river.

"The ore will be moved to the river in the winter with horses and sleds, or by same process may be delivered at the vessel-landing by drawing it thirty miles overland.

"To mine and deliver this ore in San Francisco, it is estimated to cost not to exceed $50 or $55 per ton. Cost of delivering 1,000 tons in San Francisco, as above, will be $55,000. Value of 1,000 tons, at $210, would be $210,000, leaving a profit of $155,000. This, it is believed, will be about the result realized the first year, after which the ore will be handled and delivered for much less than the above estimate.

"Ultimately a railroad will be constructed from the mine to the harbor, a distance of thirty miles, when the ore can be moved at any and all seasons of the year.

"I notice in the *Press* of January 28, that a good account is given of the Baker mining district in Montana, by your correspondent 'Yebrek,' and in speaking of the Baker mine, the 'oldest location,' and most extensively developed of any in the district, he uses the following language:

"'Ore from the mine shipped to Omaha netted over $100 per ton. This is certainly a good showing for a 20-ton lot not closely selected. In this connection it must be borne in mind that, before starting it on its long voyage down the mighty Missouri, it was hauled in wagons two hundred and fifty miles.'

"The ore in the Baker district is both milling and smelting. The ore, then, from Alaska is more accessible, and makes a better showing than that from Montana.

"The climate of Northern Alaska is not unlike that of Maine and Michigan, and not as cold as Montana and Minnesota. For six or seven months the Esquimaux live in cloth tents, and in the winter many of them live in pole or log huts. The mildness of the climate in this high latitude is attributed to the warm ocean current that flows north, along the eastern coast of Asia, through Behring's Sea and Straits to the Arctic Ocean.

"In all that part of Alaska bordering on Behring's Sea and Norton Sound to the Arctic Ocean, there were not fifty white persons up to 1882; but, now that valuable and extensive mines have been discovered, this isolated region will soon fill up with enterprising miners.

"The natives are disposed to be friendly and willing to work, and the government cannot be too vigilant in suppressing the sale of spirituous liquors to them, for it is the most deadly enemy they have ever encountered.

"Under the present climatic condition, Northern Alaska will never be agricultural; its great wealth consists in its mines, furs, and fish. Belts of timber run through Northern Alaska, but there is no large or valuable timber north and east of the Aleutian Islands until you get up the Yukon into the interior."

IDAHO.

THE statistics of the yield of mines and reports of the deposits and shipments of bullion indicate the production in Idaho during the year 1881 of $1,700,000 gold and $1,300,000 silver from the different counties, as nearly as can be approximately estimated as follows:

Counties.	*Gold.*	*Silver.*	*Total.*
Ada	$5,000	....	$5,000
Alturas	170,000	$550,000	720,000
Boisé	300,000	30,000	330,000
Cassia	25,000	....	25,000
Custer	500,000	350,000	850,000
Idaho	260,000	....	260,000
Lemhi	285,000	100,000	385,000
Nez Percés	5,000	....	5,000
Oneida	40,000	....	40,000
Owyhee	50,000	270,000	320,000
Shoshone	60,000	....	60,000
Total	$1,700,000	$1,300,000	$3,000,000

Gold was discovered in Idaho in 1860, and the Territory was organized in 1862. The reported richness of the placers in Boisé Basin, those on Snake river in the southern part of the Territory, and of Salmon river in North Idaho, brought a large influx of miners and prospectors. The alluvial deposits were, for the most part, worked out in a few years with the exception of a few large tracts of mining ground that fell into the hands of companies who have brought water by long ditches and flumes and are operating on an extensive scale. The rest of the gravel workings have been largely abandoned to Chinamen, who, with the patience and perseverance of their race, are going over the ground with rocker and sluice a second and, in some instances, a third time. The richest portion of the placers having become exhausted, attention was given to working the quartz lodes which had been discovered and located, but not to any extent operated upon. These lodes vary in size from narrow, worthless seams to ledges of many feet in width, and the vein matter ranges from a free gold-bearing quartz on one hand to the most refractory sulphurets. Within the last two years a comparatively new mining section has been opened, that of Wood river, the mines of which contain an exceedingly high grade of smelting ores. From the beginning of lode mining, Idaho has labored under many disadvantages and mishaps. Nearly the whole of the mining section of the Territory is covered with rugged, abrupt mountain ranges and irregular peaks, rendering the means of access difficult and laborious. No mining camps in North Idaho are connected with the outside world by wagon-roads, but are reached by pack-trains from May to December; during the remainder of the year communication can be kept up only on snow-shoes. For several years the Indians were troublesome, and a thorough prospecting of the country they regarded as hunting and fishing ground could not be made until after they were compelled to go upon a reservation. The failure of the Bank of California caused a cessation of operations by most of the large companies in the southern part of the Territory, and long-continued litigations and suits for the possession of property discouraged the investment of capital, without which the best of ledges and quartz veins cannot be opened and rendered profitable. From the encouraging reports it would seem that a new era is about to dawn upon the mining interests of Idaho. Railroads are shortening the distance to the principal points of the East and West; good wagon-roads are being built and bridges constructed. No trouble is experienced from the Indians; litigation has to a great extent ceased and titles to property rendered thereby more secure, and capital is seeking investment that the rich metalliferous deposits will undoubtedly repay, besides giving remunerative employment to a large number of operatives, mechanics, and laborers.

Ada County.—There are no gold or silver mines in this county worth mentioning, but the cretaceous rock of the foot-hills of the Boisé Mountains, which traverse the whole length of the county in a northwesterly direction, are coal-bearing, and the lignite discovered in several places for a distance of thirty miles is of a superior quality. Tests made in the United States assay office at Boisé City show it to be almost free of sulphur. It burns with a long, yellow flame, leaving less than four per cent. ashes. It will not coke. The largest vein so far found near the surface is on the Payette river, where a solid vein from five to eight feet in thickness is reported; a smaller one, about twenty inches wide, was exposed on the military reservation of Boisé Barracks, and float coal of excellent quality has been found in several places above and below Boisé City. No efforts have so far been made to develop and utilize these coal-beds, owing principally to the lack of a good market, but undoubtedly the advent of the Oregon Short Line Railroad will give an impetus to this industry. In the same formation beds of very fine fire-clay are found, which in the near future will become valuable and a great benefit to the rapidly rising smelting business of Alturas, Custer, and Lemhi counties. For the year 1880, production of gold in Ada county was reported to the Census Bureau as follows: from various placers, $5,001. My estimate of the production during the year 1881 is, gold, $5,000.

Alturas County.—The mines of Rocky Bar (all gold mines) have been holding their own during the year, the main producers being the Bonaparte and Ada Ellmore mines.

In 1880 and 1881, quite a number of exceptionally large and fine veins have been added to the number originally discovered. All the machinery for two first-class quartz mills is on the ground now, and during the coming season this district will turn out considerable silver bullion. The ore is remarkably good, carrying over ninety-five per cent. of silica; the silver occurs principally in the state of ruby silver, stephanite, and silver glance, making a chloridizing roasting before amalgamation unavoidable. Timber, pasture, and water are there in abundance; a first-class road has been built from Wood river, at an expense of $15,000, and with increased travel it will not be very hard to keep up communication with the Lower Wood river country and the outside world, though for a year or two it may not be quite safe to rely on them.

The production of the Wood river mines for 1881 was upwards of $500,000, but it is safe to say that it will be at least four or five fold this year. The Hailey *Times* furnishes the following statement of ore and bullion shipments from the different centers in that quarter for the season beginning May 9 and ending November 30: From Bullion: The Mayflower shipped 970 tons, carrying 175 ounces silver and 70 per cent. lead per ton. The Bullion shipped 415 tons, carrying 225 ounces silver and 50 per cent. lead per ton. The Jay Gould shipped 375 tons, carrying 120 ounces and 65 per cent. lead. The Homestake shipped twelve tons, carrying 140 ounces and 70 per cent. lead. The Eureka shipped 74 tons, carrying 100 ounces and 65 per cent. lead per ton. The Idahoan, according to the reports furnished, is entitled to the first place in the list of local ore producers. During the past season it shipped 1,000 tons of ore, averaging 150 ounces silver and 75 to 81 per cent. lead. There remains on the dump 800 tons of ore, half of which assays from $138.58 to $3,100, besides carrying from 50 to 70 per cent. of lead; the other half will yield, clear of all expenses, $53.60. The yield of the Idahoan the past season it is said has exceeded $200,000. From Hailey: The Star mine shipped ore that sold for $37,500. The Ophir, Emma Fair, Japan, Bon Ton, Washington, Narrow Gauge, French, and other groups and mines are also shipping ore, but the figures are not known. The local smelter shipped about $75,000 worth of bullion, the result of a brief trial run. The Carrie Leonard shipped thirty-eight tons, averaging 200 ounces in silver. The Rooks, Black Horse, and Allen shipped thirty tons each, which averaged 144, 144, and 130 ounces respectively. The Connors shipped twenty-five tons, carrying 120 ounces. The Elk Horn shipped 600 tons, which averaged 120 ounces of silver. From the Vienna and Mountain King mines about thirty tons of fair milling ore were shipped to Ketchum, thence to Salt Lake. They yielded 271 ounces per ton. Mr. Smiley also shipped some ore to Salt Lake, but the figures have not been obtained. The total shipments from Ketchum will probably aggregate 500 tons, carrying an average of 130 ounces of silver. From Bellevue: Reports of the shipment of 281 tons have been received.. These are as follows: Minnie Moore mine 217 tons, averaging 101.62 ounces of silver and 67 per cent. of lead. Monday, five tons, averaging 622.70 ounces silver and 54 per cent. lead. Overland, fourteen tons, averaging 99.16 ounces silver and 70 per cent. lead. Queen Victoria, thirty-four tons, averaging 137.43 ounces silver and 64 per cent. lead. Mammoth, five tons, averaging 92 ounces silver and 67 per cent. lead. Morton, six tons, averaging 152 ounces silver and 68 per cent. lead. Besides the above-mentioned, the Queen of the Hills and five other mines shipped ore, but no reports have been received. The extreme southern portion of the county contains some of the Snake river placer mines, the balance lying in Cassia county. These mines are bar mines, and very productive when sufficient water can be obtained, but as this requires a large outlay of capital, mining operations have been conducted on rather a small scale, the whole product being probably less than $35,000. The difficulty experienced in former years to catch the extremely fine gold has been successfully overcome by the use of silver plates or blankets and gunny sacks.

The reduction works on Big Wood consist of a five-ton smelter at Bellevue, a ten-ton smelter at Hailey, a forty-ton stack at Ketchum, with a sixty-ton being added, and a twenty-five ton smelter at Galena. The first three have been in operation, and the others will go into blast by June 10. Another smelter is being erected near Hailey. Three are run by water-power. The fuel employed is charcoal, obtained close by the works. In smelting the Wood river ores each ton of ore requires sixty per cent. of iron ore and twenty per cent. of limestone as a flux, and forty-two bushels of charcoal, and the cost per ton is as follows:

42 bushels charcoal, at 14 cents	$5 88
1,200 pounds iron ore, at $6 per ton	3 60
400 pounds limestone, at $4 per ton	80
Labor, wear on machinery, interest on capital, etc	1 25
Total	$11 53

This is the actual cost per ton from a forty-ton smelter running on sulphide of lead ores. Timber for charcoal, water for power, iron ore and limestone for flux, are in close proximity or within a short distance of the mines, and there is no doubt but that the cost will eventually be reduced at least twenty per cent. Throughout the Lower Wood river country are fertile valleys, capable of producing good cereals and all kinds of vegetables, and in this respect it differs from many other mining regions, which have to depend for these supplies upon the more distant agricultural sections. The past season has been one of great prosperity in Idaho; the prospector and mine-owner have both been rewarded for their labors. Reliable reports from the entire stretch of country between Saw Tooth and Wood river to the British possessions on the north confirm the statement that it is one unbroken mineral belt, and for hundreds of miles nature seems to have lavishly distributed her mineral wealth, which is only awaiting the advent of capital and enterprise to be gathered and made subservient to the uses of mankind. The production of gold and silver in Alturas county for the year 1880, as reported to the Census Bureau, by districts was:

District.	*Gold.*	*Silver.*	*Gold and Silver.*
Bear Creek or Rocky Bar quartz	$5,149	......	$5,149
Buffalo or Atlanta	38,053	$62,936	100,989
Red warrrior	8,540	......	8,540
Banes diggings and various placers.	34,999	......	34,999
Total	$86,741	$62,936	$149,677

My estimate for the year 1881 is $170,000 gold, $550,000 silver.

Boisé County.—Some of the old mines have been steadily worked, and have kept up their annual production.

During the year some little excitement was caused by the discovery of silver-bearing veins on Upper Squaw creek, and over forty locations were made during the season. The Liberty is the principal mine, and the only one which has been developed to any considerable extent. A second shaft is being sunk fifty yards from the discovery shaft, in which the ore is much richer and the vein of fair size. The ore is chiefly copper pyrites, black oxide and carbonate of copper, and peacock ore. Numerous assays give an average value of 120 ounces of silver to the ton and twenty per cent. of copper, but these do not represent the quality of the ore in bulk. Mining facilities in this district, so far as timber and water-power are concerned, are excellent, but, owing to the refractory nature of the ores, it will not become productive until proper works for their reduction are erected or cheap transportation to commercial centers is secured, the nearest railroad point at present being three hundred miles distant. The production of Boisé county for the year 1880, as reported to the Census Bureau by districts, is shown in the following table:

District.	*Gold.*	*Silver.*	*Gold and Silver.*
Banner	....	$84,182	$84,182
Cañon Creek	$22,625	......	22,625
Gambranus	3,299	......	3,299
Granite or Quartsburg	169.999	......	169.999
Mammoth or Summit Flat	5.226	......	5,226
Shaw's Mountain	12.517	......	12,517
Various placers	622,644	......	622,644
Total	$836,310	$84,182	$920,492

My estimate of the production during 1881 is gold, $300,000; silver, $30,000.

Custer County.—Custer county, north of Alturas, and drained by the headwaters of Salmon river, is attracting the attention that the richness of its mines deserves. The Yankee Fork, Bay Horse, and Kinnikinik districts contain many promising mines.

My estimate of the production of Custer county during 1881 is $500,000 gold and $350,000 silver.

Idaho County.—Idaho County was originally the largest county in the Territory. Lemhi and Custer counties were cut off from its eastern end. Boisé county has taken a strip from its southern portion, and one-half of Washington county was originally within its limits. On the other hand, it gained in 1875 a strip from the eastern side of Nez Percé county, comprising the agricultural section known as Camas Prairie and the mining camps of Elk City and Newsome Creek. The only agricultural portion is Camas Prairie, on its western border; here there are six entire and several fractional townships of arable land that produces all the usual cereals in profusion. Its elevation is not over 2,500 feet. Along Salmon river there are also a few isolated flats of small extent, which are devoted to gardening and fruit-raising. The county is watered principally by the Salmon river and its tributaries, the eastern and southern boundary being the water-shed between the branches of the Salmon and the headwaters of other streams. The northern portion is drained by some of the forks of the Clearwater. Salmon river cuts a deep chasm through the county from southeast to northwest. Its valley is from 3,000 to 4,000 feet lower than the average altitude of the mining camps scattered through the adjacent mountains, causing a marked difference in climate. In the winter snow rarely falls before February, and frequently the ground is not whitened during the year, while in the surrounding mining camps the snow covers the mountain sides from four to eight feet in depth.

Idaho county is, however, essentially a mountainous region, the principal portion of the Salmon River Mountains being included within its boundaries. These mountains are in no well-defined range, but are a vast collection of irregularly-scattered peaks, overtopping a wilderness of lesser peaks, all of a rugged and forbidding aspect. The average altitude is about 6,000 feet, though many peaks have an elevation of nearly double that height. The town of Florence is situated 6,600 feet above sea-level, and Warren 6,200 feet. The Salmon River Mountains are chiefly of granite formation, and appear to have been upheaved at a comparatively recent geological period. The deep cañon of the Salmon river affords numerous excellent opportunities for studying the character of the subjacent rocks, as surfaces are frequently exposed from 1,000 to 2,000 feet high. At a point on the river near the mouth of Little Salmon, hornblende slates begin to take the place of granite, and gneiss farther to the eastward. There is an obscure stratification and a general north and south strike. A few miles further west, at Carver's Ranch, a huge ledge of very pure limestone crosses the river; it is from 100 to 500 feet wide, and extends in a general northerly and southerly direction for about forty miles, finally dipping under the lava a short distance east of Mount Idaho. West of this other varieties of slate, mica, and clay make their appearance, with occasional bunches of quartz, and at the mouth of John Day's creek the primitive rocks disappear beneath basaltic lava and are no more seen in the bed of the river from thence to the Pacific Ocean, excepting one place in Snake river, about fifty miles below Lewiston, at Granite Point. The soil of Camas Prairie is derived from the decomposition of lava, indentical with that which overspread most of the Columbia River Valley. Many fossil remains are found in digging wells, but no minerals of value, nor are any likely to be. The mountainous region to the eastward of the lava and the anterior slate formation is probably the source of the mineral wealth of the county.

Gold in paying quantities was first discovered in Idaho, near Pearce City, in what is now Shoshone county, in 1860. At that time Idaho was still a portion of Washington Territory. Communication from point to point was slow and difficult, and there was no great rush of miners, nor any great amount of money taken out during that year. By the following spring reliable information of extensive deposits in that section was widely spread, and the search for gold was diligently prosecuted. Gold was found in the banks and bars of all the forks of Clearwater, and led to the discovery of extensive placer ground at Elk City. Paying ground was also found in many places on Salmon river, and early in July in Florence Basin, in which place thousands of mines were located in a couple of months. On the north side of the Salmon nothing worth mentioning was or has since been found. South of the Salmon gold was found in August, 1862, in Warren's Basin, which is drained by Meadow Creek and its tributaries, and empties into the Salmon river sixteen miles north of the town of Washington. At the present time the ground worth working comprises the upper eight miles of the creek. The shallow portions of the creek and neighboring gulches were worked out in a few years after the discovery of gold. The lower portion of the creek was not abandoned by white men until 1870, at which time the Chinese came in, and have since monopolized the gravel workings, going over the mining ground a second and sometimes a third time. Quartz ledges were discovered and located in Florence and Warren in 1865. In the former district very few defined ledges were found, and none that are now esteemed of much value. Almost the entire district appears to be seamed with minute veins containing gold, which are generally conceded to be the source of the great quantity of placer gold that for a time rendered the section famous.

A close approximation of the amount of ore taken out of the different ledges of Warren district and worked during the last fifteen years is as follows:

	Tons.
From the Rescue	1,000
" Knott	600
" Charity	500
" Sampson	250
" Hic Jacet	150
" Knott Treasure	25
" Scott	150
" Alder	50
" General Grant	50
" Keystone	200
" Eureka	100
" Washington	25
" Bonanza	75
" Tramp	100
" President	50
" Bullion	100
" Other small lots and float-rock	250

The yield per ton has varied greatly. Large quantities of rock from the Rescue paid from $50 to $75 per ton. Selected ore from the Charity paid from $40 to $80, and from the Scott as high as $180 per ton. The Keystone ore paid quite uniformly from $50 to $65, and, on the other hand, some lots from other ledges scarcely paid for working. The average yield of the ores of this district is not readily estimated. The processes of extraction of the precious metals have been of the simplest character; at first arrastras were used, then stamps with copper plates of limited extent, and at present the arrastra follows the battery with blanket washings saved for future treatment. Assays of tailings have rarely been made, and it is not easy to estimate the percentage of gold and silver extracted. The ore is generally calcined prior to crushing, and the returns show that more silver is saved by this preparatory treatment. Bullion from calcined ore is usually from 300 to 350 fine, while that from the raw material is 600 to 650 fine. The gold from placer mines varies much in fineness. That from the small gulches and heads of the streams is from 625 to 675 fine; in the main creek from 700 to 760 fine, and is the common currency at $14 per ounce. A great extent of ground has been worked along Salmon river, principally by rockers and other primitive appliances; the gold is usually in small particles, known as flour gold, though sometimes in scales; it is current at $16 per ounce, being from 800 to 825 fine. Near John Day's creek a few bars of limited extent have yielded coarse gold, and nuggets of from $5 to $15 each, of high grade, over 950 fine, and current $19.50 per ounce. The yield of gold from Idaho county can only be approximately stated. Five Chinese companies in Warren's take out more than half the gold of the camp; from diligent inquiry made of the principal members, the following estimate may be stated as nearly correct:

Shun Lee Company	$7,150
Wing Wo Company	16,600
Hung Wo Company	9,800
Lin Wo Company	14,250
Fook Sing Hung	22,700
Twelve minor companies	22,800
Single Chinamen	2,000
White men	13,500
Four quartz mills	18,672
Total	$127,472

Along Salmon river there are eight bars worked by Chinese and five by white men, the product of the year being about $45,000. Nearly the same amount was produced in Florence and Elk City; the smaller camps may be estimated at $43,-000, making the total production for Idaho county $260,000.

For the year 1880, the Census Bureau received the following report for Idaho county:

Copeland and scattered, quartz gold	$9,999
Butte Bar and scattered, placer gold	60,000
	$69,999

I have placed the production during 1881 as that stated by Mr. Willey, viz.: $260,000 in gold.

Lemhi County.—Mount Estes, in the southwestern part of the county, contains a rich belt of quartz ledges.

Ten lots were worked at the Bay Horse smelter, with the following results:

Date.	*Quantity.* Pounds.	*Value.* Dollars.
July 2, 1881	12,377	12,487
July 2, 1881	16,678	6,010
July 2, 1881	9,529	5,172
July 23, 1881	21,841	10,030
July 23, 1881	12,536	6,752
August 16, 1881	4,410	2,001
August 16, 1881	21,781	7,060
August 27, 1881	17,533	5,401
September 3, 1881	7,698	2,079
September 4, 1881	11,099	15,255
Total	135,482	$72,247

Since the discovery of the Charles Dickens ledge the district has produced (including the ores shipped) about $2,000,000. The product for 1882, including the ore shipments, cannot fall short of $1,500,000. Wages in the district are $3.50 to $4. Several of the companies pay $100 per month and board, but this is only where the mines are paying largely over and above development, as with the Montana and Dickens, and probably one or two others. Living is expensive as yet, owing to the cost of getting in supplies. Freights from the railroad rate at $3\frac{1}{2}$ to 4 cents. Flour and vegetables are raised on the Salmon Valley adjacent to the mining camps, and are not unreasonably high. For the year 1880, as reported to the Census Bureau, we have the following production by districts in Lemhi county:

	Gold.
Bay Horse and scattered, quartz	$125,000
Bay Horse and scattered, placer	20,000
Total	$145,000

I estimate the production during 1881 to have been $285,-000 in gold and $100,000 in silver.

Oneida and Cassia Counties.—In these counties, on the southeastern and southern borders of Idaho, mining has been confined chiefly to the placers and bars along Snake river. The gold as found here is not in the usual form of grains or scales, but in exceedingly small particles, known as flour gold, and the trouble has been to collect it; the ordinary rocker or sluice not being adequate for separating it from the gravel or sand. A number of experimental processes, some of them of considerable ingenuity, have been introduced with moderate success, but all the conditions required for saving the gold have not as yet been fully met. A considerable number of claims have been worked near Blackfoot and in the vicinity of the mouth of Raft river. At Bonanza Bar, a few miles above Raft river, work has been steadily conducted during the mining season for several years past, with satisfactory yield; the ground is not yet worked out, and at the present rate of progress and with the same system of working is good for several years to come. Farther down the river, at Shoshone Cañon, a number of Chinamen and a few whites are working with sluice or rocker with reported success. At Salmon Falls, Davis & Co. are the chief operators, and by the use of amalgamators have been enabled to save a large portion of the gold in the gravel washed on their claim, which consists of 160 acres. The production of gold and silver during the year 1880, as reported to the Census Bureau, was as follows:

ONEIDA COUNTY.

District of	*Gold.*
Caribou and scattered, quartz	$9,999
Eagle Rock and scattered, placer	29,999
Total	$39,998

CASSIA COUNTY.

Bonanza Bar, Rock Creek, and scattered	$20,000

I estimate the production of these counties during 1881 to have been for Oneida $40,000 gold, and for Cassia $25,000 gold.

Owyhee County.—This county is the extreme southwestern county of Idaho, and contains the oldest and most productive mines of the Territory, but it has never quite recovered from the blow it received through the failure of the Bank of California in 1876, which resulted in the ruin and withdrawal from the field of nearly all the large companies. The mines, however, are as good to-day as they were then, but, being expensive to work, considerable capital is required to handle them properly and profitably. The chief districts are the War Eagle and Florida Mountains, near Silver City; Wagontown, northwest of the same place; Flint, southeast, and South Mountain, thirty miles south of Silver City.

The mines of this county, taken as a whole, give promise of large yields in the future, but good honest management, to give confidence to investors, and additional capital to re-open and put in working condition some of the best mines, are the chief desiderata.

The production of Owyhee county, as reported to the Census Bureau by districts for the year 1880, is shown in the following table:

District.	*Gold.*	*Silver.*	*Gold and Silver.*
Carson or Owyhee, quartz	$168,174	$170,799	$338,973
Wagontown, quartz	7,428	3,810	13,238
Scattered, quartz	2,499 }	2,499	56,998
Scattered, placer	52,000 }		
Total	$180,101	$177,108	$409,209

I estimate the production during 1881 to have been $50,000 gold and $270,000 silver.

Shoshone and Nez Perces Counties.—The mining interests of these counties and the condition of their mines do not differ materially from those of Idado county, the description of which may be taken as general for all of North Idaho. The *Oro Fino* district in Shoshone county gives employment during the mining season to from ninety to 120 Chinamen, and half that number of white men. Its yield does not exceed $60,000 per annum. Near Pearce City there are many croppings of quartz ledges, but no developments worth mentioning have been made. The chief vein mining in the county is by the Shoshone Company, some twenty or twenty-five miles northeast of Pearce City. Nez Perces county is north of Idaho county and south of Shoshone, and has no mines of present value, except some rocker claims on Snake river above Lewiston, which are worked by a dozen or more Chinamen, and a few gulches near the head of Palouse river which produce a few hundred dollars annually. The production of the counties in 1880, as reported to the Census Bureau, was as follows:

County.	*District.*	*Description.*	*Gold.*
Shoshone	Number One and scattered	Placer	$10,001
Nez Perces	Moscow and scattered	Quartz	4,500
	Various small placers		10,001
Total			$14,501

I estimate the production of Shoshone county for 1881 to have been $60,000 in gold, and of Nez Perces county $5,000 in gold.

Estimate of Mr. A. M. Lawver of the bullion production in Idaho during the calondar year 1881, classified by counties.

Counties.	*Gold.*	*Silver.*	*Total.*
Ada	$220,729	$135,000	$355,729
Alturas	164.317	450,499	614,816
Boise	175,000	35,508	210,508
Cassia	65,351	....	65,351
Custer	....	43,853	43,853
Idaho	60,000	2.147	62,147
Lemhi	425.896	578,777	1,004,673
Nez Perces	188.599	....	188,599
Oneida	76,500	....	76.500
Owyhee	50.800	200,458	251,258
Shosohone	85,000	....	85,000
Total	$1,512,192	$1,446,242	$2,958,434

MONTANA.

MR. R. B. HARRISON, assayer in charge of the United States assay office at Helena, who had charge of the collection of mining statistics for Montana, and has furnished the principal material embodied in this review of the mines of that Territory, estimates their yield for the year to have been $2,700,000 in gold and $3,350,000 in silver. Great credit is to be given to his conclusions because of personal opportunities for observation and knowledge of the mining operations carried on in that region, and of the disposition of bullion obtained from the mines. I am constrained, however, to reduce the figures he gives, for the reason that they are not sustained by the reports received by this bureau of the amounts deposited from that Territory at the mints, transported by express companies and by railroads as freight, or reduced from ores and base bullion by smelting works and refineries. From all the sources of information at my command, I estimate that the bullion production of Montana did not in 1881 exceed $2,330,000 in gold and $2,630,000 in silver. The general description of Montana is from Mr. Harrison, and also the review of the mines with some slight modifications as to details and production.

The organic act setting off that portion of the public domain now included within the boundaries of this Territory was approved on the 26th day of May, 1864.

The name.—It is undoubtedly the prevalent belief of those acquainted with the region, that, as its name implies, it is a land of mountains, and it is a fact that the main range of the superb Rockies, for a distance of three hundred miles, traverses this empire of the Northwest; but if it had been called River-source, the name would have been more distinctively appropriate than Montana.

The topography and geography.—Of its 90,000,000 acres, only 20,000,000 are classed as mountains, while three of the great rivers of the continent rise within its borders, one of which, the Yellowstone, navigable for a distance of four hundred and fifty miles, lies wholly within its boundaries; and the Missouri, from its source, the "Three Forks," or the union of the Jefferson, Gallatin, and Madison, is carried nearly a thousand miles on Montana soil, or about one-quarter its entire length, while in the valleys of the western slope gather the waters that unite to form the great Columbia that pours its flood into the Pacific. It is estimated that fully three-fifths of the surface of the Territory are suitable for agricultural purposes, and nearly another fifth could be added to cover the extent of surface adapted for grazing.

Occasionally we have a season, as in all parts of the middle temperate zone, when early frosts interfere with the ripening cereals, but as a rule the seasons compare favorably with those of the more southerly points on the eastern plains. The rainfall of this region is slight in comparison with many other districts on the same parallel, but the streams that flow from over mountain ranges furnish an abundant supply of water for purposes of irrigation, which, as a basis of agriculture, is far more reliable, and secures better results. The absence of excessive moisture in our atmosphere renders it not only less severe in its effects during the cold weather, but also secures immunity from the various forms of contagion that arise from the marshes of the low-lands in localities where rain is abundant.

The production of Beaver Head county, as reported to the Census Bureau by districts for the year 1880, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Bald Mountains	......	$8,000	$8,000
Bannack	$19,750	300	20,050
Trapper	......	721,308	721,308
Total	$19,750	$729,608	$749,358

Choteau, Custer, and Dawson Counties.—In the northern part of Choteau county silver is known to exist in paying quantities in the region of the Bear Paw mountains, but that locality is so infested with Indians as to render it dangerous, if not wholly impracticable at present, to develop the prospects found to any extent. If the time shall come when the reservations which now cover so large a part of the Territory are open to mining enterprises, doubtless Choteau will contribute a fair share of gold and silver to the aggregate of the Territory, but for the present its product is inconsiderable. Custer has been prospected in the southern part and gold found in the vicinity of Tongue and Powder rivers, but no systematic work has yet been done to test the value of the finds. Until quite recently all of Dawson county was reserved to the Indians. The south half is now open to settlers and its resources will soon, to a great extent, be known.

Deer Lodge County.—The first discovery of gold in Montana was made on Gold creek, in the year 1861, by an old Mexican miner who was known by the sobriquet of "Gold Tom." His first location was about five miles below the present site of Pioneer Village. During the year following James and Granville Stuart brought appliances from Walla Walla, and began the first systematic operations in placer mining in the Territory on what was appropriately named "Pioneer Bar." The extent of this region known to contain gold is about five miles in an easterly and westerly direction and two miles northerly and southerly, "Independent" district being on the east, "Pioneer" on the west, and "Pike's Peak" between them. Yam Hill or Pilgrim Bar, French Gulch, Gold Hill, Squaw Gulch, Woods Flat, Wilson's Bar, Trail Gulch, Prowse Bar, Windy Bar, Hart's Gravel, Rocker Gulch, and Dry Gulch are among the many districts now included in the region designated as Pioneer. Of the ditches constructed exclusively for the purpose of mining within the limits of this small territory, there are not less than one hundred and ten miles, aggregating a cost of about $300,000, and with a flowing capacity of 10,000 inches of water, miners' measurement. Mr. Ed. H. Irvine, the manager of the Rock Creek Ditch Company, and the best authority in the matter, estimates that during the past thirteen years there have been worked under these ditches in the various camps about 3,000 acres of land, with an average depth of fifteen feet and a gross yield of nearly $12,000,000.

The banking house of Donnell, Clarke & Larabie, of Deer Lodge, bought in 1871, $1,255,000, in 1872, $1,100,000, in 1873, $970,000, in 1874, $850,000, in 1875, $725,000, in 1876, $650,000, in 1877, $450,000, in 1878, $300,000, in 1879, $225,000, in 1880, $250,000, in 1881, $230,000, or $7,075,000 within the last eleven years, which, added to the amount bought by the First National Bank, owned and operated formerly by the same parties, aggregate nearly $10,000,000 bought by one house during the last thirteen years, and nearly all of it from Pioneer and Bear districts. According to the best estimates available, the product of Pioneer for the year 1881 was not less than $195,000, none of which found its way to market until the month of July. The indications are that this region will continue productive for many years to come. New ground has been opened and improved appliances introduced, while not more than one-half of the acreage known to contain the precious metal has been worked out. Lode mining has never been prosecuted to any extent in this immediate vicinity.

In Bear Gulch, placers were first discovered in October, 1865, by Jack Reynolds and party, and the first rush of miners began in March, 1866, and during that year the first quartz location was made by an old Mexican miner, who named it Guayness. This lode, which displays from eighteen to twenty inches of very rich ore, is the only location which is all in limestone. Many other locations have been made, but they are either contact veins or in granite. There is one lode known to extend for over three miles along the divide between Bear and Elk Gulches. It seems to be a contact vein, and many of the openings upon it show remarkably rich pay chutes of gold-bearing rock. There are nine locations upon it beginning with the Homestake and running westerly. In the Homestake it is impossible to penetrate beyond a depth of forty-five feet without good facilities for freeing the vein of water. H. Grant, the owner of this property, found a pocket from which he took $900 in gold in six hours by means of a common hand mortar, and afterwards during the season increased the amount to an aggregate of $3,000 by the same means. The narrowest vein worked in this district is ten inches, and the widest yet encountered is twelve feet. No galena of any consequence is found, and as a rule very little silver, almost the entire product being gold. Mr. James B. McMaster, the assessor of Deer Lodge county, returns the amount of gold yielded in 1881 from the placer mines as follows:

Bear Gulch	$46,500
Deep Gulch	6,500
Top o'deep	13,200
Bilk	4,000
Elk	38,500
Maginnis	10,000
Two China companies in tributaries of Bear Gulch	15,000
First Chance	3,000
Williams	7,000
Kernon's Fork	2,000
Phelan's	2,500
And other prospectors	5,000
Aggregating a yield of	$153,200

In 1866 and 1867, Bear Gulch contained a population of 1,000 men, and Reynolds City in Elk Creek, 500, or an aggregate of 1,500 in what was known as Bear district, and the yield of gold was not less than $500,000 per annum for those years. The yield of the placers in German Gulch for 1881 was $5,000; Henderson Gulch for 1881 was $18,000. Since the first work done in Ophir Gulch, a tributary of the Blackfoot river, one claim patented by Mason & Kimmerly, has produced a total of $311,000; another by Mason & Stone, $42,960, and still another by Davis & Mason, $61,450. Two of these claims were worked at a great disadvantage during the past year, owing to a scarcity of water. The former was not worked, and the others yielded $2,700 and $5,300, respectively.

In Upper Ophir

Montgomery & Alley took out	$2,500
S. Trotman	2,500
David John	700
Two China Companies	6,000
Total	$11,700

From Carpenter's Bar the yield was:

J. J. Downhour	$1,500
A. A. Whittier	6,000
Barnard & Willey	800
Otto Echols & Co	3,300
Williams & Whittier	3,700
Total	$15,300

From Carpenter's Bar Gulch:

Joshua Lincoln	$1,000
Quigley & Brown	2,500
Mason & Stone, not worked	....
Total	$3,500

Ohio Gulch, P. Hanley	1,000
Illinois Gulch, not worked	......
West Illinois Gulch, J. S. Hill & Emerson	1,200

Ballyrat Gulch, Lutzd Lutzd	$1,500
Head of Three-mile, Jordan Bros	250
Side Gulch, John Many	600
Snow Shoe Gulch, Rufus Johnson	2,500
Snow Shoe Gulch, two China companies	1,000
Deadwood Gulch, John M. Irving	1,000
Washington Gulch, Duncan Seaton, M. Stuart, Mark Easterly	2,000
Washington Gulch, Geo. Bone	500
Washington Gulch, Kating	1,800
Jefferson Gulch, P. G. Birdseye	5,100
Jefferson Gulch, M. C. Carter	500
California Gulch, H. C. Keye & Co	5,000
California Gulch, Rufus Mead	500
Nevada Gulch, J. B. Wilson	2,500
Tiger Gulch, John Ruloff	600
Madison Gulch, Geo. Hysman	1,000
McClellan Gulch, Shoupe & Blume	3,000
Lower Ophir Gulch, S. W. Ryerson	3,000
Lower Ophir Gulch, C. Van Alstune	1,000
Lower Ophir Gulch, two China companies	3,300

The gold dust shipped from Deer Lodge City by the Union Pacific Express, during the year 1881, amounted to $194,156. The total product of gold and silver in the county amounts to $850,000. The production of Deer Lodge county, as reported to the Census Bureau by districts, for the year 1880, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Flint Creek	....	$249,639	$249,639
Independence	....	63,582	63,582
Silver Creek	$168,000	7,001	175,001
Summit Valley	173,930	1,745,758	1,919,688
Total	$341,930	$2,065,980	$2,407,910

Gallatin County.—This county was organized by the Territorial Legislature during the winter of 1863–'64. In the event of the ratification of the treaty made with Crow Indians in 1880, that part of their reservation which includes the Clark's Fork mines will be comprised within the limits of this county. The lodes of this district, which is about twenty-five miles square in extent, and is called the *New World district*, are wide and strong, and, as a rule, produce heavy galena ores. The surface of the ground in some places was covered with bowlders of this kind of ore when the first locations were made in 1872, but as a rule there was not much silver found in them.

The great need of this region is the requisite facilities for reducing the product under proper metallurgical skill and sagacious business management. The yield of the county in the precious metals during 1881 may be estimated at $50,000, including placers, arrastra work, and the shipments of ore.

Jefferson County.—These mines, in what is known as Basin Gulch, the placers have produced as follows:

P. H. Parkes	$10,000
——— Winters	5,000

On the east side of the Crow range of mountains in the vicinity of Indian creek, the placers have yielded as follows:

Tandy & Co.	$3,500
William Hamillton	3,907
Pat. Bowen & Co	5,000
S. Collier & Co	9,000
O'Neill & Co. (estimated)	3,500
John Murray (estimated	5,000
The new ground opened on Clancy creek has yielded	700
Lump Gulch	500
Dennis Sheehy on the Boulder	3,300
——— Thomas	5,000
Other places in the vicinity	2,000
The Homestake near Wickes, about	1,500
Mitchell Gulch (estimated)	8,000

The total yield of the county for 1881 it is safe to place at $225,000. The works erected and ready to start with the year 1882, render it probable that the product of Jefferson county will be increased manifold over that of 1881. It is claimed that the Gregory company will produce $40,000 per month, and the Alta company estimate their capacity as still greater, while the many new mills contracted for, will add to the aggregate of bullion product. The production of Jefferson county, as reported to the Census Bureau by districts for the year 1880, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Cataracts	$5,290	......	$5,290
Cedar Plain	12,800	$1,600	11,000
Colorado	6,863	39,224	46,087
Elkhorn	......	34,908	34,908
Mountain	22,749	......	22,749
Scattered	8,701	100	8,861

Lewis and Clarke County.—Among the many rich placer grounds discovered in this Territory, those of Last Chance and tributary gulches are prominent. Since the year 1864, they have produced not less than $8,000,000. The city of Helena, located at the mouth of Last Chance, has become the metropolis of the Territory, and while much of the rich pay in the lower grounds will yet be worked, there will be considerable of the good ground left unworked on account of its great value as town property. A bed-rock flume is now approaching from the valley, and as soon as the richest ground can be drained by it, the amount of product taken out will be largely increased. During the last year, the gold taken from the ground in the immediate vicinity of Helena amounted to $40,000. At Park City, about five miles above Helena, gold dust was taken out of the different claims as follows:

Paxton & Co	$5,000 00
Kuhn & Dumphy	2,600 00
F. Kuhn	2,600 00
Tom. Connor	2,100 00
Frank Leedy & Co	2,000 00
Ray Hale & Co	3,500 00
At Unionville by	
H. C. Carpenter	3,500 00
From Tucker Gulch by	
R. S. Hale (estimated)	10,000 00
From Basin Gulch by	
Dingee & Co	3,163 00
Halford & Co	9,000 00
Brown & Co	1,200 00
From Ten Mile by	
Travis Bros	1,800 00
Ashley Head	1,500 00
From Try Again by	
Travis & Son	2,500 00
From Monitor by	
Brayman	1,000 00
From Eureka by	
Jones	400 00

Many of the placers of the Territory are lying idle, under the operation of the new mining law, which enables a few persons to obtain patents for large mineral tracts, which, under the old law would be worked by prospectors, and where now only an occasional claim is worked, numbers would be opened. The total of the precious metals shipped by the Pacific Express Company from Helena during the year 1881 was—

Gold	$660,533 37
Silver	91,790 00

The total yield of gold and silver in the county for the year 1881 will net $500,000. The production of Lewis and Clarke county, as reported to the Census Bureau by districts, for the year 1880, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Silver Creek or Ottowa	$91,967	$8,073	$100,040
Stemple	32,383	17,208	49,591
Owyhee	7,150	....	7,150
Total	$131,500	$25,281	$156,781

Madison County.—The principal yield of the precious metals in Madison county is from Alder Gulch and vicinity, probably the most noted of all the placers worked in the Territory. For a distance of nearly fifteen miles from the summit of the mountains to the Ruby river, the pay has been continuous and rich. The lowest estimate of the most conservative men who have personally known its history from its discovery, place the amount of yield in gold at not less than $30,000,000. During the past year, Henry Elling, one of the bankers of Virginia City, bought during the first six months $60,000, during the last six months $140,000, gold dust and gold bullion. Raymond, Harrington & Co., of the same place, bought during the first six months $30,000, during the second six months $90,000, of which $100,000 was from Alder Gulch, $15,000 other gulches, $5,000 mill retort. The last season was not favorable for the operation of the placers of this district, on account of the short supply of water, but the increased number and better arrangement of flumes have insured nearly the average yield from the large companies; and hereafter, when the supply of water is ample, the returns will be increased. Six of the principal flume companies produced as follows: one $30,000; three $20,000 each; one $15,000; one $12,000; and there are drifters, Chinamen, and small parties scattered along the gulch and its tributaries. The ground is worked to profit along the banks as high as the water can be carried, and it is known to be rich still above the highest elevation to which the water has reached. At one time it is estimated that fully 30,000 people resided in and were interested in the development of this gulch. At the time when it was most actively worked, wages were exceedingly high, and home products so scarce and transportation so difficult as to render the cost of living ruinously high, but the outcome of the ground was so rich as to pay large returns for the entire distance worked, and it will continue for many years to come to produce largely. Until recently, the placers have attracted the attention of miners almost exclusively, and lode properties, which in other places would have been considered of great value, were quite neglected.

It is safe to estimate the product of Madison county for the year 1881 at $450,000. The gold dust shipped from Virginia City during the year 1881, $182,500, express valuation. The mining claims recorded number 365.

The production of Madison county, as reported to the Census Bureau by districts for the year 1880, was as follows:

District.	*Quartz Gold.*	*Silver.*	*Gold and Silver.*
Hot Springs	$37,555	$80	$37,635
Mineral Hill	11,700	298	11,998
Red Bluff	72	......	72
Silver Star	43,951	......	43,951
Total	$93,278	$378	$93,656

Meagher County.—In the spring of 1866 some hunters discovered in the valley of Trout creek what proved to be rich deposits of gold. Within less than six months from the date of discovery of New York Gulch a city was laid out at the junction of this gulch with Trout creek, and on the opposite side another. The first was called New York, and the other, from its relative position, Brooklyn. The placers paid richly, but the quartz very little. Wages were high, and although much of the rock carried what in such times as these would be considered good pay, the average result was not satisfactory, and quartz mining was for the time abandoned. Under the new law the desirable portion of this district was covered by relocations, but in default of all milling facilities little progress has been made towards the establishment of a camp. The highest point of land in this vicinity is Kingsbury Mountain, and from it radiate Oregon, Clarke's, Cave, and Magpie Gulches on the south and east, and Rattlesnake, New York, and Kingsbury on the north, all of which have paid well, but are worked very little, comparatively, now. The aggregate of product for Meagher county may be safely placed at $100,000 for 1881, and mostly gold. Deer Lodge, Meagher, Beaver Head, Lewis, and Clarke counties, for the year 1880, as reported to the Census Bureau, produced placer gold to the amount of $1,162,906.

Missoula County.—Formerly, in what is known as the *Cedar Creek district*, about seventy miles north of the town of Missoula, there was considerable placer mining done, and recently some excellent gold quartz has been found in that locality. In the vicinity of Stevensville, in the Bitter Root Valley, there are several prospects which give promise of ultimate value. Seven miles southwest of that point is what is known as the *Sweathouse district;* ten miles southwest is Willow Creek; ten miles northeast is Woodchuck. The Lo Lo is fifteen miles northwest, and the Wallace fifty-five miles northeast. During the coming season there will be a large influx of prospectors, and the needed appliances for the reduction of the ore product will, to some extent, be supplied, and 1882 will doubtless see Missoula county among the large producers of gold, silver, and copper. The product of the mines for 1881 may be estimated at $100,000, mostly gold. The discovery of the silver-bearing lodes was of recent date, and only small shipments of ores have been made as tests of the properties.

Silver Bow County.—Silver Bow is the smallest county in the Territory, only about eight hundred square miles, and was organized May, 1881. The most prominent among its mines is the Alice, which has been most extensively developed and operated with adequate appliances. The company owning this mine is capitalized at $10,000,000, and besides the Alice, Magna Charta, and Valdemere, which are large ore producers, they own nine other locations, covering in all 6,368 linear feet of lode claims.

Within a radius of eight miles, in townships three north, seven west, and three north, eight west, there are over 400 distinct locations which have been patented or are in process of patenting; and from the discoveries already made it is claimed that there are nearly forty parallel lodes within this remarkable mining region of which the city of Butte is the center. The placers of Silver Bow county have not produced largely during 1881, but have helped to augment the product to some extent. The grand total of the county may be safely estimated at over $2,825,000 of bullion and ores shipped during the year 1881. The stamps now in Butte and vicinity are:

Alice mill, new	60
Alice mill, old	20
Moulton	40
Silver Bow	30
Dexter	15
Lexington	10
Centennial	10
Gagnou	10
Burlington	10
Clipper	10
Grove Gulch	5
Lexington	80
Sheridan	40
Mountain Consolidated	40

REDUCTION WORKS.	*Tons per Day.*
Montana Copper Company	80
Parrott Copper Company	40
Colorado and Montana Copper Company	40
Bell Copper Company	40

The shipments of fine bullion by the Union Pacific Express Company from Butte for 1881 were: first six months, 67,708 pounds; last six months, 64,079 pounds; total, 131,787 pounds, besides $70,425 of gold dust, or a total express valuation of $1,300,425. The shipments by months, as published in the *Holiday Miner*, are as follows:

	Weight.	*Amount.*
January	8,441½	$71,535 82
February	11,253¼	112,400 35
March	13,036¼	131,483 01
April	12,835	129,292 24
May	11,738¾	106,599 47
June	10,409⅓	99,988 93
July	9,873	98,613 41
August	13,556	129,966 17
September	9,015½	78,520 11
October	11,035	94,239 28
November	9,951½	82,941 13
December	10,787¾	94,050 14
Total	137,787	$1,229,180 06

To which he adds $500,000 for other shipments, and the product of the smelters of the same district he places at about $1,271,000, which makes the total product about $3,000,000. The *Inter-Mountain* publishes the following:

"The total amount of silver, copper, and gold product in the Butte district in 1880 reached $1,428,088.26. An intelligent idea of the rapid rate at which the mining industry of the Butte district has increased since that time can be obtained from the following table of production during the year 1881: Alice Company, $1,120,937.50; Montana Copper Company, $1,042,640; Colorado Company, $864,000; Silver Bow Company, $500,000; Lexington Mill, $147,000; Dexter Mill, $76,293; Centennial and Clipper (estimated), $25,000; copper ore shipped, $197,000; gold shipped through banks, $102,280.20; total, $4,075,150.70. To this amount should be added the value of 5,000 tons of copper-silver ore extracted during the year and now at the Colorado smelter, awaiting reduction. Estimating the value of this ore at an exceedingly low figure, say $55 per ton, we have $275,000 as its total cash valuation. At the Alice mine is an extracted reserve of 4,000 tons, which, at $40 per ton, is worth $160,000. On many other mines of the district many hundreds of tons of high and low grade ore have accumulated, and the most conservative statistician would not estimate the value of the unworked ore extracted during the past year at less than $600,000."

The production of gold and silver in Montana during the year 1880, as reported to the Census Bureau, by counties was as follows:

Counties.	*Quartz Gold.*	*Silver.*	*Total Gold and Silver.*
Beaverhead	$19,750	$729,338	$749,088
Deer Lodge	341,930	2,065,980	2,407,910
Jefferson	56,403	75,892	132,295
Lewis and Clarke	131,500	25,281	156,781
Madison	93,278	378	93,656
Scattered placer mines	1,162,966	....	1,162,906
Total	$1,805,767	$2,896,869	$4,702,636

Mr. R. B. Harrison furnishes the following summary of his estimate of the gold and silver products in Montana for the year 1881:

Beaverhead	$950,000
Deer Lodge	850,000
Gallatin	50,000
Jefferson	225,000
Lewis and Clarke	500,000
Madison	450,000
Meagher	100,000
Missoula	100,000
Silver Bow	2,825,000
Total	$6,050,000

of which about $2,700,000 is gold.

This doubtless embraces the value of the base metals (lead and copper) contained, and for this reason, as well as those previously given, the amount should be reduced to that already stated, $4,960,000, of which $2,330,000 is gold and $2,630,000 is silver.

UTAH.

As early as 1863 discoveries were made in Utah of lead and copper ores of varying richness in gold and silver. The refractory nature of the vein matter for the ordinary and cheaper methods of treatment, the cost of transportation, the opposition to an immigration of a mining population by the self-constituted authorities, and, above all, the almost endless contests in the courts over mining property, discouraged investments of capital and retarded the development of the mines, and it was not until 1870 that operations commenced. In every county, and in the full extent of the mountains from the northern to the extreme southern limits of the Territory mines have been found. Many are but little worked, and some have been entirely abandoned; but with the increase of facilities for transporting and reducing ores their full development is but a question of time. At present the principal productive districts are at Park City, Cottonwood, American Fork, Sandy, Bingham, Tintic, Stockton, Frisco, and Silver Reef. At Sandy, in Salt Lake county, the large smelting and reduction works absorb most of the ore from mines accessible to that point by rail. New reduction works are being erected elsewhere; mills have been constructed, the development of the principal mines is vigorously conducted, and the prospect of future output of bullion from Utah is of the most promising character.

Washington County.—The mines worked in Washington county occur in sandstone, which seems to render necessary a revision of the received opinion that the precious metals, or silver at least, do not exist in sedimentary rocks. Mining began at Silver Reef in February, 1877. The output that year was $480,665; for 1878 it was $1,141,911; in 1879, 1,114,753. Since then it has been less on account of most of the mines changing ownership, and, later, from a strike on the part of the miners against a reduction of wages. There are four companies having mills, viz., the Darbee & Walker, the Stormont, the Christie, and the Leeds. These companies practically own all the mines, and all the ores mined in the county go through their mills. The total product of the mills of Silver Reef during the fiscal year 1881 was $798,200. The product for the last six months of the calendar year was $550,516, more than double what it was during the first six months, and for the whole year, $794,343.

Beaver County.—The production of Beaver county for the year 1880 was reported to the Census Bureau by districts as follows:

District.	*Gold Quartz.*	*Silver.*	*Gold and Silver.*
Bradshaw	$9,180	$38,383	$47,563
San Francisco	....	637,089	637,089
Star			
Total	$9,180	$675,472	$684,652

Juab County.—Two mills are in operation in this county, the Mammoth and that of the Tintic Mining and Milling Company. Prospecting is dull in Tintic, but will probably soon be stimulated by the introduction of the Swansea process, so as to get the copper, which is a valuable constituent in most of the ores of this region, and save a larger percentage of gold and silver. The precious metals, copper, and base metals are so combined in these ores that it is a great waste to mill them, as by this process alone all the copper and about half the gold and silver are lost. The Salt Lake and Western Railroad has been graded from Lehi, on the Utah Central, to and through the district as far as Tanner's Springs, and is being ironed as rapidly as possible. It is in contemplation to carry this road through the mining districts of Western Utah and of Nevada, by way of Silver Peak and the Big Trees, to Santa Cruz and San Francisco. The production of Juab county was reported to the Census Bureau by districts for the year 1880 as follows: In Tintic district—

Gold quartz	$60,238
Silver	11,200
Total	$71,438

Salt Lake County.—All the mines of Salt Lake county, except the gold mines of Bingham, ship their ores to the smelters at Sandy, in Jordan Valley, which divides the two ranges of mountains, twelve miles south of Salt Lake City. Some of the ore, however, is bought, after sampling, by agents of the Omaha Smelting Works, and of Selby & Co., of San Francisco, probably for its fluxing qualities.

The ores shipped to Omaha during the fiscal year contained $8,900 of silver, making the total output of Salt Lake county for that period $108,408 in gold and $1,164,634 in silver. During the succeeding six months to December 31, 1881, about 700 tons of lead ore were shipped to Omaha and San Francisco, which contained an average of fifteen ounces of silver per ton, equaling $13,545. The production of Salt Lake county by districts was reported to the Census Bureau for the year 1880 as follows:

District.	*Gold.*	*Silver.*	*Gold and Silver.*
West Mountain, placer	$116,329	$6,309	$122,638
West Mountain district, quartz	20,000	....	20,000
Total	$136,329	$6,309	$142,638

Toole County.—The production of Toole county for the year 1880 was reported to the Census Bureau by districts as follows:

District.	*Silver.*
Camp Floyd	$7,500
Ophir	1,001
Total	$8,501

Summit County.—Nearly the entire product of Summit county for 1881 must be credited to the Ontario Company, the Marsac mill and Park City smelter having been idle for the last half of the year; the Park City smelter has but one stack, and as its sources of supply were exhausted on account of litigation, it did not run long. The Ontario is in a condition to produce more ore than can be reduced by the present milling facilities, and a forty-stamp mill is to be erected. It is now sinking a new working shaft and putting in a Cornish pump of great capacity. Sinking with the aid of the windlass will be discontinued, and the work carried on by the pump-hoist engine until the heavy machinery is in position. In the second shaft, the vein at the 700-foot level has been run on upwards of 500 feet, all the way in ore, and the vein has been cut on the 800-foot level and reports 240-ounce ore, of two and a half feet thickness. Of projected developments, the Salt Lake City *Herald* says: "A tunnel is being run from the Ontario mill to the mines, a distance of 6,000 feet, which is intended to tap the main shaft of the mine at the 600-foot level. The object of the tunnel is to draw off the water from the mine, which will save the pumping 600 feet from all above and on the line of the tunnel. The shaft is down some 800 feet; therefore, instead of having to pump the water this distance, it will be necessary to pump it only 200 feet. In addition to running off the water it will be used for other puposes. Cars drawn by horses will be run in it to carry ore to the mill." During the fiscal year the Ontario produced $2,443,455 in silver. This mine has produced, to December 31, 1881, $9,356,290 worth of silver, valued in gold at the selling price of silver from month to month as taken out. It has paid 72 consecutive dividends, aggregating $3,925,000. The following exhibits in detail the product of this great mine, embracing that of the mine before the company had its own mill:

Date.	*No. of Bars.*	*Sold for Gold.*	*Total.*
1877.			
February	61	$109,275 34	
March	86	136,883 67	
April	80	127,087 88	
May	70	125,196 85	
June	100	157,591 09	
July	84	136,974 89	
August	86	151,042 10	
September	82	158,059 16	
October	86	152,174 66	
November	90	151,342 42	
December	97	166,546 36	
			$1,572,174 42
1878.			
January	86	$152,509 95	
February	68	129,334 02	
March	82	157,806 29	
April	90	152,151 97	
May	64	116,427 38	
June	66	90,052 97	
July	112	94,308 24	
August	148	120,501 85	
September	92	78,967 28	
October	109	83,581 90	
December	155	103,193 53	
			$1,278,835 38
1879.			
January	92	$57,995 86	
February	82	52,335 69	
March	77	49,530 05	
April	126	85,188 10	
May	142	102,245 84	
June	129	115,097 42	
July	112	100,807 92	
August	132	119,022 22	
September	126	103,110 95	
October	148	124,258 28	
November	114	113,385 13	
December	138	143,806 54	
			$1,166,784 00
1880.			
January	130	$117,663 50	
February	179	184,926 99	
May	41	53,641 98	
June	140	185,536 92	
July	132	195,299 35	
August	134	206,636 47	
September	152	186,329 02	
October	150	223,085 41	
November	160	230,899 81	
December	142	185,205 24	
			$1,769,224 69
1881.			
January	132	$167,825 02	
February	146	186,130 60	
March	174	230,238 84	
April	150	207,411 34	
May	130	169,301 33	
June	172	235,141 32	
July	188	263,704 66	
August	162	208,561 54	
September	150	194,693 20	
October	142	167,443 96	
November	158	218,819 72	
December	175	220,000 00	
			$2,469,271 53
Total	.....	....	$8,256,290 22
Amount prior to January, 1877		....	1,100,000 00
			$9,356,290 02

During March and April, 1880, the mill was closed on account of repairs of an important character being made.

The production of Summit county for the year 1880 was reported to the Census Bureau as follows: Uinta district, $1,353,243, silver.

Production of Gold and Silver from the Mines of Utah from July 1 to December 31, 1880.

Mill or Mine.	*Locality.*	*Gold.*		*Silver.*	
		Fine Ounces.	*Value.*	*Fine Ounces.*	*Value.*
BULLION.					
Barbee & Walker	Silver Reef	....	....	91,082·96	$117,763.83
Christy	........do	....	....	117,268·00	151,619.23
Stormont	........do	....	....	220,429.40	284,999.63
Horn Silver	Frisco	....	....	253,852.06	328,212.76
Frisco	.....do	348·16	$7,197.11	61,852·72	79,971.19
Mammoth	Tintic	1,126·83	23,293.64	18,559·81	23,996.52
Tintic	Homansville	166·60	3,443.93	36,140·59	46,727.23
Ontario	Park City	....	....	972.506·00	1,257,381.49
Old Telegraph	Sandy	105·56	2,182.12	37,466·74	48,441.85
Mingo	...do	451·00	9,323.00	176,216·40	227,835.35
Hanauer	...do	377·57	7,805.06	102,770·82	132,875.40
Germania	...do	560·58	11,588.22	110,536·55	142,915.94
F. J. Pascoe	Salt Lake	5·10	105.43	2,040·31	2,637.98
J. F. Brooks	Stockton	2·00	41.34	993·25	1,284.20
H. F. Swan	Sandy	11·13	230.08	4,439·05	5,739.38
Chicago	Stockton	21·19	438.04	9,435.11	12,198.93
Gulch mines	Bingham	1,193·00	24,661.50	....	
ORES.					
R. Mackintosh	Salt Lake	....	....	3,555·00	4,596.36
Total	....	4,368·72	$90,309.47	2,219,144·77	$2,869,197.27

Production of Gold and Silver from the Mines of Utah from January 1 to June 30, 1881.

Mill or Mine.	*Locality.*	*Gold.*		*Silver.*	
		Fine Ounces.	*Value.*	*Fine Ounces.*	*Value.*
BULLION.					
Barbee & Walker	Silver Reef	....	....	40,520·70	$52,390.40
Christy	........do	....	....	110,509·50	142,880.97
Stormont	........do	....	....	37,547·60	48,546.39
Horn Silver	Frisco	....	....	382,464·47	494,499.52
Frisco	...do	371·02	$7,669.66	168,570·78	217,950.10
Mammoth	Tintic	787·16	16,272.04	17,970·02	23,233.96
Ontario	Park City	....	....	917,354·00	1,186,073.86
Park City S. Co.	.......do	34·07	704.29	22,359·04	28,908.66
Great Basin	Stockton	99·59	2,058.71	24,567·16	31,763.60
Mingo	Sandy	512·00	10,583.98	187,158·50	241,982.71
Hanauer	...do	141·65	2,928.16	64,966·92	83,997.64
Germania	...do	351·58	7,267.80	149,422·35	193,192.53
F. J. Pascoe	Salt Lake	55·13	1,139.64	17,985·00	23,253.33
Tintic	Homansville	227·23	4,697.26	36,327·72	46,969.17
J. F. Brooks	Stockton	13·75	284.24	7,913·65	10,231.79
Gulch mines	Bingham	1,349·00	27,886.30		
ORES.					
Rebellion	Park City	....	....	19,260·00	24,901.82
R. Mackintosh	Salt Lake	....	....	3,345·00	4,324.85
Total	....	3,942·18	$81,492.08	2,208,242·41	$2,855,101.30

Production of Gold and Silver from the Mines of Utah during the fiscal year ending June 30, 1881.

Mill or Mine.	*Locality.*	*Gold.*		*Silver.*	
		Fine Ounces.	*Value.*	*Fine Ounces.*	*Value.*
BULLION.					
Barbee & Walker	Silver Reef	....	....	131,603·66	$170,154.23
Christy	........do	....	....	227,777·50	294,500.20
Stormont	........do	....	....	257,977·00	333,546.02
Horn Silver	Frisco	....	....	636,316·53	822,712.28
Frisco	...do	719·18	$14,866.77	230,423·50	297,921.29
Mammoth	Tintic	1,913·99	39,565.68	36,529·83	47,230.48
Ontario	Park City	....	....	1,889,860·00	2,443,455.35
Tintic	Homansville	393·83	8,141.19	72,468·31	93,696.40
Park City S. Co.	Park City	34·07	704.29	22,359·04	28,908.66
Great Basin	Stockton	99·59	2,058.71	24,567·16	31,763.60
Old Telegraph	Sandy	105·56	2,182.12	37,466·74	48,441.85
Mingo	...do	963·00	19,906.98	363,374·90	469,818.06
Hanauer	...do	519·22	10,733.22	167,737·74	216,873.04
Germania	...do	912·16	18,856.02	259,958·90	336,108.47
F. J. Pascoe	Salt Lake	60·23	1,245.07	20,025·31	25,891.31
J. F. Brooks	Stockton	15·75	325.58	8,906·90	11,515.99
H. F. Swan	Sandy	11·13	230.08	4,439·05	5,739.38
Chicago	Stockton	21·19	438.04	9,435·11	12,198.93
Gulch mines	Bingham	2,542·00	52,547.80		
ORES.					
Rebellion	Park City	....	....	19,260·00	24,901.82
R. Mackintosh	Salt Lake	....	....	6,900·00	8,921.21
Total	....	8,310·90	$171,801.55	4,427,387·18	$5,724,298.57

Wells, Fargo & Company's Statement of the Mineral Product of Utah for 1881.

Base Bullion.	*Pounds of Lead, refined.*	*Pounds of Lead, unrefined.*	*Ounces of Silver.*	*Ounces of Gold.*
Frisco Milling and Smelting Comp'y	....	3,023,213	221,846	425
Germania Smelt'g and Refin'g Works	2,645,373	3,687,284	234,260	191
Hanauer Smelter	....	3,015,228	176,320	438
Horn Silver	....	16,343,995	1,259,903	
Mingo Furnace	....	11,977,649	437,176	832
Other smelters	....	1,634,597	56,680	215
	2,645,373	39,681,966	2,386,185	2,101
Deduct base bullion purchased for Germania Refining Works	....	385,365	18,427	39
Net product base bullion	....	39,296,601	2,367,758	2,062
Lead, silver, and gold in ores shipped	....	2,895,026	276,141	560
Total refined lead, ores, and base bullion	2,645,373	42,191,627	2,643,899	2,622
DORE BARS.				
Germania Refining Works			115,219	317
Ontario Silver Mining Company			1,909,870	
Silver Reef Mills			614,368	
Tintic Mill and Mining Company			73,031	406
Other mills and places			43,804	4.643
Total dore bars			2,756,292	5,366

RECAPITULATION.

2,645,373 pounds refined lead, at 5½ cents per pound	$145,495 51
42,191,627 pounds unrefined lead, at $50 per ton	1,054,790 67
5,400,191 ounces silver, at $1.11	5,994,212 01
7,958 ounces gold, at $20	159,160 00
Total	$7,353,658 19

The above includes the ores received from Idaho, Montana, and Nevada, aggregating 3,969,440 pounds of lead, 441,846 ounces of silver, and 976 ounces of gold. Computing the gold and silver at the mint valuation, and lead at its value at the seaboard, it would increase the value of the product to $9,401,475.56.

Production of Utah, by Counties, during the calendar year 1881.

(Estimated by O. J. Hollister.)

Counties.	Gold.		Silver.	
	Fine Ounces.	*Value.*	*Fine Ounces.*	*Value.*
Washington	....	....	614,368	$794,334 38
Beaver	425	$8,785 53	1,501,341	1,941,127 75
Juab	2,332	48,206 71	105,354	136,215 27
Salt Lake	4,191	86,635 66	805,193	1,041,057 61
Summit	34	702 84	1,931,089	2,496,761 53
Total	6,982	$144,330 74	4,957,345	$6,409,496 54

COLORADO.

THE assayer in charge of the Denver mint, H. Silver, Esq., obtained and forwarded a large amount of valuable and comprehensive statistical information in regard to the production of Colorado during the year, accompanied by an able sketch of the condition of mining in the several counties, prepared by Mr. Frank Hall, of Denver, who has given much attention to the condition of the mining interests of the State. The local press, as might be expected, in their daily and weekly issues not only record the history of mining in their own localities, but publish annual reviews and summaries of mining progress during the year. Mr. Silver also obtained returns from bankers and transportation companies, and from mine officers and owners, which, though not embracing all, have been found of considerable value in ascertaining the production of different counties. From these sources and personal observation, and by a comparison of these data with other information received, a detailed review of the progress of mining for the precious metals, and the production of the different counties in Colorado during the year, has been prepared at this office. The bullion production of Colorado has increased slightly over the yield of previous years, and still exceeds that of any other State or Territory. The total production of the State for the calendar year 1881 was $3,300,000 gold and $17,160,000 silver, which, from a careful comparison of the returns received at this office and estimates of those engaged in collecting statistics, appear to have been produced by the different counties as follows:

Production of Precious Metals in Colorado for the year 1881.

Counties.	*Gold.*	*Silver.*	*Total.*
Boulder	$200,000	$350,000	$550,000
Chaffee	50,000	165,000	215,000
Clear Creek	200,000	2,000,000	2,200,000
Custer	100,000	700,000	800,000
Dolores	5,000	90,000	95,000
Fremont	....	15,000	15,000
Gilpin	1,850,000	260,000	2,110,000
Gunnison	10,000	400,000	410,000
Hinsdale	10,000	160,000	170,000
Lake	300,000	10,300,000	10,600,000
La Plata	5,000	10,000	15,000
Ouray	70,000	135,000	205,000
Park	50,000	350,000	400,000
Pitkin	100,000	30,000	130,000
Rio Grande	290,000	10,000	300,000
Routt	20,000	....	20,000
Saguache	....	40,000	40,000
San Juan	5,000	25,000	30,000
Summit	35,000	2,120,000	2,155,000
Total	$3,300,000	$17,160,000	$20,460,000

The table presents many changes from the production of localities, as published for the previous year, although the total production of the State was but slightly changed. Several of the counties seem to have reached their maximum. The yield of Lake county is about $2,000,000 less than that of 1880. Many mines in other counties have, however, become producers, and hundreds of mines are scattered through the State which contain ore in quantity and character fully justifying its shipment and treatment as soon as cheaper and more expeditious facilities for that purpose are furnished. The yield of Gilpin, the principal gold-producing county, has slightly fallen off, on account of some of the old mines having been idle, but this has been compensated for by Rio Grande county, which is rapidly developing into a gold producer. In Summit county rich discoveries have been made in all quarters, and it promises to become one of the best mining sections of the State. The Gunnison and San Juan countries are rich in mineral, and with better shipping facilities, which will soon be accorded, the output of bullion will rapidly increase. Mining in Colorado has not been unsuccessful nor unprofitable. While much of the work done has made no great returns to individual operators, hundreds of good lodes have steadily been undergoing development, and the labor and money expended during the past year will bring their fruits in the future. In addition to the profits earned by individual enterprise, of which we have no record, and the improved condition of the mines, nearly three million dollars were paid in dividends. The *Rocky Mountain Review* publishes the dividends of seventeen mining companies in Colorado for 1881, which disbursed in the aggregate $2,951,750. The dividends were paid as follows:

	Dividends.	*Amount.*
Bonanza Development Company	4	$135,000
Catalpa	3	180,000
Chrysolite	5	500,000
Dunkin	6	110,000
Evening Star	18	475,000
Gem	.....	3,750
Glass Pendery	1	25,000
Hibernia	5	160,000
Iron Silver	4	500,000
Leadville Consolidated	.....	20,000
La Plata	12	195,000
Morning Star	1	50,000
Moore M. S. Company	.....	36,000
Polonia	1	12,000
Robert E. Lee	1	50,000
Robinson	9	450,000
Silver King	1	50,000
Total	71	$2,951,750

On the Catalpa, Dunkin, Glass Pendery, Hibernia, Polonia, and Robert E. Lee dividends were paid in the first half of the year, and none paid since June. The Evening Star and La Plata paid dividends regularly during the whole year. The Chrysolite, Morning Star, and Silver King paid dividends during the latter half of the year.

The first dividend of the year of the Robinson Consolidated was paid in June, and the last in November. The Iron Silver paid its first dividend for the year in June, and in December its fourth.

Boulder County.—This county, in addition to its well-earned reputation as the agricultural garden of the State, possesses some of the most extraordinary mines. Beginning at the east line, twelve miles from the foothills, we find the immense coal measures opened at Northrop and Canfield, which have furnished Denver, Boulder, and Golden with fuel from the date of their settlement, and supplied the railways for steam purposes since their construction. The State geologist (Prof. J. Alden Smith), in his last report, says of them: "They are lignitic, very dense, generally of a jet-black color, high luster, and wholly destitute of fibrous or woody structure, far superior to most lignites, and quite equal for most purposes to the best Pennsylvania coals. Their specific gravity varies from 1·28 to 1·40, averaging about 1·23. They are also remarkably free from sulphur, the quantity rarely reaching 1 per cent. and generally falling below 0·4 per cent. The quantity of ash, too, is very low, ranging between 2 and 7 per cent., averaging about 5½. Their heating power is very high, ignite readily, burn freely, and are largely used for domestic purposes and for making steam. They are used also in the manufacture of illuminating gas, roasting pyritous ores, blacksmithing, and to a limited extent in smelting." None of them are reduced to coke, because not well adapted for use in that form. The same quality is found in nearly all quarters of that division of the county which extends from the base of the mountains eastward. This section is already accommodated by six different railways, and several others are projected. In no other county of the State is lode mining carried on so near the open plains. The first fissures occur about two miles west of the town of Boulder, those nearest the valley carrying a fair percentage of copper and some silver. A little farther up, at an altitude of 8,000 feet, are the famous telluride veins, the largest and richest in the world. "Auriferous and argentiferous telluride ores were found here in quantity for the third time in the world's history, and in greater abundance than ever previously known. I may safely assert that a single mine in Boulder county has produced more tellurium, had it been reduced and saved, than any ten of the other mines of the world combined. Hundreds of tons of ore have been shipped to smelting works that would have yielded from 5 to 10 per cent. of tellurium, and thousands of tons containing from 1 to 3 per cent. Pieces of several pounds' weight may be selected which contain 75 per cent., and it is no uncommon thing to find masses containing from 15 to 25 per cent.

"As an illustration of the richness of these ores, it may be stated that the assay value of the first-class ores from the American mine varied from $2,000 to $12,000 per ton in bulk, the average being about $4,500. The second-class yielded about $800, and third quality $200 per ton. The largest number of the productive lodes are in granite, gneiss, several are in mica schist, and but two thus far opened are between porphyry and granite."

The *News and Courier* gives the following as the product of the Boulder county mines for 1881:

Caribou silver bricks shipped through the express office at Boulder	$227,982 88
Ore purchased by the Boston and Colorado Sampling Works	100,000 00
Ore purchased by the Golden Company Sampling Works	60,000 00
Ore and base bullion shipped to other parts via C. C. Railroad.	60,000 00
Retorts shipped by Ni Wot mine to Denver	40,000 00
Gold retorts and dust shipped through banks	37,500 00
Considerable gulch gold has been produced and carried out of the county by individuals, say	10,000 00
Total net product	$535,482 88

The general average of ore produced is $126.66 per ton. The above estimate is made principally from the books of express offices, sampling works, and banks, and as they are in round numbers, the probability is that they are somewhat under the actual amounts. The following mills and mines of Boulder county have returned reports of production, viz.: Church & Co., Clark & Johnson, Jones & Smith, Phillips & Wood, Caribou Consolidated Company, Golden Age, Columbus, Friburg, Gray Copper and Vanchus, Magnolia, Prussian, Yellow Pine, Ajax, Ivers Phillips, Sugar Loaf, Wood & Germain.

I estimate that the production of Boulder county during 1881 was $200,000 in gold and $350,000 in silver; a total of $550,000.

Chaffee County.—This county was created by a division of Lake county, by legislative enactment in 1879, with Buena Vista as a principal center of traffic, and the county seat. The latter point is thirty-five miles south of Leadville, one hundred and thirty-five miles west of Denver, and one hundred and twenty miles north of Pueblo, and is in the midst of a very fair agricultural section. Water for irrigation is obtained from Cottonwood creek on one side, and from the Arkansas river on the other. Owing to the discovery of valuable mines of gold, silver, and iron in the neighboring mountains, numerous small towns or camps have been established, and most of them are in a flourishing condition. Granite district, in the northern part of the county, and east of the Arkansas river, is one of the oldest mining districts in the State. The ore from the lodes was at first free gold bearing, but as depth was attained sulphuret of iron, with some copper and lead, made their appearance, and it became too refractory for the ordinary mill process. Suitable works for treatment of the ore have not yet been erected, and a large amount of mineral is now lying on the dumps awaiting the advent of an adequate process for reduction.

The Yankee Blade is the best developed mine, and is opened by three shafts 265, 70, and 140 feet respectively. The 100-foot level has been driven from the main shaft 280 feet, and the 200-foot level 185 feet. The Robert George, O. K., Massachusetts, Washington, Mamie, Jessie Johnson, Belle of Joplin, Alta, Hattie Jane, Santa Claus, Yosemite, Solex Tiyee, Free Gold, California, Base Range, Rocky Bar, Dana, Little Troy, Atlanta, Jack Rabbit, Trafalgar, Carbonate, Hudoo, and Hancock, are all opened by shafts or tunnels of from twenty-five feet to 100 feet. The veins are generally well defined and vary from one to three feet in width.

Many large and rich mineral veins which during the year were being merely developed, will soon produce and work considerable ore, and the yield of the county for the next near will doubtless exhibit an increase. The following mills and mines of Chaffee county have returned reports of production, viz.: Dry Placer Amalgamating Company, Columbus, Gaff, Monarch, Lake County Placer, Black Tiger. The production of the precious metals in this county in 1881 was $50,000 in gold and $165,000 in silver.

Clear Creek County.—The principal centers of mining in this county are Georgetown, Empire, Lawson's, Spanish Bar, and Idaho Springs. The yield for 1881 was $2,200,000, or about $450,000 less than for 1880, owing to the large amount of "dead work" performed in opening the principal lodes. Much of the shortage was owing to harassing litigation, which is always seriously detrimental to production. It is well understood that this is the oldest silver-mining section of the Rocky Mountains, having a greater number of mines well opened, and yielding a larger percentage of high-grade ore. While a majority of the veins are narrow in comparison with those of Gilpin, its nearest neighbor; the contained mineral, as a whole, is extremely valuable; they are easily worked, and many of them have been penetrated to great depths by shafts and tunnels. At Georgetown, the county seat, there are several sampling mills, one concentrating establishment, and one in which the ores are reduced to bullion. The major part are, however, shipped to Golden, Denver, and Pueblo for reduction by smelting. The mountains being very steep are admirably suited for deep tunneling. The middle and lower portions of the county have been unusually active for a year or two past. The mines about Idaho Springs, Freeland, Chicago Creek, and Spanish Bar have been more extensively developed than in any former season. Idaho Springs is becoming quite a brisk milling center as well as a popular health resort.

But little placer mining was done on Clear creek or elsewhere in the county, and the total product of individual operators would not exceed $5,000. The following mills and mines of Clear creek county have returned reports of production, viz.: Farwell Reduction Works, Clear Creek County Reduction Works, Washington Stamp Mill, Baxter, Colorado Central Consolidated, Colorado Diamond Tunnel Company, Dunadin, Equator, Frostburg, Hukill, Lincoln, Mendota, Pay-Rock Consolidated, Red Elephant, Stevens, Pelican, Dives, Cincinnati Consolidated, Hercules and Roe, Dunderberg, Good Luck, Horn and Errickson, Silver Plume Consolidated, Equitable, R. Orchard Old, Tunnel Silver. Of the total production, $200,000 was gold and $2,000,000 silver. The following estimate of the production of Clear creek county is taken from the local press:

Bought by Georgetown Mills	$1,564,978 60
Bought by Moore & Golden Smelting Works direct from miners	109,666 00
Product of Hukill, Freeland, and mines near Idaho Springs, not included in above	474,823 71
Geneva district	30,000 00
Dumont and Empire	14,000 00
Bought by A. P. Stevens, Lawson	10,000 00
Free gold bought by Bank of Idaho Springs	1,461 93
Total	$2,204,930 34

It has been impossible to separate the value of the different metals, as an aggregate is the only account kept by most of the sampling mills, but it probably will not vary much from 86 per cent. silver, 7 per cent. gold, 4 per cent. lead, and 3 per cent. copper, or, in round figures, about as follows:

Silver	$1,904,930 34
Gold	150,000 00
Lead	90,000 00
Copper	60,000 00
Total	$2,204,930 34

Custer County.—The first discoveries of paying mineral in this county occurred near Rosita. The largest yields have been obtained from the Bassick, at Querida, and the Humboldt, Pocahontas, and Leavenworth, at Rosita. Several others, the Virginia, Leviathan, Polonia, Ben Franklin, First Chance, and Silver King, have produced considerable amounts of marketable ore. Unquestionably the Bassick is, for the present, the greatest mine in all that region of country; but as it is under the control of a company which has managed thus far to keep its own secrets from the public, no one can obtain any information of its transactions. This much may be asserted, however, that the yields are neither so large nor the ores valuable as reported by the press. What has been produced during the past year is only a matter of conjecture, but it is not far from $400,000. Other prominent properties in the intermediate vicinity of Querida are the Hector, Midnight, Poorman, Ophir, and Copper Bottom No. 1. Of Custer county's production of gold, silver, and copper during the ensuing ten years, fully three-fourths will probably be produced within a circle four miles in diameter, of which Querida is the central point. Silver Cliff is the largest settlement in the county, and contains from 2,500 to 3,000 people. All of the mines which created its prestige as a thrifty center are idle. The mills of the Racine Boy, Plata Verde, and Bull Domingo, as well as the mines, are idle, and have been so for the greater part of the year. The mill of the Racine Boy is one of the largest and finest in the State. There is no doubt that these mines and mills, placed under honest, judicious, and careful direction, would soon become very productive and profitable. The ores are there in apparently illimitable quantities, and, though not largely of the class known as high grade, are still sufficiently valuable to give handsome returns under wise management. Other properties in the vicinity have been worked steadily, however, during the year. The Boulder and Buffalo Hunter Company is erecting a 100-ton mill, and the Duryee Furnace Company has completed a fifty-ton furnace nearer town. Should these new establishments be able to treat the peculiar ores of that locality, and should the corporations which hold the better properties come to an agreement, it is probable that the county of Custer will again resume its position as one of the important mining communities of the State. A few of the properties on which the most has been accomplished in the way of systematic development, are named below: Humboldt, 1,800 feet; Victoria, 625; California, 350; La Crosse, 310; Schoolfield, 120; Good Hope, 130; Fiskdale, 200; Peerless, 50; Belle of the Gulch, 225; Silver Run, 200; Copper Bottom, 150; Empire Tunnel, 350; Song Bird, 200; First Iowa, 100; Denver, 150; Zoo, 100; Iron Mountain, 260; Butterworth, 50; Hunter, 50; Brittle Silver, 65; Del Norte, 50; Silver Horn, 250; Eureka, 200; and Black Hawk, 65. The following mines reported production: Lucille Consolidated, Twenty-Six, Lady Franklin. I estimate the production during 1881 to have been $100,000 in gold and $700,000 silver; a total of $800,000. The following from the Silver Cliff *Mining Gazette* gives the total yield of the mines of Custer county up to January 1, 1881:

SILVER CLIFF SMELTING ORES.*	
Bull Domingo	$290,000
Milkmaid	
Silver King	1,000
Zoo	256
Del Monte	2,000
MILLING ORES.	
Silver Cliff Company	375,000
Plata Verde	2,500
Horn Silver	15,000
Buffalo Hunter	2,600
Boulder	
Hecla	5,000
Vanderbilt	20,000
Julian	2,000
Song Bird	6,000
Kate	1,600
Lone Star	2,000
Sitting Bull	
Total	$724,956
ROSITA SMELTING ORES.†	
Bassick	$500,000
Humboldt	335,000
Pocahontas	317,477
Leavenworth	120,000
Invincible	
Lucille	11,900
Polonia	$36,000
Twenty-Six	2,000
Horton	1,600
First Chance	3,000
Silver King	1,000
Ophir	
Ben Franklin	10,500
Silver Coin	1,000
East Leviathan	8,000
Virginia	8,548
Total	$1,366,025

* Founded in 1879. † Founded in 1871.

Dolores County.—This county, having Rico for its principal center, was set off from Ouray county, by act of the general assembly, in 1880. For some time past, the mines of that locality have attracted much attention because of their extent and value. It is estimated that fully two-thirds of the veins thus far discovered are true fissures, cropping out through alternate layers of eruptive and sedimentary rocks, porphyry, lime, and sandstone. The remainder are contact veins between porphyry and lime. The fissures are very large, containing almost every variety of mineral, gold, silver, copper, iron, lead, antimonial silver, heavy and calc spar, etc. In some of these, as well as in the contact veins, carbonate of lead is found in great abundance. The district was discovered and prospected late in the autumn of 1879, but the winter coming on so early, and with unusual severity, little could be done until the following spring, when prospecting was resumed and carried on quite extensively, until October, 1880, when another severe winter put a stop to out-door operations. By this time, however, a considerable settlement had been formed, and the basis of active development firmly established. Near Rico is the Newman group, probably the best developed mines of the county. It comprises the Newman, Chestnut, Swansea, Swansea Extension, Stephens, Parsons, Tip Top, and Ocean Wave properties. The main ore chute lies in the Chestnut, Newman, Swansea, Swansea Extension, and Stephens lodes. These mines lie adjacent to each other, on Dolores Mountain, about half a mile from the town. Permeating all is a great contact vein, containing a pay-streak from two to eight feet thick, cropping out in an abrupt bluff like an immense coal deposit. Below this great contact vein, and cutting vertically through the stratification, are five large fissure veins.

The production of Dolores county during the last year, I estimate to have been $5,000 in gold and $90,000 in silver. This comparative meager yield is no discredit to a rich section of the State, when it is considered that, until the latter part of the year, the railroad was one hundred and seventy-five miles distant, and to reach it, high ranges had to be crossed, and ore packed on jacks the greater part of the way By next season the railway will be completed to Rico, and during the year the developments will, probably be of such character as will insure a large yield of bullion. The following mines of Dolores county have returned reports of production, viz., Puzzle Extension, Grand View Smelter.

Fremont County.—This county is chiefly famous for its magnificent coal mines, from which nearly all Southern Colorado and the Rio Grande Railway have been supplied for years. It is a superior lignite, much denser, more durable, and giving out greater heat than those of the northern division of the State. Mixed with those found at Trinidad in equal parts, it is used for the manufacture of illuminating gas, and for smelting gold and silver ores at Denver, Pueblo, and Golden. It is estimated that the coal product for the year was about 200,000 tons. But two silver mines were operated at a profit in the county during 1881. A large number of claims have been located in this vicinity. But little work, however, has been done upon any of them. The sales of ore for the year, as reported by the superintendents, are as follows:

From the Gem mine	$12,493 50
From the Cetopaxi mine	2,042 00
Total	$14,535 50

Gilpin County.—Gilpin county, situated on the eastern slope of the Rocky Mountains, is the oldest gold producing section of the State. The veins are true fissure, varying in width from two to fifteen feet, averaging from three to four feet, and containing in some instances free milling ore, while in others it is refractory and best treated by the smelting process. The bullion returns of Gilpin county for 1881 were less than those of the previous year, owing to the temporary suspension of work on some of the greatest and most productive mines. Various causes led to this result, one of which was the necessity of providing much heavier machinery for raising ore and water from the great depths attained. None of these properties were closed because of insufficient paying ore. Among the number were the Kent County, California, and New York and Colorado, all having large reserves of good ore in their lower workings at the time of suspension. The Kent county has resumed operations, and is doing well, and before the middle of the present year it is expected that the others will be again in full blast. The merchants and other business men of Black Hawk, Central, and Nevada have been operating many mines in that section the past two years under the co-operative plan. They take an abandoned mine, which has a good record so far as developed, and by sinking and drifting upon new ore bodies, each member of the syndicate paying his just proportion of the expense, until the mine becomes profitable, and then sharing the gains. Notwithstanding the temporary depression incident to the causes mentioned, Gilpin is one of the strongest mining districts on the continent. All the better systems of mining and milling ore are in full operation there. There are in the county twenty-six stamp mills, with a total of 972 stamps, as follows:

	Stamps.
Waterman, Eureka Gulch	20
Mackey, Nevadaville	37
Consolidated Kansas, Nevadaville	52
Whitcomb Mill Company	25
Kip & Buell, Central	60
United Gregory, Central	50
New York and Colorado Company	40
Bobtail Mining Company, Black Hawk	125
Empire, Black Hawk	25
Kimber, Black Hawk	35
Bostwick	25
Fullerton, Black Hawk	40
Midas Mining Company, Black Hawk	20
Hidden Treasure	50
Fullerton, upper mill	37
Arrighi	10
Wheeler	25
Gregory	50
New York	75
Randolph	50
Cashier	35
Rollins	16
Golden Flint	15
Harkaway	10
Republic	25
Miner's Reduction Company	20
Total number of stamps	972

Of the above the following have been running during the year, the majority being custom mills, or run by lessees of mines, viz.:

	Stamps.
Consolidated Kansas, Nevada	20
United Gregory, Central	50
Bobtail Mining Company	125
Kimber	35
Fullerton	40
Hidden Treasure	20
New York	50
Randolph	50
Cashier	25
Empire	25
Total	440

In addition to the ores reduced in the county, the following amounts were produced from ores shipped to other points:

Smelting Works.	*Gold.*	*Silver.*	*Total.*
Moore	$117,650	$76,432	$194,082
Boston and Colorado	398,000	76,000	474,000
Golden	144,066	58,524	202,590
Miners	58,833	11,734	70,567
Pueblo (estimated)	....	....	35,000
Omaha	....	....	63,500
Miscellaneous (estimated)	....	....	125,000
Total			$1,164,739

The shipments by express from Central City, during 1881, were as follows:

For six months ending June 30	$495,425
For six months ending December 31	426,550
Total	$921,975

The following mills and mines of Gilpin county have returned reports of production, viz.: Briggs Consolidated, Empire, Gregory, Kansas Consolidated, New York, Randolph & Co., United Gregory, Whitcomb, Mead, Arrighi, Cashier, Quartz Hill, Bobtail Consolidated, Fullerton, Kimber, New York & Colorado, Rollins, Stanley and California, Humphrey Dressing Works, Ashtabula, Boss, Bull of the Woods, California, Carr, Clifford, East Flack, Forget-me-not, Gettysburg, Grizzly, Hard Money, Jones, Keystone, King of the Ranch, La Crosse, Nottaway, Perigo, Pleasant View, Prize, Rhoderick Dhu, Star of the Mountains, Susquehanna, Toronto, Wyandotte Consolidated, Cyclop, Friebergh, James Henry, Mary Graham, Ayres, Gunuell, Valley View, Albro & Knight, American Flag, Bates, Arctic, Champion, Decanter, Dripps, Jones & Co., Fanny Lyseer, Narragansett, Linden Castle, Little Gettysburg, Register Call, Roberts Bros., Wheeler Tunnel, Wyomad, Bass, Burroughs, A. G. Derby, Gilpin County, Kansas, Lewis, Midas, Roberts Bros., Saratoga, Saint Louis, Stevens & Devor. The total production of the county during 1881 was $2,110,000, of which $1,850,000 was gold and $260,000 silver.

The *Rocky Mountain Mining Review* publishes the following estimate of the production of bullion in Gilpin county for the past nine years:

1872	$1,389,289
1873	1,530,009
1874	1,631,863
1875	1,763,985
1876	2,240,000
1877	2,203,037
1878	2,257,000
1879	2,431,291
1880	2,680,090
1881 (estimated)	2,700,000

"From 1859 to 1878 gold only was found, but since the latter date many discoveries of rich silver lodes have been made, which are now being opened up and gotten into shape to output large quantities of silver in the near future. With the aid of these silver mines and the increasing richness of the gold lodes, Gilpin county's output must constantly increase for many years to come.

"The ore is found in true fissure veins, which increase in richness as depth is attained, and make deep mining profitable in this section. Extensive enterprises are being undertaken, and money for development work is to be had in any quantity desired. New claims are being located constantly. Six hundred and thirty-one lodes were put on record in 1880, and from January 1 to November 1 of the present year 421 different lodes have been recorded."

Grand County.—Placer mines have been worked in Grand county to a limited extent for a number of years. The first ones opened were on Willow Creek in the northern part of Middle Park. The ground is quite rich, but the gold is very fine and hard to save, and the alluvial deposits are deep, so that larger capital and greater skill are required to work them successfully than have ever yet been employed. The next placers opened were in the western edge of North Park, where there is a large extent of very rich ground. Some of it is shallow to bed-rock and has been worked profitably in a small way, but much the largest portion is composed of deep gravel beds that require extensive and costly work. There are also some small rich placers along Muddy river, in the northwestern edge of Middle Park. Within the last few years an extensive belt of gold and silver bearing veins was discovered in what is known as the *Rabbitt Ear district*, which is located in the Rabbitt Ear range, Middle Park, and, with the exception of one crude wagon-road across Berthoud Pass, almost completely isolated from the chief towns of the State. Mining has been carried on there some years by a small band of men who cling to their faith in its future with desperate tenacity. There are no markets nearer than Georgetown, and to reach them a high range, almost impassable six or eight months in the year, must be crossed. The most noted and probably the finest mine in the district is the Wolverine, which has been under active development for about two years. Large bodies of mineral are reported in the various levels, left standing to await the erection of reduction works on the ground, and thus save the heavy expense of transportation to distant markets. Perhaps a dozen other mines have been fairly opened, and their character demonstrated. Owing to the absence of mills or smelters, the owners can only hold on until the march of events brings the needed relief. One or two lines of railway are being constructed from Denver westward across the mountains, and will ultimately bring about the desired connection with the Rabbitt Ear district. Large veins of albertite or cannel coal, equal to that of Nova Scotia, and some bituminous veins, are found near the mines above referred to. None of these have been opened beyond mere surface prospecting.

Gunnison County.—This county in its original boundaries was large enough for a State. It was given organization and a name by legislative authority in 1877, at which time it became the scene of considerable excitement through the discovery of valuable mines of gold and silver. People rushed in by thousands from all parts of the State and of the United States during this and the ensuing two years. A large number of districts were settled upon the mineral belts as fast as discovered, most of which have been maintained to the present time. Very little development of the mines occurred, however, until 1881, from the lack of skill and their distance from supply points and ore markets. In the autumn of that year, the Denver and Rio Grande Railway was completed to Gunnison, and later to Crested Buttes, a few miles from Ruby camp, the present limit of settlement in that direction. Immediately beyond Ruby lies the vast region recently occupied by the Ute Indians, which remains to be carefully explored for mineral treasures. The most productive camp in the county is known as Tin Cup. Its practical development began in the summer of 1880, after a long and very severe winter, in which the whole county was literally buried in snow. The season was quite short, as the snows of 1880–'81 began the following October—only sufficient to prove that valuable mines existed. During 1881, however, practical results were achieved in the form of highly creditable yields of bullion. Two smelters have been erected, one by the Virginia City Mining and Smelting Company, and the other by the Willow Creek Reduction Company. The two have a capacity of about 50 tons per day. Both will be enlarged this year to meet the increased supply of ore from the mines. About 3,000 mineral locations have been made in this district since January, 1879, though only a small portion of these have been developed.

The following smelting works, mills, and mines of Gunnison county have returned reports of production, viz.: Virginia City, Avery, Bonanza, Drew, Green Mount, Iron Cap, Jimmy Mack, May Flower, Roaring Niagara, Standard, Terrible, Venango, Iron Bonnet, Ruby, Chiquita, Forest Queen, Lead Chief. The production of the county during 1881 was $10.000 in gold and $400,000 in silver.

Hinsdale County.—Hinsdale county comprises a portion of the San Juan country, rich in argentiferous minerals. Lake City is the county seat, and is situated in the valley of the Lake Fork of the Gunnison river. Although the mines are of exceeding richness, yet the distance from a market and the want of local facilities for the reduction of the ores have hitherto retarded their general development. The chief metallurgical works are those of the Crooke Mining and Smelting Company, situated three-fourths of a mile south of Lake City. The machinery is propelled by water-power derived from Granite Falls, in the channel of the Lake Fork; the production for 1881 was 600 tons lead and 75,000 ounces of silver. The Polar Star, Ute, and Ule mines have, up to the present time, almost entirely supplied Crooke's works to their full capacity, which have been periodically enlarged to meet the extension of operations on the mines. The Ule mine now has the deepest shaft in the county, and it has passed below the normal water-level of the country, with a great increase in the value of the ore. It is situated four miles west of Lake City. These mines supply ore to the present capacity of the works, therefore there is no local market for the products of other mines tributary to Lake City. The following mills and mines of Hinsdale county have returned reports of production, viz.: Crooke & Co., Highland Mary, Ocean Wave, Ohio Consolidated. The production of the county during 1881 is estimated at $10,000 in gold and $160,000 in silver.

Huerfano County.—Huerfano county is one of the southern counties of the State, and was settled at an early day in the history of Colorado. Prospecting has been carried on in the mountains on the western borders of the county for several years, chiefly in the vicinity of the Spanish Peaks, Huerfano Park, and Ojo. On West Spanish Peak there is a group of lodes, comprising the Whale, Iowa, Nonpareil, Goss, Jeffries, Western Queen, Treasure, Monitor, Highland Lass, and Lincoln, which are controlled by the Whale Consolidated Gold and Silver Mining Company. These lodes are true fissures, containing carbonate and galena ores which assay from 100 to 200 ounces of silver to the ton, and carry a fair percentage of lead. The company is engaged in driving a tunnel to cut the veins. The work done is of good character, and the prospects for these becoming paying mines are very fair.

Lake County.—The mines of Leadville constitute Lake county, the leading bullion producer in the State. Some of the principal mines have been practically idle during a large part of the year, and in others the yield, from a variety of causes, has been materially lessened, but the total production has been maintained to an amount equaling that of the preceding year. Many mines which heretofore have been in process of development have become regular shippers of ore; new strikes have been made in properties which had been but moderately productive, and the reduced cost of treatment of the ores has permitted large amounts of low-grade mineral to be extracted and worked which formerly were allowed to remain in the mine or go to the waste dump. To give a full description of the many extensive and valuable mines of the county would be not only difficult, but in many cases impossible. In some instances the managements keep the workings and condition of their mines to themselves, or to a select few; but from the powerful influence exerted, not only upon the interests of the State but of the county at large, by the annual production of such amounts of silver bullion as have been yielded by Lake county, it would seem that the producing mines deserve more than a passing notice. The first discovery of carbonate ore was made in the spring of 1878, on Fryer Hill, which, with Yankee, Carbonate, Iron, and Breece Hills, contains the most noted mines of this section. Probably the most progressive mine on Fryer Hill is the Robert E. Lee, which dates back to March of 1879. Since that time the developments and yield have been continuous. The ore is of exceedingly high grade. At one time a mill test was made of the ore that was extracted by thirty men in a run of seventeen hours, which gave $118,500 as the result. During the last year much trouble was experienced from a large and excessive flow of water, and new and powerful pumping apparatus was erected, during which time operations were confined principally to the upper levels of the mine. Since the completion of the pump the workings from the shaft have been systematically opened in new and hitherto unexplored ground. Strikes of rich ore, varying from three to twelve feet, have been exposed in four drifts, and the sampling works are kept fully supplied with ore; the machinery at the mine consists of a large pumping engine of 105 horse-power, a 45-horse-power hoisting-engine at the new shaft, a 45-horse-power engine at the main shaft, and a 25-horse-power engine at the sampler, all run by steam generated in two large boilers at the new shaft.

The following smelting and reduction works and mines of Lake county have returned reports of production, viz.: American Company's, Billings & Eilers, Cummings & Finn, Eddy & James, Elgin Company's, Fohr & Bunson Bros., Harrison, R. W., Ohio and Missouri, Tabor, Taylor & Brunton, Grant Company, Harrison Smelting Works, La Plata, Shield's Mill and Mine, Dry Placer Amalgamating Company, Annie Consolidated, A. Y., Catalpa, Climax, Crescent, Dunkin, Highland Chief, Iowa Gulch, Iron Silver, Little Pittsburgh, Long and Derry, Matchless, Robert E. Lee, Small Hopes, Wolf Tone and Agassiz, Chrysolite, Consolidated Pigar, Denver City, Silver Cord, Carbonate Hill, Colorado Prince, Evening Star, Hennett, Hibernia Consolidated, Leadville Consolidated, Little Emma, Silver Wave, Artora, Big Pittsburgh, Dyer, Henrietta, Little Chief, Miner Boy, Morning Star Consolidated.

The following from the *Mining Index* shows the bullion product of the Leadville smelters and mills for the third quarter ended September 30, 1881:

"Below will be found the third quarterly bullion report of the Leadville district. The figures are very gratifying, showing an export of over three million of dollars, and an immense gain in the amount of ore on hand at the smelters. In calculating the commercial value of the product, silver is figured at $1.12 an ounce, and lead at five cents per pound.

"*J. B. Grant & Co.*—The smelting works of J. B. Grant

& Co., during the past quarter, shipped 2,440 tons of bullion, containing 188 ounces of silver to the ton. The entire shipment also contained gold to the value of about $2,000. Ounces of silver contained in shipment, 458,720; ounces of gold, 100; pounds of lead, 2,849,000. Value of silver, $513,766; value of gold, $2,000; value of lead, $242,450. The total valuation of product, $758,216. The works have about 7,500 tons of ore on hand.

"Grant & Co., at the present time, have only five furnaces in blast, but they are all of the largest patterns, and during the past month reduced 4,300 tons of ore. The grade of the ore is evidently improving somewhat, as the average of the bullion during the last month was about 240 ounces, but owing to the low grade in the previous two months the entire product is reduced considerably.

"*The La Plata.*—The La Plata has been running very steadily during July, August, and September, producing and shipping 3,561,500 pounds of bullion, containing 3,542,000 pounds of lead, and 280,050 ounces of silver. Value of silver, $313,656; value of lead, $177,100. Total, $490,756. The establishment has about 3,300 tons of ore on hand.

"*Billings & Eilers.*—Billings & Eilers, during the third quarter of the present year, produced 3,906,000 pounds of bullion, averaging 180 ounces in silver to the ton. Total ounces of silver in shipment, 355,180; pounds of lead, 3,882,000. Value of silver, $397,801; value of lead, $194.100. Total value of product, $591,901. Ore on hand, 5,000 tons.

"*The American.*—The American Smelting Works, during the last quarter, shipped 888 tons of bullion, containing an average of 153 ounces of silver and two and a half ounces of gold to the ton. The shipment contained a total of 135,864 ounces of silver, 2,220 ounces of gold, and 1,765,000 pounds of lead. Their value was as follows: Silver, $152,167; gold, $44,400, and lead, $88,250. Total, $284,817. Ore on hand, about 5,000 tons.

"At the American Smelting Works there are four furnaces in blast, and a fifth will be added within a fortnight. The establishment has met with good success in treating the Leadville ores, and in the near future will rank among the first in the camp.

"*Cummings & Finn.*—Cummings & Finn shipped during the last three months, 38,798 bars of bullion, weighing 3,903,153 pounds. The shipments contained 371,480 ounces of silver and 3,878,000 pounds of lead. Value of silver, $416,057; value of lead, $193,900. Total value of product and shipment, $609,957. Ore on hand, 5,250 tons.

"*The Harrison.*—The Harrison Reduction Works shipped 343,116 pounds of bullion, containing on an average eighty-six ounces in silver and six-tenths of an ounce in gold to the ton. Total ounces of silver contained in shipment, 14,749; ounces of gold, 103; pounds of lead, 342,106. Value of shipment, silver, $16,518; gold, $2,060; lead, $17,105. Total, $35,673. Ore on hand, 3,500 tons.

"The Harrison Reduction Works, during the preceding ninety days, have been engaged in enlarging and improving the establishment, and the product given above is the yield of only one furnace, which has been in blast since September 6. In a few days, however, another large furnace will be blown in, and erelong two more furnaces will be added. During the summer months this establishment has added two fifty or sixty ton furnaces, and rebuilt its old ones, giving it four splendid furnaces. A 60-horse-power engine has replaced the old engine in the smelter, and a large new stack and dust-chambers were also built. Back of the smelter, one of the most complete sampling mills to be found in the State has been erected, supplied with crushers, rolls, sampling mills, and other modern appliances for reducing and sampling ores.

"*Eddy, James & Co.*—Eddy, James & Co., during the same period, shipped 3,321 tons of ore, having an assay value of $194,041.

"*Aug. R. Meyer & Co.*—Aug. R. Meyer & Co. shipped 594¾ tons of ore, worth $41,234. The ore was all sent to the Kansas City Smelting and Refining Works.

"*The Miner Boy.*—The Miner Boy quartz mill has kept no record of the value of the bullion produced, shipping its silver and gold bricks direct to the company's headquarters in New York. The mill having treated, on an average, about nine tons a day, it would, in the past three months, have passed 810 tons of ore under the stamps. Out of this amount about $15,000 worth of silver and gold were secured. Of this 500 ounces were gold and the balance silver.

"*Taylor & Brunton.*—The stamp mill of Taylor and Brunton shipped seventy bars of silver, of an average weight of 1,136 ounces, aggregating 78,820 ounces, worth $89,062. The mill has about 2,000 tons of ore on hand.

"*Tabor Mill*—The Tabor Milling Company shipped twenty-seven bars, containing 32,212 ounces of silver, worth $36,078. The works were idle a large part of July, consequently the decreased showing.

"*The Shield's Mill.*—This mill, situated in Colorado Gulch, with the exception of the last few weeks, ran very regularly, and reports a total product for the past quarter of 14,438 ounces of silver, worth $16,500.

"The mill suspended work owing to one of the roasting cylinders becoming disabled. An additional cylinder has been ordered and is expected daily. The worn-out parts of the idle cylinder have been replaced, and in a short time the mill is expected to resume work with an increased capacity. The ore product of the district has also had an influence on the suspension of the mill, but it is estimated that hereafter abundant ore will be supplied. The manager has also experienced difficulty in securing teams to haul ore, and in making favorable road contracts, all of which has now been obviated.

"*Gulch Mines.*—The placer mines of the district are estimated to have yielded about 350 ounces of gold, valued at $7,000."

SUMMARY.

J. B. Grant & Co.		$758.216
Cummings & Finn's Smelter		609,957
Billings & Eilers's Smelter		591,901
La Plata Mining and Smelting Company		490,756
American Mining and Smelting Company		284,817
Harrison Reduction Works		35,683
Taylor & Brunton (Leadville Gold and Silver Mill Company).		89,062
Tabor Milling Company		36,078
Shield's Milling Company		16,500
Miner Boy quartz mill		15.000
Eddy, James & Co., ore buyers		194.041
Aug. R. Meyer Sampling Company		41,234
Placer mining		7,000
Total		$3,170,245
Pounds of bullion	18,369,767	
Pounds of lead	18,258,106	
Tons of ore	3,915¾	
Ounces of silver	1,746.013	
Ounces of gold	3,273	
Value of silver		1,956,600
Value of gold		65.460
Value of lead		912,900
Value of ore		235,270
Total		$3,170,245
Total first quarter		3,099,587
Total second quarter		3,419,670
Total		$9,689,502

The Leadville *Herald* publishes the following table showing the bullion product of the smelters of Leadville for the year 1881:

	First Quarter.	*Second Quarter.*	*Third Quarter.*	*Fourth Quarter.*	*Total for Year.*
The Grant Smelt. Co.	$759,502	$786,105	$758,216	$773,191	$3,077,014
La Plata Mining and Smelting Co.	484,920	604,383	490,756	380,472	1,960,531
American Mining and Smelting Co.	128.721	204,248	284,817	348 889	966,675
Utah sm'r, G. Billings	672,175	545,626	591,901	694,258	2,473,960
Harrison Reduc. Wks.	24,232	....	35,683	277,829	337,744
Eddy, James & Co	250,522	231,511	194,041	202,174	878,248
Aug. R. Meyer & Co.	46,500	49,114	41,234	948	137,796
Cummings & Finn	364,247	366,669	609,957	623,188	1,964,061
Taylor & Brunton	79,991	107,155	89,062	125,460	401,668
Tabor Milling Co.	39,000	47,250	36,078	30,109	152,437
Shield's mill	....	14,000	16,500	12,000	42,500
Colorado Prince mill.	30,000	11.000	15,000	10,000	66.000
California smelter	218,000	260,240	....	....	478,250
Oro stamp mill	....	4,000	....	....	4,000
Ohio and Missouri	....	160,692	....	....	160,692
Gulch mines	....	12,000	7,000	50,000	69.000
Total	$3,097,820	$3,403,993	$3.170,245	$3,498.518	$13,170,576

From this statement, the production for the first half of the year appears to have been $6,501,813. The Leadville *Circular* gives the product for the same period as follows:

SMELTER PRODUCT.

Months.	*Tons.*	*Value.*
January	3,868	$864,887
February	2,429	851,983
March	3,098	1,036,445
April	2,507	749,626
May	3,784	1,120,068
June	3,507	1,180,179
Total	18,193	$5,794,179

MILL PRODUCT.

Taylor & Brunton	$187,146
Tabor	77,250
Oro	4,000
Colorado Stamp	41,000
Shields	14,000
Total	$323,396

ORE SHIPMENTS.

Eddy, James & Co	$482,033
A. R. Meyer & Co	95,611
Total	$577,644

TOTAL PRODUCT OF LEADVILLE, JANUARY TO JUNE, 1881.

Smelter product	$5,794,179
Mill product	323,395
Ore shipments	577,644
Placer workings	12,000
Total product	$6,707,218

The statement of the year's product, made up by the Leadville *Democrat*, shows a less production of some of the smelters and also in the total amount. It gives the number of mines supplying each smelter, and the number of ounces of gold and silver, with the pounds of lead, respectively, as follows:

Names.	*Number of Mines.*	*Ounces of Silver.*	*Ounces of Gold.*	*Pounds of Lead.*	*Coin Value.*
La Plata Mining and Smelt. Co.	12	1,135,598	695	15,178,000	$2,050,337
Utah smelter	12	1,508,475	....	17,381,000	2,560,469
Cummings & Finn	11	1,171,144	....	11,623,000	1,898,697
Grant Smelting Company	12	1,927,350	1,090	18,005,977	3,088,566
American Smelting Company.	11	508,507	5,955	6,014,760	691,898
California smelter	6	271 861	....	3,447,900	478,238
Harrison Reduction Works	4	207,000	1,035	2,758,580	577,804
Eddy, James & Co	12	....	....	....	964,064
A. R. Meyer Mining and Smelting Company	12	....	2,450	....	191,228
Tabor Stamp Mill	12	135,500	....	....	152,437
Leadville Gold and Silver Mining Company	12	285,674	....	....	370,383
Colorado Prince	6	....	....	....	41,000
Oro stamp mill	3	....	....	....	4,000
Shields' stamp mill	6	28,125	....	....	31,640
Total	131	7,174,234	11,135	74,409,217	$13,100,761

By adding to the *Democrat's* statement, the amount of gold production for the gulches, reported by the *Herald* at $69,000, the product of the year would be brought up to $13,169,761, or within $805 of the *Herald's* exhibit. The discrepancies, in what purport to be statements of the exact production of four of these smelters, render it uncertain which is correct. Deducting from the *Democrat's* statement of the total value the value of the lead, and adding the value of the gold obtained from the gulch mines, the production of Leadville was, gold, $300,000; silver, at its coining rate, $10,300,000.

The following extract from the *Mining Index* is a revision of that paper's estimate of the bullion output of Leadville, and may be taken as very nearly correct. This estimate, as those of other papers given, includes the value of lead:

"In order to ascertain more correctly the actual value of the bullion output of Leadville, the representatives of the *Mining Index* have been busy in gathering further figures whenever opportunity presented itself. During the past week, figures have been obtained showing an aggregate of $240,355 paid by Leadville smelters for ore, credited to Lake county, which properly belongs to other counties, as follows:

	Grant Smelting Company.	*La Plata Smelting Company.*	*Total.*
Summit County	$2,000	$152,543	$154,543
Park County	6,000	8,319	14,319
Chaffee County	2,000	24,869	26,869
Pitkin County	14,000	13,621	27,624
Clear Creek County	15,000	....	15,000
Other sources	2,000	....	2,000
Total	$41,000	$199,355	$240,355

"To this amount should be added about $15,000 paid by Cummings & Finn for Robinson ore early in the year, and probably $125,000 for the value of the Aftermath ore treated. While this mine unquestionably shipped a great deal more ore, it is still lying on the premises of the smelter, and its value was not taken into account in figuring the shipments of Lake county. The result shows that Summit county contributed $294,543 to Lake county's product. Park, Chaffee, Pitkin, and Clear Creek counties, as near as can be learned, actually shipped $83,812. To which, in order to be liberal, add $30,000 from all other sources, and we have a total of $408,355. Deducting this sum from the bullion and ore shipments from Leadville, and we have a net product for Lake county for 1881 of $12,738,902."

La Plata County.—This county embraces the extreme southwestern corner of the State, adjoining the Territory of New Mexico, and was organized in 1874. Durango, the principal town and county seat, was laid out by the Denver and Rio Grande Railway Company, and within two years has become a populous and prosperous center. It is destined to be the main supply point and ore purchasing market for all the neighboring mines of La Plata and San Juan counties. The bullion product of the county has as yet been limited from the fact that until lately no railroad facilities existed and transportation was costly. The means for reduction of the ores also have been totally insufficient, the San Juan and New York Mining Company's smelter at Durango being the only one in the county.

Several placer mines are situated on the La Plata river, below Parrott City, where a long flume has been erected and attempts made to put the mines in paying condition, but thus far without material success. In the Animas Valley, in connection with extensive coal measures, large deposits of brown hematite and magnetic oxide of iron are found. The coal is readily coked, and will doubtless prove of great value when smelters for the reduction of the ores of the county shall have been erected. The production of La Plata county in 1881 was $5,000 gold and $10,000 silver.

Ouray County.—Ouray county, in the southwestern part of the State, includes a portion of the San Juan country, which comprises the adjoining counties of Dolores, San Juan, Hinsdale, and La Plata. It is the center of an extensive mining section, but has made little progress because of its remoteness from competing markets, want of local facilities for reduction of ores, and extravagantly high rates for freight. No ores yielding less than $150 to $200 per ton will pay for shipping, and as but few mines carry higher grades than these, the total amount shipped has been comparatively small. The mines of Ouray yield both gold and silver; and two systems of lodes appear to exist, one carrying gold alone, or gold and silver, and the other is argentiferous only. The gold veins are usually of large size and intersect the others. The chief silver ores are gray copper, bismuth, antimony, ruby, brittle and native silver.

Ouray county, besides its lodes of gold and silver bearing ore, has considerable placer ground. In the valley of the San Miguel, the Keystone Company was engaged most of last season in erecting flumes and other preparations for washing on an extensive scale. They ran just a month before closing down and cleaned up $3,500 in gold, worth about $16 per ounce. On bar No. 1, the Saint Louis Company ran two or three weeks and cleaned up about $1,500 gold. A few other parties, working in a small way with toms, rockers, and sluices, obtained lesser amounts. At the head of the San Miguel a deposit of very rich float-rock was discovered, which was crushed in mortars and washed by hand, yielding, it is said, about $10,000. The tract of country carrying this float-rock is doubtless quite limited. A small extent of placers occurs on the Uncompahgre, near the mouth of the Dallas creek. Some very fine bituminous coal has been found on the San Miguel, in veins about three feet thick, but none of the deposits have been well opened. On the Uncompahgre, just north of the line of the county, in Gunnison, there are very large deposits of good bituminous coal. The Denver and Rio Grande Company have located a line from their main Utah road, which strikes the Uncompahgre at Cedar creek, twenty-five miles from the town of Ouray, and it is expected they will build and put it in operation next season. When this is done, a large number of rich mines, which are now unprofitable to their owners, will be rapidly developed and placed upon the list of paying mines. The following smelting and reduction works and mines of Ouray county have returned reports of production, viz.: Long & Stout, Mount Sueffles, Munn Bros., Cimaron, Nevada, Parsons, Lower San Miguel, Upper San Miguel, and Carpenter & Ohlwiler. The production of the county during 1881 was $70,000 in gold and $135,000 in silver, a total of $205,000.

Park County.—Park county is one of the oldest mining sections of the State. Early locations were made in the rich placers in the vicinity of Tarryall, Fairplay, Buckskin, and Mosquito which yielded largely, and are still paying fairly. Numbers of lodes were also discovered, the most noted being the Phillips, Excelsior, and Orphan Boy. They were all free gold bearing on the surface, but as greater depth was reached the ores became pyritous and refractory for the then known modes of treatment, and mining was conducted only in a desultory way until discoveries were made of silver-bearing ores, when a fresh impetus was given to the mining industry in the county. The first silver mines discovered were the Moose and Dolly Varden on Mount Bross. The Moose has been very extensively worked from the north face of the mountain and furnished extraordinary large chambers of ore, one single stope having yielded about $150,000. The formation is lime and porphyry, and the mineral lies in deposits and not in defined veins. Probably not less than five miles of levels, winzes, and stopes have been run on this mine, and the product has been considerably over $3,000,000. The company owning the property erected a smelter at Dudley, which, after running awhile and undergoing frequent changes, closed down, owing to mismanagement. During the last year the work done has been principally with a view to further exploitation of the mine, and the production, while small, has been steady.

At Como, in South Park, there are quite extensive deposits of excellent bituminous coal, which gives the best coke thus far made in Colorado. These mines are owned and operated by the Denver and South Park Railway Company. From this point the Breckinridge division of the main line is constructed. At Alma there are sampling works and two smelters, but the latter are not in operation. The following smelting works, mills, and mines of Park county have returned reports of production, viz.: Upper Platte, Dry Placer Amalgamating Company, Hall & Brunk, Hock Hocking, Kansas Consolidated, Lelon Peabody, Lizzie Abington, New York, Three Brothers, Whale, Kansas, Park County, Excelsior, Kansas City, London, Moose, Russia, Sacramento, Wilson, and Lime.

The production of bullion in this county in 1881 amounted to $50,000 in gold and $350,000 in silver, making a total of $400,000.

Pitkin County.—Pitkin county, organized in 1880, was taken from the eastern portion of Gunnison county. The principal mining districts are Independence or Chipeta, Ashcroft, and Aspen. In *Independence district* a belt of gold-bearing veins was discovered in 1879. The ores are similar to those produced in Gilpin county, and are readily reduced by the ordinary milling process. The Farwell Mining Company own all the best mines, among which are the Independence Nos. 1, 2, 3, and 4, Last Dollar, Last Dime, Legal Tender, Bennington, Choler, Sheba, Friday, Mammoth, Dolly Varden, Gatton, Minnie, Mount Hope, and Golden Champion. The company purchased a 15-stamp mill, which has been running since January, 1881, and, later, have built a 30-stamp mill, which was required to treat the amount of ores extracted in the process of developing their mines.

The following mills and mines of Pitkin county have returned reports of production, viz.: Farewell Consolidated, Camp Bird, Pourtellotte group. The production during 1881 was $100,000 in gold and $30,000 in silver.

Rio Grande County.—Rio Grande county lies in the western part of San Luis Park, and derives its name from the Rio Grande river, which crosses from west to east. There is but one mining district in the connty, Summit district, which includes North and South Mountains and Lookout Peak. This district has been organized for some years, but it was only during 1881 that deposits of ores of extraordinary richness were discovered. The formation is porphyry and granite, and much of the ore is free gold-bearing and readily reduced by the ordinary stamp process. In the midst of a group of the principal mines of the district is the Little Ida, the property of the San Juan Consolidated Mining Company. At the depth of about 100 feet the vein is reported to be seventeen feet wide, ten feet of which is a decomposed quartz, yielding from $1,500 to $2,500 per ton. In about four months after encountering this rich deposit $250,000 was taken out. Arrangements are being made to develop the mine at greater depth by tunnels, and also to put it in better shape for continuous working.

The yield of the principal mines during the portion of the year that they were in operation was $289,000. It is probable that during the coming season a vast amount of prospecting will be done, and that the development of locations already made will show that this county will be an important producer of gold in the future. At Summitville, the chief town of the district, are located the mills of the different companies, as follows:

	Stamps.
The San Juan Consolidated	30
Little Annie	10
Morey & Sperry	10
Golden Queen	10
Iowa and Colorado Consolidated	10
Missionary	10
Aztec	5

The Cropsey mill is situated in Cropsey Gulch, and has twenty-four stamps, making a total of 109 stamps. The Denver *Republican*, in its annual review, says of Rio Grande county:

The bullion product for the camp during 1881 is as follows:

Gold bullion shipped	$320,000
Ore shipped	7,000
Ores on dumps, estimated	50,000
Total	$377,000

It also states that the Iowa and Colorado Consolidated Company have ordered and contracted for a 50-stamp mill. The following mills and mines of Rio Grande county have returned reports of production, viz.: Missionary, Aztec, Summit, and Little Annie. The production of the county during 1881 was $290,000 in gold and $10,000 in silver.

Routt County.—Routt, the extreme northwestern county of the State, makes but a small addition to the production of precious metals in Colorado. For many years it has been the favorite hunting ground of the Ute Indians, who have jealously and successfully guarded it against the encroachments of prospectors—the advance guard of a mining population. During the fall of 1881 silver-bearing ore was found in the Gore range, and also in the mountains about Steamboat Springs, but no reliable reports have been received of quantity or quality. Placer mining has been conducted for some years, with varying results, in the vicinity of Hahn's Peak, in the northeastern part of the county. Most of the placers have been worked by two companies, the International and the Hahn's Peak Mining Company, the latter, under the superintendency of Messrs. McIntosh and Cody, having been quite successful during the year. It is probable that an increased force of men will be employed in placer mining during 1882, and that, as the Indians have been removed, systematic prospecting for gold- and silver-bearing lodes will be conducted in the many mountain ranges traversing the county. The only report of production received from Routt county was from the Hahn's Peak mine. The total production of the county I estimate at $20,000 in gold.

Saguache County.—Saguache county, as a mining section, is not more than two years old; the first location of a mineral-bearing lode being made on Kerber creek in May, 1880. It was called the Exchequer, and is considered to be one of the best mines in Kerber creek district, although for some months but little work has been done upon it, except for development. It is opened by two shafts of inconsiderable depth, and two tunnels, fifty and eighty feet long, respectively; the ore is a decomposed quartz, carrying both gold and silver, and yielding an average of $120 per ton. The Empress Josephine is perhaps the best developed of all the mines of the county. About 150 feet of levels have been run from the shaft, now 180 feet deep, and from five to six tons of ore per day have been taken out, although no stoping has been done. The ore has been shipped, and yielded an average of $100 per ton.

The production of the county in 1881 I estimate to have been $40,000 in silver.

San Juan County.—San Juan is a small county, formerly a portion of La Plata, and is located in the central part of the mineral belt of the San Juan Mountains. Mineral wealth was known to exist here for a number of years, and considerable mining has been done, but the great drawback to the prosperity of the county is its inaccessibility, and the consequent great cost of shipping ores or mining and milling machinery. The ores appear to exist in inexhaustible quantity, and much of it is of too low grade to ship at present, but will pay largely when the country is opened by railways and local facilities for reduction are afforded. The county seat and the center of the mining industry is Silverton, located in Baker Park and surrounded by mountain peaks—Sulton Tower, Boulder, Hazleton, Anvil, and Kendall Mountains, which are traversed by fissure veins carrying chiefly silver-bearing ores. The most productive mine is the North Star, in North Star Gulch, on Sultan Mountain, about two miles from Silverton. It has been extensively worked, and has about 2,500 feet of developments. Some 3,000 tons of ore have been extracted, a portion of which has been sent to Durango for reduction. The ore is gray copper and galena, carrying 40 per cent. of lead, and yields seventy ounces of silver to the ton.

The following mills and mines of San Juan county have returned reports of production, viz.: Cement creek, E. T. Sweet, Aspen, Belcher, Gray Eagle, North Star, Cuba, McKinnie, Pride of San Juan, Tabor. The total production of the county I estimate at $5,000 in gold and $25,000 in silver.

Summit County.—Summit county embraces a large area of mountainous country, with many mining camps scattered over it, some of which date back to the early days of mining in Colorado. McNulty, Georgia, French, Galena, and Humbug Gulches, Gold Run, and various tributaries of the Blue river, all contributed a large amount of placer gold, and were worked for years to their utmost capacity. They are not by any means exhausted, and during 1881 were worked to a considerable extent. Within the last two years lode mining commenced on an extensive scale, and during the last year assumed such proportions as to place Summit county high on the list as a bullion-producing county of the State.

The following table from the Denver *Republican* shows the output of the leading producing mines of Ten Mile district:

Name.	*Mountain.*	*No. of Tons produced in 1881.*	*Present daily Output.*	*Capable daily Output.*
Robinson Consolidated	Sheep.	....	115	
Gray Eagle	do.	....	.....	25
Wheel of Fortune	do.	2,500	.....	30
Crown Point	do.	....	.....	15
Tiger	do.	....	.....	60
Snow Bank	do.	....	.....	20
Kersarge	do.	....	.....	5
Aftermath	Elk.	....	25	100
White Quail	do.	9,000	10	100
Milo	do.	3,520	15	100
Badger	do.	4,800	35	70
Silver Wave	do.	....	.....	40
Eagle and Raven	do.	550	.....	150
Colonel Sellers' Consolidated	do.	....	.....	60
Queen of the West	Jack.	180	.....	4
May Flower	do.	150	.....	10
Ida L.	do.	....	.....	15
Gilpin	Fletcher.	....	.....	10
Matchless	do.	225	.....	2

The following is an approximate statement of the weekly output of the leading producing mines of Ten Mile, Colorado:

	Tons.
Aftermath	480
Badger	210
Eagle and Raven	60
Fletcher Mountain	20
Gray Eagle	30
Ida L.	90
Little Chicago	15
Milo	240
Robinson	800
Silver Wave	90
White Quail	150
Wheel of Fortune	180
Total	2,365

Chihuahua is one of the early camps, and contains a large number of valuable mines, which were worked to a greater or less extent during the year. Some ore was shipped, and a considerable amount extracted in process of development remains on the dumps awaiting shipment.

Name of Mine.	*Number of Months worked in 1881.*	*Amount of Development.*	*Character of Ore.*	*Average Value of Ore.*	*Number of Tons shipped to home smelters.*	*Number of Tons shipped out of County.*	*Number of Tons on dump.*	*Capable daily output, Tons.*
Delaware	5	300	Galena and copper	$100 00	25	......	75	10
Orphan Boy	3	325	Lead	92 00	20	25	30	10
Blue Lode	3	100	Brittle silver	694 00	4	10	2	1½
Peruvian	4	700	Gray copper	45 00	100	......	75	10
Bullion	3	100	Galena and gray copper	290 00	......	2	10	1
Eliza Jane	2	75	Gray copper	500 00	2	2	1	½
Chicago Lode	4	200	Lead	65 00	......	10	10	1
Little Chief	1	50	Do	35 00	4	2	1	½
Silver Ledge	9	500	Antimony, silver and galena	96 00	......	5	40	50
Jennie B.	5	200	Gray copper	204 00	......	3	5	½
Telephone	3	75	Galena and yellow copper	187 00	......	2	3	¼
Atlantic and Pacific Tunnel	12	500	Lead	94 00	......	5	100	20
New Discovery	3	100	Gray copper	210 00	1	9	2	1
Frenchman	2	100	Lead	56 00	......	2	18	5

The following is a list of the stamp-mills in Summit county, with their capacity:

Name.	*Location.*	*No. of Stamps.*	*Remarks.*
Brooks & Snyder	Breckenridge	20	
Lawrence	Breckenridge	10	
Gold Park	Gold Park	40	Owned by the Gold Park Mining Co.
Little Chief	Red Cliff	30	Anglo-American mine.
Lincoln	Lincoln	10	

The smelters of the county, with their capacity and amount of production, are as follows:

Name of Works.	*Location.*	*Tons Capacity.*	*No. of Days in Operation.*	*Tons of Bullion.*	*Remarks.*
White Quail Smelter	Kokomo	30	140	950	Present owner took charge April 15. Value of bullion, $475,000.
Greer Smelting Works	Kokomo	40	76	240	Silver in bullion, 125 ounces.
Carbonateville Smelter	Carbonateville.	30	......	......	Never used.
Summit Smelter *	Robinson	80	180	......	Treated Robinson ore, using low-grade bullion for flux.
Wilson Smelter *	Breckenridge	...	......	......	Produces matt.
Boston and Colorado *	Breckenridge	...	......	......	No figures obtained.
Elyria *	Breckenridge	...	......	......	Do.
Battle Mountain *	Red Cliff	...	......	......	Do.
Sissapo *	Montezuma	...	......	......	Do.
Lincoln *	Lincoln	...	......	......	Do.

* Two stacks.

The Kokomo *Times* estimates that the ore output for Summit county for 1881 will run from $3,500,000 to $4,000,000. Of this immense production Ten Mile will furnish about $2,000,000, while the Battle Mountain district will probably be the next heaviest producer. Decatur and Montezuma have done reasonably well, and Breckenridge, coming in as she did in the summer and fall, will doubtless add materially to it.

The Breckenridge *Leader* publishes the following statement of the yield of the mines of Summit county for the years 1860 to 1881:

Gold from placers, 1860 to 1870		$5,500,000
Gold from placers, 1870	$100,000	
Gold from placers, 1871	70,000	
Gold from placers, 1872	60,000	
Gold from placers, 1873	101,000	
Silver and lead, 1869 to 1874	200,000	
		531,000
Gold from placers, 1874	76,408	
Silver and lead	50,000	
		126,408
Gold from placers, 1875	72,413	
Silver	50,000	
		122,413

Gold from placers, 1876	150,000	
Silver and lead	200,000	
		$350,000
Gold from placers, 1877	150,000	
Silver and lead	40,000	
		190,000
Gold from placers, 1876	165,774	
Silver and lead	155,000	
		320,774
Gold from placers, 1879	100,000	
Silver and lead	375,000	
		475,000
Gold from placers, 1880	50,000	
Silver and lead, 1880	400,000	
		450,000
Silver, gold, and lead, 1881		3,250,000
A total for twenty-one years of		$11,315,595

The following smelting works, mills and mines have returned reports of production, viz.: L. W. Aldrich, Lincoln City, Summit, White Quail, Gold Park, Greer, Wilson, Badger, Belden, Central Fluming, Gray Eagle Consolidated, J. L. Fuller, Matchless, Robinson Consolidated, Silver King, Silver Wave, Blue River, Bell. The total production of the county in 1881 was $2,155,000, of which $35,000 was gold and $2,120,000 silver.

Various Estimates of Production.—The following is from the Denver *Tribune*, and a comparison made with the estimates of 1880:

County.	*1881.*	*1880.*	*Increase.*	*Decrease.*
Boulder	$535,483	$850,000	....	$314,517
Chaffee	100,000	111,500	....	11,500
Clear Creek	2,204,980	2,656,000	....	451,020
Custer	608,549	960,000	....	351,451
Dolores	125,000	....	$125,000	
Fremont	14,536	....	14,536	
Gilpin	2,150,700	2,680,000	....	529,300
Grand	10,000	....	10,000	
Gunnison	535,033	300,000	235,033	
Hinsdale	187,375	....	187,375	
Lake	13,502,029	12,958,000	544,029	
La Plata and San Juan	40,000	365,000	....	325,000
Ouray	78,000	....	78,000	
Park	350,000	430,000	....	80,000
Pitkin	120,000	....	120,000	
Rio Grande	251,000	....	251,000	
Saguache	40,000	....	40,000	
Summit	1,828,000	511,000	1,317,000	
Total	$22,680,685	$21,821,500	$2,921,973	$2,062,788

The *Mining Review* published the following summary:

Lake County	$11,000,000
Summit County	3,000,000
Clear Creek County	2,800,000
Gilpin County	2,400,000
Boulder County	533,500
Chaffee County	150,000
Park County	250,000
Ouray County	80,000
Custer County	1,500,000
Gunnison County	150,000
Rio Grande	385,000
Saguache County	62,000
Hinsdale County	125,000
Other sections	1,000,000
Total	$23,435,000

The following table is the result of careful collection and arrangement of reports of production and sifting of the various returns published by the press of Colorado, made by Messrs. Hall and Smith, mining engineers, of Denver, assisted by Henry W. Comstock, editor of the *Mining Gazette*, of Cañon City, and A. F. Wueuch, editor of the Leadville *Index*:

Boulder County	$535,482 88
Chaffee County	196,400 00
Custer County	755,600 00
Clear Creek County	$2,204,980 34
Dolores County	125,000 00
Fremont County	14,535 50
Gilpin County	2,150,700 00
Grand County	10,000 00
Gunnison County	535,033 00
Hinsdale County	187,375 00
Lake County	12,738,902 00
La Plata and San Juan Counties	40,000 00
Ouray County	78,000 00
Park County	350,000 00
Pitkin County	120,000 00
Rio Grande County	280,000 00
Saguache County	53,500 00
Summit County	1,828,000 00
Total	$22,203,508 72

Of the above $3,000,000 is estimated to be gold. The value of the lead and copper produced is also included. The Denver *Tribune* publishes the following as the mining product of Colorado from 1859 to 1882:

Year.	*Gold.*	*Silver.*	*Copper.*	*Lead.*	*Total.*
1859 to 1870	$27,213,081.00	$330,000.00	$40,000.00	....	$27,583,081.00
1870	2,000,000.00	650,000.00	20,000.00	....	2,670,000.00
1871	2,000,000.00	1,029,046.00	30,000.00	....	3,059,046.00
1872	1,725,000.00	2,015,000.00	45,000.00	$5,000.00	3,790,000.00
1873	1,750,000.00	2,185,000.00	65,000.00	28,000.00	4,028,000.00
1874	2,002,487.00	3,096,023.00	90,197.00	73,676.00	5,262,383.00
1875	2,161,475.02	3,122,912.00	90,000.00	60,000.00	5,434,387.02
1876	2,726,315.82	3,315,592.00	70,000.00	80,000.00	6,191,907.82
1877	3,148,707.56	3,726,379.33	93,796.64	247,400.00	7,216,283.53
1878	3,490,384.36	6,341,807.81	89,000.00	636,924.73	10,558,116.90
1879	3,193,500.00	15,385,000.00	(*)	532,362.00	19,110,862.00
1880	3,206,500.00	18,615,000.00	(*)	1,678,000.00	23,000,000.00
1881	....	....	....	....	22,680,685.09
Total	$54,617,450.76	$59,811,760.14	$632,993.64	$3,341,362.73	$140,584,752.36

* No record of copper.

Product of Colorado Smelting Works.

BOSTON AND COLORADO WORKS, ARGO.

Counties, etc.	*Gold.*	*Silver.*	*Copper.*	*Total.*
Gilpin	$398,000	$76,000	$89,000	$563,000
Clear Creek	29,000	518,000	13,000	560,000
Boulder	48,000	23,000	1,000	72,000
Park	3,000	128,000	3,000	134,000
Lake	....	220,000	....	220,000
Chaffee and Gunnison	....	72,000	5,000	77,000
Summit	....	728,000	....	728,000
Custer	63,000	16,000	....	79,000
San Juan	4,000	33,000	....	37,000
Montana	11,000	388,000	174,000	573,000
New Mexico, Utah, etc	12,000	12,000	12,000	38,000
Total	$568,000	$2,216,000	$297,000	$3,081,000

MOORE MINING AND SMELTING COMPANY, GOLDEN.

Counties, etc.	*Tons.*	*Ounces Gold.*	*Ounces Silver.*	*Value.*
Gilpin	3,906	5,739	59,250	$183,377 67
Clear Creek	2,900	168	327,215	403,713 85
Lake	414	......	21,654	26,956 75
Other sources	902	......	52,302	64,456 90
Total	8,122	5,907	460,421	$678,505 17

GOLDEN SMELTING WORKS.

	Gold.	*Silver.*	*Lead.*	*Total.*
Clear Creek	$554 06	$184,686 96	$29,571 52	$214,809 54

Statement of Bullion forwarded by the Express Companies in the State of Colorado for the year ending December 31, 1881, as reported to the Denver Mint.

Counties.	*Six Months ending June 30.*		*Six Months ending December 31.*		*Total.*	
	Gold.	*Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*
Arapahoe	$425,710 00	$895,560 00	$953,580 00	$1,410,000 00	$1,379,290 00	$2,305,560 00
Boulder	....	....	89,380 00	111,371 60	89,380 00	111,371 60
Clear Creek	....	150,148 31	....	11,290 00	....	161,438 31
Conejos	54,090 00	3,916 00	58,840 00	3,916 00	112,930 00	7,832 00
Custer	....	....	....	82,818 01	....	82,818 01
Gilpin	495,425 00	....	426,550 00	....	921,975 00	
Jefferson	....	....	....	114,310 00	....	114,310 00
Lake	....	79,096 69	48,132 00	146,984 62	48,132 00	226,081 31
Rio Grande	....	....	78,832 00	54,831 00	78,832 00	54,831 00
Summit	....	....	5,621 00	....	5,621 00	....
Total	$975,225 00	$1,128,721 00	$1,660,935 00	$1,935,521 23	$2,636,160 00	$3,064,242 23

Statement of Bullion produced by Mills in the State of Colorado during the year ending December 31, 1881.

Counties.	*Six Months ending June 30.*		*Six Months ending December 31.*		*Total.*	
	Gold.	*Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*
Arapahoe	$281,120 00	$843,098 00	$270,685 76	$1,054,312 80	$551,805 76	$1,897,410 80
Boulder	....	78,792 35	19,506 00	111,371 60	19,506 00	190,163 95
Clear Creek	....	50,170 76	....	187,150 88	....	237,321 64
Gilpin	127,770 14	847 00	347,720 54	....	475,490 68	847 00
Gunnison	....	....	206 70	14,553 28	206 70	14,553 00
Hinsdale	684 64	8,431 36	7,234 50	78,400 00	7,919 14	86,831 36
Jefferson	85,144 87	140,424 48	159,289 00	532,907 75	244,433 87	673,332 23
Lake	13,600 00	2,999,004 49	139,931 81	4,042,830 23	153,531 81	7,041,834 72
Ouray	43 41	747 04	67,235 00	134,110 32	67,278 41	134,857 36
Park	....	39,142 30	1,678 07	41,083 45	1,678 07	80,225 75
Pitkin	....	....	81,712 64	8,345 44	81,712 64	8,345 44
Pueblo	132,940 00	282,681 28	....	....	132,940 00	282,681 28
Rio Grande	....	....	650 00	....	650 00	
San Juan	....	13,007 81	1,550 25	25,468 80	1,550 25	38,476 61
Summit	5,622 24	34,197 00	29,328 69	40,699 52	34,950 93	74,896 52
Total	$646,925 30	$4,490,543 87	$1,126,728 96	$6,271,234 07	$1,773,654 26	$10,761,777 94

Statement of Bullion handled by the Banks in the State of Colorado for the year ending December 31, 1881, as reported to the Denver Mint.

Counties.	*Six Months ending June 30.*		*Six Months ending December 31.*		*Total.*	
	Gold.	*Silver.*	*Gold.*	*Silver.*	*Gold.*	*Silver.*
Arapahoe	$13,912 55	....	$131,623 02	$140,915 94	$145,535 57	$140,915 94
Boulder	1,000 00	....	....	....	1,000 00	
Clear Creek	....	$500 00	56 55	83 22	56 55	583 22
Chaffee	....	....	....	60,000 00	....	60,000 00
Conejos	....	....	85,164 84	....	85,164 84	
Dolores	67 95	....	60 00	....	127 95	
Fremont	....	8,700 00	....	....	....	8,700 00
Gilpin	417,751 34	....	456,153 66	....	873,905 00	
Jefferson	....	....	204 90	....	204 90	
Lake	23,000 00	40,442 00	....	....	23,000 00	40,442 00
Las Animas	....	....	23,000 00	....	23,000 00	
Pueblo	....	551,042 76	....	607,700 00	....	1,158,742 76
Rio Grande	....	....	73,105 28	....	73,105 28	
San Juan	....	....	2,000 00	6,000 00	2,000 00	6,000 00
Summit	5,009 03	....	6,315 13	....	11,324 16	
Total	$460,740 87	$600,684 76	$777,683 38	$814,699 16	$1,238,424 25	$1,415,383 92

DAKOTA.

THE production of gold in Dakota during 1881 has been, approximately, $4,000,000. The Sidney and Black Hills Express Company shipped during the year $3,125,950. This, however, is the shipping valuation, the actual value being greater, probably at least fifteen per cent., which would make the amount transported by this company $3,594,842. To this should be added the amount carried out of the Territory by other conveyance and in private hands, which would not fall far short of $400,000 or $500,000. Competent local authorities estimate the production of 1881 to have been less than that of the preceding year, owing to a great scarcity of water, which caused a partial suspension of placer mining, and seriously interfered with the operations of the stamp mills. If the amount of gold deposited at the mint from this Territory can be taken as a guide to estimate or measure the production, it would appear that it is on the increase. During the year 1880, the deposits of Dakota gold amounted to $3,196,189, and in 1881 to $3,474,837, an increase of $278,648. Nearly the whole product is from the gold-bearing lodes, the gravel deposits being but secondary in importance. The lodes are of immense extent; the ore is free milling, requiring only stamp mills for its reduction, and there has been scarcely a mill erected which has had for its object simply the pulverizing of ore that has not been adequate for the purpose for which it was intended. Quartz mining, however, received a setback from the beginning of mining in the Black Hills, on account of the average low grade of the ores, and it was not until it was found necessary to increase the capacity of the mills to the fullest extent demanded by the quantity of ore, that lode mining became highly remunerative. In many particulars it costs but little more to run 100 stamps than half that number, and the best results are therefore attained by large mills, and this has been demonstrated by the practical operations of the miners who control the Homestake, De Smet, and other groups of celebrated mines. Silver ores were found in Dakota nearly as early as the discovery of gold, but the ease with which ores of the latter metal could be worked and their greater productiveness, led the miners to disregard silver, except so far as the mere location of lodes and claims was concerned. It was not until the placer mines were, to a considerable extent, worked out, and the gold-bearing lodes pretty well taken up, that the silver interests of Dakota began to receive that attention which the extent and richness of the deposits demand. The future prosperity of Dakota, as a producer of the precious metals, appears to be better assured at this time than at any previous period in her history.

Lawrence County.—The chief group of mines is that known as the Homestake, the reputation of which has been long established. The principal mines are the Homestake, Highland, Deadwood Terra, De Smet, Giant and Old Abe, Golden Star, Palmetto, American Flag, Lincoln, Amicus, Prince Oscar, Nettie, May Booth, Independence, Mineral Point, and Pea Warmer. The owners of these properties are usually designated as the Homestake Company, while in reality there are several corporations, although, to a great extent, these are composed of the same individuals. The chief companies are the Homestake, Highland, Father De Smet, Giant and Old Abe, and Deadwood Terra. So far as local officers are concerned, they are under one management. Of the extent of the mineral deposits from which the ore is drawn, but little can be said; their immense extent, however, compensates for the low-grade quality of the ore, which mills from $4 to $6 per ton. By able and careful management, by a most thoroughly perfected system of mining and milling, and by the use of large mills with numerous stamps, which experience has taught to be economy, the working of this low-grade material is successfully and profitably accomplished. The Deadwood Terra has paid fourteen dividends, amounting to $560,000; the Father De Smet sixteen, amounting to $435,000; and the Homestake forty-one, amounting to $1,230,000. The assessments upon these mines, up to the close of the year 1881, have been, on the De Smet, $200,-000, making the excess of dividends over assessments $1,-

705,000. During the last year the capacity of the Father De Smet has been increased by twenty stamps, making it a 100-stamp mill. The Highland and Golden Star mills each have 120 stamps, the Homestake eighty, and the Deadwood Terra two eighty-stamp mills, making a total of 580 stamps. The total cost of the mills, hoisting works, tramways, cars, locomotives, ditches, reservoirs, buildings, railroads, etc., is reported at $1,345,000. The Homestake Mining Company paid for the titles to the mines and locations it has secured—some fifty in number—$2,000,000, of which $400,000 was paid for the Father De Smet—four locations; $115,000 for the Deadwood Terra; $75,000 for the Homestake; $50,000 for the Golden Star; and $250,000 for the Giant and Old Abe, which with the amount expended in improvements, mills, etc., make the total amount expended by the combination $3,345,000. Five hundred men are employed in the mines, mills, shops, and various departments, at average wages of $3.50 per day. Wood is consumed for fuel, and costs $4.50 per cord. The mills can reduce $3,000 tons of ore daily, as each stamp is capable of crushing three and a half tons, at an average expense, as is reported, of $1 per ton. The stamps are placed in batteries of five each, and so arranged that one or more batteries may be stopped for repair or clean-up without interfering with the work of the others, or stopping the engine, which continues its revolutions without intermission day and night. The ore, after first passing through the rock-breakers, is discharged into the automatic ore-feeders, and thence into the batteries, rendering but little handling of the ore necessary. The deepest shaft thus far sunk is upon the Giant and Old Abe, 450 feet, which is not yet in ore, but the vein dipping toward the shaft will soon be reached. The ore from the Homestake is being taken from the 240-foot level, milling about $5.50 per ton. That from the Deadwood Terra is said to average about $4, and that from the De Smet about $3.50 per ton, although some of it will not mill over $1 per ton. The north end tunnel of the Father De Smet, at the close of the year, was 357 feet in length, having been advanced forty-three feet in December. At the same time ore was being extracted from the first, second, and third levels. The Homestake Company also own the Savage Tunnel, purchased recently on an execution against the Dakota Mining Company. The tunnel is now completed 800 feet, and it is designed to be extended a total distance of 3,000 feet to the Rattler's shaft, 2,500 feet distant. The tunnel in its course cuts the Morning Star, Jupiter, Evening Star, Hidden Prize, Queen of the Valley, North Pacific, Comet, Atlantic, Golden Wreath, Echo, and Rosebud. This property, upon which over $100,000 have been expended, was purchased at the sheriff's sale for $15,000. The Savage tunnel, when finished, will be of great utility in draining the mines at Lead City.

The amount of gold and silver produced in Lawrence county by districts, as reported by the Census Bureau, for the year 1880, was as follows:

District.	*Gold.*	*Silver.*	*Gold and Silver.*
Bear Butte	$775	$29,238	$30,013
Lost Placer	535,045	5,974	541,019
Whitewood	2,717,554	35,351	2,752,905
Various placers	47,700	....	47,700
Total	$3,301,074	$70,563	$3,371,637

Pennington County.—The rich and extensive placers of this county are, for the most part, still lying in an undeveloped condition. The deposits are high, and cannot be worked without a large expenditure of money in carrying water by means of long ditches and flumes so as to make it available for hydraulic purposes. That the placers are rich in gold is indisputable. From their discovery to the present time a number of miners have made sufficient by carting the gravel down to the creeks to wash to induce them to continue operations in this laborious and unsatisfactory manner. The amount of gold and silver produced in Pennington county by districts, as reported by the Census Bureau, for the year 1880, was as follows:

District.	*Gold.*
Rockford	$1,600
Various placers	3,159
Total	$4,759

Custer County.—The placer mines of this county are similar to those situated in Pennington county, and the same difficulty exists in obtaining water at a sufficient height to properly wash the gravel. The *Black Hills Pioneer* furnishes the following description of the Harney Hydraulic Company, which may be taken as instancing the paying qualities of the gulches and bars in Custer county.

"The property of the company consists of about six miles of the bed of Battle creek, beginning a short distance below Harney City and extending to almost the foot of Harney Peak, together with all bar and hill diggings on both sides of the gulch for the same distance; also the placer ground of Grizzly Gulch. The claims include Harney and Everly Hills and the celebrated Mitchell Bar, which are considered the richest portions of the entire possession. Applications for patents upon four hundred acres have been made, and as there are no adverse claims the company will undoubtedly be successful. Several valuable water-rights have been located both upon Battle and Grizzly, insuring an abundant supply for the extensive working of the ground projected by the company. Preparatory work began July 8, and has been executed in the most indefatigable manner, and with results of which the superintendent and all connected therewith are justly proud.

"The main ditch or flume has a total length of six and a quarter miles, and the flume for what are known as lower workings a length of two and three-quarter miles. The first-mentioned flume down to Grizzly Gulch is twenty by twenty inches in dimensions, and below Grizzly (at which point the two flumes unite) the dimensions are thirty-six by twenty inches. A trestle, forty rods in length, with forty-foot spread at the bottom and thirty-two inches at the top, and 112 feet in height, supports the flume over Grizzly Gulch. It is constructed of square timbers, firmly braced, and is the most substantial and prettiest piece of work of the kind in the hills. A similarly constructed trestle and flume, but 250 feet high, will be constructed across Battle Creek this year, to convey the water to Everly Hill, a short distance back of Harney. The company, operating its own saw-mill, cut 900,000 feet of lumber for use in the two flumes.

"Three capacious reservoirs, two on Battle creek and one on Grizzly, insures an abundant water-supply even in the driest season. This, as already intimated, is carried at a great height at Mitchell Bar 213 feet—affording tremendous pressure for hydraulicing, which will be first resorted to, although, owing to the great depth of bed-rock in the main gulch, drifting will doubtless soon become the principal system of work. An average of fifty men has been employed during the season. The estimated total cost of the works is $42,000.

"The value of the ground may be inferred from the fact that previous owners of Mitchell Bar excavated between 500 and 600 cubic yards of gravel, carted to the creek, and cleaned up over $7.50 a cubic yard.

"The company proposes to put in a bed-rock flume, beginning at the lower end of the ground, and wash everything within reach. By this variey of working plans operations can be continued summer and winter, and for many years to come. The works are about complete, and the company in readiness to begin operations with the earliest opening of spring."

The amount of gold and silver produced in the Territory of Dakota, as reported by the Census Bureau, for the year 1880, was as follows:

Counties.	*Quartz.*		*Placer.*	*Total.*		
	Gold.	*Silver.*	*Gold.*	*Gold.*	*Silver.*	*Gold and Silver.*
Lawrence	$3,253,374	$70,563	$47,700	$3,301,074	$70,563	$3,371,637
Pennington	1,600	....	3,159	4,759	....	4,759
Total	$3,254,974	$70,563	$50,859	$3,305,833	$70,563	$3,376,396

MINES OF THE APPALACHIAN RANGE.

THE earliest record at the Mint of gold of the United States was in 1804. In that year a deposit was made of gold found in North Carolina. Small amounts, not exceeding an annual average of $2,500, were received from that year to 1823, after which date there was a yearly increase, which is stated in the Mint records as follows:

In 1824	$5,000
In 1825	17,000
In 1826	20,000
In 1827	21,000
In 1828	46,000
In 1829	134,000

During the latter year, $2,500 was received also from Virginia, and $3,500 from South Carolina. The rapid increase of production stimulated the search for and mining of gold in the whole range of mountains from Virginia to Georgia, and early in the ensuing year, 1830, gold began to be received from the latter State; the receipts for that year being, from Virginia, $24,000; from North Carolina, $204,000; from South Carolina, $26,000; and from Georgia, $212,000. In the following year small amounts, aggregating $2,000, were received from Tennessee and Alabama. The total amounts of the precious metals from the mines of the South, deposited at the United States Mint from 1804 to the close of the calendar year 1881, were as follows:

From Virginia	$1,689,797 00
From North Carolina	10,750,468 64
From South Carolina	1,429,751 55
From Georgia	7,869,282 60
From Alabama	220,892 25
From Tennessee	86,511 61
Total	$22,046,703 65

This does not represent the whole production of the States, a considerable portion, undoubtedly, having been used for other than coinage purposes, or having lost its identity, as to locality of its production, before being deposited at the Mint. During the last year, the production of the Carolinas and Georgia was about $275,000. For much of the material from which the following description of the mines in these States was prepared, I am indebted to Mr. G. B. Hanna, assistant assayer of the United States assay office at Charlotte, N. C., who personally visited and examined the several localities.

North Carolina.—The gold-producing area of North Carolina comprises upwards of 25,000 square miles, in which gold is found at intervals; but the portion productive on a working scale is embraced by the western half of about 12,000 square miles. This area contains three principal geological formations, and may be divided into three belts. The eastern belt is principally of argillaceous slates, and includes the counties of Warren, Franklin, Nash, Randolph, Davidson, Union, Stanley, Montgomery, Anson, and Moore. The middle belt is best described as granite or syenite. It has been known longer and worked more extensively than either of the others. It comprises the counties of Guilford, Rowan, Cabarrus, and Mecklenburg. The western belt is gneissoid in structure, verging into hornblendic and mica schist. The counties in which mining to any extent has been carried on are Gaston, Lincoln, Catawba, Burke, McDowell, Rutherford, and Polk. In the mountainous region the mineral resources have not yet received much attention, by reason of difficulty of access. The auriferous ores of the State consist for the most part of the hydrated peroxide of iron or brown ore and pyrites, and are refractory proportionate to the amount of sulphurets. Copper is found, chiefly chalcopyrite, though chalcocite and bornite occur in small quantity. Galena is also found, but rarely in working proportion, and frequently associated with zinc blende. Nickel, cobalt, antimony, and arsenic exist, but not to any noticeable extent. Gravel deposits are found throughout all the belts; those of the middle belt were for the most part exhausted years ago, but in both the eastern and western belts they are of larger area and deeper in extent; the want of water, however, has hitherto prevented them from being extensively worked. The best known mines of this character are in Franklin and Nash counties, to the east, and in Burke county in the western part of the State. The production of North Carolina during 1881 was approximately $115,000. Of this amount $58,483 was deposited at the mints and assay offices as native gold from that State; the identity of other deposits as to locality was not ascertained. A considerable amount went out in ores and concentrates for reduction at smelting works, and the production of mines worked by foreign capital was shipped directly abroad. On the eastern or slate belt great activity is manifested. Most of the mines are situated near the contact of the slate and the granite. In the extreme eastern section the chief gravel mines are in Franklin, Nash, and Warren counties.

The Hoover Hill mine, in Randolph county, comprising 250 acres, is seventeen miles southeast of High Point. It was reopened in May, and the work of refitting has been forwarded with rapidity and skill. The underground work thus far appears to have been done principally to ascertain the resources of the mine. Two of the old shafts, the Gallimore and the Briols, have been reopened, and a new shaft sunk into the ground, which past experience led the managers to believe contained ore. In the latter a cross-cut has been begun at the ninety-foot level, with the hope of striking the same vein on which is the old Hawkins shaft, that being abandoned as unsafe. The Gallimore is down 110 feet and the Briol 120 feet. In addition to these shafts a large tunnel is being run into the hill to cut all the ore bodies known. A very complete mill, storehouse, office, machine shop, etc., have been erected; the mill is provided with four five-stamp batteries, a Blake crusher and other appliances. The ore treated comes from the Gallimore shaft and is of good quality, but the amount which the mine can furnish is uncertain, as neither drifting nor stoping has been done to any extent; the present resources are inadequate to keep the mill constantly at work. The property is in the hands of an English company, and the bullion produced is shipped direct to London. The mine is not, however, likely to produce, for some months at least, any considerable amount. The Eureka, in the same county, has been closed for some months. The Jones mine, although possessed of considerable resources, has been idle during the year. It is fifteen miles southeast of Thomasville and contains nearly 300 acres, the principal part of which is covered with decomposed chloritic and talcose schist to an average depth of about thirty feet. This material is readily mined without underground work, and, although of very low grade, the facility with which it can be worked, provided a sufficient supply of water can be obtained, renders the property of great value. The Herring (formerly the Lafflin) is adjacent to the Jones, and is of similar formation. Work was commenced during the summer. The material is treated by a Howland pulverizer, and is so soft and easily disintegrated that a very large quantity can be handled. The superintendent thinks that the entire cost of treatment will not exceed fifteen cents per ton. The supply of water is the chief consideration, as the movement of so large a quantity of material requires a large amount to effect it; hitherto there has been a deficiency, but during the last season several streams were diverted and a reservoir constructed with capacity for the storage of a supply sufficient to last over the dry season. The mines will probably give a moderate yield of gold during 1882.

The North State, in Hoover county, is being reopened; it is in the hands of wealthy and energetic men, and probably will be rapidly put into a working condition. The following in relation to this mine is taken from the *London Mining Journal:* "The North State Mining Company, incorporated under the laws of North Carolina, with a capital of $10,000,000 or £2,000,000, have issued a prospectus with a view to place shares, which are of $25 or £5 each par value in this country, at £1 each. The principal mine appears to be the noted Copper Knob mine. This is a copper mine carrying gold and silver, and is a property of 350 acres covered with heavy timber. The vein is a fissure, and varies from fifteen inches to four feet in width. The mine is opened to a depth of 157 feet on the incline, and has already produced a large quantity of rich and valuable ore. The vein at the present time is four feet wide, and carries an average of twenty per cent. of copper and $40 in gold and silver per ton. This mine is fully equipped with modern machinery, steam-hoisting engine, air-compressor, air-drills, sixty-horse-power boilers, twenty-five-horse-power engine, and two smelting furnaces of twenty tons capacity are being constructed. In the ore-house there are about 300 tons of first-class ore, and not less than 600 tons standing in the incline and drifts on the foot-wall in the mine. The ore is the vitreous copper ore, bornite, malachite and chrysocolla, all carrying free gold and silver. The properties have been very favorably reported upon. An estimate of gross earnings and receipts shows £700,000, or thirty-five per cent., available for dividends, and £32,000 to form a sinking fund for the twenty-year railway bonds issued by the company for the line from Statesville to the company's mines."

The Conrad Hill mine, in Davidson county, six miles east of Lexington, was opened again in 1880, but it is only recently that the mine has been put into so forward a state that the future work can be confidently predicted. The property consists of 257 acres, on which there are seven well-known veins, four of which are now being worked. The shaft has been put down in such a manner as to allow ultimately the working of the three other veins. The greatest depth reached in November was nearly 250 feet on a vertical measurement; a series of levels have been run, aggregating several hundred feet, and opening up a large stoping ground. An examination of the underground work showed the veins to range in width from six to twenty feet. The ore is sorted into three classes: First, a copper ore (mostly copper pyrites) containing some gold. Second, "brown ore" carrying considerable gold and a little copper. Third, material intermediate between the first and second classes, containing some pyrites and "brown ore." Iron pyrites is not abundant in this mine. The first class is a true smelting ore, and will be treated at the mine. The second class will be milled to save the gold, and the tailings concentrated to collect the sulphurets, which will then be sent to the smelting furnace. No definite plan has yet been selected to treat the third class. There are 2,500 to 3,000 tons of ore on the dump, much of it of very good grade. Two stack furnaces with all the modern appliances are now nearly completed for smelting the copper ore to a matte; it has not yet been determined whether this matte shall be further concentrated and the extraction of the valuable constituents made at the place, or whether it will be shipped to smelting establishments, at home or abroad, which make a specialty of such work; probably, however, it will be reduced on the spot. The "brown ore" will be treated by mill process, for which a very suitable plant is in course of erection. The whole establishment is the nucleus of very complete works. One hundred and fifty men are employed. The mine and works are in the hands of managers long familiar with metallurgical business, and heretofore successful in mining enterprises, and the result of their work can hardly fail to add materially to the bullion product of North Carolina. The Spring Valley mine is eleven miles east of Lexington in the same county. The deposit at present worked was discovered in June, 1880, and is almost virgin ground. The mine is entered by an underlay or inclined shaft 150 feet deep, giving a vertical depth of a little more than 100 feet; the combined length of the levels is about 100 feet. The width of the vein is on an average five feet, although in places it widens to twenty feet. The ore is galena mixed with a small proportion of blende; it is always argentiferous and usually carries a little gold; the presence of the blende renders it somewhat refractory. A considerable portion of the ore is a compact though impure galena; the lower grade is stamped and concentrated, for which four five-stamp batteries of the most approved form are used, and nine buddles. The best concentrates are probably richer than the selected solid ore, both in lead and silver. There are about 1,500 tons of selected ore and concentrates and nearly an equal quantity of second-class ore awaiting treatment. The company employs ninety men, and are considering the feasibility of erecting furnaces at the mine to produce either base bullion or matte for shipment. Whatever the course of treatment ultimately adopted, the products will probably go out of the State in an unfinished condition unless metallurgical works should be erected and successfully treat the ore with the rich iron sulphurets of this section, the lead serving as a collector of the gold. The Silver Hill mine, twelve miles east of Lexington, long in litigation, but now freed from it, will, as is reported, resume operations on a more extensive scale. In November, 1881, only six men were employed, and little was done except sinking a prospecting shaft and keeping the water in the mine down to the 250-foot level, but there was no exploitation at that depth. The greatest depth reached in this mine is a little more than 700 feet, but the efforts of late years have been confined to that portion above the 250-foot level. The ore is a mixture of galena and blende carrying a few ounces of silver and a trace of gold per ton. Usually the zinc is in larger proportion than the lead; this combination makes the ore extremely difficult to work. Smelting treatment of this material is troublesome and expensive, and the little value of the raw ore prevents its shipment. In 1878 a large body of carbonates was discovered and a part shipped during the two succeeding years; about 500 tons are now on the dump, much of which is of the highest grade that the mine furnishes. A long course of experiments will probably have to be made ere the problem of successful treatment of the ore from this mine is solved, and then the valuable constituents will likely go out of the State in a concentrated form for treatment in other establishments.

Rowan County.—In Rowan county, near Salisbury, great activity is shown. Six miles east of the town is the Rhymer. The greatest depth attained in this mine is 160 feet in shaft No. 1, from which point a level has been started for shaft No. 2, 400 feet distant; shaft No. 2 is now being sunk. A level has been run from No. 1 to No. 2 at seventy feet, and it is proposed to open one at every fifty feet. Altogether about 650 feet of the course of the vein have been opened by the levels. The vein is on an average four feet wide; the ore is a very heavy compact sulphuret of iron, estimated to have at least 40 per cent. of mineral matter. The superintendent states that 1,300 tons had been treated during the year at the Davis chlorinating works at Salisbury, in connection with which works the mine is operated; in addition to this, 2,000 tons were estimated to be on the dump. Much of the ore is of too low a grade to bear the cost of hauling seven miles over the rough country roads, and to avoid this expense a concentrating and chlorinating works is in course of erection at the mine. Two six-inch Cornish pumps and two twenty-five-horse hoists lift water and ore. The property appears to have been managed with great energy and judgment. The Bullion is the eastward extension of the Rhymer, and is about a mile distant; the ore is quite similar in character, but from some unexplained cause work was suspended during the summer. At the Dunn Mountain mine, four miles east of Salisbury, no milling was done during the year. The accumulation of ore is quite large, the foreman at the mine estimating that at least 3,000 tons were on the several dumps. The ore for the most part is brown oxide of iron with quartz and slate, but carries considerable iron pyrites and some copper pyrites. Recent changes have been effected in the ownership and management of this property, and the mill will soon be set to work. There should be a considerable production of gold during the ensuing year, as in addition to the amount of ore above ground the underground works are in condition to furnish a steady supply. The Gold Knob, nine miles east of Salisbury, is composed of a group of three mines, viz.: the Holzhauser, the Knob, and the Haynes. Eleven veins are enumerated on the property, but only those mentioned are worked. A simple prospecting mill of five stamps is the only machinery in use at present. The three veins are large and capable of supplying an ample amount of ore for a much larger plant; it is, as a rule, of low grade, but chimneys of high grade may be expected in places. The material is largely free milling, but everywhere contains sulphurets of iron and copper to a small percentage. The yield of this mine cannot, with its present machinery, be large, even if worked at its fullest capacity; it will, therefore, probably be equipped with a larger plant. The Southern Belle is seven miles east of south of Salisbury. No work except for prospecting has been done. The shaft, seventy feet deep, has not yet reached the vein; an underlay shaft had previously been sunk in the vein to a depth of forty feet; but little ore had been found, although it was always good and sometimes of high grade. The only machinery erected is that necessary for pumping and sinking. Under the most favorable circumstances this mine could not be put in condition to produce bullion to any extent in 1882. The Yadkin, one and a half miles south of Salisbury and near the Davis Chlorinating Works, is partially filled with water, and no ore has been produced for some time. Nothing reliable can be learned of its prospects. A few other tentative efforts at mining have been made around Salisbury, but none of them with promising results. The Davis Chlorinating Works were operated to some extent during the year, about 1,300 tons of ore having been worked, but no authoritative statement has been received relative to the production of bullion.

The Gold Hill mine, sixteen miles southeast of Salisbury, was reopened by an English company in the summer of 1881, and they are working a force of English miners. The mine is unwatered to a depth of nearly 400 feet, at which point the company expects to draw its supply of ore. A very complete equipment of machinery, consisting of a new "Buckeye" engine and a Becket & McDowell 20-stamp mill, has been provided, and a considerable return may be expected in 1882, but the bullion will probably be shipped direct to London. The production of Rowan county is about $10,000 per annum.

At Concord, twenty miles south of Salisbury, Cabarrus county, five mines are at work; conspicuously among them is the Phœnix, seven miles east of the town. The deepest work done at present is at the 125-foot level; the vein is one and a half to two feet wide, and the ore, which is highly sulphureted, is distributed more uniformly than is usual in veins in this section. The mine is operated in connection with the Mear's Chlorinating Works, but in its present state of development is unable to furnish a full supply of ore. The Chlorinating Works adjacent to the mine have therefore been run much below their capacity, but the results have been very satisfactory. The superintendent states that ninety per cent. of the gold contained in the ore is extracted; the full capacity is about eighteen tons per diem. The plant is very complete, efficiently operated, and bids fair to be of great advantage to the section. The Tucker, formerly known as the California, one mile south of the Phœnix, was opened last May, and its development has been rapidly pushed towards a producing point. The milling has been done chiefly to test a 10-stamp battery, and the yield of gold is considered as satisfactory. The greatest depth reached in the mine is 175 feet, and levels have been driven aggregating 117 feet; the vein is from one and a half to two feet wide; the ore is heavily charged with sulphuret of iron and is reported to be of good grade. The North Barrier, in the same vicinity, is being reopened, but as the vein has not been reached, nothing definite can be said respecting it. The ore will be worked at the Mear's works; its old reputation was fair. The Quaker City, eight miles east of Concord and one and a half miles southeast of the Phœnix, is thought to be an extension of it. There are three shafts, down forty, sixty, and eighty feet, respectively, but only short levels have so far been driven. The ore is of the usual character yielded by most of the mines, largely sulphureted, with some brown free milling ore; two or three hundred tons are on the dump or at the mill. The old stamp mill has been torn down, and a new 10-stamp battery has been erected on Buffalo creek, two miles distant; besides this there are two Chilian mills and other suitable appliances. The Reed, so famous in the early history of the State as the first authenticated producer of gold, and still more notorious for having yielded an extraordinary number of large nuggets, was again opened in the summer; operations have been confined to low-grade material near the surface, the lack of water preventing much milling. The low-grade ore will at best allow but a moderate yield. The production of Cabarrus county has probably been $15,000 to $20,000 during the year.

Twenty miles south of Concord is the better known *Charlotte district* of Mecklenburg county, in which thirteen mines are producing gold, or in process of reopening. The principal of these, the Rudisil, has changed but little during the year, but it has no such reserves of ore as it had twelve months ago. The pump shaft has been extended to the depth of 265 feet, and a level driven south, which is now in high-grade ore, but neither the drifting nor stoping has yet determined the extent of the ore body. It is equipped with a 10-stamp battery. The Saint Catharine is the north extension of the Rudisil; a new shaft was projected in July last, to cut the vein at a depth of 300 feet; at the close of 1881, a depth of 100 feet had been reached. The mine cannot be put into a producing condition this year. The McDonald, one and a half miles southwest of Charlotte, contains 100 acres; it has been exploited to the depth of 110 feet; two levels, one at sixty and the other at 110 feet, have been driven forty feet each. The ore is brown free milling, carrying a small percentage of sulphurets; a small quantity of good ore has been raised. The mill-house contains an ore breaker, Howland pulverizer, Ball amalgamator, etc.

The Smith & Palmer, between the Rudisil and McDonald, was sunk upon until drowned out by the great influx of water, and the machinery being inadequate to control it, work was suspended for the winter; the ore body had not been reached. As the known body of ore was of a fair grade for milling, the mine may be in condition for production early in the ensuing summer. At the Simpson, ten miles east of Charlotte, only prospecting has been done this year; it is not likely to turn out any gold the coming year. The Smart, fifteen miles southeast of the same city, was reopened during the spring, and a good body of galena uncovered; the ore can be treated only by smelting. The Ray, nine miles southeast from Charlotte, is entered by four shafts; the deepest level is at eighty feet, and the aggregate length of the levels is something more than 400 feet. The vein averages two and a half feet wide and is filled quite uniformly with ore consisting of quartz, brown oxides of iron, and occasional bunches of sulphurets; at greater depth heavy sulphurets will probably be met; the lode shows a tendency to copper minerals; the present material is a good grade of free milling ore. Thus far the production has not been large, but the mine is in a good condition for steady work in 1882. The Black mine in Crab Orchard township, Mecklenburg county, is nine miles east of Charlotte; it was opened in June, 1881. It is worked by two shafts; the average width of the vein is fifteen inches, and it carries an unusually good grade of brown ore. Assays made of it at the United States assay office at Charlotte show it to be always good and much of it rich; the mine is in condition for good work in the immediate future. The Maxwell, two miles south of the Black, was also reopened early in 1881, but the reports of the lessees are not favorable either as to the quality or quantity of the ore. The Hopewell is ten miles northwest of Charlotte; it was opened in the summer of 1881, but work was not vigorously pushed, and has been suspended for the winter; ore of only very moderate grade was extracted, and as it is too highly cupriferous to be easily treated in a mill, it will probably require smelting. The Capps Hill mine, five miles northwest of Charlotte, has been lying idle for nearly thirty years, but during the last year preparations were made to resume work by pumping out the mine, but at the close of the year the ore bodies had not been reached. As this mine has been the most productive of any in this county, favorable results may be expected when mining and milling is fully resumed, and it should add largely to the bullion product of the district. In the Charlotte district, taken as a whole, the condition of the mining industry is much the same as in previous years, though the yield of gold was somewhat less, owing to the excessive drought, which was greater here than elsewhere in the South. In other respects, however, the mining interests have been unfavorably affected; the efforts made by two different companies to establish metallurgical works at Charlotte led the mine owners either to delay their work, or to arrange it with reference to the operations of these establishments; the older of the works has thus far failed to satisfy the expectations raised, and at present it is doing nothing, while the death of the president and the superintendent of the other company caused a suspension of operations. The best informed men are not hopeful respecting its future, of which nothing can be said with certainty. The usual number of "processes" were introduced during the last year, but none proved to be efficient, either through inherent defects or want of proper management. The total yield of Mecklenburg county is about $10,000 per annum.

Large operations at Vein Mountain, eight miles south of Marion, McDowell county, were commenced in May, and have continued, with some interruptions, through the year. The supply of water is taken from the upper reaches of the Second Broad river, and the company was thus, to a certain extent, independent of the drought. The company has at least 200 acres of good gravel on the above mountain, and late purchases have increased the area to 600 acres, all of which is commanded by the water from the ditch, which is thought to be capable of supplying three pipes, even in the least favorable season. At present work is confined to Puzzle and Holly gulches. A number of quartz veins have been cut on the property, which are likely to add to its resources. Preliminary work has been arranged for the Hard Bargain gravel mine, adjacent to the Vein Mountain. The Granville, to the southeast of Vein Mountain, was worked as long as water was obtainable.

The hydraulic work in Burke, McDowell, and Rutherford counties was brought almost to a stand-still during the summer of 1881, but resumed for a brief period towards the close of the year; the smaller and individual operators have had very poor returns. The production of these three counties for 1881 was, approximately, $30,000.

There are fourteen well-known localities in Polk county, commencing with the Double Branch mine and extending to the vicinity of Columbus, the county seat. They all had a good reputation in the former palmy days of mining in North Carolina so long as the deposits lay contiguous to the water supplies; but at present none can be worked on an extensive scale without a large amount of water. A sufficient supply could be obtained only from the North Pacolet, in the southwestern part of the county, by a ditch at least twenty miles long. No survey has been made to determine the details of such supply. At present the mineral area is worked at three points on a notable scale, but small parties and individual operators frequently work at odd times. The Double Branch mine, in the southeastern part of the county, has been at work most of the year, though a short supply of water somewhat curtailed the operations. Attention was given exclusively to the seams of quartz running through the strata, which is a variety of mica schist, thoroughly decomposed, and easily removed at trifling expense by hydraulic work or simple mining operations. The quartz, though forming but a small portion of the whole material, is a good ore and readily treated. The Prince mine, four miles south of the Double Branch, is a purely surface mine, and the entire work is hydraulic. The property embraces 360 acres; the gravel, although of good appearance, is rarely deep, sometimes not more than two feet. A sufficient amount of water to run one pipe, even in the driest season, is taken from the property itself; with a larger supply, a considerable return might be expected; it is doubtful, however, whether an additional amount of water could be obtained. The production of Polk county is about $3,500 per annum. In regard to the transmontane region of North Carolina, no reports have been received, and diligent inquiry failed in obtaining information of any steady work. An occasional deposit of gold at the United States Assay Office at Charlotte, from Cherokee county, shows that a little mining work has been prosecuted. At the Copper Knob mine, in Ashe county, no production of the precious metals was made during the year. A little underground work was done and the mine placed in better shape for continuous operation. The ore being rich in copper will require a smelting process, and the company expresses an intention of soon erecting a furnace, but it is not probable that anything more than making copper matte will be attempted.

South Carolina.—The State of South Carolina, in common with the whole mining area of the South, suffered last year from a drought, which seriously retarded work in every locality. The cultivation of cotton, having become more remunerative than other pursuits, has almost entirely diverted miners of small means from their mining work. Notwithstanding these adverse circumstances, the condition of the gold industry in South Carolina is favorable, and the yield is evidently increasing. The production of the State in 1881 is reported by Professor Hanna, of the Charlotte Assay Office, to have been $35,000.

The Brewer mine, in Chesterfield county, until last August, fully answered expectations, and would have produced from $25,000 to $30,000 during the year had the lack of water not brought work almost entirely to a close in August. The condition of the mine and the nature of the work remains about the same as described in my last report. It is probable that the work will be enlarged and a more ample supply of water be secured. There is no mine in this section in which the cost of working and the return of bullion can be so confidently calculated as in the Brewer, and this fact alone should insure its prosperity.

Georgia.—The gold belt of Georgia is upwards of one hundred miles in width, extending across the northern and part of the eastern section of the State, from northeast to southwest. Mines have been discovered from the line of Tennessee, in Fannin county on the north, to Columbia county in the south. The area of production has steadily increased year by year. Off the main belt, but little has been done, mining having been conducted principally in the counties of White, Union, Lumpkin, Cherokee, Dawson, and Rabun, situated in the northern section of the State. After the most careful inquiries, the yield of Georgia in 1881 is ascertained to have been about $125,000. In estimating this yield, two methods have been adopted: first, by careful inquiry at the producing points, and, second, by ascertaining the amounts shipped. Mount Airy, Gainesville, and Atlanta are the three main express points for the shipment of gold. The express agents at Mount Airy and Gainesville reported the shipments as $1,333 and $93,858, respectively. The agent at Atlanta declined to furnish any statement, but from the best information obtained, the amount cannot be large, probably not over $10,000, as Atlanta is somewhat remote from the principal producing area. The agent at Gainesville estimates that at least $12,000 was carried away during the year in private hands. Considerable gold produced in the section of country above Mount Airy is transported by mail, $2,700 being officially traced. A summary of the movement of gold from the State is as follows, viz.:

From Mount Airy, by express	$1,333
From Mount Airy, by mail	2,700
From Gainesville, by express	93,858
From Gainesville, by private hands	12,000
From Atlanta, by express (estimated)	10,000
Total	$119,891

This amount substantially agrees with that ascertained from independent observation at the mines.

In Rabun, the extreme northeastern county of the State, the J. P. Wilson mine, four miles from Burton, has been opened and will soon be at work on a large scale. This property, consisting of two sections of 490 acres each, has been worked on a small scale for many years. The surface of the country is extremely diversified with high mountains and deep gulches; the latter, cutting across the gold-bearing strata or receiving the wash and drift therefrom, have been long noted for their richness; for two generations, a few parties have operated on a small scale on this property, with rude and scanty apparatus, but the return has amply remunerated them for their time. The works now projected contemplate the hydraulic treatment of that portion of the gulches which have hitherto been beyond the reach of water, and of a mill treatment of the quartz from the seams or veins. A fair supply of water has been obtained from the upper reaches of the streams lying on the property, and more can probably be obtained if needed. The quartz veins or beds have been quite well exposed by the preliminary work of the last two years. The ore-channel of quartz, with the included decomposed slates, is two and a half feet thick, and connected with it are numerous seams and stringers of quartz in the adjacent slates. From assays made of many samples of the ore, at the United States Assay Office at Charlotte, N. C., it seems to be in richness fully up to the average of Georgia ores. The forwardness of the preparations and the condition of the work appear to justify the expectation of steady operations in 1882, and of a respectable yield; the running expenses of this mine will be small. The best information obtained in Rabun and Habersham counties points to a yield of $8,000 to $10,000 in 1881, and, from the present outlook, a return of $20,000 in 1882 is not improbable.

From Rabun county to Nacoochee Valley, in White county, the mining work is conducted almost exclusively by the country people, and on a small scale; those conversant with this intervening Territory believe that the returns to individual operators have rewarded them better than would have been done by other occupations. At Nacoochee Valley great activity is manifested; the work done is almost entirely hydraulic. The Bradley mill, erected to treat the quartz of the Runnel's vein and others in its vicinity, has been closed since the death of Professor Bradley, and is likely to remain so, as it is in litigation. The Nacoochee Company, which owns and controls twelve lots, is at present working on the grounds of the Lumsden Bros; the lease, however, is short, and as the company is involved in legal troubles the result of their work in 1882 is quite uncertain. Lot No. 38 has been vigorously exploited on the Chattahoochee slope of the Hamby Mountain belt; the facilities for water, however, are inadequate for properly working the resources of this property, and the summer drought still further diminished the usual small supply, consequently work has been hindered; the return for 1882 should be fully up to that of past favorable seasons; the mill employs five stamps. The Lumsden

Bros. are effecting arrangements for putting their property at work, or for disposing of it to other parties who will. In 1880 a very slight amount of work in their kitchen garden uncovered a remarkable deposit of nuggets, to the extent of several thousand penny-weights, and old miners, conversant with the course and characteristics of "ancient streams" in this neighborhood, think that other similar discoveries are probable; the ordinary resources of these lots are ample to give a good and constant return for a long time; at present there is a deficiency of water. Half a mile to the southwest E. R. Trimble is operating the Thompson place; he has a mill of five stamps, and is prepared for steady work, if the mine should continue to make a steady output of ore; the common run is regarded as satisfactory in quality, but rich chimneys are reported as existing. Many evidences of large resources are in this vicinity, but none, except possibly the Jarrett lots, Nos. 23 and 24, in district No. 3, are likely to be worked, except by individuals. The amount produced in this neighborhood can hardly be less than $15,000 in 1881; the yield is likely to be one-half greater the next year, if the ordinary conditions of water supply are maintained.

Between the Nacoochee Valley and Loudsville, Lumpkin county, mining is conducted on a small scale; the Loud's Ditch and Mining Company are at work, and, notwithstanding the scarcity of water, the yield was little affected. The principal mining operations of the Georgia gold region are in the vicinity of Dahlonega. The Barlow & Hand mine, two miles southwest of this town, has not materially changed, either in its ore supply or yield, except so far as the lack of water has checked work; during the summer only four of its eight batteries have been in operation. The ore channel of quartz seams is of great thickness, two having a combined width of 100 to 400 feet. In the belt now worked the seams are very numerous; at one point, within a distance of fifty feet, there are eleven, not counting those so small as to be mere strings. The quartz is of good grade, and, as the management shows the same skill and efficiency as noted on other occasions, the average yield will probably be maintained through 1882. The Ivy, adjacent to Dahlonega, and on the same belt as the former mine, is similar in character and operated in the same manner, though on a smaller scale; a description would be a repetition of the details of the Barlow & Hand. It employs twenty stamps; the yield has been satisfactory, and the prosperity is likely to continue. The Finley, one and a half miles southeast of Dahlonega, has been worked with little change. The quantity of ore at command is large, quite as much so as at the time of the examination made last year, but apparently it is of slightly inferior grade; this, however, is to be expected in every mine, and signifies nothing with reference to permanent work or value. Three bodies of ore of considerable thickness are available, but only two are now exploited, for which forty inches of water are being used. This mine is not so advantageously situated for hydraulic purposes as many others, as the natural head of water needs the reënforcement of pumping apparatus to enable it to reach the highest point of the mine. It is operated by two mills, one of thirty stamps run by water, and a second of twenty stamps by steam; the former only has been in operation during the summer. The blast, on the same belt, adjoins the Finley. As the ore is similar in character, no extended notice is necessary. For some months it has been consolidated with the Ivy, and worked under the same management with reported success. The Lockhart temporarily suspended operation for lack of water. A new shaft is sinking to meet the ore body at a greater depth, which is reported to be from seven to twelve feet wide and of more than ordinary richness. For a small mine, it has had unusual prosperity. It is operated by fifteen stamps. The Singleton, one and a half miles east of Dahlonega, is worked by ten stamps, under the same management as the Lockhart. It is supplied by water from its own special ditch, which is too small to allow of piping usually practised in hydraulic work in this section. The White, or Pigeon Roost, adjoins the Barlow & Hand, and the ore is much the same; its ten-stamp mill was stopped during a great portion of the year. The following summary shows the mines about Dahlonega and the number of stamps, viz.:

	Stamps.
Findley	50
Bast	20
Ivy	20
Lockhart	15
Singleton	10
Barlow & Hand	40
White	10

More reticence than usual was shown in communicating the production for 1881, but from the best sources of information, the yield of this district was $80,000. The work at Auraria, six miles southwest of Dahlonega, and on the same belt, is not so extensively conducted, nor has there been so much prosperity. The Chicago and Georgia, adjacent to the village, employs ten stamps; it is on lot No. 663, district 12; the ore does not seem so favorable as at other points on the belt, the well-known Pigeon Roost belt, and operations have been less vigorously conducted than during the preceding year. It has lately been leased to the efficient superintendent of the Findley, Ivy, and Bast mines, and under his energetic administration it will doubtless resume its former rank as a producer of bullion. The Auraria, one and a half miles southwest of the town of the same name, has recently been set to work. The summer has been spent in cleaning out the cuts, but only one experimental run to test the machinery, a ten-stamp mill, has been made, the vein has not been reached, and no trustworthy statement can be made respecting the prospective production, although a moderate yield is anticipated by those conversant with the resources of the belt. The Wells, half a mile south of Auraria, has also been opened; the ore body exploited is a quartz vein or seam eighteen inches to three feet thick, very laminated and coated with brown ore, and often very rich; at greater depth copper pyrites makes its appearance. The ore, although of good character, will prove refractory to the mill treatment; a ten-stamp battery has been brought here from the Hightown mine. Too little work has been done to determine the amount of available ore, so that no large yield of bullion should be anticipated in the immediate future. The Baggs Branch, or Cleveland, two miles south of the town, is situated on lots Nos. 172, 173, and the north end of 208. It is operated by twenty stamps, which can be driven by water-power in part or by steam. Both mine and mill are in good condition for work, but being at the extreme end of the Hand ditch, barely one-fourth of the requisite amount of water has been obtainable; the production, however, up to the time of the drought, had been fair. The Hightown, one mile west of Cleveland, has been idle nearly the whole year, and half the stamps have been removed to the Wells; the prospects are not very encouraging. The Bell is two miles southeast of Auraria; preparations are not yet sufficiently advanced for milling work; the mine has a good repute, but the water supply is neither abundant nor well-assured, and until that is settled, the yield of bullion cannot be large. The property is in the hands of energetic men, who seem determined to leave nothing undone to ensure success. The Calhoun, on lot 164, district 11, on the east side of the Chestatee river, and three miles south of Dahlonega, has recently been started. It was formerly worked by Hon. John C. Calhoun, for whom it was named. After lying in an abandoned condition for many years, it is now likely to be placed in the list of gold producers. The following mines about Auraria indicate the work of the section, viz.:

	Stamps.
Chicago and Georgia	10
Auraria	10
Wells	10
Cleveland	20
Hightown	10
Bell	10

The production of the district has not been over $8,000 during the past year. Before leaving this locality, mention should be made of a new enterprise. Near Leather's Ford, on the Chestatee river, four miles south of Auraria, a dredging-boat has been constructed by Captain Nobles; the intention is to raise the material from the bottom of the river, preparatory to extracting the gold. Of the worth of the process, or the value of the deposit at the point selected, no statement can be made, but of the accumulation of gold in the bed of the Chestatee there can be little doubt; the river runs for sixteen miles either along with, or across, the gold belt, and, together with its affluents along the same belt, must receive the wash and tailings from seventy-five or one hundred square miles of auriferous territory; at what point the gold has lodged, and to what extent, is however a matter of conjecture.

Dawson County.—This county is farther to the southwest and on the same belt. The only large mines are those controlled by the Cincinnati Consolidated Mining Company, the Baby, Magic, Gnome, Amicalola, and Kinmore; most of the known belts of the Dahlonega and Auraria districts are found on these properties. The Magic and Amicalola are the only mines worked to a noteworthy extent, but considerable preparations are projected for enlarged operations; the water supply is drawn from the immediate neighborhood of the mines and is insufficient; two ditches have been commenced, one to bring in the waters of Shoal creek, the other to run to the head of Amicalola river; when completed, they will give 2,200 inches of water; as some difficulties in construction have been encountered, several months will probably elapse before they are finished. Both of these mines have abundant resources, and will give ample occupation to the large supply of water contemplated; the belts are large and the ore good. Only hydraulic work has been done, though occasionally a run is made through the ten-stamp mill on the Magic. The associated properties are prudently managed and bid fair during the next twelve months to become producers on a considerable scale. The Franklin and Pascoe mines, twelve or fifteen miles southwest of the above properties, have recently changed hands, and will, it is thought, soon be put to work. These mines have had a famous history, but the work was mainly done on the surface; it remains to be seen how successful vein mining will prove; the ore appears to indicate much the same conditions existing to the northeast. Still further to the southwest, the operations are very desultory at the Strickland, Sixes, and Cherokee. The production of Dawson county has been about $10,000.

All of these mines were noted in the palmy days of placer mining, and some of them have yielded large returns; of what value they would be for deep mining, nothing can be said with certainty, but the ores exhibited at the Atlanta Exposition were of good character. The yield of these counties may be placed at $5,000. In reviewing the work in Georgia, in 1881, it will be seen that there has been but little change; the quantity and quality of the ore is substantially the same as it was a year ago. A few unstable companies have succumbed, and a few unwise enterprises have been set in operation, but the well-established companies have held their way with little change except so far as the scarcity of water in the summer and early autumn compelled an abridgment of their work.

STATISTICS.

Mr. Burchard furnishes, in his report, the following statistics:

Statement showing the Amount of Bullion and Locality of Production reported by the following Smelting and Reduction Works east of the Rocky Mountains* as having been treated during the calendar year 1881.

State or Territory.	*First Six Months to June 30.*			*Second Six Months to December 31.*			*Calendar Year.*		
	Gold.	*Silver.*	*Total.*	*Gold.*	*Silver.*	*Total.*	*Gold.*	*Silver.*	*Total.*
Arizona	$14,608	$317,437	$332,045	$60,563	$614,822	$675,385	$75,171	$932,259	$1,007,430
California	2,769	121,694	124,463	9,456	31,906	41,362	12,225	153,560	165,785
Colorado	731,862	6,437,183	7,169,045	854,332	7,022,458	7,876,790	1,586,194	13,459,641	15,045,835
Idaho	3,410	84,040	87,450	57,628	470,867	528,495	61,038	554,907	615,945
Montana	5,968	528,519	534,487	27,904	715,469	743,373	33,872	1,243,988	1,277,860
Nevada	169,178	290,549	459,727	147,077	223,843	370,920	316,255	514,392	830,647
Utah	46,135	807,377	853,512	59,079	1,098,518	1,157,597	105,214	1,905,895	2,011,109
Other sources (unknown)	15,709	576,706	592,415	20,670	121,882	142,552	36,379	698,588	734,967
	$989,639	$9,163,505	$10,153,144	$1,236,709	$10,299,765	$11,536,474	$2,226,348	$19,463,230	$21,689,578

* Newark Smelting and Refining Company, St. Louis Smelting Works, Pennsylvania Lead Company, Omaha Smelting and Refining Company, Charles 8. Platt, Boston and Colorado Smelting Company, Kempf, Nenninger & Co., and Kansas City Smelting and Refining Company.

Statement of Imports and Exports of Gold and Silver during the calendar year ended December 31, 1881.

IMPORTS.

Ports.	*Gold.*				*Silver.*				*Silver.*	*Gold and Silver.*
	Bullion.	*Coins.*		*Total.*	*Bullion.*	*American Coin.*		*Foreign.*	*Total.*	*Total.*
		American.	*Foreign.*			*Trade Dollar.*	*Other.*			
NEW YORK.										
Quarter ending March 31	$9,117,200	$151,402	$2,470,379	$11,738,981	$1,788	$19,466	$315,946	$544,849	$882,049	$12,621,030
Quarter ending June 30	6,222,625	371,064	9,832,366	16,426,055	2,946	....	313,129	365,277	681,352	17,107,407
Quarter ending September 30	3,486,953	1,201,964	10,887,132	15,576,049	5,247	....	255,976	358,516	619,739	16,195,788
Quarter ending December 31	2,107,802	1,286,097	6,045,017	9,438,916	6,919	....	180,086	450,719	637,724	10,076,640
Total	$20,934,580	$3,010,527	$29,234,894	$53,180,001	$16,900	$19,466	$1,065,137	$1,719,361	$2,820,864	$56,000,865
SAN FRANCISCO.										
Quarter ending March 31	$97,091	$19,081	$297,692	$413,864	$575,830	$1,000	$124,040	$772,279	$1,473,155	$1,887,019
Quarter ending June 30	100,189	....	341,750	441,939	570,467	1,000	13,545	477,895	1,062,907	1,504,846
Quarter ending September 30	533,221	6,913	154,454	694,588	389,239	....	19,106	681,437	1,089,782	1,784,370
Quarter ending December 31	2,255,536	7,322	2,092,250	4,355,108	432,960	....	6,813	521,620	961,393	5,316,501
Total	$2,986,037	$33,316	$2,886,146	$5,905,499	$1,968,502	$2,000	$163,504	$2,453,231	$4,587,237	$10,492,736
ALL OTHER PORTS.										
Quarter ending March 31	$4,038	$317,200	$13,071	$334,309	$100,131	....	$39,036	$219,100	$358,267	$692,576
Quarter ending June 30	12,394	83,807	25,717	121,918	44,640	....	41,919	224,861	311,420	433,338
Quarter ending September 30	4,157	457,374	106,521	568,052	49,890	....	37,751	189,776	277,417	845,469
Quarter ending December 31	10,913	227,065	50,863	288,841	32,816	....	66,887	140,737	240,440	529,281
Total	$31,502	$1,085,446	$196,172	$1,313,120	$227,477	....	$185,593	$774,474	$1,187,544	$2,500,664
Grand total imports	$23,952,119	$4,129,289	$32,317,212	$60,398,620	$2,212,879	$21,466	$1,414,234	$4,947,066	$8,595,645	$68,994,265

Statement of Imports and Exports of Gold and Silver during the calendar year ending December 31, 1881.

EXPORTS (DOMESTIC).

Ports.	Gold.			Silver.				Gold and Silver.
	Bullion.	Coin.	Total.	Bullion.	Coin.		Total.	Total.
					Trade Dollars.	Other.		
NEW YORK.								
Quarter ending March 31	....	$346,600	$346,600	$2,672,850	....	$107,927	$2,780,777	$3,127,377
Quarter ending June 30	$50,000	75,659	125,659	2,420,900	....	3,958	2,424,858	2,550,517
Quarter ending September 30	10,000	168,423	178,423	2,217,200	....	27,900	2,245,100	2,423,523
Quarter ending December 31	63,000	89,207	152,207	2,577,400	....	13,510	2,610,910	2,743,117
Total	$123,000	$679,889	$802,889	$9,888,350	....	$153,295	$10,041,645	$10,844,534
SAN FRANCISCO.								
Quarter ending March 31	$800	$41,666	$42,866	$697,151	$20	$17,000	$714,171	$756,637
Quarter ending June 30	790	97,862	98,652	1,705,208	....	30,000	1,735,208	1,833,860
Quarter ending September 30	18,555	110,966	129,521	385,311	....	24,600	409,911	543,432
Quarter ending December 31	15,645	193,784	209,429	107,976	....	8,495	116,471	325,900
Total	$35,790	$444,278	$480,068	$2,899,646	$20	$80,095	$2,979,761	$3,459,829
ALL OTHER PORTS.								
Quarter ending March 31	....	$4,704	$4,704	$1,000	....	$158,954	$159,954	$164,658
Quarter ending June 30	$1,060	503,400	504,460	....	....	66,300	66,300	570,760
Quarter ending September 30	416	44,819	45,235	4,146	....	9,477	13,623	58,858
Quarter ending December 31	500	....	500	3,138	....	900	4,038	4,538
Total	$1,976	$552,923	$554,899	$8,284	....	$235,631	$243,915	$798,814
Grand total exports (domestic)	$160,766	$1,677,090	$1,837,856	$12,796,280	$20	$469,021	$13,265,321	$15,103,177

Statement of Imports and Exports of Gold and Silver during the calendar year ending December 31, 1881.

EXPORTS (FOREIGN).

Ports.	Gold.			Silver.			Gold and Silver.
	Bullion.	Coin.	Total.	Bullion.	Coin.	Total.	Total.
NEW YORK.							
Quarter ending March 31	....	$68,810	$68,810	$5,400	$288,427	$293,827	$362,637
Quarter ending June 30	$2,157	588,711	590,868	4,260	269,998	274,258	865,126
Quarter ending September 30	....	84,096	84,096	....	479,079	479,079	553,175
Quarter ending December 31	....	20,013	20,013	47,684	471,537	519,221	539,234
Total	$2,157	$761,630	$763,787	$57,344	$1,509,041	$1,566,385	$2,330,172
SAN FRANCISCO.							
Quarter ending March 31	....	....	....	....	415,574	415,574	415,574
Quarter ending June 30	....	....	....	....	674,916	674,916	674,916
Quarter ending September 30	....	1,900	1,900	....	414,587	416,487	416,487
Quarter ending December 31	....	....	....	....	602,529	602,529	602,529
Total	....	$1,900	$1,900		$2,107,586	$2,109,506	$2,111,406
ALL OTHER PORTS.							
Quarter ending March 31	....	....	....	....	107,968	107,968	107,968
Quarter ending June 30	....	....	....	....	5,532	5,532	5,532
Quarter ending September 30	....	....	....	....	1,700	1,700	1,700
Quarter ending December 31	....	....	....	....	8,762	8,762	8,762
Total	....	....	....	....	$123,962	$123,962	$123,962
Grand total export of foreign silver	$2,157	$763,530	$765,687	$57,344	$3,740,589	3,799,853	$4,565,540

Shipments of Base Bullion containing Gold or Silver via the Union Pacific Railroad from July 1 to December 31, 1880.

To whom Consigned.	State or Territory.					Total.
	Colorado.	Idaho.	Montana.	Nevada.	Utah.	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Omaha Smelting and Refining Company, Omaha, Neb	2,613,997	1,223,275	492,471	....	3,539,947	7,869,690
Newark Smelting and Refining Works, Newark, N. J	7,948,607	....	....	1,760,722	....	9,709,329
St. Louis Smelting and Refining Company, St. Louis, Mo	4,377,342	....	....	....	....	4,377,342
Manhattan Smelting and Refining Company, New York	300,000	....	....	....	....	300,000
Pennsylvania Lead Works, Mansfield, Pa	4,440,296	....	....	....	5,568,782	10,009,078
Horn Silver Mining Company, Chicago, Ill	....	....	....	....	7,177,104	7,177,104
San Juan Mining and Smelting Company, Kansas City, Mo	20,000	....	....	....	....	20,000
E. C. Atkins, Newark, N. J	....	....	2,544,592	....	....	2,544,592
Netter & Matthews, Omaha, Neb	17,985	....	....	....	....	17,985
German National Bank, Omaha, Neb	4,652,904	....	....	....	....	4,652,904
Omaha National Bank, Omaha, Neb	1,363,072	....	....	....	....	1,363,072
J. E. Dowley, Omaha, Neb	....	....	....	....	103,304	103,304
J. H. Jones, Denver, Col	20,150	....	....	....	....	20,150
A. Hammener, Ogden, Utah	....	....	10,000	....	....	10,000
Wells, Fargo & Co., Council Bluffs, Iowa	....	....	....	....	102,424	102,424
Total	25,754,353	1,223,275	3,047,063	1,760,722	16,491,561	48,276,974

Shipments of Base Bullion containing Gold or Silver via the Union Pacific Railroad from January 1 to June 30, 1881.

To whom Consigned.	*State or Territory.*					*Total.*
	Arizona.	*Colorado.*	*Idaho.*	*Montana.*	*Utah.*	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Omaha Smelting and Refining Company, Omaha, Neb	....	2,540,809	93,975	418,508	1,150,907	4,204,199
Newark Smelting and Refining Works, Newark, N. J	....	4,818,308	116,778	1,547,538	2,964,703	9,447,327
St. Louis Smelting and Refining Company, St. Louis, Mo	....	3,894,935	....	....	....	3,894,935
Manhattan Smelting and Refining Company, New York	....	336,380	....	....	....	336,380
Pennsylvania Lead Works, Mansfield, Pa	....	4,909,322	....	....	6,671,337	11,580,659
Horn Silver Mining Company, Chicago, Ill	....	....	....	....	5,633,051	5,633,051
Omaha National Bank, Omaha, Neb	....	5,332,770	....	....	....	5,332,770
Mather & Co., Omaha, Neb	....	23,898	....	....	....	23.898
Daniel Meyer, Omaha, Neb	608,118	....	....	....	....	608,118
Matthews & Co., Denver, Col	....	39,750	....	....	....	39,750
N. W. Forwarding Company, Blackfoot	....	....	29,500	....	....	29,500
P. Langhammer	....	44,100	....	....	....	44,100
Total	608,118	21,940,272	240,253	1,966,046	16,419,998	41,174.687

Shipments of Base Bullion containing Gold or Silver via the Union Pacific Railroad during the fiscal year ended June 30, 1881.

To whom Consigned.	*State or Territory.*						*Total.*
	Arizona.	*Colorado.*	*Idaho.*	*Montana.*	*Nevada.*	*Utah.*	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Omaha Smelting and Refining Company, Omaha, Neb	....	5,154,806	1,317,250	910,979	....	4,690,854	12,073,889
Newark Smelting and Refining Works, Newark, N. J	....	12,766,915	116,778	1,547,538	1,760,722	2,964,703	19.156.656
St. Louis Smelting and Refining Company, St. Louis, Mo	....	8,272,277	....	....	....	....	8,272,277
Manhattan Smelting and Refining Company, New York	....	636,380	....	....	....	....	636,380
Pennsylvania Lead Works, Mansfield, Pa	....	9,349,618	....	....	....	12,240,119	21,589,737
Horn Silver Mining Company, Chicago, Ill	....	....	....	....	....	12,810,155	12,810,250
Omaha National Bank, Omaha, Neb	....	6,695,842	....	....	....	....	6,695,842
Mather & Co., Omaha, Neb	....	23,898	....	....	....	....	23,898
Daniel Meyer, Omaha, Neb	608,118	....	....	....	....	....	608,118
Netter & Matthews, Omaha, Neb	....	17,985	....	....	....	....	17,985
German National Bank, Omaha, Neb	....	4,652,904	....	....	....	....	4.652,904
J. E. Dowley, Omaha, Neb	....	....	....	....	....	103,304	103,304
San Juan Mining and Smelting Company, Kansas City, Mo	....	20,000	....	....	....	....	20,000
C. E. Atkins, Newark, N. J	....	....	....	2,544,592	....	....	2,544,592
J. H. Jones, Denver, Col	....	20,150	....	....	....	....	20,150
A. Hammener, Ogden, Utah	....	....	....	10,000	....	....	10,000
Wells, Fargo & Co., Council Bluffs, Iowa	....	....	....	....	....	102,424	102,424
Matthews & Co., Denver, Col	....	39,750	....	....	....	....	39,750
Northwestern Forwarding Company, Blackfoot	....	....	29,500	....	....	....	29,500
P. Langhammer	....	44,100	....	....	....	....	44,100
Total	608,118	47,694,625	1,463,528	5,013,109	1,760,722	32,911,559	89,451,661

Shipments of Base Bullion containing Gold or Silver via the Atchison, Topeka, and Santa Fe Railroad from July 1 to December 31, 1880.

Locality from which Shipped.	*To whom Consigned.*					
	Newark Smelting and Refining Works, Newark, N. J.	*St. Louis Smelting and Refining Company, St. Louis. Mo.*	*Pennsylvania Lead Company, Mansfield, Pa.*	*H. S. Crooke, Agent, New York.*	*Chrysolite Silver Mining Company, New York.*	*Total.*
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Leadville, Lake County, Col	4,860,143	2,585,135	617,450	....	....	8,062,728
Malta, Lake County, Col	2,609,719	1,650.355	....	180,000	41,005	4,481,079
Pueblo, Pueblo County, Col	193,352	119,390	....	....	....	312,742
Cañon City, Frémont County, Col	....	171,071	....	....	....	171,071
Alamosa, Conejos County, Col	20,000	....	....	20,000	....	40,000
Buena Vista, Chaffee County, Col	86,420	....	....	....	....	86,420
Total	7,769,634	4,525,951	617,450	200,000	41,005	13,154,040

Shipments of Base Bullion containing Gold or Silver via the Atchison, Topeka, and Santa Fe Railroad from July 1 to December 31, 1881.

Locality from which Shipped.	*To whom Consigned.*				
	Newark Smelting and Refining Works, Newark, N. J.	*St. Louis Smelting and Refining Company, St. Louis, Mo.*	*Manhattan Smelting and Refining Works, New York.*	*Kansas City Smelting and Refining Company.*	*Total.*
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Leadville, Lake County, Col	12,909,859	3,105,548	2,212,219	....	18,227,626
Pueblo, Pueblo County, Col	2,244,687	1,215,654	....	....	3,460,341
Cañon City, Fremont County, Col	....	....	....	2,780.056	2,780,056
Total	15,154,546	4,321,202	2,212,219	2,780,056	24,468,023

Shipments of Base Bullion containing Gold or Silver via the Atchison, Topeka, and Santa Fe Railroad from January 1 to June 30, 1881.

Locality from which Shipped.	*To whom Consigned.*					
	Newark Smelting and Refining Works, Newark, N. J.	*St. Louis Smelting and Refining Company, St. Louis, Mo.*	*Manhattan Smelting and Refining Works, New York.*	*Kansas City Smelting and Refining Company.*	*H. S. Crooke, Agent, New York.*	*Total.*
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Leadville, Lake County, Col	3,414,749	7,328,392	1,001,653	5,602,633	20,000	17,367,427
Pueblo, Pueblo County, Col	650,267	...	...	...	...	650,267
Robinson, Summit County, Col	279,425	...	...	...	...	279,425
Del Norte, Rio Grande County, Col	...	...	...	...	140,000	140,000
Total	4,344,441	7,328,392	1,001,653	5,602,633	160,000	18,437,119

Shipments of Base Bullion containing Gold or Silver via the Atchison, Topeka, and Santa Fe Railroad during the fiscal year ended June 30, 1881.

Locality from which Shipped.	*To whom Consigned.*							
	Newark Smelting and Refining Works, Newark, N. J.	*St. Louis Smelting and Refining Co., St. Louis, Mo.*	*Pennsylvania Lead Comp'y, Mansfield, Pa.*	*Manhattan Smelting and Refining Works, New York.*	*Kansas City Smelting and Refining Co.*	*H. S. Crooke, Agent, New York.*	*Chrysolite Silver Min'g Co., New York.*	*Total.*
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Leadville, Lake County, Col	17,770,002	5,690,683	617,450	2,212,219	...	...	...	26,290,354
Malta, Lake County, Col	2,609,719	1,650,355	...	...	...	180,000	41,005	4,481,079
Pueblo, Pueblo County, Col	2,438,039	1,335,044	...	...	...	...	...	3,773,083
Cañon City, Fremont County, Col	...	171,071	...	...	2,780,056	...	...	2,951,127
Alamosa, Conejos County, Col	20,000	...	...	...	...	20,000	...	40,000
Buena Vista, Chaffee County, Col	86,420	...	...	...	...	...	...	86,420
Total	22,924,180	8,847,153	617,450	2,212,219	2,780,056	200,000	41,005	37,622,063

Shipments of Base Bullion containing Gold or Silver via the Atchison, Topeka, and Santa Fe Railroad during the calendar year ended December 31, 1881.

Locality from which Shipped.	*To whom Consigned.*					
	Newark Smelting and Refining Works. Newark, N. J.	*St. Louis Smelting and Refining Company, St. Louis, Mo.*	*Manhattan Smelting and Refining Works, New York.*	*Kansas City Smelting and Refining Company.*	*H. S. Crooke, Agent, New York.*	*Total.*
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Leadville, Lake County, Col	16,324,608	10,433,940	3,213,872	5,602,633	20,000	35,595,053
Pueblo, Pueblo County, Col	2,894,954	1,215,654	...	...	...	4,110,608
Canon City, Fremont County, Col	...	...	...	2,780,056	...	2,780,056
Robinson, Summit County, Col	279,425	...	...	...	...	279,425
Del Norte, Rio Grande County, Col	...	...	...	...	140,000	140,000
Total	19,498,987	11,649,594	3,213,872	8,382,689	160,000	42,905,142

Shipments of Ore and Base Bullion via the Denver and Rio Grande Railroad during the calendar year 1881.

Counties from which Shipped.	*Ore.*	*Base Bullion.*
SIX MONTHS ENDING JUNE 30.	Pounds.	Pounds.
Chaffee	999,597	
Custer	2,724,160	
Gunnison	183,500	
Lake	23,875,603	34,122,444
Pitkin	68,000	
Saguache	170,383	
Summit	12,705,482	1,328,025
Total	40,726,725	35,450,469
SIX MONTHS ENDING DECEMBER 31.		
Chaffee	1,801,800	
Custer	4,378,000	
Gunnison	1,020,000	
Lake	23,696,510	24,344,961
Pueblo	...	1,167,500
Saguache	470,000	
Summit	1,466,300	1,885,740
Total	32,832,610	27,398,201
CALENDAR YEAR 1881.		
Chaffee	2,801,397	
Custer	7,102,160	
Gunnison	1,203,500	
Lake	47,572,113	58,467,405
Pitkin	68,000	
Pueblo	...	1,167,500
Saguache	640,383	
Summit	14,171,782	3,213,765
Total	73,559,335	62,848,670

Shipment of Bullion and Ore via the Nevada Central, Carson and Colorado and Virginia and Truckee Railroads during the fiscal year 1881.

FROM THE STATE OF NEVADA.

Counties from which Shipped.	*Destination.*	*Ore.*	*Bullion or Crude Metal.*	*Copper Ore.*
		Pounds.	Pounds.	Pounds.
Churchill	East	377		
Eureka	West	...	3,993,082	
do.	East	204,860	12,219,985	
Esmeralda	West	80,030	185,408	
do.	East	221,444		
Lander	West	40,108		
do.	East	90,815		
Lyon	West	119,727	...	94,921
Ormsby	West	1,953,174½		
Storey	West	105,223,682		
Washoe	East	38,606		
Total	...	107,972,823½	16,398,475	94,921

Shipment of Ore and Bullion via the Central and Southern Pacific Railroad during the six months ended December 31, 1880.

FROM NEW MEXICO.

Counties from which Supplied.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.		Pounds.
Grant	West	280	...	1,140,820
do.	East	330	...	...
Total	...	610	...	1,140,820

Shipments of Ore and Bullion via the Central and Southern Pacific Railroad during the six months ended December 31, 1880.

FROM CALIFORNIA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Alameda	West.	....	....	101,770
do.	East.	379,860	20,000	
Amador	West.	76,810	....	12,770
Butte	West.	....	....	90
Calaveras	West.	2,858,870		
Fresno	West.	2,290		
Kern	West.	32,170	278,130	
Los Angeles	West.	5,540		
Merced	West.	26,070		
Napa	West.	3,890	....	973,940
Placer	West.	93,780		
do.	East.	14,150		
Sacramento	West.	46,460		
San Bernardino	West.	43,140	1,700	
San Diego	East.	9,600,000		
San Joaquin	West.	64,820		
Santa Clara	East.	....	....	22,500
Shasta	West.	2,220	....	24,660
Solano	West.	20,100	....	9,270
Stanislaus	West.	53.450	....	320
Tulare	West.	2,000		
Yuba	West.	269,550		
do.	East.	20,000		
Total		13,615,170	299,830	1,145,320

FROM UTAH.

Box Elder	West.	240		
do.	East.	980,730		
Weber	West.	41,150	1,399,300	217,570
Total	....	1,022,120	1,399,300	217,570

FROM ARIZONA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Cachise	West	60,610	134,470	1,751,580
Maricopa	West	23,400	....	
Pima	West	69,610	28,320	
Pinal	West	1,182,220	8.080	770
Yuma	West	1,204,380	20,590	
Total	....	2,540,220	191,460	1,752,350

FROM NEVADA.

Churchill	West	1,950		
do.	East	20,000		
Elko	West	77,850	22,310	18,100
do.	East	25,910	40,000	327,140
Eureka	West	410	2,941,080	5,280,000
do.	East	65.930	1,729,540	
Humboldt	West	530,130	650	
do.	East	57,250		
Lander	West	378,860		
do.	East	103.630		
Ormsby	West	55,970		
Storey	West	840	....	700
Washoe	West	152,080	20,000	130
Total	....	1,470,810	4,753,580	5,626,070

Recapitulation of Ore and Bullion Shipped via the Central and Southern Pacific R.R. during the six months ended Dec. 31, 1880.

State.	*Destination.*						*Total.*
	West.			*East.*			
	Ore.	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*	*Ore.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
California	3,601,160	279,830	1,122,820	10,014,010	20,000	22,500	15,060,320
Arizona	1,540,220	191,460	1,752,350	....	....	....	4,484,030
New Mexico	280	....	1,140,820	330	....	....	1,141,430
Nevada	1,198,090	2,984,040	5,298,930	272,720	1,769,540	327,140	11,850,460
Utah	41,390	1,399,300	217,570	980,730	....	....	2,638,990
Total	7,381,140	4,854,630	9,532,490	11,267,790	1,789,540	349,640	35,175,230

Shipments of Ore and Bullion via the Central and Southern Pacific Railroad during the six months ended June 30, 1881.

FROM CALIFORNIA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Alameda	West	1,073,500		
do.	East	344,710	41,250	
Amador	West	92,940	....	24,390
Butte	West	....	....	1,010
Calaveras	West	647,540		
Kern	West	62,880	696,510	
Los Angeles	West	5,560	1,270	
Merced	West	54,010		
Napa	West	44.470	....	1,070,920
Placer	West	53,550	....	300
do.	East	70		
Sacramento	West	20,120		
do.	East	....	80	280
San Bernardino	West	63,770		
San Diego	West	21,340		
do.	East	10,000,000		
San Joaquin	West	69,130		
Santa Clara	West	960		
do.	East	....	....	4,500
Shasta	West	1,830		
Solano	West	....	....	2,010
Stanislaus	West	73,340		
Yuba	West	264,090		
do.	East	42,300		
Total	......	12,936,130	739,110	1,103,410

FROM NEW MEXICO.

Grant	West	31,170	391,180	1,151,540
Total	....	31,170	391,180	1,151,540

FROM ARIZONA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Cachise	West	179,730	481,680	1,396,090
do.	East	1,470	25,960	
Maricopa	West	440		
do.	East	90		
Pima	West	17,370	43,340	
Pinal	West	189.940	33,510	20,000
Yuma	West	1,713,130	70,160	
Total	....	2,102,170	654,650	1,416,090

FROM NEVADA.

Elko	East	21,630	....	104,760
Eureka	West	....	4,728,190	3,677,560
do.	East	147,400	605,940	
Humboldt	West	486.910		
do.	East	10,430	20,300	
Lander	West	539.810		
do.	East	116,270		
Ormsby	West	2,450	770	
Storey	West	1,080		
Washoe	West	31,660	....	60,740
do.	East	1,500		
Total	....	1,359,140	5.355,200	3,843,060

FROM UTAH.

Box Elder	East	1,002,160		
Weber	West	846,450	1,395,840	928,210
Total	....	1,848,610	1,395,840	928,210

Recapitulation of Ore and Bullion shipped via the Central and Southern Pacific Railroads during the six months ended June 30, 1881.

State.	Destination.						Total.
	West.			East.			
	Ore.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.	Ore.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
California	2,549,050	697,780	1,098,680	10,387,080	41,330	4,780	14,778,650
Arizona	2,100,610	628,690	1,416,090	1,560	25,960	....	4,172,910
New Mexico	31,170	391,180	1,151,540	....	....	....	1,573,890
Nevada	1,061,910	4,728,960	3,738,300	297,230	626,240	104,760	10,557,400
Utah	846,450	1,395,840	928,210	1,002,160	....	....	4,172,660
Total	6,589,190	7,842,450	8,332,770	11,688,030	693,530	109,540	35,255,510

Shipments of Ore and Bullion via the Central and Southern Pacific Railroads during the six months ended December 31, 1881.

FROM CALIFORNIA.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
		Pounds.	Pounds.	Pounds.
Alameda	West	831,660		
do.	East	228,060	43,800	10,050
Amador	West	115,990	....	790
Butte	West	3,020	....	150
Calaveras	West	109,310		
Colusa	West	38,350		
Fresno	West	2,590		
Kern	West	3,850	202,990	
do.	East	80		
Los Angeles	West	2,390		
Merced	West	2,430		
Napa	West	1,000	....	985,800
Nevada	West	600		
Placer	West	488,240		
do.	East	10,820		
San Bernardino	West	86,160		
San Diego	East	7,100,000		
San Joaquin	West	101,350		
Santa Clara	East	....	....	64,800
Shasta	West	3,050	....	14,670
Stanislaus	West	48,090		
Yuba	West	239,240	....	650
do.	East	127,450		
Total	....	9,543,730	246,290	1,076,410

FROM UTAH.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
Box Elder	East	3,412,100	582,940	
Weber	West	91,550	....	19,150
Total	......	3,503,650	582,940	19,150

FROM ARIZONA.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
		Pounds.	Pounds.	Pounds.
Cacbise	West	8,860	....	3,200,570
do.	East	480	89,800	....
Maricopa	West	21,640	....	....
Pima	West	46,150	8,000	....
do.	East	4,130	....	....
Pinal	West	156,140	61,690	175,380
do.	East	89,320	46,880	57,380
Yuma	West	1,627,600	....	....
do	East	22,000	....	....
Total	....	1,956,520	206,370	3,433,330

FROM NEW MEXICO.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
Grant	West	20,000	....	537,090
do.	East	535,190	....	1,020,690
Total	....	555,190	....	1,557,780

FROM NEVADA.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
Elko	West	....	21,630	93,530
do.	East	86,690	....	205,700
Eureka	West	48,280	4,173,890	5,520,000
do.	East	181,770	1,056,620	
Humboldt	West	333,600		
do.	East	61,070		
Lander	West	915,140		
do.	East	264,140	163,400	
Washoe	West	114,760	322,440	
do.	East	50		
Total	......	2,005,450	5,737,980	5,819,230

Recapitulation of Ore and Bullion shipped via the Central and Southern Pacific Railroads during the six months ended December 31, 1881.

State.	Destination.						Total.
	West.			East.			
	Ore.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.	Ore.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
California	2,077,320	202,990	1,001,560	7,466,410	43,300	74,850	10,866,430
Arizona	1,860,390	69,690	3,375,950	96,130	136,680	57,380	5,596,220
New Mexico	20,000	....	537,090	535,190	....	1,020,690	2,112,970
Nevada	1,411,730	4,517,960	5,613,530	593,720	1,220,020	205,700	13,562,660
Utah	91,550	....	19,150	3,412,100	582,940	....	4,105,740
Total	5,460,990	4,790,640	10,547,280	12,103,550	1,982,940	1,358,620	36,244,020

Shipments of Ore and Bullion via the Central and Southern Pacific Railroads during the fiscal year ended June 30, 1881.

FROM NEW MEXICO.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
		Pounds.	Pounds.	Pounds.
Grant	West	31,450	391,180	2,292,360
do.	East	330		
Total	......	31,780	391,180	2,292,360

FROM UTAH.

Counties from which Shipped.	Destination.	Ores.	Base Bullion or Crude Metal.	Copper, Quicksilver, and Lead.
		Pounds.	Pounds.	Pounds.
Box Elder	West	240		
do.	East	1,982,890		
Weber	West	887,600	2,795,140	1,145,780
Total	....	2,870,730	2,795,140	1,145,780

Shipments of Ore and Bullion via the Central and Southern Pacific Railroads during the fiscal year ended June 30, 1881.

FROM CALIFORNIA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Alameda	West	1,073,500	....	101,770
do.	East	724,570	61,250	
Amador	West	169,750	....	37,160
Butte	West	....	....	1,100
Calaveras	West	3,506,410		
Fresno	West	2,290		
Kern	West	95,050	974,640	
Los Angeles	West	11,100	1,270	
Merced	West	80,080		
Napa	West	48,360	....	2,044,860
Placer	West	147,330	....	300
do.	East	14,220		
Sacramento	West	66,580		
do.	East	....	80	280
San Bernardino	West	106,910	1,700	
San Diego	West	21,340		
do.	East	19,600,000		
San Joaquin	West	133,950		
Santa Clara	West	980		
do.	East	....	....	27,000
Shasta	West	4,050	....	24,660
Solano	West	20,100	....	11,280
Stanislaus	West	126,790	....	320
Tulare	West	2,000		
Yuba	West	533,540		
do.	East	62,300		
Total	....	26,551,300	1,038,940	2,248,720

FROM ARIZONA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Cachise	West	240,340	616,150	3,147,670
do.	East	1,470	25,960	
Maricopa	West	23,840		
do.	East	90		
Pima	West	86,980	71,660	
Pinal	West	1,372,160	41,590	20,770
Yuma	West	2,917,510	90,750	
Total	......	4,642,390	846,110	3,168,440

FROM NEVADA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
Churchill	West	1,950		
do.	East	20,000		
Elko	West	77,850	22,310	18,100
do.	East	47,540	40,000	431,900
Eureka	West	410	7,669,270	8,957,560
do.	East	213,330	2,335,480	
Humboldt	West	1,017,040	650	
do.	East	67,680	20,300	
Lander	West	918,670		
do.	East	219,900		
Ormsby	West	58,420	770	
Storey	West	1,920	....	700
Washoe	West	183,740	20,000	60,870
do.	East	1,500		
Total	....	2,829,950	10,108,780	9,469,130

Recapitulation of Ore and Bullion shipped via the Central and Southern Pacific Railroads during the fiscal year ended June 30, 1881.

State.	*Destination.*						*Total.*
	West.			*East.*			
	Ore.	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*	*Ore.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
California	6,150,210	977,610	2,221,450	20,401,090	61,330	27,280	29,838,970
Arizona	4,640,830	820,150	3,168,440	1,560	25,960	....	8,656,940
New Mexico	31,450	391,180	2,292,360	330	....	....	2,715,320
Nevada	2,260,000	7,713,000	9,037,230	569,950	2,395,780	431,900	22,407,860
Utah	887,840	2,795,140	1,145,780	1,982,890	....	....	6,811,650
Total	13,970,330	12,697,080	17,865,260	22,955,820	2,483,070	459,180	70,430,740

Shipments of Ore and Bullion via the Central and Southern Pacific Railroads during the calendar year 1881.

FROM CALIFORNIA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Alameda	West	1,905,160		
do.	East	572,770	84,550	10,050
Amador	West	208,930	....	25,180
Butte	West	3,020	....	1,160
Calaveras	West	756,850		
Colusa	West	38,350		
Fresno	West	2,590		
Kern	West	66,730	899,500	
do.	East	80		
Los Angeles	West	7,950	1,270	
Merced	West	56,440		
Napa	West	45,470	....	2,056,220
Nevada	West	600		
Placer	West	541,790	....	300
do.	East	10,890		
Sacramento	West	20,120		
do.	East	....	80	280
San Bernardino	West	149,930		
San Diego	West	21,340		
do.	East	17,100,000		
San Joaquin	West	170,480		
Santa Clara	West	980		
do.	East	....	....	69,300
Shasta	West	4,880	....	14,670
Solano	West	....	....	2,010
Stanislaus	West	121,430		
Yuba	West	503,330	....	650
do.	East	169,750		
Total	....	22,479,860	985,400	2,179,820

FROM ARIZONA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Cachise	West	188,590		4,596,660
do.	East	1,950	481,680	
Maricopa	West	22,080	115,760	
do.	East	90		
Pima	West	63,520	51,340	
do.	East	4,130		
Pinal	West	346,080	95,200	195,380
do.	East	89,320	46,880	57,380
Yuma	West	3,340,730	70,160	
do.	East	2,200		
Total	....	4,058,690	861,020	4,849,420

FROM NEVADA.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
Elko	West	....	21,630	93,530
do.	East	108,320	....	310,460
Eureka	West	48,230	8,902,080	9,197,560
do.	East	329,170	1,662,560	....
Humboldt	West	820,510	....	....
do.	East	71,500	20,300	....
Lander	West	1,454,950	....	....
do.	East	380,410	163,400	....
Ormsby	West	2,450	770	....
Storey	West	1,080	....	....
Washoe	West	146,420	322,440	60,740
do.	East	1,550	....	....
Total	....	3,364,590	11,093,180	9,662,290

Shipments of Ore and Bullion via the Central and Southern Pacific Railroads during the calendar year 1881.

FROM NEW MEXICO.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Grant	West.	51,170	391,180	1,688,630
do.	East.	535,190		1,020,690
Total	....	586,360	391,180	2,709,320

FROM UTAH.

Counties from which Shipped.	*Destination.*	*Ores.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*
		Pounds.	Pounds.	Pounds.
Box Elder	West.	....	....	....
do.	East.	4,414,260	582,940	....
Weber	West.	938,000	1,395,840	947,360
Total	....	5,352,260	1,978,780	947,360

Recapitulation of Ore and Bullion shipped via the Central and Southern Pacific Railroads during the calendar year 1881.

State.	*Destination.*						*Total.*
	West.			*East.*			
	Ore.	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*	*Ore.*	*Base Bullion or Crude Metal.*	*Copper, Quicksilver, and Lead.*	
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
California	4,626,370	900,770	2,100,190	17,853,490	84,630	79.630	25,645,080
Arizona	3,961,000	698,380	4,792.040	97,690	162,640	57,380	9,769.130
New Mexico	51,170	391.180	1,688,630	535,190	....	1,020,690	3,686.860
Nevada	2,473,640	9,246,920	9,351,830	890,950	1,846,260	310,460	24,120,060
Utah	938,000	1,395,840	947,360	4,414,260	582.940	....	8,278,400
Total	12,050,180	12,633,090	18,880,050	23,791,580	2,676,470	1,468,160	71,499,530

THE MINING COMPANIES OF THE UNITED STATES.

THE details of the mining companies that follow have been gathered with considerable trouble. Some of the companies it has been possible to induce to respond to our request for details. But they number only 118 responses to 10,000 accurately addressed circulars and requests. These, as being perfectly reliable, we have placed first. Those reports that follow are gathered from the *Mining Record*, the *Engineering and Mining Journal*, the *Mining Index*, the *Iron Age*, the *Coal Trade Journal*, the *Mining and Scientific Press*, the *Maine Mining Journal*, the *Rocky Mountain Mining Review*, the reports of Mr. Burchard, and other equally reliable sources. We do not present it as being an accurate record of the mining companies of this country, but as being a partial list, indicating the great importance of the mining industry.

The compiled list is obviously, however, only partially correct; but it is a beginning. To complete this list and to make it a reference work worthy of the highest credence, is the sincere wish of the compiler. He therefore earnestly and sincerely requests that mining companies and individuals in possession of information that will correct errors or supply omissions in this list will forward the same at once, that in subsequent editions of this book the list may more nearly represent what it is hoped to make it—a full and complete catalogue of the mine owners of the United States and their property. Unless otherwise stated, all reports are for April 1, 1882.

The Reported Companies.—The details of the one hundred and twenty companies that follow, and that were sent to us by officers of the companies, contain some facts worthy of remark. Fifty-nine of these one hundred and twenty report their capitalization, which foots up a total of $138,823,000 nominal capital. An enormous fact! This large sum represents 11,900,840 shares, which average, therefore, about $11.66 per share. These are noteworthy figures.

COAL.

Avenue (First) Coal-Mines, owned by Messrs. Thomas & Sons, are located at Evansville, Ind., on the Belt Railway, and cover an area of 147 acres. They are in first-class condition throughout, entries being all timbered, and having the necessary improvements to conduct the operations with safety and economy. The depth of shaft is 270 feet. Developments were commenced in 1875. The mine is capable of producing a maximum of 43,200 tons per year. The company is a private enterprise, not being chartered, and was organized in 1875, operations being commenced the same year. The yield (gross) during 1881 was 21,600 tons. This information was furnished by Mr. E. R. Thomas, of the firm of Messrs. Thomas & Sons.

Banner Mines (The) and the **Gas-Coal Mines,** comprising an area of 432 acres, are owned by Messrs. Gamble & Risher, who have offices at the works, the main office being at 116 Water St., Pittsburg. The property is located at White Mills Station, Monongahela Division P. R. R., Washington county, Pa., and is valued at $75,000, which represents the capital of the company, which was organized in June, 1879. Developments were commenced about the same date. In 1881, the company shipped 1,460,000 bushels of coal. The Banner Mines despatch by river and the Gas Coal-Mines by rail. This information was furnished by Messrs. Gamble & Risher.

Bennett & Everhardt Collieries (The), leased to and operated by Messrs. Waddell & Co., are located in Pennsylvania,—the Bennett at Mill Creek and the Everhardt in Jenkins township. Total extent of holding is about 850 acres. The Bennett colliery was opened in May, 1881, and arrangements are not yet completed. There are to be two shafts and a breaker; estimated cost of same, $100,000. From this colliery there were shipped during April 93$\frac{18}{20}$ tons coal, and during May 736$\frac{13}{20}$ tons. The Everhardt colliery belongs to the Everhardt Coal Co., whose offices are at Boston, Mass. The mine was commenced about 1865. It came into the hands of Messrs. Waddell & Co. in 1874, who have run it up to the present time. This colliery produced in 1881 $53,661$\frac{18}{20}$ (net). This information was furnished by Messrs. Waddell & Co., the leasees of the property.

Black Hills Mine (The), owned by Miller & Co., is located at the intersection of the Pittsburg, Virginia & Charleston Railway and the Monongahela River, and comprises an extent of 200 acres. The opening to mine is by tunnel 2,500 feet in length. There are two shafts. Developments were commenced in 1879. The gross yield during 1881 was 12,500 tons. Analysis of coal gives fixed carbon, 64; ash, 2.28; sulphur, 00.13, and bitumen, 33.59. Total, 100 parts. This information was furnished by Messrs. Miller & Co., of the Black Hills.

Boston Coal-Mining Company's (The) properties, not being operated at present, are located on Herbert river, Nova Scotia, and cover an area of ten acres, with privileges to the extent of two square miles. The average width of vein is two and one-half feet. The capitalization is $100,000, in 4,000 shares of $25 each. The above information was furnished by John Moffit, agent of the Boston Coal-Mining Company.

The Central Coal and Iron Company (The) is chartered under the laws of the State of Kentucky. The officers are B. Du Pont, Pres.; Thos. J. Tapp, V. Pres.; Banner Coleman, Sec. The annual election is held first Tuesday in June of each year. The Superintendent is H. Martin. Head office is at Louisville. Branches at Central City, Du Pont, Hamilton, Mercer Station, Ky. The company owns the following mines: Green River, Render, Guylena, Strand City, Muhlenberg, and has on lease the Richmond and the Mercer Mines, all located in Ohio and Muhlenberg counties, Ky., and covering an extent of 5,000 acres. The mine is of the fissure character and is worked by drift. The plant consists of machinery, stores, and dwelling-houses at each mine, valued at $258,382.55. There are three shafts each sixty feet deep, and all the other workings are drifts; $55,389.96 has been expended in developing the mines since operations were commenced in 1880. The cost of mining and putting on cars is from 87½ cents to $1.25 per ton. The maximum yearly capacity of production at April 1, 1882, was 4,000,000 bushels, and the weekly output at same date was 40,000 bushels. Principal market is Louisville, Ky., and the South. Organized June 1, 1880. Capitalization $1,000,000; shares each $100.00. Assessable basis yield to date (April, 1882), 4,000,000 bushels; number of divisions paid to April, 1882, one; amount of same, $5,788, paid July 2, 1881. No assessments have been levied. Bonded indebtedness, April 1, 1882, $15,000; stock, $247,000; floating, $71,000. The stock, held principally in Kentucky, is at par. Wages paid to all classes of labor per week, $2,500. This information was furnished by Banner Coleman, Secretary of the Central Coal and Iron Company.

Chipdale & Company (The), R. H. Chipman, owner; head office, 95 Liberty Street, New York. Name of mine owned, Coaldale: location of mine, Osceola, Clearfield county, Pa. Amount of property in acres about 297. Date of commencing developments, February 1, 1882. Thus far yielded about 7,000 gross tons per month, now extended to capacity of about 5,000 to 6,000 per month. Information furnished by Robert Chipman.

Coal Creek Mining Company (The) is chartered under the laws of the State of Tennessee. The officers are T. H. Heald, Pres., and Daniel Lee, Sec., and Treas. J. Rooney being Superintendent, with an experience of twenty-five years. The offices are at Knoxville, Tenn. The Empire Mine is located at Coal creek, Tenn., the property having an extent of 200 acres; developments were commenced on the 23d of March of the present year. Organized 23d of March, 1882; capitalization, $50,000; shares, $100 each; no bonded or other indebtedness. This information was furnished by T. H. Heald, President of the company.

"Edgar Coal Company" is chartered under the laws of the State of Illinois. The officers are James A. Eads, Pres.; F. E. Powell, Sec'y and Treas. Date of annual election, third Monday in July. Superintendent, H. P. Davis; two years' experience. Head office, Paris, Ills. Branch office, Coal Bluff, Ind. This company own the "Grant," "Coal Bluff," and "Perth" coal-mines, located at Grant, Coal Bluff, and Perth, Ind. Amount of property in acres, 275. The character of the coal is block and bituminous. The company have two hoisting engines and two pump engines on their property. Length of tunnels, "Grant" 100 feet, "Coal Bluff" 500 feet, "Perth" 800 feet. The company have just opened in the Perth mine a four feet vein of block coal. There is a six feet vein of bituminous coal at the Coal Bluff mine, where there are 100 men employed, and a four feet vein at the Grant mine, where fifty men are employed. The development of the property was commenced March 1, 1881, and $15,000 have been expended in developing property to date. The prospects of the property are good. Cost of mining and milling per ton 80 cents, 85 cents, and $1. Maximum yearly capacity of production, April 1, 1882, 60,000 tons. Output weekly at April, 1882, 1,300 tons. Indianapolis and C. C. C. & S. R. R. are the principal markets for the company's ore. The block coal at Perth has been thoroughly tested and pronounced the best in all this block coal district. The bituminous coal at Coal Bluff is very desirable for steam purposes, and the Grant coal is also good for steam purposes as well as domestic use. This company was formed June 9, 1882, from the Powell Coal Company, which had been operating the coal-mines since March 1, 1881. Date of organization, March 1, 1881. Capitalization, $24,000. Par value per share, $100. Yield (net) to April 1, 1882, $4,000, 28,000 tons. Yield (net) during 1881, $2,500. Yield (gross tons) during 1881, 1,800. Stock and bonds held principally in Edgar county, Illinois. This information was furnished by H. P. Davis, Superintendent of the Edgar Coal Company.

Etna Coal Company is chartered under the laws of the State of Tennessee. The officers are Wm. Morrow, Pres.; D. P. Pittsburg. Gen. Manager; J. T. Hill, Sec.; Wm. McConnell. Treas. Date of annual election, August 1st. Superintendent, D. P. Pittsburg. This gentleman has had an experience of ten years at this company's mine. Head and transfer office, Whiteside, Tenn. The Etna mines, owned by this company, embrace thirteen seams of coal, seven of which are workable, but only two are operated at present. They are located at Whiteside, Marion co., Tenn. They own 2,500 acres of land. The coal is the best quality of blacksmith coal in the United States, not excepting the Blossburg and Piedmont. Character of the mines, drift or tunnel, and cost of mining per ton is $1.75, including all expenses. Miners' wages, fifty cents, sixty cents, seventy cents, and ninety cents, according to thickness of vein. The coal finds a market throughout the entire South; some coal and foundry coke sold in New Mexico and Colorado. The Kelly, Black Hill, and Mire Creek mines are worked by tunnel; first is one mile in length; second, five hundred yards; and the third, one-half mile. Prospects of the property are good. The company's mine is the only one in the southern coal fields which produces a first quality of coal for blacksmith and foundry coke purposes. Both the coal and coke find a ready sale at the mines, free on board at 12½ cents per bushel. The coke is equal in every respect to the Conallsville, and many foundries prefer it, claiming that it will bear a greater burden in the cupola. An analysis of the coal made by J. G. Pohle, of New York, is as follows: Fixed carbon, 74.20; Volatile matter, 21.30; Ash, 2.50; Sulphur, .70; Water, 1.30. Total, 100 parts. Analysis of coke made by Prof. A. W. Kinzie, Hockendanque Valley, Pa.: Fixed carbon, 90.70; Sulphur, 1.24; Ash, 8.06; total, 100 parts. The average yield per month is about 3,000 tons. Development of property was commenced by this original company, 1855. Date of organization, August 1, 1881; capitalization, $300,000; par value, $100. Company free from indebtedness. No quotation of stock has been made; all stockholders hold stiff at par. Stock not listed. Stock held principally at Nashville, Chattanooga, and Whiteside, Tenn. This information was furnished by J. T. Hill, Sec. of the Etna Coal Company.

Sangamon Coal Mining Company (The), formerly Starne, Dresser & Co., is chartered under the laws of the State of Illinois. The officers are Frank W. Tracy, Pres.; Chas. A. Starne, Gen. Manager; Saml. T. Dresser, Sec. and Treas. Directors, F. W. Tracy, C. A. Starne, and S. T. Dresser. The annual election is held 31st December. Mr. Jos. Hann is Superintendent, with an experience of twenty years. The officers are at Springfield, Ill. The property, of which the company has only an underground lease, comprises an area of 700 acres, and is located at the junction of Ills. Central R. R. and Wabash, St. Louis & Pacific Railway. Near Springfield, Ill., a small parcel of land, about six acres, belongs to the company. The coal is bituminous and of good quality. The deposit is about six feet in thickness. There are three shafts: one main shaft 250 feet deep, and one escapement shaft; also another working shaft. The mining plant and other property comprises two top works (A. and B. shafts), two engine houses, two smiths' shops, one carpenter shop, six engines, and six boilers, etc. etc., one store, one warehouse, and thirty-two tenement houses. Developments were originally commenced by C. A. Starne, and afterwards, Starne, Dresser & Co., in October, 1878. Twenty thousand dollars were spent in developments from January 1 to April 1, 1882. The total cost per ton for mining is about ninety-five cents per ton. The maximum annual capacity of production on 1st April, 1882, was 250,000, or about 2,500 tons per week. The coal is sold to the Ills. Central and Wabash Railway Company, and in the cities and towns situated thereon. Organized in December, 1881; capitalization, $300,000, in 3,000 shares of $100 each. Gross yield during 1881, 125,000 tons; gross yield from January to April, 1882, 30,000 tons. The company has not yet paid any dividends. The bonded indebtedness is $10,000. The stock is held principally in Sangamon county, Ill. This information was furnished by S. T. Dresser, Secretary of the Sangamon Coal Mining Company.

Gray & Bell. Head office, Banksville, Pa. Geo. Scott, private clerk. Branch office, Pittsburg, Sontside, Pa., Robt. Gray, head clerk. Isabella Bell is the surviving partner of the firm and transacts all the business. Martin C. Gray is Superintendent, and has had thirteen years' experience. The mines owned are, the "Coal Ridge," "Venture," and "Chess," which are located at Saw-Mill Run, Bankaville, Union township, Allegheny county, Pa. The coal is excellent, being the Pittsburg No. 8 seam, bituminous. The mines are all drift mines with the one vein of coal. There are seven standing engines and a fan blast on the property. The firm own forty mules. There are four shafts, 2 0 feet deep, and five miles of tunnels. Length of adits—that is, levels—two miles. The vein has an average width of four and a half feet. There are five tunnels, "Coal Ridge, 1;" "Venture, 1;" "Chess, 2;" Miles 1. Underground workings, dip to west 2′ 10″. The development of the property was commenced in 186. In the "Venture" the outside engine hauls for one and a half miles from the inside engine. In the "Chess" there are three engines, two hauling from the pit and one hauling from there through a hill to an incline plane, which goes to another tunnel through Duguesne Heights to supply iron mills. This tunnel was pierced at an immense cost to the firm, for the purpose of supplying the mills with coal. Its length is 1,200 yards, with an average width of five feet and height of six feet. The cars are hauled through by a standing engine at the mills with a tail rope which enables the engine to haul them back when empty. The "Venture" employs in full working order some 150 diggers, with some thirty day hands and boys. The "Chess," ninety diggers with thirty day hands and boys. The "Coal Ridge," 100 diggers, with twenty day hands and boys. The firm have two car-shops employing thirty men. Date of organization, 1860. Yield (net) during 1881, $330,-542 80. Yield (gross tons) during 1881, 236,102. Maximum yearly capacity, April 1, 1882, 219,711 tons. Output weekly at April, 1882, 3,380 tons. Wages paid to all classes of labor per week, April 1, 1882, $3,837.86. Principal market for coal, Pittsburg and West. This information was furnished by Geo. Wm. Scott, private clerk to the firm of Gray & Bell.

H. V. Coal & Salt Co. (The) is chartered under the laws of the State of Ohio. The owners are Messrs. Henry & Lowery. Mr. Wm. Henry has the superintendence of the mines, with an experience of twenty years. The offices are at Chauncey, Athens co., Ohio. The property, having an extent of 350 acres, is located at Chauncey, Athens co., Ohio. The coal is good for steam purposes, but the salt is poor, and has not been worked at a profit. The shaft is down 100 feet, and the adits have an extent of about 450 feet, which is the length of the deposit on which the company depends for its mineral supply. The property on the ground consists of one salt furnace and minor plant. The salt is shipped to Ohio, the coal having a local demand. The maximum yearly capacity of production, January, 1882, is 10,000 barrels of salt. The mine is an adjunct of a salt furnace, a small quantity, say 1,000 tons, is available for local retail sales. Thus the business is merely nominal, the returns for sales of salt barely paying cost of production. Capitalization, $50,000, in fifty shares of $1,000 each. The net yield during 1881 was $2,400 for a gross tonnage of 3,200 tons of coal. The stock is depreciated. This information is furnished by Mr. Wm. Henry, Superintendent of the company.

Keystone Coal Co. (The) is chartered under the laws of the State of Pennsylvania. Officers, Henry H. Stiles, President; Francis H. Williams, Secretary and Treasurer. Annual election is held first Monday in May. Mr. T. O. Yarington is Superintendent. The offices are at Meyersdale, Pa., and at 209 S. Third St., Philadelphia, Pa. The company owns the Keystone Mines located near Meyersdale, Somerset county, Pa. The property covers an area of 1,200 acres. Organized 4th of December, 1879; capitalization, $570,000; 11,400 shares of $50 each; no dividends have been paid or assessments levied; stock indebtedness. $570,000; stock reserved in treasury $11,608.25. The coal bed is an extension of that great deposit which eight miles off is known as the Cumberland Big Vein, which is identical with the great Pittsburg vein of coal. Stratification is nearly horizontal and the coal is entered through an adit. The coal after being mined is transported over a 3-foot narrow-gauge road a distance of five and a half miles, where it is dumped into cars on the Pittsburg branch of the B. & O. R. R. for transportation to market. The company are mining themselves about 6,000 tons per month, and by lessees about 10,000 per month more. Yield per acre of marketable coal 10,000 tons. Cost of mining per ton of coal fifty cents. The quality is medium, it being used chiefly for steam purposes, though it makes a coke of quality equal to the Connellsville. This information was furnished by Thomas Weld, and Francis H. Williams, Treasurer of the Keystone Coal Company.

Keystone Coal Company (The) is chartered under the laws of the State of West Virginia. The officers are Joseph P. Brinton, Pres., and Geo. Brooke, Treas. The annual election is held on the 2d Wednesday of December; offices at Philadelphia Pa., and at Richmond, Va. The company owns the Kanawha Mines, the Union Coal Mines, and the Mount Morris Coal Mines, located at Coal Valley, Kanawha county. West Va., covering an area of 1,200 acres held in fee-simple. Developments were commenced in January, 1881. The three properties named are partly leased to companies at twelve and a half cents per ton. The principal markets for the coal are Cincinnati and Richmond. The maximum capacity of production at April 1 was 150,000 tons. Organization, January, 1881: capitalization, $150,000, in 1,500 shares of $100 each; non-assessable. Yield to April, 1882, 3,000 tons (about), net yield during 1881, $2,000 (about;) a gross yield during 1881, 16,000 tons. There is no treasury reserve of stock which is held principally in Pennsylvania and Virginia; no stock listed or on market. This information was furnished by Jos. P. Brinton, of Richmond, Va., President of the Richmond, Fredericksburg and Potomac Railroad Company, and of the Keystone Coal Company.

McLean County Coal Company (The) is chartered under the laws of the State of Illinois. Dr. T. F. Worrell is Pres., and J. B. Stevenson, Sec. and Treas. The annual election is held in April of each year. Mr. W. W. Stevenson is Superintendent, with an experience of seven or eight years. Offices are at Bloomington, Ill. The property of the company comprises three acres, and is located at Bloomington Ill.: entrance to min s by tunnel, from second to third vein 530 feet, depth of shaft 541 feet. The second vein is four feet four inches thick, and the third vein two feet six inches; one main shaft, the roof and bottom are poor. Developments were commenced in 1867, when the company was organized; capitalization, $90,000, in 900 shares of $100 each, non-assessable; yield during 1881, $71,000: yearly average capacity, 60,000 to 70,000 tons. This information has been furnished by Jas. B. Stevenson, Secretary of the McLean County Coal Company.

Mill Creek Coal Company (The) is chartered under the laws of the State of Pennsylvania. T. F. Walters. Pres. and Treas., Bertollette, Sec. The head office is at Mauch Chunk, Pa. The mines owned are Middle Lehigh Mines, located in New Boston Basin, Schuylkill county, Pa.; the total property having an area of about 700 acres. Organized in 1881; capitalization is 2,000 shares; par value, $50; capital stock, $100,000; gross yield during 1881, 135,475 tons. This information was furnished by J. S. Cox, a director of the Mill Creek Coal Company.

Newburgh Orrel Coal Company is chartered under the laws of the State of Virginia. The officers are C. Morton Stewart, Pres.;

Charles Mackall, Sec'y and Treas. Office, Baltimore, Md. The company's property is located in West Virginia, covering 4,000 acres of land. Date of organization, 1855. Capitalization, $500,000. Par value per share, $25. Basis non-assessable. Date of latest dividend, June 1, 1882, three per cent. This information was furnished by the Newburgh Orrel Coal Company.

Nova Scotia Coal Company is chartered under the laws of the Province of Nova Scotia. The officers are C. S. Maltby, Pres.; E. H. Townsend, Sec'y; C. S. Maltby, Treas. Superintendent, M. H. Angell. The company's mine, the "Black Diamond," is located at Westville, Pictou county, Nova Scotia. The extent of claim is four quare miles. Amount of property in acres, held in fee, 800. The company ceased mining coal in 1878. The railroad, with its equipment, extensive wharves, and tug-boat belonging to the company, are used in transportation for others. This information was furnished by M. H. Angell, Superintendent of the Nova Scotia Coal Company.

Osceola Coal Company (The), represented by John Shields, J. H. Dewees, and Margaret Shields, the owners, has offices at Osceola, Pa. J. H. Dewees is Superintendent, and John Shields, Secretary. The property comprises about seventy-five acres, located at South Versailles Township, Allegheny county, Penna. The company is not chartered. The mine is worked on lease. The length of entrance tunnel is one mile. Developments were commenced about 1877, the date of organization. Four dividends, aggregating $8,000, have been paid to April 1, 1882. Only one assessment has been levied, date of same, November 7, 1877. This information was furnished by J. M. Love, Bookkeeper of the Osceola Coal Company.

Penn Colliery. Owned by Reakirt & Company. Not chartered. D. E. Conrad, Superintendent. Eighteen years' experience. Principal office, 218½ Walnut st., Philadelphia, Pa. Branch, Dudley, Huntington county, Penn.; Houtzdale, Clearfield county, Penn. The Penn Colliery mine is located in Houtzdale, Clearfield county, Pa. Extent of claim, a lease ten years. 200 acres owned by the company. The quality and character of ore is bituminous coal. Character of mines are drifts. Shipped by rail. Coal three foot thick, Two drifts are used. Property consists of main gangway, cross headings, and rooms. The cost of mining and milling per ton, fifty cents; extras, twenty cents; in all seventy cents. Royalty fifty cents. Total $1.20. Date of commencing developments, 1869. The firm of Reakirt, Bro. & Company is only composed now of E. L. Reakirt, as his brother is dead, and Mr. Osterlow going out of the company, leaves E. L. Reakirt sole proprietor. The business is all done in the name of Reakirt, Bro. & Company. The mine has been run by three other parties with no success, owing to its being a faulty mine, full of rolls, clay veins, &c.; would not be worked at all, only for its coal being of the very best quality. The company was organized 1878, with present company. Yield net to April 1, 1882, annually, 20,000 tons. Output weekly, April, 1882, 400 tons. Wages paid for labor per week, April 1, 1882, $300. Principal market for the coal, Philadelphia and New York. This blank was filled out by Henry Cook, Houtzdale, Clerk of the firm of J. Reakirt, Bro. & Company.

Price Brothers' Mines (The). under the superintendence of J. E. Price, of ten years' experience, have offices at Jackson, Ohio, three and a half miles west of Jackson branch office. The owners are W. S. Price, J. H. Price, J. E. Price, and Benj. F. Price. The mines are located three and a half miles west of Jackson, Ohio, the property having an extent of of 400 acres; there are 300 yards of tunnels in the mine; the length of the main lode, on which the supply of mineral depends, is fifty feet; the deposit varies in thickness from thirty to thirty-six inches, no blasting required; good reef and good air and dry bottom. The coal is superior for domestic purposes and for smithy purposes. Four good veins of ore, one of limestone and one of small coal. Jackson, Ohio, forms the principal market. Organized, 1876.

Sand Run and Carbon Hill Coal Mines (The), owned by J. H. Somers, are located in Hocking county, O., with office at Columbus, O.; the property having an extent of 614 acres. The quality of the coal is A 1, and is adapted for all purposes. The vein is eight feet thick and is worked by four drifts. The present cost of mining is seventy cents per ton. Developments were commenced in 1879, since which $49,200 has been expended, including an item of $17,000 for railroad cars. He estimated that there are 4,250,000 tons of coal on the property, which, at fifteen cents per ton, the price offered for it, would bring $637,500. The maximum yearly capacity of production is 250,000 tons. The output for April last was 16,900 tons; wages for same month being $11,300. The coal is shipped to the northwest, which constitutes the chief market. The net profits to 1st January, 1882, were $122,000; yield during 1881, $43,000, the product of 142,000 tons of 2,000 pounds to the ton; 275 hands are employed. The screens are operated by steam. Payments are made monthly on or before the 15th. The coal is in great demand for railway and gas-producing purposes at from five to fifteen cents above the average or market prices. The firm has also a yard at Columbus, where about 47,000 tons are sold yearly. Funds in reserve on 1st April, 1882, $38,000; Indebtedness on 1st April, 1882, $31,000. Cash balance, $7,000. This information has been furnished by J. H. Somers, the proprietor.

Seattle Coal and Transportation Company (The) is chartered under the laws of the State of California. Officers are John L. Howard, Pres.; S. O. Putnam, Sec'y. Offices, 210 Battery st., San Francisco. Annual election held, January 20. Superintendent, Jas. Williams. The company owns the Newcastle mine, located in Newcastle, Washington Territory; extent of property 1,100 acres. The coal is a lignite. One vein, ten and a half feet clean, one four feet seven inches, and one five feet 10 inches. Developments were commenced in 1871. San Francisco forms the principal market for the coal. Organized, April 12. 1871. Capitalization, $30,000. 30.000 shares, $1 each. Gross yield in 1881, 138,454 tons. Stock all owned by Oregon Improvement Company. Stock not listed. This information was furnished by John L. Howard, President of the company.

Soddy Coal Company (The) is charcred under the laws of the State of Tennessee. The officers are M. H. Cliffe, Pres.; J. W. Cliffe, Sec'y; J. T. Williams, Gen. Manager, and A. Lloyd, Supt. Annual election is held May 24. Offices at Chattanooga. The company owns the Soddy Coal Mines and the Salt creek Coal Mines, situated on the Cincinnati and Southern Railway. The property has an extent of 10,000 acres. The mine is worked by levels, the prospects being promising. Developments were commenced in 1867. Organized 1866. Capital in 10,050 shares, non-assessable, which are at a premium. Stock held entirely in Tennessee. Not listed, now at a premium. This information was furnished by J. T. Williams, Gen. Agent of the Soddy Coal Company.

Carbon Hill Mine (The) owned by Sackett Smart & Co. Name of mine owned, Carbon Hill Mine; located on Sand Run, Hocking county, Ohio, on Monday Creek Branch of C. H. & F. R. R. Extent of claim, 208 acres; amount of property in acres, 203; date of commencing development April 1, 1881. Two tunnels; length of tunnel, 1,500 feet; amount expended in developing property to April 1, 1882, $12,000; yield net to April 1, 1882, 23,322.62, 20.15 tons. Information furnished by Sackett H. Smart & Co.

Spring Hill Mining Company is chartered under the laws of Nova Scotia, special act. The directors are Alex. Macfarlan, Pres.; J. Magee, C. G. Twann, S. S. Hall, Geo. E. Franklyn, R. P. Starr, J. L. Dunn. Date of annual election, last Tuesday in January; William Hall is Manager. Office, Springhill Mines. Nova Scotia; transfer office, St. John, N. B.; transfer days, any lawful day, except ten days before annual meeting. The company's mining property consists of the Springfield Mines, located at Springhill, Cumberland county, Nova Scotia. Extent of claim, seven square miles. Amount of property in acres, about 7,000 The coal mined is superior for steam purposes, and is used largely for locomotive and rolling mills. Character of the mines, bituminous coal. The company has all the necessary plant, including three locomotives, for putting out 200,000 tons of coal per annum, workmen's houses, offices, etc. A new Blake pump is being put in. There are three slopes about 800 feet each, average angle of thirty-five. Length of adits—that is, levels, about one and a half miles. The three seams average about ten feet each of coal. Developments were commenced during the year 1873. The prospects of the property are good, output (gross tons') weekly, at April 1, 1882, 3,790. The Dominion of Canada is the principal market for the ore. The mine is situated on the Intercolonial Railway, about half-way between St. John, N. B., and Halifax, N. S., and is largely depended on by the manufactories along the whole line for their fuel. It is also the nearest mine, by railroad, to the markets of Montreal and Quebec. The coal is shipped at Dorchester, Bay of Funday, and Pawslord Basin of Minas. Unlike most of the Nova Scotia coal-mines, it is worked to its full capacity during the winter months. Date of organization, April 18, 1870. Act passed. Capitalization, $641,000. Par value, $50. Basis. non-assessable. Yield (gross tons) during 1881, 151,723. Number of dividends paid to April 1, 1882, eight. Total amount of dividends paid, $203,332.50 Date of first dividend, June 1873. Amount, $1,561.50. Date of latest dividend, February 14, 1882. Amount, $44,870; per share, $3.50. Free from all indebtedness. No treasury reserve. No stock on the market. Stock held in London, Canada, and New Brunswick. This information was furnished by order of the Board of Directors of the Springhill Mining Company, under the direction of J. W. Starr, Acting Chairman, and W. E. Vroom, Sec. and Treas.

Sunday Creek Coal Company (The), Columbus, O., is chartered under the laws of the State of Ohio. Officers, J. S. Morton, Pres.; J. W. Jonde, Sec.; A. A Hall, Manager. General office, Columbus, Ohio. Annual election, February. Fred. Witler, Supt., four years' experience. Name of mine owned, Sunday Creek; located in Perry county, Rendville. Ohio. Eighty acres of land owned by the company; shaft forty feet: length of levels, 15,000 feet; length in feet of the main lode on which the company depends for its supply of coal, 900 feet; average height of vein nine feet; one shaft is used; property owned, hoisting engine, two pumps. Developments were commenced 1877; date of organization, 1878; cost of mining and milling, ninety-two cents; capitalization, 10,000 shares; par value, $50; non-assessable. Yield net during 1881, $40,000; yield gross during 1881, $30,000; number of dividends paid to April 1, 1882, one; amount $1,000; date of first dividend, February 1, 1881; per share, $10. Stocks held principally in Columbus, Ohio. Maximum yearly capacity, 55,000 tons. Output April, 1882, 1,500 tons. Wages paid to all classes of labor per week, April 1, 1882, $1,000. Principal market for ore, Toledo, and Chicago, Ill. This information was furnished by A. A. Hall, Manager of Sunday Creek Coal Company.

W. C. Lombard & Co. Office, Galesburg, Ill. Superintendent, T. Mure. This firm owns the W. C. Lombard & Co. mine, located six miles northeast of Galesburg, Ill. Extent of claim, fifty acres; mineral found is soft coal; the firm have a coal shaft engine at the works; the shaft is seventy-five feet deep; vein four and a half feet high; five miles of tracking have been made; developments of the property were commenced about the year 1865. Galesburg is the principal market for the coal; the company was formed about the year 1865: the mine yields 2,000 bushels per day. This information was furnished by W. C Lombard, Galesburg, Ill., of the firm of W. C. Lombard & Co.

COAL AND IRON.

Southern Ohio Coal and Iron Company (The) is chartered under the laws of the State of Ohio. Officers, A. A. Thomas, Pres.; E. A. Stewart, Sec.; John H. Patterson, Man.; F. J. Patterson, Supt. Principal office, Dayton, O.; branch, Cincinnati, O. Transfer office, Dayton; transfer days, all days. The names of mines owned are Mine No. 1, Mine No. 3. Mine No. 4, Mine No. 5. Mine No. 7; located in Jackson, O The iron ore is red hematite. Fifty thousand acres of land owned by the company assays per ton sixty per cent. Four drifts and one slope mine. Developments were commenced September, 1881. Amount expended, $140,000. The company mines four veins of coal, three bituminous and one cannel coal vein; also, three veins of iron ore and one ledge of limestone rock. The latter is used for smelting iron. Company own houses, farms, lands. The peculiar characteristic of this bituminous coal is that it makes no soot, and almost no ash, and smelts iron without being coked, making Jackson county, O., the cheapest point in the United States for making first class coal-cut iron. The company's net earnings already more than pay the interest on its bonds. Its work thus far has been chiefly of preparation. Date of organization, 1881. Stock and bonds held principally in Boston, Mass. and Dayton, O. Capitalization, 15,000 shares; par value, $100; bonds reserved in treasury, $61,000; bonded indebtedness, $400,000; stock indebtedness, $1,500,000; stock quotations, $30 per share; bonds, $10 par. Stock not listed. Principal market for ore, Jackson county, O. Weekly output, 2,500 tons. This blank was filled out by John H. Patterson, Manager of the company.

COPPER.

Minnesota Mining Company (The) is chartered under the laws of the State of Michigan. The officers are Geo. D. Pond, Pres.; J. Geo. Repplier, Sec. The annual election is held third Wednesday in March. Superintendent, Thos. D. James, of twenty years' experience. Transfer and general offices, 98 Broadway, N. Y., and Rockland, Mich. Transfers can be effected at all business hours. The company owns the Minnesota mine, located in Ontonagon county, Mich. (Lake Superior district). Extent of property, 5,000 acres. The ore is a virgin copper, assaying 1,400 pounds to the ton. The mining plant consists of three engines, stamp mill, dam, miners' houses, village of Rosendale, and dock at Ontonagon, etc., etc Lowest shaft is 1,200 feet down; length of adits, 280 feet. The length of main lode on which the company depends for its supply of ore, is 2,820 feet. There are eighteen shafts. Seventeen veins run through the property; longest, 5,280 feet. Developments were commenced in 1855.

England, France, and Germany form the principal markets for the ore. In 1857, a pure mass of metallic copper was found, measuring about forty-five feet by about eight to nine feet by eighteen and a half feet in the widest part, weighing about 500 tons, and worth, as laid, about $15,000. Organized, 1855; capitalization, $1,000,000, in 20,000 shares of $50 each; assessable. Yield to January 1, 1881, 17,325 tons; yield during 1881, twelve tons, 227 pounds refined copper; value of same, $4,421. Twenty dividends, aggregating $1,820,000, have been paid. Date of first dividend, 1854; amount of same, $90,000 at $4.50 per share; date of last dividend, 1876, fifty cents per share; amount of same, $10,000. Six assessments levied, aggregating $446,000; date of first assessment, 1849, at $3.30 per share; date of last assessment, 1881, at fifty cents per share. Stock held principally in New York, Boston, Lowell, and Providence; stock is listed on Boston Mining Exchange. This information was furnished by Geo. D. Pond, President of the Minnesota Mining Company.

Planet Copper Mines (The), owned by Oliver Augdahl. The names of the mines owned are the Planet, Ashley, Sentinel, Copper Hill, Galmets, located at Flacora mining district, Yuma county, Ariz. Carbonate ore assays fifteen and a half copper per ton. Veins are the character of the mines. The Planet mine has produced up to 1873 about 7,000 tons of copper ore, assaying twenty-seven per cent. The other locations, in all, about the same grain of ore. The cost of mining and milling is $4.00 per ton. The Planet copper mine was discovered in 1863, by Richard Boyland, and worked steadily till 1873; then, through bad management, was abandoned, but was again relocated August, 1879, by me, Oliver Augdahl; no work has been carried on since then, except a little prospecting, as the large amount of ore in sight is of too low a grade for shipping. There are a number of other lodes in the group, viz.: 1, Planet; 2, Ashley; 3, Sentinel; 4, Byron; 5, Galmets; 6, Copper Hill; 7, Blue Bell. They are all parallel lodes; average width of vein, five feet; four shafts. There is no use to describe an old mine; sufficient to say that capital is all that is needed to make the property worth millions of dollars. This property is situated one-half mile south from West Fork, twelve miles east from the Colorado river; therefore have the finest facility for mining than any district in Terneska. Yield net during 1881, $492; yield gross tons, 1881, seven tons, of a lack cut during the year. Principal market for the ore, San Francisco. This information was furnished by Oliver Augdahl.

Quincy Mining Company is chartered under the laws of the State of Michigan. The Directors are T. T. Mason, F. B. Wallace, T. G. White, J. Brown, B. F. Meservey. T. T. Mason, Pres.; W. R. Todd, Sec'y and Treas. Date of annual election, June 7. T. G. White is Superintendent, and has had twenty-five years' experience. Offices, 4 Exchange Court, New York; 4 Change Avenue, Boston, Mass., and Hancock, Mich. Transfer Agent, Nathan H. Daniels. Offices, New York and Boston. Transfer days at all times. The company's property, which includes 500 acres of land, is located at Portage Lake, Lake Superior, Houghton county, Mich. The company's machinery, buildings, etc., cost about $800,000. The shaft is 2,100 feet deep, and levels are 3,200 feet in length. The main lode on which the company depends for its supply of ore is 5,000 feet in length; the vein has an average width of eight feet. There are thirty levels opened. Developments were commenced during the year of 1848. Amount expended in developing the property to April 1, 1882, $10,570,008.28. Maximum yearly capacity of production, April 1, 1882, 6,000,000 lbs. refined copper. New York is the principal market for the ore. The Quincy is one of Lake Superior's valuable mines: it produced during the decade beginning Jan. 1, 1870, and ending Dec. 31, 1879, 27,252,250 pounds of ingot copper, the average cost of which was 16.24 cents per pound. The figures showing the cost for each year of the period will be found below, and are taken from the official reports of the company:

Year.	*Cost of Ingot per Lb.*	*Year.*	*Cost of Ingot per Lb.*
1870	14.90 cents.	1875	15.79 cents.
1871	16.60 "	1876	15.72 "
1872	22.93 "	1877	15.11 "
1873	18.15 "	1878	14.01 "
1874	15.13 "	1879	13.71 "

The lowest cost for any year, it will be observed, was 1.71 cents greater than the price with which the *Bulletin* says most of the valuable mines would be satisfied; the highest cost was 10.93 cents greater, and the average cost was nearly four and one quarter cents more than the selling figure which our contemporary asserts would be satisfactory to most of the valuable mines. The Quincy is commonly considered a valuable mine, has paid $2,710,000 dividends, and ranks second only to the Calumet and Hecla. How many dividends could it have paid with copper selling at "twelve cents, and even less"? Chartered, 1848. Rechartered, March 6, 1878. Capitalization, $1,000,000. Par value per share, $25. Basis, full paid. Yield (net) to Jan. 1, 1882, $13,709,685.61; 59,560,041 lbs. of refined copper. Yield (net) during 1881, $472,591.75. Yield refined copper during 1881, 5,702,606 lbs. No. of dividends paid to April 1, 1882, 27. Amount, 3,030,000. Date of first dividend, July 31, 1862. Amount, $60,000. $3 per share. Date of latest dividends, February 20, 1882. Amount, $320,000. $8 per share. Total amount of assessments levied, 300,000. No stock or bonds are reserved in the treasury; stock quoted April 1, 1882. Stock listed on the Exchange of Boston. This information was furnished by W. R. Todd, Secretary and Treasurer of the Quincy Mining Company.

Mass Mining Co. (The) of Pittsburg is chartered under the laws of the State of Michigan. The officers are C. G. Hussey, President; Jas. W. Brown, Secretary and Treasurer. Offices, 47 Fifth Ave., Pittsburg, Pa. Date of annual election, December 1, 1881. Superintendent, John Chynoweth; twenty-five years' experience. Names of mines owned, Mass mine, located Greenland, Ontonagon county; Lake Superior, Michigan, covering an extent of 600 acres. The ore is a native copper in a matrix of common quartz, calc spar and diorite. Assays 2 per cent. per ton. The mine is described as a fissure-vein running longitudinally with the trap formation. The plant comprises hoisting, compressed air, and stamping machinery, estimated value or cost of which is $75,000. The shaft is 480 feet down; tunnel, 1,600; length of levels, 2,500 feet: length of the main lode on which the company depends for its supply of ore is 1,600 feet; average width of vein eight feet; number of shafts three. Developments were commenced in 1856, the amount expended in same being $600,000. The present prospects are favorable. The mine is well equipped for continous working, and the character of the vein is about the same as in years previous when it paid more than expenses. Cost of mining and milling, $2 per ton. Cost per ton sorting, tramming, stamping, washing, $1.40; cost per foot sinking shafts, $19.90: cost per foot drifting levels, $12.96; cost per fathom stoping, $34.00; yield of mineral per fathom, 1,050 pounds. The mine is now the largest tributer in Ontonagon county; it was worked only at intervals, according to price and other circumstances, such as lack of water in dry times, and difficulty of holding it in wet times. Date of organization, 31st of March, 1856; capitalization, $500,000; 20,000 shares of $25 each; assessable; yield net to April, 1882, $415,425, being value of 1,105 tons; net yield during 1881, $75,000; gross yield during 1881, 310 tons; no dividends paid; ten assessments levied aggregating $149,202; date of latest assessment, August 21, 1877; amount per share, $1: no bonded or other indebtedness; no treasury reserve. This information was furnished by B. F. Chynoweth, Greenland, Mich., Superintendent of the company.

Ore Knob Copper Co. (The) is chartered under the laws of the State of North Carolina. The officers are John S. Williams, President; Washington Booth, Vice-President, and seven directors. Annual election is held on 1st of May. Mr. James E. Clayton is Superintendent, of fifteen years' experience. The transfer offices are at S. Gay St., Baltimore. Transfers can be effected daily. The Ore Knob Mines are owned by the company and are located in Aske county, North Carolina, extent of same being two and a half miles, or 1,600 acres. The ore is a sulphide of iron and copper, assaying from 5 to 6 per cent. The vein is true fissure, twenty to thirty feet in thickness. The mining plant and other property comprises ten blast furnaces, mills, etc., about $300,000 in personal property. There are seven shafts and about 4,000 feet of levels; the length of main lode on which the supply of ore depends is two and a half miles; average width of vein sixteen to twenty feet; the greatest depth attained is in one shaft 360 feet. Developments were commenced in April, 1873, and the sum of $500,000 has been expended; the prospects of the property are very large; the cost of mining is $1 per ton. New York forms the principal market for the ore. The maximum yearly capacity of production is $250,000. This mine was opened previous to 1860, but has only been worked systematically during the last five or six years. Organized July, 1873; capitalization, $1,500,000, in 150 000 shares of $10 each, non-assessable; yield to April 1, 1882, $1,600,000; yield during 1881, say $250,000; gross yield during 1881, say 30,000 tons ore; five dividends have been paid, total amount of same, $210,000; first dividend in 1880; last, of twenty-five cents, 1881; no assesments levied; no stock in treasury; stock listed at Baltimore: stock quoted $2.25, April, 1882. This information was furnished by James E. Clayton, Manager of the Ore Knob Mining Company, June 8, 1882.

GALENA.

Engineer Mining and Developing Company (The) is chartered under the laws of the State of Colorado. The officers are Hon. Franklin J. Rollins, Pres., Portland, Me.; Chas. J. Chapman, Treas.; Thos. J. Little, Sec. Directors, E. D. Eastman, Frank C. Payson, W. L. Bradley, Chas. H. True, F. G. Patterson. Date of annual election, first Saturday of March. Superintendent, F. G. Patterson, three years' experience; head office, Ouray, Col.; branch office, Portland, Me. The company owns the Mountain Monarch, Sailor Boy, and Frank Silence Mines. The first two are located in Ouray county, Col.; the last, in Hinsdale county, Col.; extent of claims, 301 by 1,300 each; amount of property in acres, 10 by 14 each: the character of the ore is galena, which assays per ton from $69,027 to $1,500; length of tunnel in the Monarch, sixty feet, and thirty feet in the Frank Silence; shaft in the Sailor Boy has reached a depth of twelve feet; the main lode on which the company depends for its supply of ore is 4,500 feet in length; the average width of vein in the Monarch is six feet, that of the Silence three inches, Sailor Boy twelve inches; developments were commenced July 1, 1881, and amount expended in developing property to April 1, 1882, $1,175.42. The Mountain Monarch is in ore the entire length of sixty feet tunnel; there are twenty tons of ore on dumps, and the mine promises to be a valuable property. The Sailor Boy shaft, eleven feet in depth, has twelve inches of ore. The Frank Silence has paid a handsome profit over all expenses from thirty feet tunnel, and only work done; cost of mining and milling per ton, $58. The company have been obliged to ship their ore over 300 miles to Argo; railroad within fifteen miles next year, (1883.) Principal markets for ore, Argo and Puches, Col. The object of the company is to buy promising properties, at low figures, develop sufficiently to show their value secure to State patents, and hold for capitalists and corporations desiring good properties, complete titles, at reasonable prices. Date of organization, January 3, 1881; capitalization, $1,000,000; par value per share, $10; basis, non-assessable: yield (net) to April 1, 1882, $617.32—10,376 lbs.; yield (net) during 1881, $617.32; no indebtedness; stock held principally, Portland, and State of Maine; stock quoted April 1, 1882, $1.00. This information was furnished by F. G. Patterson, General Manager of the Engineer Mining and Developing Company.

EMERALDS.

Emerald and Hiddenite Mining Company is chartered under the laws of the State of New York. The officers are Jas. D. Yerrington, Pres.; Chas. E. S. Simmons, V. Pres.; R. H. Roberts, Sec. and Treas. Date of annual election, first Wednesday of October. Superintendent, Wm. Earl Hidden. This gentleman has had an experience of five years: head office, 192 Broadway, N. Y.; transfer office, 192 Broadway, (company's office), N. Y. The Hiddenite Mine, owned by this company, is located at Salem Church, Alexander county, N. C., the gems are found in true fissure veins of very limited extent; the company own 152 acres; depth of shaft, forty-three feet; length of adits, that is levels, 261 feet; average width of vein, two inches. The company have one shaft and tunnel; nature of under-ground workings, hard gneissoid rock; date of commencing developments, July, 1880; amount expended in developing property to April 1, 1882, $3,500; the prospects of the property are good. New York is the principal market for the ore. This is the only mine in the United States worked exclusively for precious stones; the best quality of the Hiddenite has the value of diamonds; one emerald from mine, sold for $800. The work of uncovering the gem-bearing rock is now going on over quite an extensive area, and consequently the yield of the mine at this time is small. The present work is preparatory work for large developments of the property. Date of organization, February 9, 1882; capitalization, $200,000; par value per share, $100 each; basis, non-assessable; yield (net) to April 1, 1882, $5,000; yield (net) during 1881, $5,000; free from debt; stock quoted April 1, 1882, $25; stock not listed; stock held principally in New York city; wages paid to all classes of labor per week, $200. This information was furnished by W. E. Hidden, Superintendent of the Emerald and Hiddenite Mining Company.

IRON.

Conrad Iron Mining Company (The) is chartered under the laws of the State of Michigan. The officers are Geo. W. Short, Pres., and J. V. Painter, Sec'y, of Cleveland, O. The offices are at Cleveland, O. Transfers can be effected at pleasure of holder. The Conrad mine is located in Marquette county, Michigan. Extent of property, eighty acres, on twenty years' lease, at forty cents per gross ton; minimum amount 5,000 tons yearly. The ore is a hard micaceous. Ferruginate, suitable for the production of Bessemer steel, assaying sixty-eight per cent. The shaft is seventy-five feet deep and prospects continue good. Cleveland, O., and Pittsburg are the principal markets for the ore. Work at this mine has been temporarily suspended, but will start up again in July. Organized, 1880. Capitalization, $50,000. Shares each, $2.50. Fully paid. Total yield to date, July,1882, 7,300 tons. Floating indebtedness, $13,000. No stock or bonds reserved. Stock quoted, April 1, 1882, $2. This information was furnished by C. F. Conrad, Gen. Manager of the Dayton, Dexter, and other mining companies of Marquette, Mich.

Cox Magnetic Iron Ore Mines (The), owned by D. W. Cox, are located two miles east of Dellsburg, York county, Pa., and cover an area of 176 acres. The plant comprises twelve h. p. engine and twenty-two h. p. boiler, quite new. Two feet stroke six in. cyl. Smedley pumping engine for keeping the mine clear of water. Entrance is by slope, which is now down 170 feet in the vein. At sixty feet perpendicular below surface, vein averages six and one-half feet thick; width not proven. Output, 600 tons per month. The ore is magnetic iron, forty-six per cent. low in sulphur, with scarcely a trace of phosphorous. This information was furnished by the owner of the mine, Mr. Cox.

COKE AND IRON.

Connellsville Coke and Iron Company (The) is chartered under the laws of the State of Pennsylvania. The officers are Hon. John Leisensing, Pres.; E. B. Leisensing, V.-Pres.; Superintendent and Engineer, J. K. Taggart; Consulting Engineer, E. K. Hyndman; Sec. and Treas., W. B. Whitney. Directors, Hon. John Leisensing, E. B. Leisensing, Audenried, Mauch Chunk; F. A. Potts, N. Y. City; Saml. Dickson, Philadelphia; John S. Wentz, Eckley, Pa.; M. S. Kemmerer, Mauch Chunk; Henry McCormick, Harrisburg; Dan. Bertsch, Upper Lehigh; John Fritz, Bethlehem, Pa. Date of annual election every second Thursday in February. The Connellsville mines are located at Leisenring, Fayette county, Pa. The property having an extent of about 8,000 acres. Organized, March 5, 1880. Developments commenced same time. Shaft now 375 feet deep. The capital of the company is represented by 24,850 shares of $50 each. This information was furnished by W. B. Whitney, Sec. and Treas. of the Connellsville Coke and Iron Company.

IRON AND GOLD.

Summit Mining Company (The). Company not incorporated. Officers, E. K. Hill, Sec'y and Gen. Manager. Date of annual election, September 15, 1882. The name of mine belonging to this company is the Summit; located near Summit House, Fosten Barr, Juba county, California. Extent of claim, 3,000 feet. Thirty acres of land owned. Pure ferreous sulphurets, ore easily reduced, assaying $821 to $1,000 per ton. True fissure veins, carrying very little metal, except gold and iron. Shaft, ninety feet. Tunnel, 225 feet. Length of main lode, 3,000 feet. Average width of vein, three and a half feet. One tunnel and one shaft. Developments were commenced, September 1, 1881. Amount expended in developing property, $600; 2,000 tons in sight carrying nearly ten per cent.; sulphurets evenly distributed; lowest assay, $21 per ton; estimated to average, $30. Cost of mining and milling not over $4 per ton. Date of organization, September 1t, 1881. Floating indebtedness, $100. Stocks and bonds held principally in Yuba county, California. The mine is for sale on bond. This blank was filled out by E. K. Hill, Secretary Summit Mining Company, Brownsville, Yuba county, California.

GOLD.

Shawmut Gold Quartz Mining Company (The) is chartered under the laws of the State of California. The officers are Ira P. Rankin, Pres.; S. O. Putnam, Joel Merchant, Joseph S. Bacon, Sec., all of San Francisco, and Thos. H. Bacon, Treas., of Boston. The annual election is held last Thursday in October. Transfer office is at 316 California Street, San Francisco; the head and branch offices are at San Francisco and at 22 Congress Street, Boston. The company owns the Shawmut mine, located near Murphys, Calaveras county, Cal., and is supposed to be on the same lode with the famous Sheep Ranch mine, having an extent of 2,200 feet on the lode. The ore is of excellent quality, containing quartz, some quite disintegrated. Assays from working give from $15 to $51 per ton. All the mineral, consisting of gold quartz, is above the water level. The mining plant consists of a ten-stamp mill of most improved pattern, and the necessary buildings. There is a splendid water service of over 300 feet head, for operating, hoisting, and pumping machinery which dispenses with steam-engines and boilers and their attendant expenses and risks. The entrance to mine is by tunnel 302 feet in length and two adits 189 and 181 feet respectively. The pay streak varies in width from six inches to four feet. The three tunnels are connected by air shafts and ore shutes. Developments commenced in March, 1879, since which time, $23,170 has been expended; this amount includes the cost of the stamp-mill. The present prospect of the mine is considered favorable, although nothing has been done during the present year. The work so far has only been of a preparatory character, so that no report can be given as to cost of mining and milling or of the productive capacity of the mine. Organized in July, 1878; capitalization, $500,000 in 50,000 shares of $10 each, assessable; no dividends have been paid or assessments levied. Stock not listed, none in market; stock held chiefly in Massachusetts and California. This information furnished by Thos. H. Bacon, Treasurer of the Shawmut Mining Company.

Garfield Mining Company (The), of which the following are the officers, etc.: Directors, Galush Anderson, Pres.; John S. Williams, Vice-Pres.; Geo. H. Leonard, Sec. and Treas.; C. H. Anderson, Supt. of mines; Allen D. Griffith, C. B. Nelson, Geo. G. Allen, Richard A. Clark, Andrew Cummings, L. J. Burrell. Executive committee: John S. Williams, Allen A. Griffith and Geo. H. Leonard. The company owns the following claims: Charter Oak, Virginia, Bank of England, Columbia, Garfield, Chicago, Lincoln, Herlech, Queen of the Valley, King of the Valley, Boston, Jackson, Negaunee and Goldberg; all located in the Black Hills, Pennington county, Territory of Dakota, comprising a total area of nearly 140 acres. There is already a force of fifteen men engaged in prospecting and developments in which about $10,000 has been expended. Organized at Chicago early in spring of 1882; capitalization, $2,000,000, in 200,000 shares of $10 each. The company have a ten-stamp mill which will commence working in July. This information was furnished by Mr. C. H. Anderwood, Superintendent of the company.

South Spring Hill Gold-Mining Company (The) is chartered under the laws of the State of Massachusetts. The officers are G. T. Moore, Pres.; A. L. Richardson, Treas.; C. A. Parker, S. C. Morell and E. Hall, trustees; J. R Tregloan, Supt., with fourteen years' experience. The transfer office is at Boston, Mass. The property of this company, the South Spring Hill gold mine, is located at Amador City, in Amador county, Cal., and covers an extent of seventeen acres. The ore is a soft, ribbon rock. The mine has a true fissure vein, carrying quartz. The plant comprises steam hoisting works costing about $3,000. Depth of shaft is 350 feet; length of adits, 200 feet. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. Developments were commenced in May, 1878, and about $16,000 has been expended in same. The prospects are very favorable on the Moehee lode. The estimated cost of milling is about $5 per ton. The company are now only prospecting, but have a good store for a valuable mine. Organized, May, 1878; capitalization, $5,000,000, shares, $50 each. This information was furnished by Mr. J R. Tregloan, of Amador City, Cal.

Singleton Gold-Mining Company (The) is chartered under the laws of the State of New York. Officers, Gen'l Thos. Jordan, Pres.; Sam'l Montgomery, Esq., V. Pres.; W. S. McGilton. Sec. and Treas. Trustees, G. E. Montgomery, W. B. Carpenter. Date of annual election, second Saturday in March. Joseph D. Reed, Esq., Superintendent, with several years' experience. Offices, 206 Broadway, N. Y. The property of the company consists of the following claims, Singleton, Gowdy, Luckhart, Hambleton, all adjoining and contiguous, and having a total length of one and a half miles, located one mile from Dahlonega, Lumpkin county, Georgia. The ore is free gold. The mineral is found distributed in veins and deposits. The company owns three mills, aggregating thirty-five stamps, and twelve miles of canal for hydraulic mining; two shafts, three tunnels also worked from open cuts. Length in feet of the main lode upwards of a mile, nine feet wide. Developments commenced in 1880, $75,000 having been expenses on same. The property is considered untrinsically worth more than its capitalization. Mining and milling costs fifty cents per ton. Maximum yearly capacity of production to April 1,1882, 100 tons per diem; output weekly, 600 tons. Dahlonega forms the principal market for the ore. Organized, 1880; capitalization, $300,000, or 300,000 shares of $1 each, non-assessable. No dividends have been paid, the proceeds of the mines have been expended in building millls and developing the property. No assessments have been levied; no bonded or other indebtedness. Stock reserved in treasury, April 1, 1882, $14,000. No stock quoted, none in the market. Stock and bonds held principally in the cities of New York and Philadelphia; ten stockholders owning all the mines of the company. This information was furnished by Wm. T. McGilton, Sec. and Treas. of the company.

Sierra Buttes Gold-Mining Company is chartered under the laws of England. Thomas Preston is Superintendent, and has had an experience of ten years. Offices, London and San Francisco. Transfer office, London, England. The company's mine the Sierra Buttes, is located at Lima City, Lima county, California. The ore is free milling quartz, yielding $6.00 per ton. The character of the vein is true fissure. The property includes mills, boarding-houses, and workshops. The tunnel is 5,000 feet in length; there are nine adits, that is levels; the main lode is 6,000 feet long. Development of the property was commenced during the year 1851. The mine has been worked since that time successfully without any assessments. The present company purchased the property from Reis Bros., in 1870, at a cost of $750,000. The company are only running one mill, fifty stamps now. Last March an avalanche carried away the Hawk Mill, (thirty-stamp.) The vein is from five to thirty feet in thickness, and is encased with slate on one side and serpentine on the other. The croppings of the Sierra Buttes Mine are situated on the top of a ridge 6,400 feet above the sea, fully 1,000 feet have been worked out. The main slopes are now about 1,100 below the croppings, and about 1,000 feet above the bed of the South Yuta River. The mine is worked entirely by adits or levels. The company have two main levels below the present works, that are being pushed ahead with energy. All the machinery is run with water-power. Turbine wheels are run with a face of 650 feet. The total yield of the mine since its discovery is not known, as regular accounts were not kept in early days, but the total yield is estimated, judging from the data obtainable, to be close upon $7,000,000. Mining and milling costs $4 50 per ton; weekly output April, 1882, 700 tons; current value of the mine is $937,000. Date of organization, 1870; capitalization, $225,000; par value per share, $10; basis, non-assessable; yield (net) during 1881, $323,822; yield (gross tons) during 1881, 47,423 tons; total amount of dividends paid to July 1, 1882, $1,407,496; date of latest dividend, July 1, 1882; free from all indebtedness; stock quoted April 1, 1882, $7.50; stock listed on the Mining Exchange of London; stock and bonds held principally in England and California; wages paid to all classes of labor per week, $2,000. This information was furnished by Mr. Thomas Preston, Superintendent of the Sierra Buttes Gold-Mining Company.

Riverside Gold Quartz Mining Company is chartered under the laws of the State of California. The owners are A. M. Starr and Samuel Grove. Office, Starr, Grove & Co., 330 Pine Street, San Francisco, California. Geo. A. Koch is Superintendent; he has had an experience of twenty-nine years. The company's mining property, the Riverside mine, is located in Tuolumne county, California, fifteen miles from Sonora wagon-road. The claim is 2,550 by 600 feet. The ore is gold quartz, free milling, with a small percentage of sulphurets. Easily saved, and assays from $5 to $50 per ton. Average yield $50. Character of the vein is "fissure," in slate formation with granite contact or crossing. Total depth from summit to level of tunnel now working, 800 feet, to bottom adit 450 feet more. The company's property includes one twenty stamp water mill, air compressor giving power for drilling, patent drill, one and a half mile of flume and ditch. There are three tunnels, each 600 feet in length, and the shafts are fifty and thirty feet deep. The main lode is 2,550 feet in length. The vein is from three to sixteen feet in width. There are four tunnels and two shafts. Date of commencing developments, 1852. There is a large amount of medium grade ore in sight, say $100,000. The bottom adit will give about 600 feet of ore to extract on slope of vein with a chute overhead of 500 feet in length. Cost of mining and milling at present, $2.25; $1.75, when adit is in to vein. Maximum yearly capacity of production, April 1, 1882, $75,000. The ore finds a market at the mill. The formation is tin slate, true fissure, without a fault, except two horses of vein matter, which split the ore and crowded it against each wall. It paid from surface to present level with shaft fifty feet below, that showing a large body of richer ore than above. On that showing adit was started. Chute of ore, 500 feet long, mostly slopes, out and milled; shaft on summit beyond the present chute shows large vein, and it seems advisable to drive the upper tunnels to the top of new chute, sinking shaft in tunnel to connect with bottom adit, and thus send all ore from above through shaft and adit to mill and have the mine in shape for sixty-stamp new mill in about two years. The Riverside Gold Quartz was discovered in 1852, and was successfully worked without intermission, in spite of high wages, until the mill was worn out, the ownership changing as circumstances demanded. Starr & Grove have improved the property to a great extent. About $10,000 is required to make a great property of it, and it is thought by the superintendent that with free water-power and tunnel facilities it will be one of the greatest gold mines on the coast. Capitalization, $100,000. Par value per share, $100. Basis, non-assessable. Yield (net) last three years, $78,000. No. of assessments levied, 1. Amount of assessment levied about $12,000. Date of first and latest assessment, during 1876, $12 per share. Bonded indebtedness, $95,000. This information was furnished by George A. Koch, Manager of the Riverside Gold Quartz Mining Company.

North State Mining Company (The) is chartered under the laws of the State of New York. The officers are Franklyn Coit, Pres.; Amos Howes, Vice-Pres.; B. M. Ennis, Sec.; J. P. Wortz, Treas.; which, with A. B. Ennis, constitutes the board of trustees. Principal office, 2 Morris Street, New York. The company owns the Hunnicutt mine, located at Gold Hill, Rowan county, North Carolina. The claim includes eight developed veins, the shortest being 160 feet on company's property, the longest, 1880 feet. The gold ore is a talc slate intermixed with quartz, iron, and copper pyrites, quality varying from low to very high grade, having produced from $10 to several thousand dollars per ton. The mine has true fissure-veins. Very little machinery owned by company in connection with mining plant. Depth of main shaft, 375 feet. Average of vein varies, one being twenty-eight feet. Developments commenced 1848 and were completed by 1856; amount expended on same being, to April 1, 1882, estimated at from $30,000 to $50,000; but much more work has been done than the largest of these amounts would pay for. Some so-called experts, who can see through a rock, have estimated that there is between one and two millions' worth of ore, which is absurd. There is simply a reasonably certain prospect that when worked the mine will produce fair average profits for many years. Cost of mining and milling will not exceed $1.50; much can be mined and milled for eighty cents per ton. There is an immense vein on this property twenty-eight feet wide, which carries very evenly $10 gold per ton of ore, while none of the veins are barren. Leads in carry at the rate of $50 to $75 per ton. All of this mass will be worked. So far the mining operations have always been conducted with profit. The company have not operated the mine, lack of capital to purchase machinery being the sole cause. Organized April, 1879; capitalization, $500,000, in 100,000 shares, of $5 each, non-assessable; stock held principally in New York. This information has been furnished by Franklyn Coit, President of the North State Mining Company.

Newcastle Gold-Mining Company. The directors are Charles E. Allen, O. C. Burgess, E. G. Mathews, J. A. Rudkin, and H. G. Kuhl. Office, rooms 33, 318 Pine Street, San Francisco, Cal. The company's property is located in Yankee Hill mining district, Placer county, California. Date of organization, May 5, 1882; capitalization, $50,000.

Nevada City Gold Quartz Mining Company is chartered under the laws of the State of California. The officers are M. J. Shoecroft, Pres.; J. W. Sprague, Vice-Pres.; B. N. Shoecroft, Sec. and Treas. Date of annual election, October 1. J. W. Sprague, Supt. Head office, Nevada City, Cal. The mines owned are the Schmidt, or Nevada City mine, the Luetje mine, and the Nevada City Extension mine, located in Wood's Ravine, one and a half miles west of Nevada City, Nevada county, Cal. Extent of claim, 3,000 linear feet. The company's property covers forty acres of land. The ore is bluish laminated quartz, carrying about four per cent. sulphurets. The ore assays on an average about $20 per ton. The character of the mines is described as true fissure vein on the contact between slate and granite walls, which are smooth and well-defined. The company's property includes one ten-stamp mill, three engines, two boilers, four fine concentrators, and the usual complete equipment for mining by steam-power, and complete equipment to run by water-power. The shaft was 450 feet deep June 1, 1882, and levels about 2,500 feet in length. The main lode is 300 feet in length, and the vein has an average width of three and a half feet. There is one main shaft. The company is running the third level as drain and exploration, and are approaching large ore bodies. The shaft is continued down with the intention of running levels at every 100 feet. Date of commencing developments, May, 1879. Amount expended in developing property to April 1, 1882, about $130,000. The prospects of the property are very flattering for the immediate future. Will soon reach by drain tunnel large bodies of ore hitherto untouched; ore in sight now about $180,000, but will soon be largely increased. More stamps will be added this summer. The ore is milled at the mine and bullion sent to the United States Mint. Cost of mining and milling per ton, $5. Maximum yearly capacity of production, April 1, 1882, 6,000 tons; can produce more if needed. The Schmidt claim was discovered in 1866; very slightly worked to 1879, when the present company bought it. The old owners took out about $30,000. The claim known as the Nevada City Extension was known and worked back to 1850; many rich specimens have been taken out; one pocket of ore yielded $7,000. None of the claims were worked systematically until bought by this company. The company have opened up and developed the mine and have it nearly on a dividend paying basis. Dividends are expected within six months from July 1, 1882. So far the proceeds have been used in paying for the mine, machinery, and developments, but the expectations are that it will make a large dividend paying property. Date of organization, September 30, 1878; capitalization, $3,000,000; par value per share, $30; yield (net) to April 1, 1882, $83,400; company free from debt; stock is not listed on any boards; stock held principally in New York and California; wages paid to all classes of labor, per week, $500. This information was furnished by B. N. Shoecroft, Secretary and Treasurer of the Nevada City Gold Quartz Mining Company.

Mono Gold Mining Company (The) is chartered under the laws of the State of California. The officers are W. P. Willard, Pres.; L. Teese, Jr., Vice-Pres.; Thos. Brown, Geo. W. Sessions and Joseph Clark. Annual election is held first Thursday in September. H. Aug. Whiting is Superintendent, of ten years' experience. No transfer office; main office at 62 Nevada block, San Francisco, Cal. The property owned by the company consists of the southern 750 feet of the same mines owned by the Bodie Consolidated Mining Company, viz.: Burgess, Bruce, Granger, Gilded Edith, Bodie Molly, Lucky Jack, and Fortuna, located in the Bodie mining district, Bodie, Mono county, Cal. Extent of claim, 1,095 feet by 750 feet, or, thirty-five and a half acres. The veins are fissure, in a true porphyritic diorite. The shaft is down 590 feet vertically; there are 1,760 feet of adits. Length of main lode on which the supply of ore depends, 750 feet. The underground workings consist of shafts, cross-cuts, drifts, winzes, and rises 5,550 feet of excavation. The lent shaft (in which the company has a half interest) is down 975 feet. Developments were commenced about August, 1879. No work has been done through the old shaft since September 1, 1880, the water inflow being so strong as to require long and powerful pumping machinery, accordingly, this company joined with the Bodie Consolidated Mining Company in the equiping and sinking the "lent" shaft for the purpose of reaching and exploring that portion of the Fortuna vein that extends into the Mono ground. Several quartz veins were explored by the working from the old shaft, nearly all carrying pay ore in small quantities, but not in any exploitable body. The most promising deposit was found at the 575-foot level, from which we were driven by the water; none of the old workings extended far enough east to reach the Fortuna, from the northern bonanza of which vein the Bodie Consolidated Mining Company has drawn its ore supply during the past three years. Organized, August, 1879; capitalization, $5,000,000, in 50,000 shares of $100 each; assessable; not yet productive. Seventeen assessments levied, total, $422,500; latest assessment, June 2, 1882, at twenty cents per share. No indebtedness; no stock reserve. Stock quoted June 21, 1882, $1 per share. Stock held principally in California. Stock listed on San Francisco Mining Exchange. Wages paid to miners, $4 per day; wages paid to carpenters, $5 per day; wages paid to smiths and other mechanics, $5 per day. This information was furnished by Henry Augustus Whiting, Superintendent of the Mono Gold Company.

Magnolia Gold-Mining Company, of South Carolina, is chartered under the laws of the State of New York. The officers are John Phillips, Pres.; John W. Gracrest, Sec. and Treas.; James B. Tooker, Superintendent; sixteen years' experience. Directors, John Phillips, E. S. Gross, John W. Seacrest, James B. Tooker, B. F. Crook. Date of annual election, May 1. Office, 48 Wall Street; room, No. 8, New York. The company's mines are the Broad river, Magnolia, and McSwain; located in Broad river Township, Hickory Grove, near Smith's Ford, S. C. The company's property covers 200 acres. The ore is crystalized honey-comb quartz, brown, carrying copper sulphurets. The ore assays $30, and sulphurets as high as $162. There are six fine fissure veins on the property. The company owns one ten-stamp California pat. mill, thirty-horse-power engine and buildings complete. The main shaft is 160 feet deep, and levels 600 feet in length. The vein has an average width of six feet. There are six shafts and two tunnels. This company commenced the developing of the property January 1, 1880, and have expended for this purpose $10,000 to April 1, 1882. The prospects of the property are the best, and improving every day. Estimated value of ore in sight, $20,000. Cost of mining and milling per ton, $2.90. The weekly output at April 1, 1882, was forty tons. The company find a market for their ore at home. The mine was worked in 1840-9 by a Chilian mill and arrastra, with good results; again in 1867-8, by a three-stamp steam-mill, and has been continually open and worked spasmodically, with profit until the organization of Magnolia company, which is now prospering. This mine also includes the old Arrow-wood mine, and has paid from its first opening, although worked under great disadvantages, and by crude and primitive methods and machinery. The ore seems inexhaustible. Date of organization, January 1, 1880; capitalization, $500,000; par value per share, $1.00; basis, non-assessable; yield (tons) to April 1, 1882, 10,000; no dividends have been paid, nor assessments levied; treasury reserve, $100,000; stock quoted April 1, 1882, twenty cents; stock listed on the Philadelphia Mining Exchange; stock and bonds held in New York, Pennsylvania, South Carolina, and Ohio; wages paid to all classes of labor per week, $40. This information was furnished by James B. Tooker, Superintendent of the Magnolia Gold-Mining Company.

Klamath Quartz Mining Company (The) is chartered under the laws of the State of California. The officers are Wm. Willis, Sec., and John Daggett, Supt. Directors, C. L. Waller, Pres.; Robt. Graves and John Daggett. The Superintendent has had an experience of twenty-two years. The offices are at San Francisco. The property of the company consists of the Klamath Mine, containing an area of 4,000 feet, and located on Klamath Hill, Siskiyou county, Cal. The ore is a gold quartz, free-milling. The mine is described as a true fissure vein, in black slate; it is worked by tunnels, five in number; the total length of adits 5,000 feet, average width of vein, five feet. The mining plant comprises a thirty-two stamp-mill, driven by water-power, but with an available steam-power in dry season, a double reverberatory furnace for roasting sulphurets. Organized June, 1869; capitalization, 30,000 shares of $1.00 each, $30,000; yield to April 1, 1882, 32,979 tons of ore, net value, $413,358.73; yield during 1881, 1,964 tons gross, net value, $12,679.52. This information was supplied by John Daggett, Superintendent of the Klamath Quartz-Mining Company.

Hillsboro Hydraulic Mining Company is chartered under the laws of Wyoming Territory. The officers are S. L. Miley, Pres.; W. W. Corlette, Sec.; E. G. Converse, Treas.; Adolfo Chandon, Assistant Sec. Date of annual election, May 13. G. M. Fuller, Supt. Head office, Cheyenne, W. T. Branch office, Hillsboro, N. M. Branch and transfer office, McKeesport, Pa. Transfer days at all times. The mines owned are the Hillsboro Placer Mines, located at Hillsboro, Dona Ana county, N. M. Extent of claim, about 2,500 acres, Character of the mines, placer. The washings during May showed an average of seventy-five cents' worth of gold for every cubic yard of gravel washed. The company have a fifty foot high dam, and eight miles lap-welded wrought iron pipe, manufactured by National Tube Works Company. Date of commencing developments, May, 1882. Amount expended in developing property, May, 1882, $200,000. Principal market for the ore, United States Assay Office, New York; $45,000 worth of gold was washed out by hand in a space less than 100 yards square. The gold is mostly coarse, and averages about 950 fine. Date of organization, May 13, 1881; capitalization, $1,000,000; par value per share, $50; basis, non-assessable; no dividends have yet been paid; company free from all indebtedness, April 1, 1882; no stock or bonds reserved in the treasury; stock and bonds held principally in Massachusetts and Pennsylvania; wages paid to all classes of labor per week, May 1, 1882, $14, average. This information was furnished by E. C. Converse, Treasurer of the Hillsboro Hydraulic Mining Company.

Highland Chief Consolidated Mining Company (The) is chartered under the laws of the State of Colorado. The officers are J. B. Grant, Pres.; S. H. Foss, V.-Pres.; Horace Steele, Sec.; Geo. W. Trimble, Treas.; Geo. C. Steel, Asst. Sec'y and Agent. The annual meeting is held first Monday of August. Head offices are at Leadville, Col. The company owns three mines, the Highland Chief, Highland Mary, and Bobbie Burns, located on Breece Hill, Leadville, Col., and having an extent of about thirty acres. The ore consists of sand and hard carbonates, chlorides, and bromo-chlorides, and some copper ore, assaying from $10 to $500. The deposit is a carbonate, carrying gold, silver, lead, and copper, lying under the porphyry and over the limestone; formation irregular and broken up where the main body of mineral lies. The entrance to mine is by tunnel, of 130 feet in length; there are 2,600 feet of adits. There are five shafts in addition to the entrance tunnel. The mining plant and other property comprises two shaft houses, one ore house, assay and office, smith's shop, and one thirty-horse power hoisting engine and one forty-horse power boiler. The cost of mining and milling varies from $8 to $18. Developments were commenced in August, 1879, since which time the sum of $85,000 has been expended. The amount of ore in the mine now in sight is estimated at $50,000. The ore is smelted at Leadville. Average weekly output about ninety tons. The main workings are at a depth of about 130 feet from surface. The main working shaft was sunk 290 feet deep, and the formation at bottom was broken mains of iron with lime, talc, porphyry, assaying the entire depth from three to twenty-seven ounces silver. It is believed that a regular formation lies still deeper, but on account of water encountered, the work of sinking was suspended for a time. Organized, July, 1879; capitalization, $500,000, in 50,000 shares of $10 each. The net yield to April 1, 1882, was $220,000, the value of 8,000 tons of ore. The yield during 1881 was $26,000; the gross yield during 1881 was 3,200 tons. No dividends paid or assessments levied. Bonded indebtedness, $50,000. No treasury reserves. Stock quoted April 1, 1882, $1.75; stock not listed; stock held principally in Colorado, Lake county, Boston, and New York. This information was furnished by Geo. C. Steel, Agent of company.

Hathaway Hydraulic Gravel-Mining Company is chartered under the laws of the State of California. The officers are J. O. Eldridge, Pres.; James H. Withington, Sec'y; Wesley Carroll, John M. Moore, Thomas Redmayne. Date of annual election, February 5. Superintendent, Wesley Carroll; number of years' experience of the same, 23. Branch and transfer office, 366 California Street, San Francisco, Cal. Names of mines owned, Wesley Carroll, J. H. Withington, J. O. Eldridge, J. M. Moore, and Thos. Redmayne, located at South Yuba river, Nevada county. California, near the town of Washington. Extent of claim, three miles in length, and from 300 to 800 feet wide. The company's property covers 640 acres. Nuggets are found, weighing from $1 to $300. Fine dust of gold is scattered all through the gravel, assaying $18.15 per ounce. Character of the mines, hydraulic, an ancient river bed, depth of gravel on an average eighty feet. They use about 3,000 inches of water, miners' measurement, under 315 feet of pressure in iron pipe and a six feet flume to catch the gold, and run off the gravel in. The company owns $12,000 worth of water ditches, with free water-flumes, etc.; value, $5,000. Date of commencing developments, February 23, 1879. Amount expended in developing property to April 1, 1882, $16,400. Prospects of the property are very good. The gravel is very rich in gold; $400 to the pan have been taken out in many places. Cost of mining per ton from five to ten cents. San Francisco U. S. Mint is the principal market for the ore. Output weekly at April, 1882, $2,500. The Hathaway mine embraces Scotchman's creek and all its tributaries, and it will require twenty years to work it out at the present rate of operations. The prospects are that the mine will pay much better when fairly opened. Nevada county has thousands of acres of heavy deposits of rich gravel, and hundreds of acres of gravel are from three to four hundred feet deep. The hydraulic mines are paying largely. The company have a number of good paying quartz mines. Date of organization, February 5, 1879; capitalization, $45,000. Yield (net) to April 1, 1882, $54,500, 3,000 ounces; yield (net) during 1881, $18,500. Number of dividends paid to April 1, 1882, two; total amount of dividends paid, $54,300; date of first dividend, September 5, 1881, amount, $18,300; date of latest dividend, March 7, 1882, amount, $36,000, per share, $3.60. Number of assessments levied, one; total amount of assessment levied, $25,000; date of first and latest assessment, February 5, 1879, amount per share, $2.50. Company free from indebtedness. Bonds reserved in the treasury, $5,000. No stock on the market; stock and bonds all held in San Francisco, Cal. Wages paid to all classes of labor, per week, $9 to $18. This information was furnished by Wesley Carroll, Superintendent of the Hathaway Hydraulic Gravel-Mining Company.

Golden Age Mining Company (The) is chartered under the laws of the State of New York. The officers are Samuel Eddy, Pres.; Joshua C. Sanders, Treas., and Israel E. Payne, Sec. Annual election is held 2d of May. Mr. James H. Pomeroy is Supt. Transfers can be effected during all office hours at the offices, 145 Broadway, N. Y. The company owns the Golden Age mine, located at Central City, Gilpin county, Col. The claim has an extent of 1,500 by 150. The ore is auriferous. Smelting, $1.00; milling, $15. There are two shafts, 260 and 125 feet deep, respectively. The vein, which is a true fissure, is of an average width of from two to four feet. The main lode on which the company depends for its supply of ore is 1,500 feet long. Developments were commenced in June, 1880, the sum of $28,499.31 having been expended on same. With regard to the present prospect of the property, disinterested parties say the showing is as good as any mine in Central City, considering the comparatively early stage of the developments. It is calculated that there are about $50,000 of ore in sight. The ore is sent to Central City to be milled, the company having no mills of its own. The mine is being worked in a careful and substantial manner, all the timbering in the shaft being for durability. The two large engines and boilers are new and in perfect order. The houses are fitted up in an improved modern fashion. There is also a large office, and everything is very complete. Organized June 7, 1880: capital, $500,000, in 100,000 shares of $5 each; net yield to April 1, 1882, $13,079; net yield during 1881, $12,894 56; no dividends paid; no assessments levied; no bonded or other indebtedness; stock not listed; stock held chiefly by three trustees in N. J. This information was furnished by J. E. Payne, Secretary of the company.

Faber Mine (The), owned by William Waldfred Faber, is situated in El Dorado county, Cal., about four miles north of Latrobe. The claim comprises two parallel veins about twenty feet apart, and the veins vary in size from six inches to two feet. Both veins are opened by inclined shafts. At a point some fifty feet from the surface occurs a nest, or chimney, from which the richest specimens of gold-bearing quartz have been taken, in which the metal greatly predominates over the mineral. The gold is of superior firmness, a mint certificate rating a lot of it at .935. Property owned, hoisting works and pumps, arrastras. Mr. Faber is superintendent, having had twenty-two years' experience. The shaft is 140 feet deep. Length of adits, that is levels, 200 feet. Date of commencing developments, 1880. Amount expended in developing property to April 1, 1882, $4,000. The mine is a very promising one: five tons of ore worked at a time with arrastras, paid as high as $88 per ton. Pieces of ore have been taken from the mine weighing seventeen ounces, that were found to contain twelve ounces gold, .935 fine. The property is free from any indebtedness. Yield (net) to April 1, 1882, $4,000. This information was furnished by William Waldfred Faber, sole owner of the Faber mine.

Monster Gold Claim (The), owned by John Dunn and John Eyrich, and the South Silver-mine, owned by Mr. Dunn, are located in Arizona; the first named claim is situated in Winnefred district, ten miles north of Phœnix, and the South Silver is located in Cave Creek district. This mine is down ten feet, and showing up good ore. The ore in the Monster Gold gives a gold assay of fifty-one ounces to the ton. Length of adits, that is levels, thirty-four feet. The main lode on which the company depends for its supply of ore is sixty-one feet. The vein has an average width of two feet. The development of the property was commenced January 1, 1882. There are plenty of good gold-mines in Winnefred district, fifteen miles north of Phœnix, but no capital to work on. The other mines, four miles north of them, are new property and show up well. The South Silver is a promising silver claim, with six feet of vein, gray copper, and bromine. A good investment. Any persons with a little capital wishing to invest will be given every show to do so. The company was organized January 1, 1881. Wages paid to all classes of labor per week, April 1, 1882, $24. This information was furnished by John Dunn, one of the owners of the property.

Dutch Creek Mining Company (The) is chartered under the laws of the State of North Carolina. The officers are, J. C. Pennington, Pres. and Treas.; J. J. Newman, Sec. and Supt.; directors, J. W. England, T. F. Haxsy, John C. Pennington. Wm. Pennington, J. J. Newman. The Superintendent, J. J. Newman, has had six years' experience in his occupation. Head and transfer office, Salisbury, N. C.; branch office, Sun Building, room 3, New York. The Dutch Creek Mine, owned by this company, is located ten miles south-east of Salisbury, N. C. To this company belong 166 acres of land. The ore found is brown ore, with gold, containing iron pyrites. It assays from $5 to $1,000 per ton. Character of the mine, fissure-veins, mostly quartz, with brown ore and iron pyrites, and some slate veins. The vein matter carries abundance of sulphurets, some silver and copper. Though most of the gold is in quartz, it is also found in talcose schists and argillaceous slates. Some of the ore is very rich, but calculations are based on working a large quantity of low-grade ore. There are about twenty parallel veins, mostly quartz. Will work ores by chlorination. Works erected, and will commence running about July, 1882. There are two shafts, forty-five and sixty-five feet. Length of adits, that is levels, 1,000 feet. Length in feet of the main lode on which the company depends for its supply of ore, 3,000. Average width of vein, three feet. Aggregate of shaft, winze, and tunnel, 1,200 feet. Date of commencing developments, 1881; amount expended in developing property to April 1, 1882, $5,000. It is estimated there are 20,000 tons of ore in sight, at $10. Cost of mining and milling, $2.50 per ton. Principal market for ore, home market. No milling has yet been done. Date of organization, October, 1881; capitalization, $150,000; par value per share, $100; basis, non-assessable; yield (gross tons) during 1881, 600; stock and bonds held principally in New York, New Jersey, and North Carolina. This information was furnished by J. J. Newman, Sec. and Supt. of the Dutch Creek Mining Company.

Consolidated Golden Development Company (The) is chartered under the laws of the State of Maine. The officers are Geo. F. Field, Treas.; S.W. Sargent, J. G. Philips, B. E. Perry, and C. D. Jenkins. Mr. Benton Jones, of thirty years' experience, is the superintending foreman. The offices are at Portland, Me. The company owns the Three Sisters, Nos. 1, 2, and 3 (gold), and the Jenkins (silver); located, the gold mines are at Oro near Clifton, Arizona Territory; and the silver mine at Silver City, N. M., covering a total area of 120 acres. The ore of the gold mines is a decomposed quartz, and that of the silver mine is metamorphic, yielding or assaying $116 to $198 gold, $60 silver. The gold mines are fissures between porphyry walls, the silver mines are contact veins between limestone and porphyry. The mines are thoroughly equipped, a twelve-stamp mill is just now being erected at the R. R. terminus; depth of shafts or tunnels respectively, 150 feet, forty feet, thirty-four feet, forty feet, twenty-eight feet, and thirty feet; average width of vein five feet. The underground workings are operated by tunnels. The length of main lode on which the company depends for its supply of ore is 4,500 feet. Developments were commenced in June, 1881, and about $80,000 has been expended on same. The first tunnel is 700 feet from the apex of the mountain, and has six openings five feet wide. The Silver City property, not sufficiently developed to warrant high expectations, but it adjoins the Old Timer, a valuable property. The cost of milling the gold ore is $5, and the silver ore about $10. The weekly output is about sixty tons of ore, which is milled by the company. In the Arizona mines the work can be done by tunnel and slope, and the mill driven by water-power. The fissure is well defined and developed the full length of the claim, 4,500 feet. It is intended to increase the working force as soon as the mill is completed. The Superintendent states that the amount of ore is limited only by the number of men employed. Organized, March, 1882; capitalization, $400,000, $2 shares; assessable or non-assessable at the discretion of the directors; stock reserved in treasury, $100,000; stock quoted $1, April, 1882; stock held principally in Massachusetts; stock listed, Boston Mining Exchange; wages paid to all classes of labor per week, April 1, 1882, $3 to $3.50. This information was furnished by one of the officers of the company.

Conrad Hill Gold and Copper-Mining Company (The) is chartered under the laws of the State of North Carolina. The officers are Jas. Bryce, Pres.; Washington Booth, V.-Pres. Date of annual election, May. The Superintendent is Mr. Jas. E. Clayton, who has had fourteen years' experience. The transfer office is at Baltimore. Transfer days every working day of the week. The company owns two mines, the Conrad Hill and the Dodge Hill, located in Davidson county, N. C. The claims have an extent of two miles, the acreage being 357. The ore is free-milling, and assays from $5 to $500 per ton. The character of the mine is described as fissure, there being seven main veins. Depth of shaft, 300 feet; length of adits, 1,200 feet; average width of vein from eight to nine feet. There are five shafts or tunnels. Developments were commenced in June, 1880, since which time there have been expended $125,000. There is a large body of ore in sight, but the value cannot be estimated. Cost of milling ranges from $2 to $2.50 per ton. The bullion yield is sent to the United States Mint. Organized, June, 1880; capitalization, $1,500,000; shares $5 each, non-assessable; mill just started has a capacity of $6,000 per month; about 18,000 tons on the dump; no bonded or other indebtedness; $150,000 reserved in treasury, April 1, 1882; stock quoted April 1, 1882, $190; stock held principally in Baltimore; stock listed in Baltimore; wages paid all classes of labor per week, at April 1, 1882, $2,000. This information was furnished by Jas. E. Clayton, Manager of the Conrad Hill Company.

Colorado Mining and Land Company (The) is chartered under the laws of the State of New York. There are thirteen trustees and the following officers: Matthew Wetbeck, Pres.; Gen'l W. F. Rogers, 1st V.-Pres., and W. H. Baker, 2d V.-Pres.; J. S. Buell, Sec., Treas., and General Manager; Franklin S. Buel, Assistant Sec.; Alex H. Brown, H. H. Heiser, and John Roberts, Finance Committee; Chas. H. Daniels, Attorney; Jas. Plant, 55 Pine Street, New York City, Financial Agent. Date of annual election, second Thursday in January. Thos. H. Kane is the Superintendent, his experience extending over a period of fifteen years. The head offices are at 50 East Seneca Street, Buffalo, N. Y. Branch office at Mineral Point, San Juan county, Col. The transfer office is at Buffalo, N. Y., and transfers can be effected any working day of the week. The company owns the following mines; The McIntyre, Elephant, Lake Park, Flora Temple, Buell, located at Mineral Point or City, San Juan county, Col., the claims each having an extent of 1,500 by 300 feet; total area, fifty acres. The ore is a sulphuret, free-milling, and contains slight traces of galena and copper pyrites, gold and silver, the latter predominating for the present. Assays range from $5 at surface to over $300 at a depth, and picked samples $1,500. The mines have true fissure veins, increasing in gold as depth is attained. Average elevation about 11,000 feet above sea level, surrounded on all sides by numerous rich mines, and within one mile of extensive and rich carbonate discoveries recently made upon Engineer Mountain, and probably in the richest and most extensive mineral region ever discovered. Developments, in which $55,870 have been expended, were commenced about the year 1874. The prospects of the property are exceedingly promising, there being a considerable body of ore in sight. Railroad facilities are gradually being brought nearer, and when completed a market for the ore will be furnished. No milling has so far been done. Organized, March 27, 1875; capitalization, $1,000,000; shares, $25 each, non-assessable. The company issued its entire capital stock in payment for the properties, with the tacit understanding that provision should be made for their primary development and equipment on a self-sustaining basis. To guarantee to the company that this would be done, 30,000 shares of the full paid stock amounting to $750,000 were placed in the hands of a joint trustee for sale, to provide means to carry out the objects contemplated. The company owns no stock whatever out of this reserve stock, 10,000 shares are only proposed to be sold, leaving 20,000 to be held as a guarantee fund to provide for future emergencies, or may be used in the purchase of additional property after dividends from the original mines have been reached. Bonded indebtedness, $3,000; stock indebtedness, $432,350; Floating indebtedness, about $1,400. Stock reserved in-treasury, $567,650. Bonds reserved in treasury $47,000; total, $614,560. April 1, 1882. Stock held at $15 per share; bonds held at par; stock principally held in Colorado, bonds in Buffalo, N. Y.; stock not listed, the company ignoring stock exchanges (as at present constituted) as inimical to the true interest of legitimate mining. The average wages paid to all classes of labor per week is about $3.50 per day. This information was furnished by J. S. Buell, Secretary and Treasurer of the Consolidated Mining and Land Company.

Castle Creek Gold Mining Company is chartered under the laws of the State of New York. The officers are A. P. Stanford, Pres.; John R. Murphy, Vice-Pres.; Justus C. Hall, Treas.; John R. Murphy, Sec. Date of annual election, May 29, 1882; Superintendent, E. S. Taylor. Mr. Taylor has had twenty years' experience in his occupation. Branch office, 58 Broadway, room 25, New York; transfer office, Mutual Trust Company, 115 Broadway, New York; transfer days, every day except Sunday, or when notice is given. The company's mines, or gravel bars, viz.: the Castle Creek, Sea Gull, Mud, Cornucopia, Diamond, and Taylor, are located in Ada and Owyhee counties, Idaho, on Snake river. Amount of property in acres, 680. The gravel is fine, with no boulders or large rocks, and the gold found is very fine and light; assays per cubic yard, thirty cents. The character of the mines is placer or hydraulic. The company own one canal, three and a half miles in length, capacity 1,000 inches, one set of sluices, and amalgamating plates and water rights. Date of commencing developments, November 1, 1881. The water supply and gravel bars are inexhaustible. The company are producing $136 per day with one set of sluices, and intend putting in five or six sets as soon as possible, which will increase production proportionately. Cost of mining per day is about $8, the work requiring but three men per day to the sluice, and some little quicksilver. Maximum yearly capacity of production, April 1, 1882, $43,200; weekly output at April 1, 1882, $900. The company ship their gold direct to Ogden, W. T. Since the opening of the mine, November 1, it has produced $3,600 monthly, but the company only claims dividends since the company was organized, the property previous to that time was owned by the original locators, and the product was retained by them. In addition to the located ground, the company's water-right controls 680 acres of the same quality of gravel. The gravel requires no treatment whatever, except to be washed through the sluices and over amalgamating plates, which take up the gold, while the gravel passes on with the water into the river as "tailings." This company had a clean-up of one of its sluices after a run of fifty-five days with three men, which yielded $7,505 to the company; this is an average of $136 a day. Date of organization, May 22, 1882; capitalization, $100,000; par value per share, $1; full paid, non-assessable; yield (net) to April 1, 1882, $18,000; yield (net) during 1881, $7,200. Date of first dividend, June 15, 1882; total amount, $3,000, per share, three cents; date of latest dividend, June 15, 1882. Stock and bonds held principally in New York; stock not listed, but held by private parties for dividends. Total pay roll per week, $42. This information was furnished by John R. Murphy, Jr., Secretary of the Castle Creek Gold Mining Company, of Idaho.

Atlanta Hill Gold Mining and Milling Company (The) is chartered under the laws of the State of New York. The officers are S. B. Johnston, Pres.; S. M. Cowpland, Vice-Pres. and Sec., and A. R. Chisolm, Treas. The annual election is held first Wednesday in May of each year. The mines are under the superintendence of Matthew Graham, who has a mining experience of thirty-two years to recommend him. The offices are at 61 Broadway, N. Y., transfer offices, same place. The company own the Last Chance mine, located at Atlanta, Alturas county, Idaho. The ore is free milling, carrying about three per cent. sulphurets, and assays about $100 per ton. The character of mine is described as a fissure vein. The property includes ten-stamp mill, twenty-horse-power engine and boiler, assay office, boarding-house, and five acres of ground at mill. Depth of shaft, 160 feet; length of tunnel, 980 feet; of winzes, 125 feet, of adits, 400 feet; length of the main lode on which the company depends for its supply of ore, 1,200 feet. Developments were commenced in August, 1881, about $18,000 having been expended. The prospects of the property are good, there being a considerable quantity of ore exposed. Cost of mining and milling, from $10 to $15. The company mill their own ore; the bullion is sent to New York city. Organized, 26 May, 1881; capitalization, $100,000; shares, each $5, non-assessable. Stock held principally in New York city. Average wages of miners per week of seven days, $28. This information was furnished by S. B. Johnston, Pres. of the Atlanta Hill Gold Mining and Milling Company.

GOLD AND SILVER.

Bodie Consolidated Mining Company (The) is chartered under the laws of the State of California. The officers are W. P. Willard, Pres.; Louis Teese, Jr., Vice-Pres. in San Francisco; L. M. Jones, Vice-Pres. in New York; Thos. Brown, W. F. Herrin, Geo. W. Sessions, and Jos. Clark. Annual election is held third Monday in June. Henry Augustus Whiting is superintendent; he has had ten years' experience. Head office is at 62 Nevada block, San Francisco; branch office, 137 Broadway, New York; transfer office, Laidaw & Co., New York. The company owns the following mines: The Burgess, Bruce, Granger, Gilded Edith, Bodie Mollie, Lucky Jack, Fortuna, and Euterpe; also, one mill site and three placer claims, all located in the Bodie mining district, Bodie, Mono county, Cal. The total area of claims is thirty-five and a half acres of quartz mining and about thirty-five acres of placer. The ore contains native gold, argentite, kerargyrite, carbon, "water level" and native silver in a quartz gangue and assays in gold, $47 and silver, $32=$79 per ton. This is the average of the ore milled during the year ending May 31, 1882. The vein is a fissure in a porphyritic diorite; it has a strike about North 30° West by South 30° East (mag.), with dip varying from 25° N. E. to 45° N. E., the steeper dip obtaining generally in the lowest workings. Both in dip and in strike the vein crosses the stratification or jointings of the country. The ore adheres tightly, or, in mining parlance, is "frozen" on to the walls, and the vein shows generally a combed structure. The pitch of the new silver ledge is very sharp to the east, and the rock hard. The Bodie's old shaft is 250 feet deep; Bodie new, 450 feet; lent shaft (6-22-'82), 975 feet, all vertical. There is also a main incline from 4,320-foot level, 332 feet long, the bottom of which is 618 feet vertically below collar of Bodie new shaft. Total length of adits, about 13,000 feet. The length of the main lode on which the company depends for its supply of ore is 500 feet at 640-foot level on which the shoot is longest. Average width of vein, about twelve inches. There are three shafts, named above. Since March 13, ore and waste have been brought to bank only through the lent shaft. The underground workings consist of three levels from new shaft at 206, 300, and 432 feet respectively, with cross-cuts, drifts, winzes, and rises. From 432-foot level to 618-foot level, extends a main incline 332 feet long in a westerly direction and under the Fortuna vein, and from it, at six incline levels, run drifts, cross-cuts, etc. These workings recently connected with those deeper from lent shaft. In all, with lent shaft and levels, etc. therefrom, there are about 1,675 feet of shafts (vertical), 600 feet of winzes and rises, 13,000 feet of drifts and cross-cuts; also, slopes from above the 206-foot level to the 640-foot level. Developments were commenced in July, 1877. The present expense of working, per month, is about $15,000. The mining plant and other property at surface consist of one ten-stamp mill with pans, settlers, etc., hoisting works at Bodie new shaft, complete, also, half interest in the lent shaft hoisting works, furnished with a horizontal, direct acting pumping engine, (40-inch cylinder, uncompounded eight-foot stroke), four twelve-inch plungers and one fourteen-inch lift pump. There is now in course of erection, a hoisting engine with two sixteen-inch cylinders, thirty-six-inch stroke, geared. The actual output, per week, is about 165 tons, which, at $59.26 per ton, realizes about $10,000. It may be interesting to mention that the main vein—the Fortuna—is faulted in many places, the throw varying from a few inches to about fifty feet, the latter fault is between the 550 and the 650-foot levels of the lent shaft. All of these faults obey Schmidt's rule of the obtuse angle. With the richest ore, the gangue is a mixture of quartz and porphyry, and frequently the wall-rock is enriched from the vein in a laminated casing from one to six inches thick. The necessity of sinking the lent shaft and of fully equipping the same with pumping and hoisting machinery capable of operating to a depth of 2,000 feet vertically, has operated to increase expenditures during the past two years much above the average of the ordinary mining. Organized, June, 1878, as successor of the Bodie Gold Mining Company, which was organized early in 1877. Capitalization, $10,000,000, shares each, $100, assessable. The production under the original company was $1,162,346.75; the production under the present company was $1,626,885.42; the total yield of the mines to April, 1882, being $2,789,232.17, all in silver and gold bullion. Yield during 1878, $1,042,236.80; yield during 1879, $764,067.12; yield during 1880, $429,817.80; total, $2,236,121.72; yield for fiscal year, 1881-2, was $406,158.25. Amount of dividends paid to April, 1882, $1,200,000; date of latest dividend, March, 1880, amount, at twenty-five cents per share, $25,000. Number of assessments levied, three; total amount of same, $125,000. Of the three assessments, the first and third were fifty cents each, the second, twenty-five cents. The company has no bonded or other indebtedness, and there are no stock or bonds in treasury. Stock quoted about $6 per share April, 1882; stock held principally in California and New York; stock listed at San Francisco and New York. The above information was furnished by Henry Augustus Whiting, Superintendent of the Bodie Consolidated Mining Company.

Ward Gold and Silver Mining Company (The) has property in the Virginia District, Comstock Lode, Nevada. Capitalization, $11,000,000, in 110,000 shares, of $100 each. No dividends paid; five assessments levied; total, $198,000; latest assessment, 10th December, 1879.

Buckeye Water and Hydraulic Mining Company (The) is chartered under the laws of the State of California. The officers are S. K. Holman, Pres.; W. A. Stephens, Vice-Pres., and W. H. Lowden, Sec. The annual election is held first Monday of May in each year. The President is acting as Superintendent. The head offices are at 213 Sansom Street, San Francisco, Cal. The transfer office is at same address. Transfers can be effected on all business days. The company owns the following mines or claims: Washington, Monroe, Madison, Jefferson, Cunningham, Tolly Hill, Buckeye, Centennial, Livingston, Lower Tolly, Blagrave, Hollman & Kipp, located in Trinity county, Cal., covering an area of 1,660 acres. The mines are described as "placer," or hydraulic. There is a saw-mill and the usual buildings necessary for mining. Developments were commenced in 1875, the sum of $328,333.49 having been expended in same. Prospects are good. The company have no milling machinery. Organized, 10th of May, 1875; capitalization, $3,000,000; shares each, $100; assessable basis; yield net to April 1, 1882, $18,070.25; yield net during 1881, $95.01; no dividends have been paid: number of assessments levied, four; total amount of same, $120,000; date of first assessment, October, 1875; amount per share, fifty cents; date of latest assessment, November 10, 1881; amount per share, fifty cents; bonded and other indebtedness at April 1, 1882, nil; stock and bonds reserved in treasury, April 1, 1882, nil; stock not listed; stock held principally in San Francisco and New York; wages paid to all classes, $285 per week. The above information was furnished by W. H. Lowden, Secretary of the Buckeye Water and Hydraulic Mining Company.

Columbus Consolidated Mining Company (The) is chartered under the laws of the State of California. The officers are A. G. Gudnett, Pres.; John D. Conghlin, Vice-Pres.; J. M. Buffington, Sec.; S. B. Melroy, Supt., of eight years' experience. Date of annual election, first Tuesday of August. The head and transfer offices are at 309 California Street, San Francisco. Cal. Transfers can be effected daily. The mines are the Leo, Secretary, Mountain Green, and Mount Castle, all located in the Columbus District, Esmerald county, Nevada. Extent of claim, 200 by 1,500 feet. The ore is free milling, a mill assay of 3,000 tons averaging 83 per cent. The character of the mine is described as a fissure-vein with slate and granite walls. The ore yields silver and a small percentage of gold. The mine is fitted with hoisting machinery with a sinking capacity of 1,000 feet. Depth of shafts, twenty-five feet, thirty-five feet, and sixty five feet, respectively. Average width of vein, seven feet. Developments were commenced in 1876, the sum of $8,650 having been expended on same up to April 1, 1882. The property is considered one of the best in the State of Nevada for amount of work done and money expended. The cost of milling is $14 per ton. Organized, July, 1880; capitalization, $100,000; shares each, $100; basis, assessable; no bonded or other indebtedness: stock reserved in treasury, $20,000; stock listed, San Francisco, Cal., but not called by order of the board of directors. This information was furnished by Mr. R. B. Milroy, Supt. of the Columbus Consolidated Company.

Iowa and Arizona Gold and Silver Mining Company is chartered under the laws of the State of Iowa. The officers are H. L. Kan, Pres.; F. Hashman, Vice-Pres.; F. M. Kyte, Sec.; W. G. Agnew, Treas., and board of thirteen directors. Date of annual election, second Tuesday of September. Office, Osceola, Iowa. The mines owned are the Ostrich, Teresa, and Fresnol, located in Arivaca district, Pima county, Arizona, near Baboquoin Mountain. There are 1,500 by 600 feet in each claim. Their property covers sixty-two acres of land. The ore is free milling. Fire assay: Teresa, $28 silver, $5 gold; Ostrich, $45 silver, $10 gold: Fresnol, $316 silver, $10 gold. The above assays were taken at the surface. Character of the mines is described as fissure. The vein has a width of from two to four feet. No shafts have yet been sunk on the property, nor any underground developments as yet made; so it is impossible to say as to the prospects of the property. Date of organization, March 1, 1882; capitalization, $1,000,000; par value per share, $20; basis, non-assessable. Company free from all indebtedness, April 1, 1882. Stock quoted April 1, 1882, $5 per share. Stock held principally in the State of Iowa. This information was furnished by F. M. Kyte, Secretary of the Iowa and Arizona Gold and Silver Mining Company.

Lone Mountain Gold and Silver Mining Company is chartered under the laws of the State of Indiana. The officers are J. W. Booth, Pres.; James Martin, Vice-Pres.: James M. Watts, Sec.: Johnie Lathrop, Treas. Directors, J. W Booth, Johnie Lathrop, James M. Watts, James Martin, W. B. Booth, E. J. Booth, Judge Gould. Date of annual election, November 11. Superintendent, W. B. Booth. Offices, Delphi and White Oaks, New Mexico. Transfer office, Delphi, New Mexico. The company owns the Della, Lost Creek, Baby Mine, Opher, Anabel, Hidden Crown, Modest Queen, Colorado, Hoosier Boy, and Middle Lode Mines, located at White Oaks, New Mexico. Extent of claim, 600 by 15; amount of property in acres, 220. The minerals found are gold and silver. Highest assay per ton, gold, $500; silver, $300. The character of the mines is described as fissure vein with granite walls. The Della shaft is fifty feet deep, and the Colorado shaft forty feet. The tunnel on Hoosier Boy is seventy-five feet in length. The vein has an average width of six feet. Total number of shafts, five. Development of the property was commenced during the month of February, 1882, and $20,000 have been expended in developing property to April 1, 1882. The prospects of the property are good. Date of organization, November, 1881; capitalization, $1,000,000; par value per share $10; basis, non-assessable. Company free from indebtedness, April 1, 1882. Treasury reserve $1,000,000. No stock has been sold. Wages paid to all classes of labor, $3 per day, April 1, 1882. This information was furnished by the Lone Mountain Gold and Silver Mining Company.

Narragansett Gold and Silver Mining Company (The). The incorporators are Ebenezer Read, V. C. Halley, George Brooks, H. B. Chamberlain. The company's property is located at Clear creek, Col. The company has a capitalization of $2,000,000.

Newark Gold and Silver Mining Company. The company's property is locatedin Ely district, Lincoln county, Nev. The main lode is 800 feet in length. Capitalization, $3,200,000; par value per share, $100; number of assessments levied, fourteen; total amount of assessment levied, $312,000; date of latest assessment, March 13, 1878.

North America Mining and Developing Company is chartered under the laws of the State of Connecticut. Office, 61 Broadway, New York. The company's mine, the Fanny Barrett, is located at Loveland Hill, Col. The company has 240 acres of land. The ore carries silver, gold, and lead, and has a value of from $45 to $1,000 per ton. This company, by its charter, is authorized to examine, report upon, develop, own, work, and deal in mines and mining properties, and generally do all things necessary or incidental to the prosecution of the business of the company, and the proper management thereof. Under the charter, no individual liability attaches to the stockholders. No stock will be issued at less than its par value, and, being full paid, will not be subject to future assessment. Date of organization, March, 1882. Capitalization, $1,000,000; par value, $25; basis, non-assessable, full paid.

North Rapidon Gold and Silver Mining Company is chartered under the laws of Nevada. The officers are Geo. W. Keith, Pres.; John Lathrop, Sec.; J. D. Lewis, Treas. Trustees, C. Haub, William Maxwell, J. B. Matthews, W. Croninshieds. Date of annual election, October 1. Superintendent, William Maxwell. Head and transfer office, Dayton, Lyon county, Nevada. Transfer days, all legal days. The company's claim, the North Rapidon, is located at Palmyra and Indian Springs Mining district, Lyon county, Nevada. Their property covers twenty-one acres. The character of the ore is free quartz. The poor ore assays about one part in gold to six in silver; the rich ore assaying about two-thirds gold. Some cheap ore has been milled by free melting process, sixty-nine per cent. yielding $11.57 per ton. The character of the mine is true fissure vein. The company owns small hoisting works. The incline is 230 feet long, and drifts about 180 feet. The main lode on which the company depends for its supply of ore is at least 2,000 feet in length. The development of the property was commenced in the year 1879. Amount expended in developing to January 1, 1882, $6,000. It contains a large body of ore, assaying on an average, $11, with occasional pieces and bunches assaying from $106 to $250. The ledge is from fourteen and a half to twenty feet wide. The cost of hauling and working at Dayton in custom mill, $10. If the company had its own mill, it would not exceed $5. Dayton is the principal market for the ore. The company do not claim to have a mine, but do claim it is a good prospect, and are willing to give capitalists a good chance on it. 80,000 shares of the stock are held by five persons. Thousands of tons of low grade ore in sight, which will ultimately be worked at a profit. The claim is in good condition, so that a little money, say $5,000, would prove much. The title is A 1. In immediate proximity are four patented mines, which can be bought or bonded on reasonable terms. The stockholders invite an examination by competent judges. Date of organization, June 10, 1880; capitalization, $10,000,000; par value per share, $100; basis, non-assessable; yield (net) to April 1, 1882, about $2,000, 185 tons. No dividends paid to May, 1882. Floating indebtedness, $514.65. No stock or bonds reserved in the treasury. Stock and bonds held principally in Lyon and Storey counties, Nevada. Wages paid to all classes of labor per week, $9. This information was furnished by George Keith, President of the North Rapidon Gold and Silver Mining Company.

North Rowe Gold and Silver Mining Company. The officers are W. S. Janney, Pres.; W. J. Troth, Vice-Pres.; Samuel Conway, Jr., Treas.; W. H. West, Sec. Directors, W. S. Janney, J. M. Rigg, W. J. Troth, G. R. Vernon, W. H. West, R. Robertson, S. Conway, Jr. Offices, Second and Market Streets, Camden, N. J., and 430 Walnut Street, Philadelphia, Pa. The company's property is located at Cave Creek Mining district, Maricopa county, Arizona. Capitalization, $1,000,000; par value per share, $5; basis, non-assessable; amount of stock reserved in the treasury, 70,000 shares; amount of stock issued, 130,000 shares.

Harvey, Chicago, Vesta, Success, and Black Jack Mines (The), owned by A. B. Harvey, are located at Grantsville, Nye county, Nevada. Extent of claim, 1,500 linear feet by 600 feet in width. The Chicago shaft is seventy-two feet deep; Vesta shaft, 112 feet. Date of commencing developments, 1880. The Chicago, which is being developed, joins the famous Alexander mine in the south. This information was furnished by the owner, A. B. Harvey.

Alexandria Mining Company (The) is chartered under the laws of the State of Michigan. The officers are R. O. Wheeler, Pres.; S. Heavenrich, Vice-Pres. Trustees, S. Brady, H. P. Sanger, R. K. Staunton, and T. W. Noble (Sec. and Treas.). Frank Robbins, M. E., Superintendent and Resident Trustee. Mr. Robbins has had an experience of twelve years as Superintendent. Head offices are at Bank block, Detroit, Mich. Local offices, corner Clark and Main Streets, Eureka, Nev. Transfer offices, at Detroit. The annual election is held on January 15. The company owns the Alexandria mine, located in Prospect Mountain, Eureka district, Nev., extent of claim being 800 by 200 feet. The ore may be described as composed of quartz, and carbonate of lead, and galena, the assay value averaging about $45. The vein is a fissure in limestone, the limestone lying between shales. The property attached to the mine consists of lodging, boarding, and engine houses, and smiths' shop of stone, eighteen horse-power engine and twenty-four horse-power boiler. The sinkings are 400 feet down, the length of adits aggregates about 1,200 feet. The length of the main lode on which the company depends for its supply of ore is 800 feet. The underground workings consist of main shaft and drifts and cross-cuts from foot to hanging walls. The developments were commenced in April, 1880, the amount expended in same being about $40,000. The vein is cut by the Eureka tunnel and is producing ore as rapidly as it can be hauled away from the mine by the pack trains, which convey it to the Eureka company's furnaces, a ready market being thus afforded. This vein is one of the three true fissures found on Prospect Mountain, distinct veins lying in the broad ledge called The Gnat Belt, the latter being decided a ledge by the U. S. Supreme Court. Funds are reserved in treasury for purpose of building a road to the summit of Prospect Mountain, when ore can be hauled in wagons to Eureka. There is also a fund for the purchase of adjoining property. The company was organized January, 1880, on an unassessable basis, with a capitalization of $1,000,000, in shares of $25 each. The mine has yielded to date (April, 1882,) a gross product of $55,000 value. No assessments have been levied and the company is free from debt, with funds in treasury. At the beginning of the year the stock, held principally in Detroit and Eureka, was quoted at $4. The average rate of wages paid to all classes of labor is $4 per day. The above information was furnished by Mr. Frank Robbins, M. E., Resident Trustee of the Alexandria Mining Company.

Virginia Gold and Silver Mining Company (The) is chartered under the laws of the State of Colorado. The directors are T. M. Avery, Pres.; Samuel W. Allenton, Vice-Pres. and Treas.; Geo. Schneider, Sec.; C. O. Avery, General Manager; E. Florada, W. E. White, and W. Spooner. Date of annual election, second Tuesday in January. Edward Florada is Superintendent, and has had an experience of twenty-four years. Head and transfer office, Gothic, Col.; also, room 1, 76 E. Monroe Street, Chicago. The company's mining property consists of two claims, the Virginia, and West Virginia, 300 by 1,500 each, and one tunnel site, the Virginia, 1,500 by 3,000, located one mile from Gothic, Gunnison county, Col. The ore is black and gray sulphurets, carrying some native and wire silver, and assays from four ounces to 15,000 ounces silver per ton, with occasionally some gold. Average of general run, 800 ounces silver to the ton. The character of the mine is fissure. At a depth of fifty feet the vein is three feet wide between clearly defined walls. The property includes boarding-houses, etc. There are three shafts, one sixty feet deep, one 120 feet, and one forty-six feet. The tunnel is 460 feet in length. The other lower workings aggregate 200 feet. The vein has an average width of eight feet. Developments of the property were commenced September, 1880. There is ore enough at hand to keep an ordinary smelter furnace busy. The Avery smelter is only one mile away. Date of organization, March 13, 1882; capitalization, $2,000,000; par value per share, $10; basis, non-assessable; no indebtedness; treasury reserve, 30,000 shares; no shares on the market; stock and bonds held principally in Chicago, Ill. This information was furnished by the Virginia Gold and Silver Mining Company.

Aztec Mining Company (The) is chartered under the laws of the State of New Jersey. Officers are Chas. M. Town, Pres.; Edward S. Sears, Sec. and Treas. Directors, Chas. M. Town, M. M. Gillam, Chas. E. Colby, G. C. Noble, Edward S. Sears. James K. Herring, Supt. General and transfer office, 103 Market Street, Camden, N. J. The annual election is on the first Monday in July. The mines belonging to the company are the Katie and Mollie, located on Mineral Point, San Juan county, Col. The extent of claim each, 300 by 1,500 feet; character of ore, smelting; amount expended in developing property to April 1, 1882, $300; the ore assays for $15 to $100 per ton. The character of the mines is fissure. Assessment work only. Average width of shisk, eleven inches. The company was organized May 30, 1881. Capitalization, 250,000 shares; par value, $2, non-assessable; stocks and bonds in treasury April 1, 1882, 50,000 shares; no bonded indebtedness. Stock listed in Philadelphia held principally in Pennsylvania, Massachusetts, Vermont, and Canada. This information was furnished by M. M. Gillam, Secretary and Treasurer of the Aztec Mining Company.

Baxter Mining Company (The) is the name of a private company owning two mines, the Baxter and the Palmerston, located on Republican Mountain, in Clear creek county Col., two miles west of Georgetown, and covering an area of three and three-fourths acres. The quality of the ore varies from twenty ounces to 950 ounces of silver per ton, containing galena, sulphurets, and gray copper. The character of the mines is described as fissure. Property consists of one mill at Georgetown, and two engines on the lode. Entrance to mine is by Diamond Tunnel. There are two shafts 500 and 200 feet deep, respectively. Total length of adits, 3,265 feet. The length of the main lode on which the company depends for its supply of ore is 1,400 feet. Average depth of vein, seven feet. The underground workings are chiefly drifts and stops. Developments were commenced in 1866, and about $27,000 has been expended. The prospects of the property are fair, there being from four to twelve inches of ore in lower workings, and $10,000 in sight. Cost of mining and milling is about $65 per ton. The ore is sent to Golden and Argo, Georgetown, Col. Yield to April, 1882, 2,956,909 lbs. Net value, $209,154.58. The work is all done on a lease. The company is out of debt. Mr. John G. Roberts is the Superintendent, of twenty-five years' experience as a miner, ten years as Superintendent. To him we are indebted for the foregoing information.

Jessie Benton Consolidated Mining Company is chartered under the laws of the State of Pennsylvania. The officers are Alex. H. Sherrcod, Pres.; J. H. Rittenhouse, Sec. and Treas. The date of annual election is the first Monday in February. The Superintendent, W. H. Merritt, has had eleven years' experience in his profession. Head and transfer offices, Scranton Pa. Transfer days, any time except ten days preceding annual meeting or dividend days. This company is the owner of the Jessie Benton, Seraphine, Eagle, Sunday, Buckhorn, Desert, Peach and Sleeper mines, located in Owl Head district, Pinal county, Arizona. Total area of claims in feet, 7,200,000; amount of property in acres, 160. The ore shows rich chlorides, and is free-milling; no roasting. A twenty ton shipment assayed 253 ounces to the ton. To all appearances, judging from the south walls and polished surfaces of same, and also the clay gangue, the character of the mines seems to be true fissure. The company owns a five-stamp wet crushing silver amalgamating mill, one dwelling-house, shops, windlasses, tools, pumps, etc. The depth of shaft is 545 feet; length of adits, that is levels, 250 feet. The main lode on which the company depends for its supply of ore is 1,350 feet. The vein averages one foot in width. The company have six shafts; the deepest shafts are 200 feet apart; levels driving towards each other, also in opposite directions, shafts ninety, seventy, eighty, and fifty feet, and several of less depth. Development of the property was commenced in 1880, and the company expended $8,000 for this purpose up to April 1, 1882. The cost of mining and milling per ton is estimated at $35. The value of ore in sight, on a low valuation, is thought to be several hundred thousand beyond a doubt. The production for the year 1883 is estimated at 3,000 tons, and weekly output for the same year between fifty and sixty tons. Bullion is made on the grounds and sent to New York assay office. The veins are small but unusually rich. On the Benton, no barren ground has been struck, very little gold in ore shipped, only $4 per ton. The Eagle has considerable gold in it. The company now have a mill in course of erection, which will be running in July next. Everything has been outgo with the company up to the present time, and will be till mill begins to run. Company have sold treasury stock from date of organizing for 75 per cent. par, as full paid stock. They have several hundred tons of ore on the dumps that the Superintendent estimates will assay 150 ounces silver per ton, and large bodies of rich ore of about the same value, blocked out ready for stoping. Date of organization, January 30, 1882. Capitalization, $150,000; par value per share, $1; basis, non-assessable. Fully paid. Stock in the treasury April 1, 1882, $15,000; stock quoted April 1, 1882, seventy-five cents; stock and bonds held principally in Pennsylvania, Lackawanna county, and Pinal county, Arizona Territory. Wages paid to all classes of labor per week, $21. This information was furnished by J. H. Rittenhouse, Treasurer of the Jessie Benton Consolidated Mining Company.

Black Warrior Mining Company is chartered under the laws of the State of New York. J. S. Alexander is President. Office, 24 Cliff Street, New York. The Superintendent of works is A. A. Alexander, who has had four years' experience in the business. The Black Warrior mine, owned by this company, is located in Peck district, Yavapai county, Ariz. There are 1,500 feet in the company's claim. The ore contains galena, black sulphurets, and native silver; assaying $300 per ton. The character of the mine may be described as "fissure." Length of the tunnel is 800 feet, and the shaft is down 250 feet. There are three levels of 100 feet each. The main lode on which the company depends for its supply of ore is 100 feet in length; the vein varies from one to four feet in width. Underground workings are operated from levels run from main shaft. The development of the property was commenced in 1876. The estimated value of ore in sight is $100,000; cost of mining and milling per ton, $30. The output weekly at April, 1882, was thirty tons. Date of organization, November 1, 1882. Stock and bonds held principally in New York city. Wages paid to all classes of labor, per week, $4. Information furnished by T. J. Eaman, Agent of the company.

Bullion of Paradise Mining and Milling Company (The) is chartered under the laws of the State of Nevada. The officers are T. J. H. Corlan, Pres.; Chas. Kemler, Treas.; A. W. Siegel, Sec. The annual election is held May 10 of each year. Chas. Kemler acts as Superintendent; his experience extends over a period of eighteen years. The offices are at Kemler's block, Paradise City, Humboldt county, Nev. The company owns one mine, the Grand Bullion, located in the Mt. Rose district, Humboldt county, Nev.; extent of claim, 1,225 by 600 feet. The ore is a ruby and black metal, mostly free milling. Some of the base gives an average assay of $32 per ton. The mine is described as having a true fissure vein. There is a ten-stamp mill, boarding-house, and good road to mine, two and one-fourth miles long. The shaft is down 120 feet. The total length of adits is 2,362 feet. The length of the main lode on which the company depends for its supply of ore is 1,225 feet; average width of vein, six feet. There are three shafts and three tunnels. The main work is done through tunnels, the main drift or tunnel being now 950 feet on the ledge. From this tunnel are sunk three shafts to further explore the ledge. All of these shafts are in good ore, and the ledge increases in size as depth is gained. Developments were commenced in July, 1879, and have been prosecuted at an expense, to present time, April, 1882, of $115,000, including cost of prospecting. The prospects of the property are A 1, there being at least $165,000 worth of ore in sight, and improving with each foot in depth. The cost of mining and milling is $9.75 per ton. Weekly output at April, 1882, 140 tons; the company crush their own ore. It may be of interest to note that a tunnel has been started at the south end of the mine, which will tap the ledge 275 feet below any of its present workings. The three mine shafts will be sunk to connect with this tunnel. When this work is completed, the entire mine can be worked through this tunnel, and sufficient ore will be forthcoming from above to work the mills for at least three years to come. It is the general opinion of mining men, that when the tunnel is completed and the shafts sunk to same, the mine will be the finest on the Pacific coast. The estimated cost for completing the work is $12,500. Organized, May 13, 1879; capitalization, 122,500 shares of $10 each, assessable basis. Yield (net) to April, 1882, $264,831.52; yield during 1881, $78,374.50; number of assessments levied, three, total amount, $3,500; date of first assessment, October 24, 1880, five cents; date of last assessment, December 18, 1881, twenty cents. The floating indebtedness is $19,400; the stock reserve, 26,000 shares; stock not for sale unless the whole of the treasury reserve is taken at $1.50 per share. Stock is not listed; stock held principally at Paradise, Humboldt county, Nev. Wages paid to all classes of labor, per week, $725. This information was furnished by A. W. Siegel, Secretary of the Bullion of Paradise Mining and Milling Company.

Catamaran Mining Company (The). Names of mines owned are Catamaran and Inskip. Location of mines, Buena Vista mining district, Humboldt county, Nevada. Extent of claim, 1,500 linear feet on each claim, 600 feet wide. Character of ore, chloride; assays, from twenty-six to 300 per ton. Character of mines: Catamaran, fissure: Inskip, flat vein. Dimensions of workings: tunnel, 400 feet; levels, 700, feet; length of main lode on which the company depends for its supply of ore, 1,200 feet. Number of shafts or tunnels, three. Nature of under-workings, slopes, winzes, shafts, drifts, etc. Date of commencing developments, January 1, 1880. Amount expended in same $17.000. Cost of mining and milling per ton, $1,200. Prospects of the property very good. The mines of this district are all worked by the owners (miners); company having no mills, depends on custom mills, the owners doing all their own work, extracting ore, assaying, melting, etc. Ore valued from $40,000 to $70,000. Information furnished by Wm. Woolcock.

Canajorie Mining Company (The) is chartered under the laws of the State of New York. Officers, J. A. Howland, Pres.; H. J. Brogg, Jr., Sec. and Treas. Head and branch office, New York. Transfer office, 30 Broad Street; company's office, New York. Name of mine owned, Flat Creek mine. Located in Montgomery county, N. Y. Amount of property in acres, 120. Quality of ore, very fine. Character of mine, fissure; vein of galena. Property owned by the company, engines, boilers, pump, and washer; all that is required for working the property. The company have not yet developed the mine. All facts have been given that can be noted. Date of commencing developments, 1880. Date of organization, 1879; capitalization, 100,000 shares, par value; $10 per share; non-assessable; no dividends; no assessments; bonded indebtedness, none; stock indebtedness, none; stock and bonds held principally, New York State; weekly output, 250 tons. Information furnished by H. T. Brogg, Jr., Secretary Canajorie Mining Company.

Durango Mapimi Mining Company of Council Bluffs, Iowa, is chartered under the laws of the State of Iowa. The officers are W. F. Sapp, Pres.; Dr. J. B. Shultz, Vice-Pres.; Stewart Spalding, Sec.; John Herget, Treas. Executive Committee, W. F. Sapp, P. F. Bresee, Chas. F. Craven; Directors, W. F. Sapp, Joseph Knolts, John Herget, J. B. Shultz, P. F. Bresee, H. C. Sigler, Geo. F. Wright, T. J. Walker, Chas. F. Craven. Date of annual election, first Wednesday in October. Superintendent, Carl Dietmar, who has had ten years' experience in his occupation. Head office, Council Bluffs, Iowa, Branch office, 128 La Salle Street, Chicago, Ill. Transfer office, 128 La Salle Street, Chicago, Ill. Transfer day all the year. There are eight separate mines consolidated and owned by this company, viz., Ojuda, San Vicente, Socobon, Santa Rita, El Carmen, Santa Maria, La Soledad, and San Judas. These mines are located in the State of Durango, Mapimi District, Republic of Mexico. A mine in this district has a certain measurement which is called a possession. A possession measures 200 by 200 varas. A varas is thirty-three inches English measurement. These mines have from one to three measurements each. The character of the ore is lead carbonate, carrying both gold and silver, but chiefly silver. The lead amounts to 15 per cent. of the ore. Average yield per ton about $32. The character of the mines seems to be great veins widening in places to immense deposits, but always plenty of ore. The works consist of six smelters, two large and one small refining furnaces, with sufficient store-rooms for coal, two large ore yards, a water-power turbine and blower, blacksmith and carpenter shops, furnace for brass and copper foundry, a dwelling-house and store-rooms in good condition. A complete assay office with two Becker scales. The works, including dwelling-house and yards, cover a space of 137 by 137 yards. To the works belong about thirty acres of land. The turbine is moved by ninety cubic feet of water per minute on a fall of twenty-six feet. The vein varies from five to fifty feet in different mines. There are eight shafts and one tunnel. The underground workings are very extensive, they are old Mexican workings and the shafts vary in depth from twenty-five feet to 900 feet, but without water in any of them. This company took possession of property, March, 1882. Amount expended in developing property to April 1, 1882, by former owners, $80,000. The amount of ore in sight seems to me practically unlimited and is estimated to be worth at least $8,000,000. The cost of mining and smelting per ton is $20. Maximum yearly capacity of production of works, April 1, 1882, $144,000. Weekly output at April, 1882, $3,000. Principal market for ore is Mapimi. These mines are the principal ones of the Mapimi Dist. in Northeastern Durango. They are old Mexican mines and have been worked for perhaps two or three hundred years by the early Spaniards. They have been profitable at all times. The present company have had smelters made that will increase their reduction capacity from eighteen tons to 100 tons of ore per day. Date of organization, June 11, 1881; capitalization, $1,500,000; par value, per share, $100; basis, non-assessable; yield (net) to April 1, 1882, $6,000, 400 tons; stock indebtedness, $1,200,000; stock reserved in the treasury, April 1, 1882, $300,000; stock sold, April 1, 1882, $20; stock and bonds held principally in Iowa and Ills.; stock sold only by subscription; total wages paid to all classes of labor per week, $1,000. This information was furnished by J. H. Knolts, and certified by Stewart Spalding, Secretary of the Durango Mapimi Company.

Duncan Silver Mining Company is chartered under the laws of Canada. The officers are Thos. Appleton, Pres.; L. B. Stone, Treas. Date of annual election, first Monday in December. The Superintendent, W. Kapsey, has had nine years' experience in his occupation. Transfer office, 79 Water Street, Boston, Mass. The company's works are located near Prince Arthur's Landing, Province of Ontario, L. S. Canada. Extent of claim, 600 acres. The ore contains silver flecks, native silver, minute, and zinc blends. Veins thin and assays very uncertain. The character of the mine may be described as "fissure vein," and much resembling the ground at Silver Islet, seventeen miles distant, southeast. Property owned, real estate, stamp-mill, diamond-drills, steam-drills, pumps, compressor, hoists, etc. Depth of shaft, 800 by 200 feet, by diamond-drill; aggregate of holes bored by diamond-drill, 3606 feet. The vein is pockety and thin; aggregate of shafts, levels, crosscuts, and winzes, 2,926 feet; number of shafts, four; underground workings are all in rock; amount expended in developing property to April 1, 1882, $290,000. The property is not worth further expense to develop; abandoned November 1, 1881; machinery for sale; principal market for the ore, United States. There was found but one considerable pocket of paying silver ore; and the vein was then lost, though thoroughly sought. This pocket was near the surface and yielded $18,000, leading to the continuance of work four years longer. There are yet unissued 40,000 shares of capital stock and several thousand dollars in the treasury; all obligations paid. The machinery is unmoved—laid by in good order to be removed and put to work on other property for the present owners, or other proprietors, with or without uniting with the Duncan Company. This property is owned by an American company of stockholders, working at mining in Canada. Date of organization, October 15, 1873; capitalization, $2,000,000; par value, per share, $20; basis, non-assessable; yield (net) to April 1, 1881, about $18,000; no dividends paid; number of assessments levied, nine; total amount of same, $5; date of first assessment, October 15, 1873; date of latest assessment, June 9, 1880; stock indebtedness, $1,200,000; stock quoted April 1, 1882, 25c.; stock held principally in Boston; stock listed only in Boston. This information was furnished by L. B. Stone, Treasurer of the Duncan Silver Mining Company.

Gilmer-Salisbury Mining Company (The) is chartered under the laws of the State of California. The Trustees are J. T. Gilmer, M. Salisbury, S. D. Brastow, Alf. Eoff, O. J. Salisbury. Mr. J. S. Robeison is the Secretary, and Mr. A J. Blair is the Superintendent, of eighteen years' experience. Head offices are at San Francisco, Cal., and the branch offices at Bristol, Nev. The company owns seven mines or claims, viz.: the Tempest, Iron Mine, White Rock, National, Champion, Kentuck, and Manhattan, located in the Bristol mining district, Bristol, Nev., and comprising an area of 160 acres. The ore is of a quality suitable for smelting. Some high grades will average from $70 to $80. The vein is characterized as a true fissure. The Iron Mine shaft is 200 feet deep; the Tempest shaft is 300 feet deep; the Iron Mine skip tunnel is 227 feet deep; the Tempest first level is ninety feet at 100 feet depth; the Tempest second level is forty feet at 300 feet depth. Developments were commenced January, 1881; $25,000 has been expended in same. Whilst large quantities of ore have been developed, none has been extracted for reduction. All ore taken out in sinking drifting lies on dump; this is from the Iron and the Tempest mines, to which all the foregoing information principally refers. The ore will be reduced in the immediate locality. Organized, January, 1882; capitalization, $10,000,000, in 100,000 shares of $100 each; basis, assessable, but no stock issued nor listed; wages paid to all classes of labor, per day, $4 *i. e.* (at the rate of). This information was furnished by A. J. Blair, Superintendent of the Gilmer-Salisbury Mining Company.

Florence Mine (The) and 500 feet of the Elm City Mine, owned by John G. Roberts, are located at Republican Mountain. Extent of claim, one full claim, 1,500 by 150 feet, and 500 by 150 feet, or 2,000 feet in all. The ore carries silver, milling from ninety to 3,000 ounces per ton. The richest is worth $260 per hundred pounds; average assay, 460 ounces per ton. The character of the mines is described as "fissure." Length of adits, that is, levels, eighty feet. The vein has an average width of eight feet. Extent of underground workings, eighty feet drifting and thirty by forty slope. Date of commencing developments, 1876. Amount expended in developing property, tunnel, etc., to April 1, 1882, $5,000. No estimate of ore in sight can be made owing to repairs. Cost of mining and milling per ton is very irregular, varying from $3 to $125. Mr. Roberts has had no control of these veins until lately. He found them "gouged" badly; two men made $640, $960, $1,100, $1,982, and $400 per month there. Picked specimen worth $2.60 per pound. Five sacks taken out last month netted $404. Yield (net) to April 1, 1882, $21,000, forty-five tons; free from bonded indebtedness, April 1, 1882; labor all done by lease. This information was furnished by J. S. Roberts.

Granby Mining and Smelting Company (The) is chartered under the laws of the State of Missouri. The officers are Edgar T. Wells, Pres.; Solon Humphreys, V.-Pres.; A. S. Trevor, Sec. The annual election is held in March. Mr. Peter E. Blow is Superintendent, having had about six years' experience. The head transfer office is at St. Louis. Transfers can be effected at all business hours. The company own the Granby Mine in Newton county and the Joplin and Oronogo, in Jasper county, Mo.; the property having an extent of 15,000 acres. The plant comprises two furnaces ($25,000) and a quantity of machinery. St. Louis is the principal market for ore. Organized, April, 1865; capitalization, $2,000,000, in 20,000 shares of $100 each. No assessments have been levied. The company has no bonded or other indebtedness. No stock in treasury. Stock not listed, held chiefly in St. Louis. This information was furnished by the company.

Grand Trunk Mining and Smelting Company (The) is organized under the laws of the State of New Jersey. The officers are Chas. M. Town, Pres.; M. M. Gillam, Sec. and Treas. The annual election is held on the second Wednesday of June. Mr. Jas. K. Herring is Superintendent, with an experience of twelve years. The head and transfer offices are at 103 Market Street, Camden, N. J. The company owns three mines—the Grand Trunk, C. C. Colby, and Indian Chief—situated at Mineral Point, San Juan county, Col.; each claim measuring 300 by 1,500 feet. The ore is free smelting, and gives an assay of from $40 to $110 per ton. The character of the mine is described as "true fissure." The shaft is 101 feet down, with twenty feet of level. The average width of pay streak is five feet. The length of main lode, on which the company depends for its supply of ore, is 1,500 feet. Developments were commenced in June, 1881; about $3,900 having been expended; they are being vigorously pushed, and valuable ore is already being produced. Organized, May 13, 1881; capitalization, 1,000,000, in 200,000 shares of $5 each. No bonded or other indebtedness. Stock in treasury, 30,000 shares; stock listed in Philadelphia Mining Exchange, held principally in Pennsylvania, Massachusetts, Vermont, and Colorado. This information was furnished by M. M. Gillam, Sec. and Treas. of the Grand Trunk Mining and Smelting Company.

Gunnison Crystal Mining Company is chartered under the laws of the State of Colorado. The officers are J. H. Sinclair, Pres.; Dr. Jos. M. Gerhart, Vice-Pres.; Wm. Staith, Sec. and Treas. Date of annual election first Tuesday in May. Superintendent, A. B. Hart, five years' experience. Transfer office, Colorado Springs, Col. This company are the owners of the Crystal Belle, Clara, Achilles and Little Bonnie, Jose mines, located at Ruby Camp, Gunnison county, Col. Extent of each claim, 300 by 1,500 feet. The ore is free milling, the character of the mines, fissure. The Crystal shaft is eighty feet deep and the Clara thirty feet. Only assessment work has been done in others, but a pay 8,560 ounces on Crystal lode. The company have but just commenced to develop their property, but they have already expended $6,000 upon the same, April, 1, 1882. The prospects of the property are good. In the same belt with Forest Queen, Ruby Chief, Lead Chief, etc. Date of organization, October 23, 1879; capitalization, $828,000; par value per share, $100; basis, non-assessable; yield to April 1, 1882, after smelting, from 150 to 280 ounces. The company is free from indebtedness. This information was furnished by William Staith, Secretary of the Gunnison Crystal Mining Company.

Henderson Mine (The), owned by N. M. Thayer, J. H. Mason, and W. A. Russell, is located at El Dorado, Montgomery county, N. C. Amount of property in acres, 200. The ore carries gold, copper, silver, and lead, and assays about $50 per ton. Character of the mines, "fissure." The shaft is fifteen feet deep. Length of the main lode, half a mile. The vein has an average width of seven feet. Number of shafts, three. Developments were commenced April 1, 1882. Estimated value of ore in sight, $1,000. This mine has been lately discovered, and is considered by mining experts to be very valuable for gold, silver, copper, and lead. Company organized June 13, 1882. This information was furnished by N. M. Thayer, one of the owners of the Henderson Mine.

Henrage M. Griffin is the owner of the former property of the Consolidated Hercules and Roe Silver Mining Company. Office, Georgetown, Col. The names of the lodes, all contiguous, are: Hercules, 3,000 by 50 feet: West Hercules, 3,000 by 50 feet; 7.30, 700 by 50 feet; McClung, 3,000 by 50 feet; John J. Roe, 1,500 by 50 feet; Maggie, 1,500 by 150 feet; Jennie, 1,500 by 150 feet; John M. Wilson, 1,500 by 150 feet; Clifford, 1,500 by 150 feet; Cora B., 1,500 by 150 feet. All the above lodes are patented. Wreckin, 1,500 by 150 feet, and Pell Wall, 1,500 by 150 feet; receivers' receipt. Hercules tunnel site, 1,000 feet long. The property is located in Clear Creek county, Col. Character of the ore, galena, gray and yellow copper, silver glance, wire silver, zinc blende, ruby, and brittle silver. Character of the mines described as true fissures. Amount of property in acres, $33\frac{73}{1000}$. The main shaft is 300 feet deep. Hercules tunnel, 160 feet. Length of adits—that is, levels—6,000 feet. The main lode is 6,000 feet in length. The vein has an average width of from twenty-five feet to forty feet. Georgetown, Clear Creek county, Col., is the principal market for the ore. Yield (net) to April 1, 1882, $500,000; yield (net) during 1881, $100,000. This information was furnished by Henrage M. Griffin.

Hidalgo Town and Mining Company (The) is chartered under the laws of the State of Colorado. The officers are H. E. Austin, Pres.; O. E. Henry, Vice-Pres.; M. S. Adams, Sec.; A. W. McGovern, Treas. Trustees, J. A. Merriman, L. Hays, C. A. Smith, N. H. Heath, B. F. Baldwin, Thos. Hookey. Superintendent, Thos. Hookey. Experience, one year. Offices, Silver Cliff, Custer county, Col., and Hidalgo, Gunnison county, Col. Transfer office, Silver Cliff. The company's mines are the Ontario, Little Abbie, and Tillie Maria, located at Poverty Gulch, Elk Mountains, Gunnison county, Col. Extent of claim, thirty acres. The character of the ore is dark galena, with considerable antimony. Character of the mines, fissure. As yet the company's property consists only in log-cabins for the men employed. Tunnel is forty feet in length. Length of the main lode, forty feet. The vein has an average width of ten feet between the walls. The underground workings are between two solid granite walls. Development of the property was commenced August, 1881, and the amount expended in developing property to April 1, 1882, $2,000. The ore in sight in the Ontario is very rich. The others have not been developed enough yet to say what the prospects are. Mining costs about $16 per ton. Principal markets for the ore, Denver and Pueblo. The Ontario mine is undoubtedly a valuable mine, and mill-runs will be made at Pueblo this summer. Owing to the altitude, 13,000 feet, work was suspended in September, 1881, and operations cannot be commenced until near the 1st of July, on account of lateness of snow this season. The bulk of the stock is devoted to development, and the other stock is not negotiable at present, so all stock for sale is treasury stock, exclusively for developing the property. They also have coal property. No ore has been removed from the dump yet, April 1, 1882. Date of organization, April 28, 1881; capitalization, $100,000; par value per share, $10; basis, non-assessable; yield (gross tons) during 1881, about ten tons; number of assessments levied, none; date of first assessment, July, 1881, $3.33⅓ per share; date of latest assessment, August, 1881, at the rate of $3.33⅓ per share; the company free from bonded indebtedness, April 1, 1882; stock reserved in the treasury, April 1, 1882, $61,000; stock quoted April 1, 1882, par; stock not listed. Stock held principally at Silver Cliff and Pueblo, Col., and Coicheta, Kansas. This information was furnished by Thomas Hookey, Superintendent of the Hidalgo Town and Mining Company.

Hope Mining Company (The) is represented by Laveaga, Rutherford, Woolcock, and Fielding. The mines owned are the Hope, Lucky, Dog, Snow Flake, Huascar, Carbonate, Gem, located at Buena Vista mining district, Humboldt county, Nevada. There are 1,500 feet in each mine, The company owns forty-five acres mill sites and placer mines. The character of the ore is chloride black sulphurets, with some antimonial sulphurets of silver. Assays per ton, from $16 to $800. Character of the mines, flat vein, sometimes called blanket veins, by some, contact, country rock, and calicureous slate. The company have five tunnels on their property, total length, 1,100 feet. Length of adits, that is levels, 1,200 feet. The tunnel follows the lode from the surface. The vein has an average width of two and a half feet. Shutes from drift, two to number four. Date of commencing developments, August 15, 1879. Amount expended in developing property to April 1, 1882, $32,700. Estimated value of ore in sight by expert, $60,000; the owners think more. Cost of mining and milling per ton, $13. Rented mill, run two months or over, on short water, bond since under bond from July 1, 1882. Date of organization, August 15, 1879; basis, non-assessable: yield (net) to April 1, 1882, $42,000. This information was furnished by the Hope Mining Company.

Hope Mining Company (The) is chartered under the laws of the State of Missouri. The officers are S. Gaty, Pres.; E. Harrison, Vice-Pres.; John R. Lionberger, Treas.; John T. Field, Sec. Directors, the above named officers and James O. Broadhead, A. B. Ewing, J. L. January, H. J. McKellops, A. F. Shapleigh, Louis Deustrow, L. M. Rumsey, John C. Sevan, and Chas. Taussig. Executive Committee, E. Harrison, John R. Lionberger, A. S. Shapleigh, Louis Deustrow, and Chas. Taussig. The annual meeting is held 2d Monday in November. Frank L. Perkins is the Superintendent. The offices are at (Room 7) 427 Olive Street, St. Louis, Mo. Transfers can be effected during all office hours. The company owns several claims, including Hope, Cliff Mines, Little Emma, which are the three principal ones, located at Philipsburg, Deer Lodge county, Montana, comprising an area of 3,800,000 square feet. The ore is various, some being refractory and some free milling; this applies chiefly to the Hope. The assay gives about forty-five ounces. In the Hope mine the ore bodies are embedded masses in stratified magnesian limestone, broken by faults, displacing and separating the continuous veins. In the Cliff the vein is in dolomite, or it may be termed a fissure-vein in limestone, trends east and west. Ore croppings can be traced the length of claim. Other lodes and claims are not developed. The total length of drifts, etc., in the mine is 3,443 feet. The plant includes a ten-stamp, wet-crushing mill, amalgamating pans, six and two true vanners. Fully $600,000 has been expended in developments, the present prospects of the mine being excellent. There is a large body of ore in sight. Including the cost of development the cost of mining is about $12 per ton. Including treatment of tailings the cost of milling is about $7.75. The bullion product is sold on New York assay certificate. Organized, November 23, 1872; capitalization, $400,000, in 8,000 shares of $50 each, fully paid. In 1881 the yield of ore was 5,600 tons, giving a net product of pure silver, 113,099 ounces. Total dividends paid, $22,603.50; first dividend, January 3, 1882, of $1.50 per share; second and latest, April 4, 1882, of $1.50 per share; no assessments; no bonded or other indebtedness; stock in treasury, $23,135; stock held chiefly in St. Louis, Mo.; stock not listed; stock quoted at $40; wages paid to all classes of labor per week, April, 1882, $1,372.12. This information was furnished by John T. Field, Secretary of the Hope Mining Company.

Huascar Mining Company is represented by Laveaga and Rutherford. The mines owned are the Huascar, Carbonate Gem, located at Buena Vista miningdistrict, Humboldt county, Nev. There are 1,500 linear feet in the company's claim. The ore is antimonial sulphurets; assays from $20 to $800. Character of the mines, "fissure," serpentine rock, or, green rock. Cost of mining and milling, per ton, $20. Length of adits—that is, levels, 300 feet; length of the main lode on which the company depends for its supply of ore, 370 feet. The vein has an average width of six feet. There are two shafts and two tunnels. Nature of underground workings, drifts, winzes, etc. Date of commencing developments, August, 1879. Amount expended in developing property to April 1, 1882, $24,000. Estimated value of ore in sight, $80,000. The mine originally was known as the Peru, located in 1861; relocated several times. Ore base, winze from main drift down forty-five feet; at bottom of winze, ledge is thirteen feet between the walls. The company is organized under a non-assessable basis. This information was furnished by Geo. W. Rutherford, one of the Huascar Mining Company.

Humboldt Mining Company (The), of New Mexico, is chartered under the laws of the Territory of New Mexico. The officers are David Branson, Pres.; Edmund Webster, Vice-Pres.; Ed. S. Lowry, Treas.; R. Evans Peterson, Sec.; the office of Superintendent is temporarily vacant. Annual election is held third Wednesday in March. Transfer office is at 330 Walnut Street, Philadelphia, Pa.; head office, Engle Post Office, Socorro county, N. M., on line of Atchison, Topeka & Santa Fe Railroad. Mines and mining property of Humboldt Mining Company in New Mexico, in Cuchillo Negro Mountains, Black Range, Socorro county: Garfield, Gift, Little Luella, John G. B., Providence, Sunnyside, Reward, Lookout, Little Hope, and Telegraph. In upper and middle Caballo Mountains, near Palomas, Socorro county: Gift, California, Nevada, Grammis, and Terry. In lower Caballo Mountains, near Rio Grande, Socorro county; Golden Fleece, first extension south of Golden Fleece, first extension north of Golden Fleece, Ella, Frank W., and Summit. In San Andreas Mountains, Dona Ana county: Leviathan, Kahler, Cincinnati, Chrysolite, Chloride, Adriatic, Corbit, Hembrillo No. 1, Hembrillo No. 3, Timbuctoo No. 1, Timbuctoo Discovery, Morocco, and four mill sites at Hembrillo, Cottonwood, Cincinnati, and Sulphur Springs. The property, as per particulars given above, is located in Cuchillo Negro and Caballo Mountains, Socorro county, and in San Andreas Mountains, Dona Ana county, New Mexico; the total extent is 650 acres. The ore is an argentiferous, galena, copper, and lead carbonate and chloride, and some argentiferous rock assaying from $2 to $195 per ton. The mine has true fissure and contact veins and carbonate deposits. Depth of shafts, 685 feet; length of tunnels, 308 feet. Including the whole of the claims, the total length of the main lode on which the company depends for its supply of ore is 46,500 feet. No mining plant yet erected. Developments were commenced only in December, 1881, since which, to April 1, $20,000 has been expended. The policy of the management now is to concentrate most of their efforts and expenditures on one of the groups which is most likely to prove speedily remunerative, and as soon as it becomes so, to push developments on another, and so continue until as many as can be profitably worked under one management are in full production; the surplus property to be partly developed from time to time, and sold for the benefit of the company's treasury. The claims are all on United States Government land, and were discovered in 1880 and 1881 by daring prospectors during the war with the Apache Indians. Gold, silver, copper, and lead are all contained in these properties, in some cases all four metals in the same vein. Good coal has been found near the Caballos, and abundant timber, both along the Rio Grande and in the Cuchillo Negro Mountains. Mill sites have been located in connection with them, and all are favorably situated for economical working; they are within a day's drive of the main line of the Atchison, Topeka & Santa Fe Railroad. Socorro is the principal market for ore. Organized, March 13, 1882; capitalization, $6,000,000, in 240,000 shares of $25 each, non-assessable; stock reserved in treasury, $3,000,000; stock not listed or quoted; stock held principally in Philadelphia, Pa., Socorro county, N. M., and Albuquerque, N. M. Weekly wages paid to all classes, $700. This information was furnished by David Branson, President of the Humboldt Mining Company.

Indian Queen Mining and Milling Company (The) is chartered under the laws of the State of New Jersey. The officers are G. W. Warren, Pres.; M. Dyer, Jr., Treas.; C. C. Lane, Sec. Directors, Wm. Cogswill, G. P. Langer, H. Z. Hill, T. H. Ford, John G. Webster, and W. O. Fiske. The annual election is held on November 22. Mr. M. Carey is the Superintendent, with an experience of twenty years. The transfer and other offices are at 15 Pemberton Street, Boston, Mass. Transfer days irregular. Books close ten days before dividend days. The company owns the following claims or mines: Indian Queen, Nos. 1, 2, 3, 4, and 5, Justice, Hiskey, and Darbrow, located in the Oneata Mining district, Emerald county, Nevada, covering a total extent of 7,500 feet. The ore is argentiferous, assaying from $90 to $127 per ton. The mine is a fissure of talcose slate formation. There are five entrance tunnels, aggregating 5,000 feet in length. Average width of vein two feet. Total extent of underground workings about one and a half miles. The length of main lode, on which the company depends for its supply of ore, 2,500 feet. The mining plant comprises one 8-stamp mill, a White-Howell furnace, boarding-house, stores, etc. Developments were commenced in 1870, since which time the sum of $250,000, or thereabout, has been expended. The mine is showing well for continued dividends. Cost of mining and milling is $40 per ton. The maximum yearly capacity of production in April last would be about 200,000 tons. Organized November 22, 1880; capitalization $250,000, in 125,000 shares of $2 per share, non-assessable. The net yield during 1881 was $182,439.21. $337,500 has been paid in dividends to April, 1882, total number being twenty-four. The last dividend of five cents per share, amounting to $6,250, was paid June 25, 1882. No assessments have been levied; no bonded or other indebtedness; no stock reserved in treasury. Stock listed at American Mining Exchange, New York, and Boston Stock Exchange. Quoted April, 1882, $3 per share. This information was furnished by C. C. Lane, Secretary of the company.

Knotts Silver Mexican Mining Company (The) is chartered under the laws of the State of Iowa. The officers are President, Rev. P. F. Bresee, Council Bluffs, Iowa; Vice-Presidents, Dr. J. B. Shultz, Logansport, Ind.; John Herget, Pekin, Ill.; Secretary, Stewart Spalding, Chicago, Ill.; Treasurer, J. P. Lyman, Grinnell, Iowa. Executive Committee, Rev. P. F. Bresee, C. F. Craver, J. Herget Dr. J. B. Shultz, and J. B. Knotts. Directors, Rev. P. F. Bresee, Council Bluffs, Iowa; C. F. Craver, Grinnell, Iowa; B. N. Curtis, Esq., Bloomington, Ill.; Hon. Jos. Knotts, Council Bluffs, Ia; John Herget, Esq., Pekin, Ill.; Dr. J. B. Shultz, Logansport, Ind.; J. B. Knotts, Indianola, Iowa; J. B. Gregg, Esq., Red Oak, Iowa; Hon. H. C. Sigler, Osceola, Iowa; D. G. Phillips, Esq., Madison, Ind.; J. T. Walker, Great Bend, Kan.; J. A. Harvey, Des Moines, Iowa. Annual election is held second Wednesday of June. Mr. A. B. Sawyer, of twenty years' experience, is Superintendent. The transfer office is at 128 Lasalle Street, Chicago. Transfer days all year round. Offices also at Osceola, Iowa. The company owns the consolidated mines of Parral and several mill sites in the State of Chihuahua, Republic of Mexico; extent of property, forty-five acres. The ore is a black, hard quartz, containing both native and ruby silver; average at bottom of shaft, ninety-nine ounces. The mine is described as having true fissure veins. Tunnel length, 317 feet; shaft, depth, 410 feet; length of adits, 200 feet; average width of vein, fifteen feet; length of main lode on which company depends for supply of ore, 3,960 feet. The plant comprises engines, boilers, hoisting machinery, tracks, and reduction mill; cost, $80,000. The sum of $50,000 has been expended in developments, which were commenced on the first of January, 1880. Cost (estimated) of mining and milling is about thirty dollars per ton. Value of ore in sight is variously estimated at from eight to twelve millions of dollars. The mining property of this company consists of a group of Spanish mines that have never been worked for more than a century past, yet have yielded about $60,000,000, as shown by Spanish records. The work done by the company so far has been directed towards cleaning out the mines and putting them in good working order. This has now been accomplished, and the company is now preparing for active operations. The principal market for the ore is Parral. Organized August 23, 1875; capitalization, $750,000, in 7,500 shares of $100 each, non-assessable; one stock dividend of 2,250 shares; date of said dividend, October, 1878. No assessments have been levied. Stock indebtedness, $60,000; stock reserved in treasury, $150,000; stock on market, none; stock sold only by subscription; stock held chiefly in Iowa, Illinois, and Indiana. This information has been furnished by J. B. Knotts, one of the directors of the company.

Lincoln Mining Company (The) is not a corporated company. The company owns two mines or claims, Fred Rogers and Government. Extent of same being 1,220 by 50, and 1,275 by 150, both located on Democrat Mountain, in Upper Union Mining district, Clear creek county, Col. The ore is a rich argentiferous galena, assaying an average of 250 ounces silver per ton. The mine is described as a true fissure vein. Depth of shaft, 280 feet; length of adits, about 1,800 feet; average width of crevice five feet; of pay streak six inches, about 1,660 fathoms stoped out. The length of the main lode on which the company depends for its supply of ore is 740 feet. Georgetown, of Clear creek county, Col., is the point to which the ore is forwarded. The mine is wet at present, but will soon be drained by a tunnel. Ore vein is narrow but rich. Work has been done by lessees. The two veins unite. The ore vein is pockety, not continuous. The output of ore is necessarily irregular, but has been quite good for the amount stoped out. The value of the mines will be considerably increased when thoroughly drained. The yield to April 1, 1882, was $192,912.04. The yield during 1881, was $28,043.46; (gross) yield during 1881 was 122½ tons. To April 1, 1882, twenty dividends paid, aggregating about $40,000: first dividend on December 4, 1874; amount of same, $960. Latest dividend, 5th December, 1881; amount of same, $1,600. Two assessments have been levied; total amount of same, $5,120. First assessment February 1, 1876; amount of same, $4,000; date of latest assessment, June 22, 1882; amount of same, $1,120. This information was furnished by W. A. Burr, agent of the Lincoln Mining Company.

Martin White Mining Company (The) is chartered under the laws of the State of California. The officers are Chas. H. Stanyan, Pres.; J. J. Scoville, Sec. The directors are C. H. Stanyan, Annis Merrill, W. E. Norwood, E. D. Sawyer, and R. P. Clement. Mr. Henry Sweetapple, who has had an experience of twenty years, is Superintendent. The annual election is held 3d Thursday in August. The head office is at room 59, Nevada Block, San Francisco, Cal. The company owns the following claims: Mountain Pride, Paymaster, Young America, Defiance, Mammoth, and Caroline, all patented; also the following: (the patent papers for which, excepting Wisconsin and Ben Voirlick, are now in Washington, no adverse claims filed against them) Merril Latima, one-half Juno, Alumida, Ward & Henry, Ben Voirlick, Ben Lommond, and Wisconsin, all located at Ward, Ward Mining district, Nev. The total extent of property has an extent of two square miles or 3,000 acres. The ore is argentiferous, with some gold, gangue quartz, assay (average) $100 per ton. The mine may be described as having fissure veins and deposits of sand. The tunnel has now attained a depth of 3,250 feet; length of adits including tunnel, 8,050 feet. The length of the main lode on which the company depends for its supply of ore, is 10,000 feet; average width of vein eighty feet. The workings consists of four tunnels, upraises, winzes, crosscuts, etc., in all, say 10,750 feet. Developments were commenced in June, 1876, the sum of $456,000 having been expended in same. The mining plant and surface property consists of twenty-stamp mill, (new,) with four White-Howell furnaces attached, two Water Jacket Smelting furnaces, and four Capelling furnaces. Rich ore has been struck in several places during the past few months, and it is estimated that $1,000,000 is in sight. Necessary dead-work will be completed by July 15, 1882, after which the various ore bodies will be actively explored and ore taken out. The maximum yearly capacity of production April 1, 1882, 95,000 tons. The product is marketed at San Francisco, Cal. The company owns by purchase all the water and water-rights in the district, the land conveying same being secured by United States patents. The policy of the company is to always keep out of debt, and no claims of any kind will be allowed to accrue against the property. All the business of the company is conducted upon a cash "pay as you go" basis, and the rights of the stockholders in and to their property will be protected to the utmost. The company expects to start its mill soon upon the rich ores from the recent find. Four or five Ingersoll power drills will be kept constantly at work prospecting the ore bodies. The facilities for reduction are such that the company is prepared to work any kind of ores, either milling or smelting. Organized August 17, 1874. Capitalization, $10,000,000, in 100,000 shares of $100 each; basis, assessable. Yield $961,707 to April 1, 1882. Three dividends paid, $90,000 to April 1, 1882. Date of first dividend, May 27, 1879. Amount per share, thirty cents; total amount, $30,000. Date of latest dividend, July 28, 1879. Amount per share, thirty cents: total amount, $30,000. Twelve assessments levied, $925,000. Date of first assessment, May 28, 1877; amount per share, $2. Date of latest assessment, May 9, 1882; amount per share, twenty-five cents. Stock listed on the Mining Exchanges of San Francisco, Cal., and New York. Stock held chiefly in California, New York, Pennsylvania, and Massachusetts. Stock quoted April 1, 1882, $4.50. Weekly wages, $1,250. This information was furnished by J. J. Scoville, Secretary of the company.

Monitor Mill and Mining Company (The) is represented by Robert Briggs, W. G. Lyons, Wm. McGill, and the property is managed by the above private individuals as a private enterprise, the parties in question having had large experience in mining on the Pacific Coast. The company's property covers sixty-five acres of land. Office, Steptoe Creek, White Pine county, Nevada. The company's mines are the Monitor, the Gow, the Yellow Bonanza, and the King Bee, located in Taylor Mining district, White Pine county, Nevada. Amount of property in acres, sixty-five. The ore carries free chloride of silver, very little base of any kind, and assays $45 per ton. The character of the mines is described as an immense outflow of quartz, assaying not less than $20 per ton, and containing chambers of very high grade ore, with a value of $150 to $200 per ton. The company's property includes one ten-stamp quartz mill, assay office, retort room, machine shop, store-houses, main office, boarding-houses, carpenter shops, barns for horses, eighty acres of land, and ten years' lease of 400 inches water from Stephens creek. The shaft is 125 feet deep. Length of adits—that is, levels—200 feet. The main lode is 1,500 feet in length. Developments were commenced January, 1881, and $15,000 was expended in developing the property to April 1, 1882. The ore on dumps and in sight in mine is sufficient to yield $1,000 per day for the next ninety days, besides two years' run upon low grade ore that is already exposed. Cost of mining and milling per ton, including freight, $13. The weekly output at April 1, 1882, was eighty-three tons. The ore is milled at the company's mill. The property was first located in 1872 by an Indian, who sold it for $40 and a horse to Messrs. John Platt and John Taylor during the latter portion of the year 1875. These parties sold the property to a San Francisco company, which was incorporated under the name of the Alamida Mining Company, for the sum of $18,000. This latter company worked the property for the period of two years, and expended on the same $15,000, and then abandoned the property. In 1881 it was relocated, and in the following January commenced the actual development of the property. The bullion is very pure, .990 fine. Yield (net) to April 1, 1882, $61,000; yield (net) during 1881, $15,000; yield (gross tons) during 1881, 400. Date of latest dividend, May 1, 1882; amount, $10,000. No assessments have been levied to June 1882. Wages paid to all classes of labor per day, $4. This information was furnished by Monitor Mill and Mining Company.

Mount Pleasant Mining Company (The) is chartered under the laws of the State of New Jersey. J. H. Smith, Superintendent. The Mount Pleasant mine is owned by the company. Located on Grizzly Flat, El Dorado county, Cal. Extent of claim, 5,135 feet—293·60 property in acres. Fine quality two per cent. sulphurets, iron pyrites, zinc, and galena ore; fissure veins; depth of shaft, 400 feet; levels are 4,619 feet; average width of vein, five feet; tunnel, 130 feet; one twenty-stamp mill, run by steam; double engine; hoist with cage in shaft. This blank was filled out by J. H. Smith, Superintendent of Mount Pleasant Mining Company. Any further information may be had at company's office, Room 47, No. 18 Wall Street, New York.

New Street Albans Silver Mining and Smelting Company. The Directors are M. Chase, Pres.; John H. Gordon, Treas. and Sec.; G. A. Litby, D. H. Smith, D. N. Ewell, Irving Rice, D. W. Keyes. The company's property is located at Saint Albans, Maine. The company was organized April, 1880, and has a capitalization of $500,000, in shares, with a par value of $5 per share.

Nigadoo Silver Mining Company. The officers are Jas. Hickson, E. Hickson, R. Ellis, J. H. Harding. Office, Bathurst, Glocester county. The company's property is located in the British Province of Canada. The company has a capitalization of $150,000, in 300,000 shares, with a par value of $5 per share.

North Star Mine (The) is owned by Messrs. Ragel, Nichols & Co. The property consists of two claims, the North Star and Nevada, located at McMillen, Gilo county, Arizona. The ore is a high grade chloride and horn silver, assaying from $1,000 to $7,500 per ton. The mine is a true fissure, traceable for three miles, from four to ten feet wide. The shaft is down about seventy feet, and tunnel is driven 148 feet. The length of the main lode, on which the supply of ore depends, is 1,500 feet. No mining plant exists. Developments were commenced in 1877, since which time $1,500 has been expended. The prospects of the mine are considered good, providing capital will take bold and develop. Cost of mining and milling, $35 per ton. There was a pocket of ore found in this mine five years ago which ran over $7,000. Since then it has changed hands, and very little more than assessment work has been done. We are expectant of making a sale of the property soon for $50,000. The company is not chartered, and consequently not assessable. This information is furnished by J. R. Nichols, one of the owners.

Norombega Silver Mining Company. W. P. Hubbard is Treasurer. The company's property is located in Maine, and $2,321.05 expended in developing the property to August, 1881. Real estate does not include title to the surface, and mineral rights are not taxable. The company's capital is divided into 200,000 shares. Floating indebtedness August, 1881, $750,000.

Papago Chief Consolidated Mining Company (The) is chartered under the laws of the State of Iowa. The officers are W. W. Merritt, President; A. C. Hinchman, Vice-President; B. F. Remmels, Treasurer; R. M. Roberts, Secretary. Directors, W. F. Mitchell, Robert Coles, E. B. Young, Jacob Myers, and Smith McPherson. Annual election second Tuesday in August. Jacob Myers, Superintendent. The transfer and head offices are at Red Oak, Iowa. No branch offices. Transfers can be effected at any time except during the ten days previous for general meeting. The property of the company consists of three mining claims or mines. The Longarina, Papago Chief, and Sacramento, all in Pima county, Arizona, each claim having a length of 1,500 feet; total area, 50 acres. The ore is an argentiferous galena. Battery assays were $96 to $124 per ton. The vein is true fissure with both walls perfect. There is no mining plant as yet that is worth speaking of. Two shafts each 100 feet down; length of adits or drifting, 350 feet. The length of the main lode on which the company depends for its supply of ore is 500 feet. Average width of vein, twenty-four inches. Developments were commenced in 1878, $10,000 having been expended in same. The vein at the bottom of the west shaft is in good shape, in good ore; soft gouges can be used; about $50,000 worth of ore in sight. Cost of mining and milling, twenty-six dollars per ton. The mine Longarina was opened and worked by the Spaniards many years ago. The Colt Company built a camp near it called Franita about 1865. In reference to this mine, Mr. J. H. Fawcett, treasurer in charge of the Arivico mill, says: "From the best information I can get from those best posted in regard to the Longarina and good miners who have worked in the mine, all seem to be unanimous in the opinion that it is a good mine, and that a few thousand dollars judiciously expended would set it to producing bullion and paying dividends. It is believed to be one of the best properties in this part of the territory. The only available mills at work or being built in this part of the territory are worked by free milling or amalgamation; these mills leave fully forty per cent. in the tailings, and we cannot sacrifice so much in working, and the company has not means to go ahead with developments without utilizing the ores taken out as work progresses. The level between the two shafts is run at the forty-foot level, is in the vein; the ore above this has been stoped out to within twelve feet of surface. The drift east from the east shaft is in ore vein. The incline on the west of west shaft was taken out by Mexicans. The Papago Chief and Sacramento are claims which have not as yet been developed to any extent. My report has reference generally to Longarina mine." Organized August 10, 1878; capitalization, $2,000,000, in 100,000 shares of twenty dollars each, non-assessable. Yield, net, to April 1, 1882, 177½ tons of ore; value, $8,000. Only waste or dead work done in 1881. No dividends paid. No bonded or stock indebtedness. Floating indebtedness about $2,500. Treasury stock, 12,000 shares; value, about $241,000. Preferred stock quoted at five dollars; not listed; held chiefly in Iowa and Illinois.

Paradise Gulch Mining Company is chartered under the laws of the State of Colorado. The officers are S. S. Scribner, Pres.; A. M. Searles, Sec.; F. M. Fox, Treas. J. W. Goodspeed is Superintendent; he has had a mining experience of three years. Head office, Chicago, Ills. Western office, Gothic, Cal. The mines owned are the Pride of Chicago, the Paradise, the Scribner, the Independence, and Nonesuch mines, together with five other claims, located between the heads of Slate river and Rock creek, Gunnison county, California. The ore is described as galena. The character of the mines are fissure veins and deposits. Date of commencing developments, 1880. Elko is the principal market for the ore. Date of organization, February, 1881; capitalization, $2,000,000; par value, per share, $10. This information was furnished by J. W. Goodspeed, Superintendent of the Paradise Gulch Mining Company.

Queen Bee Mining Company. The managers are Fred. Griffin, Edwin Locland, and James Jacoby. Mr. Jacoby is Superintendent, and has had an experience of ten years. Office, Rapid City, D. T. The company's property includes the Queen Bee and Telaphone mines. The property covers ten acres. The Queen Bee has turned out some of the finest specimens in the Black Hills, D. T. There is a specimen taken from this mine on exhibition at the New York College that is said to be very fine. The Telephone mine is located on Slate creek, and is one of the finest prospecting mines on Slate creek, will run $20 on twenty inches of water. The ore mined in the Bee Queen is free milling and assays as high as $2 000 to the ton. The vein is true fissure, three pounds of rock have yielded twenty-six pennyweights. Tramway has just been completed. The shaft is eighty-four feet deep. Length of levels, fifty feet. Date of commencing developments, November 1, 1878. Amount expended in developing property to April 1, 1882, $10,000. Cost of mining and milling per ton is estimated at $2 10. Date of organization April 1, 1882; yield (net) to April 1, 1882, $1,000, 100 pounds; number of dividends paid to April 1, 1882; amount of dividend paid, $400; wages paid to all classes of labor per week, $18. This information was furnished by James Jacoby, Superintendent of the Queen Bee Mining Company.

Riverside Tunnel and Mining Company (The) is chartered under the laws of the State of New York. The officers are J. S. Davenport, Pres. and Treas.; James B. Davenport, Sec. Trustees, J. B. Davenport, S. E. Church, W. H. Bosworth, James A. Monell, A. S. Briggs, C. Barcalow. Date of annual election, May 7. H. G. Burt Superintendent. Office, 24 Park Place, New York; transfer office, 24 Park Place, New York. The company's mines are the Riverside, the Follet, the Henderson, the Bosworth, the New Jersey, the Cornwall, the Empire, the Monell, the Church, the Adella, Fonda, and Mill Site, located at Uncompahgre mining district, on Red Mt. creek, Ouray county, Col. The character of the ore is galena, and iron pyrites, and some gray copper. Character of the mines are fissure. The company expects to have a mill when the railroad gets to them. Extent of underground workings is about 900 feet in all; shaft, 175 feet; balance in tunnel of 234 feet, and drifts on vein, two levels. The developing of the property was commenced September, 1878, and from $35,000 to $40,000 have been expended in developing the property to April 1, 1882. This company is a sort of close corporation, all work done and paid for by the trustees. No outside subscriptions have been solicited for working capital. The trustees take the working capital stock as fast as money has been needed for development. The trustees paid $2.50 per share for the working capital. Sales to outsiders made at those figures and higher, but only in small lots to friends. Date of organization, August, 1879; capitalization, $2,000,000; par value per share, $10; basis, non-assessable; yield from mill runs sent for sample, $78.90 per ton; free from all indebtedness. This information was furnished by J. B. Davenport, Secretary of the Riverside Tunnel and Mining Company.

San Juan and New Jersey Discovery and Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are B. A. Vail, Pres.; F. W. Jacobs, Vice-Pres.; J. C. Coddington, Treas.; J. Weaver, Sec. Directors, B. A. Vail, F. W. Jacobs, J. C. Coddington, Frank L. Sheldon, William Blanchard. Date of annual election, first Tuesday in April. Superintendent, James A. Drummond; experience, twenty years. Branch and transfer office, Exchange Building, Rahway, New Jersey. The company's claims are the Western Bell, Jersey State, Chris. Marsh, Weaver, Black Crystal, Grand Falls, Carrie Coddington, Sheldon, Diamond Tunnel, Jersey Flat, Iron Cap, Lady Franklin, Brewster, Seek No Farther, Great Whale, Sadie, Sunnyside, Rahwegian, all located in the Uncompahgre district. The Pitkin, Father Abram, Redemption, Little Cave, B. A. Vail, Nasby, Meridian Sun, Earl of Pearth, Poughkeepsie Spray, located in Poughkeepsie Gulch, Uncompahgre district; Silver Bell, Crystal Spring, Jupiter, Young America, located in Pioneer district; F. A., Sampson, Jupiter, Glencar, Menduza, and Neptune, located in Rico district, State of Colorado. Extent of claim, 60,000 by 300 feet, together with three additional mill-sites. Amount of property in acres, 400. The character of the ore is various, assaying from thirty to 100 ounces of silver per ton. The veins are mostly all true fissure, some are contact veins, carrying carbonates. The property includes three cabins for the men, storehouses at the mines, and a house and lot in the town of Ouray. Total amount of work is done in open cut, cross-cut, drifting, and tunnelling, on all the claims together about 1,000 feet. The greatest amount of work on any one claim being 150 feet on the Western Belle. Developments were commenced July, 1880, and a little over $20,000 expended in developing property to April 1, 1882. The prospects of the property are very satisfactory, but my estimate has been made as to value. The object of the company is to secure all the good mine claims possible in the San Juan district, and develop sufficient to demonstrate their character, and offer for sale at compensatory prices. Date of organization, April 2, 1880; capitalization, $1,000,000; par value per share, $10; basis, non-assessable; no ore reduced or sold as yet; stock indebtedness, $765,000; stock reserved in the treasury, April 1, 1882, $235,000, par value; stock held principally in Union county, N. J. This information furnished by John Weaver, Secretary of the San Juan and New Jersey Discovery and Mining Company.

Senate Mining and Smelting Company (The) is chartered under the laws of the State of New York. The officers are Willoughby Weston, Pres.; A. T. Tinker, Treas.; Edward Green, Gen'l Man.; Ed. McCulloch, J. C. Weston, Supts. Offices, 6 Pine Street, New York, and at works, Galena, Idaho. The company owns three mines, Senate, Red Cloud, and Chief, located in Galena, Alturas county, Idaho. Extent of property, 237 acres. The ore is a galena and carbonate, assaying from $50 to $250 per ton. Twenty-ton smelter, saw-mill, and engine Depth of shaft, fifty feet. Developments were commenced in 1880. Amount expended in same, $20,000. The prospects of the property are considered A 1. Organized May 1, 1882; capitalization, $2,000,000; shares, 200 000, $10 each; non-assessable. Yield to January 1, 1882, 300 tons; treasury reserve, 50,000 shares. Stock held principally in New York.

Silver Ledge Consolidated Mining Company is chartered under the laws of the State of Colorado. The officers are G. W. Brown, Pres.; E. Townsend, Vice-Pres.; I. R. Childs, Treas.; G. W. Zaneway, Sec. Date of annual election, third Tuesday in March. W. F. Rowen is Superintendent, and has had an experience of nine years. Head office, Chihuahua, Summit county, Col. Branch and transfer office, 125 South Third Street, Philadelphia, Pa. The company's mining property consists of five claims, viz., the Silver Ledge, the Silver Queen, the Grand View, the Transylvania, and the Penby Mountain, located in Peru mining district, Summit county, Col The ore mined is smelting ore, and averages $60 to the ton. The character of the mines are fissure veins. The main vein is about thirty-five feet wide, containing pay-streaks varying from six inches to two and a half feet in width. The company's property, covering twenty-six acres, includes boarding-house and ore-house. The shafts (three) are 100 feet deep. Length of adits—that is, levels—700 feet. Four tunnels are being driven. Developments were commenced May 25, 1881, and $20,000 expended in developing property to January 1, 1882. The prospects of the property are most excellent. The company could to-day ship ore so as to pay handsomely, but are waiting for the railroad facilities so as to get full value of ore. Maximum yearly capacity of production, 20,000 tons. Argo and Denver are the principal markets for the ore. Date of organization, March 4, 1881; capitalization, $3,000,000; par value per share, $10; basis, non-assessable. No dividends paid to April 1, 1882. Company free from debt. No stock reserved in the treasury. Stock not listed held in Pennsylvania and Colorado. Wages paid to all classes of labor per week, January 1, 1882, $200. This information was furnished by P. J. Zaneway, Secretary of the Silver Ledge Consolidated Mining Company.

Silver Hill Mining Company is chartered under the laws of the State of North Carolina. The company's mine, the Silver Hill, is located nine miles southeast of Lexington, in Davidson county, North Carolina. The property covers an area of 1,300 acres. The ore is a combination of lead, gold, zinc, copper, and sulphate of iron—massive and very heavy—carrying native silver. The ore assays from $10 to $100 per ton. The mine consists of two leading fissure veins running parallel, about twelve feet apart, with other smaller veins of same character on either side. The property includes one large stamp battery, one set Cornish rolls, one of Blake's rock-breaker, three steam-pumps, and one forty-horse power steam-engine. The shafts are 800 feet deep. Length of adits—that is, levels—1,000 feet. The main lode is 160 feet in length, and the vein has an average width of eight feet. Number of shafts, four. The development of the property was commenced during the year 1840. The prospects of the property are very flattering. Estimated value of ore in sight, $500,000. Cost of mining and milling per ton, $6. The mine is beautifully and pleasantly situated in the heart of the great mineral district of North Carolina, with all the advantages of wood, lumber, etc., and is easily drained, with water. Seemingly inexhaustible supply of ore. It is not at present in active operation, but the company are perfecting arrangements for resuming active operations soon. The property is said to be one of the finest mines opened in the State, and has produced greater quantities of ore than any other mine in the country. It was worked by the Confederate government during the rebellion, and was one of the main sources of supply of lead. Date of organization (original company), 1840. No assessments have been levied. This information was furnished by J. M. Prim, Superintendent of the Silver Hill Mining Company.

Old Guard Mining Company (The) is chartered under the laws of the Territory of Arizona. The officers are Fordyce Roper, Pres.; Francis G. Burke, Vice-Pres.; J. V. Vickers, Sec. and Treas.; Sumner P. Vickers, Supt. The annual election is held January 28. The transfer and head offices are at Tombstone, Arizona Territory, and 120 Water Street, New York. The company owns the Old Guard Mine, located in Tombstone, Arizona. Extent of claim, 600 by 1,500 (about twenty acres). The ore contains chlorides, carbonates, and sulphates; assaying $15 to $300 per ton. The vein is true fissure; shaft, 230 feet deep, and adits, 300 feet. Main lode on which the supply of ore depends, 800 feet in length; average width about four feet. There are two shafts and four tunnels. Developments were commenced in November, 1881, and $10,000 has been expended on same. The prospects are very flattering, probably $20,000 worth of ore on dumps and $100,000 worth in sight. Cost of mining and milling, $20 per ton. This is one of the most popular young mines in Arizona. Many men of moderate means, including miners employed in the mine, have taken working stock without solicitation at forty to fifty cents per share, and from the general formation of the vein and its regularity, it stands as good a chance of being a peer to the Contention and Grand Central as any in the district. The weekly output at present is thirty tons, which is sent to Custom Mill. Organized, January 28, 1882; capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable. Net yield to April 1, 1882, 300 tons; treasury stock, 400,000 shares; stock held principally in New York, Philadelphia, and Arizona. Not listed on Eastern boards: quoted at fifty cents per share, April 1, 1882. This information has been furnished by Sumner P. Vickers, Superintendent of the Guard Mining Company. The Old Guard was one of the finest mines located in the Tombstone, in 1878, by Scheffelm Bros. & Gird, the pioneers of the camp, and is one of the few properties in this district whose title is beyond dispute.

Pelican and Dives Mining Company (The) is chartered under the laws of the State of New York. The officers in 1880 were Norvin Green, Pres.; Theodore N. Vail, Vice-Pres.; R. H. Rochester, Treas.; Geo. C. Wilde, Sec. Date of annual election, April. W. A. Duff is Superintendent. Office, 197 Broadway, room 26, Western Union Building, New York. Transfer office, Farmer's Loan and Trust Company, New York. The company's mines, the Pelican, Dives, Unicorn, Zillah, Billweather, Eagle Bird, Leddon, Andes, Waverly, Bertha, Convention, and Lancaster, are located at Georgetown, Clear Creek county, Colorado. The character of the ore is silver, and the ore has given an actual average for two years of 145 ounces of silver per ton. The character of the mine is fissure vein. The main shaft is 900 feet deep, and levels several miles in length. The length of the main lode is 2,000 feet. There are two shafts and four tunnels. The underground workings are very extensive. The vein varies from fifty to 100 feet in width. Georgetown is the principal market for the ore. Date of organization, April 6, 1880; capitalization, $5,000,000; par value, per share, $10; basis, non-assessable; stock not listed; wages paid to all classes of labor per week, $21. This information was furnished by G. C. Wilde, Secretary of the Pelican and Dives Mining Company.

First National Mining Company is chartered under the laws of the State of New York. The officers are J. C. Watson, Pres.; Philip Highley, Sec. and Treas. Date of annual election, June. The Superintendent, Mr. W. H. Gardner, has had three years' experience. Branch office, 66 Devonshire Street, Boston, Mass. Transfer office, Broadway, New York. The company's mine, the First National, is located at Iowa Gulch, California district, Lake county, Col. Their claim is 1,500 feet by 300 feet. Amount of property, ten acres. The ore is low grade, galena mixed with iron. This mine is on the south side of Psalter Boy hill, one vein of galena dips into the hill at about 45°. Of this low grade ore the company can take out 100 tons a day, at seventy-five cents per ton. All that is required is concentration to make this a very valuable property, and works have been ordered. The company owns one twenty and one thirty horse engine, a baby hoister, and No. 4 Cameron pump. The shaft is 220 feet deep, and length of adits, that is, levels, 300 feet. Date of commencing developments, July, 1881. Amount expended in developing property to April 1, 1882, $20,000. There is a twenty-foot vein of galena exposed. Average assay, twelve ounces silver, fifteen per cent. lead, mixed with white iron. Leadville is the principal market for the ore. In sinking shaft, the company first cut vein at a depth of 145 feet, and found it low grade, upon which they decided to sink about sixty feet, then drift into the hill, and again cut vein. This work they are now doing with good prospect of getting an improved grade of mineral. Date of organization, May, 1882; capitalization, $200,000; par value, per share, $2; basis, non-assessable; bonded indebtedness, April, 1882, $50,000; stock reserved in the treasury, May 1, 1881, 25,000 shares, $50,000; stock quoted June 1, 1882, $2; stock not listed; stock and bonds held principally in Boston, Mass. Wages paid to all classes of labor per week, $21. This information was furnished by W. H. Gardner, Superintendent of the First National Mining Company.

Yale Mountain Mining and Milling Company (The) is chartered under the laws of the State of Colorado. The officers are John E. Faunce, Pres.; C. R. Early, Vice-Pres.; Fred. Gaston, Sec. and Treas. Directors, Jas. Wm. Newlin, Wm. Newell, Wm. P. Schell, and John W. Anthony. Annual election, June 6. Superintendent, John Greenbank, of six months' experience. Head and transfer office, 506 Walnut Street, Philadelphia, Pa.; main office, Buena Vista, Col. The property of the company includes five claims, Mt. Carmel, Bucks, Delaware, Westmoreland, and Last Chance, which, with two mill sites and twenty acres of land on Cottonwood creek, are located in Chaffee county, Col. The claims, each, have an extent of 1,500 by 300 feet. The ore consists of low grade galena, sulphurets of copper and iron, carrying silver and some gold, and assaying twenty to fifty ounces per ton. The veins are regular fissures. Mt. Carmel and Last Chance are the only claims developed—135 feet tunnel and fifty feet shaft on Mt. Carmel; 120 feet incline on Last Chance. The length of main lode, on which the supply of ore depends, is 1,500 feet; width of same, twenty-two to twenty-three feet. The workings consist of crosscut on vein Last Chance, and two levels on Mt. Carmel and crosscuts at foot of shaft. The mining plant includes a mill containing an Alden crusher and a concentrator; also saw-mill on Cottonwood creek. Developments were commenced in 1881, and about $25,000 has been expended in same. The Mt. Carmel ore ranges from twenty to four ounces per ton; Last Chance ore ranges from ten to twelve ounces per ton, with streaks of galena at fifty and seven-eighth ounces per ton; cost of mining, $3.00, and milling, $7.00, equal to $10 per ton. Denver and Pueblo form the principal markets for the ore. The mill has been erected especially for the purpose of developing this district, the mines of which are mostly low grade ore. The works were completed in the spring of the present year (1882); and on trial the crusher has a capacity for sampling work of sixty tons a day, and for concentration of thirty tons per day. Capitalization, $2,000,000, in 200,000 shares, of $10 each; organized, May 26, 1881, on a non-assessable basis; no dividends have been paid; the stock, held principally in Pennsylvania, is listed at the Philadelphia Stock Exchange, Philadelphia, Pa. This information was furnished by John Greenbank, Superintendent of the Yale Mountain Mining and Milling Company.

THE COMPILED COMPANIES.

THOSE companies which follow here are those whose record has been obtained from the columns of the mining press. The figures have therefore no further responsibility, yet are in the main correct, though not possibly quite up to date.

COAL.

Alliance Coal Mining Company (The). Officers are Rossiter W. Raymond, President; Fred. A. Potts, New Jersey, Vice-President; Abraham S. Hewitt, Treasurer. Mines located in the Schuylkill Valley, Pa.; $400,000 is set apart for opening up the lands of the company. Hewitt & Co. retain stock in the Alliance Coal Company to the amount of $300,000; Jersey Central, taken, $100,000; capitalization, $2,000,000; money paid in, $1,500,000.

Abbey Coal and Mining Company (The). E. J. Crandell, Manager, 100 North Fourth Street, St. Louis, Mo., and Collinsville, Ill., is where the general office and branch office may be found.

Acadia Coal Company (The) is chartered under the laws of the Province of Nova Scotia. The officers are J. W. Glendenin, President, and P. Harris, Secretary, having offices at 145 Broadway, New York. The mines are under the superintendence of H. S. Poole, formerly Government inspector of mines. Annual election is held on the 27th of March. The company own the Acadia and other mines. The Acadia at Westville is the only pit at present working. The properties, comprising an area of six square miles, are located in Picton county, Nova Scotia. The coal is of a quality suitable for both steam and domestic purposes and has a preference in the local markets. The seam is regular, dipping northeast at twenty degrees to twenty-eight degrees, without faults so far as proved in Acadia ground. Entrance is by slope 1,900 feet long. The levels are 5,000 feet in extent. The seam on which the company depends for its supply of coal is 5,000 feet longitudinal measurement by about ten feet wide. It has two slopes. The company was organized in 1865 on an assessable basis, with a capitalization of $1,500,000 in 15,000 shares of $100 each. The average yearly output of coal is 90,000 tons gross. The company is out of debt.

Addenda Coal Company (The). Located Mono county, Cal. Shaft 324 feet in depth, the bottom in vein matter carrying bright, lively quartz and seams of mineral bearing clay. Indications very good.

Aden Coal Company (The). Mines located near Wanomie. This company is composed of Lehigh capitalists, who have purchased many acres of valuable coal lands near Wanomie.

American Coal Company is chartered under the laws of the State of Maryland. The company has a branch office located at 110 Broadway, New York. The company's mines are located in Alleghany county, Md., the character of the coal being semi-bituminous. The company was organized in 1855, having a capitalization of $1,500,000, in 60,000 shares of $25 each, non-assessable. Total amount of dividends paid up to 1877, $1,222,-500. The latest dividend paid being at the rate of two and a half cents per share. The main vein has a width of fourteen feet.

American Coal Company (The). A. Jackson Clark, Manager. Principal office, 110 Broadway, New York. Name of mine owned, the Jackson; located opposite Lonaconing. Very little has been done during the past year 1881. Prospects are good at present. John Bradburn, mining boss. Employing about 190 men. The coal is shipped from Alexandria, Baltimore, and Jersey City. Capitalization, $1,500,000; number of shares, 60,000; par value, $5.

Ansted Coal Mines (The). Mr. Page, Superintendent. These mines are located at Hawk's Nest, West Va. The prospects for the extension of the mines are good. Have a good vein of coal from which they mine between seven and eight feet in the bottom. Miners have steady work. Mr. Page is building 100 coke-ovens. The coal makes a good grade of coke, have about three feet of coal in the bottom. The miners receive forty cents per ton for running the mine. Seventy-five men are emplyed.

Argyle Coal Company (The). Located in Cambria county, Pa. Yield per annum, 3,253 tons.

Atlantic and George's Creek Consolidated Coal Company (The). Officers, J. H. Taylor, Pres.; George Stearns, Sec. Directors, S. Rosenburg, E. S. Myers. Location of coal mines, West Virginia. Mr. Taylor purchased a valuable piece of property, on the West Virginia and Pittsburg Railroad, in Mineral county.

Aurora Coal Company (The.) Located, Cambria county, Pa.

Austin and Central Texas Coal Company (The). Francis B. Forster, Pres.; R. J. Swan Coat, Vice-Pres.; Austin M. Robinson, Sec. and Treas. and Gen. Manager. The mines of this company are located near Rockdale, Milan county, Texas. First mine struck, forty-five feet below the surface, five and one half feet thick. Capitalization, $250,000.

Baka Coal Mining Company (The). Officers, Juan Jose Baka, Pres.; J. M. Chavez, Vice-Pres.; Capt. R. A. Darst, Sec.; P. A. Simpson, Treas. Mines located near San Pedro, on the opposite side of the Rio Grande, Socorro, New Mexico.

Banner Mines and Gas-Coal Mines (The), owned by Gamble & Risher, are located at West Pittsburg, Pa. Head office, 116 Water Street, Pittsburg, Pa.

Beaver Creek and Cumberland Coal Company (The). Officers, J. W. Procter, Treas.; H. C. Ferris, Gen. Supt. Organized at Cincinnati, by Judge Van Winkle, of Danville. This company has 17,000 acres of coal lands, and is already sinking a shaft.

Beaver Dam Mining Company's works are located in Montgomery county, N. C. Yield during 1881, $5,000. The principal markets for the ore are Philadelphia and New York.

Beaver Run Coal Company (The) is chartered under the laws of the State of Pennsylvania. The officers are Henry C. Terry, Pres.; C. W. Hughes, Sec.; Jas. E. Moore, Treas. Date of annual election, fourth Monday in March. C. W. Hughes, (Min. Eng.) Superintendent, of fifteen years' experience. The head and branch offices are at 136 Walnut Street, Philadelphia, Pa.; the transfer offices are at 11 Duane Street, Boston, Mass. The Beaver mines are located at Houtzdale, Clearfield county, Pa. The coal is of the bituminous description, and is worked on the drift and slope system, the usual plant of a bituminous coal-mine. Developments were commenced April 10, 1880. Cost of mining is eighty-five cents per ton. The maximum annual capacity of production is 50,000 tons. Weekly output, April, 1882, 1,500 tons. Boston and the Eastern States form the chief market for the produce. Average wages paid to all classes, per week, $12 per head. Organized April 10, 1880; capitalization, 6,072 shares of $10 each, non-assessable. Yield (net) to April, 1882, 97,830 tons; yield during 1881, 42,200 tons, gross; yield during 1881, 37,680 tons, net. Number of dividends paid to date, six; total amount, $8,500.80; date of first dividend, July, 1880, twenty cents; total $1,214.40; date of latest dividend, April, 1882, thirty cents, total, $1,821.60; no assessments have been levied; no bonded or floating indebtedness. Stock and bonds reserved in treasury, April 1, 1882, $139,280; stock listed on the Stock Exchange, Boston, Mass. Stock and bonds held principally in Philadelphia and Boston.

Belvidere Coal Company (The). Location of mines, Mono county, Cal. Main shaft, thirty-five feet below the 400 feet station. East wall carries two feet of bright, lively quartz. Assays range from $15 to $20 per ton. Three feet of irregular seams of quartz; porphyry giving seven feet between the walls.

Belmont Coal Company's Works (The). Located near Bellaire, Ohio.

Bennett Coal Mines (The). Located at Maccan, Cumberland county, Nova Scotia. Steel Company of Canada. Forty tons of coal are now being taken out. Old shafts are to be pumped out, new ones sunk. Mr. Redpath is underground manager.

Benwood Iron Works (The). Located at Benwood, Marshall county, W. Va. The company, during 1880, mined some 27,400 tons of bituminous coal in a five-foot bed. The mine has a capacity for producing some 40,000 tons per year.

Betts Cove and Little Bay Coal Mines (The). The above mines are located in Nova Scotia. Work in the Little Bay Coal Mine was carried on in 1881 on a large scale. From ninety to one hundred men are employed by the company.

Birmingham Coal, Coke, and Iron Company (The). Officers, J. C. Neely, of Memphis, Tenn., Pres.; Thomas H. Milburn, Tenn., Sec. and Treas. Location of coal works is Birmingham, Allegheny county, Pa. The company have purchased 50,000 acres of coal and iron lands, and also own several large furnaces. Date of organization, at Decatur, Ala., August 12, 1881; capitalization, $2,000,000; yearly yield, 183,545 tons.

Bird Coal and Iron Company (The). Location, Northumberland, Pa.

Black Ball Coal Company (The). Location of works, Pennsylvania.

Black Diamond Coal Company is chartered under the laws of the State of Tennessee. The officers are E. C. Locke, Pres.; E. F. Wiley, Sec.; T. H. Heald, Treas. Date of annual election, January. Superintendent, B. F. Rooney. This gentleman has had twenty-five years' experience in the business. Transfer and head offices, Knoxville, Tenn. Transfer days, any time. The company owns the Franklin and Black Diamond Mines, located at Cool Creek, Tenn. Their property covers 375 acres of land. The company commenced developments September 1, 1872, and have expended $50,000 in developing their property to January 1, 1882. Date of organization, September 23, 1873; capitalization, $50,000; par value per share, $100; basis, non-assessable; floating indebtedness, $2,000.

Black Diamond Coal Company (The). Wm. J. Murdock, Gen. Supt. Location, near Palmyra, Ohio. The mines are reached by a shaft 110 feet deep, and are in charge of Mr. Abel Dore, Jr. Sixty men are employed.

Black Diamond Coal Company (The). W. J. Jackson, Manager. Principal office, 19 and 21 Nassau Street, room 2, New York. Agent, R. H. Chipman. Mines located in Osceola and Mt. Carmel counties, Pa. Shipping wharves in Philadelphia, Baltimore, and South Amboy. J. C. Guin, eastern agent, 15 Doane Street; P. O. Box, 1572, Boston Mass. Wm. Schwenk & Co., operators. The coal produced in 1880 amounted to 26,125.15 tons.

Blair Iron and Coal Company (The). The location of the coal works and mines is in Blair county, Pa. Yield per annum, 113,039 tons.

Blossburg Coal Company (The). Officers, O. M. Bump, Sec.; D. S. Drake, Genl. Supt. General office, Elmira, N. Y. The property owned (the Arnot Mines) is located in Pennsylvania. Date of organization, 1866. The product of their mines is known as the Blossburg semi-bituminous coal. Six drifts are open. Yearly yield, 380,883 tons.

Boulder County Coal Company. The property is located in Boulder county, Colorado. Product during 1881, 302,660 tons; number of men employed, 700.

Braceville Coal Company (The). Located in Grundy county, Illinois. Capitalization, $500,000.

Bridge Coal Company (The). Names of mines owned by the company, Diamond Rock and the Big Vein. Located in Pennsylvania. Number of acres, 150. Double breaker with a double set of rolls, capacity of from 500 to 600 tons per day. The Bridge Coal Company entered into a contract with the Delaware and Hudson Company for a supply of 100,000 tons. Product, 1881, 56,700 tons.

Brewster Coal Company (The), of Akron, Ohio, is making an opening opposite the Weaver Shutes. Coal will average about five feet in thickness.

Buck Mountain Coal Company (The). William Spencer, Superintendent. Location of mines, Pennsylvania.

Buck Ridge Coal Company(The). Location of works, Hazleton, Pa.

Buffalo Coal Company (The). Location of works, McKean county; 16,000 acres of coal land are to be connected with the McKean and Buffalo Rail by a narrow-gauge road, at a cost of $300,000.

Bulwer Consolidated Coal Company (The). Located in Mono county, California. North drift is in from the tunnel 135 feet; ledge two and a half feet wide; looks well. South drift is in 131 feet; ledge in the stone wall slopes two feet wide. In Ralston slope the ledge is three and a half feet wide and looks well. Very good ore in the Stonewall slopes.

Burlingame Mutual Coal Mining Company (The). The property is known as the Ramskill Shaft, located half a mile south and east of Carbondale across Switler creek. Depth of shaft, ninety feet.

Burnett Coal and Coke Company (The). The mines are located in Butler county, Pa. Yearly yield, 34,200 tons.

Butts Coal Company (Limited) (The). Officer, Charles J. Butts, Secretary and Treasurer. Located at Cleveland, Ohio.

Cahaba Coal Company's Works are located in Shelby county, Alabama. The company owns 1,700 acres of land in several contiguous tracts. The quality of the ore is rich bituminous, suitable for gas. Analysis gives: moisture, 166; vol. comb, 33.28; fixed carbon, 63.04; ash, 2.02; total, 100 parts. The character of the mines may be described as a bed of bituminous coal, about thirty-two feet thick, with good top and bottom, generally free from slate partings so detrimental to clean mining. With a run of three miles is given a width of 1,000 feet and a thickness of four feet, with a yield of 1,000,000 tons. The properties are well located, one of the slopes being not more than 200 feet from the main line of the N. & S. Alabama Railroad, and is connected therewith by a siding. Plant required, heavy engine, boilers, pump, and hoisting machinery. The slope is already driven, and all that is necessary is to empty it of water and start the gangways, a matter of sixty days' work.

Cameron Coal Company (The). George W. Cole, Supt.; John Little, Inside Manager. The coal field is located about 125 miles from Buffalo, N. Y. Five feet vein, with four feet three inches of good coal. The company owns a good saw-mill, under the superintendence of W. McConnell. Prospects fair. Capitalization, $2,500,000; number shares, 50,000; par value, $50.

Cambria Mine (The) is operated by Mr. Wm. T. Williams, and located at Dennison, Ohio.

Cannel Coal Mines (The). Messrs. Heron, owners. The mines are located at Little Sinking, Carter county, Ky. Very superior coal. 1,200 bushels cannel coal sent to Lexington, Ky., where it readily sold for twenty cents per bushel.

Cape Breton Colliery Association of Coal Mines (The). Owners and officers, R. H. Brown, Pres.; David McKeen, Vice-Pres.; W. Purves, Sec. and Treas. Capitalization, $50,000.

Carbon City Coal and Iron Company (The). Incorporators, Daniel Hamilton, Edward A. Scoville, Daniel W. Cross. Peter F. Black, Charles P. Scoville. Principal office, Cleveland, O. Location of works, Cleveland, O. Business will be carried on in Island creek Township, Jefferson county, and at Carbon City, Pa. The company has a capitalization of $25,000.

Carbon Hill Coal Company (The). James O. Somers, Supt. Name of mine, Carbon Hill. Located at Carbon Hill, O. About 100 men are employed.

Centerville Coal and Mining Company (The). Henry Johnson, Supt. The mines of this company are located in Iowa.

Central Gas-Coal Mines (The) are owned and operated by Jackson Oliver. The property is located at Fairmount, Marion county, West Va. About twenty men are employed in the mines. About eight feet of bituminous gas-coal have been taken out of the vein. The maximum capacity of the mines in February, 1881, was 6,000 tons. Chicago, Tiffin, O., Newark, O., and points on the Baltimore and Ohio Railroad, are the chief markets for the product.

Central Illinois Coal Company (The) is the name of a new company, the preliminary organization papers only of which have been filed so far. The principal office will be at Chicago, at present at Springfield. The company owns property in Kankakee county, Ill., and have already commenced developments. Capital, $500,000, in 5,000 shares of $100 each. Stock is held chiefly in Chicago and Springfield.

Chippewa Coal Company (The). This property is situated in Clinton, Ohio. The company is operating a drift mine, in charge of Geo. Smith. Coal averages six feet. About sixty men are employed. Coal shipped on the Mt. Vernon road.

Chicago, Wilmington, and Vermillion Coal Company (The). A. E. Sweet, Gen. Man. Principal office, 210 La Salle Street, Chicago, and Streaton, Ill.

Clearfield Coal Company (The). The property belonging to this company is located in Clearfield county, Pa. Yearly number of tons, 11,400.

Clear Spring Coal Company (The). Officers, A. M. De Witte, Pittston; John R. Davis, Pittston; Joseph L. Cake, W. H. Gerhardt, Esq., Scranton; Joseph L. Cake. Supt.; M. De Witte, Chairman; J. R. Davis, Treas. The works are located in Virginia. Their capacity will be from 1,000 to 1,200 tons per day. There are five veins of coal—the smallest seven, and the largest fourteen, feet in thickness, aggregating forty-five feet of superior coal.

Clinton Coal Company (The). The location of these works is in Jefferson county, Pa. Yearly number of tons, 25,567.

Coalport Mine (The). Owned by a party of Greensburg operators —Messrs. Huff & Coulter. Mr. Steak is looking at the inside work. The location of the works is at the terminus of Bell's Gap Road, Pa. The quality of the coal is good.

Coalton Coal Mines (The). David Ramsey and Jacob Schugh. Location of mines, near Coalton, Ky. Are working very well, with prospects of a good season; shipping from 12,000 to 15,000 bushels of coal daily; miners receive seventy cents per ton for screened coal. The coal-bed varies from three and one-half to four feet in height; shipped to Ashland; company employs 400 men in and about the mines.

Coal Valley Coal Company (The). Mines located in West Virginia. This company sent to the exhibition at Yorktown a block five and one-half feet in height, three feet two inches in width, two and one-half feet in depth.

Coke Company (The). Stockholders, Henry J. Davis, Wm. Keyser, Robert Garrett, Asman Latrobe, Henry L. Keyser, Ferdinand Latrobe, all of Baltimore, Md.; Malcom Hay, D. N. Stewart, of Pittsburg, Pa. Principal offices, Baltimore and Connellsville. The mines belonging to this company are located in Fayette county, Pa. Capitalization, $1,000,000.

Colorado Anthracite Coal Company (The). Officers, Hon. James B. Belford, Colorado, Pres.; W. J. McKnight, Sec.; Francis T. Brunkey, Treas. Trustees, Hon. J. B. Belford, Hon. Allison White, A. L. Roberts, H. E. Road, J. Howard Mitchell, Henry P. Sloan, Francis T. Brinkley, Samuel R. Shipley, Thos. P. Sargent. Principal office, 37 South Third Street.

Colorado Coal and Iron Company (The). The property of this company is under the supervision of Mr. W. S. Omertz, and is located at Hauman, Gunnison county, Col., covering an area of 1,200 acres. The vein now being worked has a clear six feet of coking coal. The company is now contemplating the building of a number of coke ovens, about 100.

Columbia Coal Company (The). Mr. Foster, Allegheny City, Gen'l Manager. Sixty men employed.

Central Mining Company (The). Mr. Josiah Wells, Manager. The mines are located in Columbus, Ohio. Three of the Lechner coal-cutting machines are used in these mines. Operated day and night.

Confidence Coal and Mining Company (The). Messrs. Seybt & Bandelich. Principal office, 22 South Commercial Street, St. Louis, Mo., and at Collinaville, Ill.

Consolidated Coal Company (The) of Maryland has its offices at 13 German Street, Baltimore, and 71 Broadway, New York. The properties are located in Maryland. The shipments are made at Georgetown, D. C., and Baltimore Md. Messrs. Roussell & Hicks, of Broadway, New York, sales agents. The company has recently begun a work at Ocean Mine, which will greatly increase its capacity. Nearly all the coal that can be reached through the present openings has been taken out.

Consolidated Coal Mining Company (The) has properties located at Camden, Mason county, West Va. Mr. W. H. Fogel being Supt., and residing at West Columbia, (P. O. address.) The head offices are at N. W. cor. Walnut and Second Streets, Cincinnati, O.

Consolidated Coal Company (The). Name of mine owned, Sand Run. Location in Ohio. Good coal taken from the mine daily. The company owns 180 acres. The coal averages seven feet deep. Fifty men are employed.

Consolidated Coal Company (The). Officers, Marvin Hughett, Pres.; Albert Keep, Vice-Pres.; J. B. Redfield, Sec.; H. W. Kirkman, Treas. Directors, Albert Keep, Marvin Hughett, H. W. Kirkman, H. W. McNeill, J. B. Redfield. Location of mines, Oskaloosa, Iowa. Extent of claim consists of 2 000 acres of land, estimated to contain 20,000,000 tons of coal. The Chicago and Northwestern Railroad Company have purchased the property, opened and equipped with mines, yards, telegraph-lines; all machinery and appliances. The present annual capacity of 1881 is 30,000 car loads. Amount of coal weekly, 104 tons; amount of coal yearly, 144,-059 tons.

Consolidated Coal Company (The). James B. Thomas, Supt. Mines located on George's creek, Cumberland region. Operations are progressing steadily over five mines, and from 16,000 to 18,000 tons per week are being shipped. The mines are located on the line or branches of the Cumberland and Pennsylvania Railroad.

Connellsville Gas Coal Company (The). Mr. H. Wickham, Superintendent. This company's property is located in Connellsville region, Pa. Have sunk a shaft, and found coal at a depth of 304 feet. Veins nine and a half feet thick. About 1,000 acres of the company's land have been leased to the Cambria Iron Company, for the use of 500 ovens. An analysis made by Charles P. Williams shows 28.50 volatile, 64.18 fixed carbon, 1.20 water, 6.12 coke, 70.30 sulphur.

Consolidated Coal Company (The). John Ford, Manager. Name of mine owned is the Ocean Mine, located five miles from Frostburg. The mine is entered by a drift brought forward by a small locomotive. 100 men are employed.

Consolidated Coal and Mining Company (The). Officers, John Sheriden, Pres.; John Wilson, Jr., Sec. Directors, John Sheriden, R. K. Snyder, John Wilson, Jr., of Piedmont; R. D. Wilson, Bridgeport, W. Va.; P. E. Haddeman, of Cumberland. The mines of the company are located two miles west of Bridgeport, W. Va. The company have 250 acres of land underlaid by a nine feet vein of gas coal.

Consolidated Coal and Mining Company (The). George W. Brashes, Superintendent. Mines located at Cincinnati, O. This company owns a number of mines in different parts of the country. The mine is in good condition. About 170 men are at work.

Connelton Coal Company (The). E. Tatnall, Treasurer. General offices, 230 South Third Street, Philadelphia; 41 South Street, New York; 91 State Street, Boston, and Baltimore. P. O. Box, 1747 New York. This property is located in West Virginia. Perkins & Co., Daniel W Job & Co., Mayer, Carroll & Co., sale agents.

Connellsville Coke and Iron Company (The). Officers, Hon. John Leisenring, Pres.; W. B. Whitney, Sec and Treas. Directors: Hon. John Leisenring, Mauch Chunk; Fred. A. Potts, New York; Samuel Dickson, Philadelphia; John S. Wentz, Eckley; E. B. Leisenring, Audenried; W. S. Kemmerer, Mauch Chunk; Henry McCormick, Harrisburg; Daniel Bertch, Upper Lehigh. The extent of claim is 8,000 acres. The company contemplates the erection of a large coke crusher, with a capacity of not less than 250 tons per day. It owns thirty-five blocks of tenement houses, and before the closing of the year, (1881) seventy blocks of houses will be required at the new shaft. The stockholders are well pleased with their property. Capitalization, $1,250,000.

Coons Iron, Coal, and Sand Company (The). Location of works, Park county, Colorado. Property owned, fifty acres of iron, and 320 acres of coal lands.

Co-operative Store Company (The). The mines of this company are located in Kansas; consists of nineteen members, all of whom are working miners. Stock was subscribed, shares of $100 each; one-fourth shares, $25, were sold. Company was organized, June, 1881.

Coos Bay Company (The). Owned by D. O. Mills and several capitalists of San Francisco. Name of mine owned, Southport; located in Oregon; explored to the depth of 3,000 feet; output, seventy-five tons per day; thirty men are employed.

Crafts Iron Company (The). Grove Stoddard, Superintendent. Location of works, Hocking Valley, Ohio. Furnace has been in blast since the summer of 1881, averaging about thirty tons daily. The mine is in charge of Robert Guess, who has twenty-six men at work.

Crescent Coal Mines. Capt. W. R. Johnson, owner. Location of mines, Great Kanawha, Crescent Station, W. Va. Prospects of the property excellent. About 80,000 tons of Kanawha coal were sent to market in 1880. Output first six months, 1881, about 5,000 tons.

Crooke Coal Mining Company (The). Mines located at Glenmary, Tenn. Large quantities of coal are being shipped.

Crown Hill Splint Coal Company (The) owns the Coalburg mine, located near Paint Creek Station, W. Va. The seam yielding the noted splint coal ranges in thickness from four feet on the top of the shaft at river front to six feet four inches on the back line. Mr. Brewer Smith is the mining superintendent.

Cumberland Region Borden Mining Company (The). The company owns two mines, the Old Drift and New Hope, opposite Borden shaft, and operated by A. C. Green. The Borden shaft is in charge of G. McMillan. The company has fine machinery for hoisting coal, and employs 200 men. Over 120,000 tons of coal have been shipped since January 1, 1881.

Cumberland Coal Mining Company (The). The property belonging to this company is located at Greenwood, Pulaski county, Ky. The company is shipping about 5,000 bushels per day. Coal is taken from five or six entries in the hills; 180 miners at work; wages, two to four dollars per day. Capitalization, $50,000; per share, four dollars. A dividend has been declared of eight per cent. per month.

Cumberland and Elk Lick Coal Company (The). Officers, Alex. Shaw, President; Alonzo Chamberlin, Vice-President; C. M. Hoult, Secretary and Treasurer. Directors, Lloyd Lowndes, Jr., C. C. Baldwin, and William A. Fisher. These mines are located in Pennsylvania.

Dayton Coal and Iron Company (The). John Ferguson, Gen. Manager; Sir Titus Salt, of Saltaire, England, principal stockholder. Location of works, Dayton, Tenn.; 128,000 acres; double shifts are worked on the entries air-shafts. The company is sinking an incline 1,100 feet; quality of coal, very fine; lower vein, four feet five inches; upper vein, four feet eight inches; fifty or sixty coke-ovens will be used.

Decatur Coal Company (The). Location of works is in Clearfield county, Pa. Yearly number tons of coal, 59,510.

Despard Coal Company are the owners of the Despard mine, located at Clarksburg, Harrison county, W. Va. There is a nine-feet bed of gas-coal, worked by drift under a cover of seventy-five feet. The company employs about sixty men. Maximum yearly capacity of production, February 1, 1881, about 40,000 tons. The principal market for ore is Baltimore and points along the B. & O. R. R. Some is sold to the Baltimore and Ohio Company, to whose railroad a branch leads from the mine.

Detmold Coal Mines (The). Owned by the Maryland Coal Company. Mr. F. E. Brackett, Superintendent. Mr. James Little is in charge of the mine as Mining Boss; prospects fair; 200 men employed.

Diamond Coal Company (The). These mines are located at Centerville, Iowa; struck coal in their new mine at the depth of 135 feet; first-class engine is owned by the company.

Dubois Allegbany Valley Company (The). A. J. McHugh, Supervisor. These works belong to Messrs. Bell, Lewis & Yates. The company owns plenty of cars; they have a large crusher and washer, fifty-six coke-ovens, capacity for 100 cars daily; vein averages five to six and one-half feet thickness; 400 men employed; miners receive forty-five cents per net ton, run of mine.

Eagle Coal and Coke Company (The). This company is located in Coal Valley, W. Va. Their works are operated by Wm. Wyant. Eagle vein, 120 feet below gas vein, contains rich bituminous coal—vein averages five feet in thickness. There are two openings by an incline 300 feet in length. 250 tons are shipped daily. Mining department is in charge of Mr. James Whitney, and is in good condition.

Excelsior Coal Company (The). The directors of this company are John H. Dravo, Wm. A. McClintock, Wm. Van Kirk, Denion Begmer, Geo. Wantman, R. B. Brown, J. H. McCreery, A. M. Sutton, A. D. Smith, A. Dempster. The mines of this company are located in Pennsylvania. They already own 1,500 acres of bituminous coal lands, situated on Street's Run, within five miles of the city of Pittsburg. Capitalization, $350,000; par value, $50.

Excelsior Coal Company (The). These mines are situated in Medina county, Ohio, near Wadsworth. The company owns 371 acres of coal land, and the coal is excellent. Vein ranges from five feet six to ten feet. Coal will be shipped to Cleveland.

Enterprise Coal and Coke Works (The). Hutchinson Bros., owners. The works are located at Mount Pleasant, Westmoreland county. Property owned by the company consists of 400 acres of coal land, worth $240 to $260 per acre.

Fairland Gas Coal Mine (The). The mine is located in Clarksburg, Harrison county, W. Va. It is owned by D. J. Adams, and leased by D. T. Farland. The mine is in nine feet seam. Forty men are employed. Output, 12,000 tons. The coal is sent to Chicago and other Western markets.

Fairmount Coal and Iron Company is chartered under the laws of the State of Pennsylvania. The directors or board of managers are F. R. Potts, Thos. Rutter, Jos. H. Harris, B. K. Jamison, John A. Wilson, Chas. C. Baird, J. H. Kershaw, De June & Co., W. C. Hall, and Chas. Broadhead. Officers, B. K. Jamison, Pres.; John A. Wilson, Vice-Pres.; Geo. H. Miller, Sec. Office, financial, New York city. The company's mines are located in Clarion and Armstrong counties, on the Red Bank creek, Pa. They own 4,800 acres of land. The coal is bituminous, excellent for gas and steam purposes. The whole tract of 4,800 acres is underlaid with veins of coal, iron ore, and beds of limestone, and also fire clay are found. Five coal veins; the top upper, Freeport, four feet thick; next lower, Freeport six feet thick; next two but two feet thick. 175 feet below the Freeport vein is lower Kittanning, four to five feet thick; an excellent steam coal, yields a fair coke. The iron is found twenty-five feet below the Kittanning. The company own thirty coke-ovens, with full machinery, crushing and washing machine attached. The property holds within itself all that is necessary for the manufacture of pig iron, so accessible as to render the cost of same cheaper than is possible in any other locality. Colliery has been worked profitably since 1873. All veins drift in and require no artificial drainage. Is sold for gas and steam purposes, and used for gas in Buffalo, Albany, and other cities. Production about 3,000 tons per week, affording more than enough profit to pay the interest of the bonded debt, without further increase of the business. Output weekly at July, 1882, 3,000 tons. Capitalization, $1,500,000; bonded indebtedness, January 1, 1882, (thirty years, six per cent. gold) $650,000.

Fall Brook Coal Company (The). Officers, Geo. J. Magee, Pres.; John Lang, Sec. and Treas. General office at Corning, Steuben county, N. Y. The mines of this company are located near Blossburg, Pa.

Fall Creek Coal Company (The). The location of this company's works is in Bradford county, Pa. Yearly number of tons of coal, 2,000.

Fayette Coal and Coke Company have their works located on the Chesapeake and Ohio Railroad, West Virginia. N. M. Jenkins is Superintendent. Application has been made for more than 30,000 tons of this coal for delivery during the present year. Ohio is the principal market for the ore. The mine has been worked since 1866. It works about sixty men, and is said to produce about 50,000 tons a year of rich bituminous gas coal that makes a 17.5-candle-power gas. This coal contains volatile combustible matter, thirty-seven to five; sulphur, 2.840; ash, 9.400 and moisture. It is marketed in New York and Washington, and belongs to the Burr Wakeman estate.

Fox Coal Mining Company's (The) property is located near Langford, Boulder county, Col. They own forty acres of land, and have a vein on their property nine feet in thickness of pure coal. The Superintendents are Mr. Fox and Col. Paul. During 1881 the mine produced over 20,000 tons of coal. Pay roll numbers sixty men.

Fox Lake Coal Mine (The). The location of the Fox Lake Coal Mine is in Ohio. Wayne county. Coal from this mine is pronounced by experts to be the finest Massillon, and is expected to find a market in Cleveland under the name of The Fox Lake Massillon coal. The mine is in charge of Mr. Evans, and is in full operation; 100 men are said to be employed. An opening has been made into four and a half feet coal at a depth of ninety-five feet.

Franklin Coal Company (The). These works are located in Alleghany county, Pa. Yearly number of tons, 1,800.

Frank Williams Coal Company. These mines are located in Armstrong county, Pa., above Fairmont Company's property. Hill contains three veins of coal; lower averages five feet. Kiltenning Vein, better known as Catfish Vein, averages five and a half to four feet; built on inclined plane 2,000 feet long from the mouth of the bank. Expects to ship largely by July 1, 1882.

Gaston Gas-Coal Company's Mine. The Gaston is located at Fairmont, Marion county, W. Va. The coal is bituminous gas from the nine-foot bed, eight feet of whidh are taken. About fifty men are employed. The prospects of the property are promising. Maximum yearly capacity of production, February 1, 1881, about 20,000 tons. Principal markets for the ore, Baltimore, Washington, Chicago, and St. Louis.

Gauley River Iron Company. The company's property is located in Fayette county, Gauley river, W. Va.

Gaymont Coal Company (The). Mr. J. S. McHugh, Manager. The East Gaymont mine is awned by this company; located one mile from Hawk's Nest, W. Va. Presided over by Mr. Fred. Effinger, of Staunton, Va. Coking vein is reached by an incline 300 feet in length. Averages three feet. Company intend building sixty or seventy coke-ovens. Twenty-five men employed. Output shipped East.

George's Creek Coal and Iron Company (The). The new mine, owned by this company, is located above Lonaconing. Operating two large companies. The underground work is in charge of John Douglas, Supervisor. Mine reached by an incline 300 feet in length. Coal brought out by a small locomotive. Charles Douglas has charge of the new mine, reached by an incline 500 feet in length; 150 men are employed.

Girard Mammoth Colliery (The). The names of the mines are Girard Mammoth, and Cuyler. This colliery is located in the Shenandoah Valley, and is owned by the Philadelphia and Reading Coal and Iron Company; purchased by the Girard Mammoth Coal Company, December, 1880. Water reached to a height, fifty feet deep on the slope. It has been drowned out for some time. The Cuyler colliery is operated by Haton & Co.; worked fifteen years; gives employment to 400 boys; has a capacity from 150 to 200 cars per day.

Glen White Coal and Lumber Company (The). Location of works is in Blair county, Pa. Yearly number of tons, 47,807.

Glascow Port Washington Iron and Coal Company (Limited) (The). The mines of this company are located near Port Washington, Ohio; 1,200 acres owned.

Gould Coal Company (The). These mines are located in Stanton, Ill. Very valuable coal mines; 500 additional miners will be placed at once to work. Purchased by Jay Gould. Cost $65,000.

Grand Canon Coal Company (The). Directors, George H. Nelson, St. Denis' Hotel, N. Y.; Colonel James Burt, 44 Pine Street, N. Y.; A. L. Hatch, 59 Liberty Street, N. Y.; George C. Keep, 24 New Street, N. Y.; Colonel Hector D. McKay, Denver, Col.; A. M. Cassidy, 52 Broadway, N. Y.; James Gondolpho, banker, 52 Broadway, N. Y. The property belonging to this company is located near Canon, Fremont county, Col.; 3,580 acres of coal land are owned by them.

Grass Creek Coal Mines (The). Owned and operated by the Union Pacific. This company's mines are located in Utah. The coal is distributed to Park City, Salt Lake, and Ogden. Total output from these mines, December, 1881, was 7,217 tons, 235 tons of which went to the Parks.

Great Bend Coal Company (The). These mines are located on Edmiston farm near Lloydsville, Pa. Good coal four and a half feet deep. Mine is opened by a drift. Mr. John Cann, of the Bells Gap, is to take charge of the inside work.

Greenock Coal Company (The). The works belonging to this company are located in Alleghany county, Pa. Number of tons per year, 3,258.

Greenburg Coal and Coke Company (The). Incorporators, Hon. James C. Clark, Gen'l Dick Coulter, Col. Geo. F. Huff, Wm. A. Huff, John Zimmerman. The mines belonging to this company are located at Greensburg, Westmoreland county, Pa. Owns 500 acres; new company.

Grant Coal Company (The). Mr. James E. Montell formerly President. The property belonging to this company is located in Eckhart, Md.

Grant Coal Company (The). The works belonging to this company are located in Alleghany county, Pa. Yearly number of tons, 41,850.

Gunnison Coal Company. D. F. Verdenal is Secretary. Office, 39 Broadway, New York. The company's mine, Castle Mountain, is located in Colorado.

Halifax Coal Company (The). The property belonging to this company is located in Nova Scotia. The company are reopening their mines at Stellartown, Nova Scotia.

Hamilton Coal Company (The). These works are located near Reynoldsville, Va. Coal averages five feet. Drift opening reached by an incline.

Hamilton Coal Company (The). A. V. Armstrong, Gen. Man. and Supervisor. This company's mines are located near Youngstown, Ohio. The mine is reached by a short incline up the hill, where it is opened, and five feet of clear coal mined. John D. Lowther, charge on the hill. Works in fine condition. Eighty men employed. The mines receive forty-five cents per net ton for run of mine; sixty-seven and a half for screened coal.

Hampshire and Baltimore Coal Company (The). Officers, J. G. Repplier, Pres.; E. L. Bowles, Vice-Pres.; Geo. D. Pond, Sec. Directors, E. S. Boylles, Henry L. Henry, J. George Repplier, George H. Potts, George B. Satterlee, James L. Merriam, Edward Bothout.

Hampton Coal Company (The). These works are located in Alleghany county, Pa. Yearly number of tons, 85,650.

Hartford City Coal and Salt Company (The). Location of works, near Hartford City, Mason county, W. Va.

Harlem Coal Company (The). These works are located in Washington county, Pa. Yearly number of tons coal, 61,306.

Hawk's Nest Coal Company. Mining Engineer, William N. Page. Office, Ansted, Fayette county, W. Va. The company's property is located at Gauley Mountain, Fayette county, W. Va. It is reported that the company is preparing to erect, from drawings made in England, eighty copper coke-ovens, having the same capacity as 160 bee-hive ovens, to meet the increasing demand for New River coke. Maximum yearly capacity of production, 1880, 49,438 tons of coal. Principal market for the ore, Portland, Maine.

Henrico Coal Company (The). Opened extensive mines on the Alleghany river. The coal company works also at Richmond, Va.

Hoboken Coal Company (The). General office, Bank Building, cor. Newark & Hudson Streets, Hoboken, N. J., and Nos. 40 & 111 Broadway, New York.

Hocking Coal and Railroad Company (The). Incorporators, Henry H. Brown, Wm. J. McKinney, Wm. B. Saunders, Henry Fenninger, W. F. Rutman. Principal office, Cleveland, O. This property is located in Cleveland, O. The mines are operated chiefly in Hocking, Perry, Athens, and Vinton counties. Capitalization, $3,000,000.

Home Coal Company (The). The Echo Mine, operated most exclusively for the Ontario Company. The mines, viz., Crismon, Spriggs, and Wahsatch, are worked under the consolidations. Location at Coalville, Utah. Yield for December, 1881, 2,218 tons clear coal. Sixty to seventy men employed.

Howard Anthracite Coal Company. Location of mines, three miles northwest of Crested Butte, Cal. The company's property covers 640 acres of land. The coal is a pure anthracite, of 1·43 specific gravity and eighty-eight per cent. carbon, and assays $75 per ton. Report says 15,000 tons were mined during the past winter. The tunnels into the vein are on the south side of the mountain, and enter the veins at the lowest point; consequently, the mines can be kept entirely free from water and worked successfully throughout the year. An extension of the D. & R. G. Railroad is to be run to this bank.

Huntington and Broad Top Mountain Railroad and Coal Company (The). Officers, B. Andrews Knight, Pres.; Rathmell Wilson, John Devereux, J. V. Williamson, James Long, James Whitaker, Joseph H. Trotter, Wm. P. Jenks, C. W. Wharton, Samuel Field, Thos. R. Paton, Jacob Naylor, Spencer M. Janney.

Imperial Coal Company (The). The Montour mine, belonging to this company, is located on the Pittsburg and Lake Erie Road, Alleghany county, Pa., at Imperial, Alleghany county. Company owns 325 acres of surface land, 500 acres of coal; mine is reached by a heavy grade to the chutes, then by an incline, 800 feet in length, to the mouth of the drift; coal bed averages five and one-half feet in thickness; coal good, but troubled with clay veins; 200 men employed; receive seventy-five cents per ton for screened coal.

Indian Territory Coal Company (The). Principal office, No. 100 N. Fourth Street, St. Louis. This property consists of the Choctaw mine, located in Newark and Shawnee, Ohio.

Industrial Coal and Mining Company (The). These mines are located in Scranton, Kansas. Organized in 1880; consists of twelve members, all miners; shaft.

Iron Mountain Company (The). The mines are located in St. Louis; is a close corporation, vested in the heirs of the three original owners. Capitalization, $3,600,000; shares, 1,000; annual dividends, varying from fifteen to eighteen per cent., have been regularly paid.

Isabella Furnace Coal Company (The). Location of the works of this company is in Westmoreland county, Pa. Yearly number tons of coal, 120,000.

John Henry Coal Company (The). Hiram Thornton, Supervisor. This company is better known as the Thornton Mine, Mineral Ridge, Ohio, located about a mile from town. The mine is entered by a shaft 127 feet in depth. Coal ore will average about three and a half feet. Fair prospects of doing well. Stephen Thornton has charge underground, employing about 100 men.

Jackson Coal Mine Company (The). This property is located in Jackson township, and is being run to its utmost capacity.

Johnson Coal Mine (The), near the Borden shaft; owned by the Central Coal Company. Mr. Thomas Hammell has charge of office. This mine is located near Lonaconing. Mr. James Thompson has charge of the underground work. The mine is entered by a slope 400 feet in length. Mine running full time. Average probably better work than any other mines in the region, About 100 men employed.

Kanawha Consolidation Coal Company (The) is chartered under the laws of the State of Virginia. The offices are at Staunton, Va., and Charlestown, W. Va. The property of the company is located in West Virginia. Capitalization, $800,000, in 8,000 shares of $100 each.

Kemble Coal and Iron Company (The). These works are located in Alleghany county, Pa. Yearly amount of coal, 13,753 tons.

Keystone Coal Company (The). Officers, Henry A. Stiles, President; Francis H. Williams Secretary and Treasurer. Principal office, 209 South Third Street, Philadelphia. This company are miners and shippers of Cumberland coal.

Knob Coal Company (The). Location of works in Washington county, Pa. Yearly number of tons of coal, 18,497.

La Cygne Coal and Mining Company (The). The mines of this company are located at La Cygne, Kansas. Choice coal; vein, 116 feet from the surface; deposit, three feet thick.

Lake View Coal Company (The). These mines are located six miles south of Akron. This company is composed of Youngstown capitalists; they have taken out from ten to fifteen cars of coal per day; shipped to Cleveland, Ohio.

Land Run Coal Mine (The). James O. Somers, Supervisor. The location of Sand Run Mine is on Carbon Hill, Ohio; 100 men are employed.

Two Large Mines, one owned by the Reynoldsonville Mining and Manufacturing Company, the other by Powers, Brown, & Co. James Powers, Supervisor. These mines are located at Soldier Run, near Reynoldsonville, Pa. This company own a large tract of coal land, recently opened (1881) into a fine piece of coal, averaging four to five and one-half to seven feet; tipple machinery, etc.

Large Coal Works. Mr. Wm. M. Page, Manager. The mines of the above works, on Gauley Mountain, 901 feet above New river, Va. The coal works are situated eight miles from the mouth of New river, on Chesapeake & Ohio Railroad. They are operated by the Hawk's Nest Coal Company, composed exclusively of English capitalists. The same company have purchased ore lands in Eastern Virginia; building two 150-blast furnaces at Goshen. Vein nine feet thick, seven of which are mined; 600 tons daily is expected. Miners receive forty cents per ton. Coal shipped East.

Leattle Coal and Transportation Company (The). The company own the Newcastle mine, located in Oregon, S.E. of Leattle, King county, W. T. Opened, 1866, by Rev. Daniel Bagley. Shipments very large.

Laurel Hill Coal Mines (The). Operated by Mr. T. P. Marshall. The Laurel Hill mines are situated in Hocking Valley, Ohio. They have done very well the past season (1881); have orders for all the coal they can get cars to ship in. The mine is reached by an incline. The underground work is in charge of J. M. Stillwell. Sixty men employed.

Lehigh Coal and Navigation Company (The). Location presumably in Pennsylvania. This property, under the supervision of Messrs. Powell & Boyd, has become one of the most valuable in the valley. The company has declared a semi-annual dividend of two per cent. Capitalization, $10,448,550; number of shares, 208,971; par value, $50; latest dividend, November, 1881, three per cent.; rate per annum, five per cent.

Lehigh Valley Coal Company (The). Officers, Harry E. Packer, Pres.; Charles Hartshorne, Vice-Pres.; Israel W. Maris, Sec.; John R. Fanshawe, Gen'l Supt.; Frederick Mercer. Tonnage various collieries fourteen in number: total production, 1,386,033 tons; shipped to northern markets. 432,555 tons; tons furnished to the line and tide water, 958,478 tons; shipped by tenants controlled by the company, 842,412 tons.

Little Fire Creek Coal Mine (The). Owned by Wm. Blury Cooper & Co. Little Fire Creek Coal Mine. The property belonging to this company is located at Caperton Station, W. Va. They have also a fine shipping mine up the mountain, reached by an incline 1,480 feet in length; fine coal three and one-half to four feet in thickness. 120 men employed. Shipping coal to James river, and to the works of the Lowmoor Iron Company.

Little Alps Coal Company (The). Snow Hill mines belong to this company. Location of coal works on the Monongahela opposite California. 130 acres of land are owned by the company.

Locust Mountain Coal and Iron Company (The). Directors, 1882, John Biddle, Pres.; Jacob P. Jones, Israel Morris, Charles Hartshorne, Wm. F. Jones, Israel W. Morris, Richard H. Downing. John Biddle re-elected President. Edward Swain, Sec. and Treas. of the company. These mines are located in Pennsylvania.

Long Valley Coal Company (The). This property is located in Bradford county, Pa. Yearly number of tons of coal, 15,970.

Louisville Coal Company (The). The mines owned by this company are located in Massillon, O. Machinery owned, one pump and boiler.

Lucas Coal Company (The). These mines are located near Scranton, Pa. Shafts sunk 140 feet; pumps used. Shaft is ten by thirty feet, accessible to coal, amounting to at least five or six millions of tons.

Lukens Valley Coal Company (The). Wicomico mines belong to this company, located in Pennsylvania. They are developing new workings in the above mines. Old tunnel in North Mountain opened, gangway driven 1,500 yards. Large deposits of coal are supposed to be deposited in the veins.

Lykens Valley Coal Company. The directors are Geo. B. Roberts, Pres.; T. J. Weston, Vice-Pres.; A. J. Cassatt, Edmund Smith, S. Kneass, W. Morris, N. P. Shortridge, J. N. Du Barry, John P. Green, Jas. W. Johnson, E. P. Worster, A. Mordecai, Sec.; T. P. Haviland, Treas. Location of works, Dauphin county, Pa.; 807 persons are employed.

Manaska Coal Company (The). This property is located in Iowa. It is the only explored coal field in that section. It is a six foot continuous vein, with a nine inch roof and floor, and no water in it.

Maple Hill Coal Company (The). The property of this company is located near Nelsonville, Ohio. Coal averages six feet in height.

Marshall Coal Mining Company (The). Officers, A. G. Langford, Pres. and Man.; Victor Robertson, Sec. and Treas. The mines belonging to this company are located in Colorado. Own over 3,000 acres, mostly under lease, January 14. 1882. Two hundred men are employed.

Maryland Coal Company (The). James Boyce is Secretary. The office is at 104 Broadway, New York. The Kingsland mine is worked by this company, located in Maryland. Large furnaces and air shafts belong to the company. Capitalization, $4,400,000; par value per share, $1; date of latest dividend, March, 1876; yield during 1881-2, 24,963 tons coal.

Maryland Union Coal Company (The). James Boyce, Treas., Baltimore. Principal offices, American Building, Baltimore. M. D. Smith Buildings, Cortland Street, New York, adjoining Coal and Iron Exchange. Shipping wharves, Locust Point, Baltimore, M. D. The mines belonging to this company are located at Flemington and Fairmount, West Virginia.

Mashannon Coal Company (The). The location of these works is in Clearfield county, Pa. Yearly output, 115,252 tons.

Massillon Region Run Coal Company (The). O. Young, General Manager. J. H. Grinnell has charge of office. These mines are located near Massillon, Ohio. Shaft, 180 feet deep. The mine has been kept running steadily. Mordecai J. Morris has had charge of the underground work; 200 men employed.

Massillon City Coal Company (The). M. J. A. Wilson, Superintendent. The mines owned by this company are located on Foltz Slope, near Massillon, Ohio.

Mattoon Coal Company (The). The mines of this company are located at Mattoon, Ill. The company have expended the sum of $65,000 sinking a shaft 466 feet deep. Expect to reach a paying vein at the depth of 600 feet.

Milwaukee and St. Paul Coal Company (The). These mines are located in Grundy county, Ill. Three shafts were sunk during the last year, 1881; 100 tenant-houses built; cost $335,000.

McIntire Coal Company (The). The company's offices are at Elmira and Buffalo, N. Y. This company's works are located in Lycoming county, Pa. Yearly number of tons of coal, 236,924.

Mill Creek Coal Company (The). Officers, T. W. Walter, President and Treasurer; F. Bertolette, Secretary. Directors, Warren Delano, Newburg, N. Y.; James S. Cox, Orange, N. J.; Joseph F Hitch, New York; T. F. Walter and Fred. Bertolette. The mines of this company are located in Pennsylvania.

Milton Furnace and Coal Company (The). Officers, H. S. Willard, President; J. E. Farrel, Secretary. These mines are located near Wellston, Ohio.

Millen Furnace and Coal Company (The). This property is located in Jackson county, Ohio, adjoining Bundy's farm. The depth of shaft, sixty feet.

Manor Valley Coal and Manufacturing Company (The) is chartered under the laws of the State of Pennsylvania. Officers, A. O. Tinsman, Pres.; W. J. K. Kline, O. B. McLain, A. B. Rutledge, Willy McCullough, A. B. Kline. Principal office, Pittsburgh. The mining property of this company is located in Westmoreland county, Pa. This company is authorized to mine coal, quarry limestone, and manufacture coke. Capitalization, $50,000.

Milesville Coal Company (The). Located in Alleghany county, Pa. Yearly number of tons of coal, 18,953.

Miller Coal Mining Company (The). Date of organization of this company, October 7, 1882, at Portland, Maine; capitalization, 500,000 shares.

Mineral Ridge Coal Mines (The). The above coal mines, at Mineral Ridge, Ohio, are all running steadily, with work every day.

Mocanaqua Colliery (The). These works are located near Shickshinny, Susquehanna river, Pa. Leased by Col. Conyngham, John Leasdale, of Wilkesbarre, Pa. Preparations are being made to resume operations in full force as soon as the new bridge across the Susquehanna is ready.

Monongahela Mine (The), owned and operated by H. J. Davis & Co., is located at Wilsonburg, Harrison county, W. Va. The mine was opened in 1872, in the nine feet seam, which yields eight and a half feet of coal. Some eighty men are worked. Most of the coal is used by the Baltimore and Ohio Railroad. The company owns a large body of coal land in this locality. Maximum yearly capacity of production, February 1, 1882, 20,000 tons.

Montauk Gas Coal Company (The). Principal office, New York city. The mines of this company are located in Flemington, Taylor county, W. Va., on the Baltimore and Ohio Railroad. Mine opened, 1878, is on what is called the nine feet vein, seventy-five feet below the surface of the country; furnishes eight feet of available coal; 200 men employed. 60,000 tons of coal are sent yearly to market, mostly to New York.

Montreal Gas Coal Company's (The) property is located at Flemington, Taylor county, W. Va. The mine opened in 1878 is on what is called the nine feet vein, which is here some seventy-five feet below the general surface of the country, and furnishes about eight feet of available coal. Maximum yearly capacity of production, February 1, 1881, over 60,000 tons. New York is the principal market for the ore.

Morris Run Coal Mining Company (The). W. S. Nearing, Superintendent. The mines belonging to this company are located in Pennsylvania. The property owned is three pumps and one of Harrison's coal-cutting machines.

Morris and Essex Coal Company (The). Capitalization, $15,000,000; number shares, 300,000; par value, $50. Latest dividend, rate per annum, seven per cent.

Mount Carbon Coal Company (The). These mines are located in Colorado. The directors have purchased from the locators 640 acres, paying therefor one-half capital stock of the company. Eighty tons daily taken out. Amount can be increased to 1,000 tons per day, if necessary.

Mount Braddock Coke Works (The). Owned by A. O. Tinstman, Esq, of Pittsburg. The property consists of 420 acres of coal, fifty acres of surface, 127 coke-ovens, and thirty-five houses. Amount paid, $165,000. The new proprietor proposes to erect fifty additional ovens at once.

Mount Diablo Coal Mines (The). The New Castle Mine owned by this company is located in California. The output in 1880 aggregated 188,723 tons.

Murphy Run Mine (The). Owned by the Burr Wakeman estate. The Murphy Run mine is located in Clarksburg, Harrison county, W. Va. A rich bituminous gas-coal that makes a 17.5-10 candle-power gas. The coal contains fixed carbon, 49.080; volatile combustible matter, 37.105; sulphur, 2.840; ash, 9 400, and moisture, 1.575. The mine has been worked since 1866; employs about sixty men. It is in the nine-foot seam, which yields eight and one-half feet of coal. Maximum from 15,000 to 20,000 tons annually. Principal market, New York, Washington, etc.

Newburg Orrell Coal Company. Superintendent, Morgan D. Orr. This company owns and operates the Palestine and Tyrconnel mines. The Palestine is located at Palatine, Marion county, W. Va., and the Tyrconnel, in Taylor county, W. Va. The character of the coal is bituminous gas. The coal is mined from the nine-foot vein, seven feet of which is here worked in two headings, with about 1,000 feet of working face. The bed mined in the Tyrconnel is the Pittsburg vein, which, there, furnishes eight feet of gas-coal. The mine was opened in 1872, and now works about fifty men, and mines some 30,000 tons of coal a year, which is marketed in Baltimore, and at places on the Baltimore & Ohio Railroad.

New Central Coal Company. The officers are W. S. Jackques, Pres.; E. J. Sterling, Vice-Pres.; Geo. H. Adams, Sec. Office, 6 and 6½ Trinity Building, New York. Robert E. Boyd, Superintendent. Big Veins and Koontz mines—this property, belonging to this company, is located near Lonaconing, Md. Koontz mine is reached by a tram-road, two miles in length; small locomotive hauls the coal to the chutes; incline, 970 feet in length; August Ricker in charge of the underground work; employs about 170 men. The Big Vein, near Lonaconing, is operated by the Central Coal Company; mine reached by an incline 550 feet in length; Wm. Powell has charge; employing about eighty men.

New Colliery of Linderman, Keen & Co. (The). Wm. Airey, Superintendent. This colliery is located at Stockton, Pa., known as West No. 1 Stockton. Slope sunk 50° 217 yards from the surface. The first left gangways are opened, 300 feet main air-ways; area, forty-two feet. Mine Inspector, Mr. Roderick.

New York and Cleveland Gas-Coal Company (The). Wm. A. McIntosh, Pres.; H. Casnegie, Vice-Pres.; W. P. De Armit, Treas.; Thos. Axworthy, Agent, Cleveland, O. Castner & Co., limited, 203 Walnut Street, Philadelphia; 111 Broadway, New York; 21 Exchange Place, Boston, and 10 South Holliday Street, Baltimore, Md. Location of mines at Pittsburgh, Pa. Youghiogheny gas-coal mined by the above company.

New York and Ohio Coal Company (The). Thomas Hall, of Eberdale, Superintendent. Principal office, Cleveland, O. The mines belonging to this company are called New Hazelton coal mines, located in Carroll county, O., half a mile from Sherretsville. Operated by the New York and Ohio Company. Everything moving in good shape.

Nuttalburg Coal and Coke Company (The). The property belonging to this company is located at New river, West Va. No 1 mine reached by an incline 1,400 feet in length; opens into a vein averaging three feet three inches. Fifty-one coke-ovens are in full blast; miners receive sixty cents per ton. No. 2 mine opened last year, 1881, at Keeney's creek. Reached by an incline substantially 1,350 feet in length; three openings made, thicker coal, averaging three feet six inches, in some places four feet.

Ohio and Pennsylvania Coal Company (The). Mr. M. Bloomer, Manager. The company owns the Yorkville mines, located at Yorkville Station, O. Mr. Bloomer, Manager, owns one-half interest in the mine. Coal is reached by an incline 190 feet in length. Vein averages five feet. Mining department is in charge of Wm. Mack; sixty to 100 men employed.

Ohio Central Coal Company (The). Col. W. C. Lemert, General Manager; Thos. Cockran, of Shanee, Mining Sup. These mines are located near Corning, O. They are all numbered. Nos. 3, 5, 7, 13, 15, and 19 are all reached by shafts ranging from thirty to seventy feet in depth. Nos. 2, 4, and 12 have drift entrances. This company employs miners and day laborers of all classes; about 500 colored miners, 350 Germans, 300 mechanics, carpenters, etc.; 300 new arrivals, 1881; eighty cents per ton for screened coal. Shafts average from eight to nine feet, and in the drifts from four to six feet; 300 neat dwellings. Hoisting apparatus machinery of the most substantial kind, having been erected regardless of cost.

Okanville Coal Mining Company (The). The property belonging to this company is located in Illinois. Capitalization, $15,000.

Old Bank Mine (The). Operated by J. S. Doe & Co. The mines are located in Columbus, Ohio. Coal brought out by a small locomotive. 100 men employed.

Old Company's Lehigh Coal. Frederick A. Potts, Agent. Offices, 110 Broadway, New York: 25 Westminster Street, Providence; 81 Church Street, New Haven, Connecticut; 14 Kilby Street, Boston, Massachusetts.

Osborne Coal Company (The). Wm. H. Warner, Supervisor. The works of this company are located near Mineral, Ohio. Underground work in charge of John B. Williams, reached by a slope 100 yards in length. From seventy to ninety men employed.

Otis Coal Company (The). Mr. Ralph Wainwright, Manager. These mines are located in Edenberg Coal Company, Ohio.

Paint Creek Mining Company. The officers are L. L. Conrad, Pres., Baltimore; G. W. Riggs, Treas. Directors, L. L. Conrad, G. W. Riggs, H. H. Parker, J. S. Barbour, James F. Patton, W. H. Edwards, I. N. Smith. Engineer, Oscar A. Veazey. The company's property, covering an area of 10,000 acres, is located at Paint creek, Kanawha county, W. Va. The principal splint coal seam averages ten feet.

Palmyra Coal Company (The). The coal works belonging to this company are located near Palmyra, Ohio. Sunk a shaft eighty feet deep, three to four and a half feet in thickness. Machinery good. Output may be increased at any time. Large pumps. Underground workings are in charge of E. T. Bowen. 100 men employed. Large quantities shipped to Chicago. Known as the Brier Hill coal.

Pancoast and Washington Collieries (The). The location of these mines is four miles from Reynoldsonville, Va. Operated by Messrs. Frank Williams & Co. Coal seam averaging four to five feet in thickness. Mines get seventy-five cents for screening coal.

Peach Orchard Coal Mines (The). Morris Lee, Superintendent. The Peach Orchard mines are located in Kentucky. Seventy-five men employed. Tunnel used.

Pennsylvania Coal Company (The). Officers, Geo. O. Hoyt, Pres.; W. E. Street, Sec.; E. H. Mead, Treas. General office, 111 Broadway, New York; Buffalo office, 64 Pearl Street; Chicago office, 94 Dearborn Street. H. S. Van Ingen, Superintendent; Thos. Hodgson, Western Superintendent.

Penn Coal Company (The). Capitalization, $5,000,000; number of shares, 100,000; par value, $50.

Pittsburg and Walnut Hill Coal Company (The). This company's works are located in Washington county, Pa. Number of tons of coal annually, 40,000.

Pennsylvania Gas Coal Company (The). These works are located in Westmoreland county, Pa. Yearly number of tons of coal, 468,240.

Pennsylvania and Ohio Coal Company (The). These mines are located at West Newton, Pa. Shaft sunk; struck a four feet vein at 100 feet searching for the Pittsburg vein.

Penny Coal Company (The). The location of this company's property is in Alleghany county, Pa. Yearly number of tons, 15,873.

Percy Mining Company (The). Location of works in Fayette county, Pa. Number of tons of coal per year, 194,176.

Phœnix Iron Company (The). These works are located at Phœnixville, Pa. They are now heating their furnaces with gas manufactured from anthracite.

Phœnix Colliery (The). The property belonging to this company is located at Pittston, Pa. Shaft sunk; found red ash coal bed; excellent quality and of encouraging depth.

Philadelphia and Reading Coal and Iron Company (The). The mines of this company are located in Shenandoah Valley, South Buck Mountain. Nineteen feet of good coal has been reached in the Norwegian shaft. Largest shippers in the region.

Pine Ridge Colliery (The). John L. George, owner, Home and Union Coal Works. Location of works on the Delaware and Hudson county, Monongahela river, Conshockon, Ohio.

Pittsburg and Kiskiminetas Coal Company (The). This property, consisting of the Bagdad and other mines, is located near Pittsburg, Pa. Since May, 1881, have a shipping capacity of 150 tons per day; 350 acres of Westmoreland coal; two veins; four feet worked by drift; other seven feet, 173 feet below the four-feet vein. Mine worked by double entry 150 yards apart. Bagdad mines, capacity 150 tons. Two veins; top vein, four feet. Own 700 acres at Leechburg.

Pittsburg and Westmoreland Coal and Mining Company (The). Stockholders, John Schwalen, Alfred Hyicks, of Leechburg; E. S. Golden, L. S. Singer, W. D. Patton, Kittanning. Capitalization, $100,000.

Pittsburg Coal Mining Company (The). Location of works in Clarion county, Pa. Yearly number of tons of coal, 47,544.

Pioneer Coal Company (The). These mines are located at Paint Creek, W. Va. Capt. Henry W. Reynolds and Wm. Lovell, Esq., are opening a cannel coal vein at Paint Creek.

Pioneer Coal Company (The). The mines located at Campbell Creek, W. Va. The company have introduced a Letchner mining machine, which can bore in six or seven feet by means of a number of revolving diamond drills. It will dig more coal in a day than ten or fifteen men.

Pittston Coal Company (The). Michael J. Langan, boss of the shaft. The trim shaft is located at the Junction, Pa. Eight feet excellent coal.

Potomac Coal Company (The). Geo. W. Lyons, Man. The Swanton mine is owned by the company. Located at Barton. Mine in charge of Archibald McDonald; employing about fifty men.

Raney Bank Coal Company (The). Thomas St. Johns, Supt. These mines are located in Ohio, near the Pittsburg and Cleveland Railroad. The mine is reached by an incline. Two openings into about five and a half feet of coal. Miners receive seventy-five cents per ton for screened coal. The mining department is in charge of John Thompson. Prospects are very good. 120 men employed.

Raton Coal and Coke Company (The). The name of the mine owned by this company, Dillon Cañon, located at Raton, N. M., two miles this side of Blossburg. Quality of the coal unsurpassed. A fine vein has been discovered, six feet ten and a half inches wide. Vein discovered by R. J. Goade.

Rend Coal Company (The). The mines of this company are located at Rendville, above Corning, Ohio. The coal is of the same character as the Ohio Central Coal Company.

Reynoldson Coal Company (The). This company's works are located in Jefferson county, Pa. Yearly number of tons, 32,582.

Rich Hill Coal Company (The). Rich Hill and Carbon Center mines. These mines, belonging to this company, are located in Bates county, Mo. The coal here is in considerable quantity and good quality. The Rich Hill Coal Company intend also to work their leased mining property at Bradford station. Veins, two to six feet. The grand total of their coal shipments for the month was 600 car-loads. The shipments by the Galf road for January, 1881, amounted to 1,500 car loads, principally from the Rich Hill and Carbon Center mine.

Ridge Vein Coal and Coke Company (The). Works located at Bradenville, Pa., along the P. R. R. Company's line. New corporation.

Robbins Block Coal Company (The). This property is located in Washington county, Pa. Yearly number of tons of coal, 75,000.

Robinson Coal Company. Neil Robinson is Manager. The property belonging to this company is located at Coalburg, W. Va., and covers an area of 1,428 acres. An analysis of the coal is given as follows: sixty-two per cent. fixed carbon; 32·50 volatile; 150 ash; 400 water; total, 100 parts. The coal has been used by Eastern gas-light companies. The mines, during 1880, turned out 70,208 tons of coal, the bulk of which went westward.

Rochester Colliery (The). These works are located in Pennsylvania; operated by Messrs. Bell, Lewis & Yates; coal averages six and one-half feet; double drift openings; averages 600 tons daily; last year's product (1881), 28,000 tons coke. The company owns a large crusher and Stulz washer; 400 men employed.

Rochester and Pittsburg Coal and Iron Company (The). Directors, Frederick A. Brown, New York; Walston H. Brown, New York; Thos. F. Wentworth, New York; Augustus Kountz; Messrs. Brown, Callery, and Kountz. Fred. A. Brown, Treas. Principal office located at Brookville. The mines are located in Young and Snyder townships, Jefferson county, Pa., embracing an area of 6,000 acres, 3,100 in Snyder township. Capitalization, $4,000,000; shareholders, Herbert C. Brown, New York; James Callery, Pittsburg; Geo. A. Jenks, Brookville.

Rocky Point Mining Company (The). Principal office, 314 Bush Street, San Francisco, Cal. The property owned by the company is located in Placer county, Cal.

Rodes Coal Company (The). Mr. P. Keller, Supervisor. The mines belonging to this company are located near Massillon, O. Mountain shaft is the largest; underground works in charge of Geo. Swire; 225 men employed; coal is reached by a shaft 133 feet deep.

Redstone Coke Company (The). General Manager, Col. Shoemaker. The company's property is located three miles south of Greensburg, Pa., on the line of the South-West Railway, in South Union township, just at the end of the mountain. The company has 600 acres of coal and 500 acres surface. The coke is superior. The property is worked by slope, flat headings, and butte headings. Slope is now in 1,000 feet. A new slope is now being started from the southern end, July, 1882. The company's property includes 171 ovens, tipple, and several dwellings, and 142 ovens in course of erection. The development of the property was commenced during the year 1880. The surface property is judiciously farmed and is a source of great revenue to the company. The coke manufactured is sold in the market, the company owning no furnaces to require its use. Daily average production, 275 tons. The mine is well ventilated, and supplied with water from Redstone creek. Stock and bonds are held exclusively by J. W. Moore, Greensburg, Pa., Col. J. M. Schoonmaker, Pittsburg, Pa., and P. H. Moore, of Redstone, Pa. Wages paid to diggers per day, July 1, 1882, $2.

Salisbury Central Coal Company (The). Thos. Gemmel, General Agent, 8 South Gay Street, Baltimore, Maryland. This company are miners and shippers of the Big Vein Cumberland Coal.

Sandy Lick Gas and Coal Company (The). Frank Williams, General Manager. These mines are located in Alleghany Valley, Pa. Operated by Heim Goodwill. Seam five feet thick; output 200 tons daily; mining in charge of Henry Williams; 60 men employed. The Washington mine, a short distance away, is under the same supervision; forty men employed. The miners receive sixty-two and one-half cents per ton for screened coal in these two mines.

Sandusky and Shawnee Coal and Iron Company (The) has property located at Shawnee, Perry county, Ohio, consisting of the Shields Coal Mine, under the supervision of A. W. Mason; also smelting furnace, under the charge of Mr. John Bailey; twenty-eight men and boys being steadily employed.

Screader Coal Company (The). Location of works in Badford county, Pa. Yearly amount of coal, 210,415 tons.

Sharp Mountain Colliery (The). These works are located in Pennsylvania. Slope sunk to the Bancroft vein.

Shenango Coal Company (The). R. J. Wicks is Superintendent. These works are located near Brookfield, Ohio. The underground work in charge of Thos. Maxwell. Slope 225 feet in length; 150 men and boys employed. The coal, like other mines, varies in thickness from three to four feet.

Shimmel Run Mine (The). Owned by D. W. Holt & Co. The Shimmel mine is located in Philipsburg, Pa.; 2,100 acres coal land under the control of the company.

Silver Creek Coal Mining Company (The). Officers, E. G. Loomis, Pres. and Gen. Supt.; D. V. Hoffman, Gen. Mang. (mining boss); John Burgess, Mang. The property of this coal mining company is located in Doylestown, Wayne county. Operating two mines, and sinking a new shaft near Wadsworth. G. D. Hoffman has a man at each mine under his supervision. About forty men employed.

Silver Brook Coal Mine (The). The Silver Brook mine is located at Summit Station, Audenried, Pa. Splendid coal, twenty-one feet thick; 1881 started to sink a trial shaft.

Silver Star Mining Company (The). Officers, E. W. Ashby, Pres.; S. T. Lathrop, Vice-President; J. F. Broadhead, H. J. Spear, A. M. Wing, J. W. McClurg, Secs. The mines of this company are located in Gila county, Arizona.

Sippo Coal Company (The). Officers, Clement Russell, Pres.; M. W. Wilson, Sec.; George Phillips, Supt. The mines are located in Tuscarawas Valley, near Massillon. Coal excellent; 125 men employed. The entries are being driven double shift. A good producing mine. The underground works are reached by a slope 300 feet in length; are in charge of Matt. English. 100 men employed.

Skinner and Jefferson Coal Mines are owned by Mr. Thomas M. Skinner, Mr. E. H. Jefferson, and Mr. D. Lands. The mines are located at Crusted Butte, Gunnison county, Col. The property covers 880 acres, the greater part of which is underlaid with coal. The coal in lower veins is good coking, that in the upper veins being best quality of the bituminous for domestic purposes. There are five distinct coal veins, two and a half, five, five, eight, and ten feet thick respectively. Veins dip 10° to 15° to the west, and 2° to 3° to the north. The four feet are opened by an entry of nearly 500 feet, from which three large chambers are being worked out. The mine as opened is well arranged as to ventilation. Large bodies of unstratified building-stone are lying between the lower beds. Maximum daily capacity of production, July, 1882, 100 tons.

Snyder Coal Company (The). The property belonging to this company is in Mercer county, Pa. Yearly number of tons, 32,810.

South Forks Coal Works (The). The property belonging to this company is located in Cambria county, Pa. Total number of tons of coal per year, 11,502.

Southwest Coal and Coke Company (The). Incorporators, H. Clay Frick, E. M. Ferguson, W. Ferguson, W. J. Hitchman, D. W. Shyrock, Jacob E. Stoner, Joseph W. Stoner, William Stoner, George W. Stoner and P. R. Tarr. Principal office, Mt. Pleasant, Pa. Branch office, Pittsburg. The mines are located in Westmoreland and Fayette counties, Pa. Maximum yearly capacity, 52,625 tons. Capitalization, $400,000.

Spring Hill Mining Company (The). Officer, Senator McFarlane, President. The mines are located in Canada. Total output of coal for the year 1881, 170,000 tons; ten feet. Superior coal. Entrance to the mines by tunnel.

Southwest Coal Company (The). These works are located near Tarrs, Westmoreland county. A shaft; coal lies 100 feet from the surface; will sink a shaft. Morewood branch railroad will be extended to these works.

Spring Hill Mining Company (The). Location of the mines of this company is in Nova Scotia. At 100 yards north of the west slope a new seam of coal has been found twelve feet six inches in thickness. The west slope will be driven down 400 feet farther.

Steubenville Coal and Mining Company (The). Officer, James Wallace, President. Company operates the mines in Ohio successfully.

Straight Creek Coal Company (The). Officer, Jessie H. Baker, President and Superintendent. This company have opened a new mine, located on the line of the Big Sandy Railroad, 103 miles from Lexington, Ky. Capitalization, $100,000.

Straitsville Coal and Iron Company, 1881 (The). J. D. Martin, President; James Coyle, Manager. This company own the Plummer Mine, located in Hocking Valley. Have 160 cars of their own. They are building a revolving screen and putting up a small engine to enable them to take pea coal from their stack; 160 men employed.

Straitsville and Shawnee Town Mines (The). The name of these mines are Upson, Smith, New York, and Manly Mines, located at Straitsville and Shawnee Town, Ohio. All large mines, employing a large force of men; are kept in constant operation.

Standard Coal and Iron Company (The). Officers, General Samuel Thomas, Pres.; Oliver Ames, Treas.; J. Henry Brooks, Sec. This company's mines are located in Hocking Valley, W. Va. The property consists of 30,000 acres of well selected land; controls all the prominent coal mines in the valley, producing 5,000 tons of coal daily. 160 net tons to the foot of thickness per acre in the great vein. Average thickness, seven feet; amount available runs into hundred millions of tons. Capitalization, $25,000,000.

St. Bernard Coal Company (The). Officer, J. B. Atkinson, Sec. and Treas. The mines are located in Earlington, Ky.

St. Clair Coal Company (The). Incorporators are John Russell, Hugh Means, A. R. Fennacy, of Ashland, Ky.; Wm. Wyant, Thomas Wharton, of the Eagle Works. The location of these mines are near Coal Valley, W. Va. Under the superintendence of Wm. Wyant, Eagle vein will be opened at once. Thirty coke-ovens will be built this spring. Coal mined will be manufactured into coke. 1881.

St. Mary's Coal Company (The). Location of works in Elk county, Pa. Yearly output, 84,000 tons.

Sugar Creek Coal Company (The). Anthony Howell, Gen. Mang., formerly State Treasurer. The property of this company, 1882, is located eight miles south of Massillon, Ohio. Shaft, 150 feet in depth.

Summit Branch Railroad Company (The) has property in Dauphin county, Pa. The officers are Geo. B. Roberts, Pres.; Isaac J. Wistar, Vice-Pres.; A. Mordecai, Sec., and T. P. Haviland, Treas. Directors, Geo. B. Roberts, I. J. Wistar, A. J. Cassatt, Ed. Smith, Strickland Kneass, Wistar Morris, N. Parker Shortridge, J. N. Du Barry, John P. Green, James W. Johnson, Ed. P. Worster. The mine employs 803 persons. Organized with a capital of $500,000, in 100,000 shares of $5 each. Net profits in 1881, $121,258.12.

Superior Coal and Mining Company (The). The mines belonging to this company are located at Osage City, Kansas. It is a joint stock enterprise, composed of forty-one members, all miners. Organized, 1879. The company owns fifty-six acres of land. Mines worked successfully.

Susquehanna Coal Company (The). Officers, Frederick Fraley, Pres.; Richard Wilkins, Sec. and Treas.; John V. Hutchingson, Charles W. Whaton, George Brooks, Charles Baker. Managers, Michael Ward, Thos. R. Patton. The mines of this company are located in Pennsylvania. Receipts during 1881 were $364,359.77; payments, $319,024.88.

Susquehanna Coal Company (The). Officers elected for 1882; George B. Roberts, Pres.; I. J. Wistar, Vice-Pres. Directors, George B. Roberts, I. J. Wistar, John B. Green, A. J. Cassatt, Strickland Kneass, Wistar Morris, N. P. Shortridge, J. N. Du Barry, Edmund Smith. Alfred Mordecai, Sec.; Thomas P. Hoaviland, Treas. The mines belonging to this company are located in Luzerne county, Pa. Preparing, shipping, exclusive of royalties, taxes, insurance, charge for exhaustion of land, in 1880, 1.20\frac{88}{100}$, and in 1881, $1.22; this increase of one per cent. per ton was due partly to an inconsiderable strike in August, and partly to a slight excess over last year in the improvement expenditures, which in this company are charged to cost of mining. Not only the financial advantage, but the practical policy of selling surface lots, on easy terms of payment, to employees, has produced the best results both from them and the company, and should be adhered to and encouraged by liberality in every way, and strikes, discontent, and difficulties invariably originate with those who possess no such stake in the vicinity, as was clearly illustrated during the difficulties which suspended production for a short period in August. Under head of casualties in company's report for 1881, it states that twelve men were killed during the year. Yield net profits, during 1881, $431,362.94; yield gross tons, 852,676.17; date of latest dividend, December, 1881; amount, $85,472; 2,341 persons employed, wages paid to all classes during year 1881, $881,446.

Towanda Coal Company (The). The property belonging to this company is located in Bradford county, Pa. Number of tons of coal per year, 228,471 tons.

Tennessee Coal and Railroad Company (The). This is known as the Sewanee Seam Coal. Semi-bituminous, easily broken. Located at Tracy City, Tennessee. Classed, the upper coal measures, main entry 1,922 feet above sea level.

Terragenta Iron and Coal Company (The). Officers, S. R. Early, Pres., New York city; J. W. Blake, Sup't. These works are located on Davis Creek, Kanawha, W. Va. The lands are north-west of the property of the Black Iron and Coal Company.

Tinsalia Coal and Iron Company. Gen. J. D. Imboden is Superintendent. The company's property, covering 60,000 acres of land, is located at Big-Stone-Gap coal basin, Wise county, Va. One bed yields a coke with less than ·03 per cent. of ash, and is exceptionally rich in carbon. The company has ample funds to carry out its plans.

Thompson's Anthracite Coal Mines, owned by L. R. & H. C. Thompson, I. Brown, and M. O. Rollins, are located on the south fork of Anthracite creek, three miles south of Irwin, Gunnison county, Col. The property covers 640 acres of land. The coal is pure anthracite; analysis giving ninety-two to ninety-three per cent. fixed carbon, and only three to four per cent. of ash; considered equal to the Lehigh of Pennsylvania; two distinct veins, of three to four feet each, are now opened in some dozen different places; permanent works at creek, where coal can be sloped down to a tunnel below. It is said that this is the only true anthracite of Colorado. The land over this coal is covered completely with good pine timber, of considerable value. The town of Irwin is supplied from these mines. The development of the property was commenced during the year 1879; and several thousand dollars have been spent in developing the mines, construction of roads, etc.

Tyrconnel Coal Mine (The). Owned and operated by the Newburg Orrel Coal Company. These mines are located in Tyrconnel, Taylor county, W. Va. The Pittsburg vein furnishes eight feet gas-coal; mine opened 1872; fifty men employed; production, 30,000 tons of coal per year; forwarded to Baltimore and to places on the B. & O. R. R.

Union Coal and Coke Company (The). The location of the coal works of this company is at Coalville, Butler county, Pa.; 260 men employed.

Union and Central Pacific Company's (The) mines are located at Alma, Wyoming. Alma is situated on the Union Pacific Railroad, seventy-five miles east of Ogden, is noted for its immense coal mines, operated by the Union and Central Pacific Companies. The former has several mines, which are worked to supply the road with coal, besides selling great quantities in Salt Lake, and other cities and towns. Most of the coal used on the Utah and Northern is taken from the Union Pacific mines, at Alma. The Central Pacific own and operate two mines there, which are opened up to such an extent that, when it is required, they can turn out 700 tons of coal per day, but the quantity mined is graduated by demand for operating the road and supplying the shops and offices with fuel. At present the output is 500 tons per day, which is taken to the various points along the road, as far as Truckee, California, and is used for making steam to operate six hundred miles of road. Two hundred and fifty men are employed in and around the two mines.

Union Coal Company (The). The mines belonging to this company are located at Cuba, Illinois. Air-shaft sixty-seven feet deep and runs through thirty-three feet of rock; was sunk from the bottom, up, and all done in twenty-eight days, by Daniel Burbridge & Son.

United Coal and Coke Company (The). Mines located in Pennsylvania; ninety feet deep; vein, eighty-five feet; three shifts of men at work.

Ursina Coal Company (The). Officers, J. M. Reid, Pres.; W. P. Thompson, Sec.; E. M. Read, Treas. Directors, J. F. Dravo, Dr. F. Le Mayne, W. K. Gillespie, E. H. Reid. Geo. B. Sterritt, W. M. Thompson, J. M. Reid, also owner of the company. The mines are located in Pennsylvania.

Victor Coal Company (The). Officers, D. W. Holt, Pres.; S. P. Griffiths, Treas.; O. Perry Jones, Sec. This company is operating in the Clearfield Mine, upper end of Campbell branch, two miles from Phillipsburg. John Walton is in charge of the mining affairs. Coal ranges from four to four feet ten inches in thickness.

Wadsworth Coal Company's Mine (The). Fred. Reese, Manager. The works of this company are located at Akron, Ohio; 100 men employed.

Wyoming Valley Coal Company (The). Directors, J. H. Foster, Stamford, Conn.; S. A. Caldwell, Philadelphia; Wm. S. Hillard, John C. Phelps, John S. Law, J. G. Snoyer, Wilkesbarre; Abram Nesbitt, Kingston, Luzerne county, Office, Wilkesbarre, Pa. The mines are located in Luzerne and Lackawana counties. Wyoming coal fields' head-quarters are located at Wilkesbarre, Pa. Capitalization, $1,200,000.

Walnut Hill and Primrose Coal Mines (The). The Walnut Hill and Primrose mines, also the Yellow Grove mines of Noblestown—the former located at Midway, Pa.—are operated by T. Burr Robbins, and under the supervision of Chas. McDonald. Mines in good condition; well worked; 150 men employed. Coal bed will average, 1881, about four and a half feet in thickness.

Watson Coal and Mining Company (The) is chartered under the laws of the State of Indiana. The officers are Thos. Watson, Pres., and M. D. Watson, Sec. and Treas. The annual meeting is held the second Tuesday in January. John Watson, Supt., with fifteen years' experience. The officers are at Brazil, Ind. The shafts are each down about ninety feet. Yield during 1881, 154,000 tons, the market being Chicago. The property has a total extent of 1,996 acres, including four mines known as the Etna, Gartsberrie, Garfield, and Cornwell. Organized October 1, 1871; developments commenced same time. Capitalization, $1,500,000, in 30,000 shares of $50 each.

Webster Coal Company (The). These works are located in Westmoreland county, Pa. Yearly number of tons, coal, 194,176.

West Fairmont and Marion Consolidation Coal Company (The). Mr. Davidson, Agent. Location of works at Fairmont, Marion county, W. Va. Working seven and a half feet of the nine feet vein; 50,000 to 75,000 tons of coal are mined yearly. Twenty-six men are employed. Marketed chiefly in Baltimore and New York.

Westmoreland Coal Company (The). Officers, Edward C. Biddle, Pres.; F. H. Jackson, Vice-Pres. and Treas. Directors, Messrs. Samuel Welch, Henry Windsor, P. P. Morris, Stephen H. Brooke, George A. Wood, Horace Magee, P. S. Hutchinson.

West Newton Coal Mines (The). Mr. W.H. Watt, Supervisor. The West Newton mines are located at West Newton, Pa., 1881. These mines have been idle for a long time; are now ready to go into operation, having been refitted with new engines, pumps, and other improved machinery.

Whitebread Coal Mining Company (The) is chartered under the laws of the State of Iowa. Officers, J. C. Osgood, Pres.; C. M. Schench, Vice-Pres.; J. S. Mauss, Sec.; T. J. Phillips, Supt. Transfer office, Ottumwa, Iowa; general office, Lincoln, Nebraska; branch, head and branch offices, Ottumwa, Iowa. The Cleveland Mine No. 1 and Cleveland Mine No. 2 belong to this company, Located in Whitebread township, Lucas township, Iowa. 1,366 acres owned by the company. Amount expended in developing property, April 1, 1882, $225,000; shaft, 250 feet; width of vein, five and a half feet. Three shafts, underground workings, 325 rooms, working. Date of organization, January 16, 1876; capitalization, 1,500 shares; par value, $100; non-assessable; yield (net) to April 1, 1882, 749,000 tons; yield (gross tons) during 1881, 205,627; assessments levied, none; bonded indebtedness, April 1, 1882, $40,000; stock indebtedness, $150,000; floating indebtedesss, $35,000. Stocks and bonds held principally in Burlington, Des Moines county, Iowa. Maximum capacity of production, April 1, 1882, 500,000 tons; output, weekly, 6,500 tons. Wages paid to all classes, April 1, 1882, $8,000. Principal market for the ore, Iowa and Nebraska.

Wilmington and Grove Coal Mines (The). J. M. Schuckers, Supt. This company owns the Warmington and the Grove mines. Mines good, yielding a fine quality of furnace coal. 100 men employed in the Warmington mine. The Grove shaft, in charge of David Naysmith, has about ninety men employed.

Windsor Coal Company (The). The mines are located a short distance from Foltz Slope, Mansellon City, Ohio. Thirty men employed under the same management; have had some difficulties; hope to get over them. They are operating a drift near Philadelphia, Tuscarawas county; forty to fifty men employed.

Youghiogheny River Coal Company (The). Wm. L. Scott, of Erie, President. The coal lands of this company are located in Alleghany and Westmoreland counties, Pa. There are nine shareholders. Capitalization, $1,000,000.

Young Coal Company (The). O. Young, General Manager; Joseph Collier, Mining Superintendent. This property is located one mile from Pigeon Run, Ohio, near Navarre Station; it is better known as the Camp Creek shaft. Coal averages about five feet, reached by a shaft 179 feet deep; about 165 men employed.

Youngstown Coke Company (The). This company's works are located in Fayette county, Pennsylvania. Yearly number of tons, 120,157.

Winifrede Coal Company (The). Has offices at 307 Walnut Street, Philadelphia, Pa. The incorporators are E. M. Davis. James Albright, Theodore Wright, H. H. Houston, A. R. Little, all of Philadelphia, Pa. James A. Wright, Treasurer. The property of the company is located near the Great Kanawha, between Field and Slaughter creeks, Virginia, having an area of 12,000 acres. Capitalization, $150,000.

COPPER.

Albany and Boston Mining Company is chartered under the laws of the State of Michigan. The company's works are located in Houghton county, Mich. Property owned includes thirty-three dwelling-houses, warehouses, and store, engine-house, hoisting and pumping engine, winding machinery, etc., etc. The prospects of the property are said to be rather disappointing. Company was organized and commenced developments in 1860. Worked on tribute since 1869, and that only limited.

Franklin Mining Company (The) is chartered under the laws of the State of Michigan. Capt. Thos. Dennis is Superintendent. The company's works are located in Houghton county, Mich. They own 850 acres of land. They have machinery plant, buildings, etc., and the surface improvements are good. It is estimated that the cost of manipulating the ore, per ton, is about $2.34. The mine was worked on tribute for a few years prior to 1874, when, under a new management, prosecuting a vigorous policy, with the effect of enhancing the value of the stock sixfold. Have not sunk deep enough to give it a fair trial. Current value of mine is $715,000. Date of organization, April 23, 1857; number of shares, 54,000. Yield to January 1, 1881, 15,052 tons; yield during 1881, $488,722.69; yield during 1880 to December 1, 2,876,519 pounds of mineral, yielding $82,767. Product of refined copper in 1881, 1,338 tons. Total amount of dividends paid, $240,000; date of latest dividend, June 24, 1882; date of first assessment, 1857, amount per share, fifty cents. Stock quoted, May 1, 1882, $11.

Lake Superior Mining Company. D. L. Demmon, Sec. and Treas.; Superintendent, S. B. Harris, Greenland Mich. Office, Boston, Mass. The company's property is located at Ontonagon, Mich., covering 895 acres. They have horse-whims on their property and a few dwelling-houses. The mine was worked on tribute for some time subsequent to 1874. The company was organized in 1859; yield to January 1, 1882, seven tons, 821 pounds; total amount of assessments levied, $40,000.

Schoolcraft Mining Company is chartered under the laws of the State of Michigan. The officers are S. L. Smith, Pres.; Jessie Hoyt, Sec. and Treas.; W. Harris is Superintendent. Office, New York. The company's property is located in Houghton county, Mich., and includes two hoisting engines, and pumping engines, and one stamp-mill, with thirty-two Gates' stamps, all intact. Developments of the property were commenced during the year 1869; prospects of the property are reported as very promising. Date of organization, 1863; capitalization, $1,000,000; par value per share, $25.

Tecumseh Mining Company was organized March, 1880; Chas. H. Palmer is the Superintendent. The company's property, covering 480 acres of land, is located in Houghton county, Mich. The property includes dwelling-houses, and a forty-horse-power engine for pumping and hoisting. The property is crossed by the Calumet Conglomerate and the Osceola Amygdaloid, and other important lodes.

Adventure Mining Company (The), chartered under the laws of the State of Michigan. The officers are Thos. F. Mason, Pres.; W. Hart Smith, Sec. and Treas. Head office is at Exchange Place, New York city. S. B. Harris, Supt.; residence, Greenland, Mich. The mines are located at Ontonagon county, Mich. The company was organized in the year 1870; capitalization, 1,000 shares; par value, $20. The mine has yielded to date, 1881, $1,368.75; during same year, three tons, 1,500 pounds. This mine is worked on the tribute system. Amount of property in acres, 480.

Allouez Mining Company is chartered under the laws of the State of Michigan. Emmerson Coleman, Pres., and W. C. Stewart, Sec. and Treas.; Fred. Smith is Supt. Branch office, No. 29 Drexel Building, 25 Wall Street, New York. The company's works are located in Keweenaw county Mich., covering an area of 2,000 acres. Ore found is copperiferous, assaying $767 per ton. The lode may be described as conglomerate. Company owns mining plant, buildings, etc. Burleigh drills in use, also stamp-mill. Estimated total value, $500,000; shaft 1,060 feet down; length of main lode, 3,000 feet. Date of organization, September, 1880; capitalization, $2,000,000; par value per share, $25; yield during 1881, $268,823.67; 736 tons after smelting). Date of first assessment, September, 1880; $1 per share; stock quoted July, 1882, $2.25.

Amygdaloid Mining Company (The) owns a mining property of the extent of 1,760 acres, located in Keweenaw county, Mich. The ore yields 72½ per cent. of ingot copper. The character of the mine is described as true fissure, there being three veins. The main mine is in what is called the Drexel, south of the Greenstone. The mining plant and other property comprises a large number of miners' houses, thirty-two stamp-mill, (Gates' pattern,) inclined railroad, pumping and winding machinery and engine for operating the same, offices, rock-house, and six rock-breakers. In June, 1863, the surface stock was nearly all destroyed by fire, including all the tenements. By November following, forty-one new houses had been constructed through the untiring energy of the Agent, Mr. A. C. Davis. Again, in 1864, the company suffered another blow in the bursting of two boilers, causing great inconvenience and delay at a time when copper was at its maximum price. Organized, July 1860; capital, $500,000; shares each, $25. Latest assessment was levied in 1872; amount per share, fifty cents.

Ash Bed Mining Company (The) is chartered under the laws of the State of Michigan. The officers are W. Hunt, Pres.; W. C. Coffin, Sec. and Treas. M. A. Delano, Agent; Capt. Petherick, Superintendent. The offices are at Boston, Mass. The company owns two mines, the Hill and the Copper Falls mine, located in Keweenaw county, Mich., covering an extent of 1,200 acres. There is a stamp-mill attached to the mine, but the ore prospects have not yet been realized. Date of organization, 1861. In 1881 the yield of pure metal was six tons, 1,984 pounds, of the value of $2,552.08.

Atlantic Copper Mining Company (The), of which Jos. E. Gray is Pres., and J. M. Stanton Sec. and Treas., and Capt. W. Tonkin, Superintendent, has its offices at 76 Wall Street, New York. The property is located in the Lake Superior district, Houghton county, Mich. The ore is a native copper, yielding seventy-two per cent. metal. The property, in mining plant, consists of engines for hoisting and pumping, boilers, shaft-house, R. R. locomotive, compressor, and five drills, 113 dwelling-houses. Depth of shaft at end of 1880, about 1,000 feet. Developments were commenced in 1872. The mining plant is first-class and adapted for carrying on operations to an almost unlimited extent. A saving of $7 per fathom is effected by the use of air drills. There are 5,200 feet of adits, levels, etc. The cost of ingot copper produced and marketed by the Atlantic mine was as follows in the five years undermentioned:

Year.	*Cost of ingot copper per lb.*
1875	19.92 cents.
1876	18.11 "
1877	15.74 "
1878	15.51 "
1879	12.20 "
Average cost	16.29 cents.

Organized; capital, $1,000,000; shares each, $25; yield to January, 1881, 9,084 tons; yield (gross) during 1881, $461,361.65; yield net during 1881, 1,264 tons; dividends, total paid to June, 1882, $220,090; date of last dividend, February 1, 1882; amount per share, $2; total assessment levied, January, 1881, $280,000; first assessment levied, February, 1873; amount per share, $2; date of latest assessment, April, 1882, ten cents per share. In 1880, the cost of different operations was as follows: stamping, washing, etc., 87.96 cents per ton of rock; sinking shaft, $38 per foot; sinking winzes, $19.78 per foot; drifting, $19.09 per foot; stoping, $22.28 per fathom.

Aztec Copper Company (The). A. A. Page, Sec. and Treas. of the company. Principal office, Boston, Mass. Capt. John Chynoweth, Superintendent. Mines owned are located in Ontonagon county, Mich. Amount of property (in acres), 1,208, in addition to mining location. Quality, etc., of ore of irregular veins, and difficult to trace. Developments were commenced 1852. Prospects of the company are very fair. Were organized in 1880. Total amount of assessments levied, $150,000: capitalization, $1,000,000; yield net to January 1, 1881, 351 tons, 734 pounds; yield during 1881, $1,619.50; yield (net) refined copper, four and two-fifths tons.

Bisbee Copper Mining and Smelting Company (The). Officers elected June 14, 1881: Directors, D. H. Brisbee, S. L. Milliken, Secretary and Treasurer; for agent, Isaac Coombs, Auditor of Accounts; W. E. Grindle and G. F. Wood, Belfast, Me. Principal office, Belfast, Me. Character of mines, extension of Douglass lode.

Black Bear Copper Mining Company of Chicago (The). Names of officers: W. L. Barnum, President; Anson Gorton, Vice-President; Amos T. Hall, Secretary and General Manager; F. E. Morse, Assistant Secretary; George W. Huddleston. Directors, W. L. Barnum, H. N. Hibbard, Amos T. Hall, Anson Gorton, John R. Hoxie, and F. E. Morse. W. F. Witherell, Superintendent. Names of mines owned by the company: Youngstown, Excellent, Boss, and Black Bear; all full claims. Location, Ash Cañon, Huachuca, Mountains, Cachise county, Arizona. Date of organization, August 10, 1881; capitalization, $1,000,000; shares, 100,000; par value, $10. Non-assessable. Stock full paid.

Bonanza Development Company's (The) works are located in Colorado. This company, whose property is a portion of the Santa Reita grant (for half of which $1,000,000 has recently been offered), has paid since its organization four cash dividends aggregating $225,000, and, according to its last statement issued September 1, 1881, it has $633,186 in cash assets on hand. It owns, besides, several large tracts of land and one-half of the capital stock of the Santa Reita Copper and Iron Company, which is now producing and shipping from seventy-five to 100 tons of ingot copper per month. Date of latest dividend, January 3, 1882.

Boroa Copper Mining Company is chartered under the laws of the State of New York. The mines owned by this company are the Boroa, Chausun, Sunrise, and Sunset, located in Arizona. These mines improve as developments progress. Work has been steadily carried on, and the foreman reports the mines in condition to take out seventy tons of ore per day. Assays average twenty-three per cent. of copper. Capitalization, $1,000,000; par value per share, ten dollars; non-assessable; full paid.

Boston Copper Mining Company is chartered under the laws of the State of Massachusetts. Edward B. Earle, President; George D. Eldridge, Treasurer. Office, 79 Milk Street, Boston, Mass. This property is thoroughly developed, the dead work is done, and it is all ready to be put on a dividend paying basis. The value of the mine has been proved, and with the low capitalization and small number of shares it takes its place as an investment rather than a speculative stock. The ore assays seventeen and a half to twenty per cent. copper. Capitalization, $50,000; par value per share, ten dollars.

Brooksville Copper Mining Company. The officers are M. G. Palmer, President. Directors, M. G. Palmer, George Burnham, Jr., J. S. Winslow, W. H. Sanborn, and G. F. Gould. Secretary and Treasurer, G. A. Gould. Office, 85 Exchange Street, Portland, Maine. Capitalization, $500,000; par value per share, five dollars; cash in treasury March, 1881, $1,000; shares in treasury March, 1881, 38,000.

Calumet and Hecla Consolidated Mining Company (The) is chartered under the laws of the State of Michigan. The officers are Alex. Agazziz, Pres.; Chas. W. Seabury, Sec. and Treas.; J. N. Wright, Sup't. The head offices are at 67 Milk Street, Boston. The company owns extensive properties in the Lake Superior district, Houghton county, Mich. A parcel of 120 acres has recently been purchased at cost of $1,250,000. It is expected this will prolong the life of the mine for many years. It is estimated that in about forty of these acres there are from five to twenty millions' worth of copper. The copper is nearly pure, the mixture being a species of rock of a reddish color and very hard. The main vein is a conglomerate from eight to eighteen feet thick, dipping into the earth at an angle of about 38°. It runs north-east and south-west, extending the entire length of the Keweenaw Peninsula, and is supposed to be the same vein that passes under Lake Superior and crops out at Isle Royal seventy miles distant. The mining plant and surface improvements are the finest in the world. One of the engines is 4,700 horse-power. The stamp-mills are lighted by electricity. There are eight shafts of an aggregate depth of 2,650 feet. There are twenty-five miles of drifts. The main lode on which the company depends for its supply of ore is 1,300 feet. Developments were originally commenced in 1867. The maximum yearly capacity of production is 31,595,300 pounds of ore. The current value of the mine is about $24,000,000. By new and improved processes of smelting, the company is able to profitably concentrate the tailings. Date of organization or consolidation of the Calumet with the Hecla company, May, 1871; capitalization, $2,500,000; shares each, $25; yield of refined copper to January 1, 1881, 126,558; yield during 1881, 15,680 tons refined copper = 5,723,342; amount of dividend paid to July, 1882, $21,350,000; date of first dividend, 1869 (Dec.); amount of same, $5 per share, paid regularly every quarter; date of latest dividend, May 15, 1882; amount of same, $5 per share; total assessments levied, $1,200,000; amount per share of last assessment, fifteen cents; bonded and other indebtedness, none.

Calumet Belt Mining Company (The) have their works located in Keweenaw county, Mich., covering an area of forty acres. Red and blue ore are found. An amygdaloid and conglomerate belt extends two and one-half miles on the property. No work has been done yet. Capital stock, $250,000.

Carp Lake Mining Company (The) is chartered under the laws of the State of Michigan. Mines are located in Ontonagon county, Mich. Character of the mines; copper occurs in fine particles, disseminated in a belt of altered sandstone, 500 feet thick, this being underlaid by a belt of amygdaloid. Property owned, log huts, machinery for stamp-mill. Dimensions of workings: levels, 250 and forty feet. Operations suspended in 1881. Efforts now being made by Mr. A. Meads to revive an interest in the locality with a view to the resumption of mining operations. Yield net to January, 151,135 tons.

Central Copper Mining Company (The) is chartered under the laws of the State of Michigan. The officers are Dr. C. G. Hussey, Pres.; Waterman Palmer, Sec. and Treas. Directors, S. W. Hill, John Slawson, A. A. Bennett, John Robingson, and Waterman Palmer. Mr. A. A. Bennett is Superintendent. The offices of the company, formerly at Eagle Harbor and Pittsburg, are now at New York. The properties of the company are located in Keweenaw county, Mich. The ore yields seventy-two per cent. of pure copper, and is found in masses. The plant and other fixtures of the mine consist of several miners' houses, twenty of them being new. New pumping and hoisting machinery and engine, rock-breakers and stamping machinery. The aggregate depth of shaft is about 4,180 feet, of adits 22,979 feet. The total length of lode on which the company depends for its supply of ore is 5,280 feet. Developments were commenced in 1855, since which time there has been paid in developments and working expenses, the sum of $6,932,317.25, to Jan. 1, 1881. Up to July, 1855, this was the first instance of a mine yielding a surplus in the first year of its existence. The surface improvements during this year consisted of three houses and horse-whim. The capital was, therefore, not absorbed in expenditure on machinery and improvements. The deposit has subsequently proved to be one of the richest of the Lake Superior district. The cost of smelting the ore in Detroit is, or was, about $18.32 per ton. The general expenditure to the end of December, 1880, was $2,958,132.22; total sales of copper to same date, $3,904,496.51; average cost of sinking shafts and winzes was $24.86 per linear fathom; average cost of drifting, $13.16 per linear fathom; average cost of stoping, $18.71 per cubic fathom. The Central is one of our most valuable mines, and produces its copper at a very low cost, as will be seen by the following official figures:

Year.	*Cost of Ingot per lb.*
1874	14.82 cents.
1875	15.81 "
1876	12.95 "
1877	13.19 "
1878	11.23 "
1879	11.16 "
1880	11.85 "

Average yield in mineral per cubic fathom, 614 pounds = 473 refined copper; total cost per ton for breaking and tramming to mill, .14$\frac{86}{100}$ cents; total cost per ton for stamping and washing .98$\frac{34}{100}$ cents. Organized, November, 1854; capitalization, 20,000 shares of $25 each; yield to January 1, 1881, 14,510 tons refined copper; yield during 1881, 709 tons refined copper; value of product for 1881, $258,869.86; total dividend paid to February 1, 1882, $1,660,000; date of latest dividend, February, 1882; amount of same $50,000, or $2.50 per share; total of assessments levied, $100,000, to September, 1861; date of latest assessment, September 10, 1861; amount, of same, sixty-five cents per share; stock quoted July 1, 1882, $30 per share; (average) wages paid to all classes of labor per week, $13.18.

Cliff Copper Company (The) is chartered under the laws of Michigan. James Wilson, Supt. Location of mines, Keweenaw county, Mich. Amount of property in acres, 1,000. Dimensions of workings are, by tunnel, 135 feet; length of levels, 1,700 feet. Date of commencing developments, 1859; date of organization, 1858. Yield (net) to January 1, 1882, nil; yield during 1881, $14,487.21; yield tons during 1881, 39 tons, 1,382 pounds.

Conglomerate Mining Company is chartered under the laws of the State of Michigan. The officers are Henry C. Davis, Pres.; Edward Hoopes, Pres. pro tem.; Chas. M. Foulke, Treas.; Geo. H. Lewars, Sec. Directors, Chas. W. Trotter, Edward Hoopes, Samuel Simea, Edward Lewis, W. P. Thomas, Chas. M. Foulke, Henry C. Davis, and Jos. E. Gillingham. Main office, 205 Walnut Place, Philadelphia; mine office, Delaware Mine P. O., Keweenaw county, Mich. The company's property is located in Keweenaw county, Mich. They own 19,000 acres of land. There is an amygdaloid bed running east and west through the mines, yielding one per cent. ore. The company own a new compressor-house, built of stone, 150 by 50 feet, costing, with its equipment, some $63,000. $21,000 have been expended in erecting dwelling-houses, $27,735 in fitting up the general running plant, and $19,644 for stamp-mill additions. Tramways connect the rock-house with the several shafts, and the cars are propelled by a small locomotive, which facilitates the transmission of rock from the mine to the mill. The company have in their compressor-house a set of Babcock and Wilcox boilers of 320 horse-power, and have room left for another set of like power. They have also a very spacious and convenient store, among other improvements. The shafts number six, though at present but four are actively worked. They are numbered from the west, and have been sunk respectively as follows: No. 1, west of the northwest vein, 330 feet; No. 2, on vein, 740 feet; No. 3, east of northwest vein, 515 feet; No. 4, east of northwest vein, 270 feet; No. 5, east of northwest vein, 345 feet; No. 6, east of northwest vein, 270 feet; total sinking, 2,470 feet. Length of the main lode, 3,500 feet. The levels have stretched themselves out with marvelous rapidity, until they offer the underground traveller a promenade of nearly a million avenues, twelve feet wide by eight feet in height. Adit level, 2,000 feet; ten fathom level, 893 feet; twenty fathom level, 880 feet; thirty fathom level, 830 feet; forty fathom level, seventy feet. There are numerous winzes in the neighborhood of the No. 2 shaft, on the ten, twenty, and thirty fathom levels. Development of the property was commenced January, 1881. Amount expended in developing property to April 1, 1881, nearly $2,000,000. The stoping field is a block of ground 141 fathoms in length, seventy-two fathoms in height, and (as regards the copper-bearing portion of the belt) about two fathoms in thickness, which gives 20,104 cubic fathoms. 250 men are employed, 200 being miners. At time of writing, we learn that conglomerate has been struck on the fifth level, better than any above, showing that at 1,000 feet depth the vein is improving in strength. Date of organization, October, 1880; capitalization paid in, April 15, 1881, $2,-500,000. Par value per share, $25. Yield during 1881, $70,461.60; yield refined copper 1881, 193 tons, 91 pounds. Total amount of assessments levied, $1,500,000. Whole number of shares (100,000) have been issued. 50,000 shares have $6 paid on each, and liable for $19 more. The reserve in the treasury is the amount per share that can be called on the 50,000 shares assessable stock, or $19 on 50,000 shares equals $950,000.

Copper Belt Mining Company (The). Location of mines, Marysville, Puck county, Utah. Date of commencing developments, 1881; date of organization, October 1, 1881; capitalization, 100,000 shares. Stock and bonds held principally in Connecticut.

Copper Falls Company is chartered under the laws of the State of Michigan. John T. Heard, Pres.; Horatio Bigelow, Sec. Office, Boston, Mass. W. P. Merick is the Superintendent. This company are the owners of the Hill and Copper Falls Mines, located in Keweenaw county, Mich. They own 4,261.5 acres of land. The ore is mixed with considerable silver, and assays twenty-one per cent. per ton of rock. The character of the mines may be described as fissure, chiefly stamp rock. The company have twenty dwelling-houses, two boarding-houses, offices, shops, engine-house, boiler-house, saw-mill, washers, and slime tables, three locomotive boilers, and machine-shop with requisite machinery. Length of adits—that is, levels—5,300 feet. The prospects of the property are favorable. Cost of mining and milling of rock per ton, $3.64. Output weekly, June, 1882, 1,750 tons. In 1874 several men were killed by a large portion of hanging wall. After that time the product declined. Date of organization, 1845; capitalization, $2,000,000; par value per share, $50. Yield to January 1, 1881, 6,754 tons, 1,157 pounds; yield refined copper, January 1, 1881, 334 tons, 1,121 pounds. Number of dividends paid to August, 1871, three; total amount of same, $100,000; date of latest dividend, August, 1871. Total amount of assessments levied, $620,000; date of latest assessment, October 4, 1881.

Copper Harbor Mining Company (The) (formerly the French Copper Mining Company) are the owners of the Agate Harbor, Clark, Montreal, and Bell mines, located in Keweenaw county, Mich. Amount of property, 2,500 acres. The character of the ore is black oxide, and is found in masses. The company have a stamp-mill, and hoisting and pumping engines at the works. Date of organization, May 14, 1858.

Copper King Mining Company (The). Incorporators are Milo A. Smith, Thomas L. Drake, Sam'l S. Griswold. The mines are located in Park county, Col. Capitalization, $2,000,000.

Copper Queen Mining Company is chartered under the laws of the State of New York. The officers are A. A. Hayes, Jr., Pres.; Louis Zeckendorf, Sec. and Treas. Trustees, C. C. Martin and W. H. Martin. Offices at 34 and 36 Thomas Street, New York. Transfer books close June 28 and open July 3. This company owns the famous Copper Queen mine, located at Bisbee, Ariz. This mine was located December 13, 1878, by G. A. Ealham and M. Herring. Subsequently G. W. Anschultz, G. Kleim, G. W. Atkins, and D. B. Rea became interested in the property; and these parties bonded the mine to E. Reilly for $18,000. The transaction was perfected September 24, 1879, by the sale of the Copper Queen to W. H. Martin & Co, and work was begun in April, 1880. The erection of a thirty-ton smelter was begun on July 1 of that year; on September 11 the first bullion was shipped; during the month 160,829 pounds were turned out by the smelter; since then the shipment has been as follows: October, 1880, 335,408 pounds; November, 316,000 pounds; December, 353,340 pounds; January, 1881, 308,118 pounds; February, 316,000 pounds; March, 305,972 pounds. For each fourteen car-loads of coke there have been produced from the mines twenty car-loads of copper. The coke is made from English coal, and laid down at San Francisco at a cost of $27 per ton. The gross average price received for the copper has been eighteen and one-half cents per pound, profit, over and above all expenses. April 1, 1882, the company smelted 17,651 tons of ore, which yielded 5,753,235 pounds of black copper, which, refined to ninety-six and one-half per cent., produced 5,551,871 pounds of refined copper, the value of which, in New York, was $1,020,859.72. During March, 1882, the mine produced 694,181 pounds; and the first two days of April yielded 82,000 pounds. The current value of the mine is $1,500,000, and was purchased by a New York company for $1,250,000. Amount expended in developing property to April 30, 1882, $532,733.33. Property consists of two water-jacket furnaces, capable of smelting from eighty to ninety tons of ore per day. Extensive improvements have been made in the way of new buildings, steam-hoisting and other machinery; flow of water is now from 10,000 to 12,000 gallons; while the capacity of the Cameron pump, purchased recently, is capable of handling 100,000 gallons. The Superintendent estimates the amount of ore now in sight above second level, at 63,000 tons. Capitalization, $2,500,000; par value per share, $10; total amount of dividends paid, $400,000; date of latest dividend, July 1, 1882, forty cents per share; yield (refined copper) for fiscal year ending April 20, 1882, $1,020,859.72; stock quoted June 17, 1882, $6 per share.

Copper Prince Mining Company is chartered under the laws of the State of New York. The officers are Hon. A. H. Cragin, Pres.; A. H. Ward, Vice-Pres.; C. J. Brushnell, Sec. and Treas. Office, Room 64, 35 Broadway, New York. The company's works are located at Digby Gut, Nova Scotia. They own mining plant, and have buildings in course of erection; specimen of ore taken from the surface shows great richness in virgin copper; stock and bonds held principally in New York.

Copper King Mining Company (The). Pres., Hiram Preble, of Bangor; Treas., J. H. Smith, of Bangor. One of the chief owners is Mr. Isaac Stevens, of Bangor, where the offices are also located. The mines are located at Clifton, Graham county, Ariz. Date of organization, March 11, 1882; capitalization, $500,000; stock held principally in Bangor, Me.

Copperopolis Mining Company (The). Officers, Geo. E. Harrington, Pres.; S. L. Symonds, Treas.; W. Oscar Arnold, Sec. Directors, Geo. E. Harrington, Geo. West, Francis Tuckerman; Salem, P. Muller, L. W. Hodgkins; Ellsworth, John Shornbar. Head office, 4 Sear's Building, Boston, Mass. Character of ore, high grade copper, thirty per cent. copper; prospects of property, will soon be equipped with engines, boilers; depth of shaft, 110 feet down. Capitalization, $500,000; shares, 200,000; par value, $2.50; stock quoted March 1, 1882, four to five cents; stock quoted July 1, 1882, 003 asked.

Copper Mountain Mining Company (The). Officers, W. A. Healey, Pres.; I. T. Stogund, E. B. Brown, Sec.; M. S. Taft, Supt. Location of mines, Big Bug district. The mine of this company is showing up well, considerable quantities of high grade oxides and carbonates of copper having been developed. Date of organization, 1882; capitalization, $300,000.

Crescent Copper Mining Company (The), of which George W. Smiley is Pres., is located in Del Norte county, Cal. The ore consists of green carbonates. The mine consists of two claims. each 1,500 feet in length by 600 feet in width. The developments consist of one shaft thirty feet deep; one open cut, twenty feet on the ledge. and twenty-eight feet northerly on the ledge; one shaft 100 feet deep, with level from the foot. 100 feet north on the ledge; one shaft forty feet deep, with level running thirty feet north on the ledge; and five prospect shafts from five to ten feet deep. With the ore in sight, and improvements in progress, 1,000 tons of ore can be extracted in sixty days, when smelters will be ready. Capitalization, $2,000,000, in shares of $10 each; 200,000 shares, non-assessable.

Dominion Mining Company. The officers are James Richards, Pres.; F. F. Hale. Sec.; A. T. Parker, Treas. Directors, James Richards. H. S. Bacon, A. T. Parker, T. V. Wright. This company was organized at Portland, June 9, 1881. Capitalization, $500,000.

Douglass Mining Company (The), of which Mr. J. H. Foster is Supt., is located in Houghton county, Mich. Organized in 1863. Net yield in 1868, eighty-five tons refined copper. Stock quoted May, 1882, one-half cent; June, three-fourths cent per share.

Ely Copper Mine (The) is located at Vershire, Vt. Mr. Smith Ely has control, holding 96,000 of the 100,000 shares of the company. The quality of the ore is three and a half per cent., and cobbed up to seven per cent. It assays ninety-five per cent. to the ton. The ore-body, 300 feet in length, varies from five feet massive to twenty-five feet disseminated. Depth of shaft, 3,000 feet. The company have a large engine of 400 horse-power, to do hoisting, about 100 houses, and three new boilers, Jarvis setting. They have twelve furnaces running, and employ 700 men. The Superintendent is Wm. Long. Mining and milling can be done under $6 per ton. Maximum yearly capacity of production. 3,000,000 pounds copper ore. Output, weekly, to January, 1882, 1,500 tons of ore. About thirty-seven and a half tons ingots.

Evergreen Bluff Mining Company (The) is chartered under the laws of the State of Michigan. F. W. Capon, Sec. and Treas.; L. Collins, Supt. Principal office was originally Detroit, but lately removed to New York. The mines are in Ontonagon county, Mich. The ore assays about seventy per cent. Property owned by the company consists of five engines, all in place, house (occupied), working plant, machinery, etc. Developments were commenced 1853. Organized in the same year; worked since 1870 on tribute at seven cents per pound. Yield (net) to January 1, 1881, was 675 tons and 206 pounds; during 1881, $176.66. Yield refined copper during 1881. 968 pounds. Stock of this company held in Michigan, Detroit, and Pontiac.

Falmouth Copper Mining Company (The). The officers are James N. Winslow, Pres.; Wm. S. Thomas, Treas; George H. Blake, Sec. The mines being worked by this company are held on lease of ninety-nine years. They are located at Falmouth, near the city of Portland, Me. Two assays of the ore gave respectively five and thirty-three per cent. copper. The company own steam-pumping and hoisting apparatus.

Flint Steel Mining Company. Walter Ferguson is Sec. and Treas.; Stephen Martin, Agent, Greenland, Mich. Superintendent, Dr. McKinnie. Office, 35 Sear's Building, Boston, Mass. The company's mines are the Flint Steel and the Caledonia, located in Ontonagon county, Mich. The company have twenty-five houses on their property. The prospects of the property are very moderate. The mines were leased to Captain Martin in 1873, and worked only at intervals. Date of organization, 1871; yield to January 1, 1881, 413 tons, 318 pounds; yield during 1881, $985.86; yield, refined copper, during 1881, two tons, 400 pounds.

Fulton Mining Company (The) have their works located in Keweenaw county, Mich. They run 3,000 acres of land. The ore found yields considerable silver. Property is crossed by kearsage, conglomerate, and kearsage amygdaloid. The ore is found in masses.

Globe Copper Company have their works located at Globe, Arizona.

Grand Portage Mining Company (The) is chartered under the laws of the State of Michigan. Peter Ruffe, Esq., is Secretary and Treasurer; the Mining Superintendent being M. L. Tallon, who has had fourteen years' experience. The property of the company is located in Houghton county. Mich., and has an area of 800 acres. The ore is found in masses, the usual form of the copper deposits of Michigan. There are twenty-seven houses on the property. The shaft is 350 feet deep, and the adits extend about 350 feet. Prospects of the mine at present are highly favorable. Date of organization, 1860; capitalization, $500,000. Yield during 1881, $4,793; yield during 1881, thirteen tons and 264 pounds.

Eagle Harbor Mining Company is chartered under the laws of the State of Michigan. W. Hart Smith, Secretary and Treasurer. Office, No. 4 Exchange Court, New York. The mines owned are the Waterbury, Eagle Harbor, and Connecticut, located in Keweenaw county, Mich. The company owns 7,000 acres of land. The property is worked partly on tribute. The character of the mines is described as fissure veins.

Gregory Copper Mining Company. The Directors are H. Gregory, Jr., Pres.; Maynard Sumner, S. M. Bird, A. T. Ames, Geo. Gregory, J. Fred. Merrill, Henry Spaulding, H. T. Beveridge, Treas. Office, Rockland, Maine. The company's property is located at Gardner Mountain, N. H. They have a capitalization of $500,000, in 100,000 shares, at a par value of $5 each.

H. A. Lee Mining Company (The). The officers are Dr. Horn, Pres.; W. M. Farnan, Vice-Pres. and Supt.; Dr. Lee, Treas.; H. Lee, Sec. The company owns twelve claims, Domingo, on Poverty Gulch, Col., the Castle Group of nine, on Brush creek, the Sunnyside, on Locolli Mountain, and one on Rock creek. The character of the ore is gray copper, sulphuret and bromide. Mill run of 400 pounds, gave 184 ounces to the ton. The Domingo is opened by a fifty-foot tunnel, exposing a six-foot vein between walls, with an eighteen-inch pay streak. Bonded indebtedness, January 1, 1882, $21,000. Stock quoted, July 1, 1882, twenty-seven and a half cents. Stock and bonds are held principally in Colorado and Illinois.

Hancock Mining Company (The) is chartered under the laws of the State of Michigan. The officers are Ed. Ryan, Pres., and August Mette, Sec. and Treas. The offices are at Hancock, Mich. The property of the company is located in Houghton county, Mich. The deposit is amygdaloid, about four feet wide, yielding about two per cent. copper. The shaft is 610 feet deep. It is reported (July, 1882) that good ore has been struck. The company was organized about the end of 1879. Capitalization, $100,000, in 40,000 shares of $2.50 each. Yield to January, 1881, 1,403 tons of refined copper: yield during 1881, 285 tons 1,897 pounds of refined copper, of the value of $104,371.20. Stock held principally in Hancock, Chicago, Milwaukee, and Cleveland. Wages paid to all classes of labor per week, $10.75. Sinking costs about $23 per foot; stoping costs from $6 to $12 per fathom.

Harrisburg Copper Mining and Smelting Company is chartered under the laws of the State of Pennsylvania. Geo. R. Hursch, Pres.; H. C. Chisholm, Sec. Office, No. 26 Third Street, Harrisburg, Pa. The company own 3,000 acres of land, most of which is located on the southeast side of South Mountain, on the mineral belt running through southern Pennsylvania, Indiana, and Virginia. The company have a capitalization of $100,000, in shares at a par value of $1 each. Basis, non-assessable; full paid.

Hilton Mining Company. Location of property, Ontonagon county, Mich. The ore assays 72 per cent. copper per ton. The veins are composed of epidote and quartz, bearing but little copper. The company owns hoisting apparatus consisting of horse-whim or man-power. They have several houses, change house, and smith's shop; there are two shafts 100 feet deep; levels, 350 feet. Date of commencing developments, 1863; amount expended in developing property to January 1, 1881, $45,000. This company's property has been worked at intervals on tribute, on a small scale after 1865, when work on the company's account was definitely suspended. There is no water on property for stamping purposes. Date of organization, 1863: yield to January 1, 1882, twenty-one tons, 1,819 pounds; total amount of assessments levied, $50,000.

Huron Copper Company is chartered under the laws of the State of Michigan. D. L. Demmon is Sec. and Treas.; Capt. Johnson Vivian is Supt. Office, Boston, Mass. The company's property is located on the south side of Portage Lake, Houghton county, Mich. The prospects of the property are favorable under vigorous and intelligent management. There are about eighty men at work. Date of organization, 1880; capitalization, $1,000,000; par value per share, $25; yield to January 1, 1881, 3,847 tons, 431 pounds. Yield during 1881, $46,448.98; yield refined copper, 1881, 127 tons, 575 pounds. Stock quoted July 1, 1882, $1.73.

Isle Royal Mining Company (The) is chartered under the laws of the State of Michigan. F. W. Chapin is Sec. and Treas.; Graham Pope, of Houghton. is Supt. The offices are at New York. The property is located in Houghton county, Mich., and comprises an area of 501½ acres. The ore is an almost pure metal of 80 per cent. The shaft is 800 feet deep. Length of adits, 3,000 feet. In January last, the property, mining plant, etc., was reported in somewhat ruinous condition. Developments were commenced in 1852. The net yield to January 1, 1881, is 4,538 tons; yield during 1880, 45,860 pounds ingot copper; during 1881, twenty-three tons, 1,308 pounds; refined copper, $1,500,000 has been levied for assessments.

Knowlton Mining Company (The) is chartered under the laws of the State of Michigan. Capt. Dunn, Supt. The property of the company, consisting of 600 acres, is located in Ontonagon county, Mich. The ore is an epidote quartz, calcic chloride, etc., assaying 62 per cent. The length of the main lode on which the company depends for its supply of ore is 1,100 feet. Since 1867 the mine has been worked on tribute, producing from three to forty-five tons per year. The company was organized in 1853. Developments commenced 1862. Yield (net) to January, 1881. 263 tons, 973 pounds.

Linden Mountain Mining Company. The officers are M. H. Hegarty, Pres.: office, 8 and 10 Pratt Street, New York. J. W. Kalley, Treas.; office, 211 Montague Street, Brooklyn, N. Y. The company's property is located in Colorado. The company's mine is rich in gray copper, reported to be among the richest mines in San Juan district, Hensdale county, Col. Capitalization, $1,000,000; par value per share, $5.

Schmidt Madison Mining Company (The) has its offices in Boston, Mass. Chas. H. Ward is Sec. and Treas.; Mr. Jos. Snell is now Supt. The property of the company is located in Keweenaw county, Mich. The mine is described as fissure, the working being on three veins. This mine seems to have been worked in an unskillful manner, but will probably be worked more cautiously in future. Organized, 1859; capitalization, $1,000,000, in 40,000 shares, of $25 each; yield of refined copper during 1881, 1,534 pounds; value, $279.95. Six assessments levied. First assessment levied March, 1863, $1 per share.

Megantic Consolidated Copper Mining Company of Canada has property in the township of Leeds, Megantic county, Province of Quebec, covering an extent of 4,000 acres. Mr. W. G. Bunham is Supt. The mine furnishes talcoid, mica slates, lenticular mass, and interstratified beds of copper ore. The mining plant and other property comprises buildings and machinery of the most improved construction; 150 horse-power engine, main shaft house, smith and machinery shop, saw-mill and carpenter shop, three large store-houses, barn and two stables, harness and tool house, twelve tenement houses, and one boarding house, store and office. Total cost of same, $100,000. Capitalization, $3,000,000, in 300,000 shares of $10 each.

Meadow Mining Company (The) has property located in Keweenaw county, Mich. The mine or property is crossed by transverse fissure veins, which, when first discovered, were lined with ancient pits containing considerable copper. The company was organized in 1853.

Mesnara Mining Company (The) is chartered under the laws of the State of Michigan. The officers are A. M. Byers, Pres.; W. H. McCurdy, Vice-Pres.; J. H. Outhwaite, Sec. and Treas. The offices are at Boston, Mass. The property of the company is located in Houghton county, Mich., having an extent of 160 acres, held under lease from the Atlantic Iron Company. The ore, a hard hematite, has an epidote matrix. The vein is true fissure. The mine has a fifty-foot shaft and other workings. Operated since 1876, when it passed into the hands of the Pewabic. The company originated from the discovery of an eighteen-ton mass. This mass had been moved forty-eight feet from its original bed by the ancient miners, and was buried beneath the earth, on which was growing trees corresponding in size with those of the surrounding forest. Organized, 1862; non-assessable. The stock of this company is taken by individual shareholders of the Atlantic Iron Company; said stock or shares being subject to additional assessments not to exceed $1.50 in all.

Minong Copper Company (The) has its offices in Detroit, Mich. Hiram Walker, Pres.; E. W. Hudson, Sec. and Treas. The property of the company is located near W. McCargoe's Cove, Isle Royal, Houghton county, Mich. There is little being done, the work being done on tribute. The company was organized in 1874. The yield to January 1, 1881, was 230 tons; in 1881, the yield was seven tons, 1,897 pounds refined copper of the value of $2,809.95.

Michipicoton Native Copper Company (The) has property located in Michipicoton Island, Lake Superior district, Canada. The ore is stamp rock, averaging two and one-half per cent. copper. There are several shafts, varying from sixty to 100 feet in depth. One hundred men are employed. Developments, so far, have not been rewarded with success. The stock of the company is quoted in London, England. at £1 1s. 8d. to £1 1s. 4d. per share, equivalent to from $5.20 to $5.12.

Mendota Mining Company's property is located near Lac la Belle, Mich. They own 4,300 acres of land, and have a grant of 100,000. The character of the ore is sulphuret of copper, and carries gray, black, and copper pyrites. The company owns hoisting-engine, rock-crusher, and fifteen houses.

Metropolitan Iron and Land Company. The officers are

S. P. Burt, Pres.; R. C. Hanna, Sec. and Treas.; Superintendent, Jeff Day. The company's works are located in Marquette county, Mich. Leasehold, 520 acres. The ore is high grade, hard, and of a bluish color. Analysis gives sixty-four to sixty-eight per cent. metallic iron, low in phosphorous. The extent of deposit has not been ascertained, but has every appearance of being large. The company has a new plant of machinery, consisting of 310x12 duplex Rochester engines, with six and one-half foot drums. Length of adits, that is, levels, 1,000 feet. A force of fifty men are employed.

National Copper Company (The) is chartered under the laws of the State of Michigan. D. L. Demmon, Esq., is Sec. and Treas. Ed. Parnell, of twenty-five years' experience, is Superintendent. Offices are at No. 19 Congress Street, Boston, Mass. The property of the company is located at Rockland, Ontonagon county, Mich.; extent of same, 1,514 acres. The ore gives an assay of seventy-two per cent. Developments commenced in 1855; ceased working in 1870; recommenced on tribute, 1871. Long and costly litigation with the Minnesota about the title of 115 acres of land; decided finally in favor of National, but the mine, at present, is not working, although plenty of ore is obtainable. The company prefers waiting for railway facilities b fore expending anything more in developments. This may account for the neglect and dilapidation everywhere apparent about the mine. Organized, 1848; capitalization, $500,000, in 20,000 shares of $25 each. $360,000 total of dividends paid to November, 1877, the date of latest dividend. $18,000 levied on assessments; date of latest assessment, October, 1877. Stock quoted January 1, 1882, $1.25 per share.

Nepiune Mining Company. The officers are Charles Deering, Pres.; John M. Reck, Treas.; Dr. Sylvester, Sec. Office, Portland, Maine. The company's property is located at Cross Island, Macheas Bay, Maine. Samples of the ore shown, are the purest copper sulphurets, thirty-three and one-half per cent. The company has been offered $120. Prospect shaft is twelve feet deep. The main lode on which the company depends for its supply of ore is 1,500 feet in length.

Nonesuch Mining Company (The). The officers are R. P. Wade, President; J. H. Wade, Secretary and Treasurer. Office, Cleveland, Ohio. The company's property is located in Ontonagon county, Mich. The ore yields a low percentage of copper, assaying about sixty-two per cent. per ton. The lode has a uniform width of seven feet, copper being distributed through the bed with remarkable uniformity. The company's property includes a twenty-five-horse-power engine, washing apparatus, (after pattern of lead washing apparatus used in north of England), turbine overshot wheel, twelve good log dwelling houses, offices, store houses, etc., etc. The prospects of the property are favorable under the practical and able management of Captain Hooper. In 1876 Mr. Wade died, when work was discontinued. About 1878 the property was leased to Captain Theo. Hooker for seven years, conditionally to owners receiving twenty-five per cent. of product. Date of organization, 1867; capitalization, $1,000,000; par value per share, $25; yield during 1881, $21,728.63; yield, refined copper, 59 tons, 1,061 pounds. Stock and bonds held principally at Cleveland, Ohio. Average cost for stoping, ten to eleven dollars per cubic fathom; average cost for sinking, ten dollars per foot; drifting, five dollars per foot.

North American Mining Company (The) is chartered under the laws of the State of Michigan. The officers are Thomas Dickwell, President; Waterman Palmer, Secretary and Treasurer; Superintendent, Captain W. E. Dickinson. Office, Pittsburg, Pa. The company's property is located in Keweenaw county, Mich., covering an area of 2,400 acres. The vein is irregular and variable in width; seems to be split in three parts. The company's property includes a pumping engine, three hoisting engines, and a number of houses, including shaft houses; 150 acres of land is said to be under cultivation and producing excellent crops. The shaft is 415 feet deep. The prospects of the property were favorable at first. Date of organization, 1848; capitalization, $300,000; par value per share, $50; yield to January 1, 1882, 446,000 pounds after smelting and refining; total amount of assessments levied, $233,864, in addition to original capital of $500,000.

Ogima Mining Company (The). Officers, Samuel Cooper, Secretary and Treasurer; L. Collins, Agent, Greenland, Mich. Principal office, New York. The mining property of this company is located in Ontonagan county, Mich. The ore assays per ton seventy and seventy-five per cent. The property owned by the company consists of twelve dwelling-houses, stamping, pumping, and hoisting machinery. Operations were stopped in 1868; since worked by a few tributers where not prevented by water. Tributers paid seven cents per pound for copper got out. Capitalization, $500,000; yield, net, to January 1, 1881, 472 tons 167 pounds; yield during 1881, 3,061 tons 62 pounds; yield, gross tons, to 1881, refined copper, 8 tons 776 pounds; amount latest dividend, $15,000.

Old Dominion Copper Mining Company (The) is chartered under the laws of the State of New York. Officers are George W. Dunn, Pres. Stockholders, Jessie R. Grant (son of Ex-President Grant), J. Reilly, J. Cooke (of H. D. Cooke & Co.). Bankers, Washington. Principal offices, 72 Broadway, New York. The names of mines owned by the company are, viz.: New York, Chicago, Copper Mine, and the Old Dominion, located at Glove district, Gila county, Arizona. Each mine is 1,500 by 600 feet. Titles, perfect. The ore is very rich, chiefly red oxides, blue and green, carbonates and glance, assaying $57 in gold to the ton. Company own three furnaces. Length of tunnel, 375 feet. Width of level, five feet. After going ten feet, found the body of ore, coming from the level above, fully three and a half feet in width, pitching in the same direction with the level. Work was resumed on the level, which is now in eighty-eight feet. It still carries with it the free gold. In cutting through from tunnel to shaft we struck some of the best ore yet found in the mine, assaying forty to fifty per cent. copper. The ore vein steadily improving, and width of vein increasing as we advance into the hill; eight hundred feet all told of shafts and tunnels have been run, which are in ore most of the distance. Open cuts disclose a very wide vein—in fact, so wide in places as to appear incredible. Some forty tons of ore taken from an open cut some two years ago yielded, as I am informed, over thirty-five per cent. of copper. There are two veins running entire length of mine, making in the three properties over a mile of ore vein, yielding an average of over thirty-five per cent. copper. The Old Dominion has shipped 170 tons of copper of the value of $61,500 for twenty-one days ending July 8, 1882. Every day increases; immense value of property, and is very favorable. Capitalization, $2,000,000; shares, 200,000; par value, $10; non-assessable; full paid.

Omega Copper Mines (The), opened by Hummel & Meng, of Philadelphia, and Tully & Co., F. G. Hughes, and T. J. Jeffords, New York, and of which Mr. Fred. Hughes is Supt., are located in Santa Reita Mountains, Arizona, twenty-five miles south of Tucson.

Original Hidden Treasure Company (The). The mines are located on Measure Hill, White Pine county, Nev. Capitalization, $2,133,000; shares, 21,333; par value, $1; number of assessments levied, 11; total amount of same, $330,000; date of latest assessment, October 12, 1874; 2,600 feet in mine.

Osceola Consolidated Mining Company (The) has its offices at 178 Devonshire Street, Boston. The officers are Jas. D. Clark, Pres.; A. S. Bigelow, Sec. and Treas. Mr. John Daniels, Osceola, Mich., is Agent. The property of the company is located in Houghton county, Mich. The plant comprises stamping-mills, rock-house, engines, machinery, buildings, etc. Developments commenced in 1873, prospects at present promising; report says that fresh discoveries of ore are being frequently made as developments progress. Organized, 1873 (originally); re-organized, February, 1880; capitalization, $1,250,000, in 50,000 shares of $25 each. In 1881 the product of the mines was 4,797,396 pounds of mineral, which being smelted yielded 87,130-1000 per cent., or 4,179,976 pounds of refined copper, for which at about 17.76-100 cents per pound has been realized the sum of $742,585.84; from sales of silver, $2,604.25; from receipts of interest, $8,894.96, making gross receipts, $754,175.05; expenses at mine were $439,491.08, other expenses, $88,178.99, making total cost of copper, $527,670.07, leaving a mining profit of $226,504.08; deduct amount of construction, $46,128.38, leaves as net profit $180,376.60, add balance of assets January 1, 1881, $301,041.39, less dividends paid in 1881, $225,000, $166,041.30, leaves as balance of assets January 1, 1882, $346,417.99, from which a dividend of $50,000 was declared payable January 2, 1882. Date of latest dividend, April 1, 1882, $1 per share; date of latest assessment, November, 21, 1879; stock quoted from thirty to thirty-seven per share; current value of mine, $1,650,000; saving of forty per cent. effected by stoping with powder drills; saving of twenty per cent. effected by drifting with powder drills; current value of the mine now, $1,850,000; capital stock, $1,250,000.

Pewabic Mining Company. D. L. Demmon is Sec. and Treas.; Capt. J. Vivian, Superintendent; J. Hay, Mining Engineer. Office, 0 Congress Street, Boston, Mass. The company's works are located in Houghton county, Mich. Amount of property in acres, 1,205. The company owns four Ball's stamps, Collum's washers, Evans' slime tables, new compressor and engine, pumping, hoisting machinery and engines, houses, offices, etc. The development of the property was commenced in 1853. The mine was worked on tribute part of the time, after 1868, under Capt. Wren. Date of organization, 1853; capitalization, $400,000; par value per share, $100; yield to January 1, 1881, 11,519 tons, 320 pounds; yield during 1881, $342,414.53; yield refined copper during 1881, 938 tons, 244 pounds; number of dividends paid to January 1, 1882, one; amount of dividend paid, $460,000; first assessment was levied in 1855, amount, $15,000; stock quoted, July 1, 1882, $10 asked, $9.50 bid.

Phenix Copper Company (The) is chartered under the laws of the State of Michigan. Directors, A. W. Spencer, J. W. Ward, Mark Healy, B. W. Balch. Residence, all Boston, Mass. Simon Mandlebaum, Eagle River, Pres.; H. W. Spencer, Gen'l Treas.; Horatio Bigelow, Simon Mandlebaum, former Superintendent. M. A. Delano, Superintendent at present. Eastern business office, 8 Pine Street, Boston. The mines are located in Keweenaw county, Mich. The former extent of property in acres consisted of 34,500; company own at present 2,477 acres. Developments commenced 1850. The ore assays 144 pounds to the ton. The character of mines consists of five distinct veins, low percentage of stump rock. Property owned—stamp-mills, hoisting and pumping machinery, etc., also productive farm land. In 1878 work progressing rapidly and the property gradually improving. Minimum product, 640,555 pounds, yielding seventy-five and one-half per cent. ingot = 521,081 refined copper at $30\frac{63}{100}$ cents per pound. Profit about $5,000, expended in improvements. In this year a terrible explosion of dualine occurred at the mine killing six men, including Captain John Haalston, who was succeeded by Captain Edward Parnell, as mining captain. The cost of mining and milling per ton, $347.20. The company was organized on the 31st of March, 1849. Capitalization, 3 000 shares; par value, $100; yield net to January 1, 1881, 2,971,450 pounds; yield net during 1881, $74,707.65; yield gross tons during 1881, refined copper, 201 tons, 132 pounds; number of dividends paid to January 1, 1882, one; amount, small.

Piedras Verdes Copper Mining Company. The officers are W. L. McAfee, Pres.; E. M. Knox, Vice-Pres.; S. M. Hamilton, Sec. and Treas. Office, 31 United Bank building, corner Broadway and Wall Street, New York. The company's property is located in the district of Alamos, State of Sonora, Mexico. 5,000 shares of the working capital placed on first allotment at the price of $2.50 per share, the proceeds of which it is estimated will be sufficient to procure smelting furnaces. Capitalization, $2,500,000; par value per share, $25.

Ridge Copper Company is chartered under the laws of the State of Michigan. The officers are Thomas F. Mason, Pres.; W. Hart Smith, Sec. and Treas.; Capt. S. B. Harris, Greenland, Mich., is Superintendent. Office, 4 Exchange Place, New York. The company's property is located in Ontonagon county, Mich., and covers an area of 1,494 acres of land. The ore assays seventy-two per cent. to the ton. The prospects of the company are reported as very favorable. The mine is remarkable for contortion of the veins. Date of commening developments, 1849. Date of organization, April, 1850; capitalization, $500,000; yield to January 1, 1881, 2,175 tons, 1,775 pounds; yield during 1881, $42,998.10; yield refined copper, 117 tons, 1,606 pounds; total amount of dividends paid to January 1, 1881, $100,000; date of first dividend, 1872; amount, $50,000; date of latest dividend, January, 1880, fifty cents per share.

Rockland Mining Company is chartered under the laws of the State of Michigan. J. B. Townsend is Superintendent. The company's mining property is located at Ontonagon, Mich. Amount of property in acres, 760. The ore assays seventy-two per cent. to the ton. Developments were commenced during 1853. The mining property has been worked on tributes since about 1870. Date of organization, September 27, 1853; capitalization, $500,000; par value, $25; yield to January 1, 1882, 3,105 tons, 309 pounds; yield rough copper during 1880, 47,000 pounds.

San Francisco Copper Mining Company. Jeffery Queen, Pres.; A. Boel, Treas.; Superintendent and Manager, W. E. Ellis. The company's mine is located in Nevada county, (near Spenceville,) Cal. The company has worked the mine for several years, and report says, May 20, 1882, has recently brought it to a paying basis. The ledge is becoming richer as depth is attained. The first dividend was paid May 20, 1882.

Santa Reita Company's property is situated in the Black Range, New Mexico. The company has about 15,000 tons of ore on hand that is expected to run high in copper. The mill is running steadily on copper ore from the mines. It is found that the coarse copper, as saved and cleaned up from the batteries twice a day, is running ninety-five per cent. fine, and of sufficient purity to ship direct without smelting. The number two concentrations from jigs run ninety-five per cent. to seventy-five per cent. fine copper, and the number three slime concentrations run from thirty to forty per cent. fine; both numbers two and three concentrators go to the smelter. The company employs 100 men, who mine 200 tons of ore per day.

Seneca Mining Company (The) has offices at 198 Devonshire Street, Boston, Mass. The officers are Joseph W. Clark, Pres.; A. F. Bigelow, Sec. and Treas.; Superintendent, Capt. Daniels. The property is located in Keweenaw county, Mich. The mines are described as a conglomerate belt. The mining plant includes hoisting and pumping engines, machinery, and twelve dwelling-houses. The ground is low and somewhat wet.

Sheldon and Columbian Mining Company (The) is chartered under the laws of the State of Michigan. The property is located in Houghton county, Mich., and is controlled by J. H. Forster, of Houghton, Mich. The copper assays 71⅛ per cent. There is no mining plant or other property about the mine, all having been disposed of. The buildings certainly remain. The mine is therefore in a forlorn condition, with little prospect of a change for the better. Developments were commenced in 1853. Since 1870 it has occasionally been worked on tribute. Capitalization, $500,000, in 200,000 shares of $25 each; yield to January 1, 1881, 696 tons 1,394 pounds; yield during 1881, five tons thirty-one pounds refined copper; value of same, $1,830; $460,000 levied in assessments; stock held principally in Michigan.

Star Mining Company (The). Officer, J. B. Maas, President. The Star mine, belonging to this company, is located in Houghton and Keweenaw counties, Mich.; fine-looking hematite ore; deposit lies in low ground; property owned, one four and one-half inch Knowles' pump, sufficient to keep workings dry; small engine drum does the hoisting; railroad and Eastport close at hand; developments were commenced in 1851; some interest recently awakened by the discovery of a deposit of black oxide of copper, Harbor Vein, which was soon worked out; yield during 1881, $138.33; yield during 1881, refined copper, 758 pounds.

Toltec Consolidated Mining Company. Joseph Vild is Sec. and Treas. Office, Boston, Mass. The company's property is located in Ontonagon county, Mich. Depth of shafts, 1,000 feet. Length of adits—that is, levels—1,700 feet. The development of the property was commenced March 8, 1851, and $300,000 is said to have been expended in developing the property to January 1, 1881. The property includes houses, stamp-mill, and pumping machinery. There are considerable expensive surface improvements. Date of organization, 1850; yield to January 1, 1881, 206 tons, 1,433 pounds. Stock in its infancy quoted well in market, $18 to $20 per share.

The St. Genevieve Copper Company, of which Frank Nicholson, Esq., is Supt., has property located at St. Genevieve, Mo. The product will rank in purity with the celebrated Lake copper. Prof. Potter, of Washington Ter., is making an analysis, and thus far is able to pronounce it the finest produced in America. Capitalization, information not obtained.

U. S. Copper Mining Company (The). The company's property is located at Somerville, N. J. The ore is said to be of excellent quality.

Warrior's Mark Mining Company (The). Officers, George Puterbaugh, Pres.; J. J. Loomis, Gen. Man. Principal office, Breckinridge, Col. The names of the mines owned by the company are Snow Drift Mine, located near Breckinridge Pass, Summit county, Col. High grade gray copper ore, assaying 9,220 ounces per ton. Fissure veins extend 700 feet to the south, at an angle of fifteen degrees, 1880. The most remarkable mineral development is found at the quarry; here the county rock on both sides of the vein is the red micaceous sandstone of the belt. The vein expands to a width of 200 feet. The ore here found is, however, much of it as rich in silver as any of which record has been made. Many of the veins of gray copper are found to extend up through the drift to the grass roots, the drift varying in thickness from one to two feet. Capitalization, 300,000 shares; par value, $10.

Washington Copper Mining Company (The) has property located in Somerville, N. J. Operations proceeding day and night, said to be developing an extensive body of ore of excellent quality.

Yakoma Copper Mining Company (The) is chartered under the laws of the State of New York. The officers are Wm. S. Hoyt, Pres.; Henry Cummins, Vice-Pres.; J. H. Work, Treas. Directors, C. J. Franklyn, John J. Safely, R. Foster; Sec., E. Washburn. The offices are at 120 Broadway, New York, room 40 Equitable Building. The property of the company is located at Globe City, Arizona. Capitalization, $1,200,000, in 48,000 shares of $25 each. Treasury stock consists of 8,000 shares.

GOLD.

Ætna Mining Company is chartered under the laws of the State of California. The officers are J. F. Weatheriner, Pres.; A. F. McGrew, Vice-Pres.; F. M. Blackstone, Sec. Office, 420 Montgomery Street, San Francisco, Cal.; transfer office, 140 South 4th Street, room 6, Philadelphia. This company are the owners of the Ætna Mines, located in Globe district, Arizona. The ore is of a porphyry formation, thoroughly impregnated with oxide of iron, giving a gold assay of $361 per ton. Vein of quartz is more than three feet in width; croppings show entire length of claim, traceable for more than a mile. Capitalization, $10,000,000; par value per share, $100; assessable. Stock reserved in treasury, 10,000 shares. Stock listed on the Philadelphia Mining Annex and California Stock Exchange.

Alamosa Mine (The), owned by Mr. M. M. Giles. The mines are located at El Dorado district, Utah. Assays as high as $540; main shaft forty feet, penetrated a ten-foot vein carrying free gold in paying quantities.

Albington Gold Mining Company (The). Mr. Platt McDonald, Manager. The name of mine, owned by this company, is the Lizzie Abbington, located in Colorado. Quality of ore very fine, composed of gold, silver, and copper. Character of mine are veins, three to five feet in width. The mineral carries from two to five ounces in gold, seventy-five ounces in silver, about 15 per cent. in copper.

Alexander Mining Company. Branch office, 328 Montgomery Street, San Francisco, Cal. Annual election held during October. The company's mine, the Alexander, is located in Grantsville, Nye county, Nev. Large bodies of pay ore are in sight, and it is thought to be one of the biggest mines ever opened in Eastern Nevada. The quartz assays $93 per ton. Length of main lode is 4,500 feet. The company have a capitalization of $5,000,000, in 50,000 shares of $100 each. Yield during 1880, $236,152. Paid their first dividend, January, 1882; amount of which was $100,000, being at the rate of $2 per share. First and only asssessment levied, October 31, 1881; amounting to $150,000.

Alpha Mine (The). Messrs. Kirkham and Hitchcock, owners. Name of mine, Alpha. Located in Idaho, Nevada county, Cal. Character and quality of ore, yielding rock so exceptionally rich that the owners realize big wages. Working only an arrastra and hand mortar. Mohican turning out ore that goes about $30 to the ton. 1880.

Amador Consolidated Gold Mining Company (The). Location of mines, Amador county, Cal. Capitalization, $3,000,000; 30,000 shares; par value, $100. Number of dividends paid to January 11, 1879; total amount, $3,347,500; date of latest dividend, January 14, 1879; twenty-six cents per share. The last set of timbers has been placed in the shaft, and prospecting for the ledge will commence in due course. Twelve men were employed in sinking shaft; this force will be increased in proportion as developments proceed and permit. The company has a five-stamp mill, which ran a short time on ore from the St. Louis mine.

Antioch Mining Company. Messrs. Wood and others, owners. Location on Breece Hill, Colorado. Quality and character of ore, gold and silver; very fine. The property owned by the company, engine mill, shaft house. Prospects of the property, etc., substantial preparations are being made for working the mine properly. The old quartz mine at Oro City has been secured, and will pass into the possession of the Antioch owners, January, 1882; it will be improved, and the facilities for shipping the ore down the hill to Oro will be provided.

Argentine Quartz Mine (The). Thompson Bros., owners. Located in Plumas county, Cal. Company own a five-stamp mill. Gold is very fine; will sell at $18 per ounce; $400 and $500 has been received from the mine, result of a ten days' run of the mill.

Aurora Gold Mining Company is chartered under the laws of the State of New York. Office, 31 Broad Street, New York. The company's property is located at Whitewood, Black Hills, Dakota. The ore gives a gold assay of $19 per ton. Date of organization, December 20, 1878; capitalization, $500,000; par value per share, $10; basis, non-assessable.

Aurora Gold Mining Company (The) owns a group of mines, comprising the Charter Oak, Gem, North Eclipse, Ezra White, Effie, Blagden, and Augusta May, all located in Gilpin county. The Charter Oak has been reopened and cleaned out to a depth of 110 feet. The shaft, regardless of expense, has been put into proper condition for deeper working. New hoisting and milling machinery has been erected. The main shafts of the Gem and North Eclipse have also been put into good working condition, and the result of the current year should be a large and profitable production.

Bald Mountain Extension Company. Their property is located at Forest City, Sierra county, Cal. The company have now completed their preparations for bringing down water from the pliocene shaft, and ten inches are steadily flowing into the reservoir at Forest City. There are 800 car-loads of gravel in the lower dump, a large portion of which is rich. As soon as the lengthy run of sluices is finished, the lower dump will be cleared; and when the new iron air-pipe is all received, and put up in the main tunnel, 3,600 feet to the incline and gangways, the main tunnel will be turned up the ridge, through the center of the channel, and gangways run to the right and left, affording constant employment to a large force of men. The future prospects of the mine are encouraging, as it is being demonstrated that the extension of the main lead of the noted Bald Mountain claim comes through the extension ground for three miles, and beyond to Gold Lake. The gross yield of the Bald Mountain for the past eight years has been very close to $3,000,000, half of which was dividends on the trifling investment of $20,000 for opening the mine.

Baltic Gold Mining Company. The officers are Henry D. Morse, Pres.; J. W. Brady, Treas. Office, 31 Milk Street, Boston, Mass. The company's works are located at Grass Valley, Cal. Amount expended in developing property up to 1882, $12,000. Organized at Saco, March 19, 1881; capitalization, $200,000; par value per share, $2; basis, non-assessable.

Banner Mining Company (The). The officers are Samuel Conover, Pres.; Thomas P. Malony, Sec. Office, room 36, 63 Broadway, New York. This company's property consists of the Banner mine, of Inyo county, Cal., which is 1,500 by 600 feet, and its appurtenances. This mine was located in December, 1879, by John H. Ely, and is situated in latitude 37° North, and longitude 118° West, on the Inyo Mountains, in southeastern California, about fifty miles north of Owens lake, and two miles from Owens river. This property being in a county of fabulous mineral deposits and adjoining the famous Union mine, which has given out $17,000,000 in ten years, is well worth attention. The company have a capitalization of $1,000,000, in shares worth a par value of $5 each.

Bechtel Consolidated Mining Company. W. H. Lent, Sec., 309 Montgomery Street, San Francisco, Cal. This company's property is located in Bodie district, Cal., covering an area of 900,000 square feet. The lowest grade rock in the Bechtel Consolidated mine will give a milling average of $18 per ton. The cost of reduction is $10, leaving $8 as net profit per ton. There are inexhaustible bodies of low grade ore in old workings. The three ledges of this mine show a disposition to unite into one solid bed at a depth of from 600 to 800 feet. The company have commodious hoisting works, erected with powerful machinery, capable of working to a depth of 2,000 feet. The old shaft has reached the depth of 700 feet; the present, that of 513 feet. The first clean-up after a three weeks' run amounted to $53,952. It is reported that this company will be joined with the Bodie Tunnel to form one company. Capitalization, $10,000,000; par value per share, $100. Yield of the Bechtel Consolidated:

1878	$58,634 93
1878—crude bullion in October	1,550 00
1879	11,506 05
Total	$71,690 98

Number of assessments levied, eight; total amount, $215,000; date of latest assessment, December 3, 1882, twenty-five cents per share; bonds reserved in the treasury April 1, 1882, $1,128; indebtedness February 1, 1882, $8,930.53; working expenses, $3,500 per month. The financial statement shows the annual working expenses to be $765,813.66, $35,000 of which is for mine labor.

Black Bear Quartz Gold Mining Company. The officers are Thomas Bell, Pres.; S. Heydenfeldt, Vice-Pres.; Alpheus Bull, F. Logan, J. Daggell, Wm. Letts Oliver, Sec. The company's works are located at Black Bear Gulch, Siskiyou county, Cal. There are 4,500 feet in mine. Capitalization, $3,000,000; par value per share, $100; yield to January 1, 1881, $129,400; total amount of dividends paid to July, 1882, $878,500; number of assessments levied, fifteen; total amount of same, $15,000; shares not in market.

Black Hawk Gold Mining Company (The). Officer, H. A. Charles. Principal office, 419 California Street, San Francisco, Cal. Location of mines, Brodie district, Cal. Amount of property in acres, 410 by 1,500 feet. Character of mine, three veins, ore better grade on upper level than below and less mixed, say $40 per ton. Hoisting works belong to the company. Dimensions of workings is by tunnel, 450 feet in length. Working expenses per month, $3,000. 100 tons of mineral on the dump; 1,000 in sight in the mine. 1,500 feet in mine. Capitalization, $5,000,000; shares, 50,000; par value, $100; assessments levied, thirteen; dividends, none; total amount assessments, $185,000; date latest assessment, November 9, 1881; amount per share, ten cents; stock quoted January 1, 1880, $5, reached highest point; cash on hand February 1, 1882, $148.77; cash on hand April 1, 1882, $273.

Blue Tent Hydraulic Mining Company (The) have consolidated with the Fall Creek Lake Water Company, and will be known as The Yuba River Gold-Washing Company, Limited. The consolidation owns about thirty-five miles of ditches. The Blue Tent claims, located in

Nevada county, Cal., are among the principal hydraulic mines in the county, and employ about 100 men, using five monitors for washing, with a head of water amounting to 2,500 inches.

Bonanza Mine (The) owned by Sidney C. Brown. The Bonanza Mine is located in Calaveras county, Cal., near Copperopolis. Quartz mining.

Bobtail Consolidated Gold Mining Company (The) owns property located in Gilpin county, Col. The Bobtail mine, owned by this company, is one of the principal producers of this district. The shaft is now about 1,000 feet in depth. The mine is a labyrinth of drifts and levels, total extent of same being 2,260 feet. The shaft is cut at the 500-foot level by the main tunnel, 1,440 feet from its mouth, and the ore raised to the tunnel-level is run out on a tramway direct to the mill, which has a capacity of 125 tons per day. Many improvemeuts are added to the mine, machinery, etc., which facilitate operations, and reduce the expenses of working. About 250 men are employed. The current value of the mine is $454,652. Capitalization, $1,136,630; par value per share; $5; non-assessable. Number of dividends paid to March 30, 1880, four; total amount of same, $147,161; date of latest dividend, March 30, 1880—ten cents per share. Stock quoted June 10, 1882, $2.

Bonanza Chief Gold Mining Company is chartered under the laws of Montana Territory. The officers, in 1880, were W. W. Wicks, Pres.; Michael Snow, Vice-Pres.; R. F. Brooke, Sec. Office, 35 Broad Street, New York. The company's property is located eight miles from Helena, Montana. The character of the ore is gold. Value per ton, $10. The company are pushing mining operations with great energy, employing 300 men. The furnaces are turning out about two car-loads of base bullion per day. Company owns twenty-stamp mill and steam hoist, etc. Date of incorporation, 1879; capitalization, $1,000,000; par value per share, $1; non-assessable.

Booth Gold Mining Company (The). Principal office, No. 314 Pine Street, San Francisco, Cal. Mine located at Auburn, Placer county, Cal.

Boston and Halifax Gold Mining Company's (The) works are located near Fifteen-Mile Stream, New Glasgow, covering an area of 130 acres. The company owns a fifteen-stamp crusher, and it is intended to furnish a first-class plant at a cost of $100,000. The government has made a grant of $800 towards repairing the road to the gold field. Company was organized at Boston, May, 1882, having a capitalization of $500,000.

Boston and Montana Gold Mining Company. L. R. Nettin is Supt. The company's works are located in Montana. Character of the ore found is all pay ore. The vein is from twelve to fifteen feet wide between walls. Rock is followed for a distance of 1,100 feet. The mine is well timbered, with a security that admits of no fear of accidents. There are 115 tons of milling ore on the dumps. The company have the latest improved machinery, including two mills, one a twenty-stamp, of twenty ton capacity; the other, a sixty-stamp, crushes eighty tons per day of twenty-four hours. Sectional area of shaft, six feet by sixteen feet, 1881. Capitalization, $2,000,000; par value per share, $10; total amount of dividends to July 1, 1882, $360,000; date of latest dividend, July, 1882, ten cents per share.

Brewer Mining Company (The) are the owners of the Brewer Mine, located in Chesterfield county, S. C., twenty-nine miles south from Monroe. The character of the mine is gravel, admirably fitted for hydraulic treatment. The company have an abundant water supply, pump supplying 1,000 gallons per minute.

Briggs Consolidated Gold and Silver Mining Company (The). Location of mines, Colorado. Capitalization, $2,000,000; shares, 200,000; par value, $10. Number of dividends paid to December 10, 1879, amount, $8,000. Date of latest dividend, four cents per share.

Buffalo and Idaho Gold and Silver Mining Company (The) have property located in the vicinity of Atlanta, Alturas county, Idaho. The Superintendent, Mr. W. W. Miller, speaks enthusiastically of the prospects of the company. It must be remembered that it is in a rich or gold producing locality.

Buena Gold Mining Company (The) is chartered under the laws of the State of Colorado. Officers, Thos. H. Gill, Pres.; M. Newkirk, Vice-Pres.; E. H. Green, Treas. Directors, Jos. C. Murphy, D. R. Patterson, John M. Fox, James A. McCowlas, William Rosengarten, J. H. C. Whiting. Principal office, Jamestown, Colorado. Transfer office rooms, 27 and 29 312 Stock Exchange Place, Philadelphia, Pa. Names of mines owned by the company are Buena, Michigan, Ben Franklin, Bouncer. A mill site belongs to the company, with a capacity of twenty-four tons per day. Four shafts each, of 100 feet, seventy feet, fifty feet, and twenty feet; tunnel 255 feet. About 2,000 tons of ore on the dump. Capitalization, 615,384 shares; par value, $10; non-assessable.

Bullion Mining Company. A. J. McDonnell is Secretary. Office, 328 Montgomery Street, San Francisco, Cal. The Bullion mine owned by this company is located at Gold Hill district, Comstock Lode, Nevada. Capitalization, $10,000,000; par value per share, $100; number of assessments levied, twenty-four; total amount of assessments levied to December, 1880, $352,000; date of latest assessment, May 29, 1882; amount per share, twenty-five cents; depth of workings, 2,450 feet; length in feet of the main lode on which the company depends for its supply of ore, 943½ feet; indebtedness March, 1, 1882, $20,431.

Bulwer Consolidated Mining Company (The). Principal office, 309 Montgomery Street, San Francisco, California. Names of mines owned, the Ralston Ledge and the Stonewall. Located at Bodie, Mono county, Cal. Amount of property in acres, 200 feet by 500 feet. Quality and character of ore; low grade at 400-foot level, better quality lower down. In September last (1881) the shaft was down 650 feet. Gold and silver assays $10 to $20 per ton. Character of mine: three ledges from one to four feet wide. Thirty-stamp mill is owned by the company. Stonewall tunnel 1,850 feet; Ralston tunnel 500 feet. Expenses of the company are nominal, accompanied with results and prospects; a small number of men employed. Date of organization, April, 1879. Current value of mine $200,000, 3,000 feet in mine. Capitalization, $1,000,000; yield net:

1879	$241,094 38
1880	117,498 33
Total	$358,592 71

Number of shares, 100,000; a fiscal, 1880, $122,247; par value, $100; number of dividends paid July 12, 1882, total amount, $10,000; date of latest dividend, July 12, 1882; date latest assessment, December, 1877; amount, $50; per share, $10; number of assessments levied, one; total amount of same, $30,000; stock quoted June 10, $2; cash on hand, February 1, 1882, $89,112.81; cash on hand, April, 1 1882, $82,247.00.

Bunker Hill Gold Mining Company (The) is chartered under the laws of the State of New Jersey. Officers are Francis W. Kennedy, Pres.; W. A. Leavitt, Vice-Pres.; Nelson F. Evans, Treas.; Henry H. Kennedy, Sec. Directors, F. W. Kennedy, W. G. Warden, Wm. A. Leavitt, Nelson F. Evans, Peter B. Simons, J. W. Knox, W. L. Palmer. Principal office, 103 Market Street, Camden, New Jersey. Names of mines owned; Bunker Hill, May Flower, and 2,614 feet on Mother Lode. The mines are located at Amador, Amador county, Cal. It is one of the richest and oldest gold quartz mining districts in the State. Amount expended developing property underground $300,000, above ground about $100,000. Property owned by the company: one mill site and superior water privileges; forty stamp-mills with a capacity of from eighty to 100 tons, entirely new, have been built. Prospects of the property: free from all incumbrances, with a surplus fund of $40,000 beyond all current liabilities. Capitalization, 300,000 shares; par value, $10; non-assessable. The shaft is down 500 feet; the bottom of the ledge is about eighteen feet wide with an average quality of about ten per cent. per ton. The Blatchley, Hendy, and True processes for saving sulphurets have all been tried, and the preference given to the True. A Mear's chlorinating furnace is said to save about seven per cent.

Calaveras Water and Mining Company is chartered under the laws of the State of New York. J. P. Marshall, Pres.; R. K. Southerick, Sec. Office, 25 Broad Street, New York. The company's property is located in Calaveras county, Cal. They have a capitalization of $300,000, non-assessable.

Caledonia Gold Mining Company (The). Officers, Thomas Bell, Pres.; F. Locan, Vice-Pres.; W. Litts Obion, Sec. Head office, No. 327 Pine Street, San Francisco, Cal. Mr. W. W. Allen, Supt. Date of annual election, June 7. Mines located in Whitewood district, Dakota. Property owned by the company: pumps, machinery, all working nicely. Prospects of property, etc. Improvement in the appearance of the ore. 1,500 feet in mine; depth of shaft, 107 feet. Yield during 1880, 102,422. Capitalization, $10,000,000; shares, 100,000; par value, $100. Number of dividends paid to January 1, 1882, none. Number of assessments levied, eleven; total amount of same, $440,000; date of latest assessment, March 17, 1881.

Canada Consolidated Gold Mining Company (The) is chartered under the laws of the State of New York. The officers are Henry Loveridge, Pres.; J. W. Loveridge, Sec. and Treas. Wm. H. Doughty, W. B. Walker, C. Butler, Austin Gallagher, Walter Shanley. Date of annual election, January 13, 1881. Head office, room 59, Smith Building, New York. The company's mine is located at Marmora, Ontario, Canada. They own from 800 to 1,000 acres of land. The ore is very rich and remarkably uniform. It yields the large average net profit of from $9 to $12 per ton, without sorting. The gold is of very fine grade, 960 to 980 fine. The main vein has been shown to be continuous over a length of more than 3,000 feet; thickness of from eight to twenty-five feet. The Geological Survey of Canada, from twelve samples taken from this property, found an average assay value of $39.47 gold per ton. The mine has been carefully and thoroughly tested. It is a fact, that in all these tests never has a single sample been found which did not contain sufficient gold to have paid for mining and milling, and often to have left a margin for profit. There are reserves of ore now in sight sufficient to supply 100 tons a day for nearly two years, having a net value of $8,700,000 after deducting expenses. The company own a twenty-stamp mill and boarding-houses. This property has magnificent water-power. Wood costs $1 to $1.25 per cord delivered; labor, $1 to $1.25 per day. Titles perfect, no taxes on mine or mineral, and within twenty-four hours of New York. Capital stock, $500,000, in shares $1 each; fully paid.

Carrahee Mining and Milling Company (The), Georgia, is chartered under the laws of the State of New Jersey. Officers, Henry McConnell, Pres.; Juhu Woods, Jr. Directors, Henry McConnell, Charles N. Selser, Juhu Woods, Jr., Josephus Robert, Wm. R. Thompson, J. S. Doughty, Isaac A. Braddock. Head office, Camden, N. J. Name of mine, Burton Tract. Located in Harrington, Thompson, and Hall counties, Georgia. Amount of property in acres, 700. Quality and character of ore, good. Large percentage in galena, sulphuret, and free gold. Assays per ton, from $18 to $460. Character of mines, four feet vein with assays, from $18 to $460 per ton. Property owned by company: five-stamp mill, with eighteen-horse power engine and boiler. Dimensions of workings, main shaft, down, forty feet; tunnel, 500 feet. Capitalization, 100,000 shares; par value, $1; non-assessable. Amount of stock issued, 87,500 shares; amount reserved in treasury, 12,500 shares.

Castle Creek Hydraulic Company. The property is located in Pennington county, Dakota. The company are engaged in cutting a 500-feet tunnel through a granite promontory, through which it is proposed to drain over a mile of a bend in Rapid Creek, for the purpose of obtaining deposits of gold believed to be very rich upon the bed-rock of the stream. The company own some sixty claims on the creek.

Cataract and Wide West Gravel Mining Company (The). Principal office, 26½ Kearny Street, San Francisco, Cal. Location of mines, Eho mining district, Calaveras county, California.

Charter Oak Gold Mining Company (The). Location of mines, Lawrence county, Dakota. Property owned by the company, ten stamps. Date of organization, April 19, 1881; capitalization, $500,000.

Chaparral Gold Mining Company (The), of California. Head and branch office, Mr. Aldersly, Supt., 61 Broadway, rooms 7 and 8, New York. Registrars of transfers, Farmers' Loan and Trust Company, John Adams, Contractor. Names of mines owned, Chaparral, Champion, Excelsior, Claims. Located in Kelsey Mining district, El Dorado county, Cal. Character of ore, free-milling quartz gold, impregnated with sulphurets, showing some fine free-gold. Character of mines, vein uniform and regular, about five and a half feet wide, all pay ore. Property owned by the company, ten-stamp mill, steam hoisting machinery, and all necessary apparatus. Everything in first-class order. Mines now clear of water, September, 1881, and work resumed. Purchased by Mr. Bernard Lands, for $45,000; $5 per foot for tunnel drawing. Capitalization, $2,000,000; shares, 200,000; par value, $10; non-assessable.

Cherokee Gold Mining Company (The) is chartered under the laws of the State of New York. Head office, 18 Wall Street, New York. The Cherokee mine is located at Greenville, Plumas county, Cal. The ore is free-milling, carrying gold and assays, $10 to $20 per ton. The Cherokee, which was reopened under a new management, has been developed to a considerable extent. A new shaft, the Garfield, has been sunk 204 feet, and a ledge averaging three feet, struck. The shaft is a double compartment, with a cage and guides on one side, at a depth of 100 feet. A cross-cut was run into the hanging wall, which intersected two strong veins of quartz, which milled well. A new level, No. 3, was started, and a fine vein of ore found. The lode is from three to six feet thick, and of excellent quality. Enough is being taken out now to keep the mill running steadily, and the ledge continues to open well. This mine has now been developed enough to prove that it is of great value. Within a distance of 240 feet, four separate ledges have been found, known respectively as the White, Josephine, Kettle, and Old Bach ledges. The first is irregular in thickness, varying from six to twelve feet; the second is about two and a half feet thick; the third five feet, and the fourth about the same. Enough of these have now been opened to furnish work for the mill for a long time to come. The ore is reduced by a twenty-stamp mill run by water-power, situated about a mile and a half from the mine, and below the dam of the Round Valley Reservoir. The mill is valued at $30,000. The main lode is 4,000 feet in length. The yield heretofore has been large, but the property was worked at a disadvantage, no depth was gained. Now, with the help of modern improvements in mining machinery, and with good management, the owners will open up one of the richest mines in the country. Date of organization, January 9, 1880; capitalization, $1,500,000; par value per share, $10; basis, non-assessable. Treasury reserve, January 1, 1882, $4,000; stock held principally in New York.

Challenge Consolidated Mining Company (The) is chartered under the laws of the State of California. The offices are at San Francisco. The properties are located at Gold Hill, Nev. Organized, November, 1879; capitalization, $5,000,000; shares each, $100. Cash on hand April, 1882, $273; total amount of assessments levied to 1881, $10,000.

Cheyne Consolidated Mining Company (The). Officers, Col. G. M. Totten, Pres.; A. C. Edgerton, Vice-Pres.; R. McNaught, Sec. and Treas. Offices at 55 Broadway, New York. The mining properties are located in the Black Hills district, near the Homestake and Father de Smet Mines. The mine is being fitted with an improved hoisting works, and a new thirty-four inch boiler. In the opening of a new cut in the Hoodleberg Mine to connect with old cut, a splendid body of ore was struck, showing a good deal of free-gold. Capitalization, $300,000; shares each, $1; non-assessable, full paid.

Cincinnati Consolidated Mining Company. The property is located in Dawson county, Georgia, and consists of the Baby, Magic, Gnome, Amicolola, Kinmore mines. Most of the known belts of the Dahlonega and Auraria districts are found on these properties. The Magic and Amicolola are the only mines worked to a noteworthy extent, but considerable preparations are projected for enlarged operations.

Cisco Consolidated Gold Mining Company is chartered under the laws of the State of New York. The directors are P. S. Van Renselaer, E. M. Walker, W. L. Oliver, Chas, D. Fink, Charles Kaufman. This company owns eight mines, viz.: the Badger, Riddle, Black Hawk, Charlotte, Last Chance, Cisco, Reynolds, and Keystone, located in Placer county, Cal. The quality of the ore is good, assaying $290 per ton. Some of it running as high as $690. The company own a mill. The tunnel is thirty-four feet in length, and the shaft is down seventy feet. Date of organization, March 23, 1882; capitalization, $10,000,000; par value per share, $100.

Clifton Hydraulic Company (The). Location of mines, on San Francisco river, near Clifton, Ariz. Amount of property in acres, 10,000. Quality and character of the ore, coarse; gravel yields from five cents to $2 per pan. Capitalization, five shares.

Clio Gold Mining Company. The officers are G. B. Flint, Pres.; B. Heath, V.-Pres.; W. Brandreth, Treas.; R. Hall, Sec. Office, 52 Broadway, New York. The property is located at Jacksonville, Tuolumne county, Cal. Capitalization, $500,000; par value per share, $1.

Colombo Quartz Mining Company. Their property is located in Sierra county, Cal. The company are running a tunnel to reach their ledge. They have progressed 170 feet through slate rock. The shaft is thirty-one feet in depth, with rich quartz in the bottom.

Commodore Gold Mining Company (The) is chartered under the laws of the State of New York. Incorporators, F. Shepard, T. J. Van Wyck, P. W. Hohines. Trustees; T. J. Salter, S. Mead, H. Dayton, A. F. Phelps, F. Shepard, T. J. Van Wyck, P. W. Hohines. Location of mines, Goochland, and Fluvanna counties, Va. Capitalization, $250,000; par value, $1. Term, fifty years.

Consolidated Gold Mining Company's works are located at Georgia, Ga. They have a capitalization of $500,000, in 100,000 shares at a par value of $5 each; basis, non-assessable. Total amount of dividends paid to April 18, 1882, $275,000.

Consolidated Yankee Fork Gravel Mining Company (The). Officers, E. B. Hinsdale, Pres.; Silas C. Hay, V.-Pres.; J. Milnor Decker, Sec. Principal office, 31 Broad Street, New York. Capitalization, $500,000; par value, $1.

Constantine Gold Mining Company. Directors, David Porter, N. C. Fassett, A. F. Main, H. W. Jacobs, Geo. Storey. Location of mines, Mariposa county, Cal. Capitalization, $4,000,000.

Columbia Gold Mining Company (The). Officer, Hon. A. M. Keiley. Name of mine owned, Tellurium, located near Columbia Station, Fluvanna, Goochland county, Va. Amount of property in acres, 344. Character of ore, the gold-bearing matrix is slate, quartz, brown oxide of iron, tellurium, etc. An assay of fifty tons of Tellurium ore gave, the lowest $4.80, highest, $137.60, averaging $51.12. Deepest shaft, 120 feet. Professor Stone, of Washington, D. C., assayed some Tellurium mine ore by crushing it and passing it through a sixty holes to the inch seive, then agitated in water and allowed thirty seconds to settle: the water was then poured off, filtered, rinsed, and dried, when it yielded 38.98. This with the gold that subsided made the ore worth 88.06. There are three veins here, the big sandstone, the middle, and the little veins. The average value of the ores from the little and middle veins during the years of the Fisher-Bowles lease was $100 per ton, the minimum $5, the maximum $300.

Crowell Gold Mining Company (The) is chartered under the laws of the State of New York. The officers are G. B. Flint, President, New York city; G. R. McCarty, Vice-President, and W. Brandreth, Secretary. The offices are at 52 Broadway, New York, Room 52. The property is located near the famous Gold Hill mine, in North Carolina, Stanley county, having an area of 850 acres. The ore is highly auriferous and assays $6.72. The mineral track is covered by an unknown depth of disintegrated quartz bearing gold in large quantities. Nuggets weighing from five dollars to $800 have been found. The plant comprises a five-stamp mill, a twenty-horse power engine and boiler. Fuel costs one dollar per cord, delivered at mill. Water is abundant. Wages average $1 per day. Organized March, 1880; capitalization, $1,000,000; shares each, $2.50; unassessable.

Dahlonega Gold Mining Company is chartered under the laws of the State of New York. Office, 40 Broadway, New York. The company owns a ten-stamp mill. The company's works are located in Dahlonega district, Ga. They own eighty acres of land. Date of organization, 1877; capitalization, $250,000; par value per share, one dollar; basis non-assessable; no dividends have yet been paid.

Dardanelles Consolidated Gravel Mining Company. The Directors are Fred. O. Prince, Boston; Peter W. French, John Hitchcock, W. B. Mack, W. E. Smith, George T. Coulter, and Joseph McGillivary. The company's works are located at Forest Hill Divide, Placer county, Cal. A report from the superintendent says they are taking out considerable good gravel. The output has been increased considerably, and will be increased regularly from now on, as they open wider breasts. They are now breasting it out some seven feet high, and will have to increase that. The gravel pays richly. The Rerenhart tunnel is progressing rapidly considering the hardness of the rock. At times they have taken out for days in succession over twenty dollars a day of gold. The ore shows splendid-looking coarse gold. Rock very hard. The company has a capitalization of $1,000,000.

Davenport Placer Mining Company. The officers are Dr. A. S. Maxwell, President; Thomas Thompson, Vice-President; J. B. Carmichael, Secretary; W. O. Bennett, Treasurer and General Manager. Directors, E. S. Bennett, A. W. Bowman, J. H. Maxwell, William Batchelder, and W. S. Handy. The company's property is located near Golden, New Mexico. The property covers 520 acres. From eleven assays made from specimens secured at different parts of the claim, and at depths varying to seventy-six feet, an average of $7.50 per cubic yard was secured. The company has an artesian well on their lands 250 feet deep. Capitalization, $50,000; par value per share, $500; (all shares are taken up.) Stock and bonds reserved in the treasury, April 1, 1882, $10,558.

Deadwood Terra Mining Company is chartered under the laws of the State of California. H. B. Parsons, Secretary. Transfer office, 65 Broadway, New York; branch office, 18 Wall Street, New York. The company's property is located at Whitewood, Black Hills, Dakota. The ore is rich sulphate, assays from ninety to 130 ounces per ton. The company have 580 stamps, offices, and boarding houses. Depth of shaft, 112 feet. Current value of mine, $1,200,000. Date of organization, October 4, 1878; consolidated, December, 1880; capitalization, $5,000,000; par value per share, $25. Total amount of dividends paid to July, 1882, $710,000; date of latest dividend, June, 1882, fifteen cents per share. Stock quoted July 1, 1882, $6.

Defiance Gold Mining Company (The), California. Officer, W. H. Lent, Secretary. Principal office, 369 Montgomery Street, San Francisco.

Diamond Flume and Hydraulic Company. Their property is located at Confederate Gulch, Meagher county, Montana. Operated by James King. This company has built two flumes, one three feet and the other four feet. Their ditches are about eight miles in extent and carry nearly 4,000 inches of water, and have a pressure, if necessary, of over 400 feet.

Dudley Gold Mining Company are the owners of the Dudley mine, located in Bodie district, Mono county, Cal. The quality of the ore is low grade. The mine shows strong ledge formation, and will require considerable depth to make it pay. Increased in width from two feet at surface to ten feet at 400-foot depth. From wall to wall, it is one solid mass of quartz, samples of which assay from $600 to $6,000 per ton, and will give a milling average of $65 per ton. Feet in mine, 1,125. Capitalization, $6,400,000; par value per share, $1. Number of assessments levied, eleven; total amount of assessments levied $182,400.

Durango Gold Mining Company is chartered under the laws of the State of New York. The officers are Alexander McDonald, Pres.; Geo. E. Spencer, V.-Pres.; Effingham Lawrence, Treas.; Willis A. Barnes, Sec. Superintendent, Walter G. Gates. Office, room 43, 115 Broadway, New York. The Durango, located in Lawrence county, Dakota, is a cement deposit, the bed-rock pitching into the mountain; the ore from this mine has been worked at a custom mill, yielding $8 per ton. Capitalization, $500,000; par value per share, $5. Date of latest dividend, June, 1881; seven and a half cents per share.

Eintracht Gravel Company (The). Principal office, 209 Sansome Street, San Francisco, Cal. Date of annual election, December 6. The mines of this company are located in California. Nine assessments levied; latest assessment, May 2, 1882; amount per share, five cents.—*Mining Record*, June 17.

El Dorado Hill Company (The). These mines are located in Nevada. The Quartz mine, owned by E. J. McCoon, has very rich specimens of quartz. A mill is the property of the company.

Empire Gold Mining Company (The) is chartered under the laws of the State of New York. Head office, 58 Broadway, New York. The Empire is one of the oldest quartz mines in the State that is still at work. It was discovered in 1852. It has been worked successfully since 1871. Location of mines, Plymouth, Amador county, Cal. Character of mines, gold; assays about $15 per ton. Property owned by the company, eighty-stamp mill, actuated by either water or steam. Dimensions of workings, 1,900 feet. Ore is chiefly got from 1,200-foot level. Litigation with the Pacific company and other circumstances have interfered with the regular workings of the mine. Date of organization, July, 1878; capitalization, $2,000,000; shares, 200,000; par value, $10; number of dividends paid to March 5, 1880, eleven; amount, $478,000; date of latest dividend, May 5 1880; amount per share, seventeen cents; yield during 1880, $481,000; stock quoted 1882, July 1, $2.

Empire Mine (The), owned by Hon. Thomas Fowler. The Empire Mine is located in Tulare, Nevada county, Cal. Mill in good working order. This mine has been one of the chief producers of gold for twenty-five years, and is now being extensively worked. Heavier pumps have recently been introduced, and improvements have been made to boilers and machinery which have reduced the consumption of fuel nearly one-half. There are nearly 190 men at work in the mine.

Empire Gold Mining Company. Name of mine owned, Empire, located at Grass Valley, Nevada county, Cal. This mine produces good milling ore and some very rich specimens. Length of levels, 1,200 feet. Length of main lode on which the company depends for its supply of ore, 3,600 feet. The mine has been drained of water to the 800-foot level; to accomplish this the pumps had three months of incessant work. Tributes at work taking out rock from the levels that are drained. Capitalization, $2,000,000; shares, 20,000; par value, $100; number of dividends paid to January 20, 1878, sixteen: date of latest dividend, January 20, 1882, amount, twenty-five cents; amount, $146,000; number assessments levied, 40,000; date of latest assessment, August 5, 1871; stock quoted July 1, 1882, $2.

Empire Mining Company (The) is chartered under the laws of the State of New York. Transfer office, 52 Wall Street, New York. The Empire mine is owned by this company; located in Utah mining district, Park City, Utah. Capitalization, $10,000,000; shares, 100,000.

Empress Gold Mining Company (The). Officers, Charles H. North, Pres.; C. F. Hall, Treas.; Clar. Hale, Sec.; Dr. Red, Superintendent. Name of mines owned, none named. Location of mines, Renfew, Nova Scotia. Amount of property in acres, 102. Capitalization, $60,000; par value, $1.

English and Blue Gravel Company (The). The mining property belonging to this company is located on Galice Creek, Oregon.

Esperance Company is represented by Messrs. Coleman, McLean, and others. The company have something like a half a mile of ground, situated in Nevada county, Cal., below the famous Milton mine, and supposedly on the same channel. The bed-rock tunnel is now in about 200 feet, but will probably have to be pushed 1,800 feet before reaching the gravel deposit being searched for. A full force of men are working on it day and night, Sundays as well.

Eastern Mining Company (The). The Whiskey Slide mine is owned by this company. Located in Calaveras county, Cal.

Essex Consolidated Gold Mine (The). M. Smart, Supt. Location of mines, Lyman, Grafton county, N. H. Quality and character of ore, impregnated with rich sulphates, being a porous, iron-stained, honey-combed quartz. Character of mine, vein eight to ten feet wide. Entrance by tunnel, 120 feet. Timbered.

Eureka Consolidated Drift Mining Company. The property is located in Sierra county, Cal. The company have actively prosecuted work. The tunnel, which is in blue cement, has been run a distance of 230 feet.

Eureka Gold Mining Company. This company was chartered under the laws of the State of Colorado. Location of mine on Calaveras river, Calaveras county (Grass Valley), Cal. The company own about 6,000 feet of pipe and a flume. During the last season about four acres of surface, averaging sixty feet in depth, were washed and yielded about $40,000. Capitalization, $2,000,000; shares, 20,000; par value, $100; number of dividends paid to April 29, 1878; amount, $2,149,000; date of last dividend, April 29, 1878; amount per share, twenty-five cents; stock quoted, January 1, 1882; shares not in market.

Excelsior Water and Mining Company (The). chartered under the laws of the State of California. Office is in San Francisco, Cal. The mines owned by the company are in Smartville, Yuba county, Cal. 525 acres belong to the company. Gold is the character of ore. Length of main lode, on which the company depends for its supply of ore, 521 feet. It is the leading mine of the county, one of the most extensive hydraulic enterprises of the State, and the principal supply of water is through its ditches. Company used in year ending March, 1880, 418,000 inches of water. In addition to the 525 acres of gold-bearing gravel, the company owns a farm of 2,300 acres, 300 of which are irrigated, and all well equipped and stocked. The improvements and appliances embrace six tunnels, the construction of which, before the acquisition of the property, had cost $441,000; 23,000 feet of the rock-paved flumes and undercurrents that had cost $50,000; 115 miles of ditches, which, with their strong, well-placed dams, had cost originally $1,000,000; two distributing reservoirs, having the capacity to store 13,000 inches of water over night; a complete hydraulic equipment, with all the buildings necessary for the most advantageous exploitation of so extensive a property. About 350 men are constantly employed to collect the tailings, and prevent their emptying into the Yuba river. The company has constructed a dam fifteen feet high and 800 feet long across the mouth of a ravine one mile and a half below their mines. It is intended to make the dam eighty feet high, and 2,000 feet long, with a slope of four feet to one. It is calculated that it will form a basin covering an area of 140 acres. The dam is formed principally of pine trees, covered with rock laid upon a foundation of stone, brush being placed upon the upper side, through which the water sweeps, retaining the débris. The company expect, by means of the dam, to be enabled to continue the workings of the gold gravel without violating the injunction suits or damaging the property of farmers in the Sacramento Valleys. Date of organization, March 9, 1879; capitalization, $10,000,000; shares, 100,000; par value, $100. Number of dividends paid to September 6, 1880, $850,000: date of latest dividend, September 6, 1880, twenty-five cents per share; number assessments levied, 18; total amount of same, $300,000; date of latest assessment, May, 1882; amount per share, twenty-five cents; yield (net) during 1880, $111,000. Stock quoted July 1, 1882, $4.50.

Fairview Gold Mining Company is chartered under the laws of the State of Colorado. The officers are J. L. Sprogle, Pres.; Jos. L. Fryer, Sec. and Treas. Directors, J. L. Sprogle, Jos. L. Fryer, T. J. Stewart, Thos. Barrett, A. Wasserman, D. P. Southworth, E. Klantscheck. Office, 310 Chestnut Street, Philadelphia, Pa. The company's property is located in Colorado. Capitalization, $2,500,000; par value per share, $5; basis, non-assessable; amount of stock issued, 200,000 shares; amount reserved in treasury, 25,000 shares.

Father De Smet Gold Mining Company is chartered under the laws of the State of California. The officers are J. B. Haggin, Pres.; J. Clark, Vice-Pres.; H. Deas, Sec. Offices, 404 Montgomery Street, San Francisco, Cal., and 14 Wall Street, New York. The company's mine, the Father De Smet, is located in Whitewood district, Black Hills, Dakota. The ore gives a gold assay and has a value of $10 per ton. The ore body shows a width, in some cases, of twenty-six feet. The company has an eighty-stamp mill, crushing at the rate of 2,318 tons of ore per week. The main lode is 1,500 feet in length. A rich strike was recently made on the second level of the Father De Smet mine. The ore body, showing a width of twenty-six feet, gives promise of widening to seventy-five feet. For the week ending June 8,625 tons of ore were extracted from the first level, 1,500 from second level, and 100 tons from third level. The North End tunnel is in 621 feet. The ore has an average assay of about $3.50 per ton. Current value of mine, $600,000. The annual report of this mine shows the gross receipts to have been $502,360.80, and the expenses $314,665.82. From March to December dividends were paid to the amount of $174,995, and there was a balance on hand January 1, 1882, of $42,826.65. The Superintendent says in a report of January, 1882, the ore is low grade, but our facilities for handling it are such that we can and will for the ensuing year run at a profit. Date of organization, January 23, 1878; capitalization, $10,000,000; par value per share, $100; yield during 1880, $277,730; yield (gross tons), 90,754, equal to 600,011; number of dividends paid to July 1, 1882, twenty; total amount of dividends paid, $520,000; date of latest dividend, July 1, 1882, twenty cents per share; number of assessments levied, two; total amount of assessments levied, $200,000; date of latest assessment, November 13, 1878, $1 per share; stock quoted July 1, 1882, $7.

Ferguson Consolidated Gold Mining Company is chartered under the laws of the State of California. Company's office, Sonora, Cal.; branch office, 17 Milk Street, Boston, Mass. The company's property is located in Mariposa county, Cal. The ore has a value of $10 per ton. The company have a ten-stamp mill, houses, shops, etc., valued at $30,000. Date of incorporation, 1879; capitalization, $5,000,000; par value per share, $30; basis, non-assessable. Total amount of dividends paid to 1881, $5,000; date of latest dividend, 1881, five cents per share.

Findley Gold Mining Company (The) is chartered under the laws of the State of New York. Geo. F. Peabody, Secretary. Office, 70 Broadway, New York. The company's mine is located in Lumpkin county, Ga. The mine is well developed, with ample ground to supply its two mills, 50 stamps. The quantity of ore at command is large. Three bodies of ore, of considerable thickness, are available, but only two are now exploited, for which forty inches of water are being used. Date of organization, June 25, 1878; capitalization, $200,000; basis, non-assessable; par value per share, $1. Yield during 1881, about $35,000. Total amount of dividends paid to May 26, 1879, $400,000; date of latest dividend, May 26, 1879. Stock quoted July 1, 1882, seventeen cents.

Franklin Gravel Mining Company have their works located at Dutch Flat, Placer county, Cal. Office, 310 Pine Street, room No. 44, San Francisco, Cal.

Franklin and McDonald Mining and Manufacturing Company. The Directors are A. O. Tinstman, Pres.; J. McCreighton, V.-Pres.; A. H. Moore, Gen. Mang.; Geo. F. Huff, Geo. W. Shallcross, R. Spencer, Sec. and Treas.; F. R. Shamuck, Asst. Sec.; Alex. P. Colesberry, Solicitor. Office of financial agents, Ladner Bros., bankers and brokers, 30 S. Third Street, Philadelphia, Pa.; transfer office, 38 S. Third Street, Philadelphia. The company's mines are located on the Etowah river, Cherokee county, Ga. These mines have been worked on a small scale in a primitive manner for over forty years, and hundreds of thousands of dollars have been coined from the Franklin mine alone. The company own 1,300 acres of land. Character of the ore, sulphurets predominate in quantity and richness. The poorest ores assay from $10 to $110; higher grade as high as $230 per ton. There are seven gold-bearing quartz veins running through the property for a distance of about three miles. The company have water-power on the spot. The main lode on which the company depends for its supply of ore is 500 feet in length. Capitalization, $10,000,000; par value per share, $100; basis, non-assessable. Stock reserved in the treasury, January, 1882, 20,000 shares.

Fresno Enterprise Company. The Directors are Judge James Grant, Pres., Leadville: Captain T. J. Lane, George H. Parker, W. H. McCormick, I. N. Farwell, David Kelly, J. D. Parker, George Elwood, H. Anderson, J. T. Warre. Henry Fisher, C. A. Toering, and James Thompson. The company's mine, the San Francisco, is located five miles from Merced, Cal., on the stage route to the Yosemite. The main lode is 1,500 feet in length, running northwest and southeast, and dipping to the southwest near the surface. Formation, slope. The developments under present company are four tunnel levels, two machine shafts, winzes. Ore is now being extracted which averages $163 per ton. The reduction works consist of three arrastras, of crushing capacity of 100 tons per month. Actual yield of ore crushed, $160 per ton. During last two years, $200,000 has been taken out, and $125,000 paid in dividends. Capitalization, $5,000,000; par value per share, $50. Total amount of dividends paid, $100,000; date of latest dividend, December 20, 1881, twenty-five cents per share. Yield during 1880, $102,086.

Fricke and Davis Mine (The). Messrs. Fricke and Davis, owners. Fricke Davis and Sebastian mines are owned by the above gentlemen. H. E Willey, Fred. Diner, Henry Dore, McConnell. These mines are located near Deadwood, Shasta county, Nevada. There are various mines, paying well, near Whiskeytown, and the recent developments (reported) in quartz near Deadwood has made French Gulf a prosperous town. The shaft's quartz ledge is on French Gulf and Deadwood, from which (1880) is cleared $1,500 per week.

Frost and Rule Mining Company's (The) property is located in Butte county, Cal., and is considered very valuable. It was purchased by Boston capitalists for $200,000. All stock is now bought up. The company have ten miles of ditch and flume, finest work of the kind in the State. There is a face of gravel 200 feet high and one to one and a half miles wide, extending back over the ridge for over five miles; an inexhaustible supply of gold-bearing ground. The stock and bonds are held principally in Boston, Mass.

Green Mountain Company (The). H. G. Bidwell, Pres. Green Mountain mine is owned by this company. Located in Plumas county, Nevada. The mill recently (1881) cleared $8,300 for a run of twenty days with thirty-two stamps, $10 per ton.

Gallibar Gold Mining Company. The officers are H. R. Fisher, Pres.; C. R. Titcomb, Vice-Pres.; H. M. Willis, Treas.; A. J. Savage, Sec. Directors, H. R. Fisher, H. M. Willis, A. J. Savage, G. H. Shultack. Superintendent, J. W. Douglass; has had a long experience in California and Nevada. Office, Portland, Maine. The company's property is located at Isaac's Harbor, Nova Scotia. The company own substantial mill buildings, boiler houses, mining machinery of the most approved pattern, including steam drills, air compressor pumps, and hoisting engines, superintendent's office, with director's parlor, and sleeping rooms. The shaft is 190 feet deep. The company's property promises to be a very productive mine. Eighty-six men are employed at the works. The company exhibit a bar of gold, weighing 149 ounces, taken from fifty-one tons quartz, and valued at $2,993. A body of quartz is in sight sufficient to supply mill for twelve months. Stock and bonds are held principally in the State of Massachusetts.

Glyn Dale Consolidated Gold Mining Company. Office, 115 Broadway, New York. The company's property is located in Bodie district, Mono county, Cal. It is situated on the western side of the cone of Silver Hill, just west of the Oro and Addenda, and is a consolidation of the Glyn and Dale locations. It has steam-hoisting works, the necessary buildings, and a shaft down 240 feet, work only having been commenced in the spring of 1881. The veins cut so far are not of a paying character.

Gold Alda Mining Company (The). Directors, P. A. Barney, W. H. Stanley, Joseph Nash, J. C. Plunkett, A. W. Blair. Location of mines, Nevada. Capitalization, $1,000,000.

Godfrey Gravel Mining Company. The Godfrey Gravel mine is located in Nevada county, Cal. This mine, after making fair returns, has been closed. It has been worked by the drifting method, the gravel having been crushed by mill process. Mr. Godfrey reports that as the gold cannot be increased, nor the expenses, at the present rate of wages, reduced, there are no immediate prospects of the mine being opened.

Gold Cliff Mining Company. Nathaniel Niles, Pres. and Treas. Transfer office, 61 Broadway, room 42, New York. The company's property is located in Calaveras county, Cal. They have a capitalization of $250,000, in shares at a par value of $2.50 each.

Gold Gravel Hydraulic Company (The) has its offices at 155 and 157 Broadway, New York. The officers are John H. Mortimer, Pres.; Geo. W. Warner, Treas.; Monroe E. Babcock, Sec. The properties of the company, comprising an area of 2,295 acres, are located in Plumas and Sierra counties, Cal. Capitalization, $1,000,000, in 200,000 shares of $5 each. In January last a proposal was made to reorganize on an assessable basis.

Gold Medal Mining and Milling Company's (The) works are located in Boulder county, Col. They have a capitalization of $1,000,000.

Gold Prize Mining Company (The). This property is located at Silver creek, Col. 1881. Produces a 3,600 gold retort from a recent seven days' run.

Gold Stripe Mining Company. L. D. Cartwright, Vice-Pres. Office, 18 Wall Street, New York. The Gold Stripe mine, owned by this company, is located in Greenville district, Plumas county, Col. The gold quartz is high grade, easy to mine and mill; it assays from $8 to $10 per ton. Two mills of fifteen and twenty-four stamps, respectively, are running steadily upon the ore. The prospects of the property are constantly improving. The recovery of the Goodwin ledge is an important strike. It was feared the vein was lost, but careful development work has succeeded in recovering it at the greatest depth of working in the mine. This gives 175 feet of unworked reserve of ore to the upper tunnel, where the vein averaged about twelve feet in width. The incline on this ledge has encountered a strong body of ore, eight feet wide, which assays very uniformly. They have drifted along thus for 130 feet, and the workings through the Kerr tunnel will give them about 200 feet of backs: the grade of ore at this point has always given good returns. The current value of the mine is $45,000. Forty tons of ore are being crushed per day. The mine has been worked for years, and has never failed in making a monthly shipment; twenty-two men are employed. The mill had been running six and a half days when the works were visited, June 30, 1882. The plates had hardly got in first-rate order, but on applying the hose with water they appeared to be covered well with amalgam. From the first day the yield from the plates alone would give a profit over all expenses. Capitalization, $1,500,000; par value per share, $10. Yield during 1880, $42,294. Total amount of dividends paid, $76,250. Date of latest dividend, June 30, 1881, fifteen cents per share. Stock quoted July 1, 1882, forty cents per share.

Go Slow Company. Their property is located just above the Kanaka claim, at Virginia Bar, Sierra county, Cal. This is a new organization. They are prospecting above the Kanaka claim, for the purpose of finding rich gravel at bed-rock, by sinking a shaft and drifting preparatory to building a wing-dam, and putting up a derrick.

Governor Group Gold Mining Company (The) is chartered under the laws of the State of Colorado. The officers are Fred'k M. Adams, Pres.; J. H. C. Whiting, Vice-Pres.; H. D. Hughes, Sec.; R. M. Blakemore, Treas. Directors, F. M. Adams, J. H. Whiting, R. M. Blakemore, H. D. Hughes, W. H. Drake, J. Warren Coulston, and W. C. Cranmer. The offices are at Jamestown, Boulder county, Col., and at 312 Stock Exchange Place, Philadelphia, Pa. The company owns the following mines: President, Governor, Denver Vein, Fannie H. Charter, and Star of the North, all patented except last named. Located in Boulder county, Col. The plant comprises a first-class roasting and amalgamation mill, of twenty-four tons' capacity, now in running order with all necessary machinery. There are two shafts, 244 and 262 feet deep respectively. The workings are all well timbered. The capitalization is $2,000,000, in 200,000 shares of $10 each, non-assessable. Bonded indebtedness, $25,000, secured by first mortgage bonds running three years from September 1, 1880, bearing 7 per cent. interest. Amount of stock issued, 185,000 shares; amount of stock reserved, 15,000 shares. Stock quoted July, 1882, twenty-five cents.

Granville Gold Mining Company (The) is chartered under the laws of the State of New York. Office, 23 Dey Street, New York. The company's property is located in McDowell county, N. C. The ore yields about $18 per ton. Character of the mines, gravel; hydraulic. There are 1,200 feet in the mine. The company have ditches twenty miles long, with a head of sixty feet of water. Date of organization, November, 1876; capitalization, $300,000; basis, non-assessable.

Graphic Mining Company. The officers are Col. Rush H. Field, Pres.; J. J. McRobbin, Treas. Mr. Youman is Supt. The company's mines, the Graphic Group and Champion, are located at French Mountain, Col. They own a number of claims in Little Half-Moon Gulch. The gangue of the vein is composed of porphyritic quartz, carrying galena sulphurets of iron. There are rich gold-bearing quartz leads. The company have several mills, and they have a tunnel 300 feet in length, which is located at right angles with the majority of the veins. This company own thirteen locations. Capitalization, $4,000,000; par value per share, $10.

Gravel Mining Company. Elisha Riggs, Pres. and Treas. Office, 18 Wall Street, New York, rooms 48, 49, and 50. The company's property is located at Black Hills, Custer county, Dakota. They have a capitalization of $5,000,000.

Great Eastern Gold Mining Company is chartered under the laws of the State of New York. Office, 31 Broad Street, New York. The Great Eastern, Flora Belle, Golden Rule, Badger, and Elgin are the property of the Great Eastern Company, located in the Black Hills, Dakota. The company also own the Exchequer, American No. 2, and several placer claims on Deadwood Gulch. Forty men are employed. The total product since July, 1877, is 50,000 tons of ore, crushed, and the value of the bullion, $200,000. The company's twenty-stamp mill, valued at $20,000, was one of the first erected in the Black Hills. The Flora Belle is reported to be of as good quality as the famous Belt mines, and would, with equal mill capacity, make large returns. The character of the ore mined is gold, having a value of $7 per ton. The main lode on which the company depends for its supply of ore is 1,200 feet in length. Current value of mine is $25,000. Date of incorporation, March 26, 1879; capitalization, $500,000; par value per share, $1; basis, non-assessable. Total amount of dividends paid, $24,000. Stock quoted July 10, 1882, five cents.

Green Mountain Gold Mining Company is chartered under the laws of the State of New York. The officers are H. C. Bidwill, Pres.; J. Jay Pardee, Sec. Office, 18 Wall Street, New York. The company's mine, the Green Mountain, is located at the north end of Indian Valley, Granville district, Plumas county, Cal. They own three contiguous claims and an extensive timber tract, all held under U. S. patents. The ore is free milling, assaying from $8 to $10 per ton. Vein is increasing in width as depth is attained; now about 100 feet wide. The company now owns ninety-two stamps, having lately purchased a new stamp-mill of sixty stamps, supplied with an ore-breaker and automatic feeders, involving an expenditure of $60,000. The stamps are about 800 pounds' weight with aprons eight feet long. The plates are all silver, and all silver plates extend down the sluice boxes opened. The company have also extensive water privileges applied through a six-foot Knight water-wheel under 400-foot pressure through eleven-inch iron pipes. The mill dump has a capacity of 1000 tons; mine cars, from which cars are loaded, a capacity of 800 tons. The current value of mine is $262,000. The mine is situated on the point of a high range of hills which rise on the southwest side of the valley. The average width of the lode is about fourteen feet, although it widens in places to thirty or forty feet. The country rock is granite, but at some points on the line of the lode it changes to porphyry, and at others to a stratified slaty material. The main tunnel is in upwards of 3,000 feet, and over 1,000 feet of pay ore have been penetrated. The lode crops at various places along the line, but has not been sloped to the surface. The west hanging-wall of the lode is found carrying a gouge, but the east foot-wall has not been found. A cross-cut is to be run to cut the same if possible. The ore is free milling and is worked by the ordinary stamp process, no concentrators nor stamps being necessary. The output of the mine is 150 tons per twenty-four hours. The mills crush the same. The quality of ore now taken from the shaft that is being sunk on the white ledge is superior to any milled for some time, and it is confidently expected that good results will be given. The mine shows a strong and permanent ledge, and when the lower Bidwell tunnel reaches the ledge it will give good reserves of ore to last for many years to come. The mine is in fine condition, and the indications in the face of the main drift of number five tunnel continue highly encouraging. Cost of milling is estimated at $2.50, including cost of delivery. The company have let a contract for running the number six tunnel 100 feet, at $6 per foot. The sulphuret ledge, east of the main ledge, has widened out from fifteen inches to thirteen feet, the quartz being of bluish color. Between numbers four and five tunnels two levels have been opened nearly 100 feet apart, and run further on the vein, exposing a good grade of ore. Date of organization, June 2, 1879; capitalization, $1,250,000; par value, $10 per share; basis, non-assessable; yield during 1880, $159,313; total amount of dividends paid, $212,375; date of latest dividend, November 26, 1881, seven and a half cents per share.

Headlight Mining Company. A. W. Rose, Secretary. Office, 302 Montgomery Street, San Francisco, Cal. The company's property is located in California.

Halle Mining Company (The) have two mines, the chief of which is the Blauvelt, located in Lancaster county, S. C., about thirty miles south of Monroe, N. C. The ore carries about three per cent. iron pyrites and is somewhat refractory; assays from $7 to $15. The character of the mine is described as one vast bed of talco-chloritic and micaceous schists, with alternations of siliceous schists. Ore masses, lenticular in shape, and with a width varying from six to sixty feet, and alternating with heavy bodies of nearly pure iron pyrites, sometimes eight feet thick. Mining plant includes a ten-stamp battery with other minor appliances to a more thorough treatment of the ore. An increased plant is contemplated, the present being adequate only for a production of 1,000 tons per month. The present administration is energetic and apparently supported liberally by capital.

Harney Hydraulic Company. The property of the company is located in Custer county, Dakota, and consists of about six miles of the bed of Battle creek, beginning a short distance below Harney City, and extending to almost the foot of Harney Peak, together with all bar and hill diggings on both sides of the gulch for the same distance; also, the placer ground of Grizzly Gulch. The claims include Harney, Everly Hills, and the celebrated Mitchell Bar, which are considered the richest portions of the entire possession. Applications for patents upon 400 acres have been made, and, as there are no adverse claims, the company will undoubtedly be successful. The main ditch has a total length of six and three-fourths miles. Three capacious reservoirs insure an abundant water supply even in the driest season. An average of fifty men have been employed during the season. The estimated total cost of the works is $42,000. Mitchell Bar has yielded $7.50 per cubic yard. The company propose to put in a bed-rock flume, beginning at the lower end of the ground, and wash everything within reach.

Haverley Golden Group Mining Company (The). Officers, J. H. Haverley, Pres.; Hon. H. H. Walker, Vice-Pres.; Col. N. P. Richmond, Sec.; C. N. Pratt, Ass't Sec.; A. F. Armstrong, Treas.; Richard Hieucheon, Supt. Head and branch offices, 116 Dearborn Street, Chicago, Ill.; Nos. 1151 and 57 Broadway, New York; 205 Washington Street, Boston, Mass.

Henrietta Gravel Mining Company. Location of works, California. Office, 309 California Street, San Francisco, Cal.

Hite Gold Quartz Mining Company. J. R. Bothwell, Sec., 2 Nassau Street, cor. Wall Street, New York. The company's mine, viz., the Hite, is located at Hite's Cove, Mariposa county, Cal. There are 1,000 feet in the mine. The prospects of the property are good. The mine has been worked successfully for the last fifteen years, and is still yielding ore in large quantities. The main shaft is opened into the 900-feet level. The company has completed several important improvements, consisting in putting in one of the largest compressors ever made, rebuilding the dam, repairing the flume, putting in new plates, and reconstructing the machinery of the mill, and other improvements belonging to the mine. A compressor-engine has been placed at the lower dam, and a mile of four-inch pipe has been laid to conduct the air to the pump, hoisting-engines, and power-drills in the mine. Shaft is being sunk to 500 feet. Capitalization, $2,000,000: par value per share, $10; basis, non-assessable. Number of dividends paid to August, 1878, thirty-eight; total amount of dividends paid, $1,370,000; date of latest dividend, August, 1878, ten cents per share. Stock and bonds held principally in New York.

Homer Land, Mill, Water Mining Company (The). The mines belonging to this company are located on Mill creek, Mono county, Cal. These mines embrace the best properties in the county. Tunnel used and shaft.

Hunters' Flat Gravel Company (The). The property owned by this company is located in Calaveras county, Cal.

Idaho Gold Mining Company. The officers are E. Coleman, Pres.; E. C. Creller, Vice-Pres.; J. C. Coleman, Treas.; Geo. W. Hill, Sec. E. Coleman, Superintendent. Office, 324 Pine Street, San Francisco California. In Grass Valley district is situated the well known Idaho mine, Nevada county, Cal., which may be considered as one of the representative gold mines in this State. We give some figures concerning this mine from their last annual report, as it will give readers a broad idea of the expense of running such a mine. After an expenditure of about $90,000 on the property, the Idaho mine commenced paying dividends in 1869, and with but few intermissions has paid regular monthly dividends ever since, the total number of such being 136, amounting to $2,830,300 out of a total yield in the twelve years of $6,140,188.02. The yield of the past year has been $440,445.59, out of which dividends to the amount of $127,100 have been paid. There has been paid out in dividends to the stockholders as follows:

Year.	*Dividend.*	*Per Cent.*	*Amount.*
1869	11	55	$170,500
1870	7	12	31,200
1871	12	75	232,500
1872	11	52½	162,750
1873	12	220	683,000
1874	12	102½	317,750
1875	11	55½	172,050
1876	12	82½	255,750
1877	12	77½	240,250
1878	12	85	263,500
1879	12	54½	168,950
1880	12	41	127,100

Being for twelve years 136 dividends, aggregating 913 per cent. on the capital stock, and amounting to $2,830,300. The ore worked during the year amounted to 28,072 tons. Of this amount 6,270½ came from the 800 level; 134½ from the 900 level; 6,051½ from the 1,000 level; 14,776½ from the 1,100 level; and 739 from the 1,200 level. This gave a yield of

24,457 ounces of bullion	$426,938 46
Sixty-eight tons of slime sold	1,252 00
Estimated cost working same	1,005 00
Tailings worked on shares	5,068 12
Thirty-six and three quarters tons tailing sulphurets	4,580 72
Fifty tons of buddle sulphurets	4,317 04
Sold ten and one-eighth tons sulphurets	689 85
Estimated cost of working same	202 50
Specimens sold	65 00
	$444,118 69

Yielding an average of \$15.82 per ton; average cost of milling per ton, \$9.29½. Following is a table of expenses for the year:

Milling, mining, repairing	\$260,611 43
Grinding tailing on per cent.	1,428 17
Exhaust fan for air shaft	425 00
Iron bobs for underground	719 00
Three plunger poles and castings	1,225 00
Steam capstan	1,648 64
Sinking incline	7,496 00
Prospecting on 1,000 level and cross-cut	1,578 25
General account	12,821 62
Saving sulphurets	2,542 50
Total expenses	\$290,795 61

The Idaho Quartz is the leading mine here. It has been a large gold producer for many years, and is at the present time one of the best in the State. We learn that the product of this mine has shown a marked increase in the last three or four months, and the future prospects are most excellent. Recent operations are reported in the Idaho as follows: a new fourteen-inch pump has been put in the Idaho mine, reaching from the surface to the 700 level, to take the place of the twelve-inch pump heretofore in use, which will increase the pumping capacity about twenty-five per cent. There are also being set up two steam capstans to aid in setting the pumps and making repairs to them when necessary, and as an auxiliary to the big pumping engine when extra power is required. During the extraordinary rains of last April a large amount of surface water had to be contended against, which found its way into the Idaho from the old workings of the Eureka mine, and it was all the Idaho pumps could do to hold the water. In fact, for several days they could not do so, as the pump tanks on the seventh and eighth levels were filled beyond their capacity, and the surplus water that escaped and fell below filled the workings of the mine up to the number ten level and interfered with work for some days. By putting in a pump of increased size all the surface water, which is troublesome as far down as the 700 level, can be handled easily and do away with all danger of flooding the mine. From the seventh to the eighth a nine-inch pump will be continued in use, and below the eigthh level a six-inch pump is as large as there is any necessity for. The company's principal mine is the Mayflower. The ore carries considerable quantity of sulphurets. Three distinct fissure veins present the peculiarity of being opened by levels to a depth of 1,070 feet and a length of 2,000 feet. At a depth of 1,200 feet the lode presents a clean regular face of four feet of quartz. Capitalization, \$3,100,000; par value per share, \$100; basis, non-assessable. The mine was opened in 1869, since which time the receipts from all sources have been \$6,780,295.60; amount paid in dividends, \$3,101,550. The success of the mine has been due as much to wise and judicious management as to the quantity and quality of the ore. During the year 1881, 27,945 tons of rock have been crushed, which have yielded an average of \$22.95¾ per ton; average cost of mining and milling during the year, \$9.51¼.

Idaho Springs Company (The). The mines owned by this company are Althea, Little Etta, Bulger, Manchester, Cleopatra, Garoo, Underwood, Alma Brooks, Helen Bassett, Winning Horse, and Gilbert. This property is located in Spring Gulch, Idaho. Cleopatra shows about sixteen in. ore, assaying \$210. Bulger, eight or ten in. vein, yielded fifty per ton in gold. Shaft on Little Etta, ten feet deep, width of three feet, gives a return fifty-nine per ton, specimens as high as \$800 recently reported so.

Indiana Hill Company. Their property is located in Placer county, Cal. The company have been running a mill for crushing the lower strata of gravel which, while generally very rich, is too hard or too thoroughly cemented to wash to advantage.

Indian Valley Mining Company. The property consists of the Indian Valley and Union mines, located in Plumas county, Cal. The mine is a mile above the town of Greenville, at an elevation of 500 feet above the valley from which it takes its name. A well-timbered tunnel has been run 1,000 feet under the old shaft of the Indian Valley into ore averaging eighteen feet in width. New hoisting and pumping machinery has been put upon the Blood shaft. This shaft is 700 feet deep, being 300 feet deeper than the tunnel leading to the mill. At the point where the tunnel intersects the shaft a level has been run eighty feet to the west and sixty feet to the east, all through low-grade ore. From the top of the shaft a way is graded to the upper tunnels; from these the ore will be run out and dumped down the shaft 400 feet to the inner end of the tunnel. The space left by the old stopes gives room for shutes, at which the cars will be loaded for the mill. The upper tunnels are being cleaned out and timbered so that ore can be taken from them as wanted. In the old condition of the mine no system could be discerned; now there is a comprehensive plan connecting all these tunnels and the shaft in one design. The arrangement is so good that all ore containing over \$2 per ton in gold can be worked at a profit. The mill has twenty-four stamps with Hendy automatic feeds. The ore is run through a rock-breaker and then passes directly to the batteries. There are six batteries of four stamps each, fifty-horse-power engine. Water is obtained from the Round Valley Water Company, whose ditch passes around the mountain 1,000 feet above the mill.

Iowa and Colorado Consolidated Mining Company (The) is chartered under the laws of the State of Colorado. The officers are Ex-Gov. John H. Gear, Pres.; Geo. Millard, Treas.. both of Burlington, Iowa; B. S. Ferris, Princeton, Ill., Vice-Pres.; Geo. A. Bailey, Glenwood, Iowa, Asst Sec.; John H. Shaw, State Agt. for Colorado; John Gibson, Creston, Iowa, Sec.; Bancroft, Gulch & McGaughan, attorneys and counsel. Directors, Hon. John H. Gear, W. Hale, Geo. Millard, James Callanan, Mr. McArthur, John Gibson, E. S. Jenison, John H. Shaw, B. S. Ferris, R. P. Smith, Geo. A. Bailey, Hon. W. D. Lucas. The company owns numerous claims (seventeen), mostly small; total area of same being about 529 acres. The character of the main lode running through the property is described as a true fissure vein. The ore is mostly free milling; estimated yield about \$12 per ton. The property is located in South Mountain Summit district, Rio Grande county, Col. The mining plant is complete, including thirty stamps. Capitalization, \$10,000,000, in 500,000 shares of \$20 each; non-assessable; 40,000 shares of treasury stock now on the market at \$1.50 per share.

Johnson Mine (The). Messrs. Sneden, Spence & Bennell, owners; D. H. Sullivan, manager and lessee. The Johnson mine is located in Inyo county, Cal., opposite Bishop creek. Mines consist of gold ledges, known as the Golden Era, Tender. Buena Vista. and Luella.

Jordan Creek Mining Company (The). This mining property is located at Yankee Fork, Idaho; is very rich in gold; reached bedrock, twenty-four feet; drain, 1,600 feet long, with an open cut, 550 feet; remainder, 1,050 feet. Is under cover and well timbered. Prospects are favorable.

Julia Gold Quartz Mine (The). Messrs. Sloan & Dunn, owners. The Julia quartz mine is located on Deer creek, Nevada county, Cal., above the Merrifield and opposite the Providence mine. Incline, sixty feet deep. Tunnel, forty-five feet. Good mill sight north of tunnel. The owners express themselves as satisfied with their claim; 1880.

Keystone Hydraulic Mining Company (The) owns property located in Colorado. The officers are J. A. L. Whittier, Pres.; C. C. Carpenter, Sec. and Treas.; D. T. Thompson, Gen. Manager. The annual election is held on January 16. Offices at 306 Pine Street, San Francisco, Cal. Capitalization, \$300,000.

King Bee Mining Company (The) has offices at 115 Broadway, New York city. Mr. T. W. Buzzo is Superintendent. The officers are A. J. Severance, Pres.; C. F. Collins, Vice-Pres.; D. C. Ferris, Treas.; and E. D. Barnes, Sec. The property of the company is located at Bodie, Cal. Capitalization, \$5,000,000, in 100,000 shares of \$50 each; non-assessable.

King Solomon Mountain Tunnel and Mining Company (The). Principal office, Howardsville, Col. The mining property belonging to this company is located at San Juan, Col. Capitalization, \$500,000; shares, 10,000; par value, \$10.

King's Mountain Mining Company (The) has property located in Gaston county, N. C. The ore is an impure limestone, with small percentage of galena and blende, iron and copper pyrites, etc. Two veins or ore bodies are being worked at present; they range from eleven to fifteen feet in thickness, and have but a trifling proportion of refractory sulphurets to lessen the yield of gold. The mining plant includes double batteries and other machinery capable of treating sixty to eighty tons per day. It is one of the most completely equipped establishments of the State. It has been a most productive mine. Depth of shaft, 320 feet.

Lady Emma Gold Mining Company (The). Officer, F. R. Bunker, Sec. Principal office, 606 Montgomery Street, San Francisco, Cal. The mining property belonging to this company is located in California.

Lilly White Mining Company (The). Officers, George White, President; Mr. G. W. Hodge, Superintendent. The mines owned by this company are Hortense No. 2, Silver Cliff, and others located on Mount Princeton, Colorado. The ore is gold chlorides, galena, and lead; assays \$100 per ton. The mineral is deposited in veins. Property owned by company is a mill (Waitz). The properties owned by the Lilly White Company are capitalized as follows: Stock, \$1,000,000; company has \$20,000 cash; stock in treasury, \$40,000.

Little Maud Mining Company (The) has offices at Boulder, Colorado, and at 42 S. Third Street, Philadelphia, Pa., Dunn, Smith & Co., bankers. The officers are Edwin Booth, Pres.; R. M. Townsend, M. D., V.-Pres.; Chas. D. Powell, Sec. and Treas. Directors, Edwin Booth, R. M. Townsend, M. D., C. C. Dunn, Jr., Sparta Fritz, and F. C. Arnold. The company owns two full claims, the Pickwick and Little Maud, located in Boulder county, Col. One shaft is down 110 feet, with drift 100 feet, to a second shaft of ninety feet. Capitalization, \$2,000,000, in 200,000 shares of \$10 each; non-assessable. Stock quoted January 1, \$1.

Little York Company (The). The property belonging to this company is located in Placer county, Nev.; running from hydraulic claims, one at Little York, Christmas Hill, Liberty Hill, and one at Remington Hill.

Louisiana Mine (The). Owned by Mr. Lombards. The Louisiana mine is located near Summersville, Tuolumne county, Nev. A new eight-stamp mill, hydraulic; vein ranging in width from one foot upwards is anticipated; will pay \$60 per ton; 250 tons are already on the dump, (1881.)

Magnolia Gold Company. Location of property, California. Total amount of dividends paid to September, 1881, \$15,000; date of latest dividend, September, 1881.

Manhattan Mining Company. The Directors are A. K. P. Harmon, C. E. Gibbs, E. B. Pond, M. Curtis, R. W. Paxton. Superintendent, Walter Birmingham. Office, 327 Pine Street, San Francisco, Cal. The company's property is located at Austin, Lander county, Nev. The main lode on which the company depends for its supply of ore is 129,810 feet in length. During the year 1881 the company received \$2,354,049.52 and disbursed \$2,358,892.15. Capitalization, \$5,000,000; par value per share, \$100; yield during 1880, \$997,400; number of dividends paid to February 1, 1877, eight; total amount of dividends paid, \$400,000; date of latest dividend, February 1, 1877. Number of assessments levied, three; date of latest assessment, July 16, 1879; cash on hand, February 4, 1882, \$4,160.25.

May Belle Gold Mining Company. W. J. Taylor, Secretary. Office, 310 Pine Street, San Francisco, Cal. Capitalization, \$10,000,000; par value per share, \$100; total amount of assessments levied, \$84,000; date of latest assessment, December, 1881, 20 cents per share.

Mayflower Gravel Company. J. Morizo, Secretary. Office, 328 Montgomery Street, San Francisco, Cal. The company's property, covering an area of 450 acres of ground, is located in the State of California. Character of the mine, fissure vein. Sixteen assessments have been levied. Date of latest assessment, May 31, 1882; amount per share, ten cents.

Maxwell Gold Mine (The). The Maxwell mine is located at Stockbridge, Wis.

Mendocino Flume and Mining Company. The officers are Albert W. Mann, President; W. A. Travis. Treasurer; John Chelvet, Secretary; W. T. Reily, Superintendent. Office, 79 Milk Street, Boston, Mass. Robert Harrison, attorney for the company on the Pacific coast; office, 430 California Street, San Francisco, Cal. The company's mines comprise 300 acres of valuable placer claims near Capella. Hardly a pan of gravel can be taken up in hundreds of acres at Catalpa, Mendocino county, Cal. (where these mines are located), that has not the color in it. The gravel is calculated for free working, as it is free from pipe clay. Mr. John Simpson, mining engineer, made a thorough examination of the property, and says he found gold from top to bottom in the prospect openings, yielding from thirty cents to \$1 per cubic yard. Leonard's Lake, owned by this compsny, has an area of sixty acres and an average depth of ninety-six feet, perfectly land-locked. Smith tract, which is also the property of this company, is covered with a dense growth of Oregon pine and redwood, also oak, alder, and mountain mahogany. This tract comprises 454 acres. The company will erect a saw-mill here. Reeves tract, owned by the company, contains 1,103 acres of the finest timber. This timber the flume brings to market at a cost (including cutting, manufacturing, and delivery) of \$6 per thousand, where it will find ready sale on delivery for from \$15 to \$35 per thousand, cash, according to kind of lumber. The reports of practical miners who have prospected the placer claims, place the receipts of the company from this source at over \$500 per day. The machinery, mills, houses, etc., belonging to Reeves' tract are valued at \$10,000. Date of organization, November, 1880; capitalization, \$1,000,000; par value per share, \$10; stock quoted July 14, 1882, 14 cents per share.

Menlo Gold Quartz Company, of New York. The property is situated between the New York Hill and Allison Ranch mines, Nevada county, Cal.; consists of seven mines, among which are the Homeward Bound, Wisconsin, Illinois, White Oak, Bowery, and Pennsylvania. The company is running a deep drain tunnel to tap all of these mines. On the Homeward Bound, the main shaft is sunk to the tunnel level 230 feet, and drifts are being driven both ways on the line of the tunnel. Two pumps, one eleven inch and the other eight inch, will be used to drain the lower levels. On the Pennsylvania, work has also commenced. This ledge has been quite extensively worked on the surface, the croppings having been taken out and worked for about 900 feet. The ground, however, was always wet, and as the Pennsylvania company had no pumping machinery, no great depth was ever attained. The Menlo company have purchased for this mine the pumping machinery and hoisting works formerly belonging to the Alaska company, which have sufficient capacity to sink a shaft at least 800 feet. The new shaft is a double compartment one, and heavily timbered.

Merced Hydraulic Company (The) is chartered under the laws of the State of New York. The offices are at 33 Wall Street, New York. The property of the company is located in Mariposa, Cal. The ore or gravel is auriferous. In February, the new cut of the company struck the old river bed, which was looked on as a valuable discovery, and from the appearance of the gravel bank, good developments are expected for some time to come. Capitalization, $600,000, in 120,000 shares of $5 each; non-assessable.

Milbourn Consolidated Company. The property covering an area of 600 acres of ground is located in Sierra county, Cal. Their gravel mine is three miles north of South Forks, at Bassett's, toward Gold Lake, ten miles north of Sierra city. They have been sinking a shaft, having let the contract for 800 feet at $1.99 per foot. The shaft when sunk 140 feet, was in good-looking quartz gravel. Many boulders were encountered in sinking the shaft, which impeded its progress.

Monte Christo Consolidated Mining Company (The). Butler Burris is Sec. Principal office is at 309 Montgomery Street, San Francisco, Cal. The company's mining property is located at Spanish Peak, Plumas county, Cal. Work is going on satisfactorily. Every cross-cut and shaft more thoroughly proves the value of the property. A building for the engine has been put up, and the engine and air-compressor are being put in place. A large Burleigh drill is also being fitted up. The main tunnel is to be run ahead several hundred feet this winter, and it is calculated that room for a large force of miners will be made by spring. The developments lately made show that the rich blue gravel is plentiful, and all that is necessary is time to open it and put it in a shape to handle rapidly. This winter will be devoted to that purpose.

Massachusetts Mining Company (The). The property is situated in Yuba county, Cal. The company are opening Garden Valley claim, on Willow Creek, between Comptonville and Bullard's bar, which property was mined to some extent in the early days, but the tailings from the mines above drove out the miners, and covered the pay-gravel up from twelve to twenty feet deep. It is now proposed to rework the whole deposit.

Nevada Mining Company (The). The mines belonging to this company are located at Richland, Nevada. Free gold and sulphurets is the character and quality of the ore. Depth of tunnel is 200 feet; tunnel drifts, 400 feet; ledge, eighteen to twenty inches in width—1881. Very encouraging prospects.

Nevada Reservoir and Ditch Company. The property is located at Smartsville, Yuba county, Cal. The company is associated with the Golden Gate company, and reports the second largest production in the county. The gravel of this mine can all be worked from the bed-rock to the surface, and will pay an average of forty-two cents to the cubic yard. The Golden Gate claim has, during about ten years' work, washed away some seven acres of land, which has produced $1,250,000.

New York Hydraulic Mining Company. Their property is located at Morristown, Sierra county, Cal. The company have commenced drifting in one of their claims, which is the first mining done by that process in the camp. Storage dumps have been built, and everything is in readiness for operating on an extensive scale. Sixteen men are employed at present, but this force will be increased as soon as a sufficient quantity of water can be procured. A large portion of the company's ground can only be worked profitably by the hydraulic process.

New York Hill Gold Mining Company (The) has property located in Grass Valley, Nevada county, Cal. The New York Hill mine has continued successful operations during the past year. In the spring there was some falling off in the receipts, owing to the bad condition of the roads, caused by stormy weather, which prevented the hauling of ore to the mill; but the quartz crushed yielded an average amount of bullion. The workings of the mine are all in a favorable condition, and the prospects are that it will continue to pay its regular dividends. Capitalization, $5,000,000, in 50,000 shares of $100 each; $195,000, amount of eight dividends paid to September 1, 1881, the date of latest dividend, which was at the rate of twenty cents per share: six assessments; total, $55,000 levied to March 26, 1878, date of latest dividend; treasury reserve, June 10, 1882, $14,539,86; no stock in the market.

Niagara Irrigating and Water-Power Manufacturing Company (The). The company's property is located in Bent county, Col. The company has a capitalization of $100,000.

North Carolina Gold Mining and Reduction Company (The) has offices at 205 Walnut Street, Philadelphia, Pa. The officers are Wm. Morris Davis, Pres.; Henry C. Davis, Sec. and Tress. Directors, Wm. Morris Davis, Chas. Gibbons, Edward M. Davis, Jr., W. J. Ladd, J. N. A. Griswold, Henry C. Davis, Benj. Jacobs, and Edward M. Davis. The property, comprising an area of 737½ acres, is located at Salisbury, N. C. The company was organized at Portland, Maine, February 9, 1881. Capitalization, $1,000,000, in 200,000 shares of $5 each.

North Hite and Yosemite Gold Mining Company (The) has offices at rooms 22 and 23, 58 Broadway, New York. The agents in Boston, Mass., are H. Whitney & Co., 17 Milk Street; agents in Philadelphia, Pa., Tracey & Vall, 312 Stock Exchange Place. The officers are H. Spooner, Pres.; L. F. Leaman, Sec. and Treas.; H. Williams, Gen. Agent; W. W. Clewell, Financial Agent. The property of the company is located in Mariposa county, Cal., and lies adjacent to the famous Hite mine. It lies between two of the most celebrated and best paying mines, and possesses extraordinary advantages of timber: mill site and water privileges equal to any in the State. Capitalization, $1,000,000, in 500,000 shares of $2 each.

Ogden Gold Mining Company (The). Officers, James E. Thomas, Pres.; John H. Avery, Sec. and Treas., Chicago, Ill. Headquarters of the company, Chicago, Ill. The mining property of this company are located in Ogden, Utah. Eight claims of 600 and 1,500 feet are owned by the company. Property lies between Taylor and Waterfall Canyons, and within three miles of the depot of Ogden City. Organized in the year 1880 by Judge Brewster; capitalization, $1,000,000; per share, $10.

Old Gold Mining Company (The). Date of organization at Kiltory, October 22, 1881; capitalization, $500,000.

Olsen Gold Mining Company (The). Officers, Milton S. Latham, Pres.; A. T. Beach, Sec. Principal office, 18 Wall Street, room 23, New York. The mining properties of this company are located in Tuolumne county, Cal. Capitalization, $2,000,000; shares, 200,000; par value, $1; stock quoted July 1, $34.75.

Ontario Mine (The), owned by Lieutenant-Gov. Tabor. The location of Ontario mine owned by Gov. Tabor is in Summit county, Col., near French Gulf. The developments are by shafts. The ores met with are of good quality.

Oregon Hydraulic Gold Mining Company (The) has offices at 414 California Street, San Francisco, Cal. The property of the company is located in Oregon. Organized with a capitalization of $60,000, in 3,000 shares of $20 each; dividends paid to December 10, 1881; aggregate, $2,250; amount of latest dividend, December 10, 1881; twelve and a half cents per share; stock quoted.

Original Gold Hill Gold and Silver Mining Company (The). Officer, J. M. Buffington. Principal office, 309 California Street, San Francisco, Cal. The mining property of this company is located in Nevada.

Oriental Company (The). The mines are located on what is known as the Canada Hill Channel, Placer county, Cal. They have sunk a prospect shaft in the cement eighty feet to bed-rock, and drifting from it found ground warranting the running of a bed-rock tunnel next season. The Canada Hill Channel is at an elevation of about 7,000 feet, and, contrary to the ordinary course of the buried river channels of the Sierras, runs from west to east. The gold is a coarse quartz, very little washed, and often connected with its original quartz matrix. The sources from which this quartz comes are evidently ledges in the immediate vicinity, Several of these ledges have been prospected, and yield well.

Oriental Mining Company (The) has property located in Nevada. The total length of main lode on which the company depends for its supply of ore is 1,500, the size of the claim being 300 by 1,500 feet. The company is organized with a capital of $2,000,000, in 200,000 shares of $10 each.

One Thousand and One Gravel Company (The). The property is located in Sierra county, Cal. The company is steadily driving its main tunnel, now 950 feet long, and contemplate also sinking for the bed-rock, which is supposed to be about twenty feet below the tunnel-level. A scarcity of water has somewhat retarded their operations.

Ourang Outang Quartz Mining Company (The). The mines owned by this company are located at Shaker Ridge, Amador county, Cal., southeast from the Golden Gate mine. Mr. Heath, from Whitmore's mill, struck some very fine ore and diggings on Mill creek.

Painsville Company (The). Their mining property is located in Ord district, San Bernardino county, Cal. The ore is of rather low grade for milling, yielding principally gold. The company has spent over $35,000 in developments, and now contemplates building a mill on the Mohave, twenty miles away, and also a tramway from mines to mill. The chief claims are the Painsville and the Rio Vista, on which shafts have been sunk with communicating tunnels and horizontal drifts. Besides these, there are the Coupon, Last Chance, Central, Modesto, Josephine, etc., all belonging to the same company, and upon all of which some work has been done.

Park Range Mining and Prospecting Company (The). Stockholders, A. W. Campbell, George H. Robinson, W. D. Chapman, James H. Hawley, Wm. M. Glassou, F. B. McNorton, E. N. Fenkell, and others. One hundred and sixty acres owned by the company, mill run two and one-half to 176 ounces in gold. Veins showing 700 feet above the primitive rock. Capitalization, $50,000; shares, 5,000; par value, $10.

Phœnix Company (The). The property is located in Sierra county, Cal. The company have developed a chimney 250 feet long; the ledge is from three to six feet wide, and the ore averages $30 to the ton. It is reported that the owners lately refused $125,000 for this mine, which speaks well for the confidence they have in its richness and permanency.

Placer Mines (The). Quirolo & Co., owners. The Placer mines are located in Amador county, Cal. More work has been done around Pine Grove than for years. Quirolo & Co. have a hydraulic claim in full blast. Grass Valley running a good force under the management of J. Bradshaw. J. L. Wheeler is operating a claim near the Grove. W. R. Hayes and others have been employed on a placer mine on the Stanley branch.

Plumas Eureka Gold Mining Company. Office, Merchants' Exchange, San Francisco, Cal. The company's mine, the Plumas Eureka, is located in the State of California, near Jamisou city, Plumas county, on the top of a mountain some 3,000 feet from or above the creek, and is said to be one of the best imbedded quartz mines in the State. The tunnel is 3,400 feet in length. The quartz is drawn out in large iron cars by mules, each car containing one and a half tons of quartz, and five cars are taken out each trip. The lode is from four to twenty feet in width. At the mouth of the tunnel is a large steam-boiler; the steam is forced in through iron pipe, driving two engines in the mine used for hoisting ore. There is no waste rock, everything is crushed. Their mills are run by water-power. A lake is located on the top of the mountain from which water is obtained. The company built a new sixty-stamp mill at the foot of the mountain. It has sixty stamps, three ore-breakers, self-feeder, twenty-four pans, and all modern improvements for saving gold. All the machinery is run by a turbine wheel. A tunnel is now running from the mill to the lode, and will tap the lode at least 1,000 feet lower than it has ever been worked before. This mine is systematically worked, and appears to be on a sound financial basis. The mine has a current value of $510,812. Capitalization, $4,062,500; par value per share, $100. Total amount of assessments levied, $1,509,219. Date of latest dividend April 14, 1882, seventy-five cents per share. Stock quoted June 10, 1882, $12.50.

Plumas National Quartz Mining Company's property is located at Loda creek, Plumas county, Cal. The ore is quartz, rich in sulphurets. The company's property includes seven fine concentrators, to collect sulphurets, and it is their intention to add a furnace and chlorination works. Total value of plant, $300,000. Valuable developments are reported in the lower tunnels. Main pay shute is over 600 feet in length, with rich pay ore still in the face. There is a supply of ore many years ahead of present capacity for crushing. Capitalization, $1,000,000; par value per share, $10. Total amount of dividends paid, $141,000. Date of latest dividend, July 22, 1879, eight cents per share. No assessments have been levied. Stock quoted July 1, $1.00.

Prince Albert Gold Mining Company (The), of which T. B. Donaldson is the Supt., and D. J. H. Rae, Pres. and Man., is organized with a capital of $60,000, in 60,000 shares of $1 each.

Pigeon Roost Mining Company (The). The property belonging to this mining company is located in Lumpkin county, Georgia. Machinery operated by a turbine water-wheel. The mine is well developed and provided with the best appliances to secure economy and efficiency. Considered the richest mine of the section in which it is located. Yield, gross, during 1879, $35,000; probably same for 1880.

Paradise Mining Company (The). The mining property belonging to this company is located at Paradise district, Nevada. Very rich ore; eighteen tons daily. This company employ forty men. Ships nearly 200,000 tons monthly. Property owned is a twenty-stamp mill; fifty cents per share.

Pacific Consolidated Mining Company. The company's property is located in the State of California. Capitalization, $600,000; par value per share, $100; total amount of assessments levied, $126,000; date of latest assessment, January, 1882, twenty cents per share.

Rappahannock Mining Company is chartered under the laws of the State of New York. Office, 60 Broadway, New York. The company's property is located in Stafford county, Virginia, and covers an area of 345 acres, including buildings worth $6,500, and machinery valued at $10,000. The ore is free milling and carrying gold, and has a value of $12 per ton. Date of organization, July 22, 1879; capitalization, $250,000; par value per share, $1; basis, non-assessable.

Red Hill Hydraulic Mining and Water Company. This company's property is located at West Branch, Feather river, near Magalia, California. The Red Hill is one of the oldest claims in the country, its location dating back to 1852. Late expenditure of $30,000 has been made in dams, flumes, giants, pipes, buildings, etc. The property is under the direction of experienced miners. Six assessments have been levied, the latest was levied May 10, 1882, at the rate of ten cents per share.

Renfrew Gold Mining Company (The) is chartered under the laws of the State of Maine. Dr. Julio H. Rae is General Manager. The company's property is located at Renfrew, Nova Scotia, covering an area of 134 acres. There are ten good veins of free gold quartz. The company owns one eight stamp-mill, hoisting and milling machinery driven by water-power, houses, shops, and tools. Date of organization, October 30, 1881; number of dividends paid to March 1, 1882, three; date of first dividend, January, 1882; amount, $600,000; date of latest dividend, March 20, 1882, paid at the rate of one per cent. of capital stock.

Resumption Mining and Smelting Company is chartered under the laws of the State of New York. Office, 35 Wall Street, rooms 7 and 8, New York. The company's mining property consists of the Niwot Gold and Silver mine, located at Ward mining district, Boulder county, Col. The company has a capitalization of $500,000; par value per share, $1.

Ricci & Company's Mine (The), Mr. George Bowen, owner. This property is located at El Dorado, Cal. Remunerative since 1866.

Rising Sun Gold Mining Company is chartered under the laws of the State of New York. L. D. Cortright is Secretary. Office, 18 Wall Street, New York. The company's mine, the Rising Sun, is located in Placer county, Cal. The ore is high grade, free milling quartz, and assays $28 per ton. The ledge is three and a half feet wide. The company owns a new twenty-stamp mill, which was reported to be running on full time July 1, 1882. The engine is being replaced by a new and larger one; self-feeders will be put in; another pair of Eureka rubbers will be added, and the concentrating machinery will be increased in proportion to the increased capacity of the mill. The pumping engine is also to be replaced by a larger engine. In order that there may be no doubt about keeping the twenty-stamps employed, a new hoisting shaft is being sunk on the ledge some 800 feet west of the present works. This shaft is now down a little more than 150 feet on a large, well-defined ledge of highly sulphureted ore, showing considerable free gold, which is reported as surpassing the best ore ever mined in the eastern part of the mine. It has gradually been improving in condition the past month. The ledge in the 500 level west has also gradually improved since it was struck both in strength and richness, and if it holds out as it gives promise, the production will be very largely increased. The mine has a current value of $23,000. Capitalization, $750,000; par value per share, $5; basis, non-assessable; total amount of dividends paid to May 31, 1881, $51,875; date of latest dividend, May 31, 1881, at the rate of seven and a half cents per share.

Robinson Gold Mine. The officers are Lewis Robinson, Pres.; George G. Fryer; Treas.; Daniel Carhart, Sec. The directors are L. W. Robinson, G. G. Fryer, E. P. Roney, Alfred H. Cordey, G. C. Fitzgerald. Ed. P. Roney is Superintendent. This property lies in the gold belt in Spottsylvania county, Virginia, about eighty-two miles from Washington, and five miles from the Potomac, Fredericksburg, and Piedmont (Narrow Gauge) Railroad. The gold belt in this section of Virginia is from fifteen to twenty miles in width, running in a north-east and south-west direction, and belongs to the Montalban group of the Archæn formation, the strata being composed of a series of slates interstratified with trap-dykes, veins of gold-bearing quartz, seams of iron, manganese and copper ores, and overlaid in many places by the debris of the same carrying much free gold forming placers, which have been worked profitably during the past fifty years with very rude and simple processes. Little prospecting has been done so far owing to the property being so heavily timbered. No developments except a dam and a few sluices.

Rocky Point Mining Company. The company's works are located a few miles above Auburn, on the middle fork of the American river, Placer county, Cal. They are putting in full time prospecting their claim, working day and night. Some paying gravel has been taken out of this mine.

Sierra Nevada Company (The). Mr. John Steel, Mang. The property belonging to the company is located at Cedar Hill, Cal. Rich quartz gold. The mines are entered by drifts. The whole hill is reported to be so rich in gold that, could water be obtained, it would pay to sluice down everything sluicable found on its surface.

Sailor Flat Hydraulic Mining Company. The property is located at Blue Tent, Nevada county, Cal. They made their first clean up in March, taking out for the season a considerable amount of gold.

Sacramento Mining Company is chartered under the laws of the State of Colorado. The officers are W. B. Frue, Pres.; J. Hobson, Vice-Pres.; R. G. Lay, Sec. and Treas. Offices, 62 Broadway, rooms 12 and 13, New York, and Sacramento, Cal. The company's mining property is located six miles west of Fairplay, at the head of Sacramento Gulch, Park county, Col. The property embraces seven mining claims, covering seventy acres. The ore body varies from one-half foot to nearly six feet in thickness, mainly argentiferous galena. Value per ton, $260. Date of organization, December 21, 1878. Capitalization, $2,000,000; par value per share, $10. Basis, non-assessable. Stock, full paid.

Sam Christian Gold Mining Company. The officers are G. A. Benson, Pres.; C. W. Schwartz, Vice-Pres.; H. B. Carpenter, Sec. and Treas. Directors, G. A. Benson, C. W. Schwartz, H. B. Carpenter, N. S. Higgins, W. R. Stockham, J. R. Vallance, W. I. Sharpless. The Superintendent is N. S. Higgins. The company's property is located in Montgomery county, N. C. The property embraces the Placer and Creek deposits, on the Wilson Moor and Gains' tracts, besides those of the original South Carolina tract, 1,200 acres, on Rock and Clark creeks. The company has a capitalization of $600,000. Par value per share, $10.

Sampson Flat Mines (The), owned by Little, Beebe & Co. The Big Sampson mine, belonging to this company, is located in Fresno county, Cal. Assays $90 to $100 in gold per ton. Ledge, eight feet wide.

Seaton Gold Mining Company. A. Warren is Treas. Office, 528 California Street, San Francisco, Cal. The Seaton mine, owned by the company, is located at Dayton, Amado county, Cal. Number of assessments levied, one; date of assessment, June 6, 1882. Fifteen cents per share.

Senate Mine. Owned by Hon. James Moynahan. Location of mine, near Alma county, Mosquito Town, Col. Character of ore, gold. Assays per ton, $50. Vein is from three to five feet in thickness.

Sir Roderick Dhu Gold Mining Company. John McGinnis, Jr., is Pres. The company's property is located at the Black Hills, Dakota, adjoining the Father De Smet mine. The company have a fine 100-stamp mill at the works. Capitalization, $2,000,000; par value per share, $10.

South Hite Mining Company (The). Officers, F. A. Berlin, Sec., California; J. T. Fowler, Assist. Sec., New York. Date of meeting, annual election, January 9. General office, 429 Montgomery Street, room 29, San Francisco, Cal. Rooms 44 and 45, No. 35 Broadway, New York. The mines are located in Hite's Cove, Mariposa county, Cal. Capitalization, $2,500,000; shares, 100,000; par value, $100. Date latest assessment, May 3, 1882; amount per share, 10 cents. Mining Record, June 17.

South Side Milling and Mining Company (The). Officers, J. F. Tabor, Pres.; John J. McGowan, Sec. General office, Nos. 4 and 5 Boston Block, Leadville, Col. The mining property belonging to this company is located in Lackawana Gulch, Lake county, Col. Gold-bearing quartz veins. Capitalization, $3,000,000; par value, $10 per share.

South Idaho Quartz Mining Company (The.) Directors, A. Teal, E. E. Webster, W. A. Nygle, C. H. Moore, A. St. Paul. The mining property of this company is located in Nevada county, Cal. Company was organized March 3, 1880; capitalization, $300,000.

South Zuba Water Mining Company (The) of New York. The mines of this company are located in Nevada and Placer counties, Cal. Medium grade ore ledge, four feet thick. Property owned is Richmond power-drills. Fine concentrators in mill, which is kept running night and day. Canals and ditches in thorough repair. The Fordyce and the many other reservoirs of this company contain 1,800,000,000 cubic feet of water, or capacity for such a quantity. Length of upper level, 300 feet; lower or main, 700 feet. Organized at New York. Amount of dividends paid to October 15, 1881, $82,000; date of latest dividend, October 15, 1881, seventy-five cents per share.

Spring Valley Hydraulic Company (The) is chartered under the laws of the State of New York. Directors, A. K. P Harman, Isaac L. Regna, Thomas H. Williams, C. C. Frank. The mining property, consisting of the Cherokee Flat Blue Gravel mine, located in Oreville, Butte county, Cal.; 1,200 acres of land owned by the company. Ore slightly mixed with platinum of the finest quality, assaying 950 to 985, fine gold. Current value of mine, $580,000. Upwards of a million dollars expended in constructing ditches and reservoirs, purchasing farms, which were covered with tailings, and for other improvements which are intended to give permanency to the mines. There are eighty miles of ditches and several miles of iron pipe, carrying over 2,000 inches of water. A tunnel nine feet by nine feet high is being run, which will open the mine 100 feet deeper, so that from fifty to eighty feet of bottom gravel can be worked; and, as this is very rich, it is estimated that the production will be increased to $700,000 per annum. A large force of men are employed, and about fifteen hydraulic chiefs are at work. The mines are lighted by electricity, reports say, with perfect satisfaction. Property owned, 100 miles ditches, 400 acres of reservoirs, 3,300 acres of put-up ground for tailings. Date of organization, March, 1879; capitalization, $200,000, par value, $1 each. Yield during 1881, $74,500. Amount of dividends paid to January 5, 1881, $50,000; date of latest dividend, January 5, 1881; amount, twenty-five cents per share. Stock quotations, July 1, 1882, $2.75. Maximum yearly capacity of production, January 1, 1882, $500,000. Wages paid to all classes, $2,500.

Standard Consolidated Mining Company (The) is chartered under the laws of the State of California. The officers are R. Cook, Vice-Pres., and W. Willis, Sec. Offices at 26 Exchange Place, New York, and room 29, 309 Montgomery Street, Nevada Block, San Francisco, Cal. The company owns the Standard and Bulwer claims, 1,200 by 1,500, located on Bodie Bluff, Mono county, Cal. The ore is of fair average grade, assaying about $60 per ton. Ledges of this ore vary from five to twenty-five feet in width; the rock is somewhat hard; depth of workings, 2,400 feet; length of drifts and cross-cuts, 1,139 feet. The company has seven mills aggregating 120 stamps, including Bulwer Standard of thirty stamps averaging 120 tons per day; total capacity of stamps about 400 tons per day; yet insufficient or inadequate to present requirements, April 26, 1882. During past week the company crushed 1,306 tons of ore, from which was received, crude bullion, 3,265 ounces, worth $15,420. This company has also a foundry and machine-shop, prepared to do all kinds of casting and machine work for mills and mines; the cupola and crane of full capacity of heat for all present demands; two steam hoisting works; large air-compressors; Cornish pump, etc., of capacity to sink 2,000 feet; 150 men are employed; developments were commenced in 1877. The present condition and prospects of this great mine are too well known to need comment. Only in January last (1882) the mine produced in gold, $145,954, and in silver, $14,190. Current value of the mine is $1,725,000. The mine was purchased for a nominal sum a few years ago by the Cook Bros., who still retain a controlling interest. It was not incorporated until it was sufficiently developed to show a business proposition. In this respect it differs from scores of other mining corporations. Usually, the incorporation of a claim takes precedence of its development. That is a strong point with a certain class of operators, who think they have nothing of value until the certificate book is ready. The Standard has never been assessed. The Standard paid fifty-three dividends in fifty-one consecutive months. The dividends of the Standard have been as follows:

September, 1877	$50,000	March	$50,000
October	50,000	April	50,000
November	50,000	May	50,000
December	50,000	June	50,000
January, 1878	50,000	July	50,000
February	50,000	August	50,000
March	50,000	September	50,000
April	50,000	October	50,000
May	50,000	November	50,000
June	50,000	December	50,000
July	50,000	January, 1880	50,000
August	50,000	February	50,000
September	50,000	March	75,000
October	50 000	April	75,000
November	50,000	May	75,000
December	50,000	June	75,000
January, 1879	50,000	July	75,000
February	50,000	August	75,000

September	$75,000	May	$75,000
October	75,000	June	75,000
November	75,000	July	75,000
December	150,000	August	75,000
January, 1881	75,000	September	75,000
February	75,000	October	75,000
March	75,000	November	75,000
April	75,000	December	150,000
Total			$3,300,000

Organized, April 11, 1877; capitalization, $10,000,000, in 100,000 shares of $100 each; yield to January, 1880, 51,239 tons of ore; value in gold, $2,990,000; in silver, $179,386; total, $3,169,386.

1877	$784,522 80
1878	1,025,383 35
1879	1,448,845 47
1880	1,858,763 46
Total	$5,117,515 08

Total dividends paid, $4,125,000, to June 12, date of latest dividend of seventy-five cents per share; $50,000 was levied in assessments to July 1878, the date of latest assessment; stock reserved in treasury, $267,494; stock quoted July 1, $18.25. The yield during 1881 is estimated at over $2,000,000.

State Line Gold Mining Company (The) is chartered under the laws of the State of New York. Officers, Lee R. Shyrock, Pres.; George D. Roberts, Treas.; D. F. Verdenal, Sec.; Isaac M. Taylor, Supt. The names of the mines owned by the company are State Line Gold Mining Company, Nos. 1, 2, 3, 4, located on Gold Mountain district, Esmeralda county, Nevada. The following assays of State Line ores were made at our request by Professor Richards, of the Institute of Technology. These assays are from samples taken at random from a shipment of ore recently received from the mines, represented as the average sample rock in the drifts. Much of the ore runs into the thousands, as reported by Professor Kaufman. The assayer at the mines represents the average ore as considerably over $100. Sample No. 1 assayed $477.48; No. 2, $409. 27; No. 3, $31 gold. So far as appearances go, one could not detect any difference in the sample of quartz. The quartz is of peculiar structure, showing no free gold. Capitalization, $5,000,000; shares, 200,000; par value, $25.

Star Consolidated Gold Mining Company (The) of Maine. The mines belonging to this company are located in Boulder county, Col. Capitalization, 250,000 shares; $14,000 paid in.

Steep Hollow Gold Mining Company. Office, 310 Pine Street, San Francisco, Cal. Location of works, Liberty Hill district, Nevada county, Cal.

Summit Gold Mining Company (The). Officers, W. H. Lent, Sec. Office, 309 Montgomery Street, San Francisco, Cal. The mines of the Summit Mountain Company are located in California.

Swamp Angel Gold Mining Company (The). Officer, Charles W. Badger, Sec. Office, 315 California Street, San Francisco, Cal. The mines belonging to this company are located in California.

Sonora Consolidated Mining Company (The) is chartered under the laws of the State of New York. The officers are O. G. Dawson, Pres.; H. K. Adams, Sec., and C. P. Wood, Treas.; Geo. S. Herrick, Supt.; Offices, 43 Exchange Place, New York. The company owns seven mines; the Sonora, Polar Star, War Eagle, Pogonip, Pocosillo, Ontario, and Margarita, located in Bodie, Cal. The location is considered most favorable. The developments consist of a double compartment shaft, timbered to a depth of 107 feet, now cross-cutting on the vein formation. Capitalization, $10,000,000, in 100,000 shares of $100 each; non-assessable for ever. Title complete; $12,000 has been paid in dividends.

Stein's Pass Mining Company is chartered under the laws of the State of New York. The officers are W. Barker, Pres.; A. Daprat, Treas.; J. S. Sherburne, Sec. Office, 66 Broadway, room 46, New York. The company's mine, the Alaska, is located in New Mexico. A very rich body of ore has been uncovered in the Alaska mine, situated in the vicinity of Hard Money mine. This is one of the most important strikes made in this vicinity for some time. The shaft is 200 feet deep. Capitalization, $1,000,000; par value per share, $5; basis, non-assessable; full paid. Treasury reserve, 80,000 shares.

True Mining Company (The). The mines owned by this company are the Young Harman, True, and Halleck, 300 feet. Located in Placerville, El Dorado county, Cal. Assays per ton, Young Harman, $6 to $8 per ton. True mine, $8 to $15. Property owned, a stamp-mill, water-power, 1,000 feet seven-inch pipe, and fall of 500 feet, requiring only thirteen feet of water to run the mill. Cost of milling per ton, $1.25.

Tuolumne Gold Mining Company (The). Officers, George R. Eager, Pres.; Charles Wendall, Sec. General office, 69 Milk Street, Boston, and 21 Nassau Street, New York. Located in Tuolumne county, Cal. The company has 125 miles of ditches, six miles of flumes. Grade of ditches, eleven to thirty-two miles; total cost of plant, $300,000; ditches cost about $4.50 per yard, flumes, $14 per yard, and pipes $6 per yard. Capitalization, $1,000,000; shares, 200,000; par value, $5.

Taylor Plumas Gold Mining Company (The) has its office at 62 Broadway, (basement,) New York. The officers are O. D. Russell, Pres.; J. G. Moody, Sec. and Treas.; W. B. Bransford, General Supt. The company owns the Taylor Plumas mine, located in Greenville district, Plumas county, Cal. A tunnel is being driven into the mountain along the line of the lode, which daily improves both in width and richness. The face of the drift now shows five feet of high grade ore. Capitalization, $1,000,000, in 200,000 shares of $5 each; non-assessable.

University Gold Mining Company. W. L. Oliver is Sec. Office, 328 Montgomery Street, San Francisco, Cal. The company's property is located in Bodie district, Cal. Extent of claim, 200 by 1,500 feet. The ore is much mixed, and low grade, assaying from nominal sum up to $900 per ton. There are five different veins cut, varying from two to twenty-two feet in width. The quartz from the twenty-two-foot vein averages about $30 per ton, principally gold. The company has machinery for operating the mine to a depth of 1,800 feet. The prospect shaft is 328 feet deep, and the main shaft 670. Capitalization, $10,000,000; par value per share, $100. No dividends paid to June, 1882. Number of assessments levied, ten; total amount of assessments levied, $107,500.

Utah Consolidated Mining Company is chartered under the laws of the State of California. The directors are J. Meyers, Pres.; J. Ressayre, Vice-Pres.; C. H. Redmond, J. H. Kavangh, S. B. Henderreich. Office, 309 Montgomery Street, San Francisco, Cal. The company's mining claims are the La Belle, Bredemyer, Meacoque, Wacht am Rheim, Ladie Anna, Borussia, and Cologne, located in Virginia district, Nevada. The character of the ore is carbonate of lead and galena, carrying free gold. The ore assays on an average $67 to the ton. The main tunnel, Queen of the West, is 300 feet in length, and there are six other tunnels, aggregating 1,000 feet. Depth of workings, 2,500 feet. The main lode on which the company depends for its supply of ore is 1,000 feet in length. Date of organization, April 9, 1872; capitalization, $200,000; par value per share, $100; number of assessments levied, thirty-nine; total amount of assessments levied, $1,300,000; date of latest assessment, May 4, 1882; amount per share, $1. Floating indebtedness, April 1, 1882, $4,172.

Vallecito Hydraulic Mining Company (The). Directors, A. J. Bryant, E. P. Pond, Wm. Dumphy, C. H. Livingston, H. M. Mitchell. The mines belonging to this company are located in Calaveras county, Cal. It was organized April 5, 1880; capitalization, $1,000,000.

Vein Mountain Mining Company's (The) property is located eight miles south of Marion, on West N. C. Railroad, North Carolina, covering an area of 6,800 acres. The character of the mine is hydraulic, gravel, auriferous. The ditch is six miles long, and the company has 150 feet head of water.

Whitehall Mining Company (The). William A. Clear, Superintendent. The Whitehall mine is located in Spottsylvania county, W. Va. It is announced that the mine has been bought by a company, among the members of which are Senator Call of Florida, Senator Jones of Louisiana, Congressmen Springs and Berry, Delegate Luna of New Mexico, and H. B. Clifford, a mining expert of Arizona. Commodore Stockton worked the mine from 1848 until just before the war. The mine is said to have yielded $1,800,000 in pure gold since its discovery, as shown by the books of the Philadelphia Mint. Within a space of three square feet, at a depth of twenty-eight feet, $160,000 worth of pure gold was taken out. Yield surprising anything known in the annals of mining. Gold was first found there in 1806.

Wilderness Gold Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, William Reed, President; J. T. Salter, Secretary. Directors, William Reed, S. Lawrence French, J. D. Sargeant, George W. Dyer, C. H. Graham, and J. T. Salter. General office, 333 Chestnut Street, Philadelphia, Pa. The Belzara and Catharpion mines, belonging to this company, are located in Virginia. The number of acres owned, 1,090, Belzara mine, 374 acres; Catharpion, 716 acres. The ore is very profitable to work. All necessary steam appliances. Capitalization, 100,000 shares; par value, $5; non-assessable; amount of stock issued, 100,000 shares; amount reserved in treasury, 50,000 shares.

Winona Gold Mining Company (The). Officers, B. Findley Anderson, President; T. A. Roundey, Secretary and Treasurer. General office, 61 Broadway, New York, room 7. The location of the mining property of this company is on Gold Hill, Boulder county, Col. Capitalization, $2,000,000; shares, 200,000; par value, $10; non-assessable.

Willshire Hydraulic Gold Mining Company (The) is chartered under the laws of the State of New Jersey. In 1880, officers J. S. Bailey, President; Thomas L. Watson, Treasurer; Edward F. Bailey, J. S. Bailey, Jr., Treasurer; William Potts, Director. General office, 60 Wall Street, New York. The mining property belonging to this company is located at Cox's Bar, Trinity county, Cal. Own 104 acres. Two-thirds of the mineral lands owned by this company are covered by banks of gold-bearing gravel. A ditch and tunnel with a capacity of conveying 2,000 miners' inches of water; four feet bottom, six feet top, two and a half feet deep; blacksmith shop, iron pipe giant. The grade of gravel is about thirty cents per cubic yard, though under favorable conditions five cents per cubic yard would leave a margin above expenses.

Yuba Gold Mining Company (The) has property located in Nevada and Placer counties, Cal. The company has paid $4,000 in dividends to September, 1881, date of latest dividend of $1 per share. The length of the main lode on which the supply of ore depends is 1,200 feet.

Yreka Creek Gold Mining Company (The). These mines belonging to the above company are located in Siskiyou county, Cal. The Cranston hydraulic elevator used. It is stated they are going to work in earnest, having set aside 15,000 shares of their stock as working capital. Expect to be able to work ground thirty-five or forty feet deep. Capitalization, 50,000 shares; each share, $150.

IRON.

Annandale Iron Company is chartered under the laws of the State of New Jersey. The officers are Lewis Barnes, President; E. P. Carpenter, Secretary. Directors, John M. Robbins, E. P. Carpenter, Lewis Barnes, W. J. String, W. A. Wade, and J. M. Halton. Branch office, 113 South Fourth Street, Philadelphia. The company own four mines, viz.: The Sharp, Haver, Welsh, and Hoffman. The mines cover an area of 150 acres. Depth of shaft, fifty feet. Haver mine is now producing twenty tons of iron ore per day. The company have a capitalization of $10,000,000, in shares of $25 each; non-assessable; amount of shares reserved in treasury, 1882, 1,400.

Argyle Iron Company (The), formerly the Pittsburg and Lake Angeline Company, have their works located at Humboldt, Marquette county, Mich. The officers are Don. M. Dickinson, President; Ligmund Rothschild, Vice-President; Alexander H. Day, Treasurer; D. R. Show, Secretary; W. W. Wheaton, General Manager. There is reported to be a large show of ore on the company's property. Their plant includes one of Merritt's 18 by 30 engines and 4 by 5 feet V-friction drums. There are about seventy-five hands employed. Stock and bonds are held principally in Detroit. Product has been as below:

	Gross Tons.		*Gross Tons.*
1866	2,843	1874	2,849
1867	4,928	1875	12,804
1868	17,360	1876	19,330
1869	19,151	1877	10,419
1870	24,232	1878	10,351
1871	26,437	1879	5,455
1872	28,380	1881	4,584
1873	38,968		
Total			228,091

Battle Mountain Mines (The), viz., the Black Iron, Silverware, Eagle Bird, Kingfisher, and Little Olive mines, are located at Bell's Camp, Col. The ore contains carbonate and sulphate, lead ore, and iron.

Black Band Iron Ore Company (The). Officers, John Woolridge, President; F. A. Dearborn, Treasurer, and W. S. Denny, all of Boston, Mass; J. H. Huling, of Charlestown, W. Va. Mines are located at Davis Creek, Kanawha county, W. Va. Amount of property in acres, 3,500. The ore is compact and resembles in appearance cannel shale. It contains a large percentage of iron which is in the form of a carbonate. The principal coal is always found at about fifteen feet below the base of the ore, and the thin streak of coal above the deposit seems always to be purest. The ore is always between three and four feet in thickness. Interesting facts relative to the mine are: Six beds of coal, ranging in thickness from three feet five inches to ten feet, have been opened on the land of this company. A bed of splint coal three to five feet thick has been found under the black flint. Forty feet below this is a bed of black band iron ore. Twenty feet below this is the ten-foot coal bed. Two coal beds, one of them four feet thick, have been exposed beneath, the last above water level.

Breece Mining Company (The) is chartered under the laws of the State of New York. Geo. W. Dunn, Pres. Head office, 72 Broadway, New York. Location of mines, Colorado. Prospects of the property are good. The mine is looking extremely well, showing an abundance of fine iron ore in nearly all the workings. The face of the incline and the breasts of all the cross-cuts and stopes show magnificent iron ore. Two stopes in mine, one about sixty feet by ninety feet; the other, forty by ten feet. Depth of shaft, 340 feet. Interesting facts; at this mine there is an excellent hematite of great purity, containing but a trace of silica and other substances mixed through it; for this reason Breece iron is in great demand, the mine shipping thirty tons per day. Capitalization, 200,000 shares; par value, $25; non-assessable. Number of dividends paid to January 1, 1882; total amount, $2,000. Date of latest dividend, February, 1880. Stock quoted July 1, 1882, $1 per share.

Calumet Iron Company. The officers are W. B. Cornell, Pres.; Geo. H. Cornell, Sec.; R. McCurdy, Treas.; John R. Wood is Supt. The company's property is located in Marquette county, Mich., developments of which were commenced July, 1881. The company owns two seven by ten duplex Rochester engines, with three foot drums, to which will be added Lane plant, with two drums of larger size. The Calumet, on the Fitch Mountain range, is proving a veritable bonanza. The cross from foot-wall of No. 2 shaft was fifty-four feet in ore on the 13th of July, 1882, with no signs of the hanging-wall being near. Sixty-five men are employed, and more are added daily, and the force will be considerably augmented as soon as the railroad reaches the mine, which is expected in a month or two. The management expect to ship 20,000 tons of ore this season.

Cambria Iron Company (The). This company's property is located in Cambria county, Pa. Yearly amount of coal, 260,142 tons.

Champion Iron Company (The) is chartered under the laws of the State of Michigan. Capt. James Pasco is the mining Supt. The company owns the Northampton and the Champion mines, located in Marquette county, Mich. The walls of the belt are quite regular. The machinery and other plant is of the most improved pattern and of ample capacity. There are machine, carpenter, and other shops and buildings. A Rand twenty by forty-eight duplex compressor now being added to present plant. The prospect of the mine, under the supervision of Capt. Pasco, exceedingly promising; ore showing in abundance. This mine stands fourth on the list in regard to its productive capacity. Scenery in neighborhood of mine highly picturesque. The mine was discovered in 1867. Drill explorations are in continual progress. 450 men employed. Organized, 1869; capitalization, $500,000; shares, each, $25. Since 1867, in which year the Champion deposit was first discovered, the annual product of the mine has been as follows:

	Gross Tons.		*Gross Tons.*
1868	6,255	1875	56,877
1869	21,535	1876	66,002
1870	73,161	1877	70,883
1871	67,588	1878	73 464
1872	68,408	1879	94,027
1873	72,782	1880	112,401
1874	47,097	1881	145,427
Total			957,907

Total yield to 1881, $1,454,270.

Cherry Valley Iron Company (The). Works located at Lectonia, Ohio. Employ 6,000 workmen, use 6,000 tons of coal per month.

Clancy Iron Company. The officers are John Clancy, Pres.; M. W. Bates, Sec.; J. M. Watson, Treas. The company's property is located at Marquette, Mich. A force of men are employed in prospecting in search of the wheat vein.

Cleveland Iron Company (The). J. C. Morse, Agent, Marquette, Mich.; D. H. Bacon, Superintendent, Ishpeming, Mich. Name of mines owned, New York mine, and South Sunday. Location of mines, Marquette county, Mich. Character and quality of ore, iron, first-class. Property owned by the company, mining plant, machine shop, carpenter shop, two locomotive engines, new stone engine house with new pumping plant. Date of commencing developments, 1854. Date of organization, 1853; yield net to January 1, 1882, $2,067,197. The following table shows the annual production of the Cleveland during a period of thirty years:

	Gross Tons.		*Gross Tons.*
1852–1854	3,000	1868	102,112
1855	1,449	1869	106,133
1856	6,343	1870	132,884
1857	13,204	1871	142,658
1858	909	1872	151,724
1859	15,787	1873	133,265
1860	40,091	1874	105,858
1861	11,795	1875	129 881
1862	40,364	1876	146,393
1863	46,842	1877	152,188
1864	44,959	1878	152,737
1865	33,355	1879	131,167
1866	42,680	1880	212,748
1867	75,864	1881	198,569
Total			2,381,959

Columbia Iron Company (The). Officers, P. B. Shumay, Pres.; B. H. Jones, Sec. and Treas.; C. M. Nicker, Gen. Mang.; A. B. Meeker & Co., Sales Agents. Name of mine owned, Kloman. Location of mine, Marquette county, Mich. Character of the mine, vein of ore said to vary from five to thirteen feet in thickness. Yield, net, to January 1, 1882, 70,311 tons; yield, gross tons, during 1881, 11,158. The Columbia mine produced in

	Gross Tons.
1873	21,065
1874	35,088
1875	8,059
1880	6.663
1881	11,158
Total	82,033

Commonwealth Iron Company (The). Officers, Alexander Nimick, Pres.; W. W. Masters, Vice-Pres.; W. H. Harvey, Sec. and Treas.; H. A. Tuttle, Gen. Mang. Agent, W. E. Dickinson. Annual election, May 3. Captain Dickinson, Supt. Head and branch office, Cleveland, O. The mines are located in Menominee county, Mich. Amount of property in acres, 3,000. Quality and character of ore improving. In progress of shaft downwards, hard, bluish-black color, velvety texture, and conchoidal, splinting fracture. Property owned by the company. Machinery consists of four drums—Frazer and Chalmers. Expect to use power-drills soon. The property is yet in a crude state of development. 17,200 tons of ore ready for shipping May 1, 1881. Yield (gross) to January 1, 1882 $608,812.50; yield (gross tons) during 1881, 97,910.

Conrad Iron Company (The). Officer, J. C. Morse. Pres. Operated by the Davids Brothers. Alexander Grant, Supt. Name of mines owned, Two North Range, and another, probably the Sterling mine, located at Marquette, Mich. Property owned by the company. Considerable surface improvements, chiefly at North Range. Prospects of the property are considered promising, June, 1882. After having been idle for some time, operations at this mine are about to be renewed.

Cranberry Iron Company (The). Mines located in Mitchell county, N. C. Cranberry company have discovered on their property in Mitchell county, N. C., two veins of the finest magnetic ore, one eighteen feet, the other thirty-four feet. They have tunnelled through the veins in building a railroad.

Crystal Falls Iron Compony (The). Officers, N. K. Fairbanks, Pres.; J. H. Howe, Vice-Pres.; F. H. Head, Sec. and Treas. Superintendents, E. P. Mills (of Crystal Falls mine) and J. H. Ellinore (of the Fairbanks mine). The company owns the Crystal Falls and the Fairbanks mines, located at Crystal Falls, on Paint River, southwest of Marquette county, Mich. The character of the mine is somewhat peculiar, the vein being twisted and distorted. There are railway facilities to the mine, but no shipments of ore have been made.

Dalliba Iron Mining Company (The). Officers, James H. Dalliba, Pres.; W. S. Pollock, Sec.; D. Z. Morton, Treas.; E. D. A. Skinner and Walter Fitch, Local Agents. Mr. John Foley is Supt. The company own the Dalliba or North Dalliba mine, located in Marquette county, Mich. The mine possesses the ordinary plant of an iron mine. There are about ninety men employed. Gross yield during 1881, 10.986 tons; value, $60,423; all of which was mined from a single pit, the hanging wall of which has not yet been found. The daily yield at present, December, 1881, is at the rate of 130 tons per day of twenty-four hours. There is now on the ground, and ready for erection, a hoisting-plant, consisting of engine and two thirty-inch drums.

East Champion Mining Company's works are located in Marquette county, Mich. The directors are A. Kidder, Jas. Pascoe, J. R. Case, F. B. Spear, and R. V. Travus; Superintendent, Capt. Edwards. The East Champion shipped her first cargo of the season the 1st of July, and will send more after it in the near future, though no more work is being done at present than is necessary to put the mine in good shape for future operations. They are now raising thirty tons of ore per day, with a force of less than twenty-five men. Property is fully equipped; notwithstanding its past vicissitudes, the property now promises to become one of the best of the smaller mines of the district. There are 5,000 shares of stock, 2,000 to be sold at once to supply working capital, and balance as necessities of company demanded. Product has been as below:

	Gross Tons.
1873	10,426
1874	227
1875	3,346
1876	7,715
1877	14,495
1878	5,401
1879	4,029
1880	10,217
1881	3,408
Total	64,264

Emmett Mining Company (The). Officers are S. Kimberley, Pres.; Geo. Boyce. Vice-Pres.; R. Williamson, Sec. and Treas.; E. P. Foster, Agent.; M. Harrington, Supt. The Keel Ridge Mine is owned by this company. Located in Menominee county, Mich. Very fine situation for mining purposes. The yield net during 1881 consisted of 66,007 tons ore. The gross tons for 1881 was 648; value, $3,564.

Erie Iron Company's (The) officers are E. H. Wright, Pres.; Peter Pascoe, Vice-Pres.; W. A. Wright, Sec. and Treas. Directors, E. H. Wright, W. W. Wright, Peter Pascoe, Byron H. Andrews, and F. H. Kearney. Superintendents, Messrs. Wright, Martin, and Welch. The Erie mine, owned by this company, is situated on the west side of the Michigan river, Marquette county, Mich. Property on lease. The character of the ore is slate, magnetic, martite, quartz, etc. The ore body is large, but is cut up with alternate stratifications of soap-stone. Yield to July, 1882, under present company, 3,000 tons.

Florence Mining Company. Mr. Alex. Kempt is General Manager and Superintendent, with Capt. Budder, an experienced miner, in charge of the underground work. The company's property is located in Wisconsin. The mine is worked on the underground plan; 350 men are employed, fifty of them on the surface. Since the first shipment was made, less than two years ago, the output has been as follows: gross tons, 1880, 14,143; 1881, 100,501; total, 114,644.

Forest City Iron Mining Company. The officers are C. A. Otis, Pres.; T. H. Brooks, Treas.; F. A. Bates, Sec.; G. R. Tuttle, General Agent and Supt. The company's property is located in Marquette county, Mich. They own sixty acres of land. The ore is hard and soft hematite, 60 per cent. metal. The company's surface plant is small, consisting of small engine and larger engine in course of erection. The mine is now shut down, supposed to be worked out. Development of the property was commenced in 1880. Yield during 1881, 1,895 gross tons; value, $10,422.

Glengary Consolidation Mining Company (The). Officers, Albert Sherwin, Pres.; W. K. Clay, Vice-Pres.; S. D. Wilder, Sec. and Treas. J. W. Kennedy, Manager. Directors, Albert Sherwin, S. D. Wilder, Max Boehmer, J. W. Kennedy, W. K. Clay, J. G. Bedford, Leadville, Col.; M. B. Newcombe, Breckenridge, Col.; J. M. McCutcheoson, Monmouth, Ill. The company own the Glengary, Eclipse, Yates, portion of Hidden Treasure, Little Vinnie, and Fulton lodes. The location of these mines is on Breece Hill, Colorado; twenty acres owned. Very promising specimens of mineral have been obtained. Depth of shaft, ninety to 110 feet, showing from three to five feet of auriferous iron, 1881. Several deep shafts have been sunk on the property.

Goodrich Mine (The), is owned and operated by Capt. Goodrich of Chicago, is located in Marquette county, Chicago. Capt. H. Davis is the Mining Superintendent. The ore is of a peculiar character and the formation is very irregular. A new three-foot Lane drum has lately been added to the plant. The staff of men is about forty-five. The prospects are good under the able superintendence of present Capt. Davis. To

January 1, 1881, the yield was 31,361 tons; during 1881 the yield was 10,245 tons; total, 41,606 tons. Below is given the annual yield since 1873:

THE GOODRICH YIELD.	Gross Tons.
1873	3,258
1874	1,300
1875	1,780
1877	503
1878	7,547
1879	3,992
1880	11,181
1881	10,245
Total	41,606

An observer has suggested with much earnestness the use of Bullock's diamond drills on this tract as a most profitable field, believing that a rich slate will be revealed.

Grand Rapids Iron Mining Company. The officers are I. J. Whitfield, Pres.; Marcus W. Bates, Sec.; Isaac Philips, Treas. The company's works are located at Marquette, Mich.; they have forty acres on lease. The ore is second-class silicious ore, and is found in deposits. The use of the diamond drill is suggested as the easiest and most economical means of discovering good ore.

Great Western Mining Company. The officers are Sam'l C. Hall, Pres.; J. M. Case, Vice-Pres.; S. D. Hollister, Sec.; Geo. Runkle, Treas. and Gen'l Supt. This company was organized this year (1882). Their property is located in Marquette county, Mich.

Halston Iron and Steel Company (The.) The property of this company is located in Virginia. Capitalization, $500,000.

Hecla Iron Company. The officers are E. Breitung, Pres. and Treas.; B. D. Jones, Sec. Location of works, Marquette county, Mich. The character of the ore is given as very fine, soft, blue specular, high in metallic iron, and low in silica and phosphorus. Character of the mine; trend of formation from north-east to south-west, and the dip to the south-east. Diamond drill employed in searching for and determining the character of the veins.

Hematite Mining Company (The). The officers are S. F. Joseph, Pres.; Rich. S. Fay, Treas.; A. C. Towns, Sec.; C. H. Hall, Agt. The company's works are located in Marquette county, Mich.; 500 sixteen-power drills are employed. Maximum yearly capacity of production, 1881, 40,000 tons.

Humboldt Iron Company. General Manager, John B. Maas; Superintendent, John Hosking. The company owns the Washington mine, located at Marquette, Mich. The ore is rich specular schistose in structure, often friable, and sounds leaden when struck with a hammer; other portions magnetic. The ore is between conglomerate and jasper walls. Plant of machinery embraces one 16x24 engine, two four-foot clutch drums, etc. Ingersoll's power drills are extensively used. The prospects of the property are most promising; mining force about 160. Since the commencement of operations in 1864, the annual product of the Humboldt has been as follows:

	Gross Tons.		Gross Tons.
1865	4,782	1873	38,014
1866	15,150	1874	27,890
1867	25,440	1875	9,642
1868	35,757	1876	3,333
1869	58,462	1877	16,545
1870	79,763	1878	23,920
1871	48,725	1879	18,204
1872	38,841	1880	14,726
		1881	26,302
Total			485,495

Indiana Iron Company (The). John A. Kruse, Pres.; D. W. Irwin, Treas.; R. C. Flannigan, Sec.; R. P. Travers, Gen. Mang. The property of the company is located in Menominee county, Mich., and comprises an area of eighty acres. The ore is of uniform good quality, average analyses giving 69.3 per cent. of metallic iron; silica, forty-five per cent., and barely a trace of phosphorus. The first cargo of ore is reported ready for shipment. The face of the vein shows rich ore. The weekly output July, 1882, 600 tons. Developments were commenced on the west 40 in 1880. During 1880 the yield was 14,000 tons of rather inferior quality. Yield during 1881, 583 tons; value, $3,166.50.

Iron Duke Mine (The), owned by Messrs. Wylie & Hall, is located in the township of Darling, Lanark county, Ontario. These parties control about 1,200 acres of iron lands on which timber is plentiful, both pine and hard wood. Main roads are good, though hilly, and good winter roads can be got between the hills in any direction. The ore is said to be of good quality, magnetic, free from titanic acid and other injurious substances. Surface sample assays per ton 62.90 per cent.

Iron Cliffs Mining Company (The) is chartered under the laws of the State of Michigan. Capt. Sedgwick is the superintendent of one of the chief mines, the Barnum. The company owns four mines; the Barnum, Salisbury, Foster, and Section Twelve, all located in Marquette county, Mich. The ore is high grade, especially that of the Barnum, which has an extensive plant and employs about ninety men. The tunnel is 375 feet. Below is given the yield of the four mines during the various periods of their existence, to the end of 1881. During the past fourteen years the annual product of the Barnum has been as follows;

	Gross Tons.		Gross Tons.
1868	14,380	1875	43,209
1869	33,484	1876	37,632
1870	44,798	1877	37,509
1871	45,939	1878	26,680
1872	38,381	1879	24,015
1873	48,076	1880	24,522
1874	41,403	1881	27,883
Total			487,906

Since the mine was opened in 1872, the Salisbury yield has been as follows:

	Gross Tons.		Gross Tons.
1872	545	1877	37,869
1873	11,023	1878	52,155
1874	6,370	1879	39,293
1875	4,571	1880	21,457
1876	20,510	1881	43,690
Total			237,843

Product of Foster mine:

	Gross Tons.		Gross Tons.
1865–8	6,000	1874	4,719
1869	14,540	1875	847
1870	23,458	1876	125
1871	13,532	1879	4,804
1872	18,684	1880	1,122
1873	18,107	1881	3,011
Total			108,949

The output of Section Twelve mine has been as follows;

	Gross Tons.
1879	5,027
1880	330
1881	13,243
Total	18,600

Iron Duke Mine (The). Owned by Messrs. Tingley and others. The Iron Duke mine is located in Colorado.

Iron Mine (The). Owned and operated by Messrs. C. M. Wheeler and J. H. King, the former residing in Marquette county, Mich., Mr. King in Ohio. The mining property is located in Marquette county, Mich. Soft hematite ore; deposit all fifty feet wide. Yield net to January 1, 1881, 65,606 tons ore.

Iron Mining and Smelting Company (The), of which H. F. Smith is Superintendent, has property located at Crested Butte, Gunnison county, Col. The surface property comprises the smelting works, etc. The company has a treasury reserve of 40,000 shares of the company's stock.

Iron Mountain Pig Iron Company (The). Incorporated by G. W. Applegate, B. F. Ruyers, A. C. Neall, John R. Brown. The mines belonging to this company are located in Como district, Clipper Clap Station, Nevada. (1880). This property was recently purchased by J. E. Judson. "Giant Powder Man" works will be put up at once for making pig iron. The company was organized in the year 1864. Capitalization, 500,000 shares.

Iron River Mining Company (The) has offices located in Florence. Officers, John Stambaugh, Pres.; Geo. Boyce, Vice-Pres.; R. McCurdy, Sec. and Treas.; J. P. Jones, Gen. Agent. Jas. N. Porter is the Superintendent. The property, held on lease, is located in Marquette county, Mich. The ore is a hard hematite, rich in metallic iron (about sixty-two per cent.), and low in silica. The mine has a belt of clean ore (mostly), averaging 100 feet in width by half a mile in length. 200 men are employed, mostly in grading on the railroad, for which the company has the contract. To February last, date of latest dividend, the mine has paid $1,660,000 in dividends.

Jackson Iron Company (The) has for its officers Abm. V. Berry, I. M. Everett, S. T., G. W., and F. W. Carr, E. M. Rockwell, F. W. Kirtland, W. H. Munroe, A. W. Ernst, and F. Farrand. The mines are under the able supervision of Capt. H. Merry, who has had an experience of twenty years or more. The company owns three mines, the Pioneer, the North Jackson, and South Jackson, located in Marquette county, Mich. The quality of the ore is superior. The formation of the vein or deposit is much contorted. There is a new skiproad at an angle of 66° to the perpendicular. Developments were commenced in 1850. The men are working in all directions wherever the ore leads them. The North mine was surrendered to the Iron Cliffs Company at end of year 1881, in exchange for the Pioneer, opening of which that company held a lease, in which the ore is reported to have been exhausted. The company was organized in 1848; in 1881 the gross yield was 118,939 tons; value, $1,024,500.50. Since the commencement, the annual production of the Jackson has been as follows:

	Gross Tons.		Gross Tons.
1856 and previous	30,000	1869	125,908
1857	12,442	1870	127,642
1858	10,309	1871	132,297
1859	28,377	1872	119,910
1860	41,295	1873	130,131
1861	12,919	1874	105,600
1862	46,096	1875	90,568
1863	77,237	1876	98,480
1864	83,905	1877	80,340
1865	65,505	1878	83,121
1866	92,287	1879	103,219
1867	127,491	1880	120,620
1868	130,524	1881	118,939
Total			2,195,162

Jim Pascoe Mining Company (The). Walter Fitch, Agt. Capt. Foley is Superintendent. The company's mine, Jim Pascoe, is located in Marquette county, Mich. The character of the ore is hematite. The average width of stope is nearly fifty feet by thirty feet, and is one of the largest deposits of hematite ore in the country, with perhaps one or two exceptions. The workings are chiefly on the surface. The company's property includes large mining plant, Merritt's hoisting engine. About fifty men employed, July 1, 1882.

Keystone Iron Company (The) owns property in Marquette county, Michigan. The ore contains a rather large proportion of phosphorus. The formation of the deposit is somewhat irregular. Developments were commenced about 1873. In the spring of last year the prospects of the mine were not promising. During 1881 the yield was 3,408 tons; value, $27,264.

Laxey Mining Company (The). The officers are J. Q. Adams, Pres.; P. B. Kirkwood, Sec. and Treas.; H. M. Atkinson, Gen. Manager. The company's works are located at Marquette, Mich. The ore is the best quality of hematite, and assays per ton 64.70 per cent. metallic iron, and only .028 per cent. phosphorus. The extent of the deposit is not yet known. Property owned consists in a small hoisting plant. The shaft is seventy feet deep, and drift of thirty feet from the same is all the way in ore. A fine show of ore is reported. Stock quoted June 17, 1882, thirty-five cents per share.

Lake Superior Mining Company (The) has property located in Marquette county, Michigan. The mines are Lake Superior, Lothian, and New England mines. Mr. C. H. Hall is the General Agent, and Mr. John McEnroe the Underground Captain. The ore is a hematite. The adits are 560 feet in length; width of vein, about twenty feet. The mining plant and other property consist of new stone engine house and a hoisting apparatus second only to Calumet and Hecla. Ore is abundant and prospects continue to improve. The principal pits are lighted by electricity. Maximum yearly capacity of production, 300,000 tons. Organized, 1853; capitalization, $500,000, in 200,000 shares of $2.50 each. Gross yield during 1881 was 262,235 tons; value of same $2,185,576.50. Yield since 1858, when shipments first commenced:

	Gross Tons.		Gross Tons.
1858	4,658	1870	166,582
1859	24,668	1871	158,047
1860	33,015	1872	185,070
1861	25,195	1873	158,078
1862	37,769	1874	114,070
1863	78,976	1875	129,339
1864	86,763	1876	111,766
1865	50,201	1877	127,349
1866	68,002	1878	109,674
1867	119,935	1879	173,938
1868	105,745	1880	204,094
1869	131,343	1881	262,235
Total			2,666,456

Number of dividends paid to August, 1881, $100,000; date of latest dividend, August, 1881; amount per share, fifty cents.

Licking Iron Company (The). Jacob Opperman, Supervisor. These mines are located in Shawnee, Ohio. Two furnaces, one in full blast, under Mr. Opperman's supervision; No. 1 has a forty-eight-foot stack, twelve and a half foot bosh, and six tuyeres; No. 2, in blast, is averaging twenty-five tons daily on all native ores. Their mine, in charge of Wm. Richards, employs twenty-five men.

Longdale Iron Company. The Manager is John McGuffin. The company's mine, the Sewell, is located in Alleghany county, Va. The vein is three to four feet thick, and has a capacity of 160 tons per day. Maximum yearly capacity of production, 1880, nearly 13,000 tons of coal. The company has been mining the Sewell seam, the bottom one of the middle measures, but it has recently been opening one of the lower measures beds, probably the Fire Creek, which it will mine before long.

Lowmoor Iron Company (The), of which Mr W. H. Sadler is Superintendent, has the following officers: Col. H. W. Goodwin, General Manager; C. F. Conrad, Resident Engineer. The company owns the Stack mine, located at Dunlap creek, Alleghany county, Va., the property covering an extent of 1,000 acres.

Lumberman's Mining Company (The) owns the Ludington and the Stephenson mines. Mr. Geo. E. Stockbridge is the General Manager and Superintendent; M. W. Brise, Mining Capt. The officers are Hon. H. Ludington, Pres.; S. M. Stephenson, V.-Pres.; Isaac Stephenson, Treas.; Jos. Flesheim, Sec., and Geo. E. Stockbridge, General Manager. The property is located in Menominee county, Mich. The ore of the Ludington mine is soft, blue specular. A new plant is being erected with a view to work the mine on a large scale, and a large body of ore is now being operated on. The gross yield of ore to January 1, 1881, was 33,000 tons. In 1880, the Ludington produced 8,816 tons; in 1881, the Ludington produced 3,374 tons.

Magnetic Consolidated Iron Company (The) of New Jersey is chartered under the laws of the State of New Jersey. Officers, D. L. Wood, Pres.; E. P. Carpenter, Treas. Directors, David L. Wood, J. M. Richmond, H. B. Fowler, E. P. Carpenter, J. O. Marshall. Principal office, 134 South Fourth Street, Philadelphia, Pa. The Hazen, Duckworth, and Eckel; 150 acres is the extent of property owned. Four shafts from forty to seventy-five feet. Tunnel seventy feet; 1,000 tons of ore on the dump. Capitalization, 30,000 shares; par value, $5; non-assessable.

Manhattan Iron Company (The) has property located in Marquette county, Mich. The officers are E. Breitung, Pres.; J. H. Onthwaite, Sec. and Treas.

Marine Iron Company (The) has property located in Marquette county, Mich. The mine has an ore deposit about eighty feet wide by 150 feet long, and lies at the mouth of a deep ravine; trend nearly east and west. Skip-roads are now being constructed. The plant includes an engine and two Merritt's thirty-inch interior gear drums but recently added. Mine possesses important facilities for shipping both by water and rail, and promises to develop into a paying mine.

Mastodon Mining Company (The) has property located in Marquette county, Mich. The officers are E. Breitung, Pres.; Joseph Austrian, Sec. and Treas. The Superintendent, Mr. Richard Polkinghorn, has had considerable experience. The outcrop was discovered by Jack Armstrong, about 1879. Developments are proceeding, and although there are no shipping facilities at present time, the mine promises to grow into a profitable undertaking.

McComber Iron Company (The) has property located in Marquette county, Mich. The officers are S. L. Mather, Pres. and Treas.; Fred. A. Morse, Sec.; J. C. Morse, Gen. Agent; Capt. H. Merry, Local Agent; Capt. Charles Fox, with fourteen years' experience as a foreman in the Jackson mine, is the Mining Superintendent. There are seventy-five men employed. The plant is simple and inexpensive but sufficient for present requirements. The ore is a soft hematite of superior quality. The prospects of the property are promising, as ore is revealed at various points. Product for 1882 estimated at from 35,000 to 40,000 tons. The workings are only on the surface at present, but preparing for underground working in the near future. Organized, 1872; capitalization, $500,000, in 20,000 shares of $25 each. Yield to January, 1882, 224,312 tons of ore; yield during 1881, 23,051 tons of ore; value of same, $154,280.50.

McCulloch Iron Company (The). Delaplaine McDaniel, Pres. The mining property belonging to this company is located in Delaware.

Menominee Mining Company (The) is chartered under the laws of the State of Michigan. The officers in 1880 were J. J. Hagerman, Pres.; J. H. Van Dyke, Sec. and Treas; A. C. Brown, Gen. Agent; N. P. Hulst, Superintendent; Jeff. D. Day, Asst. Superintendent. The company owns, or owned, seven mines, viz., the Florence, Chapin, Quinnesec, Cyclops, Norway, Vulcan, and Lowell, located in Menominee county, Mich. These mines or claims are the choice of the range. The company is considered the wealthiest in the world, although it has only been organized about four years. It was during the summer of 1873 that H. D. Fisher, one of a party of three, rested himself on a robust hill less than half a mile from the present village of Florence. He was looking for iron, and was wellnigh despairing of success in the search, when he stumbled against a substance which attracted his attention; this proved to be iron ore, and further prospecting showed the existence of a rich deposit. This was subsequently developed, and is now known as the Florence mine. Mr. Fisher may be said to be the founder of Florence. The excellent quality of the ore is well known. All the different mines are amply furnished with the most improved mining apparatus. Some of them are lighted with the Brush electric light. A new saw-mill is being constructed. There are 500 men employed in the Vulcan and about 900 in the Chapin, which has now, July, 1882, a capacity for producing at the rate of about 50,000 tons per month. Here is the largest single deposit of iron ore in the upper peninsula, barring none of the great mines of Marquette county. The total yield of all the mines to the first January, 1881, was 707,000 tons of ore.

	1860. Tons.	1881. Tons.
Yield of Florence	13,936	100,501
Yield of Chapin	34,556	*
Yield of Quinnesec	52,237	43,711
Yield of Cyclops	14,268	12,644
Yield of Norway	198,165	137,077
Yield of Vulcan	72,571	*
Yield of Lowell	14,571	*

* Returns not obtained.

The annual output of the Vulcan, of which Curnow is Captain, since the beginning, has been as follows:

	Gross Tons.
1877	4,593
1878	38,799
1879	56,975
1880	86,976
1881	85,274
Total	272,617

Mexican Iron Company (The). Officers, W. F. Swift, Pres.; Geo. W. Hayden, Sec. and Treas.; Geo. Berringer, Superintendent. The Old Carr mine belongs to this company on lease, with option of purchase. This company was organized in the fall of 1881. Not working at present. Yield net during 1872, 2,380 tons; second-class ore.

Michigameme Iron Company (The) is under the superintendence of Mr. J. C. Fowle, of Michigamme, Mich. Hon. W. H. Barnum, Pres.; John Rood, Sec. and Treas. The property of the compony is located in Marquette county, Mich. The ore is specular and magnetic. The mine is furnished with a superior plant in excellent condition. There were about 200 men employed in January last (1882). Since 1872 the annual product has been as follows;

	Gross Tons.		Gross Tons.
1872	141	1877	28,238
1873	29,107	1878	58,622
1874	45,294	1879	56,970
1875	44,763	1880	52,766
1876	70,074	1881	57,272
Total			443,247

The value of the yield for the last year was $544,084.

Mike and Starr Company. The directors are W. D. Lewis, Pres.; Geo. C. Harrington, Treas.; C. F. Mackenzie, W. J. Mann, Geo. West, H. R. Gardner, and Geo. F. Ropes; Horace T. Starr, Sec.; John Shoenbar, Superintendent. Office, 4 Sear's Building, Boston, Mass. The company's mine, the Mike and Starr, is located at Leadville district, Col. The ore carries galena, copper, iron, and pyrites, all rich in silver. Fine hematite samples show sixty-seven and one-half per cent. metallic iron. Three samples assayed 387 ounces, 422 ounces, and 458 ounces to ton silver, and twenty to thirty per cent. in lead. It is said that only four men working on ore body broke and sent to the surface in twenty-four hours about sixteen tons of ore. Twelve tons have been shipped and results are awaited. The company has a capitalization of $1,000,000; 200,000 shares; par value per share, $5.

Milwaukee Iron Company (The) has property located in Marquette county, Mich. James A. Foley is Superintendent; R. S. Fary, Pres. and Treas.; A. Kidder, General Agent. Analysis of ore shows sixty-one per cent. metallic iron; one per cent. phosphorus, and five per cent. silica. The deposit is irregular. The plant includes two double engines, one fifty and one seventy horse-power; also a small portable hoisting engine. The main shaft is now being cribbed out. The prospects of the mine are reported good and ore abundant. Mining can be carried on cheaply. The company was organized in 1878, and developments were commenced same time. To January, 1881, 14,083 tons of ore were extracted; in 1881, the yield was 31,635 tons; value, $173,992.50.

Mitchell Iron Company (The), of which Capt. Thos. Walker is the Superintendent; S. Mitchell, Pres.; Chas. Merryweather, Sec. and Treas. The property of the company is located in Marquette county, Mich. The ore is of a fine quality, remarkably clean, soft, blue hematite, high in metallic iron and low in phosphorus and silica. Veins in contact with drift overlying, to a depth of from seventy to eighty feet. The mining plant includes a new steam-engine. Ninety men are employed. The following is the yield since 1872:

	Gross Tons.		Gross Tons.
1872	197	1878	4,259
1873	8,658	1879	11,131
1874	7,549	1880	13,297
1876	5,596	1881	21,146
1877	3,989		
Total			75,731

The company was organized in 1877. Value of product in 1881, $116,303.

Mount Lincoln Consolidated Mining Company (The). The Kingfisher and Little Ollie mines belong to this company. Located on Battle Mountain, Colorado. The ore is exceedingly pure carbonate, and sulphate, and oxides of lead ore, mixed with oxides of iron and manganese. The mines are worked by a shaft and drifts. The shaft is sixty-five feet deep. Capitalization, $1,000,000; shares, 6,000.

Nanaimo Iron Company (The). Officers, John S. McDonald, Pres. and Treas.; John Spence, Sec.; Thomas Luxmore, Supt. The mines of the Nanaimo Iron Company are located in Marquette county, Mich. There is a leasehold on the property. Small plant of machinery is owned by the company.

National Mining Company (The). Captain Samuel Mitchell is Superintendent, and Captain Williams, Local Superintendent. The National Mine, owned by this company, and located in Marquette county, Mich., is leased from the Lake Superior Iron Company. The company have 240 acres of land. The ore is hard, granular and very pure. The deposit is fifty feet thick. The company's property includes twenty good dwellings, hoisting, pumping, and other machinery plant. Developments were commenced in 1878. 100 miners are employed. The annual product of the National has been as follows:

	Gross Tons.
1878	4,191
1879	33,310
1880	29,351
1881	24,833
Total	91,685

Stock quoted July 1, 1882. $2.00 asked, $1.38 bid.

New York Mining Company. John C. Cutter, Sec. and Treas. Lawrence McClosky is Superintendent, and Augustus Burling, Assistant Superintendent. The company's property is located in Marquette county, Mich. Mr. Samuel J. Tilden, is chief owner. The property covers forty acres of land. Character of ore, rich specular. Formation of the mine is considerably contorted, but all the workings are in admiable condition. The past gratifying history of the mine may be expected to be repeated for twelve years to come. Mining force, 200 men. Date of organization, 1865. Annual yield since 1864:

	Gross Tons.		Gross Tons.
1864	8,000	1874	77,017
1865	12,214	1875	70,103
1866	33,761	1876	58,863
1867	43,302	1877	55,581
1868	45,665	1878	21,903
1869	71,456	1879	57,528
1870	94,809	1880	58,000
1871	76.381	1881	50,489
1872	68,950		
1873	70,882	Total	974,489

Stock and bonds are held principally by Mr. Samuel J. Tilden, New York.

North State Mining Company (The) is chartered under the laws of the State of North Carolina. Edwin Mulford is Secretary. The head offices are at Salisbury, N. C.; branch offices at 52 Broadway, New York city, and at 115 Broadway, New York, in office of the Mutual Trust Company. The property of the company is located in Aske county. N. C. The ore is a pure magnetic, free from sulphur, phosphorus. and titanic acid, assaying $60 and twenty per cent. copper. The deposits are of immense extent, the veins vary from four to sixteen feet wide on the surface, and their elevation above the level of the watercourse varies from 200 to 400 feet. The mine is equipped with the most improved machinery. Furnaces are now being erected for the manufacture of charcoal blooms and loop iron, upon which a profit of at least $20 a ton can be made. Special furnaces are building for the manufacture of steel directly from the ore by the new process owned by this company. Capitalization, $10,000,000, in 400,000 shares of $25 each; the latest dividend was on May 9. 1882, $1 per share.

North Western Iron Company (The) has property located in Marquette county, Mich. The officers are S. D. Rees, Pres.; Ed. Breitung, Vice-Pres.; J. N. Glidden, Sec. and Treas. The tract is held in lease from the Beavor Iron Co. A number of charcoal kilns are being erected, with a view of treating the low grade ores on the spot. The mining plant comprises a twelve-stamp mill, hoisting machinery, stamp mill engines with capacity of 24 stamps, with surplus for saw mill, a great convenience to the neighboring counties, four more stamps recently added, dwelling-houses increased to twenty-four. Later accounts report the property in a dilapidated condition. Capitalization, $300,000.

Norwich Iron Company (The) is chartered under the laws of the State of Michigan. C. E. Roberts is Superintendent. The company's property is located in Ontonagon county, Mich., where they own forty acres of land in fee. The character of the ore is hematite. The company owns stamp mill, hoisting engine, portable saw mill, agent's house and office, warehouse, shops, and seventy miners' houses. Developments were commenced during the year 1850, and $230,000 have been expended in developing the property to January 1, 1882. Yield to January 1, 1882, 1,496 tons, 1,360 lbs.

Ohio Valley Iron Mining Company (The). Officers, Thomas Axworthy, Pres.; D. McGarry, Vice-Pres.; John T. Hayes, F. W. Judd, Superintendents. The location of the mines belonging to the above company is near Crystal Falls, Marquette county, Mich. The company was organized 19th of May, 1882, in Cleveland.

Paint River Mining Company. The Directors are Max Wineman, Pres.; Jos. Austriana, Sec. and Treas.; E. Breitung, John McKenna, and Dr. Bond. C. Y. Roberts, Superintendent. Mines worked by the company are leased from Hon. E. Breitung. The property is located at Crystal Falls, Marquette county, Mich.

Pennsylvania and Virginia Iron and Coal Company. The mines belonging to this company are located in Fayette county, West Virginia. Quinnimant furnace used in 1880.

Penn Iron Mining Company (The). Officers, W. H. Barnum, President; James Rood, Jr., Treasurer; John Q. Adams, Secretary; A. W. Maitland, General Manager. Directors, W. H. Barnum, James Rood, A. W. Maitland and Joseph Winter; Superintendent, A. W. Maitland. Mr. A. Bristow, of Philapelphia, acts as Resident Manager; Mr. Powell Stackhouse as General Superintendent. Lake Superior mines. This company was originally called the Cambria Iron Company: changed to its present name July 1, 1882. The names of mines owned are Quinnesec, Cyclops, Norman, Vulcan, Lowell, (formerly owned by the Menominee company,) all located in Marquette county, Michigan. 50,000 acres of land owned by the company. Fine quality of ore, consisting of soft hematite, 66 per cent. metallic iron. Property owned is an engine house, engine and boiler, two three-foot and friction drums. Yield (net) to January 1, 1881, 34,267 tons. Yield of the Cambria since

1874	2,610 tons.
1876	6,329 "
1877	10,083 "
1878	3,754 "
1879	6,724 "
1880	6,958 "
1881	19,245 "

Philadelphia and Reading Coal and Iron Company (The). General offices, 227 South Fourth Street, Philadelphia. Thomas M. Richards, Philadelphia, general coal agent. New York office, 7 Courtland Street; Buffalo, 14 Main; Providence, 5 Customhouse.

Pictou Iron Drill Company (The). This company own the Spring Hill mines, located in Nova Scotia.

Pilot Knob Iron Company (The). The mines belonging to this company are the Pilot Knob, Shepherd Mountain, Cedar Hill, Russell Mountain, Buford Mountain, Shuton Mountain, etc., located in the State of Missouri. Ore formed in the mines is very valuable in the manufacture of steel. Capitalization. $2,000,000.

Pittsburg and Lake Superior Iron Company (The). Officers, James Laughlins, Pres.; J. H. Outwaite, Sec. and Treas.; Harvey Diamond, Supt. Principal office, Cascade. The Dalma mine is owned by the company, located in Marquette county, Mich. Quality and character of ore, superior specular slate and granular specular, latterly ore changing to soft hematite of excellent quality. Lens trending E. W.; walls, hard and firm, dipping to N.; vein, uniform. The length of workings about 1,000 feet. Mining plant has been recently increased by a new boiler and a Bullock diamond drill, also a new steam saw-mill and shingle-mill, lathe machine, and planer. Developments commenced 1863. Yield (net) to January 1, 1882, 525,637 tons. Yield of Pittsburg and Lake Superior during the following years, viz.:

	Gross Tons.		Gross Tons.
1871	4,171	1877	20,211
1872	40,655	1878	5,929
1873	50,418	1879	24,633
1874	19,560	1880	28,881
1875	4,071	1881	39,276
1876	15,324		
Total			263,129

Average daily output, 150 tons of ore. Diamond drill in use.

Republic Iron Company. The directors or trustees are S. O. E. Ely, E. Breitung, E. D. Parsons. Capt. Peter Pascoe is Supt. The company's property is located in Marquette county, Mich. The ore mined is very rich. The ore stratum sharply folded by latteral pressure from N. W. to S. E. Massive gray quartzite, similar to that in all hard ore mines. The company's plant, complete in every particular, was built in the Iron Bay foundry, Marquette. Ore of good quality is abundant. The mine is in the best possible condition for rapid and economical working. Date of organization, October 20, 1870; capitalization, $500,000; par value per share, $25. The mine has produced as follows:

	Gross Tons.		Gross Tons.
1872	11,025	1877	165.839
1873	105,453	1878	176,221
1874	122,639	1879	135,231
1875	119,726	1880	235,387
1876	120,095	1881	233,786
Total			1,425,399

Rocky Mountain Coal and Iron Company (The). The mines of this company are located at Alma Station, Wyoming Ter.

Rossett Mine (The), owned by T. B. Clare, and operated by C. S. Hurd, is located at Ironton, Taylor county, W. Va. The mine is worked by drift, and furnishes hard and still ore from the same stratum. It is not worked to more than half its capacity. Maximum yearly capacity of production, February 1, 1881, 12,000 tons.

Saint Clair Mining Company (The). Officers, John Brooks, Mr. Delano, Sup't Gen'l. Office, Boston, Massachusetts. The mines belonging to this company are located in Keweenaw county, Mich. Date of re-organization, 1879–1880. Property owned: fifteen houses, hoisting engines and rock crusher, twelve head stamp-mill, and wash house. Depth of shaft, 300 feet; yield, net. during 1881, $22,902.59; yield, gross tons refined copper during 1881, sixty-two tons, 1,493 pounds; date latest assessment, 1880; amount per share, thirty-seven and one-half cents.

Saginaw Mining Company. The officers are Henry Chisholm, Pres.; S. H. Chisholm, Sec. and Treas.; S. Mitchell is Superintendent. The mines held on lease by this company were bought from Messrs. Maas & Co. for $300,000. The company also holds a section of the Nineteen mine. The property is located three and a half miles south of Ishpeming, Marquette county, Mich. The character of the ore is specular, containing some magnesia. The vein was pinched in old workings. New discovery at depth of eighty-five feet, promises compensation for loss of old deposit. Shaft is now being sunk. The company's property includes 110 dwellings, several stores, saw-mill, etc. About 100 men are employed. The development of the property was commenced during the year 1879. The show of ore by drill is said to warrant high expectations. The Saginaw has produced as follows, annually:

	Gross Tons.		Gross Tons.
1872	18,503	1877	44,005
1873	37,188	1878	54,097
1874	45,486	1879	43,396
1875	55,318	1880	35,059
1876	56,979	1881	30,793
Total			420,774

Sierra Iron Company (The). Officers, F. McKnight, Pres.; P. N. Lilienthal, Sec.; Charles Kohler, Treas. Trustees, P. N. Lilienthal, J. Benjamin, H. P. Bush.

Shenandoah Iron, Lumber, Mining, and Manufacturing Company (The) is chartered under the laws of the State of Virginia. The officers are Alfred Creveling, Pres.; John Milnes. Treas.; Wm. Milnes, Jr., Gen. Mang.; L. S. Boyer, Sec. The property of the company held in fee-simple and being 31,483 acres in extent, or forty-nine square miles, is located on the Shenandoah Valley Railroad, Page county, Va. The real estate on the property consists of dwelling-houses for officers and employees of company, carpenter and smiths' shops, forty-horse stable, forge, refinery, coal-house, reservoirs, stores, offices, and warehouses. etc. Mining operations are now in progress at each of the mines, there being about eighty men employed. The original incorporators were Wm. Milnes, John Fields, Thos. Johnson, and Wm. Milnes, Jr. Organized June 30, 1880; par value of shares, $100.

Sleepy-Hollow Iron Mines (The) are owned by A. S. Burford, President, Richmond and Danville R. R.; John P. Branch, Thos. Branch, and others. Attorney for owners, Richard Irley, of 1214 Main Street, Richmond, Virginia. The property is located on a small stream running down to James river, two miles from Richmond and Alleghany R. R., 105 miles off Richmond, and thirty-six from Lynchburg; total extent of same, 1,800 acres. The ores are hematite, specular, and magnetic. The quality is sesqui-oxide 73.53 per cent. = 51.47 metallic iron. The main vein of hematite widens with depth. Magnesia supposed to exist on the property. There are on the property one and two story dwelling-houses, and water-power can be had on liberal terms. Limestone for flux, and timber in immediate locality. Coke for smelting by rail.

Spur Iron Mining Company (The). W. B. Davis, Agent and Superintendent. The mines belonging to this company are located in Baraga county, Mich. Property owned, new boiler, a compressor; six power drills have recently been added to the plant, diamond drills not in use. Company organized, May 12, 1881; gross net to January, 1882, 146,612 tons. The annual product of the Spur has been as follows:

	Gross Tons.
1873	31,933
1874	42,068
1875	23,094
1876	20,276
1877	22,801
1878	2,225
1879	1,409
1881	2,746
Total	146,612

Sturgeon River Mining Company (The). John M. Douglas, Pres.; G. C. Benton, Sec. and Tres. The mines belonging to this company are located in Menominee county, Michigan. Amount of property in leasehold. Trends of the formation is nearly east and west, dip supposed to be high to the north. About 8,000 tons of ore in sight. Developments were commenced in 1881. Shaft, fifty feet; drifts, 100 feet; length of levels, fifty feet; all in ore.

Titan Iron Company. The officers are H. C. Young, Pres.; W. F. Swift, Sec. The company's mines are leased from the Michigan Land and Iron Company, and adjoin the Beauport, Michigan. The company was organized at Ishpeming, May, 1882.

Thomas Coal and Iron Company (The). Mr. Wm. Iot, Manager. The Troy mine is owned by this company, location at Straitsville, Ohio. Mr. Joseph Mitchell has the underground work in charge, also charge of the business and financial departments for the company, employing 200 men; expect to start forty men in the new mine at an early day.

Virginia Iron and Coal Company (The). Officers, Ex-Gov. Hartranft, of Penna., Pres.; Mayor James F. Lewis, New York, Vice-Pres., and Gen'l Manager of the works. This company own a number of mines located at Ferrol, Virginia. They own the Quinimont furnace, cake works, and 1,000 acres of land. They also own the Grace furnace, with 7,000 acres of fine ore land; have an average of twenty-eight tons of good iron daily. The company has a capitalization of $1,500,000.

Vulcan Iron and Steel Company (The). This company is capitalized with $1,000,000; sustained with a bonded indebtedness of $1,000,000; formerly yielded ten per cent.; now pays to the bondholders seven per cent. on their investment.

Wampum Iron Company (The). These works are located in Lawrence county, Pa. Yearly number of tons, 14,118.

Wellston Coal and Iron Company (The). The mines belonging to this company are located at Jackson, O., discovered by Hon. H. S. Bundy. Shaft sunk and two furnaces built. Wellston, which had no existence in 1873, contained a population of 1,200 souls in the year 1875. The two furnaces were built on the Bundy territory in 1874.

Wenona Iron Company (The). E. R. Green, Supt. Location, Ohio. Has a good record since lighting up, producing an average of twenty-seven tons daily, using native and lake ores and mill cinder. Stack fifty feet high.

West Republic Mining Company (The) has property located in Marquette county, Mich. The officers are J. N. St. Clair, Pres.; E. G. St. Clair, Sec. and Treas.; Captain George Mitchell, Supt. The ore is specular; the rock hard and difficult to work. Yellow ochre is sometimes met with. The mining-plant includes the shaft-house and contents. Diamond drills are in operation here. About eighty men are engaged. Prospects at present are considered hopeful. The company was organized in October, 1880. Yield during first half of current year, 11,000 tons; 25,000 expected by end of year; yield during 1881, 7,354 tons; value, $69,863.

Wheat Iron Mining Company (The). Officers, Daniel McGarry, Pres.; T. Axworthy, Sec. and Treas.; Captain Prant, Supt. The mining property of this company is located in Marquette county, Mich. The ore consists of metallic iron, sixty-five per cent. by analysis. Property owned, a dwelling-house and plant. A new and important discovery has recently been made of a large deposit of hard, blue hematite, of sixty-two to sixty-three per cent. of metallic iron. The location is convenient for approach. Yield (net) to January 1, 1882; yield (gross tons) during 1881, 17,000 tons of ore; actual, 9,040; expected, 10,000; value, $76,840. Thirty-five men employed.

Winthrop Hematite Company (The) is chartered under the laws of the State of Michigan. Officers, J. O. St. Clair, Pres.; E. G. St. Clair, Sec. and Treas.; G. A. St. Clair, Supt. The mines belonging to this company are located in Marquette county, Mich. The ore is soft hematite. Property owned, two engines, thirteen boilers, thirty-five houses. Developments commenced 1870. Date of organization, 1870. The mine fell in fall of 1881, owing to the heavy rains causing the supporting pillars to give way, a body of 150,000 tons of rock being thus let down into the workings, burying the pumps and blocking the skip-roads. A large portion of this rock is yet to be removed; 150 men employed.

The annual product of the Winthrop during the past twelve years has been as follows:

	Gross Tons.		Gross Tons.
1870	3,469	1876	27,236
1871	11,088	1877	12,549
1872	14,239	1878	23,740
1873	33,456	1879	26,595
1874	7,549	1880	45,247
1875	7,502	1881	43,630
Total			256,300

Youngstown Iron Mining Company (The), of which Mr. F. P. Mills, Jr., formerly Mining Engineer and Assistant Supt. of the Cleveland mine is the Superintendent. Owns the Youngstown mine, located in Marquette county, Mich. The ore is a hard hematite, averaging well in metallic iron, but too high in phosphorus for Bessemer purposes. The character of the mine is not correctly ascertained; surface indications show vein extending 1,200 feet by forty-five feet in width, trend east and west. Prospects are promising, and a great mine is looked for. The ground is very wet, being recently covered with a dense growth of timber. It may be mentioned that explorations are conducted by drill, and are progressing favorably. Organized in June of the current year (1882).

KAOLITE.

W. Robinson & Co. This company's property is located in the bluff on the east bank of the Ontonagon river, Mich. The quality of the mineral is superior, and is excellent for polish and for the manufacture of fine earthenware. Maximum yearly capacity of production, one vessel load. There is an extensive deposit on the property. The prospects are promising. The company was organized during the year 1875.

LEAD.

Amador Gravel Mining Company (The). Located in Amador county, Cal. Lead of blue gravel. Prospects, excellent drifting.

Arizona Mining Company (The) is chartered under the laws of the State of New York. The officers are, viz.: Edward K. Moulton, James H. Kidder, Fred. G. Swazey, Trustees. There is found a very wide ledge of lime-rock, near the center of which is a vein, fully fifteen feet wide, carrying iron spar, carbonate of lead. Work is being carried steadily forward, the ore being left on the dumps until the smelter starts up in summer. Capitalization, $100,000.

Belden Mining Company (The). C. H. Thompson, Manager. Names of mines owned, Mamie and Cora; located on Battle Mountain, Col. Extent of claim, twenty-seven acres. (31) Beckett & McDonald, of New York, are building a forty-horse-power engine for the purpose of the present hoister at the mine, just completed, and a cast-iron pipe, two and a half feet in diameter, sunk in the ground. There will be but little fear that work will stop during the winter for want of water. (31) Where the Battle Mountain formations are exposed, showing the granite quartzites, shales limestone, ore deposit, and porphyry, and limestone has been followed in a northeasterly direction into the mountain for a distance of 540 feet. The dimensions of workings, Cora shaft down at 145 feet. The general appearance of the mine is very satisfactory, the ore deposits being large and continuous, though there is considerable change throughout in the actual masses of ore. Billings & Eiler have contracted for 10,000 tons of ore from this property, which is thirty per cent. of lead. Interesting parts of this mine, are the ground between the levels No. 1 and No. 2, cross-cuts from the main incline, shows ore, which for the main part is made up of iron and manganese oxides mixed throughout with galena and carbonate of lead ore. Company was organized at Portland, February 15, 1881; capitalization, 50,000 shares; par value, $10. Thirty men employed; monthly expense, $6,000.

Black Mountain Mine (The) is owned by D. B. Belden, Esq. Mines owned are Silver Wave, Eagle Bird; located on Battle Mountain, Col. Quality and character of ore, very fair mineral; character of mine, veins consisting of carbonate, sulphate, and oxides of lead. Very fine prospects of the property. Steel rails are laid, and an iron car is in use. The breast of this incline shows a solid mass of ore, the thicknes of which is not yet known with certainty. Length of tunnel, 130 feet.

Consolidated Pacific Mining Company (The). Capt. Isaac Cooper, owner, Denver, Col. Names of mines owned by the company, Yellow Boy, Unicorn, Sedalia; location, Colorado. Quality and character of the ore, leads of remarkable promise.

Fisher Mining Company (The). The mines of this company are located in May Flower Gulch, Col. Four hundred tons of fine lead ore have been received.

Lead Mine, owned by Wylie & Cram, is located in the township of Ramsay, county of Lanark, Ontario, Canada. The company owns 100 acres of farming land. The gangue calc spar, a very pure dense sulphate of baryta, three assays, made by Dr. Girard Wood, were as follows: 1st, seventeen ounces silver, three-fourths ounces gold; 2d, four ounces silver; 3d, one ounce silver. There are about forty tons of ore on the dump. The owners are not in position to work the property extensively themselves, but will probably develop it further during the summer. 1882.

New River Mineral Company have their property located in Wythe county, Va. The company, working six men for four months, raised twenty-five tons of lead ore and fifty tons of zinc ore, the latter carbonates and sulphurets.

St. Joseph Lead Company. The officers are J. W. Jones, Pres.; H. N. Camp, Sec. C. B. Parsons is Superintendent. Office, 152 Broadway, New York. The company's mine, the Gem Silver Prize, is located in St. Francis county, seventy miles south of St. Louis, Mo. The ore has a high percentage of nickel and cobalt, combined with native silver, contained in the ores. The nickel is in black and green oxides, mixed with feldspar and silica. Horizontal disseminated vein in limestone. The ore is under eighty feet of cap rock. The rock runs from five to fifteen per cent. ore, and is cut out twenty-five feet deep, and the roof supported by pillars left standing; 200 tons of rock are excavated daily; thirty acres have been bored through, equally rich. There are twelve stockholders. This is said to be the largest lead mine found yet in Europe or America. The mine has a current value of $750,000. The property includes fire-hose and apparatus and new crushers. St. Louis is the principal market for the ore. Date of organization, at St. Joseph, February, 1882. Capitalization, $1,000,000; par value per share, $10; total amount of dividends paid to June 12, 1882, $350,000; date of latest dividend, June 12, 1882; twenty cents per share; stock quoted, June 17, 1882, $7.50 per share.

MANGANESE.

Crimora Manganese Mine (The). Leased by Messrs. Davis & White, of Pittsburg, Pa. S. M. Donald, Jr., Superintendent. The Crimora mine, located in Shenandoah Valley, Augusta county, Va., is considered to be one of the most productive mines in the country.

Hopewell Manganese Company is chartered under the laws of the State of Maine. The Directors are S. W. Pollard, Pres.; F. W. Prescot, Sec.; E. H. Hastings, Ambrose Leed, E. F. Dole, E. H. Peck, W. A. Travis. The company's property is located at the Parish of Harvey, Albert county, New Brunswick. Amount of property in acres, 250. The character of the ore is said to be compact black oxide, as high as ninety per cent. Capitalization, $40,000; par value per share, $5; stock and bonds are held principally in Massachusetts.

MICA.

Anglo-American Mica Company (The). Officers, Mr. Palmer, Pres.; Col. H. L. Dunkle, Superintendent and Gen. Manager. Name of mine owned, Bald Eagle. Location of mine, Black Hills, Dakota.

Black Hills Mica Mines, owned by H. C. McMackin, Esq., are located at Custer. The mineral is of superior quality; the largest sheets, eight by sixteen inches; average, five and one-half by six inches. The weekly output at June, 1881, was 600 pounds. Cleveland, O., constitutes the chief market for the product.

Crystal Mica Mining Company. The officers are Earl A. Shissell, Pres.; A. T. Atherton, Treas.; J. Y. Bradbury, Sec. Office, Lowell, Mass. This company's property is located in the town of Groton, N. H., and is but a short distance from the town of Rumney, on the B. C. & M.

R. R.; and is but a short distance from the Ruggles mine, which has for a number of years furnished a large portion of the mica used in this country.

Mica Mine (The). Owned by prominent officials of the Atchison, Topeka, and Santa Fe. Mr. Solomon Teal, Superintendent. The Mica mine is located near Currant Creek, Colorado.

GOLD AND SILVER.

Ada Elmore Gold and Silver Mining Company owns the Ada Elmore mine, located on Bear creek, Idaho.

Alpha Consolidated Gold and Silver Mining Company (The). The names of officers (Directors) are John W. Coleman, J. S. Wall, J. B. Russell, Joseph Clark, O. L. Weller, William Willis, Secretary and Treasurer. Head office, 309 Montgomery Street, San Francisco, California. Date annual election, June 16. The company own the Alpha mine, located at Gold Hill district, Comstock Lode, Nevada (ore looking well), composed of fine gold and sulphurets. The mine continues to look well. Vein about two feet in width; linear feet in mine, 306; capitalization, $3,000,000; shares, 30,000; par value, $100; number of assessments levied, sixteen; total amount of same, $420,000; date of latest assessment, March 20, 1882; cash on hand April 1, 1882, $523; company in debt February 1, 1882, $6,459.

Alta Montana Company (The). The officers were in 1880 W. W. Wickes, President; Michael Snow, Vice-President; Cole Saunders, Assistant Manager; R. F. Brooke, Secretary. Directors, A. S. Barnes, Alanson Trask, L. M. Sheldon, Michael Snow, New York. Head office, 35 Broad Street, New York. The company own eleven mines, located at Wickes, Montana. Ten of these extend on the Alta vein two miles. Four are developed from both sides of the mountain by the silver tunnel 1,700 feet. Width of vein, five feet; latest assays average 140 to 240 ounces per ton. The company have also purchased the Comet mine, and erected concentrating works upon it. The product of this mine is a heavy galena, intermixed with sulphides of iron and zinc and mispickel. The vein is wide and regular, and has produced largely. Capitalization, $5,000,000; shares, $10; par value, $100; yield (net) to January 1, 1880, $435,980.

American Flag Mining Company is chartered under the laws of the State of New York. Office, 59 William Street, New York. The company's works are located at Ely district, Lincoln county, Colorado and Arizona. The ore found contains gold, silver, and copper, assaying $30 per ton, average width of vein being seven feet, and length of main lode 5,300 feet. The width of the pay streak is two feet, the ore giving an assay of $100 to the ton. It has been opened by shafts and drafts to the extent of 2,000 feet or more, and has produced a large amount of the richest ore ever mined in the country, most of which has been sent to San Francisco for reduction. Date of organization, February 17, 1864; capitalization, $4,000,000: par value per share, $100; number of assessments levied, ten; total amount of same, $280,000; date of latest assessment, April, 1882, ten cents per share.

American Mining Company (The). The mines are located in Nevada county, California. Quality of ore, copper high grade ore. Ledge two feet wide. Rich in gold and silver, which assays per ton, $100.

American Gold and Silver Mining Company (The). Location of mines, Colorado. Number of dividends paid June 24, 1882, total amount, $90,000.

Anglo-American Company (The). Location of mines, Horn Silver Mountain, near Red Cliff, Col. A mill is owned by the company. The character of the ore is very fair, consisting of quartz and clay. Fair assays silver and gold; assays per ton, $16.22; 119,118 ounces gold per ton. Prospects of the property are very good. The assays have given results far beyond the most sanguine expectations.

Anglo-Celt Silver Mining Company is chartered under the laws of the State of Iowa. The officers are Hon. Jas. Harlan; B. N. Curtis, Sec. Main office, Mount Pleasant, Iowa. The Anglo-Celt and Emperor mines, owned by this company, are full claims, and located in Oro Blanco district, Peria county, Ariz. The Emperor ore is yellow and blue chlorides of silver, bearing both gold and silver, and is about eighty per cent. free milling. The Anglo-Celt ore is mostly gold and silver-bearing quartz, with an unsually large percentage of the former. Emperor mine shows a true fissure vein as does also the Anglo-Celt. Capitalization, $2,000,000; par value per share, $20.

Antelope Gold and Silver Mining Company (The). This company owns ten claims on two groups, viz.: Wild Horse, Belle, Texas Ranger, Point, Tenderfoot, Time, Francis Fisher, Atlantic, and Grand Army. They are located near the base of Red Mountain, Aspen city, Roaring Forks district, Gunnison county, Col.

Argenta Mining Company. The directors are J. L. Brown, J. E. Dixon, Thomas Cole, Geo. Congdon, W. H. King; E. M. Hall, Sec. Branch office, 327 Pine Street, San Francisco, Cal. The company mines are located at Tuscarora, Elko county, Nev. The length in feet of the main lode, on which the company depends for its supply of ore, is 1,500. The Argenta mine has been working on its 600-foot level, where rich ore has been found, the vein being ten inches wide at the bottom. Free gold is plainly discernible in a considerable portion of the quartz. The silver ore on either side of the gold streak is of a good quality, and will pay handsomely for mining and milling. Capitalization, $10,000,000; par value per share, $100; yield during 1880, $118,870; total amount of dividends paid to February, 1880, $40 000; date of latest dividend, February, 1880, twenty cents per share; number of assessments levied, five; total amount of same to November, 1880, $110,000; date of latest assessment, April 12, 1882, at the rate of ten cents per share: stock in the treasury, April, 1882, $485; stock quoted, July 1, 1882, twenty-five cents.

Arizona Gold and Silver Mining Company is chartered under the laws of the State of New York. They have an office located at 61 Broadway, New York. The company's mines are located in Mohave county, Ariz. The ore is both auriferous and argentiferous, assaying $67.60 per ton. Organization of company, May, 1879; capitalization, $2,500,000; par value per share, $25; non-assessable.

Arizona and New Mexico Prospecting, Developing, and Mining Company is chartered under the laws of the State of New Jersey. The officers are E. Joy Morris, Pres.; J. W. Brown, Treas.; George C. Barber, Sec. Main office, 407 Linden Street, Camden, N. J.; local office, 311½ Walnut Street, Philadelphia, Pa. The company is not confined to the mining of precious metals alone, but extends to operations in pre-emptions of lands, towns, mill and water sites. The company has for sale gold, silver, copper, coal, iron, and other valuable metals, and mineral bearing veins, singly or in groups. This company have a capitalization of $1,000,000, in 200,000 shares of $5 each. Non-assessable. Stock reserved in treasury, 77,000 shares.

Arizona Southern Mining and Milling Company (The) is chartered under the laws of the State of New Jersey. The officers are James W. Kems, Pres.; George B. Dresher, Vice-Pres.; W. H. Dresher, Treas.; James Cohoun, Sec.; H. B. Ring, Asst. Sec. The Superintendent is H. S. Searle, of six years' experience. Annual election is held first Monday in March. The principal offices are at 106 Market Street, Camden, New Jersey; branch office, 174 South Fourth Street, Oro Blanco, Arizona. Transfer offices, Camden, N. J. Transfer days, every week day. The company owns five mines, the Searle, Pilot, Herman, Arizona Southern, and Silver Wing, located in Oro Blanco, Pima county, Ariz., covering an area of ninety-six acres. The ore gives a silver assay of $74.21, and gold $19.25, and yields a net profit of about $54 per ton. Developments were commenced in June, 1881, and are consequently not far advanced, $3,100 having so far (to June, 1882) been expended. Experts pronounce property valuable and prospects excellent; cost of mining and milling is $27 per ton. The company will mill its own ore. Experts who have made careful examination of the mines suggest that no time should be lost in prosecuting the developments, suggesting a beginning on the Silver Wing, the ore of this mine being of the highest grade; its productions would not only develop the others, but would probably leave a margin from which to pay a dividend, and the development of the group would no doubt within a short time increase the dividends very largely. Organized, 25th February, 1881; capitalization, $300,000; shares each, $1; unassessable; bonded indebtedness, June, 1882, nil; stock indebtedness June, 1882, $179,915; floating indebtedness June, 1882, nil; stock in treasury June, 1882, $120,085; stock qutoations, 27½ cents; stock held principally in Pennsylvania and Arizona; stock listed at Mining Annex, Philadelphia; wages paid to all classes of labor per day range from fifty cents to $5; work is done by contract.

Associate Mining and Investment Company is chartered under the laws of the State of New York. The officers are William Guild, Pres.; Edward M. Parker, Vice-Pres.; Henry E. Maline, Sec.; Samuel Thompson, Treas. Office, 40 Broadway, New York. This company has been organized for the purpose of not only transacting a general mining business, but more especially for organizing, developing, and negotiating the sale of mines and mining claims. Capitalization, $1,000,000; par value per share, $1.

Addenda Gold and Silver Mining Company. T. H. Dixon, Sec. Head and branch office is located at 328 Montgomery Street, San Francisco, California. The mine is located on the very crest of Silver Hill, Bodie district, Cal. Amount of property owned by the company in acres are 200 and 1,500, generally of a low grade, too low to pay, but occasionally developing quick, rich spots and streaks. The property owned by the company, steam hoisting, costing $6,000. Depth of shaft, 500 feet; total length of level, 1,000 feet; ledge, fifteen to twenty-five feet in width; blue clay wall in places one foot thick; also strata of pure, white granulated quartz, carrying traces of gold and silver. The shaft has recently been repaired and work actively resumed. Capitalization, $10,000,000; par value, $100; five assessments levied, total amount of the same, $90,000; commenced by sale of $2,000 stock, and twenty cents assessment applied. Date of annual election, September 7, 1881.

Ætna Mining Company (The) are the owners of the Ætna mine, located at Carbonate Hill, Colorado. The Manager, Mr. J. R. Loker, has been employing fifty-three men and taking out about forty tons of ore per week. The company's property covers ten acres of land. The character of the ore may be described as lead carbonate. It is very rich, giving a silver assay of from one to twelve ounces per ton, and a gold assay of from six-tenths to 176 ounces per ton. The total profits of mine since discovery have been $161,666. Capitalization, $2,200; par value per share, $1; date of latest dividend, January, 1881; surplus on hand, $60,000.

Alaska Gold and Silver Mining, Milling, and Trading Company. The company's claims, the Pioneer and Omiluk, are located in Fish River mining district, situated in the Omiluk range of mountains, Alaska. They are 1,500 feet in length, each, by 600 feet in width, and join on the summit of the ridge. On the Pioneer, a shaft was put down twenty-two and a half feet in ore. On the Omiluk, a shaft was put down twelve feet in ore, also, and of the same general character as that in the first shaft. The ore is argentiferous galena, with some iron croppings. Limestone forms one wall and micaceous slate the other. These walls seem to be separated about 200 feet where the ore body crosses the mountains. Some fifteen tons of ore are now on the dump of the shafts. The ore carries a very high percentage in lead, and gives an average of $140.16 in silver per ton. The percentage of lead is so great that no reduction works will be required at the mine; however, there is an abundance of timber near the mine for all practical purposes. To mine and deliver this ore in San Francisco, it is estimated to cost from $50 to $55 per ton. After the first year, the ore will be hauled and delivered for much less than the above amount.

Alder Gulch Placer Mining and Water Company. The Directors are Edward W. Knight, Alex. A. Beattie, Joseph K. Toole, Theodore H. Kleinschmidt, E. W. Toole, Chas. Rinda, James McEvily. This is a new company, the object of which is to construct a water ditch from Wigwam Gulch, in Madison county, Montana, to cover the mineral bars and gulches in and about Alder Gulch, in said county, to work placer and lode claims, etc. The mines covered by the proposed ditch, the right to which has been secured by the company, have been long known to be very valuable, and nothing but the want of water has left them undeveloped so long. Capitalization, $100,000. Par value per share, $1.00.

Alice Gold and Silver Mining Company. The officers are Joseph R. Walker, Pres.; Benjamin C. Raymond, Sec.; and W. E. Hall has the general superintendence of affairs, having had thirty-four years' experience in Europe and America. They have a branch office located at Salt Lake City, Utah, and transfer office at 47 Broadway, New York. The company's chief mines are the Magna Charta, Valdemere, and Alice. They own eight other claims, which are as yet undeveloped. The mines are located at Waterville, Butte district, Montana, covering an area of ninety acres. The ore gives a silver assay of 46 oz. per ton, and of gold 30 oz. per ton. The gangue of the ore is white quartz, containing gold and silver, silver glance, argentiferous gray copper, native silver in thin plates and wire form, and zinc blende. Dip 68° to 70°. True and well defined fissures in granite. Rock very hard, rendering progress in drilling slow. The richest thing known now in Butte is the ore body on the second level of the Magna Charta. North of the shaft a ten-inch body averages $1,000 to the ton. On the first level of the Alice mine are immense reserves of free ore, some of it low grade, but assays show it to be of good working quality. Ledge wide and ore clean and compact. On the second level an abundance of ore is in sight, somewhat more base than that of the first level, but susceptible of profitable reduction. On the third level, a big winze has been started on a body of base ore, measuring fully seven feet across, and assays from 60 to 100 oz. per ton. Further east, stope shows nine feet of ore, some assaying $33, but all rich enough to pay a handsome profit. The company owns two stamp mills, one twenty-stamp and one sixty-stamp. Also plant of sufficient capacity to sink to the depth of 2,000 feet, together with Cornish pumps, Rower drills, hoisting engine, heavy boilers, and other machinery, buildings etc., including shaft houses. The depth of shaft in the Magna Charta is 400 feet, while that in the Alice has reached a depth of over 700 feet. Since commencing operations, the company have expended about $200,000 in developing their property. Prospects of the property are excellent. The company is free from debt, and facilities will be greatly extended, and double the present income is predicted. Cost of mining and milling per ton is $20.25. Capitalization, $10,000,000; par value per share $25; non-assessable. Yield to January 1881, $1,120,937.30. Yield (gross tons) 2,040,780 $\frac{55}{100}$. Number of dividends paid to December 15, 1881, ten. Total assessment of same, $400,000. Stock quoted July 5, 1882, $2.85 per share.

Booker Consolidated Mining Company (The). J. M. Brasell, Sec. Principal office, 203 Bush Street, San Francisco. Mines located in California.

Boston Consolidated Mining Company is chartered under the laws of the State of California. F. F. Luty, Sec. Office, 330 Pine Street, San Francisco, Cal. The company's works are located in Mono county, Cal. The ore found gives an assay of both gold and silver, and averages about $60 per ton. Formation, chiefly porphyry rock, firm, and filled with iron pyrites. Ledge shows clearage at 300-feet level. Average width of vein in 1881, four feet. Ore from 200-foot level assays from a few dollars to $1,500 per ton. Other ores of high, uniform grade. Value of property owned, viz., large, whim, w. h. shops, etc., $4,000. Date of incorporation, July 14, 1879; capitalization, $10,000,000; par value per share, $100. Number of assessments levied, three; total amount of two assessments, $50,000; date of latest assessment, May 23, 1882, twenty cents per share.

Boston Gold and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are E. H. Goff, Pres.; Col. R. W. Thyng, Vice-Pres.; H. E. Irvine, Sec.; James B. Potter, Treas. Superintendent, Col. A. J. Ware. Head office, Goff, Hastings & Co., Bankers and Financial Agts., 292 Washington Street, Boston. The company own the Dolly Varden mine, located on the southern slope of Mount Brass, Park county, Col. Property covers some 860 acres of land; ore assays about thirty ounces per ton. Property owned, boarding-houses, smith-shops, ore-houses, stable, and office. There are two cross-cut adits, one 320, and one 100, feet. The Dolly Varden mining estate was purchased for $400,000. Date of organization, July 23, 1880; capitalization, $2,000,000; par value per share, $10; non-assessable; full paid. Bonds issued for $350,000, and placed on London market, ninety-seven per cent.

Boulder Mountain Mining Company. President, C. S. O. Tintsman, Pittsburg, Pa. The Salem, Brooklyn, and North Star mines, belonging to this company, are located at Tower Mountain, Col. The Brooklyn lode has a drift on the vein of eighty feet, showing a pay-streak of spar and telluride ore of about three feet in width, and assaying high in silver and gold. The Salem mine has a fifty-foot drift on the vein, and now shows a pay-streak of eight inches of galena, carrying silver and a large per cent. of lead. Number of assessments levied, twelve; date of latest assessment, May, 1882, ten cents per share.

Boulder Mining Company (The). E. S. Rice, Pres.; Dr. J. C. Shultz, Vice-Pres.; J. K. Waltz, Sec.; A. R. Schroyer, Logansport. Directors, E. S. Rice, Dr. J. C. Shultz, S. A. Vaughn, A. R. Shroyer, John Brown, J. K. Waltz, W. H. Snyder, Dr. J. H. Shultz, Logansport; C. C. Clements, New Castle, Ind.; Joseph V. Lawson, Salt Lake City; Sheridan Cox, Kokomo. Head office, Logansport, Indiana. Name of mine owned is the Boulder, located in Cataract district, Jefferson county, Montana (near Butte City). A ten-stamp mill on Basin Creek is the property of the company. Developments commenced February, 1880. Prospects of the company are very good. Many thousand tons of ore are now in sight, carrying both gold and silver, some assaying as high as $1,200 to $1,500 in gold per ton, and from eighty to 150 ounces in silver. The average assay value $25 per ton. Interesting facts of the mine; there are six shafts varying from twenty-five to 150 feet in depth, levels are run to the bottom of these shafts, and by a tunnel 250 feet in length along the vein.

Brook Snider Consolidated Gold and Silver Mining Company (The) is chartered under the laws of the State of New Jersey. John Crump, Pres.; Geo. W. Brattan, Vice-Pres.; Henry J. Crump, Sec. and Treas. Directors, John Crump, Geo. W. Brattan, S. P. Griffits, Albert Foster, Ephraim Young, Col. T. W. Brooks, Alex. Muckle. Superintendent, Rufus H. Snider. Office, Breckenridge, Col. Transfer office, 711 Walnut Street, Philada. Mines owned by this company are the Illinois, Fannie Barrett, and Peerless, located at Schock Hill, Spaulding district, Summit county, Col. Amount of property in acres, thirty-two and one-half. The company owns a twenty-ton stamp-mill, which will soon be increased to forty-stamp. There over 1,300 tons of ore on the dump. Capitalization, $2,000,000; par value per share, $5; non-assessable.

Buckeye Mining and Tunnel Company is chartered under the laws of the State of Colorado. The company's mines are located at Silver Cliff, etc., Colorado. Ore contains gold, silver, lead, and coal, and assays from $20 to $75 per ton. Company owns hoisting works, machinery, etc.; value, $40,000. Date of organization, February 5, 1876; capitalization, $2,000,000; par value per share, $5; non-assessable; stock quoted July 14, at three cents.

Buffalo and Hamburg Mining Company is chartered under the laws of the State of New York. Trustees are Simon P. Swift, Pres.; Joel P. Lewis, Vice-Pres.; F. F. Fargo, Sec.; Jos. Maycock, Treas. Zeneas M. Swift, Attorney; Herman Poole, Assayer. The company's property is located at Hamburg, Erie county, N. Y., in the centre of what is known as Potter's Farm, on Wolf Creek, covering an area of twenty acres. The character of the ore may be described as slate rock, yielding a gold assay of $31.83, and silver, $110.32, which makes the total value per ton, $142.15. The mine shows dark slate interspersed with crystals of iron. Pyrites holding the precious metals, generally distributed in very fine particles. The cost of extraction per ton is estimated at $5. Date of organization, October 13, 1881; capitalization, $100,000; par value per share, $10: non-assessable; paid up.

Bangor Gold and Silver Company is chartered under the laws of the State of New York. Office, 60 Liberty Street, New York. The company's works are located at Nevada City, Col. The company have a capitalization of $2,000,000, in 200,000 shares, with a par value of $10 each. The company was incorporated October, 1879; basis, non-assessable.

Barcelona Mining Company is chartered under the laws of the State of New York. Office, 115 Broadway, New York. The company's mines are located at Spanish Belt, Nev. The ore contains silver, gold, and cinnabar, and assays $85 per ton. Property owned, diamond drills, hoisting works, etc. Date of incorporation, June 30, 1880; capitalization, $5,000,000; par value per share, $25; non-assessable; stock quoted July 13, 1882, eight cents.

Bassick Mining Company is chartered under the laws of the State of New York. The officers are F. G. Brown, Pres.; Dennis Ryan, Vice-Pres.; W. S. Hoyt, Sec.; W. F. Van Pelt, Treas. Office, 44 Wall Street, New York. The company's mine, the Bassick, is located at Rosita, Custer county, Col., being the most important in the district. The ore contains tellurides of gold and silver, and assays $200 per ton. Property owned, hoisting works, engine, and boiler-house, ore-house, etc. Crushing capacity, seventy tons per day, fully kept going by the output of the mine. The mill and mine are lighted by the Brush electric lights, and work proceeds uninterruptedly week in and week out. Little information of a definite character can be obtained respecting the productive capacity of this mine. It is believed to be close upon $400,000 for the past year. Date of organization, July 15, 1879; capitalization, $10,000,000; par value per share, $100; basis, non-assessable; total amount of dividends paid to February, 1880, $25,000; date of latest dividend, February, 1880, twenty-five cents per share; stock quoted July, 1882, $13.

Belcher Gold and Silver Mining Company is chartered under the laws of the State of California. J. Creackett, Sec. Office, 327 Pine Street, San Francisco, Cal. The company's works are located at Gold Hill district, Nev. The ore is both auriferous and argentiferous, the former predominating. Length in feet of the main lode, 1,040. Date of organization, November 2, 1868; capitalization, $10,400,000; par value per share, $100; number of dividends paid to April 10, 1876, thirty-eight; total amount of same, $15,397,200; date of latest dividend, April 10, 1876, $1 per share; number of assessments levied, thirty; total amount of same, $2,580,000; date of latest assessment, April, 1882, twenty-five cents per share. Floating indebtedness, April, 1882, $25,000.

Belle Isle Mining Company (The). Office, 327 Pine Street, San Francisco, Cal. The Belle Isle mine is situated in Elko county, Nevada. The company has been working in the 250-foot level. An open-cut shaft has been completed, which exposed a well-defined ledge of green carbonatea, intermixed with black oxide. Green copper is found in a prospect shaft, 200 feet to the left of the cut, which is considered favorable to the permanency of the deposit, and being found on the summit of the mountain, indicates that the ore body extends through the entire mountain. The vein at the 240-foot level averages five inches in width of high-grade ore. The 250-foot level shows a vein about six inches wide, of low-grade ore. Capitalization, $10,000,000; par value per share, $100. Yield during 1880, $21,560. Number of dividends paid to December 6, 1879, six; total amount of dividends, $300,000; date of latest dividend, December 5, 1879. Total amount of assessments levied, $65,000; date of latest assessment, May 23, 1882. Stock quoted July 14, 1882, forty-eight cents. Cash on hand April 1, 1882, $1,345; company in debt, March 1, 1882, $146.

Belvidere Mining Company is chartered under the laws of the State of California. C. D. V. Hubbard is Secretary, and has his office at No. 310 Pine Street, San Francisco. This company owns the Belvidere mine, which is located in Bodie district, Mono county, Cal. Extent of claim, 200 feet by 1,500 feet. The ore found assays both gold and silver. The mine shows four well-defined ledges, four feet wide in some parts. The company are the owners of a whim. The main lode on which the company depends for its supply of ore is 1,500 feet in length. There are 4,000 feet of excavations. Shaft is down 650 feet. Date of incorporation, November 1, 1877; capitalization, $6,000,000; par value per share, $100. Yield during 1880, $25,901.26. Total amount of assessments levied, $282,000; date of latest assessment, February, 1882, twenty-five cents per share. Working expenses about $2,000 per month.

Berkshire Consolidated Gold and Silver Mining Company. The officers are K. B. Cheeney, of Lee, Mass., Pres.; Henry Pike, V.-Pres.; Wellington Smith, Treas.; J. B. Crosby, Sec.; Asst. Supt., M. P. McNamee. This company owns the Hailstorm, Homeward Bound, and Silver Bell mines, located at Black Hills, Dakota. A rich strike is reported in one of the mines, at Bald Mountain; the ore assaying $8,000 in gold and silver, principally the latter. Three hundred tons of ore on the dump will assay from $50 to $150 per ton. Capitalization, $2,500,000; par value per share, $5.

Best and Belcher Mining Company (The). Officer, W. Willis, Secretary. Principal office, 309 Montgomery Street, San Francisco, Cal. The mines are located in Virginia district, Comstock Lode, Nev. Character of ore, gold and silver. Depth of workings is by tunnel, 2,220 feet. Length in feet of main lode, on which the company depends for its supply of ore, 545 feet. Capitalization, $10,080,000; shares, 100,000; par value, $100. Dividends, none. Number of assessments levied, twenty-three; total amount, $1,243,390; first assessment, amount per share, fifty cents; date of latest assessment, April, 1882; amount, fifty cents. Floating indebtedness, $7,629. Cash on hand, March, 1882, $4,629.—*Mining Record*, June 17.

Black Range Company (The), of Carrollton, Ill. Officers, David Dodgson, Pres.: Wm. M. Fry, V.-Pres.; Wm. L. Orr, Sec.; John J. Sharon, Treas. Directors, J. K. Sharon, L. R. Lakin, Adam Gimmy, David Dodgson, Wm. M. Fry, H. C. Sieverling, Lewis F. Gimmy, S. A. Vedder, John J. Sharon, J. B. Nulton, Superintendent. Names of mines owned, Dreadnaught, Ivanhoe, Buffom, Colossal, Mail Line. Location of mines, Dry creek, Socorro county, N. M. Buffom has a shaft 184 feet, Colossal shaft, 100 feet; Dreadnaught shaft, twenty-five feet; Mail Line, thirty feet. The Colossal property is being worked under bond; it shows four feet of mineral, sampling $300 in silver, and some gold. Some assays give a result of 1,200 ounces in silver. The Dreadnaught shows a five-foot vein of ore, assaying 200 ounces of silver to the ton, and forty per cent. copper. The ore in the Mail Line assays high.

Black Horse Gold and Silver Mining Company (The). Location of mines, Portland, Me. Date of organization, May 5, 1881. Capitalization, $200,000.

Bloomer Gold and Silver Mining Company. The Trustees are J. E. Bloomer, W. J. Bloomer, E. W. Wallace, E. H. Coffin, E. L. Hall, A. W. Bliss, and F. Wooster. The company's mines are located in Vermont. They have a capitalization of $1,000,000.

Bodie Queen Gold and Silver Mining Company (The). Officers are William H. H. Hart, Leander Shores, George S. Carrier, A. H. Todd, and J. L. Armstrong, Directors. The mine is located in Bodie, Mono county, Cal. This company was organized March 5, 1880.

Bonanza Gold and Silver Mining Company. The organizers were James C. Cline, E. W. Banker, C. S. Jennings, G. L. McCuen, and F. J. Sweeney. The company's property is located in Lake, Pitkin, and Summit counties, Col. The company has a capitalization of $2,500,000. The mining property of this company is located in Colorado. The ore body is said to be in splendid condition, and the mine, the Empress Josephine, well developed. The depth of shaft is 185 feet. Length of levels, 208 feet.

Bonanza and Union Tunnel Company (The) is driving the Bonanza tunnel, which penetrates Maryland or Bonanza Mountain in Gilpin county, Col., its entrance being from Chase Gulch and its course nearly due north. The Union tunnel is heading toward Central under Castro Mountains from the opposite site of Chase Gulch. So far twelve well-defined gold and silver veins have been cut and crossed by the tunnels. The Maryland, the Bonnell, and the Henry B. Hyde veins each showing remarkably large, true fissures from which 1,000 tons of ore were taken. The company purposes developing each of these veins so as to increase the output to the greatest possible extent.

California Water and Mining Company (The) is chartered under the laws of the State of New York. Office, 115 Broadway, New York. The French mine, owned by this company, is located at Georgetown Divide, El Dorado county, Cal. The reservoir has a capacity of 600,000,000 cubic feet. Pilot Creek and Leon Lake are the sources of supply. The company have 250 miles of ditches; grade, six to sixteen feet per mile; 1,200 inches; flumes, two and a half miles; total cost of plant, $600,000; date of incorporation, May, 1880; capitalization, $10,000,000; par value per share, $20.

California Gold and Silver Mining Company is chartered under the laws of the State of California. The company's Secretary is C. P. Gordon. Office, 309 Montgomery Street, San Francisco. The company's property is located in Virginia mining district, Storey county, Nevada. There are 600 linear feet in the mine on Comstock lode. The ore contains gold and silver in about equal parts, and assays $23.21 per ton. The cost of working mine per ton is thought to be about $17.60. The production of ore for 1880 was 37,454 tons, which amounted to about 890,515 ounces of fine silver. Date of incorporation, December 31, 1873. Capitalization, $54,000,000; par value per share, $100; ounces of fine silver to date (January, 1881), 1,812,237,340, equal to 664 tons 450 pounds; number of bars to date (January, 1881), 11,020; total production of gold to January 1, 1881, $23,310,281.98; total production of silver to January 1, 1881, $23,432,490.12; yield during 1880, 26,475,790 ounces of fine silver; number of dividends paid to December 16, 1879, thirty-four; total amount of same, $31,320,000; date of first dividend, May, 1876; date of latest dividend, December 16, 1879, fifty cents per share; number of assessments levied, four; total amount of same, $432.00; date of latest assessment, June 10, 1882, ten cents per share; indebtedness March 1, 1882, $3,549; Stock quoted July 7, fifty cents; wages paid to all classes of labor per week averages $24.

Candalaria Mining Company (The). Trustees, J. B. Russell, Oscar R. Jones, Wm. E. Norwood, Cornelius Reilly, S. Igland. Directors, S. Reinhart, H. M. Levy, R. P. Keating, T. M. Luce, P. J. White. Mines located in Esmeralda county, Nevada. Organized, March 17, 1880. Property owned, mill. Capitalization, $10,000,000.

Carmine Hill Gold and Silver Mining Company (The). Officers, Saml S. Campbell, Pres.; Charles M. Campbell, Treas. Directors, S. S. Campbell and Charles M. Campbell, Otto F. Gehricke. Head and branch offices, Portland, Me. Capitalization, $500,000; shares, 100,000; par value, $5; total amount of assessments levied, $15,000.

Central Arizona Mining Company (The) is chartered under the laws of the State of New York. The offices are at 30 Broad Street, New York city. The properties of the company are located in Maricopa county, Arizona. The Vulture mine, owned by the company, is the oldest and most important in the county. It was discovered in 1863, and steadily operated for about ten years, when it was abandoned on account of the expense attending the hauling of the ore to the mill, a distance of ten miles. In 1878, it came into the hands of the Central Arizona, under whose management it has been systematically opened and worked. The main shaft has attained a depth of nearly 400 feet, and is otherwise opened by working levels and cross-cuts. The ledge is gold quartz, from fifty to 100 feet in width, between well-defined walls of porphyry and talcose slate. The ores are low grade, assaying from $10 to $12 per ton, but can be worked for about $2.25 per ton. An eighty-stamp mill has been erected, and the necessary water is piped from the Hassayampa, a distance of some fifteen miles. The product amounts to about $20,000 monthly, according to official statement of company. The average product of ore and waste milled was $269¼ per ton; average cost of operating, $241⅞ per ton; average total expenses, $281⅝ per ton. The ore is argentiferous and free milling, assaying from $12 to $15 per ton. The buildings connected with the mine are of stone and are in excellent condition. Organized, November, 1878; capitalization, $10,000,000; shares, $100 each; non-assessable; full paid; stock quoted July 14, 1882, seventy-seven cents. The product for the fiscal year 1879–80 was as follows: gold, $90,072; silver, $238,119; total, $328,191.

Central City Gold and Silver Mining Company (The) owns the Scandia mine, located in Gilpin county, Col. The shaft is double compartment four by nine, and 300 feet deep. Considerable excavations have been made, but no ore bodies of consequence have been met with. The mine is, however, in good condition for the prosecution of further developments.

Certat Mill and Mining Company (The), owned by John Barry. Location of mines, Certat, Mohave county, Arizona. A mill is owned, doing excellent work from the mine, which is one of the best in the country.

Champion Mining Company (The), of which M. B. Burris is Secretary, has its offices at 327 Pine Street, San Francisco, Cal. The company owns the Champion mine, located at Bodie, Nevada county, Cal., the extent of claim being 200 feet by 1,500 feet. In a winze sunk eighty-seven feet below the 400-foot level, vein matter was encountered which gives promise of much more than average value, doubtless ledge formation, including clean quartz dipping under the cap from the direction of the Bodie and Mono. The main shaft is 600 feet deep. Total extent of excavation, about 1,500 feet. The mine is fitted with a Cornish pump of twelve-inch column, of sufficient capacity to carry the workings to the depth of 1,500 feet. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. For six months in the year 1880, the mine was water-logged on 500-foot level. The Champion has been doing prospecting and development work in the mine; the production has consequently been small for past six months. Two cross-cuts have been driven from the main tunnel, one east and the other west. These cross-cuts are 300 feet below the surface, and 1,653 feet from the mouth of the tunnel, and will give excellent drainage. Five quartz ledges will be cut, three of which have been satisfactorily prospected by shafts. The work in the tunnel was commenced five years ago, and has continued ever since without intermission. It is mostly through hard rock, which requires constant blasting, and timbers are only required in a few places. The formation previously was granite, but at the face of the tunnel it is in slate, which is considered an indication of permanency. Capitalization, $10,000,000, in 100,000 shares of $100 each; number of assessments levied, ten; total, $245,000; date of latest assessment, January 12, 1882, twenty-five cents per share; no dividends have been paid.

Charles Dickens Mining Company. The owners are W. A. Norton and John Rohrer, of Yankee Fork, and Fred. Phillips, of Salmon city, Idaho. The Charles Dickens mine is located in Yankee Fork district, Lemhi county, Idaho, and is the first ledge of note discovered in the district, and probably the most extensively developed in Yankee Fork country. It has been worked steadily for a period of five years, and has paid from the date of its discovery. The ore is free-milling. The shipping class sampled from $1,000 to $3,700. At the depth of 300 feet the vein carries gold and silver in nearly equal proportions, but nearer the surface gold greatly predominates. The ledge is opened at different points on the surface, covering nearly the entire length of the location. The character of the mine is true fissure. The main Dickens vein is from two to twelve feet in width, and a new vein has been encountered, which in point of quality and quantity of the ore, is fully as important as the original Dickens vein. The quartz shows much free-gold and silver. The first-class ore in the new vein, as sampled a few days previous to the closing of the report on the mines of the Yankee Fork district, gave $3,681.48; second-class, $1,972.54. The ore is free-milling. The value of the ore now in sight in the mine above the lower tunnel is estimated at $1,500,000. The company has a large two-bed arrastra, with a crushing capacity of two to two and a half tons of quartz per day. A pan and settler are attached. The machinery is propelled by water-power. The company employs ten to twelve men in the mine.

Cherry Creek Mining Company (The). The mines are located at Cherry creek, White Pine county, Nev. 1,000 linear feet in mine. Capitalization, $3,000,000; shares, 30,000; par value, $100; no dividends. Number of assessments levied, eight. Total amount of same, $63,000. Date of latest assessment, January 10, 1877.

Cheyenne Mining Company (The). Officers, Col. G. M. Totton, Pres.; A. C. Edgerton, Vice-Pres.; R. McNaught, Sec. and Treas. Principal office, 55 Broadway, New York city. Mines located at Dakota Territory, situated on Black Hills.

Chicago Enterprise Gold and Silver Mining Company (The). Officers, F. A. Griswold, Pres.; E. S. Hunt, Sec. Office, 110 Dearborn Street, Chicago, Ill. The company's works are located in San Juan, Col. They have a capitalization of $120,000, in shares at a par value of $25 each.

Chollar Gold and Silver Mining Company (The). Location of mines, Nevada. Capitalization, $11,000,000; shares, 110,000; par value, $100. Number of dividends paid to July 19, 1880, $224,000. Date of latest dividend, July 19, 1880. Amount, $50 per share. Number of assessments levied, eight. Date of latest assessment, May 9, 1882; amount per share, twenty-five cents. Stock and bonds in treasury, April, 1882, $14,378.

Chicago Enterprise Gold and Silver Mining Company (The). Officers, Francis A. Griswold, Chicago, Pres.; N. N. Hurst, M. D., Vice-Pres., Chicago; Charles H. Lawrence, 2d Vice-Pres., New Orleans, La.; Edward S. Hunt, Sec., Chicago; Oliver H. Perry, Treas., Chicago. Principal office, No. 110 Dearborn Street, Chicago. Location of mines, Animas Forks, San Juan, Colorado. 40,000 shares reserved in treasury for developing fund. Balance of the block of treasury stock ordered to be sold at $2.50 per share. Capitalization, 120,000 shares; par value, $25, full paid; non-assessable.

Cincinnati Gold and Silver Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, Wm. H. Wright, Pres.; Wilson Lloyd, Treas.; O. J. Rinsley, Sec. Principal office, 138 South Fourth Street, Philadelphia, Pa. Capitalization, 200,000 shares; par value, $10; non-assessable.

Cleora Mine (The) is located in Chaffer county, Col. The tunnel in mine has been pushed to a depth of 230 feet, and is under contract for a farther advance of 50 feet. The ore in this lode, which is about three feet wide between walls at the outcrop, is a white quartz carrying gold, silver, and copper. The ore is free milling. This mine contains numerous lodes of copper.

Columbia Gold and Silver Mining Company (The). Principal office, Indianola. Mines located in Iowa. Capitalization, $1,000,000; shares, 100,000; par value, $10.

Columbia Consolidated Gold and Silver Mining Company (The) is chartered under the laws of the State of California. The officers are A. G. Garnett, Pres.; J. D. Coughlin, Vice-Pres.; J. M. Buffington, Sec.; Wells, Fargo & Co.'s Bank, Treas.; Estee & Boalt, Attorneys; Trustees, A. G. Garnett, J. D. Coughlin, H. B. Wright, Jas. McCord, and John R. McKenzie. The head offices are at 309 California Street, San Francisco, California. The property is located in the Columbus mining district, and comprises four claims, viz.: the Leo, Mountain Queen, Mr. Castle, and Secretary, in Esmeralda county, Nev., at an elevation of about 6,400 feet. The ore is free milling. The lode has an east and west course, the general trend of all the paying mines of this district, and has a northerly dip or inclination of about 45°; walls of slate formation, of light gray color, impregnated with lime. There are four distinct ledges or veins running parallel, two and a half to fourteen feet in width. The mining plant includes a quartz mill, costing $116,000, in course of erection for custom work. Organized July, 1880. Capital, $5,000,000; shares, each, $50; non-assessable. 20,000 shares in treasury; when sold, work will commence active operations.

Colorado Springs Silver Company (The). Name of mines owned, Crystalline mine, only one developed. Location, Gunnison county, Col. Quality and character of ore, gangue of white quartz, ruby wire and native silver, in connection with zinc, iron pyrites, and white iron; assays 123 to 2,023 ounces per ton, with a heavy trace of gold. Character of mine, vein nine feet wide, with a pay streak from five to eighteen inches wide, surrounding rock of slate lime; streak grows richer and wider with depth. Dimensions of workings, three shafts aggregating eighty-three feet. Date of commencing developments, June, 1879.

Consolidated Imperial Mining Company, W. E. Dean, Sec. Office, 309 Montgomery Street, San Francisco, California. This company are the owners of the Consolidated Imperial mine, located in Virginia district, Comstock lode, Nev. The main lode, on which the company depends for its supply of ore, is 468 feet in length. Capitalization, $50,000,000; par value per share, $100. Yield (gross tons), 1881, 25,484 pig. Number of assessments levied, seventeen; total amount of assessments levied, $1,377,000; date of first assessment, July, 1880, ten cents per share; date of latest assessment, January 4, 1882, ten cents per share. Stock quoted, July, 1882, at five cents.

Consolidated Imperial Company (The). Names of mines owned, Alpha. Location, Washoe district, Nev. Character of ore, quartz and porphyry. Length of levels, 2,800 feet; total length, 260 feet.

Consolidated Treasure Company (The). The mines owned are the Central Treasure and Bay mines, located at Treasure Hill, White Pine district, Nev. The mines are worked by drifts.

Consolidated Pay Rock Mining Company. The officers are W. G. Steinmetz, Pres.; Capt. J. R. Riley, Vice-Pres.; A. B. Mullett, Sec. Office, 30 Broad Street corner Exchange Place, New York. The company's property, the Pay Rock mine, is located in Griffith district, Clear Creek county, Col. The ore is of very high grade, assaying $26.70 per ton. The ore vein in the north wall is four inches wide, running 800 ounces, and indications excellent for catching the same vein in the east drift of the north wall. A party visiting the mine says: "We found in the different levels no rocks or piles of debris to impede work; all is kept clean." Some 300 sacks of ore were shipped November, 1881, amounting to $7,000. A force of forty-two men are employed at Pay Rock mine, thirty being lessees. Lode No. 5, which was cut February, 1881, has been opened by a level that has been driven sixty-five feet eastward and forty feet westerly. This lode shows large quantities of ore of good grade in the level, and along the back level solid ore is found in a gorge vein, which shows the best pay is above the level. The winze shows a three-inch vein of smelting ore. Capitalization, $2,500,000; par value per share, $10.

Consolidated Virginia Mining Company (The), of which Charles H. Fish is Pres., and A. W. Havens, Sec., has its offices at room 26, 309 Montgomery Street, (Nevada Block,) San Francisco, Cal. The date of annual election is 12th January every year. The Consolidated Virginia mine is on the great Comstock lode, Nevada. The ore is argentiferous and auriferous and mills freely. Assay value $31.76. There is a blast furnace provided for reducing the ores. Aggregate depth of workings, 2,500 feet. The length of the main lode on which the company depends for its supply of ore is 710 feet. The cost of working mine for twelve months from January to December, 1880, was $946,759.52; cost of extraction and reduction about $17.04 per ton; maximum yearly capacity of production on January 1, 1880, $1,756,536; current value of the mine, $199,800. Organized 7th June, 1867; capitalization, $54,000,000; shares, $100 each. The net yield for the seven years preceding June, 1879, was, gold, $28,029,925; silver, $35,184,316; total, $63,214,241; yield during 1880, fine silver, 54,977,650, $1,755,020; the total product to 5th March, 1880, was 2,768,356,030 ounces fine silver; number of dividends paid to date, fifty-one; total of same, $42,930,000; ten of these were at the rate of $3 per share; thirteen of these were at the rate of $10 per share; date of first dividend May, 1874; date of latest dividend, August 16, 1880; amount, fifty cents per share; number of assessments levied to June, 1875, seventeen; total amount of same, $411,200; date of latest assessment, January 31, 1882; amount per share, thirty cents; floating indebtedness, $17,600; stock and bonds reserved in treasury, April, 1882, $106,762; from this has since been paid an indebtedness of $25,883, for a judgment of Supreme Court of Nevada. Stock quoted July 1, forty-five cents.

Consolidated Amador Mining Company. The Amador Consolidated mine owned by this company, is located in Amador county, California.

Consolidated Pacific Mining Company. F. E. Luty is Secretary. Office, 330 Pine Street, San Francisco, California. The Pacific mine, owned by this company, is located in Bodie district, California. Eighty-one tons yielded $4,137.60, or a little over $51 per ton, and mill test of 301 tons assayed $46 per ton. There are five ledges about five feet wide at 400 feet depth. The company have on their property very fine hoisting works, costing $18.000. Working expenses are about $2,000 per month. Extent of claim, 438x1,400 feet. Capitalization, $6,000,000; par value per share, $100; total amount of dividends paid, $17,000; number of assessments levied, four; total amount of assessments, $126,000; date of latest assessment, January 28, 1882; amount per share, twenty-five cents.

Copper Knob Mining Company is chartered under the laws of the State of New York. The officers are G. B. Flint, President; Wm. Brandreth, Vice-President and Treasurer; Edwin H. Mulford, Secretary. The Superintendent of the works is R. M. Evans, M. E. Branch office, 52 Broadway, New York. The company's property is located in Ashe county, North Carolina. They own 366 acres of land. The ore found assays copper, gold, and silver. The average value per ton is $70. 600 pounds of ore of this company were found to produce by working test of 100 pounds, gold, 465 cwt.; copper, 47½ per cent.; silver, nineteen ounces per ton. Date of organization, 1879; capitalization, $500,000; par value per share, $2; basis, non-assessable; number of dividends paid to November, 1880, two; total amount, $15,000; date of latest dividend, November, 1880; two cents per share.

Criterion Mine (The), owned by W. H. Kingsbury and others, is located in Colorado. The quality of the ore is high grade. A mill run of eighteen to twenty tons gave twenty-four ounces silver, $5 gold, and 50 per cent. iron. Estimating a profit of $10 per ton, there are several hundred thousand dollars in sight. The tunnel is 150 feet in length. Length of adits (that is, levels), from 125 to 130 feet.

Crown Point Silver and Gold Mining Company. The officers are C. L. Willer, President; A. K. P. Harmon, Vice-President; James Newlands, Secretary; J. H. Dobinson. J. P. Jackson, R. F. Morrow. Appointed Superintendent, Sam. I. Jones. This company are the owners of the Crown Point mine, located in Gold Hill district, Comstock Lode, Nevada. Length of the main lode upon which the company depends for its supply of ore, 600 feet. Capitalization, $10,000 000; par value per share, $25: number of dividends paid to January 12, 1875, fifty; total amount of dividends paid to January 12, 1875, $11,688,000; date of latest dividend, January 12, 1875, $2 per share; number of assessments levied, forty-seven; total amount of same, $2,673,370; date of latest assessment, February 16, 1882; company in debt, March 1, 1882, $544; cash on hand, April 1, 1882, $18 270.

Dahlgren Mining Company. The officers are G. E. Hutchinson, Pres.; A. W. Masterson, Sec. and Treas. Office, 63 Broadway, room 31, New York. The Morning Star mine is the property of the Dahlgren Mining Company, and is located in Pittsburg district, Lander county, Nev. It is worked by means of a tunnel and incline shaft. The tunnel level is forty-eight feet in length where it strikes the ledge. All of the workings are in ore from two and a half to five feet in width. The ledge increases as depth is attained, is well-defined, and lies between the two walls in an unbroken mass, rich in both silver and gold. Seventeen miners are employed. Considerable good ore has been taken out and piled up on the flat above the mine. Capitalization, $2,000,000; par value per share, $10; basis, full paid; non-assessable.

Davenport Consolidated Mining and Smelting Company (The) is chartered under the laws of the State of New Jersey. The officers in 1880 were E. S. Douglas, Pres.; R. Da Parrott, Vice-Pres.; J. C. Todd, Treas.; Superintendent, Nathan Cornish. The offices are at 229 Broadway, New York, room No. 18; 203 Pine Street, St. Louis, Mo. The company owns the four mines or claims, the Davenport, Wicker, Ashtabula, and Palermo, located in San Juan county, Col. The ore contains galena, gold, and silver, and gives an average assay of $60. Organized, January 6, 1880; capitalization, $1,000,000, in 200,000 shares of $5 each.

Dayton Gold and Silver Mining Company's (The) property is located at Devil's Gate, Lyon county, Nev. The main lode, on which the company depends for its supply of ore, is 1,600 linear feet in length. Capitalization, $10,000,000; par value per share, $100; no dividends paid to June, 1882. Number of assessments levied, ten; total amount of assessments levied, $750,000; date of latest assessment, April 2, 1878.

Decatur Silver Mining Company is chartered under the laws of the State of New York. The officers are Walter K. Marvin, Pres.; Horace Winans, Sec.; R. H. Gordon, Treas.; Superintendent, Jas. H. Pomeroy. Branch offices, 64 and 66 Broadway, and No. 19 New Street, New York; transfer office, 66 Broadway, room 43, New York. The company owns 1,500 feet on the Decatur, 1,500 feet on the Paul, and 3,000 feet on the Helmer, in Willis Gulch, located in Gilpin county, Col. The ore assays about two-fifths gold and three-fifths silver. Value per ton, $104.42. Work has been prosecuted only on the Decatur and Helmer. On the former, a depth of 110 feet has been attained. The Helmer workings are 185 feet down, at which point levels are being driven east and west. The ore is first concentrated and then sold, bringing $45 per ton of concentrates. A Cornish pump controls the water inflow. Date of organization, March 5, 1880; capitalization, $1,000,000; par value per share, $20. Basis, non-assessable.

Delano Gold and Silver Mining Company (The). Their property is located at Deer Creek, Tulare county, Cal. The company have been successfully developing their mine, and putting it in a condition for extracting a large quantity of ore. Originally an incline was sunk on the ledge to a depth of forty-three feet, showing the presence of ore the entire distance, varying in width from four inches to eighteen inches. A vertical shaft was afterwards sunk to the west of the ledge to a depth of seventy-five feet, when a cross-cut was run east, and to the ledge, eighteen feet, when drifts were run north and south on the vein, aggregating forty-five feet, and were only discontinued for the purpose of concentrating the labor at the straight shaft, the extremes of the drift showing the same character and quality of ore as is exposed in the incline. In the meantime, the incline was sunk to a depth of seventy-five feet from the surface, showing an unmistakable ledge formation, carrying quartz the entire distance. The extent of the ore-body, laterally, has never been determined, as only forty-five feet (in the drifts) have ever been explored, but the samples have been assayed, and show that they are as rich as in the upper drift. No difficulties are encountered in mining, as the mine has ample machinery, pumps, etc., to keep it dry, and extract ore at minimum figures. The ledge-matter is soft and yielding, and rapid progress can be made in drifting and stoping.

Del Monte Gold and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are V. G. Edwards, Pres.; J. C. Turner, Vice-Pres.; C. P. Johnson, Treas. Directors, V. G. Edwards, F. Sheip, J. C. Turner, A. Hallowell, H. W. Peters, Wm. Cheattey, Wm. Spotts, Robert Storey. Office, 136 South Fourth Street, Philadelphia. The character of the mines are true fissure vein. The vein three and a half feet wide, which indicates most promisingly the existence of gold and silver, with copper tracing at 110 feet. Depth of shaft, 130 feet. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable.

Devil's Rapids' Gold Mining Company is chartered under the laws of the State of Maine. The officers are Geo. Ames, Pres.; H. K. Flagler, Treas.; E. C. Spinner, Sec. Directors, Geo. Ames, H. K. Hagler, Theo. S. Very, Chas. F. D. Vabasco, H. R. Gardner, Andrew Telfer, and W. Home. The company's property is located at St. Francis, Bence county. The ore is both auriferous and argentiferous. Date of organization, June, 1881; capitalization, $500,000; par value per share, $5.

Dominion Mining and Silver Company (The). Location of mines, Hukill Gulch, Col. Quality and character of ore, $387 per ton in gold, silver, and lead, latter running $35. Specimens assay $600. Character of mines show a pay-vein eighteen inches in width, consisting of iron pyrites, copper pyrites, and galena. Dimensions of workings opened by four shafts aggregating 165 feet in depth.

Dragoon Gold and Silver Mining Company is chartered under the laws of the State of Pennsylvania. The officers are Charles Mathews, Pres.; John H. Schreiner, Treas.; Jos. R. Black, Sec. Office, 430 Walnut Street, rooms 5 and 6, Philadelphia, Pa. The company's mines are the Paymaster, Osceola, Pysche, Mazeppa, and Southern. Capitalization, $5,000,000; par value per share, $50; non-assessable; amount of stock, issued, 80,000 shares; reserved in treasury, 20,000 shares.

Eastern Oregon Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are T. E. Farrish, Pres.; A. B. Stanton, Sec. Directors, T. E. Farrish, Willard Brown, I. Van Orden, G. F. Geise, of Philadelphia; E. M. Zulick, Gen. R. V. Aukeny, and P. H. Cummings. The company own two claims on the Monumental lode and seven on lodes struck in the tunnel, all located in the Granite creek mining district, Grant county, Oregon, on the Blue Mountains, forty miles from Baker City. The ore is chiefly a ruby and antimonial silver, and contains auriferous iron pyrites. The actual average assays are from $70 to $80, about one-fourth being gold. The veins are characterized as true fissure, varying from one to forty feet in width, and from forty-five to eighty-five degrees in dip. Strike being nearly due north and south. The principal vein is the Monumental, with a ledge from two to three feet. The various workings are of considerable extent. The length of lode on which the company depends for its supply of ore is 3,000 feet. The plant includes a ten-stamp mill, fitted with Thompson's chloridizing roasting furnace, and driven by eighty-horse-power engine, fed by two sixteen-foot tubular boilers. It is claimed that ore, of quality specified, in sight will suffice to keep a twenty-stamp mill going for two years. Present cost of mining and milling is $24 per ton, but this is expected to be reduced by $5 upon completion of the Monumental Railroad to Baker City. The prospective weekly output is calculated at $25,000. Capitalization, $2,500,000.

Echo Consolidated Gold and Silver Mining Company (The). Incorporators, 1880, James L. Grub, Wm. Flint, A. M. Peel, J. J. Wilbraham, James G. Peel. The property belonging to this company is located in Colorado. Capitalization, $400,000.

Edgar Gold and Silver Mining Company (The), of Kentucky. Principal office, Denver, Col. Wm. S. Marshall, Pres. and Agt.

Eldorado Gold and Silver Mining Company (The). Officer, A. C. Hammond, Sec. Principal office, 401 California Street, San Francisco. Mines are located in Nevada.

Elko Consolidated Milling and Smelting Company is chartered under the laws of the State of New York. The officers are W. W. Wakeman, Pres.; M. A. Miller, Vice-Pres.; Geo. H. Everett, Sec. and Treas. Office, 152 Broadway, room 2, second floor. The company's property is located in Elko county, Nev. The ore contains silver, gold, and lead; value per ton, $75. The vein is 2,200 feet in length, tested by ten shafts and five tunnels. The company have furnace, etc., complete ready for active operations. Date of organization, November 19, 1879; capitalization, $1,000,000; par value per share, $10; basis, non-assessable; no incumbrances.

Elmira Company own the following mines, Crown Point, Wolverine, Banner, Idaho, Star of the West, and Washoe, located in Bosie county, Idaho. The ore from these ledges is found in pockets and contains chloride and ruby silver. The company have a fine twenty-stamp mill, rock breaker, roasting furnaces, and other appliances for working their ores, all in excellent condition of equipment. In the Crown Point a shaft was sunk to the depth of thirty feet, and drift run east from the bottom of it. The face of the drift is in a body of ore seven feet wide, the battery assays of which give $90 per ton. Four men are kept at work taking out rock, ten or twelve tons per day are being extracted. 100 tons are on the dump at the Crown Point, and thirty at the Banner. The company have thirty-eight men employed in all.

Emerson Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. Officers, Charles H. Emerson, Pres.; John S. Hulin, Treas.; Charles A. Burgess, Sec. Principal offices, 115 Broadway, New York, and 31 Milk Street, Boston, Mass. Location of mines, Clear Creek, Colorado. Capitalization, 200,000 shares; par value, $10.

Escondido Mining Company. The property consists of the Escondido, Comet, Lyon, Moses, and Wral mines, located in Lawrence county, Dakota. The company are driving a tunnel to strike the mother ledge of the district. The tunnel is already in 650 feet, and has encountered many rich seams, some of which are reported as high as 800 ounces to the ton.

Eureka Consolidated Silver Mining Company (The). W. W. Taylor, Sec. Head offices, Laidlow & Co., 14 Wall Street, New York, and 309 Montgomery Street, San Francisco, Cal. Thos. J. Read, Superintendent. Annual election, October 17. The Eureka Consolidated mine belongs (1882) to this company, located in Eureka county, Nev. The ore is about 55 per cent. gold, and from 20 to 30 per cent. lead. The assays are various; some give from $80 to $120. The property consists of two new hoisting engines, two pumping engines, six large boilers, and other appliances connected with the hydraulic work. The pumping capacity is estimated at 30,000 gallons per minute on a rise of 8,000 feet. Besides the company's regular forces, considerable work has been done by tributers, and ore taken out from the twelfth level up. The mine is explored to the fourteenth level, but the water will not allow much work to be done until after the new pumping machinery is in operation. The principal extraction of ore was from the eighth and ninth levels. The financial statement for the month of May shows that the base bullion out-turn was nearly 524½ tons, yielding $176,985.17. Among the expenditures were, for mining, $44,895.48; smelting, $34,368.32; freight, refining, etc., $25,598.68; construction of new shaft, $10,140.27. The report of the Secretary contains some interesting facts. The out-turn of base bullion for the month yielded $79,324; the expenses amounted to $33,154. The cost of construction of a new shaft was $10,455. The resources are, estimated value of base bullion on hand, $41,364; cash, $111,274. The liabilities are $8,515; the approximate net resources, January, 1882, were $144,123; net earnings for December were $7,335. The mine looks better now than at any time for several years. Plenty of ore in sight to continue two furnaces running. Two men working on fourth level cleaned up each between 2,000 and 3,000 tons within eight months. March 18, 1882. Eureka Consolidated sold on Monday an advance of $14 per share, within a few weeks having sold as low as $9.00. Capitalization, $5,000,000; shares, 50,000; par value, $100; yield during 1880, $1,553,394; number of dividends paid to July, 1882, 73; total amount of dividends to July, 1882 $4,780,000; current value of mine, $800,000; latest dividend, July, 1882; assessments levied, 2; total amount, $100,000; latest assessment, May 26, 1877, $1.00; cash on hand, May 12, 1882, $194,504.63; floating indebtedness, $16,038.20; stock quoted July 1, 1882, $15.25; stock quoted July 16, 1882, $16.50; yearly capacity of production, about 36,634 tons.

Excelsior Company (The). The company owns the Russler and Excelsior mines. The property owned by this company is situated on American Fork, Utah. The company employs eight men. The ore is free gold, carbonate of lead, and galena; average value, $87 per ton. The property is developed by two shafts, and levels, and drifts. There are three lodes on the property.

Exchequer Gold and Silver Mining Company's Mine (The), the Exchequer, is located on Comstock Lode, Nevada. The main lode on which the company depends for its supply of ore is 400 feet in length. Property in acres, 400. Capitalization, $10,000,000; par value per share, $100; no dividends have yet been paid; number of assessments levied, eighteen; total amount of assessments levied, $680,000; date of latest assessment, January 12, 1882; indebtedness, February 1, 1882, $4,572.22; cash on hand April 1, 1882, $10,558.

Eureka-Nevada Mining Company. This is an English organization that has secured the Eagle series, comprising the War Eagle, Spread Eagle, White Eagle, Bald Eagle, Gray Eagle, Black Eagle, Golden Eagle, Silver Eagle, Double Eagle, Eagle Bird, Eaglet, and Eagle's Nest, all on the east slope of Prospect Mountain, in Eureka county, Nevada. They have commenced to develop the property with energy. These mines have all yielded well, considering the desultory manner in which they have been operated. The company have also secured the Williamsburg mine on Adams Hill which is being systematically exploited.

Frisco Company (The). Their property in Utah consists of the carbonate mine, concentrating works, and a fifty-ton smelter at Frisco, Beaver county, the Cave mine in Bradshaw district, the Bigelow in Lincoln district, and several undeveloped mines near Marysville, Piute county. The carbonate mine has attained a vertical depth of over 500 feet. The company produced during the fiscal year, $14,866 of gold and $297,921 of silver, and during the calendar year $8,785 of gold and $286,831 of silver. The mill was idle four out of the last six months of the year.

Fidelity Gold and Silver Mining Company is chartered under the laws of the State of New Jersey. C. G. Stoddart, Sec. Office, 201 Chestnut Street, Philadelphia, Pa. This company own the New York and Clara mines (full claims), located at Los Cerillos district, New Mexico. Assays from the Clara show sixty-three ounces silver, with trace of gold; depth ten feet. Quartz taken from the surface show 132 ounces of silver, one-half ounce gold. From the New York, assays show at ten feet deep, thirteen ounces gold, ten ounces silver; surface quartz has run as high as thirty ounces gold and thirty-seven ounces silver. The company was organized, November 3, 1881, and is free from debt of every kind. There are 80,000 shares reserved in the treasury.

First National Mine (The) is located at Iowa Gulch, Colorado. The character of the ore is black galena. It gives assays of forty-five ounces of silver per ton, four-tenths of an ounce of gold, and forty-seven per cent. lead. There is a mill engine and shaft house on the property. The shaft is 165 feet deep.

Flora Morrison Gold and Silver Mining Company (The) is chartered under the laws of the State of New Jersey. Joseph F. Bailey, President; Hamilton Disston, Treasurer; H. B. Ring, Secretary. Principal office. 105 Market Street, Camden, N. J. These mines are located in Arizona. Gold and silver ore. Capitalization, 250,000 shares; par value, $2; non-assessable.

Freeland Mining Company (The) is chartered under the laws of the State of New York. The officers are R. C. McCormick, President; Theo. M. Lilienthal, Vice-President; Bank of Nevada, Treasurer; Edw. W. Willett, Secretary. Trustees, J. P. Jones, R. C. McCormick, Henry Rosener. Office, 115 Broadway, New York. The company's property is located at Idaho Springs, Clear Creek county, Col. The ore is free milling and carries gold, silver, and copper assaying $60 per ton. There are 5,000 feet in mine. The company have a concentrating mill; capacity, 100 tons daily. The output of the Freeland for one month in June, 1881, was 600 tons of ore; 100 men are employed about the mine. Twenty stamps and four circular buddles are employed and eight to ten men are required to run the mill. The mine yields a profit of between $2,000 and $3,000 per month. A powerful hoisting engine has been supplied to this mine, it being found that the supply of water was insufficient to run the dressing works of the company to their full capacity. Date of organization, June 18, 1879; capitalization, $5,000,000; par value per share, $25: basis, non-assessable; total amount of dividends paid to May 20, 1880, $50,000; date of latest dividend, May 20, 1880; amount per share, twenty-five cents.

Glengary Mines (The), owned by Messrs. Clint Rondebush, James Campbell, H. A. Butters, and O. K. King. The Glengary mines are located on Cross Creek, Col. The ore is gold and silver. Highest assay, 188 ounces silver; gold, six and one-half ounces to the ton; copper, six per cent. Lowest assays, silver, twenty-two ounces; gold, one and nine-tenth ounces to the ton; copper, six per cent.; lead, twenty-three per cent. Fissure veins, eighteen inches is the length of levels, 1880. These mines have been worked with vigor all summer, showing up splendidly. The developments consist of an adit driven in on the vein for a distance of 100 feet. At the entrance of the adit the pay streak shows to a width of eighteen inches, widens gradually until at the face it discloses three feet nine inches of pay mineral in over twelve feet of quartz, which constitutes the gangue.

Golden Age and Group Gold and Silver Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are Richard F. Donovan, Pres.; B. Trautman, M. D., Vice-Pres.; O. J. Kinsley, Sec.; C. B. McKean, Treas. Directors, R. F. Donovan, B. Trautman, M. D., Wm. Maybaum, T. Henry Asbury, C. B. McKeon, John Muldoon, and H. K. Whitner, M. D. The offices are at 140 South Third Street, Philadelphia, Pa. The company owns the following mines or claims: the Orlando, Saginaw, and Bay City, located. Capitalization, $600,000, in 300,000 shares of $2 each; non-assessable.

Gold Hill Mining and Smelting Company. Office, 292 Washington Street, Boston, Mass. The company owns twenty-one claims. Their property is located at Ten Mile district, Colorado, adjoining the famous Robinson company mines. They have a capitalization of $3,000,000. The company have a small amount of treasury stock for sale to meet current expenses.

Gold Park Mining Company's mine, the Little Mollie, is located in Colorado. The quality of the ore is good. The shaft is eighty feet deep.

Gazelle Mining Company (The). The mines belonging to this company are located near Meadow Lake district, Nevada county, Cal. Ledge thirty feet wide. Good assays.

Gila Mining Company (The) has property located in Revelle, Nye county, Nev. The officers are G. W. Handy, Pres.; John Hammond, Vice-Pres., and J. J. McGeoghegan, Sec. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. The yield during the fiscal year of 1879-80 was $12,413. Total of dividends paid to August, 1875, $50,000. Date of latest dividend, August 16, 1875. Eight assessments have been made, aggregating $195,000. Date of latest assessment, July, 1881.

Great Mountain Mining Company's works are located in California. Capitalization, $1,250,000; par value per share, $10. Total amount of dividends paid, $212,000; date of latest dividend, November, 1881. Stock quoted July 1, 1882, $2.30.

Gould and Curry Mining Company (The), of which Mr. Alfred Durbrow is Secretary, has its offices at 69 Nevada Block, and 309 Montgomery Street, San Francisco, Cal. The date of annual election is December 19. The property is located in the State of Nevada. The workings of the mine are 1,900 feet deep. The length of the main lode on which the company depends for its supply of ore is 612 feet. The capital of the company is $10,800,000, in 108,000 shares of $100 each. Total dividends paid to January, 1881, $3,826,800; date of last dividend, August 4, 1880; amount of same, $1.50 per share. Number of assessments levied, forty-two; total amount of same, $3,206,000; date of last assessment, May 23, 1882; amount of same, fifty cents per share. Floating debt, February, 1882, $22,594. Stock in treasury, April 1, 1882, $21,199.

Golden Development Company (The) is chartered under the laws of the State of Maine. The officers are C. D. Jenkins, Pres.; C. A. Homans, Treas.; J. F. Coles, Sec. Directors, B. E. Perry, John G. Phillips, Geo. F. Field and C. D. Jenkins. The offices are at 40 Water Street, rooms 52 and 53, Boston, Mass. The company owns four mines, three gold and one silver; the former, viz., the Pinafore, Colchis, and Jason, are located at Clifton, Ariz., and the latter, the Jenkins, at Silver City, N. M. The ore is a carbonate, free milling, and assaying $116.54, viz., gold $104 and silver $12.54. At some depth, the lode is eight feet thick. The rocks are chiefly feldspar and porphyry. The plant, comprising a water-wheel and mill-machinery, is now in course of construction, and will soon be ready for operation. There is enough free-milling ore to keep a ten-stamp mill running for one year. Date of organization, May, 1881; capitalization, $400,000, in 200,000 shares of $2 each. $20,000 reserved in treasury.

Goodshaw Mining Company's (The) mine, the Goodshaw, is located in Bodie district, Cal. Extent of claim, 300 feet by 1,500 feet. The ore is high average grade, averaging $41.50, with streaks ranging from $200 to $5,000 per ton. The ledge is about four feet wide. Ledges of this district show a tendency to unite by depth. Depth of shaft is 500 feet; stopped by water. Total excavations, January 1, 1882, 2,000 feet. The company have new hoisting works in course of erection; original, destroyed by fire; pump costing $20,000. The water having disappeared from the mine, it has been started up again. Shaft is now down 695 feet, and sixty or seventy-five feet more are expected to bring the sinkings to the ledge. The work is progressing rapidly. The formation in the bottom of the shaft being blue porphyry, seamed with quartz and of a hard character, with an occasional stratum of clay running through it; all the material carrying a large percentage of iron; a very desirable formation for gold-bearing ledges. Capitalization, $10,000,000. No dividends paid to June, 1882. Number of assessments levied, eleven; total amount of assessments levied, $180,000; date of latest assessment, June 1, 1882, ten cents per share. Working expenses per month, $2,500.

Grand Union Gold and Silver Mining Company (The) is chartered under the laws of the State of Colorado. The officers are W. Dunlap, Pres.; J. J. Wilbraham, V.-Pres.; J. V. Tullaway, Treas.; Enon M. Harris, Sec. Directors, W. Dunlap, J. J. Wilbraham, W. H. Wade, Jos. Pettit, Chas. Lockrey, Jr., J. V. Tullaway and J. W. Anthony. The company owns the Grand Union, Monroe, Adams, Gov. Curtin, Madison, and Washington, located at Cottonwood district, Chaffee county, Col. The tunnel of the Monroe is 750 feet long, and of the Adams, fifty feet long, and developments are rapidly progressing. Capitalization, $2,500,000, in 250,000 shares of $10 each.

Granite State Gold and Silver Mining Company. The officers are Wm. C. Tallman, Pres.; H. L. White, Treas.; James Anderson, Sec.; Superintendent, M. Millesnn, M. E. Office, 31 Milk Street, Boston, Mass. The company's property is located in Cheshire county, New Hampshire. They have a capitalization of $2,500,000, in shares at a par value of $25 each; basis, non-assessable.

Gunnison Exchange and Silver Mining Company. The officers are Seth P. Bryant, Pres.; W. D. Middleton, Vice-Pres.; E. S. Carl, Treas.; H. M. Martin, Sec.; A. P. Doe, Genl. Mang. Directors, A. P. Doe, J. H. Murphy, A. Moritz, S. P. Hobson, and Geo. Paul. Superintendent, P. G. Gates. Office, Davenport, Iowa. This company control a number of mining properties in Gunnison county, Col., three on Treasury Mountain being best known, the Eureka, Garfield, and Hancock. The group is known as the Eureka mine. They control all of the Bryant mine at the foot of Crystal Mountain, parts of Friendship and Bouton mines on Galena Mountain, in Rock district, parts of the Gunnison Exchange, Silver Beauty, and Ada mines in Ruby district, parts of the Black Jack and Iron mines on Crystal Mountain, a placer claim of twenty acres, suitable for a town site, near Scofield, which is to be called Silver Center, a one-half interest in a coal field of 160 acres in size near the town of Crested Butte. The properties are not in the market, and facts concerning them are obtained with difficulty. Date of organization, 1880; capitalization, $600,000; par value per share, $25.

Gunnison Improvement Company is chartered under the laws of the State of Colorado. The officers are August Moore, Pres.; J. L. M. Duffield, Sec. Transfer office, 203 Walnut Place, Philadelphia, Pa. The company's property is located in Cochetopa and Spring creek districts, Colorado. The value of this company's property consists in coal lands, gold and silver mines, buildings, town sites, toll roads, and water powers. They are now pushing developments on coal property. The company is interested in the following properties in the Cochetop a district: The Maple Leaf, gold lode, Little Nellie, gold lode; Accidental, gold lode; John Harley, (placer claim and town site) John V. Gault, (placer claim and town site,) the water claim of the Cochetopa creek. The first three are well-defined gold bearing veins, and the first mentioned a well known and very valuable lode. The property is now being developed. In the Spring creek district are the following carbonate claims: The King, the Princeton, the Capital. Amount of stock issued, 70,000 shares; capitalization, $1,000,000; par value per share, $10; basis, non-assessable; stock reserved in the treasury, 1882, as working capital, 30,000 shares.

Giant and Old Abe Mining Company (The) is located at Whitewood, Lawrence county, Dakota. Capitalization, $10,000,000, in 100,000 shares, of $100 each; the mine produced during the fiscal year of 1879 and 1880, $2,750; no dividends have been paid; six assessments have been made aggregating $300,000; date of last assessment, September 3, 1881.

Girard Gold and Silver Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are W. H. Wright, Pres.; Wilson Lloyd, Treas.; and A. J. Kimsley, Sec.; Messrs. Hamilton Disston, W. H. Wright, W. H. Tabor, Wilson Lloyd, J. F. Bailey, W. Cochrane, and Chas. Disston being the chief stockholders. The offices are at 138 South Fourth Street, Philadelphia, Pa. The property is located in the Tombstone district, Ariz., and has an area of about eleven acres. The claim being contiguous to the Tranquillity, Good Enough, Tough Nut, etc., the mine should, with proper development, become a good producer. It is opened by a shaft to a depth of about 450 feet. The main working-shaft is double compartment and supplied with steam hoisting works of improved pattern. The ore is taken chiefly from the 350-feet level and below. Vein, four to eight feet wide. From 3,000 to 4,000 tons of ore on dump ready for twenty-stamp mill in course of erection. About twenty-five men are employed. The company also owns the water-power in the Tombstone district, and report says that it will prove a considerable source of profit. The quality of the ore increases as depth is obtained. Capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable, full paid. The receipts of the company last year were $171,478.92, and there is now a balance of $154.86 in the treasury. All the shares have been disposed of.

Givin Mining Company (The). The Givin mine is located near Mokelumne Hill, Calevaras county, Cal. It is one of the finest pieces of mining property in the State, and one which for many years past has been yielding its wealth of precious metal. There are complete hoisting works on the mine, and two quartz-mills, the upper mill having thirty-two stamps, and the lower one twenty-four. Also sulphuret works, and in fact everything that is necessary for working their ore. The pumps are in excellent order, and running regularly, no trouble being experienced from the water. The work of retimbering the old shaft is now completed down to the 600-foot level, the tunnel repaired, and everything is about ready to commence hoisting ore. There is a large reserve of good quality ore in the level, which will supply 100 tons of rock a day for a year. Work is still being done in the 400-foot level, showing very rich rock in the upper slopes of the level. Some difficulty is experienced in getting it, owing to the heavy caves in the lower slopes. Work is also being done in the 400-foot level in the north shaft. A large body of ore was tapped in the Smith ground, recently purchased by the company. A tunnel on the surface of the Smith ground was run about fifty feet on the ledge, which is from six to eight feet in width and fair grade ore. The prospects of the mine are very favorable.

Glasgow Gold and Silver Mining Company's (The) property is located at Devil's Gate, Lyon county, Nev. The main lode, on which the company depends for its supply of ore, is 1,500 feet in length. Capitalization, $9,000,000; par value per share, $100; number of assessments levied, five; total amount of assessments levied, $45,000; date of latest assessment, February 11, 1878.

Glass Pendery Consolidated Mining Company (The), of which R. Vogel is Vice-Pres. and C. A. Manners, Sec. and J. W. Wallace, Manager, has its offices at 55 and 57 Boreel Building, Broadway, New York. The company owns two mines, the Glass Pendery and the Rough and Ready, located at Carbonate Hill, Leadville, Lake county, Col. Extent of property about sixteen acres. In the old Pendery a new strike of great richness has been made; a vein of eighteen inches in thickness of rich chloride ore was struck, which will run as high as 3,000 to 6,000 ounces of silver to the ton; the main ore body showing a thickness of four to six feet. Sufficient ore has been taken out to pay all current expenses of the mine, including development work. The ore-bins at both shaft-houses are well filled, and shipments are being regularly made. The ore is a carbonate of lead of high grade, assaying from sixty to 150 ounces per ton. Recent developments show large quantities of ore to the north in the Pendery claim. Besides the ore bodies an immense amount of iron and lime exists, both of which carry some silver, and are valuable as a fluxe for smelting. The shipment of these alone returns a large profit to the company, and leaves the entire product from the ore a profit. A special engine is employed in hoisting the product from this rich vein. The weekly output is about 180 tons. Capital stock, $5,000,000, in 250,000 shares of $25 each; dividends paid to April, 1881, $25,000; date of last dividend, April 8, 1881, ten cents per share: stock quoted July 1, $2.15 per share; surplus fund on hand, $70,000; total profits of mine since discovery, about $9,000; twenty men employed.

Hailstone Gold and Silver Mining Company (The) is chartered under the laws of the State of Colorado. The officers are Jas. S. Lever, Pres.; Wm. Flint, Treas.; H. W. Kelly, Sec. Directors, Jas. S. Lever, Wm. Flint, H. W. Kelly, H. Fricke, J. C. Barnitz, Geo. V. Magee, and H. Rea. The offices are at 14 S. Third Street, Philadelphia, Pa. Organized on a non-assessable basis; capitalization, $2,500,000, in 250,000 shares of $10 each.

Hale and Norcross Silver Mining Company (The) has offices at 309 Montgomery Street, San Francisco, Cal. The officers are Geo. Congdon, Pres.; Walter E. Sell, Vice-Pres.; Nevada Bank, Treas.; Joel F. Lightner, Sec. The property of the company is located in the Virginia district, Comstock lode, Nevada. Depth of workings, 2,400 feet. Total length of main lode (Comstock), on which the company depends for its supply of ore, is 400 feet. To January 1, 1882, the sum of $90,000 has been expended in developments. Fifty-nine men are employed at the Hale and Norcross mine. Capitalization, $11,200,000, in 112,000 shares of $100 each; number of dividends paid to April, 1871, thirty-six; total amount of same, $598,000; latest dividend, April 10, 1871, $5 per share; seventy-four assessments levied; total, $3,950,000; latest assessment, May 16, 1882, fifty cents per share; floating indebtedness, $18,962, April 1, 1882; cash on hand March 1, 1882, $2,164; preferred stock reserved in treasury.

Happy Camp Hydraulic Mining Company. The property is located in Del Norte county, Cal. The company are running their mine night and day with two pipes. Considerable river-bed mining has been done with profit during the past season along both the Kalmath and Smith rivers by means of wing damming. A dam is constructed half-way across the river and then continued down the stream to any desired distance, thus turning the whole body of water into one-half of its channel. The water enclosed by the dam is then pumped out by the force of the current acting on wheels attached to shafts projecting beyond the dam, and the gravel on the portion of the river bed laid bare is raised with derricks and emptied into sluice-boxes for washing.

Harper Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are Lewis Jones, Pres.; Geo. G. Terry, V.-Pres.; Rollin M. Morgan, Sec.; Giles Blagan, Treas. The Trustees are Lewis Jones, Egbert Guernsey, M. D.; R. M. Morgan, Geo. H. Burrows, G. S. Terry, Giles Blagen, and Thos. H. Cathart. The annual election is held in May. Geo. W. Burrows is the Superintendent. The offices are at 120 Broadway, New York city. The property of the company, comprising the Imperial Bower mine, is located at San Juan, Hinsdale county, Col., on the southeast slope of Ida Mountain, head of American Basin, Park Mining district, ten miles northeast from Silverton. The area of the claim is 300x1,500 on the Imperial lode. The ore is argentiferous galena, containing much brittle silver, sulphurets, and gray copper; yields from thirty-four to 100 ounces silver and thirteen ounces gold per ton. It is said that the ore of the adjoining mine, at a depth of thirty-five feet, averages nearly $200 per ton, and, as the ore of the two mines is the same in character, it is reasonable to suppose that the Bower will prove equally rich at an equal depth of development. The vein is described as a true fissure from eight to twelve feet thick, and exceptionally rich, chiefly with silver. It extends downwards nearly vertically, its trend being west about ten degrees south. The extension of the Denver and Rio Grande Railroad runs within about three miles of the mine at Eureka, in San Juan county. Capitalization, $400,000, in 40,000 shares of $10 each; fully paid; non-assessable; treasury reserves consist of 11,500 shares.

Hastings Consolidated Gold and Silver Mining Company. Messrs. C. C. Hastings and G. Newton are the directors. The Surpriser mine, owned by this company, is located at Hastings, Arizona. Property owned, extra fine twenty-stamp mill.

Haverley Golden Group Mining Company (The) is chartered under the laws of the State of Colorado. Officers, J. H. Haverley, Pres.; Hon. H. H. Walker, V.-Pres.; Col. N. P. Richmond, Sec.; C. N. Pratt, Asst. Sec.; A. F. Armstrong, Treas.; Richard Hiencheon, Supt. Principal offices, 116 Dearborn Street, Chicago; 1151 and 1157 Broadway, New York; 205 Washington Street, Boston, Mass. The mining property belonging to this company is located on Bear creek, head of San Miguel river, Ouray county, Southwestern Colorado. Gold and silver ore; assays per ton, $145.88 upwards. Have large bodies of high-grade, free-milling ore. The property owned by the company consists of a first-class twenty-stamp mill. This mine has adopted the plan of placing their treasury stock at $2.50 per share, and guaranteeing seven per cent. par value of $10 each, which dividend takes precedence over the ordinary or common stock of the company. At a meeting of Directors held at office of said company in city of Chicago, 8th December, 1880, the following resolution was passed and unanimously adopted: "*Resolved*, That the 160,000 shares of the company set aside as development stock, upon which a dividend of seven per cent. per annum shall be paid annually out of the net earnings of the mine of the said company, before any dividends shall be declared on the common stock, and that 20,000 shares of the preferred stock be placed on the market at the price of $2.50 per share." Incorporated, February 11, 1880; capitalization, $6,000,000; shares, 600,000; par value $10; non-assessable forever; owe no debts; dividend-paying mine.

Hawkeye Consolidated Mining and Milling Company. The officers are Robert Law, Pres.; O. F. Gibbs, Vice-Pres.; Robert H. Law, Sec. and Treas., all of Chicago, Ill. S. C. Robinson, the discoverer, is Superintendent. This company owns five claims, viz., the North, East, West, and North-West Hawkeye, and Alpha, located in Colorado. The character of the ore is black tellurium sulphide, antimonial and ruby silver, galena and gold. Mill runs give 100 to 250 ounces to ton. The ore vein stripped on the surface for over 200 feet, and it can be traced 3,000 feet. The pay streak is about eighteen inches. The property is developed by tunnels. Date of organization, 1882; capitalization, $600,000; par value per share, $50.

Hidden Treasure Mining Company. H. H. Power, Sec. The company's mine, Hidden Treasure, is located at Sunny South, Placer county, Cal. The company has laid a new track through the entire length of the tunnel in the mine, and work has been renewed with a great display of activity.

Homestake Mining Company (The) is chartered under the laws of the State of California. H. B. Parsons, Esq., is Secretary. The offices are at San Francisco, Cal., and at 18 Wall Streets, New York, the latter being an office for effecting transfers. The property of the company, including the Homestake mines, is located in the Black Hills, Deadwood, Dakota. The ore is a ferruginous quartz, intermixed with chloritic slate and small quantities of iron pyrites, low grade, but soft and easy milling, each stamp is capable of crushing three and one-half tons per day at an average cost of $1 per ton. Assay value, $7 to $10 per ton. The mine is a true fissure. The chief vein, called the Golden Star, has large bodies of low grade ore, varying in width from five to 150 feet, and of great depth. The mining plant comprises two stamp-mills aggregating 200 stamps, costing $503,475; a 300-horse-power Corliss engine, fly-wheel of which weighs 26,000 pounds, 4-54. in. boilers sixteen feet long in each mill. Steam drum heaters, with six Ludlow hydrants for protection against fire. The hoisting machinery is supplied with all the latest improvements. Gold is smelted in laboratory connected with the mill. When its appointments are completed, the metal will leave the mill in bars ready for the mint. The length of the main lode on which the company depends for its supply of ore is 2,850 feet. Nearly $1,000,000 has been expended in developments to January, 1881. Present prospects are excellent, a large amount of high grade ore being exposed. A monthly clean-up of the six mills was made recently, and the resulting bullion, $123,000, was shipped to New York. The current value of mine is $1,738,000. The mine is well timbered, no caves or movements of the hanging-wall having taken place. The cost of mining is $2.48 per ton. The fact of the mines being surrounded by forests necessitates great precaution against fire, for which the company is well provided in the possession of six hydrants, an ample supply of water, and a properly organized brigade of volunteer firemen, all employees of the company. Organized, November 5, 1877; capitalization, $10,000,000, in 100,000 shares of $100 each; yield during fiscal year 1879–80, $1,033,272; yield during 1881, $1,239,600; dividends paid to June, 1882, $1,420,000; (No. 46) last dividend paid June 26, 1882; forty cents per share; another dividend (No. 47) is declared for July 25, of the same amount; two assessments have been levied, total, $20,000; latest assessment, April 8, 1878, $1 per share. The stock, held principally in San Francisco, is quoted at $17.38 per share.

Home Ticket and Two-Jack Mines (The). Messrs. Frost & Palmer, owners. The mines Home Ticket and Two Jack mines are located in Lone Mountain district, New Mexico. Splendid ore taken in large quantities. Give returns of forty ounces in silver, seven-tenths of an ounce in gold, and twenty-four per cent. in lead. Netting $5,444 per ton over smelting charges. Mill four tons. These two mines show a batch of three tons, worked by J. W. Holson, returned over 500 ounces to the ton.

Hopewell Company. M. J. Hudmett, Manager. The Michigan mine owned by this company is located at Sheep Mountain, Col., from which report says there have been taken some handsome specimens of copper. The ore assays nineteen ounces in silver, seventy per cent. lead, and some gold and iron. The company have hoisting machinery and shaft house at the works. The shaft is 120 feet deep. During March, 1882, it was reported a level had been started from the drift to avoid the inconvenience of working through the uprise, and facilitate the extraction of ore. Shipments were expected to be made at an early date. The ore is said to differ from most of the Sheep Mountain ores inasmuch as it is not refractory—analysis showing no zinc, antimony, or arsenic.

Hukill Gold and Silver Mining Company is chartered under the laws of the State of New York. The officers are J. L. Brownell, Pres.; S. V. White, Treas.; E. W. Willett, Sec. Trustees, Nath'l A. Boynton, Geo. H. Seeley, Benjamin Blair. Superintendent, F. F. Osbiston. Office, 115 Broadway, Boreel Building, rooms 58 and 60, New York. The company's property, the Hukill mine, is located in S. Bar district, Clear Creek county, Col. The character of the ore is gold, silver, and copper, in quality first class. Value per ton, $80. The mine is shipping twenty tons of ore daily to the concentrator. Sending out one car-load of smelting ore per week (worth $80 a ton), and two car-loads of concentrated ore (worth about $40 a ton). Some fine bodies of mineral have been struck in this mine. The company own mill and hoisting works. The main lode is 3,288 feet in length. Capitalization, $1,000,000; par value per share, $10; basis, non-assessable; yield during 1880, $133,000; total amount of dividends paid, $210,000; date of latest dividend, December 10, 1878, ten cents per share; stock quoted July 7, 1882, thirty-five cents.

I. X. L. District Bayfield Company (The). The mining property of this district are located in Nevada. Extraordinary high grade ore. Mr. Bayfield has just received the results of three assays made by Mr. R. S. Day, of Oreana. Highest, $1,700 in silver, $3,300 in gold, making a total of $5,000 per ton.

I. X. L. Mine (The). Owned by Messrs. Casey & McLain. The I. X. L. mine is located in Laurel district, Mono county, Cal. Large quantities of ore taken from a shaft only sixteen to eighteen feet deep. Free gold in quantities, and seam also shows chlorides of silver.

Isabella Gold and Silver Mining Company (The), of which Lewis Chalmers, Esq., is Superintendent. owns the Stella mine located in Inyo county, Cal. Extent, 1,019 acres. The company are now operating at Silver Mountain. They are driving a tunnel upwards of 8,000 feet, for the purpose of developing three ledges, the Isabella, I. X. L., and Exchequer. A new mill has been built and is crushing ore, of which there is sufficient to keep it running to its full capacity. The company is English.

Iron Hill Company. The company own a group of mines located in Lawrence county, Dakota. They have sunk shafts to the depth of fifty, thirty-one, and twelve feet in the Utica and Ultimo. Rich ore, consisting of gray carbonate, containing horn silver, is said to have been struck, but the extent of the deposit had not been determined. To the east of this carbonate belt is a wide and rich vein of gold-bearing ore, from which assays have run as high as $2 to the ton.

Ida L (The), Queen of the West. Officers, J. B. Bissell, Pres.; J. M. Wallace, Vice-Pres.; R. H. Buck, Sec.; L. M. Dwight, Treas. The Mayflower mines are owned by this company. Located in the Ten Mile district, Col. The ore consists of gold and copper. A tunnel cross-cutting the vein, at a distance of 130 feet, at which point a winze was sunk in the vein to a depth of twenty feet, and then drifts run east and west along the vein, a distance of seventy feet in all, 1881. Arrangements have now been made to prosecute vigorously the works of opening the mine. Mill four tons. Gave returns of forty ounces in silver, seven-tenths of an ounce in gold, and 24 per cent. in lead, netting $5,444 per ton over smelting charges. Capitalization, 150,000 shares: value, $10 each; working capital, $30,000.

Ilesite Mine (The), owned by F. T. Hughes and others. The Ilesite mine is located at Middle Swan creek, Summit county, Col. Gold and silver ore, assaying per ton $10 to $20 in gold and silver. Drifts and veins are the character of the mine. Vein over thirty feet wide.

Intervener Gold and Silver Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are T. Henry Ashbury, Pres.; Wilson Lloyd, Treas.; L. W. Klahr, Sec. Offices are at 138 South Fourth Street, Philadelphia, Pa.

Jackson Mining Company (The) owns property located in Eureka, Nev. Capitalization, $5,000,000, in 500,000 shares of $100 each. No dividends have been paid; thirteen assessments have been levied; total amount of same, $262,500; latest, November 23, 1880. Cash on hand, February 1, 1882, $5,330.43.

Juniper Mining Company (The). E. C. Master, Sec. Principal office, 309 Montgomery Street, San Francisco, Cal. The mines belonging to this company are located in California.

Julian Mine (The). Mr. Dubois, Supt. This mine is located near New Castle, Placer county, Cal. The company own one twenty-stamp mill. The Superintendent was formally in charge of the Extra mine, Copper City, Shasta county. The mine cost $200,000. The mill run by a hurdy-gurdy wheel, with 140 feet of water from the Bear River ditch. Shaft is down 700 feet.

Justice Mining Company (The) has offices at 419 California Street, San Francisco, Cal. The officers are J. P. Cavallier, Pres.; H. M. Levy, Vice-Pres.; R. E. Kelly, Sec.; Bank of California, Treas. Office, 419 California Street, San Francisco. The property is located on the Gold Hill district, Nevada. The length of the main lode on which the company depends for its supply of ore is 2,100 feet. Capitalization, $10,500,000, in 105,000 shares of $100 each. Yield during fiscal years 1879, 1880, was $5,300; no dividends have been paid: thirty-six assessments have been levied; total amount of same, $3,206,500; date of last assessment, May 22, 1882; amount per share, twenty cents; cash on hand, February 1, 1882, $21,056.99; cash on hand, March, 1882, $15,564.

Julia Consolidated Mining Company (The) has its offices at 419 California Street, San Francisco, Cal. H. A. Charles, Secretary. The annual election is held August 10. The property is located on the Comstock lode, in the Virginia district. Nev. The depth attained on the workings is 2,450 feet. The length of the main lode, on which the company depends for its supply of ore, is 3,000 feet. Capitalization, $11,000,000, in 110,000 shares of $100 each; no dividends have been paid; seventeen assessments have been levied; total amount of same, $1,457,500; latest assessment, twenty cents per share, January, 1882; cash on hand, March 1, 1882, $1,066.

Jupiter Mining Company (The) owns property in the Bodie district, Cal. Extent of claim, 200 by 1,500 feet. The ore is rather low grade, but possesses good milling qualities. The mine has a vein formation over forty feet in width, assaying strong in gold and silver, which has been exciting much curiosity. The shaft is 500 feet deep. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. There are in the mine nearly 2,000 linear feet of excavation, including shafts. The mining plant includes a new hoisting apparatus of 1,200 feet capacity and costing $20,000. Capitalization, 64,000 shares; no dividends paid; twelve assessments levied; total amount of same, $216,000.

Kansas Mining Company (The). Mr. J. W. Whitlatch, Superintendent. The Catalpa and Crescent mines are owned by this company and located in Park county, Col. Quality and character of ore are gold and silver, 1880. There is but little doubt (so reported) that it will soon rank among the foremost producers of gold and silver in Park county. The depth of shaft is thirty feet. Averaging the depths of the shaft, cuts, and levels on the mine at thirty feet, and the ore streak at only two feet in width, there are now in sight 4,125 tons of ore, having a value of $32,000, after deducting the percentage of loss in treatment. A mill is owned by the company, California pattern. Will run ten 750-pound stamps, having engine and boiler capacity sufficient to use twenty. The mill will run almost automatically, being supplied with self-feeders and other improved labor-saving appliances. The mines are located upon one of the largest and best-filled fissures of the district, and are opened from the surface by means of fifteen different shafts, cuts, and levels in the vein. In addition to the fine location, there are two cross-cut tunnels run in to tap the vein lower down; one at seventy-seven, the other 150 feet. Throughout the workings of the mines there is not a pinch or barren spot shown, and the full meaning of this statement can be better understood when we say that the surface openings given are extended to a total length, along the vein, of 825 feet, several of them being long open cuts, or rather trenches, exposing ore for their entire length. At each of these openings there are many tons of ore, and a close estimate of the total amount upon the different dumps places it at 300 tons. Mining and milling cost $12 per ton. The ore will be found equally as plentiful and rich in the lower levels, as is shown in the working of the well-known Nova Zembla mine, which joins the Kansas upon the same vein, and which has been exploited to a depth of over 200 feet. At that distance from the surface the Nova Zembla is productive of ore, having a value of $200 per ton in gold and carrying some silver. Yield, net, to January 1, 1882, $12 per ton; yield, net, during 1881, $82,500.

Keystone Mining Company's Mine (The), the Keystone, is located in Amador county, Cal., and appears to be a valuable and profitable property. The mill has been recently rebuilt; it has forty stamps, self-feeding, rock-breaker, large ore-bin, with a capacity of 3,000 tons, to hold in reserve in case of accident in the mine, and Hendy concentrators giving satisfactory results.

Kearsarge Silver Mining Company (The) is chartered under the laws of the State of New York. The offices are at 54 Wall Street, New York. The property of the company is located near Salt Lake City. The ore is gold, silver, and lead. Organized in 1877; capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable. Yield during fiscal year 1879 80, $2,150.

Kentuck Mining Company (The) has offices at 234 Montgomery Street, San Francisco, California. J. W. Pew, Esq., is Secretary. The property is located on the Comstock lode, Nevada. The length of the main lode or which the company depends for its supply of ore is ninety-five feet. Fifteen men are employed at the Kentuck mine. Capitalization, $3,000,000, in 30,000 shares of $100 each; thirty-two dividends were paid up to March 10, 1870, date of last dividend; total amount of same, $1,252,000; amount of last dividend, $5 per share; seventeen assessments have been levied; total amount of same, $342,000; date of last assessment, November 23, 1881, at thirty cents per share.

King's Mountain Mining Company (The) is chartered under the laws of the State of New York. The offices are at 52 Broadway, New York city. The property of the company, consisting of 500 acres, is located in Gaston county, N. C. The ore is auriferous with some silver. Organized September 10, 1877; capitalization, $1,200,000, in shares of $10 equals 120,000 shares; non-assessable. To May of the current year, no dividends had been paid.

Lacrosse Gold and Silver Mining Company is chartered under the laws of the State of New York. Office, 59 Williams Street, New York. The company's property is located in Colorado. Character of the ore is gold and silver, and has a value of $40 per ton. Date of incorporation, June 16, 1863; capitalization, $1,000,000; par value per share, $10.

Last Chance Mining Company is chartered under the laws of the State of California. Office, San Francisco, Cal. The company's property is located at Bodie, Mono county, Cal. The ore carries both gold and silver, and has a value of $30 per ton. The company owns whim, hoisting works, etc. Date of organization, July 3, 1879. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable.

Lady Helen Gold and Silver Mining Company (The) has its offices at No. 29 Broad Street, New York. The officers are Paul O. d'Esterhazer, Pres.; Robt. Rayner, Sec.; R. G. Anderson, Supt. The company owns the Lady Helen mine, located near the Senate mine, Colorado, and employs in it a considerable staff of men. The prospects of success are at present promising. Capitalization, $500,000, in 100,000 shares of $5 each.

Lawler Gold and Silver Mining Company (The). Principal office, Leadville, Colorado. The mining property belonging to this company is located in Park county, Colorado. Capitalization, $5,000,000; shares, 500,000; par value, $10.

Leeds Mountain Gold and Silver Mining Company (The) is chartered under the laws of the State of Colorado. The offices are at Topeka, Kansas, and Maysville, Colorado. The directors and officers are

Gov. John P. St. John, Pres.; Hon. A. H. Horton, Vice-Pres.; A. B. Jetmore, Gen. Mang.; Owen T. Welch, Treas.; W. H. Ward, Sec.; Col. P. S. Noble, Hon. Ed. Knowles, Hon. J. O. Pickering, and C. M. Johnson. The Executive Committee consists of Hon. A. B. Jetmore, Hon. G. B. Johnston, and W. C. Edwards. Organized April 21, 1881; capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable. Stockholders not individually liable.

Lida Gold and Silver Mining Company (The). Officer, A. C. Hammond, Sec. Principal office, 401 California Street, San Francisco. The above mines are located in Nevada.

Little Bobtail Gold and Silver Mining Company (The) own a group of mines comprising the Little Bobtail, Salt Lake, Dovetail, Little Chance, Mary, Flint, Railroad, Baltic, Juanita, and Marion, all located in Gilpin county, Col. The Baltic at a depth of sixty feet has a sixteen-inch pay streak. The Railroad mine at its junction with the Baltic has a shaft 230 feet in depth, also a sixty-foot shaft. On the Flint, the shaft is down 130 feet, with ten inches of vein matter at the bottom. This mine produces a good smelting ore from the ninety-foot level. The incorporators were John H. Boen, John H. Matthews, M. G. Ferguson. The company has a capitalization of $1,000,000.

Little Piney Gold and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are Edwin G. Fay, Pres.; Geo. G. Magee; Vice-Pres.; E. P. Graves, Sec. and Treas. Superintendent, F. C. Fay. Office, Corning, New York. The company's property is located in California mining districts, Col. Amount of property in acres, 320. The company's property consists of Placer and Lode mining claims. They have a capitalization of $1,000,000. Par value per share, $10. Basis, non-assessable.

Little Rapid Placer Mining Company (The) is chartered under the laws of the State of New York. The President of the company is Benjamin Homans. Office, 251 Broadway, New York. The property of the company is located in the Black Hills, Dakota. The ore is free smelting. A rich pay streak shows in the breasts of all the drifts and levels in the mines, generally about two feet in width. It consists of a fine-looking brown and gray quartz ore, containing much copper in a carbonized condition. Capitalization, $1,000,000, in 200,000 shares of $5 each.

Long and Derry Hill Mining Company (The) is chartered under the laws of the State of New York. Officers are Hon. Wm. Fullerton, President; Wm. E. Redding, Vice-President; Gen. John A. Anderson, Treasurer; D. Olyphant Talbot, Secretary. Mr. J. L. Sprogell, Jr., is Superintendent. Offices are at 145 Broadway, New York, and 310 Chestnut Street, Philadelphia, Pa. The company owns two mines, Little Canada and Mount Carbon, located in Colorado. The mineral ranges in value from $1 to $500 per ton. Seams of carbonate are reported to have been met with. After standing idle for some time, operations in the mine were recommenced May 1, under most favorable circumstances. About forty men are now employed, and regular shipments of about eighteen tons of ore per week are being made. Organized March, 1880; capitalization, $5,000,000, in shares of $10 each, 500,000 shares; floating debt, March 1, $13,116; 300,000 shares issued, 200,000 reserved in treasury.

Lyon (or Robinson) Mining Company (The). The Lyon or Robinson mine is located near Placerville, El Dorado county, California, and has been worked for a number of years with great success. The mine consists of an immense gravel deposit, and the principal work has thus far been done upon what appears to have been an old channel running from northeast to southwest, and varies from 1:0 to 250 feet in width. Heretofore operations have been confined to the eastern portion of the claim, and to the flat in the immediate vicinity of the mill, until within the past year, since the property came into the hands of the present company, who built new hoisting works. The gravel bed, interspersed with large, smoothly washed boulders, is about four feet in depth, all of which, save the boulders, is milled. The mill consists of twenty stamps, with a capacity of fifty tons of gravel every twenty-four hours. Good gravel also exists in the Cedar Spring mines, formerly the Dickerhoff and Goyan claim, the property of the same company.

Leviathan Mining Company. The officers are H. A, Deming, President: L. W. Boyer, Vice-President; B. B. Smith, Secretary; R. W. Hent, C. F. Tolford, G. P. Theller. The company's property is located at Gold Hill district, Comstock lode, Nevada. There are 2,000 linear feet in their mine. Capitalization, $10,000,000; par value per share, $100; number of assessments levied, twelve; total amount of assessments levied, $355,-000; date of latest assessment, March 23, 1881.

Leopard Mining Company. Location of the property, Cornucopia, Elks county, Nevada. The main lode is 1,500 linear feet in the company's mine. Capitalization, $5,000,000; par value per share, $100; yield during 1880, $10,178; number of dividends paid to December 11, 1876, six; total amount of dividends paid, $162.50; date of latest dividend, December 11, 1876; number of assessments levied, thirteen; total amount of assessments levied, $347,500; date of latest assessment, April 5, 1880.

Leviathan Mining Company (The). F. A. Frisus, Sec.; principal office at San Francisco, Cal. The mines belonging to this company are located in Nevada.

Tom Moore Mining Company. R. S. Cross is Superintendent. This company own the Tom Moore and Byron lodes, and also others on Jones Mountains, San Juan county, Colorado. They are on a large vein whose general bend is northeast and southwest. This vein is about seventy-five feet wide. There are several pay streaks; one near the hanging wall is fourteen inches wide, carrying a solid body of galena and gray copper ore, which will run 251 ounces of silver per ton. The pay streak near the foot wall is nine inches thick, carrying galena which mills sixty-eight ounces of silver per ton. The main or centre pay streak is three to seven feet wide, carrying galena, gray copper, native copper, and gold quartz; assays $100 gold, from 700 to 800 ounces in silver, and about twenty-five per cent. copper. This vein has been opened at short intervals by cross-cuts throughout its whole length, showing good mineral in each opening. There is also a tunnel 165 feet in length on the Tom Moore, from which a drift has been run sixty feet on the hanging wall.

Melvina Mining Company (The). Officer, T. A. Bryant, Asst. Sec.; principal office, 108 Washington Street, Chicago, Ill. The locality of the mines of this company is at Salina, in Boulder county, Col.

Mt. Potosi Consolidated Mining Company (The). Officer, E. A. Holmes, Secretary. Principal office, 318 Pine Street, San Francisco, Cal. The mining property belonging to this company is located in Nevada. Capitalization, $10,000,000; shares, 100,000; par value, $100. Yield during 1880, $21,900. Number of dividends, none; number of assessments levied, eight; total amount of same, $175,000; latest assessment, October 20, 1881.

Mackey Gold and Silver Mining Company (The). Officer, J. M. Buffington, Secretary. Principal office, 309 California Street, San Francisco, Cal. The location of the mines belonging to this company is in Nevada.

Manhattan Gold and Silver Mining Company (The) has property located in Clear Creek county, Col. The company owns the following lodes: Thompson, Sterling, Ringgold, Thunderbolt, Beaver, Lennox, Kenton, Lamar, and Melverne; located on the junction of Ute creek. They will be worked through the Manhattan tunnel, which is now in a distance of eighty-seven feet. The company are working the group very systematically, showing excellent management, with good prospects of success. The tunnel will cut the whole of the lodes and at a depth where the best ore is to be found. The Thunderbolt is considered the best of the group, and is developed by a shaft which is now down ninety-six feet; this exposes a true fissure vein, nine feet between the walls, which is producing very fine mineral.

Mariposa Gold and Silver Mining Company (The). Directors, Mr. H. H. White, J. F. Brown, W. E. Brown, J. W. Snyder, E. S. Utter. D. Walton Birmingham, Superintendent. The mines belonging to this company, the Succedo mine, the Pine Tree, Josephine, Princeton, Green Gulch, Mexican, Oro, Mount Ophir, Linn, Mariposa, New Britain or Mariposa, are located in Mariposa county, Cal. Very little has been done at them lately, but preparations are being made for active work. Reports say that the fresh developments will commence at the north end of the estate, in the river tunnel, in the vein known as the Succedo mine. An immense vein of quartz, some thirty feet in thickness, has been struck. The quartz is irregularly stratified, but resembles in a measure that of the Josephine mine, breaking apart without difficulty at the points of stratification, which are more or less charged with fine sulphurets containing gold, and showing a strong presence of auriferous lead. The ore is refractory to work by the ordinary process, and the company propose to introduce other methods by which low grade and rebellious ores are rendered profitable to work, and it is hoped that this large body of ore will not have to be passed by as worthless. The company have levied twenty-two assessments. Date of latest assesmeent, December 23, 1881, being levied at the rate of twenty-five cents per share. Capitalization, $2,500,0000.

Maryland Consolidated Gold Mining Company (The). Principal office, 219 Sansome Street, San Francisco, California. Annual election, December 23. The mines belonging to this company are located in Brodie district, Cal. They are immediately south of and adjoining the Noondays. Amount of property in acres consists of 400 by 1,500 feet. This is a property of great value. Fair grade of ore, assaying $30 to $150 gold and silver. There are five ledges, varying from one to three feet in thickness, containing very fine ore. Shaft is double compartment, 550 feet deep; 5,000 feet in mine. An engine cabling of best steel, guaranteed to sink 1,500 feet, using cars and cages; 6 000 feet in mine. The ores are chiefly decomposed quartz mixed with clay, carrying about three-quarters gold and one-quarter silver. Capitalization, $12,000,000; shares, 120,000; par value, $100; shares sold for working capital, 20,000. No dividends paid to January 1, 1882. Number of assessments levied, two; total amount of same, $60,000. Not listed.

Mayflower Consolidated Gold and Silver Mining Company is chartered under the laws of the State of New York. The officers are G. Burt, Pres. and Robert White, Sec. Office. 161 Broadway, New York. The company's property is located at Idaho Springs, Clear Creek county, Col. The ore carries gold and silver. It is claimed by parties interested that 8,000 tons are practically developed. Date of incorporation, May, 1879. Capitalization, $1,000,000: par value per share, $10. Basis, non-assessable; full paid. There is a limited number of shares for sale at $4 per share. Stock quoted July 12, 1882, twenty cents per share.

McElroy Gravel Mining Company (The) is chartered under the laws of the State of California. The officers or directors are Southard Hoffman, Clerk U. S. District Court; James Phelan, capitalist; Geo. Schultz, merchant; W. R. Sloan, real estate; D. V. B. Henarie, merchant. President, Southard Hoffman; Secretary, Lewis Lillie. Date of annual election, first Tuesday in June. The present Superintendent is Jos. Eadley. The offices are at 607 Washington Street, San Francisco. The property of the company is at Altarvile, Calaveras county, Cal., and has an extent of 440 acres. The ore is found in the deep gravel of a river drift or bed. The shaft is 210 feet down. Tunnel for drainage, about 600 feet. The length of the deposit on which the supply of ore depends is 3,000 feet. Developments were commenced in 1874, $30,000 having been expended on the same, and the prospects of the property are favorable. Organized December 18, 1872. Capitalization, $5,000,000, in 500,000 shares of $10 each. Stock assessable. Balance stock of the corporation, 14,683 shares. Five assessments have been levied, aggregating $12,543.19; date of first assessment, July 23, 1878; amount per share, ten cents; date of latest assessment, January 24, 1882; amount per share, ten cents.

Michoacan Syndicate Mining Company. The officers are H. A. W. Tabor, Pres.; Alex. McDonald, Vice-Pres.; Bernard Whitman, Sec.; all of New York. Morelia committee, Senor Don Gustavo J. Gravenhorst, Pres.; Senor Don J. M. Sorlozano, Vice-Pres. General Agent, Senor Don Pedro Gutierrez. David Ferguson, Esq., Agent in City of Mexico. Offices, Morelia. State of Michoacan, Mexico, and 115 Broadway (rooms 53 to 61), New York. The company's property consists of a group of developed and producing gold and silver mines in district of Chapatuato; group of developed and producing silver mines in district of Oznmatlan; group of undeveloped working gold mines in district of Sinda; and group of gold prospects in the district of Tiquio. The company's capitalization is divided into 300,000 shares. Full paid and non-assessable.

Midland Mining Company. The property of this company, the John Lee, Little Johnny, Cimarron, Niegold, Begole, Ashurst, Thoran, Grace Clifford, Pemberton, and Roedel mines, is located in San Juan county, Col. They also own the Roedel tunnel site, which was located in 1876, which has already been driven in over 450 feet, and will cut the Little Johnny at a depth of 500 feet from the surface. Veins are strong and well defined, and enclosed between granite walls. The vein material is galena copper pyrites, and carbonate, carrying gold, silver, and lead, varying from thirty to sixty per cent. lead, and from ten to 100 ounces silver.

Mexican Gold and Silver Mining Company (The) is chartered under the laws of the State of California, C. L. McCoy, Esq., is the Secretary. The offices are at 309 Montgomery Street, San Francisco, Cal. The property of the company is located in the Virginia district, Comstock lode, Nevada. The ore is gold and silver, low grade. The workings are 2,600 feet down. The length of the main lode (Comstock) on which the company depends for its supply of ore is 600 linear feet. Sixty-three miners are employed at the Mexican mine. Organized, December 8, 1874; capitalization, $10,800,000, in 108,000 shares of $100 each. No dividends have been paid. Nineteen assessments have been levied; latest, June 6, 1882, of fifty cents per share. Indebtedness, April 1, 1882, $43,590; cash on hand, February 1, $1,809.82.

Minerva Gold and Silver Mining Company owns the Minerva mine located in Butler county, north-west of Orrville, Cal. The company's property consists of 150 acres lode claims, and 320 placer. The ore is mostly of a sulphuret nature, and pays about $16 per ton. Length of the main tunnel is 600 feet, or 500 feet from the mouth of the tunnel of the mine. The main lode is 39,000 feet in length.

Minnie Lee Gold and Silver Mining Company (The). The property belonging to this company is located in Summit county, Col. Capitalization, $2,000,000; par value, $10.

Mint Gold and Silver Mining Company (The). The mining works of this company are located in Virginia district, Comstock lode, Nevada. 6,200 linear feet in mine. Capitalization, $5,000,000; shares, 50,000; par value, $100; number of assessments levied, twenty-four; total amount of same, $165,000; date of latest assessment, July 28, 1880.

Mohave Mining and Milling Company is chartered under the laws of the State of New York. The officers are Edward M. Clark, Pres.; W. D. Crapin, Treas.; R. W. C. Merington, Sec.; Superintendent, Major George Clendon. Office, 120 Broadway, New York. The company's property is located at Mineral Parts, Mohave county, Ariz. The ore carries gold and silver; value per ton, from $60 to $150. Date of organization, November, 1879; capitalization, $1,000,000; par value per share, $10; basis, non-assessable.

Morning Star Consolidated Mining Company. W. L. Ward is Manager. Office, 331 Montgomery Street, San Francisco, Cal. The company's mine, the Morning Star, is located at Carbonate Hill, Mosquito Gulch, Leadville, Col. It is the first southern extension of the Gunsight Mining Claim. Amount of property (in acres) twenty-six. It is opened by a shaft sixty feet in depth, all in good ore. Assays give $101 to the ton; 100 tons now on the dump. The ore carries silver, gold, lead, and sand carbonate, assaying eleven ounces of silver, and one and a half ounces of gold per ton. The mines are worked by drift and level. The ore (body) is reported to be twenty feet in thickness. The company is shipping regularly, and paying regular monthly dividends. Plenty of ore is said to be in sight. Output weekly January, 1882, 100 tons. The current value of the mine is $2,200,000. A rich strike is reported to have been recently made in the lower workings of the mine. About 100 men are employed. Organized December, 1881; capitalization, $1,000,000; par value per share, $10; basis, non-assessable. Number of dividends paid to July 6, 1882, ten. Total amount of dividends paid, $490,000. Date of latest dividend, July 6, 1882; amount, $25,000. Surplus May 20, 1882, $80,000. Stock quoted June 10, 1882, $22. Weekly output of ore, 700 tons. Monthly expenses about $10,000.

Mountain Monarch Silver Mining Company (The) is chartered under the laws of the State of Iowa. Officers, Hon. James Harlan, Pres., Mt. Pleasant, Iowa; Wm. E. Mason, Chicago, Ill., Sec.; J. B. Coate, Mt. Pleasant, Iowa, Treas.; A. S. Hunter, Mt. Pleasant, Iowa. Directors, James Harlan, W. M. Stone, E. H. Winans, Hamilton White, W. H. Mason, J. B. Coate, S. F. Bangham, Ex-Gov. J. G. Newbold, A. S. Hunter. E. H. Winans, Gen. Agent. Principal office, Mt. Pleasant, Iowa. The mines belonging to this company are the Mountain Monarch, Island Lode, (each 1,500 feet long by 300 feet wide.) Located at Spanish Peaks, La Veta, Huerfano county, Col. True fissure veins, nine feet wide, filled with decomposed vein matter, with streaks of mineral, which assays $66 in silver, and $20 in gold. The ore, galena and pyrites, grows richer at every foot advancement, and the chimney widens with depth. Stock has advanced to $10. All necessary buildings and tools for the proper development of the property. Specimens of ore from the lower drift assayed 59$\frac{3}{10}$ ounces of silver, or $66.41. This assay does not include the gold, of which there is a considerable quantity, amounting to about $90 per ton *in toto*. Four tunnels on different levels have been driven into the distance of about 130 to 200 feet each. The private property of stockholders is exempt from liability for corporate obligations, and the company has no power to contract debts in excess of the money unappropriated in the treasury, nor to water its stock; 25,000 shares of the stock, of the denomination of $20 each, aggregating the par value of $500,000, have been placed in the treasury of the company as working capital stock for the common benefit of private stockholders, to be disposed of and the proceeds applied to the development of the mines until they shall be on a dividend paying basis, when the residue of said working capital stock will be distributed *pro rata* to all individual stockholders. The articles of incorporation are iron-clad. The stock can never be assessed, and under no consideration any indebtedness in excess of cash in the treasury. Individual property of stockholders can never be held liable for any action of the company. Amount expended developing property, January 1, 1882, $20,000; capitalization, $2,000,000; shares, 100,000; par value, $20; non-assessable. Number of assessments levied, no account.

Mount Diablo Mining Company (The) has offices at 318 Pine Street, San Francisco, Cal. Date of annual meeting, December 19. The company's property consists of the Mount Diablo claim, located in Candelaria district, Nev. The ore is a rotten quartz mixed with chlorides, the ore from drift assaying from $60 to $98 per ton. The present prospects of the mine are promising, the vein having a pay streak of about six inches wide. Length of main lode on which the supply of ore depends, 1,400 feet. Capitalization, $5,000,000, in 50,000 shares of $100 each; yield during 1880, $126,000; no dividends paid; three assessments levied, total, $137,500; latest assessment, June 22, 1880; floating indebtedness, $10,120, March 1, 1882.

Murchie Gold and Silver Company (The). Officer, S. D. Roger, Sec. Principal office, 328 Montgomery Street, San Francisco, Cal. The mines belonging to this company are located in California.

Nevada Chief Gold and Silver Mining Company (The). A. C. Hammond, Sec. Principal office, 401 San Francisco, Cal.

New York and Idaho Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are Hon. Ed. J. Curtis, Pres.; Jas. Turner, Vice-Pres.; Richard Sterling, Treas. The offices are at 42 Pine Street, New York. The company owns one mine, the Pacific, located at Atlanta Hill, Alturas county, Idaho Territory. The claim is 2,300 feet in length by 600 feet in width, and the property also embraces a fine mill-site, with wood and water in abundance. Organized on a non-assessable basis; capitalization, $1,000,000, in 200,000 shares of $5 each. A limited amount of stock for sale at $2 per share.

Northern Light Gold and Silver Mining Company (The). F. S. Monroe, Sec. Principal office, 310 Pine Street, San Francisco, Cal.

North State Mining Company (The) is incorporated under the laws of North Carolina. The principal mine appears to be the Copper Knob mine, located in North Carolina. This is a copper mine carrying gold and silver, and is a property of 350 acres, covered with heavy timber. The vein is a fissure, and varies from fifteen inches to four feet in width. The mine is opened to a depth of 157 feet on the incline, and has already produced a large quantity of rich and valuable ore. The vein, at a width of four feet, carries an average of 20 per cent. of copper, and $40 in gold and silver per ton. This mine is fully equipped with modern machinery, steam-hoisting engine, air-compressor, air-drills, 60-horse-power boilers, 25-horse-power engine, and two smelting furnaces of twenty tons capacity are being constructed. In the ore house there are about 300 tons of first-class ore, and not less than 600 tons standing in the incline and drifts on the foot-wall in the mine. The company has a capitalization of $10,000,000; par value per share, $25.

Noonday Mining Company (The) has its offices at 310 Pine Street, San Francisco, California. The annual meeting is held on August 25. The company's property comprises the Noonday mine, located in the Bodie district, California. Extent of claim, 600x1500 feet. The ore assays $24 per ton, gold and silver. The mine has two, well-defined fissures, one averaging two feet, and the other five to eight feet in width. Ledges run in the main ridge and dip to the east. The mining plant includes hoisting works, air-compressor, patent drills, etc., costing $30,000, with capacity for sinking probably 1,500 feet, thirty-stamp mill, costing $100,000. Main shaft is joint, three-compartment, 500 feet in depth. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. Powerful pumping apparatus is required to contend with the water, which accumulates rapidly at 500 feet depth. A 350-horse-power engine has been introduced, and ten stamps have been added, making forty in all, and as the water prevents the extraction of the ore, they are running on Bechtel Consolidated ore. A rich vein of ore has recently been struck in this mine, with a ledge of five feet of clean ore, three assays from which give the following results:

	No. 1.	No. 2.	No. 3.
Gold	$50.23	$46.44	$46.44
Silver	348.73	659.78	342.43
	$398.96	$706.22	$388.87

Outside of this vein, the walls of which are of clay, there is a harder quality of quartz of lower grade, so that really the width of this vein is unknown. Capitalization, $10,000,000, in 100,000 shares of $100 each; no dividends have been paid; five assessments levied, $118,000; yield during fiscal year 1879-80, $12,350; stock has been quoted at $5.

Niagara Gold and Silver Mining Company (The) has offices at 409 Montgomery Street, San Francisco, California. Mr. O. C. Miller is one of the officers. The company owns property in the Gold Hill district, Nevada. The length of the main lode on which the supply of ore depends is 1,500 feet. Capitalization, $6,000,000, in 60,000 shares of $100 each; no dividends have been paid; six assessments have been levied; total amount of same, $117,000.

Norwich Gold and Silver Mining Company (The) has offices at 310 Pine Street, room 15, San Francisco, California. The Secretary is W. L. Perkins, Esq. The mines and property are located in the Glencoe mining district, Calaveras county, Cal.

North Noonday Mining Company (The) has its offices at 316 California Street, San Francisco, Cal. The company own two claims, the North Noonday and Orient, comprising an area of 600x1,500 feet, 900,000 square feet, located in the Bodie district, California. The North Noonday Company seems to be working in conjunction with the Noonday, as the working-plant of the latter company is used in common. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends have been paid. Five assessments have been levied; total amount of same. Yield during 1880, $293,385.

North Bloomfield Gold Gravel Mining Company (The) has property located at North Bloomfield, Nevada county, Cal. The company owns two claims, the Omega and the Extension, located on the western slope of the Santa Reita mountains, twenty-five miles from Tucson. They were located some six years ago, and have been recently patented. Several thousand dollars have been expended in developments which show up a vast deposit or vein of high-grade copper ore. A large cross-cut into the vein, twenty-five feet, shows a solid body of ore, and the foot wall has not yet been reached. The average assay for all ore is from thirty to forty per cent. on copper, free smelting carrying its own flux. Facilities for taking and smelting ore are all favorable. Smelter will be located in the valley about one mile from the mines, where a good water supply is available. It is hoped to have the smelters in working order by 1st October, 1882. The mines present the largest body of high-grade ore in the Territory. One hundred men are employed at present. The company have 157 miles of ditches, including reservoirs. Capacity, 3,200 inches; grade, twelve to sixteen feet per mile. Cost of plant, $708,841. It costs $13,463 per year to keep the reservoirs and ditches in repair. This company light their mines and mills by electricity, having 12,000 candle-power in use. It is found to be both effective and economical. The company recently shipped the largest bar of gold ever sent through Wells, Fargo & Co.'s office at North Bloomfield. Over 4,000 inches of water are used in daily washings. The length of the deposit is 1,800 feet. Capitalization, $4,500,000, in 45,000 shares of $100 each. Yield during 1880, $275,766. Total dividends to November 5, 1880, $225,000; latest dividend to November 5, 1880, $1 per share. Forty-four assessments levied; total, $1,590,000; last assessment levied, January 23, 1877, $33.33⅓ per share. No stock in the market.

Newcastle Mining Company. The property is located east of Pino, Placer county, Cal., and has been put in good shape.

Ochoco Gold and Silver Mining Company. The property is located in the Ochoco Mountains, Wasco county, Oregon. A tunnel is being run to strike the ledge which is in a distance of 200 feet.

Organ Mountain Mining and Smelting Association (The). The officers are Isaac W. Heysunger, M. D., Chairman; Ellis Branson, Vice-Pres.; William Brice, Treas.; W. C. Carrick, Trustee. W. H. Skidmore, of Las Cruces, New Mexico, is Superintendent. Office, 821 Cherry Street, Philadelphia, Pa. The company's mining property is known as the Organ mines, (some fifty or sixty in number,) and is located twelve and one-half miles east of Las Cruces. The names of the mines of the different groups are as follows: Cueva Group, Lipan and Apache; Fillmore Pass Group, Excelsior, Dos Arroyos (mill site); Colorado Group, Colorado Grande, Plata Verde, Plata Grande, Colorado Chiquito, Mina del Ray, Mesa Colorado, Empire, Pennsylvania, Jersey Blue; Alto Group, Fulton, Alto, Basso, Eagle; Stephenson Group, McClellan, Leadland, Stephenson East, Dona Ana, Panther, Alamo, Regina; Memphis Group, Mill Site, Memphis East, Mexican Girl; Black Quartz Group, Valley Green, Tremont, Continental, Short Cut, Black Quartz, Girard, Keystone, Quaker City, West Philadelphia, Schuylkill, Lehigh; Rio Grande Group, Acejarah, two-thirds interest, Rio Grande, one-half interest, Southern Cross, two-thirds interest, North Star, two-thirds interest; Chippewa Group, Comanche, Chippewa, Copper Belt, Copper King; East Side Group, Philadelphia, Washington, Silver Belt, Black Diamond. The Cueva Group comprises forty-one and one-third acres. The mines each measure 1,500 by 600. The central mineral-bearing ledge is exposed from four to eight feet wide for nearly the entire 3,000 feet. Specimens taken from various points all gave silver in the assays. No work has been done upon these properties except with the hammers. The Fillmore Pass Group comprises over eighty acres in the well-known Fillmore Pass, from the western entrance of which it is distant something over one mile. The properties here show immense masses of silver ore in limestone. Pieces kicked off with the boot-heel assayed $25 per ton in silver, and the supply upon at least three of the properties is said to be inexhaustible. In the Colorado Group each property is 1,500 by 600 feet, and they comprise in all 1.86 acres of ground. From a pinnacle of rock upon the Colorado Chiquito immense ledges of metamorphic limestone, seamed with red hematite and copper oxides, extend down across the Colorado Grande and the Mesa Colorado. Upon the Plata Verde and the Plata Grande the limestone carries the yellow varnish caused by the action of subterranean heat upon deposits of zinc ore beneath. The Pennsylvania and Jersey Blue show large and fine silver-bearing ledges at the surface. The Alto Group comprise over eighty acres of ground and is believed to be of very great value by the Association. The Fulton and Alto cover 3,000 linear feet lying upon and including the great mother lode of the district, where developed to its greatest extent. The vein matter at the surface is more than thirty feet wide, and extends for 3,000 feet upon this Association's grounds without a break. A blue rock, which does not show up especially well, runs fifty-six ounces in silver. The Stephenson Group comprise an area of more than 140 acres. These properties lie about two and a half miles south of San Augustine Pass, and immediately alongside of and all around the celebrated Stephenson mine, which has been fully recognized for nearly thirty years. As will be seen, the Stephenson East lies immediately east of and against the Stephenson mine, taking the southern part of the formation upon which the principal shafts are sunk, further to the east, on the same property, appears an enormous vein which has been pronounced by good judges to be the true mother vein of the formation. It lies between granite and limestone, and at the surface is more than twenty feet in width. The Association propose to push the work upon these mines energetically, and instructions have been given to that effect. The Memphis Group comprise an area of sixty-two acres, and are situated to the east of the Memphis mine. The mineral outcrop on the Mill Site property extends along the edge of a great syenite precipice, and reveals several outcrops of argentiferous galena in a gangue of limestone and porphyry, and will doubtless develop into a valuable mining property. the veins being large and well defined and crossing each other at various angles. There are four fine springs on the property, hence its name. The Memphis East adjoins the celebrated Memphis mine in its whole extent, lying parallel with and against it on the eastern side. Advices received announce that the main shaft of the Memphis is down over 100 feet, and that at this depth a rich strike has been made in carbonates and sulphurets. It is said that the ores now assay in the mass from $32 to $160 per ton in silver, and that the entire mass of ore, which apparently covers a surface of 200 feet in width by 1,000 in length, will average over $50 per ton in this metal alone. The Association think there is little doubt they can, by sinking, strike the Memphis mineral in this property, the Memphis East, and will open this property shortly by a shaft nearly opposite the main outcrop of the neighboring mine. The Black Quartz Group comprise an area of 222 acres, all the mines being full-sized except the Black Quartz, which measures 1,050 by 600 feet. This group is the centre of the Association's mining operations. The Superintendent lives here. The Black Quartz was opened July 12, 1881, and work has been going on vigorously ever since, and the Short Cut was opened early in August, and the Girard in September. There are three shafts down upon the Short Cut, one to a depth of seven feet, another twelve, and the third twenty feet, with a twenty-foot drift from that depth along a nine-foot vein of excellent white quartz which assays $10 per ton in gold from unselected specimens, and shows up well in argentiferous galena. It bears every appearance of running into native silver at no great depth. The veins in this district constantly enlarge as depth is gained. A fine vein has been opened on the Short Cut. There are four shafts down on the Black Quartz; one of these, a prospect shaft, only uncovered a two-feet vein of iron at a depth of four feet, which grows wider as it descends. Another opening shows up ferruginous vein matter and argentiferous galena. Upon the west slope of the eastern hill a shaft was put down in close-grained porphyry, and a fine vein was struck which the Association propose to connect with their main shaft on the opposite hill by a drift already commenced, and to work both from a central shaft upon the neck of the two hills. The main Black Quartz shaft is down fifty feet. The ore is nearly a pure argentiferous and auriferous galena, much of it in masses weighing from fifty to 200 pounds apiece. In opening the mine this silver-bearing lead ore lay just beneath the surface in an almost solid bed. A new vein has been discovered on the Girard property. The lode is rapidly widening, being at last advices a vein of solid ore six feet thick, and specimens consist of masses of gold- and silver-bearing galena. The Rio Grande Group. The properties are all full sized excepting the Southern Cross, which is 1,100 by 600 feet. The most important mine of this group is the Rio Grande. The shaft is now down to a depth of fifteen feet, and at this depth the vein is now fuel five feet wide, and the pay streak of gold- and silver-bearing lead and copper ore is over two feet wide. It is a true fissure vein in solid granite. The Chippewa Group comprises ninety-three acres in extent. There are three prominent north and south parallel outcrops exposed along the greater part of the Chippewa. All these are exceedingly fine and large copper- and silver-bearing ledges. The East Side comprises an area of eighty-two acres. The cross ledge is a black iron outcrop, and pieces knocked off resemble freshly broken cast iron. The shares of the Association are 1,000 in all.

Oriental Consolidated Gold and Silver Mining Company (The). Officer, H. C. Hinman, Sec. General office, 411 California Street, San Francisco. The mines belonging to this company are located in California.

Original Summit Mill and Mining Company (The) is chartered under the laws of the State of New York. Officers, J. S. Ellis, Pres.; J. G. Holbrook, J. J. Kelly, Vice-Pres.; J. S. Ellis, Treas.; A. M. Ellsworth, Supt. Principal office, 21, 22, 23 Mutual Building, 95 Mill Street, Boston, Mass. The location of the mines belonging to this company are in Bodie, California. Capitalization, $10,000,000; shares, 100,000; par value, $100.

Ornament S. S. Mining Company (The). Fulton Haight, Esq., Supt. The names of mines belonging to this company are the Ohio, Ornament, and Group, located on Rock creek, eight miles west of Hailey, Idaho. One shipment of fifteen tons returned 800 ounces of silver to the ton. Ore carries ruby sulphates and native silver. Main shaft down 120 feet. The most extensive hoisting works on the river were put up on these mines last fall, and twelve men have been steadily at work during the winter. One tunnel is 180 feet, with an incline down eighty feet on the ledge.

Overman Mining Company (The). Officer, G. D. Edwards, Sec. Principal office, 414 California Street, San Francisco, Cal. The Overman mine belongs to the company; is located on Gold Hill district, Comstock Lode, Nev. Capitalization, $11,520,000; shares, 115,200; number of assessments levied, fifty-three; total amount of same, $3,604,700; date of latest assessment, May 1, 1882; amount per share, twenty-five cents. Depth of workings by tunnel, 2,275 feet; length in feet on which the company depends for its supply of ore, 1,200 feet; company in debt, February 1, 1882, $15,624. Mining Record, June 17.

Panther Consolidated Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are J. R. F. Bell, Pres.; T. J. W. Cooper, Vice-Pres.; Charles G. Walstrom, Sec. and Treas. Directors, Dr. J. R. F. Bell, T. J. W. Cooper, Chas. G. Walstrom, Gen. Geo. R. Vernon, Albert Gaw, C. W. Cunningham, Alex. T. Wilson. The offices are at 133 Bank Avenue, Philadelphia, Pa. The property of the company comprises two full claims, Panther No. 1, and Panther No. 2, located in Maricopa county, Arizona. The shaft is down 100 feet on the ledge. Capitalization of company, $500,000, in 200,000 shares of $2.50 each; non-assessable; amount of stock issued, 200,000 shares; amount reserved in treasury, 50,000 shares.

Permanent Gold and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are J. J. Wilbraham, Pres.; William Flint, Secretary; H. F. Smith, Treasurer. Directors, J. J. Wilbraham, William Flint, H. F. Smith, John Cochran, E. Clinton, A. M. Peel. Office, 14 South Third Street, Philadelphia, Pa. The property of the company is the Up Hill mine, in the Lackawanna district, Lake county, Colorado. Operations have been commenced, and will be pushed vigorously. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable.

Pine Tree Gold and Silver Mining Company (The.) Officers, Peter Fish, Pres.; J. Edward Fay, Treas.; E. P. Reed, Sec. Principal office, No. 162 Washington Street, Chicago, Ill., rooms 49 and 50. Capitalization, $150,000; par value, $10; stock full paid; non-assessable: 30,000 shares reserved for working capital by order of the board of directors; the first 5,000 of working capital will be sold at fifty cents per share.

Pittsburg Gold and Silver Mining Company (The). Officers, A. Martin, Pres.; J. W. Dale, Sec.; J. Murphy, Canon City, Col., M. D. Patton of Pueblo, Col., Superintendent. The principal claims belonging to the company are the Della May, the Emma, Decomplsy, Neptune, Austin, and William Lee, all located on Slak river, Colorado. The ore is various, both silver and gold, the former predominating. The company was organized in Danville, Ill.

Pizarro Gold and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are V. G. Edwards, Pres.; Alfred Hallowell, Vice-Pres.; Charles P. Johnson, Treas.; Seth Smith, Sec.; Gen. Manager, A. A. Freeman. Directors, V. G. Edwards, Alfred Hallowell, C. P. Johnson, W. Klemm, Jesse Tomlinson, Seth Smith, John C. Turner, W. Cohlman, W. H. Cheatley. Office, 136 South Fourth street Philadelphia, Pa. The company's property is located at Central City, Gilpin county, Col. The company has a capitalization of $2,000,000 in 200,000 shares; par value per share, $10; basis, non-assessable.

Plumas Mining and Water Company (The) has property located in Plumas county, Cal. The company was organized with a capital of $150,000 in 1,500 shares of $100 each; yield during 1880, $5,592; dividends paid, $41,300 to July 8, 1881, date of latest dividend of $5 per share; total assessment to date, $30,000; latest assessment, October 4, 1875. Stock quoted July 17, five cents per share; current value of mine, $750.

Potosi Mining Company is chartered under the laws of the State of California. W. E. Dean, Sec., 309 Montgomery Street, San Francisco, Cal. The company's property is located in Virginia district, Comstock lode, Nevada. The ore carries gold and silver assaying $28 per ton. The main lode is 700 feet in length. Date of organization, March 31, 1879; capitalization, $11,200,000; par value per share, $100. No dividends paid to April, 1882; number of assessments levied, eight; total amount of assessments levied, $448,000; date of latest assessment, April 12, 1882, at the rate of fifty cents per share. Treasury reserve, April 1, 1882, $14,417; stock quoted June 15, 1882, $5.

Plumas Mining and Water Company (The) is organized with a capital of $1,000,000 in 100,000 shares of $10 each. The property is located in California. Total amount of dividends paid, $151,000; date of last dividend, July, 1879, eight cents per share.

Providence Mining Company. The Providence mine is located in Nevada City district, Nevada county, Cal. After having been for a long time retarded in its operations by experimenting with various reduction processes, and by the destruction of its hoisting works by fire, it has recommenced operations with new and efficient mine machinery, and a new mill and chlorination works. The mine presents the peculiarity of being opened by levels to a depth of 1,070 feet, and a length of over 2,000 feet, while very little ore has been extracted, except between the 600 and 700 foot levels; and now the mill is supplied entirely from the 100-foot level, which, opening on the steep banks of Deer creek, is also the drainage tunnel. The several levels were driven through ground which supplied the old mill of twenty stamps with profitable ore, and encouraged the prosecution of work; but the true character and size of the lode were probably not suspected; for it is now known that large bodies of ore lie to the right and left of the levels, imbedded in a decomposed granite, the ore bodies themselves being quartzose, lenticular in shape and interlocking. From such lenticular masses, attaining (though rarely) twenty feet in thickness from the 100-foot level, eighty tons of ore are daily extracted. The width of the lode, assuming it to consist of this decomposed granite carrying these isolated quartz masses, is supposed to be 150 feet. The new mill of the company is of forty stamps, fed by Hendy feeders, the rock having previously been broken by a Blake rock-breaker. The mill is large, well-lighted, and commodious. This company has effected an arrangement for obtaining its motive-power from the Snow Mountain ditch, which carries a full head summer as well as winter. By the arrangement, the owner of the Snow Mountain will make a branch ditch leading from their main one, a distance of a mile to the edge of the Champion ground, where a tank will be constructed. From this tank, the Providence company will lay about 3,500 feet of pipe across the Champion and over Deer creek to their forty-stamp mill. The Champion company have given the right of way for a period of fifteen years, and it will result advantageously to both companies. It is reported that a large portion of the stock of this company is held in London.

Quartz Hill Consolidated Mining Company (The), of which William Hanson, Jr., Esq., is the Agent, is an English company, which purchased the mines formerly worked by the Monmouth, Kan., company, consisting of a portion of the Kansas, Kansas Extension, Irish Flag, and Camp Grove. The principal work consists in developments. The shaft is down 1,280 feet, and an aggregate of 9,800 feet of excavations have been made. The mineral from a sixteen-inch vein in the 1,275-feet level is entirely smelting. An average sample treated at the Boston and Colorado Smelting Works gave an average of $102 per ton. A lack of water for battery purposes has been experienced. The ore is conveyed by tramway from the mine to the mill, which numbers fifty-two stamps.

Querida Gold and Silver Mining Company (The). Incorporators, J. H. Kerr, Henry Kellogg, and F. L. Martin. The location of the mining property of this company is in Custer county, Col. Capitalization, $1,000,000; shares, 10,000.

Queen Bee Mining Company (The). Officers, G. W. Fisher, 324 Pine Street. Principal office, San Francisco, Cal. The location of the mining property of this company is at California.

Phil. Sheridan Mining Company's property is located in Virginia District, Nev. The main lode is 1,200 feet in length. Capitalization, $10,000,000; par value per share, $100; no dividends paid to April, 1882; number of assessments levied, ten; total amount of assessments levied, $170,000; date of latest assessment, June 22, 1880.

Red Cross Mining Company. The company's property is located in Storey county, Nev. There are 1,300 linear feet in the mine. No dividends have been paid, nor assessments levied, to April, 1882. Capitalization, $10,000,000; par value per share, $100.

Rara Avis Gold and Silver Mining Company. The officers are J. Stewart, Jr., Pres.; A. G. Postlethwaite, Vice-Pres.; J. C. McNaughton, Treas.; G. Stark, Sec. Directors, J. M. Taylor, E. Young, A. Warthman, C. H. Jordan, L. Conwell, G. Stark, J. Stewart, Jr., A. G. Postlethwaite, J. C. McNaughton. H. H. Bucher, Mining Engineer. Office, room 30, No. 306, Stock Exchange Place, Philadelphia, Pa. The company's mines are at Rara Avis, the J. P. Whitney, and the Little Mac mines, located on Prosser Mountain, in Gilpin county, Col. The company's property includes steam hoisting works, and they are about to erect reduction works, the machinery being already on the ground. There are three shafts; No. 1 is down 320 feet. Levels have been run at 40, 100, 150, and 300 feet. With present openings from thirty to forty tons of ore a day can be stoped out. Capitalization, $2,000,000; par value, $10 per share; basis, non-assessable; treasury reserve, $75,200; amount of stock issued, 124,800 shares.

Red Cloud Mining Company. Office, 310 Pine Street, San Francisco, Cal. The company's property is located in Bodie district, California. The company's claim, patented, is 600 by 1,500 feet. There are five ledges, varying in width from eighteen inches to nine feet: have been drifted on in the 250 and 400 levels. Total excavations, 4,000 feet. The company owns steam works costing $30,000, 1,500 feet sinking capacity. The prospects of the property are favorable. Capitalization, $5,000,000; par value per share, $100; no dividends paid to April, 1882; number of assessments levied, ten; total amount of assessments levied, $155,000.

Red Jacket Gold and Silver Mining Company (The). Directors, J. M. Tash, P. G. Vibbard, C. H. Wakelee, G. W. Spencer, S. C. Curtis. This company was organized March 24, 1880. Capitalization, $1,000,000.

Rex Gold and Silver Mining Company is chartered under the laws of Arizona. The officers are S. S. Campbell, Pres.; John H. Shrei, Treas.; Wm. Gladding, Sec. Office, 430 Walnut Street, Philadelphia, Pa., rooms 5 and 6. The company owns five mines, viz.: the Golden Shield, Republic, Tycoon, Mansworth, and San Jacinto. Mines located in Arizona. Capitalization, $5,000,000; par value per share, $5; basis, non-assessable; treasury reserve, 20,000 shares; amount of stock issued, 80,000 shares.

Richardson Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. The Directors are D. D. Baldwin, Pres.; T. J. Barbour, Sec. and Treas.; L. Jones, Vice-Pres.; R. Guernsey, M. L. Jones; E. E. Pray, Supt. Office, Financial agents, Gold, Barbour & Swords, Bankers, 92 Broadway, New York. The company's property is located in the heart of Gilpin county, on the Gold belt, Col. There are 3,900 feet in the property. The ore is rich smelting ore, and assays without concentration $23 per ton. The price ranges from $20 to $80. It is doubled by concentration. The vein is five feet in width, and all mineralized, nearly ready to commence stoping. The management expresses a sure expectation of paying back to the stockholders in one year every dollar of their investments. The cost of mining and milling per ton is estimated at $5. Date of organization, October, 1879; capitalization, $500,000; par value per share, $10; basis, non-assessable; fully paid; yield to June 1, 1882, $8,000.

Rock Island Gold and Silver Mining Company. The company's property is located in Gold Hill district, Comstock Lode, Nev. There are 1,200 linear feet in the mine. Capitalization, $10,000,000; par value per share, $100; no dividends paid to June, 1882; number of assessments levied, thirteen; total amount of assessments levied, $365,000; date of latest assessment, January 9, 1878.

Rollins Gold and Silver Mining Company is chartered under the laws of the State of New York. G. W. Barrett is Supt. Office, 137 Broadway, New York. The company's mining property is located in Gilpin county, Col. The company controls a large area of mining ground. Their lines extend from Gold district and Perigo Mountains on the south to the South Boulder on the north. A large amount has been expended in the construction of a ditch and flume, for the conveyance of water to their placer claims in the South Boulder valley. The piping, elevators, and giant hydraulics have now been placed in position. The product of the Perigo mine from July 1, 1881, to December 31, 1881, was $30,000. A mill of from forty to sixty stamps is proposed for Rollinsville, where an eighty-foot fall of water is available. The ore has a value of $1.37 to $5.93. The fissure vein is from four to seven feet wide. The company owns large mill, machinery, hotel, houses, etc. Date of incorporation, August 8, 1879; capitalization, $5,000,000; par value per share, $25; basis, non-assessable; total amount of dividends paid to January 1, 1881, $1,000,000.

Ruelana Consolidated Company (The). The officers are J. Thompson, Pres.; Fred. H. Hancock, V.-Pres.; J. D. Fidlar, Sec.; E. C. Chapin, Treas. Directors, or Trustees, E. C. Chapin, F. H. Griggs, H. Egbert, A. J. Holmes, W. S. Hobart, W. E. Sell, R. E. Wilson, J. E. Dixon. Henry Cooper, of Leadville, Superintendent. Office, Davenport, Iowa. This company owns the Nick-of-Time mine and part of seven claims, one mile south of it, located in Los Cerillos district, N. M. The ore carries zinc, galena, blende copper, green and blue carbonates of copper, chlorides of silver, iron pyrites, native silver, sulphides and gold. The company has a forty-horse-power hoisting works on the ground. The mine shows about three feet of galena ore. The shaft is 250 feet deep. The pay-streak in level running south, sixty feet down, is eighteen inches wide. At a depth of 200 feet is an important level with improved ore, showing galena and sulphurets of silver. This company is a close corporation, comprising many wealthy citizens of Davenport, Iowa.

Russell Gold and Silver Mining Company is chartered under the laws of Arizona. The officers are A. C. Harmer, Pres.; John H. Schreiner, Sec.; J. R. Black, Treas. Directors, A. C. Harmer, G. F. Wiggan, L. K. Rishel, J. Grove, J. H. Schreiner, C. F. Matthews, J. R. Black, S. S. Campbell, W. Glading. Office, 430 Walnut Street, Philadelphia, Pa. The company's mining property includes the Peabody, the Dona Ana, the Copper King, the Highland Mary, and the Tam O'Shanter mines located in Pima county, Ariz. Some of the ores smelted give sixty-one per cent. of copper. A concentrator is being erected. Capitalization, $5,000,000; par value per share, $50; basis, non-assessable.

Rara Avis Extension Gold and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are A. Warthman, Pres.; H. K. Schoch, Treas.; G. Stark, Sec. Directors, A. Warthman, H. R. Shoch, G. M. Wright, C. H. Jordan, J. C. Shoch. Office, room 30, No. 306 Stock Exchange Place, Philadelphia, Pa. The company's property is located in the State of Colorado. The tunnel run in the Rara Avis to lap the shaft at a depth of 300 feet, was completed the 21st of June. This puts the property in shape for ready and economical working. The shaft is sixty feet deep; pay-ore in sight. Capitalization, $100,000; par value per share, $1; basis, non-assessable. Treasury reserve, 35,000 shares. Stock issued, 100,000 shares; stock quoted July, 1882, $1.25.

San Juan di Dias and Refugio Mines (The). Owned by R. H. Chase, H. M. Atkinson, Surveyor-General of New Mexico; S. H. Lucas, C. R. Pearson, A. Scott, J. B. Gifford and S. A. Chaboyga, are located near Hermosillo, capital of Sonora, Mexico. The property owned covers 44,000 acres. The ore is one-half smelting and one-half free-milling. It is said specimens valued at several hundred dollars run upward of $10,000 to the ton. The San Juan di Dias has an ore body, at a depth of 140 feet, ten feet wide. The Kefugio mine is a true fissure vein, with an ore body varying from seventy-five to 100 feet in width, and can be traced with the eye for over 400 yards. From the surface, it runs from twenty-five to seventy-five per cent. in lead, from forty to 300 ounces in silver, and as high as $45 per ton of gold. The ore is a carbonate. The company have every convenience of mining import.

Steel Gold and Silver Mining Company (The) has property located in Clear Creek county, Col. The company owns the Daybreak and Sterling mines, situated in the Columbia Mountain.

Santiago Gold and Silver Mining Company. The property is located in Los Angeles county, Cal. The company have displayed considerable energy and enterprise in developing their mine in Santiago Cañon. The ore extracted is argentiferous galena and chloride. The company erected a Mexican roasting furnace, and the lead bullion produced yielded $500 to the ton. Arrangements have been made for a more extensive working of the mine.

Savage Mining Company. E. B. Holmes is Secretary. Date of annual election, July 21. Superintendent, M. Ball. Office, 3 Montgomery Street, San Francisco, Cal. The company's property is located in Virginia district, Comstock Lode, Nev. The character of the ore is horn silver, chlorides, and magnesia. The country rock carries silver. The main lode is 800 feet in length. Pay-streak, eighteen inches; the ore being worth about $200 per ton. Two shafts, one forty and one fifty feet. Capitalization, $11,200.00; par value per share, $100; total amount of dividends paid, $4,460,000; date of latest dividend, June 11, 1879; $3 per share; number of assessments levied, fifty-one; total amount of assessments levied, $5,608,000; date of latest assessment, May 4, 1882; fifty cents per share; stock quoted, July 1, 1882, $7.88 per share.

Shakespeare and Quaker Mines (The), owned by Messrs. Keeler, Read, and others. The Quaker mine is ten feet wide, showing at the depth of ten feet, where the vein is cut, a pay streak of from five to six feet, carrying both gold and silver, which collectively averages about $70 per ton. The Shakespeare is also the large vein, showing an average cropping from three to eight feet wide.

Sierra Nevada Mining Company. E. L. Parker is Secretary. Office, 309 Montgomery Street, San Francisco, Cal. The company's mine, the Sierra Nevada, is located in Virginia district, Comstock Lode, Nev. Depth of workings, 2,700 feet. The main lode is 3,650 feet in length. Seventy-six miners and fourteen surface men are employed at this mine. Capitalization, $10,000,000; par value per share, $100; yield during 1880, $46,422; yield during 1881, 6,077 tons, $195,213.53; total amount of dividends paid, $102,000; date of latest dividend, January, 1871, $1 per share; number of assessments levied, seventy-three; amount, $4,350,000; date of latest assessment, May 17, 1882, $1 per share; floating indebtedness, April 1, 1882, $27,500; cash on hand, February 1, 1882, $15,534.63; stock quoted, July 14, 1882, $5.

Silver Bow Mining and Milling Company. James A. Talbot is Business Manager. The property is located in Silver Bow county, Montana. Their twenty-stamp mill was enlarged to thirty stamps during the latter part of 1881. Yield during 1881, $500,000.

South Comstock Gold and Silver Mining Company (The). Principal office, 309 Montgomery Street, San Francisco, California. Date of annual election or meeting, November 23. The mines belonging to this company are located in Gold Hill district, Comstock lode, Nev.; 636 linear feet in mine. Capitalization, $10,000,000; shares, 100,000; par value, $100. Dividends, none. Number of assessments levied, six; whole amount, $79,000; date of latest assessment, September 9, 1879.

Southern Nevada Gold and Silver Mining Company (The). Directors, H. L. Coye, J. G. Lavery, H. L. Fox, E. E. Elliott, J. J. More. The location of the mines belonging to this company is in Esmeralda county, Nev. Capitalization, $10,000,000.

South Star Gold and Silver Mining Company (The). Officer, J. F. Atwell, Sec. General office, 606 Montgomery Street, San Francisco, California. The mining property belonging to this company is located in Nevada.

Specie Paying Gold and Silver Mining Company (The) has offices at La Porte, Indiana. The directors of the company are J. N. Whitehead, John J. Steadman, Ed. Geo. M. Dakin, and A. G. Stevenson. The property of the company is located in Pinal county, Ariz., being the first southern extension of the Alice claim. The mine has been opened by several shafts, and gives promise of developing into a valuable mine. One of the openings has exposed a fine body of galena ore, carrying $30 silver to the ton. One shaft and cross-cut at a depth of 140 feet shows fourteen feet of ore, assaying from $700 to $800 per ton. Work is being pushed with vigor.

Spaulding Gold and Silver Mining Company (The) has property located in the Bodie district, Cal., consisting of two claims, one, 100 by 1,500 feet, the other, 400 by 1,500 feet; total area, 750,000 feet (square). The ore is fair grade. The length of the main lode, on which the company depends for its supply of ore, is 3,000 feet. The ore-vein in the north drift, first level, has widened to five feet, and the south drift is also showing improvement. The mill was started, and the pipes, pumps, and everything found to work well. There is a large supply of ore at the batteries, and considerable quantities broken down in the mine ready for hoisting. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends paid. Two assessments levied; total amount of same, $10,000. Date of latest assessment, June 28, 1882; amount of same, ten cents per share.

Star Mining Company (The). Officers, William Stuart, Secretary; office, 320 Sansome Street, San Francisco, Cal. The Star mine is located in White Pine county, Nev. There are 1,500 linear feet in the mine. This mine is destined to become one of the most valuable properties in Eastern Nevada. During the year 1881 it was a regular producer. The mill has run as high as 600 tons each month, the ore yielding $60 to $70 per ton. The total shipments of this mine, as reported by the *Engineering and Mining Journal* for 1881, were $294,743. The monthly expenses of the mill and mine averaged $20,000. Capitalization, $10,000,000; par value per share, $100; number of assessments levied, ten; amount of nine, $190,000; date of latest assessment, March 22, 1882, ten cents per share; indebtedness February 1, 1882, $8,901.65.

Stevens' Gold and Silver Mining Company. A. Wartenurlen is Manager. The Stevens mine is located in Silver Bow county, Cal.

Over 1,500 feet of levels have been opened. Fine specimens of wire gold and native silver are found in this mine. The first work done on this property was for the gold. The mine is equipped with a steam hoist, a double plunger, Knowles' pumps, and a sinking pump. The company is capitalized at $4,000,000.

Succor Mine and Milling Company (The) has property located in the Cold Hill district, Nev. Capitalization, $6,840,000, in 68,400 shares of $100 each; two dividends, amounting to $22,800, paid to October 16, 1871, date of latest dividend. Twenty-four assessments have been levied; total amount of same, $763,800; date of latest assessment, August 30, 1879.

The Swansea Lode, owned by Messrs. V. Shaw, Kennedy, and Charles Ellethorpe. The Swansea Lode is located on Ewing Mountain, Colorado. Silver and gold ore assaying per ton, eleven ounces of gold, fifty-two ounces of silver, and five per cent. lead.

Tilden Mining Company. Office, 43 Exchange Place, New York. The company's property is located in Clear Creek mining district, Chaffee county, Col.

Tellurium Gold and Silver Mining Company. J. M. Litchfield, Sec. Principal office, 415 Montgomery Street, San Francisco. The mines belonging to this company are located in California.

Town Talk Grand Mining Company (The) have been prospecting in the gravel ridge running through Sutton's ranch, west of Town Talk House, Nevada county, Cal., for the last year, and the prospects for opening a good mine there are considered excellent. A tunnel was run into the ridge on the south side a distance of 550 feet, and a bed of blue gravel struck which prospered well: but, owing to the pitch of the bed rock for the last fifty or sixty feet that the tunnel was run, it was found that the mine could not be worked to advantage on account of the water. The company then commenced running a new tunnel on the lower grade to bottom the channel, and this tunnel is now in a distance of nearly 550 feet, and with a further extension of fifty feet it will be in the blue gravel, and the channel can be completely drained. Six men have been constantly engaged in draining the channel, working on regular shifts.

Tuscarora Mining and Milling Company (The). Office, 309 Montgomery Street, San Francisco, Cal. The property of the company consists of five claims, the Raven, Atlas, Castle No. 1, Castle No. 2, and the Whale, situated a short distance west of the town of Tuscarora, in Elko county, Nevada. A large amount of work has been done upon these locations during the years 1880 and 1881, but as yet but little bullion has been produced. The Raven has a shaft down 100 feet, and at the bottom a drift runs forty feet to the north, encountering considerable water. So far the ore found has been of low grade, with here and there high-grade ore, but not in sufficient quantity to pay for extracting. The shaft on the Whale has been sunk ninety feet, finding upon drifting 200 feet only low-grade ores. Capitalization, $10,000,000: par value per share, $100.

Tybo Consolidated Mining Company (The) has its offices at 318 Pine Street, San Francisco, Cal. The property of the company is located in the Tybo district, Nye county, Nevada. The length of the lode on which the company depends for its supply of ore is 6.275 feet long. Capitalization, $15,000,000, in 150,000 shares of $100 each. No dividends have been paid; no assessments been levied.

Tyrone Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. Officers, John H. Strickler, Pres.; P. M. Stackhouse, Sec. and Treas. Directors, John H. Strickler, David Hardie, James F. Kennedy, Amos Burton, P. M. Stackhouse. Principal office, 303 Walnut Street, Philadelphia, Pa. The location of the mining property of this company is in Arizona. Capitalization, 200,000 shares; par value, $5; non-assessable.

Union Consolidated Mining Company. A. B. Walker, Sec. Office, Council Bluffs, Iowa. The company's mining property consists of the Cross, Seaman, Ewing, Convict, Walker, Garfield, Gleason, Butte, General Grant, Hero, Little Harry, Hattie, Little Pet, and Bullion claims, located in Carbonate mining district, Minta county, Utah. Report says the Cross lode has heavy iron and copper croppings. It can be traced the entire length, 1,500 feet, of the claim. It is from three to six feet in width, and the ore assays from ten to eighty ounces in silver and from thirty to sixty per cent. copper. There are two shafts ten feet deep. The character of the ore is improving rapidly and the vein is increasing in width. The Convict embraces two ledges, one a vein of copper glance two and one-half feet in width, carrying from thirty to eighty ounces of silver; the other an eight-foot vein of feldspar and quartz carrying gray copper, and contains both gold and silver. On the first ledge there are two shafts, one twenty and the other sixty feet deep. The Ewing has two good veins running the entire length of the claim. On one there is a shaft forty feet deep, the ore assaying forty per cent. copper and fourteen ounces in silver. The ledge in the bottom of the shaft is about three feet wide and still increasing in width. On the other ledge is a shaft twenty feet deep. Surface croppings about ten feet wide, consisting of copper and iron; and the amount of silver contained in the ore is increasing with depth. Average of ore from bottom of shaft assayed $6.25 in silver. The company have acquired by location the Walker, Garfield, Gleason, and Butte lodes. The Garfield is from fifty to 150 feet in width, the Butte from ten to twenty feet, and the Gleason two feet. The Butte assays $1.56 in silver and $8 in gold. They also own one-half of the Bonanza, and three-fourths of the Leonore. The Bonanza croppings are chiefly galena, and an average of the ore assayed $5 in silver and twenty-four per cent. lead. The Leonore assays at three feet $3 in silver, and at five feet, $11.30. It shows fifteen per cent. galena and a small amount of gold; shaft is eight feet deep. The General Grant has a shaft seven feet deep. The Little Harry has a shaft ten feet, with considerable amount of feldspar. Surface assays gave $5 in silver. Walker samples assayed $7.54 silver and $3 gold. The Bonanza, on assay test, gives lead, twenty-four, $7.54 silver, and $3 gold. Some of the ore of the Convict ledge runs ninety high in silver, and some at least thirty per cent. The company's property includes water privileges, mill sites, town sites, and placer claims.

United States Gold and Silver Mining Company of Colorado is chartered under the laws of the State of Illinois. The officers are H. Kaerhen, Pres.; J. C. Meyer, Vice-Pres.; W. E. Johnson, second Vice-Pres.; W. P. Nixon, Sec.; Henry Furst, Treas. Date of annual election, January 7, 1882. J. W. Warren is Superintendent. Office, 355 Clark Street, room 10, Chicago, Ill. The company's mines are the Little Winnie, the Virginius, and the Free American, located at Little Ella Hill, South Evans, three and one-half miles from Leadville, Col. Extent of claim is about 600 by 2,500 feet. The property covers an area of eighteen acres. The ore is lead carbonate, and assays twenty ounces silver, and thirty-seven per cent. lead. Cost of mining and milling per ton, $17. The character of the mine is contact vein. Date of commencing developments, August, 1879. Amount expended in developing property to April 1, 1882, about $25,000. No machinery or mills owned. Date of organization, June 5, 1879; capitalization, $2,000,000; par value per share, $10; basis, non-assessable; yield to April 1, 1882, 29,896 pounds; mine was not worked during 1881; bonded indebtedness May 15, 1882, $50,000; treasury reserve, $750,000.

Vulcan Gold and Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are Hon. Lewis Jones, Pres.; Meredith L. Jones, Sec. and Treas. The above named and Egbert Guernsey, M. D., constitute the board of directors. The offices are at 120 Broadway, New York. The property of the company is located on Mt. Sneffelz, Ouray county, Colorado; extent of claim, 1,500 feet by 300. The ore is ruby and brittle silver, and fine galena full of gray copper. The low grades show more or less zinc, but mineral in rock is high grade, gangue is light calc spar and quartz. An excellent average of fourteen samples taken from dump assayed $184. The lode runs east and west across the mountain, dips south into mountain, varies in width from eight to twelve feet. Pay-streak is from one foot to two feet six inches wide, carrying the following kind of ores—ruby and brittle silver, fine galena, full and gray copper. The tunnel is five feet six by six feet seven high, and sixty-six feet long. The expenditure of a small amount of capital will provide all necessary storehouses, etc. Capitalization, $300,000, in 30,000 shares of $10 each; non-assessable; full paid.

Wales Consolidated Company. They own eleven claims, embracing about 4,200 feet, located in Eureka county, Nevada, between the end lines of the Albion and Richmond properties, and that of the Silver Lick company. This company, which lost their works by fire, have erected new hoisting works with a capacity for sinking 2,000 feet. A large amount of work has been done during the year.

West Comstock Gold and Silver Mining Company (The) is chartered under the laws of the State of California. The officers are W. A. H. Hart, Pres.; J. C. Beatty, Sec.; trustees, Chas. Moss and Leander Shires. Annual election, 23d December. Transfer office, 230 Montgomery Street, (room 24) San Francisco. Head office, 250 Montgomery Street, (room 23.) Property located in Storey county, Nevada. Extent of claim, 3,000 feet. The ore is argentiferous, and assays from $20 to $50 per ton. The veins are quartz, running about four feet in width. There are 3,000 feet of tunnel; lead is struck at about 400 feet deep. The vein averages about three feet in thickness. Drifts run on ledge about 200 feet each way from the tunnel. The mines were originally located and developed about twenty years ago, having been recently reorganized. The mine is not worked at present. Organized 1873 (June); capitalization, $1,000,000, in 100,000 shares of $10 each; assessable; latest assessment levied, December, 1880, twenty-five cents per share; stock listed on Pacific Stock Board, San Francisco, Cal.; stock quoted twenty-five cents per share. The information was furnished by J. C. Beatty, Secretary of the West Comstock Gold and Silver Mining Company.

The Ward Gold and Silver Mining Company. Officer, Jacob Stadfeld, Sec.: general office, 419 California Street, San Francisco, Cal. The names of the mines belonging to this company are not known. The location is in Nevada.

West Camden Gold and Silver Mining Company (The) has property located at West Camden, Me. The officers are G. E. Williams, Pres.; J. A. Clark, Sec. and Treas. Directors, G. E. Williams, T. Lord, Jr., A. R. Soloman, Jas. Walden, J. H. Williams, I. B. Pratt, and F. F. Phillips. Acting Supt., G. E. Williams. Organized, May, 1880; capitalization, $500,000, in 100,000 shares of $5 each; 36,000 shares constitute the treasury reserve.

Western Union Gold and Silver Mining Company (The). The mines belonging to this company are located in Clear Creek county, Col. Capitalization, 20,000,000 shares; par value, $10.

Western World Mine (The). Owned by Messrs. Owsley, Allport, Ransome, and Frank. The Western World mine is situated directly west of the Andy Johnson mine. Fine shafts have been sunk to water level. Ore assayed 45 ounces in silver, $7 in gold.

West Virginia Mining Company (The). Mr. Otto Linzoos, Manager. The mining property owned by this company is located in Colorado, viz., Berkeley, Danuba, Ironi, and Alice mines. Beautiful specimens of silver and gold ore.

Whale Consolidated Gold and Silver Mining Company (The) is chartered under the laws of the State of Colorado. The officers are Senator Jas. Harlan, Pres.; D. D. Ryus, Sec. The original incorporators were F. L. Martin, D. D. Ryus, Jas. A. Maynard, G. W. Frederick, and Jas. Harlan. The head offices are at La Veta, Col. The property of the company, located in West Spanish Peak, La Veta, Col., comprises the Whales Nos. 1, 2, and 3, and the Iowa, in all 5,250 feet long and 300 feet wide. The company also owns the lodes Nonpareil, Goss, Jeffries, Western Queen, Treasure, Monitor, Highland Lass, and Lincoln, all true fissure veins, containing carbonate and galena ores assaying from 100 to 200 ounces of silver to the ton, and a fair percentage of lead; also an interest in several other claims. The main lode is a true fissure from four to twelve feet wide, with perfect wall rocks on each side (in Whale No. 1). The shaft on this lode uncovers a large body of "lead carbonates," and argentiferous galena ore, assaying from twenty to sixty ounces of silver and from forty to sixty per cent. of lead per ton. A tunnel driven in twenty feet and a shaft sunk thirty feet at inner end of tunnel on Whale No. 2, uncovers mineral from wall to wall a width of five feet, which assays fifty-five ounces of silver and forty-six per cent. of lead per ton. A cut thirty feet long and twenty-five feet deep on the Iowa section of Whale lode reveals solid vein of mineral assaying from 103 to 225 ounces of silver, and a little gold, some copper, and fifty-five per cent. of lead per ton. Capitalization, $2,000,000, in 100,000 shares of $20 each; non-assessable; 30,000 shares constitute the working capital.

White Mountain Water Company. The property, the Princess mine, is located in Esmeralda county, Nev. Only development work was done during the year, the mine being opened to the depth of 300 feet, and a large amount of ore exposed. A new sixty-stamp-mill has been under course of construction, and a steam hoist erected. After the surface improvements are completed, the work of extracting and milling the ore will commence, and, from all appearance, it will not be without profit.

Wood River Smelting Company (The) has its offices at 61 Broadway, New York. The property comprises the Keystone mine, May Queen, Evergreen, Highland Chief, Scorpion, Julia, Red Bird, and Emma, all located at Bellevue, Wood river, Alturas county, Idaho. The ore is high grade, assaying $150 per ton. Owing to the inconvenience of having to ship the ores to Salt Lake City to be smelted, several smelters are now being put up for treatment of ores from the surrounding mines. The mine was visited by the owners (chiefly of Philadelphia) in May last (1882). Notwithstanding the cost of $50 per ton incurred previously to the smelters being erected, by sending to Salt Lake City, a handsome profit was obtained. The bullion will be refined at Tatham's works, on Windmill island, on the Delaware. The Keystone mine (upon condition of the net profits over the cost of mining and smelting), has been let on a lease. Capitalization, $100,000, in 4,000 shares of $25 each.

Winnebago and O. K. Mining Company (The) is chartered under the laws of the State of New York. Officers (1880). Wm. F. Buckley, Pres.; Thomas J. Buckley, V.-Pres.; Henry W. Ford, Treas.; Drake De Kay, Sec. J. W. Davis, Superintendent. General office, 115 Broadway, New York, and 51 to 57 Borcel Buildings. The mines belonging to this company are located in Central City, Gilpin county, Col. The ore is composed of gold and silver and copper, smelting and milling. Organized, November, 1879; capitalization, $2,000,000; shares, 100,000; par value, $20; non-assessable.

Wyandotte Consolidated Gold and Silver Mining Company (The). Officers, Hon. Lewis Jones, Pres.; E. C. Pray, Treas.; Dr. Levi Harsh, Supt. General office, 16 Broad Street, New York. The company owns a group of mines, of which the Wyandotte is the principal; located in Gilpin county, Col. Extent of claim, 12,270 feet. Amount of property in acres, forty. Veins approach each other at an acute angle, and can be mined and operated through main shaft; sunk at focal point of all; elevation above sea level 9,600 feet. The management are prosecuting developments without attempting to make dividends, which will not be done until the mine is thoroughly opened. Twenty-one men are employed, taking out about 600 tons of iron ore per month. The working shaft of the Wyandotte is 400 feet deep. West of this, the company has a working shaft on another claim, the Crawford County, 265 feet deep, both being connected by a level 245 feet in length, and a cross-cut north from the former vein 140 feet in length. Some developments have also been made on the Leavenworth lode and others. The average of the smelting ore raised is $80 per ton net. The mines generally are in good working condition. The average output is about 100 tons of ore per month. Auriferous banks of gravel to washing out the free gold. It requires no chemical or mechanical process, no stamp-mills or furnaces. The mine is in active operation and under the local management of Mr. F. T. Hawley, of Brooklyn, New York. Capitalization, $50,000; par value, $1; non-assessable. Stock registered with the Mercantile Trust Company, 120 Broadway, New York.

Yellow Jacket Gold and Silver Mining Company (The) is chartered under the laws of the State of Nevada. The offices are at Gold Hill, Nevada. The property of the company includes the Yellow Jacket mine, located in the Gold Hill district, Comstock Lode, Nev. The ore is auriferous and argentiferous, in the proportion of thirty-three per cent. and sixty-seven per cent. The length of the main lode on which the company depends for its supply of ore is 957 feet. The main shaft was down, March 18, 1882, 3,000 feet, and is the deepest of all the deep mines on the lode, and, indeed, in the United States. Organized, February 17, 1863; capitalization, $12,000,000, in 120,000 shares of $100 each. Twenty-five dividends have been paid; total, $2,181,000; to August 10, 1871, the date of latest dividend, which was at the rate of $3 per share. Forty-three assessments have been levied; total, $5,358,000; to February 7, 1882, date of latest assessment, of $1 per share. No indebtedness.

Young America Mining Company (The) has property located in Tuscarora, Elko county, Nev. The length of the main lode on which the company depends for its supply of ore is 1,000 feet. Capitalization, $3,000,000, in 30,000 shares of $100 each. No dividends paid. Ten assessments levied; total, $57,000; last assessment, June 27, 1878.

SILVER.

Abbott Mining Company is chartered under the laws of the State of New York. Branch office, 48 John Street, New York. The company's works are located in Ouray county, Col. Extent of claim being ten lodes and mill sites. The property is undeveloped. Date of organization, May 12, 1879; capitalization, $2,000,000; par value per share, $10; basis, non-assessable.

Abbott Mining and Milling Company's (The) property is located at Chaffee county, Col. Capitalization, $150,000; par, per share, $10.

Abington Mining and Milling Company (The). Branch office, Leadville, Col. Location of mines, Boulder county, Col. Capitalization, $1,000,000, divided into 100,000 shares; par value, $10 each.

Acme Mining Company (The) is chartered under the laws of the State of Colorado. Officers and directors are G. P. Smith, F. M. Hibbard, Dr. T. Cummings, Geo. W. Stoner, R. Mickle. Principal office at Denver, Col. The mines are located in Colorado. Capitalization, 100,000, shares; par value, $10 each.

Alaskan Mining Company (The). Name of mine owned by the company is the Alaskan, located at Alaska, Col. Quality and character of ore eighty-three and eighty-five per cent. lead, and $121 and $161 silver; almost pure galena, which contains eighty-six per cent. lead. The country rock is mainly a micaceous slate; no gold found. The mountain seems to be composed of a white spar, which some supposed to be lime. There are great dikes of granite extending for miles. No sulphurets of iron were found; plenty of mica in great scales and sheets.

Albion Mining Company. The officers are L. L. Robinson, Pres.; Clinton Gurnee, Vice-Pres.; D. B. Chrisholm, Sec.; California Bank, Treas.; X. W. Robinson, Supt. The company's mines are located in Eureka district, Nevada. Aggregate of drifts, shafts, levels, etc., 6,000 feet Capitalization, $1,000,000; par value per share, $10; number of assessments levied, ten; total amount of same, $397,500; date of latest assessment, March 6, 1882. Indebtedness March 1, 1882, $19,276; funds reserved in the treasury April 1, 1882, $1,789.

Algonquin Mining and Milling Company (The) is chartered under the laws of the Territory of Montana. The officers are H. A. Stiles, Pres.; F. H. Williams, Sec. and Treas. Directors, H. A. Stiles, John F. Smith, E. C. Markley, James Fuller, M.D., D. C. Spooner. Name of mines owned are Algonquin, Salmon, Belle, Estelle. Amount expended in developing property to January 1, 1882, $200,000. Property owned by company, one 24-stamp mill, steam-hoist on two lodes, pumps, etc. Capitalization, 200,000 shares; par value, $10; assessable.

Alice Mining Company (The), whose property is situated in Utah, have a promising mine; the vein of which is over forty feet in width. The ore is good milling but hard, being rich in silver, yielding per ton as follows: First grade, sixty-five ounces; second grade, forty ounces; third grade, thirty ounces; fourth grade, twenty ounces. The property consists of two engines and tubular boilers; twenty-stamp dry crusher (Blake's); forty others, making a total of sixty stamps. The mine has a vertical three-compartment shaft, 712 feet down. The staff of hands employed aggregates 100.

Allied Mines (The). The company is chartered under the laws of the State of New York. The Directors are Gen. Thomas Ewing and Geo. Bissett; General Manager and Mining Engineer, W. M. Weston. Office, 63 Broadway, New York. Their mines are the Gertrude, Yellow Norma, Hidden Treasure, Rose, Talisman, Crusader, Emily. Located at Imogen Basin; Ouray county, Colorado, covering an area of seventy acres. The properties are all true fissure veins, which cannot be exhausted in depth. Capitalization, $10,000,000; par value per share, $10; non-assessable (no personal liabilities).

Alturas Gold Hill Mining Company. The officers are W. M. Little, Pres.; L. A. Richter, Vice-Pres.; E. Webb, Sec.; L. A. Richter, Treas. Office, 63 Broadway, New York. This company owns the Alturas, Bonanza, Buffalo, and Bullion mines, located at Rocky Bar, Alturas county, Idaho. The property is in first-rate condition in every way. Capitalization, $1,000,000; par value per share, $5.; non-assessable.

Alonza Mining Company (The) is chartered under the laws of the State of California. The officers are A. D. Oakley, Pres.; A. F. McGrew, Vice-Pres.; F. M. Blackstone, Sec.; and A. F. McGrew, Treas. The transfer office is at room 6, No. 140 S. Fourth Street, Philadelphia, Pa. The company owns the Mammoth mine, located at West Tintic mining district, Juab county, Utah. Organized, March, 1880. Capitalization, $10,000,000; shares each, $100; assessable. Stock reserve, 10,000 shares; stock has been quoted as high as $2.50; stock listed, Philadelphia Mining Annex.

Alpine Silver Mining Company is chartered under the laws of the State of New York. Office, 51 Broadway, New York. The company's works are located at Chalk Creek, Col., covering an area of 115 acres. Date of incorporation, January 6, 1879. Capitalization, $2,000,000; par value per share, $10; non-assessable.

Alta Montana Mining Company is chartered under the laws of the State of New York. Office, 76 Wall Street, New York. This company owns eleven mines (two of which are the Alta and Comet); ten of them extend on the Alta vein two miles, and four are developed from both sides of the mountain by seven tunnels aggregating 1,700 feet. This property is located in Jefferson county, Montana. The ore gives a silver assay of $80 per ton. The average width of vein is two feet. Company own extensive reduction works, which they value at $500,000, also stamp-mill, railroad, etc., valued at $350,000. Aggregate of tunnels and levels up to 1882, 3,000 feet. Shafts down from sixty feet to 300 feet. Date of incorporation, July 16, 1879. Capitalization, $15,000,000; par value per share, $10; non-assessable.

Alta Silver Mining Company. W. H. Watson, Sec.; office, 302 Montgomery Street, San Francisco, California. This company owns the Alta mine, located in Gold Hill district, Comstock lode, Nev., in which the workings have attained the depth of 2,250 feet. Amount expended in developing property has probably been about $150,000. Seventy-four miners are employed in the Alta mine. Capitalization, $10,800,000; par value per share, $100. No dividends paid up to 1882. Number of assessments levied, twenty-four; total amount of same, $1,641,600. Date of first assessment, August, 1880, fifty cents per share; date of latest assessment, May 2, 1882, fifty cents per share. Bonds reserved in the treasury, April 1, 1882, $16,485.

American Mining and Smelting Company (The). Andrew Wallace, Supt. Name of mine owned, Little Ellen, located in South Evans gulch, Col. Dimension of workings—line shaft, 180 feet, the wheel, sixteen feet in diameter (1881). The works are undoubtedly the largest of the kind in Colorado.

Amie Consolidated Mining Company (The) is chartered under the laws of the State of New York. The offices are 57 Broadway, New York. The company owns three mines, the Amie, the Climax, and the Deer Lodge. Located at Leadville, Freyer Hill, Col. The ore is very rich, containing iron and more or less chloride of silver, an assay in 1881 giving $78 per ton. Property owned by the company is $50,000 worth of machinery, all first-class (year 1881). Depth of shaft, 180 feet. East of the Amie mine is the Deer Lodge, showing a few little stopes from which the lessees have just taken March, 1881, $18,000 within the past few weeks. The ore has been followed west and south until the Amie and Climax were reached, and the lessees are now engaging in working toward the north with almost encouraging prospects. The interesting facts of the mines are, that the ore from the Deer Lodge, or Amie shaft, No. 5, is still holding out remarkably well, and the general prospect is that it will continue mineral, increasing in size. The drift running east sixty feet from No. 5, north shaft, shows a vein of very high grade ore six inches to two feet in thickness. This vein averages 400 ounces of silver to the ton. Outside of this is a large body of iron, impregnated with mineral, that yields $30 to $40 a ton net; eighty men employed, and ships some sixty tons of carbonates daily. Product will soon exceed 200.

Amie and Climax Mines. Rich pockets have been found in both, which have been succeeded by vein streaks; its output reached fifty tons of ore per day, and a very good grade. Climax has been very erratic in its performance, sometimes outputting considerable quantities of fine ore, and then again running into almost barren iron. This company was organized June 30, 1879; capitalization, $5,000,000; shares, 50,000; par value, $10; non-assessable. Total amount of dividends, July 15, 1881, $305,000; latest dividend May 17, 1880; amount, $10. Current value of mine, $115,000. Stock quoted, twenty-eight cents per share, March, 1882.

Andes Silver Mining Company. Officer, Butler Berris, Sec. 309 Montgomery Street, San Francisco, Cal., is the location of principal office. The mines are located in Virginia district, Comstock Lode, Nev. Capitalization, $10,000,000; 100,000 shares; par value, $100; assessable. Number of assessments levied, nineteen; date of latest assessment, June 14, 1882; amount per share, twenty-five cents; linear feet in mine, 2,000; cash on hand February 1, 1882, $2,991.37; April 1, 1882, $11,640. Eighteen assessments. Mining Record, June 17. Stock and bonds reserved in the treasury April 1, 1881, $11,640.

Anglo-American Mining Company (The), of Chicago, has property in Chaffee county, Col. The company owns the following mines or claims, viz.: Ocean Wave, Dolly Varden, and Eight Wonder, all of which are opened by shafts from twenty to forty feet deep, showing good veins of mineral.

Argent Mining Company (The) are the owners of the Iron Hill, Leadville Consolidated, La Plata, Silver Cord, Iron Group, Gilt Edge Strike mines. Located at Yankee Hill, Col., covering an area of thirty-five acres. Ore assays fifty-one ounces of silver to the ton. The iron mines are shipping fine carbonate ores. La Plata mine shows large stopes of lead ore, and has yielded sixty tons of ore per day. Capitalization, $5,000,000; par value per share, $10.

Argent Mining Company is chartered under the laws of the State of Colorado. The officers are A. G. B. Hinkle, Pres.; M. T. Vandever, Vice-Pres.; Chas. H. Graham, Treas.; B. Huckle, Sec. Directors, A. G. B. Hinkle, M. T. Vandever, Chas. H. Graham, J. B. Wilson, J. T. Hampton, Henry Leipman, Jas. Fuller, Wm. Carp. and Chas. Kleinirt. Office, 360 Stock Exchange Place, rooms 27 and 28. The Vining, Chieftain, Baltimore, and Frank C. Shipman mines, located at Leadville, Colorado, are owned by this company. Capitalization, $400,000; value per share, $10; non-assessable. Bonded indebtedness January 1, 1882, $21,000.

Argentine Mining and Smelting Company (The) is chartered under the laws of Colorado. Officers are M. J. Dunne, Pres.; J. A. Roach, Treas.; J. A. Roche, Sec. Head office, room 1, No. 78 Dearborn Street, Chicago. Name of mine owned is Garfield. Location, Sheep Mountain, Summit county, Col. The Garfield is surrounded on all sides by paying mines in close proximity thereto. All the veins on the eastern slope of Sheep Mountain are Blanket contact veins, and the probability of the Garfield becoming a large paying vein is very strong. A few shares of the Working-Fund Stock remain to be sold, and are preferred. The length of shaft is 115 feet. Capitalization, 30,000 shares; par value, $10, full paid; non-assessable.

Arizona Southern Mining and Milling Company (The) is chartered under the laws of the State of New Jersey. Officers are Samuel White, Jr., Pres.; Wm. H. Dresher, Vice-Pres.; Geo. B. Dresher, Treas.; Edw. B. Williams, Sec. Solicitor, E. A. Armstrong. Head office, 106 Market Street, Camden, N. J. Branch office, 407 Locust Street, Philadelphia, Pa. H. S. Searle, Supt. Names of mines owned are Silver Wing, Herman, Searle, Pilot, Arizona Southern. All full claims. Located at Oro Blanco mining district, of Pima county, Arizona. The amount of property consists of ninety-six acres. Character of ore, Silver Wing, sulphuret of silver, carrying silver glance, or argentite, stephanite, black sulphuret, chloride of silver, and gray carbon. Herman, gray and yellow carbonates. Searle, antimonial sulphurets of lead and gray. Assays per ton, $93.46. Average samples, $186.91. Character of mines are lenticular masses of quartz. The veins are strong, large, well-defined lodes, formed by ore. Waters entering from below give every indication of permanence of depth. Pilot, yellow carbonates, sulphuret of silver, containing antimonial sulphuret of lead and gray copper and carbonate of copper, with a gangue of quartz. A mill site is owned by the company. Date of commencing developments, June 8, 1881. Cost of mining, $400 per ton; milling, $23.00 per ton. There is a development of shaft of over fifty-five feet on Silver Wing claim. Company organized March, 1881. Capitalization, $300,000; par value, $5; non-assessable. Amount of shares issued, 240,000; reserved in treasury, 60,000 shares; capital stock now reduced to one dollar, par value. Amount of stocks and bonds reserved in the treasury January 1, 1882, $300,000. Stock indebtedness, $1,200,000. Wages paid for labor, 1882, from $1 to $4 per day.

Armstrong Gulch Consolidated Silver Mining Company's works are located in Colorado. Company have a capitalization of $1,250,000, in shares of $25 each.

***Atlantic and Pacific Tunnel Company (The).** Mr. Brick Pomeroy, of Denver, Pres. and Treas. The company's property is located at Clear Creek, Clear Creek county, Col., and contains numerous rich veins of minerals, the product of which is expected to pay cost of driving the tunnel 4,000 feet. The tunnel is being driven from the base of Kelso Mountain on Quail Creek to a point near Decatur, on the western slope, a distance of four miles. Operations are progressing at both ends. They will open a very large number of fine lodes at great depth, and measurably solve the yet unsolved problem of the downward tendency of these silver fissures. Commenced development of property during the year of 1880. Capitalization, $7,000,000; par value per share, $10; stock reserved in the treasury, October, 1881, 300,000 shares, at $2.50 per share; bonds reserved in the treasury, October, 1881, $300,000.

Atlanta Mining Company is chartered under the laws of the State of California. The officers are John Oppenheim, Pres.; A. F. McGrue, Vice-Pres.; F. M. Blackstone, Sec.; O. W. Thompson, Treas. Transfer office, 140 South Fourth Street, room 6, Philadelphia. The company owns the Noon lode, which is located at West Tintic, Juab county, Utah. The ore found resembles that of the celebrated Ontario mine in Utah. Character of the mine is described as showing a true fissure vein. Company own one mill-site and water-power. Capitalization, $10,000,000; par value per share, $100; assessable; stock reserved in the treasury, 20,000; stock listed on the Mining Exchange of California and Philadelphia.

A. Y. Mine (The), located at Iron Hill, Leadville, Col., is the property of Graham & Co., and is one of the recent accessories to the list of the producing mines of Leadville. The character of the ore is lead carbonate, grade in silver low. The mine is now yielding from fifty to seventy tons of ore per day. The average value is low, and nets from $3 to $30 per ton. The company own four oil Greek pumps. The mine shows good surface improvements and extensive underground developments, disclosing considerable quantities of ore. Mine well timbered.

Bay Horse Mining and Smelting Company. Location, Lemhi county, Idaho. This company have now in operation smelting works which are manipulating the ores of fifteen mines in neighboring districts, thus affording an important facility to mining speculations in that locality.

Belding Mining Company (The) own property in Esmeralda county, Nev. Stock and bonds reserved in the treasury, April, 1882, $523; cash on hand, April 1, 1882, $523.

Bald Mountain Mining Company (The) is chartered under the laws of the State of New York. The offices of the company are at 21 Nassau Street, New York. The company owns the Gold Cup group of mines, located in the Tin Cup district, Gunnison county, Col. Owing to some misunderstanding among the stockholders, these mines have been idle for a while, but are expected to be opened again shortly. They are said to contain a fine body of high-grade ore, characteristic of the district, which has a porphyritic and calcareous formation, and the veins carrying sulphides of silver, lead, and copper carbonates. The mineral of these mines is said to run from 240 to 1,800 ounces per ton (silver). They have been large producers in the past, and there is little doubt that with judicious management they will again be made to pay handsome dividends. Capitalization, $10,000,000, in 100,000 shares of $10 each.

Banker Lode (The), on Breece Hill, Col. has been working incessantly for the past year. The lower workings show a vein of quartz opened to a width of four and a half feet, without disclosing the foot-wall (81). The ore gives a silver assay of forty-seven ounces per ton. The company have a five-horse-power engine, ten-inch pump, and baby hoister; shaft, 208 feet in depth.

Barbee & Walker Silver Mining Company is chartered under the laws of the State of New York. Office, 59 Drexel Buildings, New York. This company own the Barbee & Walker mines, located at Silver Reef, Utah. The mine is situated on the margin of the camp, and has the advantage of receiving its ores directly from the hoisting works. The ore is argentiferous and very fine, assaying $32 per ton. The average width of vein is eight feet. A body of ore lately opened up in the north and south drifts gives promise of a most satisfactory product. The face is in a strong four-foot ledge of $50 ore. The company own a five-stamp mill, two pans, and one settler, hoisting machinery, and other buildings. The lode on which the company depends for its supply of ore is 2,817 feet. The main incline has attained a depth of 303 feet, and at the bottom the ledge continues intact. Contracts have just been let to develop both the front and back ledges on the fifth levels north and south. The lower workings show to good advantage, and the prospects are very favorable. The monthly output of bullion has averaged $100,000, and is increasing. The drift from the bottom of the 100-foot winze has been advanced 110 feet in excellent ground, and now shows a four-foot facing of ore that samples from $100 to $700. Date of organization, 1879; capitalization, $1,000,000; par value per share, $10; basis, non-assessable; yield during fiscal year 1881, $170,154; calendar year, $205,524; total amount of dividends paid to November, 1880, $60,000; (six yearly dividends of $10,000 each, equal to twenty-four per cent. per annum on capital); date of latest dividend, November, 1880; amount per share, ten cents; stock quoted July 1, 1882, ten cents per share; stock and bonds held principally in New York.

Ben Franklin Silver Mining Company The officers are Robert Crane, Pres; Wm. Curtiss, Vice-Pres.; Dr. Henry Carpenter, Treas.; F. X. Kelley, Sec. Directors, Robert Crane, F. X. Kelly, Jr., Wm. Curtiss, Henry Carpenter, C. S. Kauffman, J. F. Frueauff, J. W. Anthony, J. H. Stelle, A. W. Stone. Main office, Leadville, Col. Branch office, 319 Walnut Street, Philadelphia, Pa. The property is located in Custer county, Col. One month's working shows a production of $2,500. Date of organization, November, 1881; capitalization, $500,000; par value per share, $25. There will be an assessment of five cents levied quarterly until fifty cents have been levied on each share.

Battle Mountain Silver Mining Company is chartered under the laws of the State of Colorado. The officers are D. J. Chapman, Pres.; J. H. Hunter, Vice-Pres.; P. J. L. Carberry, Treas.; Chas. N. G. Felten, Sec. Office, 218½ Walnut Street, room 23, Philadelphia, Pa. The company's mines are the Grief and Evening Star.

Bay State Silver Mining Company's works are located in Nevada. J. W. Pew, Sec. Office, 310 Pine Street, San Francisco.

Bay View Silver and Copper Mining Company. The officers are W. T. Rearson, Pres.; R. W. Kimball, Sec. and Treas. Directors, E. C. Hincks, W. T. Rearson, J. W. Milliken, R. W. Kimball. Date of organization, at Bangor, February 7, 1881; 370,302 shares of stock reserved in the treasury.

Belcher Silver Mining Company (The). Officer, John Crockett, Sec. Principal office, 203 Bush Street, San Francisco. Location of mines, Nevada, Washoe district. South drift ore vein, 115 feet; excellent vein material; 3,000 feet level; the south drift, east crescent, on this level, was pushed eighty feet into a fine vein formation carrying bunches of good quartz.

Bellevue Mining Company (The). Officers are O. B. Johnston, Pres.; O. M. Copeland, Treas.; D. C. Butterfield, Sec. John Horton, Supt Names of mines owned, Dead Shot, Noonday, Chicago, and Eadle. Location of mines, Mineral Hill district, Wood River, Idaho. Character of ore, dry carbonate; assays as high as 600 ounces in silver, and running heavy in lead. Three tunnels and shaft used. Character of mines: ledge, five feet wide; pay streak, two feet wide at top of tunnel, and two and a half feet on the floor; mineral is easily worked, one shot loosening tons, which can be taken out with the pick and shovel; walls solid, requiring little timbering. The claim known as the Dead Shot, was discovered in 1880, by S. A. James, now foreman of the company. The Noonday is thought to be the richest mine on the river, according to Mr. Horton's statement, March 25, 1882. Capitalization, $1,000,000; shares, 200,000; par value, $5.

Belmont Consolidated Mining Company (The). Officers, B. W. Lewis, Pres.; J. W. Harrison, Sec. Local Representative, J. M. McDougal, Attorney for the company. Names of mines owned, Black King Mountain and Lyon's Lode, located in Gunnison county, Col. There is a vein on Lyon's Lode some fourteen feet in width. This and the other two veins are cut by Belmont Consolidated Mining Company's tunnel. The properties are being worked energetically, with prospect of certain yield. Date of latest assessment, May 20, 1882, ten cents. Yield during 1880, $26,419.

Belmont (Monitor) Mining Company. J. W. Pew is Secretary. Office, 310 Pine Street, San Francisco, California. This company's property is located at Philadelphia, Nye county, Nev. There are 3,500 linear feet in mine. Capitalization, $5,000,000; par value per share, $100; number of assessments levied, thirty-two; total amount of thirty-one, $707,500; date of latest assessment, May 20, 1882, ten cents per share.

Betty O'Neal Mining Company (The). D. P. Pierce is Superintendent. The Betty O'Neal property is about half a mile from Lewis, Lander county, Nev. The main working-shaft is down about 160 feet, from which the lower level has been run on good ore some 200 feet. A body of ruby and wire silver has been struck, portions of it assaying as high as $1,000 per ton. A new pump has been put in which has a capacity for raising water from 450 feet. Yield during 1880, $31,474; bonded indebtedness, March, $6,329.54; floating indebtedness, April 1, 1882, $9,953; company in debt, April 1, 1882, $9,953.

Big Half-Moon Mining Company's works are located near Leadville, Colorado. The ore assays from five to fourteen ounces in silver and half an ounce in gold. The veins in the Big Half-Moon vary from one to twenty feet in width.

Big Chief Mine (The), Neils, Larsen, McComte & Co., owners. Name of mine owned, Big Chief; located in Carbonate Hill, Colorado. This mine is located just above the Morning and Evening Stars, and has proved one of the most valuable developments made about Leadville in the past year. Much of the owners' attention has been devoted to the erection of buildings and machinery, also to preliminary developments; and although an inroad on the ore has only just commenced, a considerable quantity has been shipped. Amount of property, ten acres. Quality and character of ore, very fair—lead carbonate. Character of mine, drifts twenty to twenty-five feet in width; depth of shaft, 500 feet. The indications, 1880, as far as the developments in the Big Chief mine admit of judging from appearances, are certainly very favorable. Passing along to the north-east portion of the workings, a rather chaotic mass of carbonates, sand, iron, and porphyry was disclosed to view. Weekly output, seventy-eight tons.

Big Pittsburg Mining Company (The). Mines located in Lake county, Col. Capitalization, 200,000 shares; par value, $100.

Black Jack Mining Company (The). Mines located in California. Capitalization; 100,000 shares; par value, $2.50.

Black Metal Mine (The). owned by Mr. Blake and others. Name of mine, Linda; mines located at Tucson, Ariz. Character of ore, silver and copper; assays 400 in silver, and 312. At the bottom of the shaft, at the depth of twenty-two feet of metal, has widened to eighteen-inch assay from the top. Linda mine has two pieces of ore; one assayed $300, the other $500.

Bear Creek Mining Company is chartered under the laws of the State of New York. The officers are Hon. Abram Wakeman, Pres.; Hon. John Cummins, Vice-Pres.; R. D. Wood, Sec.; Chas. S. Bunn, Treas. Office, 145 Broadway, room 11, New York. The company's works are located in San Juan district, Col. They have a capitalization of $300,000.

Brockman and Black Rock Mines, (The) owned by C. Leavitt, T. Pendergast, and other residents of San Francisco. The Brockman mine is located near Greenwood, El Dorado, Cal. The company owns a five-stamp mill.

Black Rock Mining Company (The) has property located in Yuma county, Ariz. The company owns two mines, which adjoin each

* Practically, a Temperance organization.

other, the Black Rock and Pacific, the purchase-price of which was $175,000. By a cross-cut through the ledge, the ore of the latter was proved similar in quality to the Black Rock, which is a rich, black galena. It is claimed, on behalf of the Black Rock, that it has developed a richer and larger body of ore than was ever shown by any of the best Nevada mines. Work is carried on in shifts by night and day. The erection of steam-hoisting works and additional reduction works is contemplated. A new wagon-road is being constructed for the conveyance of the ore to the mill on the river. In a cross-cut of the Pacific, at a depth of thirty-three feet, a four-foot vein, containing four inches of ore, assaying $300 per ton, was encountered.

Boar Mining Company. The officers are J. A. Greenlaw, Pres.; H. R. Calkins, Vice-Pres.; and H. F. Smith, Sec. H. M. Danielson, Superintendent. The Mountain Star, Charles 12th, Centennial, Little Stella, and Louisiana mines, owned by this company, are located at Looland Hill, near Leadville, Col. The character of the ore found is very rich sulphuret, mill-run showing from 200 to 250 ounces to the ton. A vertical vein of galena has been opened up that mills forty-five per cent. in lead. A shipment of ore to the Alta Smelting Company gave a return of $274 to the ton. Length of adits in the Charles 12th mine, 125 feet.

Bob Ingersoll Mining Company owns the Bob Ingersoll mine, located in Arizona. The claim lies near to and west of the Survey and Tribute claims. During the year, some $15,000 worth of bullion was produced by the Boston mill from ores of this mine; this constituting its entire production to the present time. The dump, however, contains over 3,000 tons of ore, that are expected to average about $80 to the ton. The shaft is down 250 feet, and is opened by the necessary levels, drifts, etc. The hoisting apparatus consists of a whim, which at present depth answers every purpose. After the construction of the mill proposed by the company, the hoisting facilities will be proportionately increased. The ore shows gray and yellow carbonates and green chlorides, with some bunches of rich galena. The reports of this mine are of a very satisfactory nature. A good body of very high-grade ore is reported to have been disclosed. There are 2,200 to 2,300 tons of ore on the dump. The richest ore extracted from the Ingersoll was discovered accidentally, in an ore-body on the eighty-foot level, by the side of an old stope. About ten tons of ore are hoisted daily.

Bonanza Company's Mine (The), the Delmonico, is located at Jack Mountain, Ten Mile district, Col. The ore found may be termed both sulphuret and carbonate. Mill run of 700 pounds assayed 136 ounces in silver per ton. Tunnel, 160 feet deep.

Bonanza King Consolidated Mining Company's works, of which Mr. Gillette is manager, are located in California. The character of the ore is high grade. The average, which seems almost incredible, for the month of June being about $400 per ton for all the ore extracted. The company own a ten-stamp mill.

Bonanza Queen Silver Mining Company's (The) works are located in Chaffee and Pitkin counties, Col. Capitalization, $50,000; par value per share, $100.

Boston, Burning Moscow, Hickory, Cortez, and Esmeralda Mines (The), owned by Messrs. W. L. Searles and C. C. Woodhouse, of Beaver, Pa. These mines are located in Star district, Utah. Ore body at a great depth. Burning Moscow presents an immense body of low-grade ore. The Boston, owned by W. L. Searles (1880), has been surveyed and patent granted. The Rebel mine, perpendicular shaft, 200 feet down, and a drift produced $120,000 in ore (recently reported). Hickory is one of the first patented mines in Star district, once sold for $80,000. Mill used. The Cortez and Esmeralda mines, owned by C. C. Woodhouse, have been patented, and are true fissure veins. The Chief of the Hill has been sold. Mammoth mine also in the district; tunnel used; worked by Matthew Cullen.

Boston and Sheep Mountain Mining Company. The officers are Edward H. Goff, Pres; Silas Gurney, Vice-Pres.; H. E. Irvine, Sec. and Treas.; Superintendent, Thomas Gowenloch. Office, 131 Devonshire Street, Boston, Mass. This company owns eight full claims immediately adjoining the famous Robinson Consolidated mines of Leadville, Col., a large portion being located on the same ore chute. The development work of this property is being pushed with all possible rapidity, with the expectation of soon striking the extensions of the rich ore bodies now being worked in the Smuggler and the Checkmate claims of the Robinson Consolidated. Capitalization, $2,000,000; non-assessable.

Bowman Silver Mining Company's (The) works are located in Nevada. The company was organized March 1, 1881, having a capitalization of $100,000. Property not yet developed.

Bradshaw Silver Mining Company (The) has properties located in Arizona, in the Tombstone district (western portion), near the San Pedro. It is opened by a shaft to the depth of about 400 feet. The vein is from two to six feet in width. The ore is rich chloride, and carries horn silver assaying from $80 to $100 per ton. The mine is fitted with improved hoisting machinery and all necessary appliances. A ten-stamp mill has been erected. The mine has produced about $50,000 worth of bullion since first opened. Capitalization, $2,250,000, in 225,000 shares of $10 each.

Bristol Silver Mining Company. The officers are Geo. H. Keith, Pres.; F. A. Lewis, Vice-Pres.; T. E. Hughes, Sec.; Mark W. Lewis, Treas.; General Manager, H. M. Goodhue. The company owns the Mayflower mine, located in Nevada. Ore in bottom of winze turning from milling into heavy gray carbonate, averaging three per cent. in lead, and running all the way from $65 to $2,400 in silver. Capitalization, $175,134; value per share, $25; non-assessable; total amount of dividends paid to July, 1882, $28, 824; date of latest dividend, July, 1882, at the rate of $2 per share.

Brittle Silver Mining Company. The officers are H. O'Neil, Pres.; Archilles Falco; General Manager; W. A. Hall, Sec. Office, 8 Broad Street, New York. This company owns eight mines, viz., Iowa, Isabel, Brittle Silver, Good Hope, Maringo, Alvaredo, Ontario, and Atlantic, located at the head of Quartz creek, Gunnison county, Col. Amount of property in land, thirty-eight acres. The mines show true fissure in porphyry. The Brittle Silver mine has a vein of eighteen inches of sulphide of silver, running from $150 to $1,200. Prospects of the property are good. Rich showings of minerals are to be seen in all the workings. The company is assured of dividends by August, 1882. A force of sixteen men is working on the property. Capitalization, $500,000; par value per share, $1.25.

Buckeye Mining Company (The). Officers are J. K. Holman, Pres.; Wm. A. Stephens, Vice-Pres.; W. Bayard Cutting, James Heron, Henry Wadsworth. The mines are located at Devil's Gate, Lyon county, Nev. 3,000 linear feet in mine. Capitalization, $4,800,000: shares, 48,000; par value, $1.00; number of assessments levied, nineteen; total amount of same, $332,000; date of latest assessment, November 25, 1878.

Bull Domingo Consolidated Mining Company (The) is chartered under the laws of the State of New York. The officers are W. H. Barnum, Pres.; D. S. Draper, Vice-Pres., and N. B. Stevens, Sec. and Treas. The head and transfer offices are at 115 Broadway, New York. Branch office at mines, Silver Cliff, Col. The books are always open. Date of annual election, 3d Monday in November. The company owns the following mines: the Domingo, Johnnie Bull, Little Dorritt, Little Dorritt No. 2, and Thomas Paine, located in the Hardscrabble district, about three miles from Silver Cliff, in Custer county, Col., covering an area of about fifty acres. The ore is a galena, thirty per cent. lead, and fifteen ounces silver to the ton. The character of the mines are described as true fissure, wide, filled with conglomerate of boulders. The ore adheres to the boulders, or rather is in the space between the boulders, and is mainly confined to the hanging wall running from it into the fissure about thirty feet, and in it about sixty feet. The property consists of hoisting works, concentrating mill, saw-mill, blacksmith and machine shop, ore house, office, and several dwellings. A depth (sinking) of 350 feet has been reached; length of adits, 120 to 225 feet. There are two shafts or tunnels. The vein varies considerably in width at different points. The three levels and a number of drifts aggregate 1,000 linear feet or more. Developments were commenced 1st of January, 1880, since which about $415,000 has been expended. Although the ore body is lost for the present, the prospect of finding it again is favorable. The cost per ton for mining and milling is $6. Organized November 17, 1879; capitalization, $10,000,000; shares, $50; non-assessable. Yield, net, to April, 1882, $275.000; Yield, net, during 1881, $275,000; no dividends have been paid. Bonded indebtedness, $300,000: stock indebtedness, $10,000,000; floating indebtedness, $20,000; stock in treasury, $135,000, April 1, 1882.

Bulwer Consolidated Mining Company (The). The Ralston and Stonewall mines are owned by the company. Located in Mono county, Cal. Vein, 125 feet. Ledge, Ralston vein, two feet wide. One Stonewall ledge, two feet; one Ralston ledge, four feet. Entrance is by tunnel, 119 feet in length. The chief source of revenue of this company is from its fine mill. Capitalization, $10 000,000; par value per share, $100. Yield during 1880, $101,736. Total amount of dividends paid to June 12, 1882, $70,000: date of latest dividend, June 12, 1882, ten cents per share. Total amount of assessments levied to December, 1880, $352,000; date of latest assessment, December, 1880, $1 per share. Bonds reserved in the treasury April, 1882, $82,247; stock quoted July 1, 1882, $2 per share. Current value of the mine, $195,000. On the 1st of December, 1881, a cash balance of $100,000 was reported.

Colorado Consolidated Mining Company. Incorporators, W. R. Hunt, C. C. Hughes, and John Jennings. The company's works are located in Georgetown district, Clear Creek county, Col. Capitalization, $1,625,000; par value per share, $25; basis, non-assessable. Total amount of dividends paid to July, 1875, $251,875: date of latest dividend, July, 1875.

Climax Mining Company's (The) works are located at Leadville, Col. Current value of mine, $44,000. Capitalization, $2,000,000; par value per share, $10: total amount of dividends, $180,000; date of latest dividend, August 20, 1880, thirty cents per share; date of latest assessment, December 12, 1877.

Chicago Consolidated Silver Mining Company (The). Directors, F. H. Wells, E. C. Freeland, Wm. Irelan, John Nutall, P. B. Bowles. Mines located in South Fork, district Shasta, Cal. At Igo, the company completed its mill and reduction works. The machinery was put into successful operation and ore worked ever since, yielding from $30 to $500 per ton. About 200 tons of ore were taken out last summer and fall, which will be sufficient to keep the mill and reduction works running for several weeks, and until the company takes out more ore. The shaft is down twenty feet, and a tunnel run in about 400 feet, which taps the ore body near the bottom of the shaft. The ore now being worked yields about eighty-five per cent. of silver, and continues to be of a superior quality.

Caledonia Silver Mining Company. R. Wagner, Sec. Office, 414 California Street, San Francisco, Cal. The company's works are located in Gold Hill district, Nev. There are 2,188 linear feet in mine. Capitalization, $10,000,000; par value per share, $100; number of assessments levied, 38; total amount of same, $2,710,000; date of latest assessment, December 6, 1881.

Catalpa Mining Company. H. W. Wesson, Treas. Office, 66 Broad Street, New York. This company owns the Crescent and Catalpa mines, located in Lake county, Col. The ore is very fine. The Crescent will be connected with the workings of the Catalpa mines by a series of cross-cuts from the main incline, and all the hoisting will be done through shafts. To the northwest, where the bulk of the company's property extends, a level is running through this portion of the mine, from which great results are confidently expected. The mine is keeping up its shipments, shipping from twelve to fifteen tons of ore per day, and is reported as in fine condition and outlook encouraging, there being considerable territory yet to be explored. A tour through the underground workings of the mine is said to reveal considerable fine sand-carbonates, especially in west or lower shaft. A fine body of iron was brought to light running well in silver, some carrying as much as 100 ounces. The vein has an average width of from four to six feet, and the ore is said to have a value of $100 per ton. Date of organization, February, 1880; capitalization, $3,000,000; par value per share, $10; basis, non-assessable. Number of dividends paid to June 15, 1881, 3; total amount of dividends paid, $180,000; date of latest dividend, June 15, 1881, twenty cents per share; stock quoted July 1, 1882, fifty cents. Stock held chiefly in Boston, Mass. About seventy men are being worked. From 250 to 300 tons per week are being shipped. In 1881 the production was 3,856 tons, and 1,888 lbs. of ore averaging $56.44 per ton over smelting expenses, or $217,823.92. The running expenses were $83,531.69. From the net amount, $120,000 has been paid on dividends. After payment of every expense, the company had January 1, 1882, cash on hand, $55,161.45.

Caribou Mining Company is chartered under the laws of the State of New York. Office, 18 Wall Street, New York. The company's property is located in Boulder county, Col. The ore gives a silver assay of $75 per ton. The vein is from two to eight feet wide. Property owned (building, machinery, etc.), all first class; value over $150,000. The length of the main lode is 1,400 feet. Date of organization, April 23, 1879; capitalization, $1,000,000; par value per share, $10; basis, non-assessable. Number of dividends paid to February 20, 1880, 6; total amount of dividends paid to February 20, 1880, $60,000; date of latest dividend, March 20, 1880, at the rate of ten cents per share. Stock quoted July 1882, $2.50.

Carbonate Hill Mining Company (The) is chartered under the laws of the State of New York. Mr. Geo. Summers is the Manager. Office, 115 Broadway, New York. This company are the owners of the Brookland, Catalpa, Crescent, Wolf Tone, Modoc, and the Glass Pendery mines, all of which are located in Colorado. Amount of property, ten acres. The ore gives a silver assay of from ninety to 150 ounces per ton. Weekly output of ore about seven tons, and monthly expense account is estimated at $1,000; six men have been employed. Date of incorporation, 1879; capitalization, $4,000,000; par value per share, $10.

Cascade Mining Company. Jacob Hoopes, Pres., and Thomas M. Skinner, Superintendent. Office, Crested Butte, Col. The company's mines, viz., the Beaconsfield, Big Elephant, and Big Strike, all adjoining each other, are located in Gunnison county, Col. The character of the ore may be described as bromide of silver; mill tests giving seventy to 150 ounces of silver and sixty per cent. lead. The Beaconsfield vein is six feet wide; that of the Big Elephant, twenty feet, and the Big Strike mine shows a nine-foot vein. Prospects are good. Recent work exposed a large body of bromide of silver. Capitalization, $500,000; par value per share, $25.

Castine Copper and Silver Mining Company (The). Head office, Castine, Me. Mines located in Bagadirce mining district, New England. Stock and bonds held in Castine.

Castle Dome Silver and Mining Company (The). Trustees, John M. Wells, Henry K. Southwick, John W. King, Wm. Bond, James E. Hayes, Geo. A. Miner, Andrew H. Carghill. The company owns the following mines, which are the most profitable in the district: the Railroad, Flora Temple, William Penn, Pocahontas, and Caledonia, all located in Yuma county, Ariz. The William Penn has a strong vein of good ore. It is opened by two shafts, each of which is over 200 feet in depth; these shafts being connected by a tunnel 400 feet in length. The Flora Temple is well opened, and has a main shaft of 300 feet in depth; its ledge shows a four-foot vein of good ore, which yields an average of thirty ounces of silver and seventy-eight per cent. of lead per ton. The Pocahontas and Railroad are connected by a drift of 200 feet, and their shafts are about 250 feet each in depth. The total production of these mines is given as $2,000,000. Capitalization, $1,000,000.

Catskill Silver Mining Company (The) have properties in Nevada. Share capital, $1,500,000; shares, 300,000; shares, $5 each.

Centennial Mining and Milling Company (The) is chartered under the laws of the State of Connecticut. The officers are Wm. A. Simmons, Pres.; M. S. Pollard, Vice-Pres.; Nelson C. Parker, Sec.; Jas. M. Shute, Jr., Treas. Office, 31 Milk Street, Boston, Mass. The company's works are located in Tombstone district, Arizona. They have a capitalization of $5,000,000 in 200.000 shares, at a par value of $25 each.

Centennial Silver Mining Company is chartered under the laws of the State of New York. Office, 115 Broadway, New York. The company's works are located in Pinal county, Arizona. The ore gives a silver assay, with some gold and copper; value per ton, $125. Date of incorporation, July, 1880; capitalization, $2,500,000; par value per share, $10; basis, non-assessable.

Champion Mining and Milling Company (The) have property located near Pitkin, in Gunnison county, Col. Capitalization, $5,000.000; shares, 50,000, each $100.

Cherryfield Silver Mining Company (The). Officers, Sam. M. Campbell, Pres.; W. Freeman, Sec., Treas., and Man. Directors, J. A. Milliken, S. M. Campbell, Wm. Freeman of Cherryfield, Thos. Dolby, F. H. Williams of Boston Head. Office, Cherryfield, Maine. W. A. Leonard, Supt. Names of mines owned, Cherryfield, located at Cherryfield, Maine. Property owned, concentrating mill. Dimensions of workings; tunnel, 175 feet; length of levels, 200 feet. Principal market for the ore, Newark, N. J. Capitalization, $500,000, divided in 100,000 shares; par value, $5; non-assessable. Stock quoted Jan. 1, 1882, $1.

Chihuahua Silver Mining Company (The). Officer, W. H. Snyder, Sec., Indiana. Principal office, Logansport, Indiana. The mines are located in Chihuahua, Mexico. Par value shares, $100.

Christy Mining Company (The). Name of mines owned; Maggie, Uncle Sam, Silver Point, Silver Crown, Hillside, Great Western, and Northern Light. Location, Silver Reef, Utah. Length in feet of the main lode on which the company depends for its supply of ore, 10,000 feet; 10,000 feet in mine. Capitalization, $6,000,000; shares, 60,000; par value, $100; non-assessable. Yield during 1880, $272,100; number of dividends paid January, 1882, ten; number of dividends paid Dec. 9, 1881, nine; total amount, $54,000; up to Jan. 12, $6,000; amount. $60,000; date of latest dividend, Jan. 7, 1882; amount per share, ten cents.

Chrysolite Silver Mining Company is chartered under the laws of the State of New York. Mr. R. Neilson Clark is the present Superintendent, and Mr. Robinson, Engineer. Secretary, Henry C. Cooper. Offices, 18 Wall Street, and 115 Broadway, New York. The company's mines, viz., the Old Vultnre, Vulture, Kit Carson, Fairview, Colorado, Chief, Muldoon, Chrysolite, and Chrysopolis, are located at Fryer Hill, Lake county, Col. The company have a property of sixty-six acres. The iron ore is showing noticeable improvement in gravel. Ore assays per ton, 64.88 per cent. Company owns fine and complete saw-mill, ore-house, shafting, etc; value, $150,978.39. Developments disclose a large number of fine ore faces. A handful of the sand is nearly as heavy as so much bird-shot. The cost of mining and milling per ton is estimated at $64. The Chrysolite mine, since its first discovery in the fall of 1878 to the present time, has produced 50,270 tons of ore. Of this amount, 12,806 tons were produced before the Chrysolite company obtained a control, covering a period of one year ending October 9, 1879. Nearly two miles of shafts and cross-cuts have been made underground. Ore in some places, thirty to forty feet in thickness. The telegrams from the Superintendent have been, April 3, 1882, shipped fifty-two tons, remitted $4,000; April 4, shipped fifty tons: April 5, fifty tons, remitted $5,000; April 7, shipped last two days, seventy-seven tons, remitted $8,500; April 9, twenty-one tons shipped; April 10, twenty-six tons; April 11, shipped forty-five tons; average output being about forty-seven tons per day. The receipts of the mine per month a little over $50,000. The Chrysolite mine contained some time since over 31,000 linear feet of drifts and levels, or about six miles. The two levels of the mines are fifty feet apart, one at the depth of 100 feet, and the other, 150 feet. Altogether, in the mine, there are 52,000 to 53,000 feet of drifts. Current value of mine is $700,000. There are 534 men employed at the mine. Date of organization, December, 1879. Capitalization, $10,000,000; par value per share, $50. Number of dividends paid to December 10, 1881, eleven; total amount of dividends, $1,600,000. Date of latest dividend, December 10, 1881, fifty cents per share; date of latest assessment, December 12, 1877.

Climax Silver Mining Company is chartered under the laws of the State of New York. Office, 62 Broadway, New York. The company's mines are located at Leadville, Col., and cover an area of six and a quarter acres. The ore gives a silver assay; value per ton, $200. The current value of the mine is $56,000. Date of organization, September 22, 1879. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable. Number of dividends to date, five; total amount of same, $180,000. Date of latest dividend, August 20, 1880, thirty cents per share. Stock quoted June 10, 1882, twenty-nine cents.

Collateral Mine (The). Owned by Messrs. Bedell, Witherell, Smith, and others. Name of mine, Collateral. Located on Iron Hill, Col. The indication of the mine is most flattering. Shaft, 145 feet deep; drift, 112 feet. Best kind of ore; sixty ounces in silver, fifty per cent. in lead.

Colorado Central Consolidated Mining Company is chartered under the laws of the State of New York. The officers are Paul Lichtenstein, Pres.; Herm. R. Battzer, Vice-Pres.; Paul O. d'Esterhazy, Sec.; Alb. Krohn, Treas. Office, 29 Broad Street, New York. The company's works are located in Georgetown, Clear Creek county, Col. The character of the ore is silver; value per ton, $150. The company own two engines, pumps, and buildings, valued at $46,200. They have five tunnels, which range all the way from 200 feet to 1,500 feet in length. Date of organization, November, 1879. Capitalization, $3,000,000; par value per share, $10; basis, non-assessable.

Colorado and New Haven Mining Company (The). Mr. H. Remington, Manager, one of the stockholders. Name of mine owned, Bullion. Location of mine, situated on the north spur of Lincoln, beyond the Russia mine. December, 1881. The Bullion is a new mine, having been opened up during the last season. This mine is now listed as one of the steady producers of this district. It is shipping from ten to thirty tons per month of ore that mills 150 ounces.

Confidence Silver Mining Company (The). Location of mines, Gold Hill district, Nevada. 130 linear feet in mine. Capitalization, $2,496,000; shares, 24,960; par value, $100. Number of dividends paid to May 1, 1865, six; total amount, $78,000; date of latest dividend, May 1, 1865; number of assessments levied, twelve; total amount of same, $268,-800. Date of latest assessment, February 12, 1881.

Continental Divide Mining Company (The). Officers, Trustees, 1881, B. Mark Wheeler, Davis H. Waite, Arthur R. Waite. Head office, Aspen, Pitkin county, Col. Capitalization, $10,000,000; shares, 1,-000.000; par value. $10.

Connell Mining Company (The). A very rough country, covered with snow, and impassable for six months in the year. Throughout the region are found fissure veins of silver-bearing rock and beds of anthracite coal of good quality. Capitalization, $500,000. Date of organization, May 9, 1881.

Columbia Consolidated Mining, Milling, and Smelting Company (The). Directors, E. H. Mack, Jacob Fleischer, Simon Doran, Wm. Franklin, and Jacob A. Fischer. Offices at Denver, Col. The property of the company is located in Summit county, Colorado. The capital stock is $5,000.000; number of shares, 500,000; shares each, $10.

Consolidated Rico Mining and Milling Company (The) owns the Cleveland and Dolores lodes on Expectation Mountain, and the Elgin Boy and Lady Elgin on Horn Gulch, all of which have been worked during the past year with satisfactory result.

Contention Consolidated Mining Company (The). Vice-President, W. Hart Smith. This company owns the Contention (formerly the Western), the Flora Morrison, and the south-east half of the Sulphuret. The consolidation of these properties was effected during the past summer. The Contention, the most important of these mines, has long been known as one of the principal mines of the district. It was opened by several shafts, the deepest being 700 feet, and by levels, drifts, winzes, cross-cuts, etc., aggregating many thousands of feet. Ore is being extracted from various parts of the mine, and gives various assays ranging from $100 to $200 per ton. Total production for year 1881, $1,500,000, as per statement in *Tombstone Epitaph*. The Flora Morrison is a valuable property. The working shaft is down more than 500 feet. The yield of this mine and the Sulphuret is included in the general yield of the company's property. Ore has been traced to water level, and galenites and pyrites begin to appear in quantity. The dike itself is now solid and dioritic, and is accompanied with ore of a high grade, giving promise of continuance downward with the dike. This company, known as the Western, up to December 10, 1881, paid $1,475,000. Capitalization, $12,500,-000; shares each, $50. In the year 1880 the mine yielded $1,214 055: gold, $224,448; silver, $989,607. Amount of dividends paid to July, 1882, $562,500; date of latest dividend, May 27, 1882. Amount per share, 25 cents. The Farmers' Loan and Trust Company are their agents in the city of New York for the transfer and registration of stock certificates at the office, No. 26 Exchange Place.

Continental Mine (The). George Clark, owner. This mine is located on Finkey creek, Arizona. Quality and character of ore, very fine silver; some very fine specimens have lately been discovered, 1880.

Contra Casta Silver Mining Company (The). Date of organization, October 24, 1881, at Portland, Me.; capitalization, $50,000.

Cora Silver Mining and Smelting Company (The) is chartered under the laws of the State of New York. The officers are W. Henderson, Pres.; H. H. Marks, Vice-Pres.; R. S. Yardley, Sec.; R. B. Leake, Treas. Trustees, W. Henderson, W. H. Marks, R. T. Yardley, R. B. Leake, and J. Leake. Supt. of mine, Nathaniel Primrose. The offices are at 63 Broadway, (room 14) New York. The properties of the company are located in Dakota. Capitalization, $1,000,000, in 200,000 shares of $5 each; a limited number of shares offered at fifty cents per share.

Corihuirachie Silver Mountain Company (The). Location of mines, at the foot of Silver Mountain, Mexico. Character of ore, silver. Ore yields about $60 to the ton of silver. Two mills turn out about $4,000 per week silver bullion. Property owned by the company, two mills and two smelters, one a fifteen-stamp mill, the other a twenty-stamp mill. Company employ about 420 men.

Crooke Mining and Smelting Company (The) has property located in Hinsdale county, Col. The company owns the chief smelting works in the district, which are situated three-quarters of a mile south of Lake City. The machinery is propelled by water-power derived from Granite Falls in the channel of Lake Fork. Production for 1881, 600 tons lead and 75,000 ounces of silver.

"**Crown Mining Company (The)** is chartered under the laws of the State of New Jersey. Officers, J. L. Sprogle, Pres.: Jos. L. Fryer, Sec. and Treas. Directors, J. L. Sprogle, Jas. L. Fryer, A. M. Peel, M. Cullis, Charles De Haven. Principal office, 310 Chestnut Street, Philadelphia, Pa. The property owned is the Charlotte and Judson lodes; location on Prospect Mountain, Little Evans Gulch, Lake county, Col. Capitalization, 200,000 shares; par value, $5; non-assessable.

Cunard Mining Company (The) owns the Lucky Mine, located near Breckenridge, Col., about one mile northwest of Lincoln. About $10,000 has been spent in developments, and there are on the dumps at the present time about 400 tons of galena ore, valued at sixty dollars per ton. The mine is located at an altitude of 11,000 feet. The vein is a fissure, the ore soft and good for milling, assaying forty-five ounces of silver, at the rate of sixty-five per cent. lead. The stock is held by three Chicago parties, who bought it for $5,000 in October last.

Cushing Mine (The) is located on Yankee Hill, Dake county, Col., the owners being J. M. Dougherty, Lucius Cushing, Simon Wheatley, and W. R. Holly. A strike of good ore has been made. It is said to be of higher grade than any yet found on the property, running about $50 to the ton, sixty-eight per cent. of lead and twenty-one ounces of silver. The vein shows an irregular streak from two to five feet in thickness. Twenty tons of ore have been shipped to Meyer's Reduction Works. Developments are being energetically prosecuted.

Day Silver Mining Company. The officers are H. A. W. Tabor, Pres.; Dennis Sullivan, Vice-Pres.; Geo. R. Fisher, Treas.; J. F. Wellhorn, Sec.; T. Foley, Gen. Mang. Directors, N. H. Bush, Chas. L. Hall, Thos. G. Gibson, and J. W. Gaynor. Date of annual election, September 20. Office, 310 Pine Street, San Francisco. The company's property is located in Jack Rabbit district, Lincoln county, Nev. Capitalization, $10,000,000; par value per share, $100. No dividends paid to date (June, 1882.) Number of assessments levied, 10; total amount of same, $180,000; date of latest assessment, January 28, 1882; amount per share, 50 cents. Floating indebtedness, April 1, 1882, $85,000.

Decker Mine (The). Owned by Messrs. J. S. Morris, G. S. Price, and J. M. Brooks. The Decker Mine is located in Placer county, Cal., near Bloomer. Old shaft down sixty-five feet. Thirty tons of rock have recently (September, 1880) been sent to Pugh's Mill to be crushed. The claim is 1,500 feet in length and 100 feet on each side of the ledge. Have taken up the eastern extension of 1,500 feet and are sinking a second shaft. Fifteen men employed.

Defiance Mining Company (The) has property located in Chaffee county, consisting of twenty-four claims in a group, nearly all of which are worked by three cross-cut tunnels, named respectively the Whale, Victoria, and Arkansas. The Whale is in forty feet, the Arkansas fifty feet, and the Victoria 150 feet. The lodes to be cut all show the mineral characteristic of the section, and the veins are usually strong and well defined.

De Frees Mill and Mining Company's (The) property is located at Tuscarora, Elko county, Nev. There are 1,300 linear feet in mine. Capitalization, $5,000,000; par value per share, $100; number of assessments levied, eleven; total amount of assessments levied, $162,500; date of latest assessment, July 21, 1881.

Denver City Consolidated Silver Mining Company is chartered under the laws of the State of Colorado. The officers are J. Whitake Wright, Pres.; C. E. Johnson, Vice-Pres.; Edward D. Cope, Treas.; Geo. L. Smedley, Sec.; Superintendent, Robert Bunson. Offices, Third and Walnut Streets, Exchange Building, Philadelphia, Pa., and Post-Office Building, Leadville, Col. Transfer office, Exchange Building, Philadelphia. The company's mines are the Denver City, Shamus, O'Brien, and Quadrilateral, located at Fryer Hill, Leadville, Lake county, Col. Depth of shaft, 250 feet. Amount expended in developing property to January, 1882, $200,000. Capital stock all issued. The Denver City ships about fifteen tons of ore per day; eighty men employed in mine, and two shafts worked. Capitalization, $5,000,000; par value per share, $10; basis, non-assessable, full paid; stock quoted July 1, 1882, thirty-two and a half cents to thirty-five cents.

Denver and Rainbow Mining Company (The) has property located in Chaffee county, Col. The company owns the Denver and Rainbow mines, situated at head of Taylor Gulch. The developments on Denver consist of a sixty-eight-foot shaft, and tunnel 344 feet, showing a fifteen-inch streak on the Denver vein, which assays seventy-eight ounces of silver. A drift has been run from this tunnel to the Rainbow vein, a distance of 156 feet, exposing twenty-six inches of mineral galena and carbonates, assaying seventy ounces of silver and thirty-two ounces of gold. Assays from the mineral in the Rainbow shaft range from 225 to 1,420 ounces.

Derby Mine (The). Owned by Willey, Shane, Lowell, Adams, Bardwell, and others. The Derby mine is located one mile above Sunny South, Placer county, Cal. Is being prospected.

Diamond Queen Mining Company (The) has property located in Chaffee county, Col. The company owns the Diamond Queen mine, on Boulder Mountain, and the Alpine and Betsy Link mines, on the same mountain (Boulder). The incline shaft of 135 feet and two levels are all in heavy galena ore with eight feet of vein matter, and neither wall developed. The workings show about ten inches of pyrites, coarse galena, oxide of copper and carbonate of iron. Other streaks carry fine galena and copper, making a total pay-streak of four feet; the average value of which is twenty ounces of silver, and in some instances as high as seventy-two per cent. of lead, and in others as high as thirty-seven per cent. copper.

Dolores Valley Mining Company (The) is one of the Pioneer enterprises of Dolores county. The property comprises numerous groups of mines scattered over the entire mining district of Rico. The Deadwood Gulch group contains fifteen mines; the Brunette Gulch group, ten mines; Expectation Mountain group, eleven mines; Silver Creek group, nine mines; Telescope Mountain group, nine mines; Dolores Mountain group, three mines; Concord group, eleven mines; C. B. & Q. group, four mines, and several others situated in various parts of the district. The Dolores group is being developed by a large cross-cut tunnel about 800 feet in length. It is proposed to operate the Silver Creek group also by a tunnel (cross-cut), running north into Telescope Mountain to cut some of the veins, hundreds of feet below the outcrop.

Dolly Varden Mine (The) is located in Pitkin county, Col. Mr. Geo. W. Brunt is General Manager and Capt. Andrew Gallagher, Superintendent. The property is looking well. Ore assays from 100 to 700 ounces per ton. The Dolly Varden is employing a force of about twenty-five men, and is shipping from thirty to forty tons of ore per month.

Dolphin Mining Company (The). Dennis Sullivan, Manager. The Dolphin mine, owned by this company, is located on Fryer Hill, Col. About six acres of property owned. Dry silver ore. (1880.) This mine, adjoining the Matchless on the west, under Mr. Sullivan's management, is rapidly gaining prominence as a productive and profitable property. At present the mine is yielding, from accounts, about seventy-five tons of ore per week; low in lead, but of very high grade in silver. There is quite a pile of medium grade ore on the dump, or in the shaft-house, running from $80 to $100 to the ton. The mine has done a creditable amount of work, considering the time it has been in operation. Thirty men are employed. Capitalization, $2,500,000; shares, 250,000; par value, $20. Total profits of mine since discovery, $75,000. Weekly output of ore, tons, 200. Monthly expense account, $4,500.

Dry Mountain Silver Mining Company, of Terre Haute, Ind., is chartered under the laws of the State of Indiana. The officers are J. B. Schultz, Pres.; David Kern, V.-Pres.; D. N. Taylor, Sec.; J. P. Lyman, Treas. Superintendent, Dr. James Wright. Office, 302½ Main Street, Terre Haute, Ind. This company are the owners of the La Luz and Prieta mines, located at Parral, State of Chihuahua, Mexico. The ore assays from $30 to $80 per ton. Capitalization, $1,000,000; par value per share, $100.

Duncan Silver Mining Company is chartered under the laws of Canada. The officers are Thos. Appleton, Pres.; L. B. Stone, Treas. Transfer office, 79 Water Street, Boston, Mass. Transfer days, any.

Dunderburg Silver Mining Company is chartered under the laws of the State of New York. Office, 62 Broadway, New York. The company's property is located at Georgetown, Clear Creek county, Col. The ore assays both silver and lead; value per ton, $200. Total extent of claim, six lodes, 7,900 feet. The company's buildings are first-class; value, $100,000. Date of organization, May, 1879; capitalization, $1,500,000; par value per share, $10; basis, non-assessable; stock held principally in New York.

Dunkin Mining Company is chartered under the laws of the State of Colorado. Office, 60 Broadway, New York. The Dunkin mine, owned by this company, is located at Leadville, Col.; extent of claim being about nine acres. The ore contains silver with lead. The Dunkin mine was purchased in April, 1879; mining operations were commenced at once, and mineral was soon struck. A report under date of May 28, 1881, says of this mine, since August the Dunkin mine has been turning out from $21,000 to $33,700 per month, while the expenses for the same time have averaged only $6,500 per month. Ore now worked nets from $22 to $35 per ton, and there is said to be considerable ore in sight. The company have on their property, engine, ore house, and shaft house. The current value of the mine is $70,000. At a comparatively short distance from the surface, the company has recently found a deposit of extremely high-grade ore (chloride), a ton of which, selected, assayed 4,673 ounces of silver to the ton. Four tons more, not so carefully selected, have been shipped, and there are several more tons in the ore house. The streak of very rich chloride is carefully sacked and kept separate. The iron ore outside the pay-streak is broken up into fine pieces and selected. There are thus three grades of ore produced. The first-class will run 4,000 to 5,000 ounces; the second class, 500 to 1,000 ounces, and the third class about 100 ounces to the ton. There are also other deposits which will pay handsomely for shipping. Date of organization, 1879; capitalization, $5,000,000; par value per share, $25; basis, non-assessable; yield during 1880, $179,278; number of dividends paid to June 2, 1881, fifteen; total amount of dividends paid, $200,000; date of latest dividend, June 2, 1881, seven and a half cents per share; stock quoted July, 1882, fifty cents.

Durango Parrott City and Fort Lewis Toll Roll Company (The). Trustees, A. P. Camp, Charles Merrin, Otto Mears. Mines located in Colorado. Capitalization, $15,000, shares, 150; par value, $100.

Eagle Smelting and Silver Mining Company is chartered under the laws of the State of Colorado. The officers are P. P. Gustine, Pres.: A. H. Woodward, Sec.; Dr. E. S. Perkins, Treas. Office, 125 South Fourth Street, Philadelphia, Pa. Capitalization, $3,000,000.

Eagle Mine (The), owned by Messrs. George Desalier and Philip Carter. The location of this mine is in Canyon, California. Ore, smelting character; assays over 100 ounces of silver per ton. Shaft sunk on a fine vein of ore two feet in width, traced several hundred feet on the surface.

Eagle Consolidated and Silver Mining Company (The). Officer, F. W. Ulter, Sec. Principal office, No. 112 Leidesdorff Street, San Francisco, Cal. Location of mines, California.

Eagle Rock Silver Mining Company (The). Officers, S. N. Doten, Pres.; A. N. Hawls, Treas.; Dr. S. A. Packard, Sec. Location of mines, Sedgewick, Maine. Capitalization, $500,000; shares, 100,000; par value, $5.

Eagle Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are William S. Clark, Pres.; John R. Bothwell, Sec. and Treas. Superintendent, G. W. Bothwell. Office, 2 Nassau Street, New York. This company's property is located at Lewis Camp, Lander county, Nev. Capitalization of $2,000,000, in shares at a par value of $10 each.

El Guebic Mining Company (The). Officers, R. W. Thyng, Pres.; S. P. Wardell, and H. E. Irvine, Sec. and Treas. Directors, the above officers and Geo. A. Wadley, J. Y. Mainland, Geo. J. Wilder, A. B. Foster, J. W. Smith. Financial Agents' office, Goff, Hastings & Co., No. 292 Washington Street, Boston. The mines of this company are located in the State of Sonora, Mexico. It was organized at Saco, Maine, May 7, 1881. Capitalization, $500,000.

Elk Mountain Mining Company. Offices, Central City and Leadville, Col. This company owns the Nevada mine and half of the Last Chance. Their works are located above timber line, six and a half miles from Gothic, between Eureka and Cliff mines, Gunnison county, Col. The company has good water-power, sufficient to run largest class of concentration works. They have a capitalization of $1,000,000, in 100,000 shares at a par value of $10 each.

Elm Tree Silver Mining Company (The). Officers are R. R. Call, Pres.; W. Muirhead, Jr., Treas.; W. A. Hickson, Sec. Directors, R. R. Call, W. Muirhead, Jr., John Sadler, John Ellis, W. R. Payne, John J. Adams, New York; W. A. Hickson. Principal office, Chatham, N. B. These mines are located on branch of Elm Tree river, Gloucester county. The ore is chiefly galena, associated with zinc blende; it assays $100 to $250 in silver and lead. The character is gangue of quartz; to wall of slate; no wall of white stone, apparently. Extent of deposit, unknown. Capitalization, $500,000; shares, 100,000; par value, $5.

Empire Mining Company (The). This company owns the Empire mine, located in the Tombstone district, Arizona. This mine is in the same group with the Girard and Tranquillity, both productive mines. It is opened by a double compartment shaft to a depth of 450 feet, and by working levels, drifts, winzes, etc., to a considerable extent. On the 200-foot level the vein has been intersected by a cross-cut, and a drift has been driven along it several hundred feet. The mining plant consists of good buildings and excellent steam hoisting words of sufficient capacity to sink 1,200 feet. The ore is very fine. A large body on the 450-foot level is steadily enlarging. No stoping is at present done, all work being in way of development. As far as explored, the ore body on the forty-five level is from twenty-five to thirty feet in width. About seven tons of ore are hoisted daily.

Endomile (The) is located in Grand county, Colorado, and prospects of the property are favorable; the ore body increasing in size as development progresses. Depth of shaft, 300 feet; length of adits, that is levels, 168 feet.

Engineer Mountain Silver Mining and Smelting Company. Mr. Charles L. Hill, Manager. Location of mines, Hinsdale, Col. Capitalization, $200,000.

Exchange Silver Mining Company is chartered under the laws of the State of New York. The officers are W. H. Jarvis, Pres.; W. H. Howell, Treas. Office, 34 Broad Street, New York. The company's property is located in Nevada. Capitalization, $1,000,000; par value per share, $10. Total amount of dividends paid to July, 1882, $18,000. Date of latest dividend, July, 1882.

Evening Star Mining Company (The), under the supervision of Mr. W. S. Ward, is one of the most valuable properties on Carbonate Hill. The mines owned by this company are located in Leadville, Lake county, Col. The property has an extent of five acres, only two of which have been developed, and this chiefly by drifts, the manager stating that it is his intention to continue drifting while the entire property is being developed. The output is about eighty tons per day, netting $42 a ton, or a total of $100,000 per month. Developments were commenced 1879. $400,000 were expended May 20, 1882. During 1880, the performance of the mine was very erratic. 150 men employed. Capitalization, $500,000, in 50,000 shares; par value, $10; non-assessable. There were forty-three dividends paid to June 17, 1882; total amount, $1,175,000. Latest dividend, June 9, 1882, $1 per share. Stock quoted July 1, 1882, $50. Working expenses per month, $15,000.

Empire Mine, owned by W. H. S. Wright. The Empire is located in Los Currillon district, about one mile from Bonduza city, New Mexico. Gray ore, sixty-five per cent. copper, assaying per ton, $200.

Falco Silver Mining Company (The) has property located in Chaffee county, Colorado. The company owns the Black Crook, in the Chalk Creek district. The main shaft is down 150 feet, and a drift has been run at the 100-foot level. The vein is a strong one, being from four to ten feet in width, and though the ore is low grade, it improves with depth; and where so large a body of ore is found, there is little doubt that, with proper development, it will become a dividend-paying mine, or at least self-sustaining.

Falcon Silver Mining Company's (The) property is located at Alpine district, Colorado. The company's mine is an auxiliary of the Brittle Silver. They have a capitalization of $1,000,000.

Forest Queen Mining Company (The). The officers are Gen. Palmer, Pres.; R. W. Woodbury, Vice-Pres.; R. F. Woodward, Sec.; B. C. Dodge, Treas. Superintendent, Ira Brown. The company's mine is located in Ruby district, Gunnison county, Col. In the early history of the mine the ore had to be packed and hauled to Alamosa, 175 miles distant, then shipped to Pueblo and Denver for treatment, incurring a total cost of transport of $100 per ton, and even then a heavy margin was left the company. On the dumps of 1879 and 1880 large quantities of 100 and 130 ounce ore can be selected, while that mined to-day by rough sorting will easily produce 200 to 500 ounces per ton. The mine is now in a condition to stope out and suck up from the surface from fifty to sixty tons per day. There is no stock in the market.

Fort Meade Silver Mining Company. The property is located in Lawrence county, Dakota, and consists of the Fort Meade, San Joaquin, San Jacinto, Red Cloud, and a portion of the Mammoth mines, and operations upon the same are being energetically conducted. The Superintendent, in his report of the operations in the Red Cloud for November, says, a large body of non-mineral-bearing rock has been removed from the tunnel, and the vein uncovered, exposing ore 180 feet in length, and from four to nine feet in width, and of unknown depth. The rich brown sulphurets found about seventy feet from the mouth of the tunnel are still found in wide strata as far as new work has progressed, and the gray carbonates so noticeable on the west side of the vein are still present in about the same proportion as when first discovered. More chloride and native silver appears as the work proceeds under the heavier portion of the hill, while the oxides and sulphurets of iron are found in all parts of the vein. Galena of a high grade in silver is now present in larger proportions than at any previous time, and from the oxide of iron present larger bodies of the lead ores are looked for as depth is attained. Beyond the 180-foot station, a drift is being driven to the east. This has already progressed some fourteen feet, and is in a fine body of ore. This, with the exception of a very large proportion of oxide of iron, closely resembles the other ores; but where the oxide occurs, the ore by assay shows $100 in gold per ton, and 104 ounces, $116.48, in silver. This drift is about four feet in ore, and will be continued until a wall is reached upon the east side. During the month of November, 21,150 pounds of ore were shipped to Omaha from this mine, yielding on an average $205 per ton. The freight on the same was about $30 per ton; reduction, $25 per ton, less 85 per cent. of the value of lead, reducing smelting charges to about $15 per ton, and making the total cost, delivered in Omaha and reduced to bullion, about $45 per ton, and leaving a net profit over mining, freighting, and reduction of over $150 per ton.

Frank Hough Mines (The), owned by J. W. Watson, J. H. Dudley, J. F. Sanders, Col. Hall, Wm. Parker, and Phil. Golding, are located in Engineer Mountain, Hinsdale county, Col. Mr. Blaisdell was appointed Superintendent in 1881. The ore is extremely solid and heavy mineralized. Its great uniformity of value is very remarkable, for the nets all show very near the same results. Hundreds of tons of ore are now out on the dump of the mine, and an almost unlimited amount can be mined from developments already made. The ore from the mine is of a very peculiar character. It much resembles the copper matter produced at the Argo smelting works, and has the appearance of having been already smelted. It is very solid ore. Numerous tests made show its value to be about thirty per cent. in copper and carrying about eighty ounces in silver to a ton.

Gaff Mining Company (The) has property located in Chaffee county, Col. The company owns the Cache Creek, which is the principal of the rich placer mines of the Hope district which lies west of Granite and extends from the Arkansas river to Lost Cañon Mountain. The property comprises about 1,000 acres. The mine is worked by a bedrock flume nearly two miles in length.

Galena Gulch Mining Company (The) owns the following mines: the North Star, Narrow Gauge, Muldoon, and No. 3, which together constitute a fine block of property located in Galena Gulch, Gunnison county, Col. The North Star is a granite and lime contact on which three shafts have been sunk to pay material. The character and quality of mineral varies in the different workings. The Muldoon is a granite and lime contact, at fifty feet down, all in vein matter, mostly iron with manganese and some copper. No. 3 is a lime contact, showing eighteen feet by three and one-half feet of soft carbonates, with a six-inch streak carrying galena. The company have shipped from 50 to 60 tons of mineral during the season of 1881, giving mill returns ranging from $30 to $70 per ton, and have built a good wagon-way from the town of White Pine to the mines.

Geneva Consolidated Silver Mining Company (The). The company's works are located at Cherry Creek, White Pine county, Nevada. There are 3,000 linear feet in the company's mine. Capitalization, $5,000,000; par value per share, $100; number of assessments levied, seven; total amount of assessments levied, $82,500; date of latest assessment, March 6, 1876.

Gilpin County Mining Company (The) owns 550 feet of the valuable property situated in Lake Gulch, Gilpin county, Col. The mine has been worked with a small force during the last two and a half years. The improvements are of a substantial character. The mine was discovered in the early mining days of the county, and produced large quantities of free milling ores before the smelting facilities were introduced. From July, 1877, to December 31, 1881, the production was about $140,000, and the company have at the present time a reserve of about $150.000 in the treasury. The discovery shaft is 568 feet deep and has never been out of pay, there being at the bottom at the present time thirty-five inches of good ore; over 1,500 feet of excavations, chiefly levels, have been worked, all in good ore. The average value of the smelting ore is $75 per ton.

Glascow Silver Mining Company (The). This company owns the Iron mine, located in Buckskin Gulch, Loreland Hill, Col. The character of the ore is iron, 262 ounces in silver per ton, mill run, six tons. The character of mines consist of veins, 1881. The company intends to commence work on this property and to prosecute the same at once.

Glasgow Silver Mining Company. Principal office, Leadville, Col. Branch office, Boston, Mass. The company's works are located in Colorado. They have a capitalization of $1,000,000.

Golconda Silver Mining Company is chartered under the laws of the State of Colorado. They have a capitalization of $500,000.

Golden Fleece (The). Mine located on the Bobtail Hill, is owned by A. G. Elliott. The mine has been a large producer, and is well opened by a 400-foot shaft, and levels to an extent of 550 feet. The vein is four feet wide, carrying both milling and smelting ore; the latter averaging $140 to the ton.

Gold Field Consolidated Mining Company. Mr. R. Vogel is Vice-Pres. and Mang. The company was organized in 1880. Their property is located in Colorado. The ore is a mixture of gray copper, galena, and sulphide of silver. Sometime since the company developed a streak of ore three feet in thickness, mill run giving returns of 118, seventy, and fifty-five ounces in silver. Character of the mines; veins and drifts. The company have hoisting machinery and machine drill at their works.

Gold and Silver Mining Company (The). Incorporators, E. H. Wiley, W. S. Edwards, J. C. Chalmers, Frederick Frank, H. P. Wood. The Virginia mine is owned by this company, located on Little Ellen Hill, Col. First-class ore, silver and lead, twenty-two and a half ounces silver, 46 per cent. lead. Assays, seventeen and a half ounces silver, 30 per cent lead (second class). This company is owned by the United States.

Good Hope Silver Mining Company. Office, Leadville, Col. The company's property is located in Park and Lake counties, Col. The company has a capitalization of $300,000, in shares at a par value of $10 each.

Grand Central Silver Mining Company (The) is chartered under the laws of the State of Ohio. The Grand Central mine, one of the most important properties in the district, is located in the Tombstone district, Cachise county, Ariz. The mining plant comprises all known improvements, including thirty stamps, sixteen pans, eight settlers, and one agitator, through which comes all pulp that comes from the batteries. The main shaft is 600 feet deep, and a new working shaft 500 feet deep. The workings are in excellent condition, ninety tons of ore are shipped daily, the mill being gained on at the rate of ten tons per day. There are 185 men employed. The mill is driven by a 140-horse-power engine, fed by four large boilers. On the 300-feet level, there is a continuous body of ore several hundred feet long, widening from ten to forty feet, all good milling ore. Up to November, 1881, there were mined 20,000 tons of ore, 18,000 of which, when milled, yielded $848,176.46. Capitalization, $10,000,000; to July 1, 1882, ten dividends paid, total amount of same, $250,000; amount of last dividend, $1 per share. The weekly yield of ore is about 500 tons. Production for the nine months prior to December 31, 1881, 1,061,520.

Grand Prize Mining Company (The), of which E. M. Hall is Sec., has its offices at 827 Pine Street, San Francisco, Cal. The annual election is held on September 20. The property is located at Tuscarora, Elko county, Nevada. The mine is filled with the usual plant of machinery, etc. The length of lode on which the company depends for its supply of ore is 1,500 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. The yield during 1880 was $281,604. Amount of dividends, $450,000, to September, 1880, date of last dividend, September, 1880; amount per share, twenty-five cents; eight assessments levied; total, $315,000; last assessment, May 2, 1882, ten cents per share. Floating indebtedness, $32,872; stock and bonds reserved in treasury, $146,501. Since October, 1881, the mine has been shut down, and is now in the hands of the creditors. Preparations are now being made to resume work, as there is rock-milling ore below the 600-foot line. Stock was quoted at eighteen cents, July 14, 1882.

Grand Victory Mining Company (The), formerly known as the Grose, has property located at Diamond Springs, El Dorado county, Cal. The ore is low grade, containing sulphurets and a low percentage of silver, making the amalgam worth from $3 to $5 per ounce. Average assay value from $3 to $8 per ton. Single specimens of bunchy ore assaying as high as $700 per ton. The lode is from twenty to thirty feet wide. The quartz being frozen to the side walls of hard porphyry rock. The mining plant comprises a fine fifty-stamp mill, with all modern improvements, run by cheap water-power. The main shaft is down 100 feet. There is considerable ore in sight that will keep the stamp-mill going for a long time to come.

Grand Central Mine (The). Owned by Messrs. Marks, Goldtree & Co. The Grand Central Mine is located in Arizona. Depth of shaft, 175 feet; has some very rich ore. Assays run very high. Contention taking out chlorides, and getting ready for the mill. The Rattlesnake and Emerald located near the property of the above owners, 1880. Shaft will be sunk. Same party have begun work on the Blue Jacket, which shows a fine ledge of ore, averaging about $125 per ton. Own an interest in the War Up mine, on which they will sink a fifty-foot shaft.

Granby Mining Company (The). Offices, Silverton and Denver, Col. The mining property owned by this company consists of the Granby, Mountain Rain, Rough and Ready Basin, and Little Albert lodes. The property is located in Needle Mountain mining district, La Plata county, Col. The company has a capitalization of $1,000,000.

Grand View Mining and Smelting Company (The) own the Grand View mine, situated on Nigger Baby Hill, Dolores county, Col., which is developed by an incline shaft 160 feet in two drifts, 153 feet and eighty feet, respectively. The pay-streak gives iron and manganese, and is from two to three feet in width, and mills from fifty to 500 ounces per ton in silver, with traces of gold. About 300 tons of this ore have been treated at the company's smelter with good results, the iron in it forming a good flux.

Granger Mining Company (The). The officers are Albert E. Clary, Pres.; Dexter H. Follett, Treas. Col. Granges and Mr. Nahum Hinkley, Superintendents. The company's works are located at Blue Hill, Maine. They own about seventy acres of land. The ore assays 100 pounds of copper, and nine ounces silver to the ton. They own shaft house, engine house, ore house, and smith's shop. Depth of shaft, 150 feet. The main lode is 2,640 feet in length. Date of organization, December, 1881; capitalization, $100,000; par value per share, $1; stockholders are subject to an assessment of five cents quarterly till fifty cents have been paid; stock reserved in the treasury, April, 1882, 25,000 shares; stock quoted, November, 1881, six cents per share.

Great Basin Mining and Smelting Company. Gen'l P. E. Connor, Mining Director. The Great Basin mine, owned by this company, is located at Mineral Hill, Utah. The ore assays 100 ounces per ton. The company has a smelter at Stockton; concentrating works lighted by electricity and best appliances are being introduced. The main lode is 2,100 feet in length. In 1881 the average yield of this mine per day was reported to be about twenty-five tons of good merchantable ore, besides forty tons of jigging ore, with present facilities for hoisting. Supply of water is furnished by a four-inch galvanized pipe which is laid for a distance of about six miles. They have one stack in operation reducing about twenty-five tons of ore per day, turning out about five and one-half tons of bullion, which runs 100 ounces per ton. The company's concentrating works reduce about 100 tons of ore per day to twenty tons of concentration by the web process. The yield of mine, at present about twenty-five tons, will be considerably increased on completion of large combination shaft, now eighty feet down. Stock and bonds are held principally in Boston, Mass.

Great Baltic Silver Mining Company (The) is chartered under the laws of the State of New York. Office, 17 Dey Street, New York. The company own three full claims, (total extent of claims, 1,800 by 1,500 feet,) and a mill site, located at Reece River Ditch, Lander county, Nev. The ore has a value of from $60 to $80 per ton. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable; full paid.

Great Sierra Mining Company is chartered under the laws of the State of New York. The company's property is located in Tuolumne and Mono counties, Cal. They are the owners of the Mt. Dana mine. The ore is high grade, running from $40 per ton up into the hundreds, with a touch of refractory elements that prevent free milling, but these are readily expelled by the Frue concentrator The Mount Dana is one of the largest silver-bearing ledges in the country, carrying an ore vein sixty-two feet in width and vein matter to a width of nearly 200 feet. The company own a twenty-four-stamp mill. Date of organization, June 26, 1881; capitalization, $10,000,000; par value per share, $10; basis, non-assessable.

Great Vein Silver Mining Company (The). Incorporators, Frank J. Moody, A. K. Bonta, A. J. Strand. The location of the mines of this company is in Summit county, Col. Capitalization, $5,000,000.

Great West Mining Company (The). G. W. Kellogg, Gen. Manager. The location of the mining property belonging to this company is on Mount Bross, Col.

Guadalupe Silver Mining Company (The) have their works located at Urique, State of Chihuahua, Mexico. Wm. Rockwood is Sec. Office, 109 California Street, San Francisco, Cal. The company have levied twenty-eight assessments; date of latest, April 28, 1882.

Gunnison Mining, Milling, and Smelting Company. Location of property, Colorado. Capitalization, $2,000,000.

Gunsight Consolidated Silver Mining Company is chartered under the laws of the State of New Jersey. The officers are S. T. Latham, Pres.; G. P. Matthews, Treas.; W. H. H. Graham, Sec. Directors, S. T. Latham, B. F. Bivius, W. R. Warner, W. H. Graham, G. P. Matthews, H. A. Colburn. Office, N. E. cor. Broad and Chestnut Streets, Philadelphia, Pa. This company owns the Gunsight, Silver Girt, and Eastern mines, located in Myers district, Pima county, Arizona. All full claims. The property is situated on the slopes of the Sierra de la Esperanza, the ledge dipping into the mountain at an angle of 45°. An inclined shaft, sunk on the ledge, has reached a depth of 200 feet, where an abundance of low or medium ore is available. The assay is about $40 per ton. Improved steam-hoisting machinery is now being erected over the main shaft, which is triple compartment. A forty-stamp mill is proposed as soon as circumstances will permit, and it is estimated there is sufficient ore in sight to keep this number of stamps in operation for a year. Capitalization, $2,000,000; par value per share, $10; basis, non assessable.

Gunnel Consolidated Mining Company (The) owns an area of 7,055 feet on the Gunnel, Gunnel No. 2, Wheeler, Marine, and Hattie, located on Prosser Mountain, Gilpin county, Col. The improvements effected during the past year in the mine consisted of sinkings in the main shaft to the extent of 228 feet, giving a total pumping depth of 1,228 feet. A new counter-balance bob has been put in at the 700-foot station, and the eight-inch Cornish-pump carried down 200 feet, the sinking of the main shaft still being continued. The total development work was 1,550 feet. The ore on an average has been low grade. The Marine lode, on the south slope of the mountain, has a main shaft down 220 feet, which has been sunk under contract. At 100 feet a level is driven west sixty-five feet, striking a mineral vein of ore similar in character to that of the Whitney.

Hall and Brink Silver Mining Company (The) own the Dolly Varden mine, located on Mount Bross (eastern slope), Park county, Col., and adjoining the Moose; the property comprising eighteen claims. The ore body varies from one foot to twenty feet in thickness, and is found for a distance of 150 feet below the surface. The country rock on this mountain is a hard, blue limestone, and carries a baryta gangue with galena and antimony, though the ore is principally sulphuret. The developments are by tunnels, shafts, and inclines. The greatest vertical depth is 200 feet, and the greatest horizontal length is 350 feet. Total depth of shafts, 350 feet; total length of tunnels, etc., 2,800 feet. A tunnel run 200 feet below the main workings has opened a fine body of ore, and the mine is in a good condition for producing largely. The total yield to date is $1,300,000.

Hambleton Silver Mining Company (The). The mines of this company are located in Mariposa county, Cal. Messrs. John Hambleton, James Hambleton (his son), and Capt. E. T. Cady, owners. Incorporated in 1880. Each have a claim of 1,500 feet, consolidated into one company. One of these claims was discovered twelve or fifteen years ago. A shaft was sunk to a depth of 125 feet by J. H. Neal and A. W. Jee, known as the Rockwell shaft.

Hancock Silver Mining Company (The) is chartered under the laws of the State of New Jersey. The directors are E. Silverstein, A. S. Carter, Aaron Teller. David Loewen, Sec. and Treas. The offices are at Camden, N. J., and at 23 S. Third Street and 310 Chestnut Street Philadelphia, Pa. The company owns the Hancock lode, located in Colorado. Character of mine, a true fissure vein, increasing in width as depth is attained. The shaft is down only twenty-five feet. Organized on a non-assessable basis; capitalization, $2,500,000, in 250,000 shares of $10 each.

Harshaw Silver Mining Company (The) has property located in Arizona. Capitalization, $10,000,000, in 100,000 shares of $100 each.

Head Centre Mining Company. J. W. Pew, Secretary. Office, 310 Pine Street, San Francisco, Cal. The company's property is located at Tombstone, Ariz. The mine is very thoroughly developed to a depth exceeding 600 feet. The weekly output is about 200 tons per week, which is about the capacity of the ten-stamp mill. The mine is being worked with vigor and energy, and promises to become at an early day one of the dividend-paying mines of the district. Average width of vein from four feet to eight feet. Ore, free-milling and containing a heavy percentage of gold. The mining plant is complete and first class in its appointments. The company has a capitalization of $5,000,000, in 200,000 shares, with a par value of $25 each. Yield during 1880, $17,000. Number of assessments levied, three; amount of two assessments, $120,000; date of latest assessment, May 25, 1882; amount per share, twenty cents. The production averages about $25,000 per month.

Hecla Mining Company (The). Their mining property, of twenty claims, is located in Trapper district, Beaver Head county, Montana. Among the most important of their mines are the Cleopatra, Atlantics, True Fissure, Mountain Sheep, and Silver Quartz; the others, however, all give promise of becoming equally as good as any of the named properties. Besides the supply of ore in the mines, it is estimated that at least 50,000 tons of second-class ores are now on their various dumps waiting to be concentrated; this carries from twenty to forty ounces of silver per ton. The mines are all worked through adit levels, and the cost of extracting the product is comparatively small. Ten miles below the mines, on Trapper creek, are the reduction works of the company. A water-power, under a pressure of 140 feet, equivalent to 125 horse-power, and two water-jacket furnaces, each rated at thirty tons per day, with all necessary auxiliaries, constitute the principal features of the plant. About 300 men are employed. The company also owns the iron mines, twelve miles distant, from which fluxing ore is taken. In the vicinity of the works, lime is found in abundance. Capitalization, $1,500,000; par value per share, $50. Total amount of dividends paid to July, 1882, $402,000; date of latest dividend, July 1, 1882.

Hibernia Mining Company. A. T. Gorman, Sec. Office, 115 Broadway, rooms 51 to 61, New York. The company's mine is located at Leadville, Col. The ore is high grade, mineral, chloride of silver. The ore has a value of $50 per ton. The amount of mineral in sight is quite considerable and very rich, much of it showing a great deal of chloride of silver. The company has two shaft-houses and machinery, valued at $20,000. The shaft is 200 feet deep. At the May Queen shaft on this mine there is a forty-horse-power boiler and a twenty-horse-power boiler. At the bottom of the shaft a steam-pump is placed, and drains shaft from water. All along the line bordering the property a continuous breast of ore is exposed, averaging about ten feet in thickness. About one-half of the ore is first class, running from 500 to 1,000 ounces in silver to the ton; the remainder contains from 200 to 300 ounces to the ton. A prospect shaft has been driven southward, which shows ore the entire length. Mr. Cone has leased this mine, and has quite a number of miners and mechanics at work putting the machinery in repair and retimbering and clearing out some of the more important of the old workings. The mine having been lying idle for a considerable time, the workings have fallen into bad repair, and cannot be worked with safety till the work in question is accomplished. The current value of the mine is $24,000. Output weekly at January, 1882, about sixty tons. Date of organization, April, 1880. Capitalization, $7,500,000. Yield (net) during 1881, $33,464. Par value, $25 per share; number of dividends paid to July, 1881, six; total amount of dividends paid, $200,000; date of latest dividend, July, 1881, ten cents per share. Stock quoted, July, 1882, eleven cents.

Highbridge Silver Mining Company. The company's property is located in Philadelphia district, Nye county, Nev. The main lode on which the company depends for its supply of ore is 6,000 feet in length. Capitalization, $10,000,000; par value per share, $100. Yield during 1879–80, $65,550, fiscal year. Number of assessments levied, one; amount of same, $30,000; date of latest assessment, June 23, 1880.

High Line Silver Mining Company (The). Incorporators, A. H. Bonta, A. J. Strand, Frank J. Moody. The company has property located in Lake and Summit counties, Col. Capitalization, $5,000,000.

Hooker Silver Mining Company. The officers are T. J. Fitzgerald, Pres.; Robert Hook, Sec.; W. L. Henry, Treas. Office, room 53, Reaper Block, Chicago, Ill. The company's mines are the Hooker and Solomon, located at San Juan, Col. The company has a capitalization of $1,500,000, in 75,000 shares, at a par value of twenty dollars each.

Humboldt Mining Company (The) has its offices at Engle Station, Atchison, Topeka, and Santa Fe Railroad, New Mexico. Office of the financial agents, 330 Walnut Street, Philadelphia, Pa. The officers are David Branson, Pres.; Edmund Webster, Vice-Pres.; Edward S. Lowry, Treas.; John H. Edwards, Asst. Sec.; A. Evans Peterson, Secretary and Financial Agent. The company owns a large amount of excellent and favorably situated mining property in various stages of development, which, it is claimed, are now being worked on sound business principles. These properties are located in Socorro and Dona Ana counties, New Mexico. Capitalization, $6,000,000, in 240,000 shares of $25 each; non-assessable; fully paid. Yield during 1881, $35,000.

Hidden Treasure Mining Company (The) has its offices at 40 Congress Street, Boston. The property is located in San Juan county, Col. Capitalization, $500,000, in 200,000 shares of $2.50 each.

Hidden Treasure Mining Company (The) has its main office at Armenia, N. Y. The mines owned by the company, Big Chief and Quick Relief, are located in Yavapai county, Arizona. The company has had a mill run of 450 pounds of selected ore, from which they have derived a silver brick worth $242.88. The mine is opened by a shaft of about fifty feet in depth on a ledge of twelve feet in depth, which assays from $27 to $200 per ton, gold and silver.

Highland Chief Consolidated Mining Company (The) owns a group of mines situated on the summit of Breece Hill, three and a half miles from Leadville, the property having an extent of thirty-three and a half acres, only about one-fourth of an acre of which has been explored around the Highland Chief shaft. A more thorough development recently commenced, by sinking a new shaft (Central), will connect the Robert Burns and Highland Mary shafts, 900 feet apart, with the present workings and tunnel outlet. Considering the immense ore bodies discovered in its limited development, this property is justly regarded as one of the most promising on the hill.

Henriette Mine (The), owned by Moffat, Tabor & Co., is located at Carbonate Hill, Leadville, Col. The company's property covers ten acres of land. Thirty-eight workmen have been employed at the works.

Hillside Mining and Milling Company. E. Frankenthral, Sec. Office, 380 Pine Street, San Francisco, Cal. The mines owned are the Can, Mayflower, Hillside, and Mendha, located at Bristol, Lincoln county, Nev. The ore assays $50 per ton. The company owns a ten-stamp mill, artesian well apparatus, capable of sinking to depth of 3,000 feet, and a fifty-five-ton water-jacket furnace. The shaft is 120 feet deep, all in ore. Length of adits, 100 feet. The main lode is 5,000 feet in length. The company has expended $25,000 fitting the property up for operations. The weekly output at January, 1882, was about 150 tons. The ore is sent direct to the smelter. Date of organization, 1881; capitalization, $10,000,000; par value per share, $100; yield during 1880, $139,892; number of assessments levied, five; total amount of assessments levied, $310,000; date of latest assessment, July 20, 1881.

Holland Mining and Milling Company (The) has property located in Yuma county, Arizona. The company have a smelter located at Lower Noria. Much difficulty has been experienced in handling the ores, but since those that are especially refractory have been subjected to the roasting process, success has been complete. Late reports from the works show that they are producing from two to two and a half tons base bullion per day.

Homer Mining Company. Hon. James D. Minor, Supt. Location of works, Bodie district, Cal. Number of assessments levied, two. Date of latest assessment, June 1, 1882, twenty cents per share.

Homestake Mining Company is chartered under the laws of the State of New Jersey. The officers are E. Klautscheck, Pres.; W. J, Radcliff, Sec.; Thos. J. Stewart, Treas. Directors, Thomas Barnett, Wm. Torry, W. J. Radcliff, H. P. Nulter, Jr., Elvin Klautscheck, T. J. Stewart, A. Wasserman, C. I. Fireng, J. L. Fryer. Offices, Leadville, Col., and 310 Chestnut Street, Philadelphia, Pa. This company owns the Homestake mine, located at Homestake Mountain, Col. The mineral improves as developments are made. There are well defined fissure veins sixteen feet in width on the property. Capitalization, $1,000,000; par value per share, $5; basis, non-assessable.

Honora Consolidated Mining Company. The company's mines, viz.: Iron Rod, Warriors' Mark, and Silver King, are located at Breckenridge, Col. The company has a capitalization of $1,500,000.

Hoosier Girl Mining and Milling Company (The). Office, Leadville, Col. Location of works, Lake county, Col. Capitalization, $2,-000,000.

Horn Silver Mining Company (The) is chartered under the laws of the Territory of Utah. The officers are C. G. Francklyn, Pres.; F. G. Brown, Vice-Pres.; W. S. Hoyt, Sec.; W. F. Van Pelt, Treas. Directors, A. G. Campbell, M. Cullen, D. Ryan, and A. Bryain. The offices are at 44 Wall Street, New York city. The company owns the Horn Silver mine, located in Frisco, Beaver county, Utah. The ore is a high-grade carbonate of lead with silver, giving about seventy ounces of silver per ton. The mining plant includes smelting and refining works. The amount of ore in sight has been reported at $50,000,000. The length of the main lode on which the company depends for its supply of ore is 1,400 feet. Current value of mine is given as $4,000,000. Cost of reduction, $28 per ton. Prof. J. S. Newbury, of the Columbia School of Mines says, "The mine contains the most valuable body of silver ore known to exist in any mine in the world. It stands, to-day, as having a greater ascertained value than any other silver mine known." As an indication of the richness of the ledge, it may be mentioned that it produced in the first nine months of the year 1881 nearly $1,000,000, the quarterly dividends amounting to $300,000. Organized February 7, 1879. Capitalization, $10,-000,000, in 400,000 shares of $25 each. Yield during 1881, 16,341,995 pounds of lead, and 1,259,903 ounces of silver. Total amount of dividends paid to July, 1882, $1,700,000. Date of last dividend, July, 1882.

Iron Silver Mining Company is chartered under the laws of the State of New York. Mr. James McKenn, Captain of the Iron mine; Mr. Huber, Engineer. Office, 11 Broadway, New York. The company's mines, the Iron mine and Rock and Stone, are located at California Gulch, Leadville, Col. The company's property covers seventy acres of land. Character of the ore, good grade, lead, carbonate, and galena, with a streak of iron. The ore yield on an average was 20.34 ounces of silver per ton, and 31.1 per cent. lead, or in the aggregate, 1,169,495 ounces of silver, and 17,628 tons of lead. In one year 11,600 feet of drifting and 2,065 feet of sinking was done, and the stoping is estimated at 1,089,000 cubic feet. Amount expended in developing property to 1880 is reported to have been $754,728. This company is reported to be reliable and permanent, and it is said that since the advent of new machinery and a good ore market, the company's mines have produced with remarkable regularity. Considerable ore is said to be in sight. The current value of mine is $1,075 000. Several important developments have been made under many of the old stopes; large bodies of mineral, report says, were uncovered, and the indications are that the lime rock will be found gashed with veins of rich carbonate ore. 200 tons of ore are being shipped per day, and 510 men are employed. Monthly expenses, $37,000. Date of organization, March, 1880. Capitalization, $10,000,000; par value per share, $20; basis, non-assessable. Yield (net) during 1880, $729,525; yield during 1881, 63,583 tons, $1,241,014.98. Number of dividends paid to June 26, 1882, seven. Total amount of dividends paid, $700,000. Date of latest dividend June 26, 1882, twenty cents per share. Stock and bonds reserved in the treasury April 1, 1882, $183,001.04. Stock quoted June 17, 1882, $2.15

Income Mining Company is chartered under the laws of the State of Maine. The officers are Levi Newcomb, Pres.; C. J. Rich, Treas.; Hon. W. A. Simmons, Sec. Office, 40 Water Street, rooms 51 and 52, Boston, Mass. The company's property is located at Silver City, New Mexico. They have a capitalization of $500,000. Treasury stock for sale at $2. No shares in market.

Independent Mining Company (The), of which E. M. Hall, Esq., is Sec., has its annual election on the 15th of August. The offices are at 327 Pine Street, San Francisco, Cal. The property of the company is located at Tuscarora, Elko county, Nevada. Total length of lode on which the company depends for its supply of ore is 1,500 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. In 1880 the yield was $23,330. Total amount of dividends paid, $225,000, since September, 1879, which was the date of the first dividend of twenty-five cents per share. Nine assessments have been levied, aggregating $185,000. Date of latest assessment, February 24, 1882; amount of same, fifteen cents per share. Floating indebtedness to April, 1882, $6,697. Stock quoted at thirty-eight cents per share.

Iron Bonnett Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are A. C. Brownell, Pres.; A. G. Hutcheson, Sec.; Apollos Smith, Treas.; H. M. Beaver, Manager. The offices are at 21 Nassau Street, New York city. The company own three mines, Iron Bonnett, Excelsior, and Albino, all located in the Tin Cup district, Gunnison county Col. Each of them is a full claim of 300 feet by 1,500 feet The company also owns in the same district, a mill site of five acres, making a consolidated interest of thirty acres of land. The ore is high grade, containing chlorides and sulphurets, and giving assays of $145 per ton. Some five-ton parcels unearthed have yielded as high as 146 ounces to the ton. General H. B. Bearce, speaking of the Iron Bonnett mine, says: "The present developments show a very strong vein of from twelve to thirty inches in thickness, regular in its course and dip, and of extraordinary richness, considering the depth attained, the incline being in but twenty-five feet. An average of twenty-four assays made from time to time under my (Gen. Bearce's) direction gave 391 ounces per ton silver and one-fourth of an ounce of gold." In Aug., 1881, the manager writes: "We have a splendid vein of rich ore on number three incline over four feet in thickness." The working expenses are small, and can be provided for by sale of treasury stock. Organized on non-assessable basis. Capitalization, $1,000,000; in 200,000 shares of $5 each; one assessment levied of twenty cents per share, April 28, 1882; no floating indebtedness.

Jocuista Mining Company (The) have offices at 18 Wall Street, New York. R. P. Lounsbery, Treas. The property of the company is located in Mexico. The cost of mining and milling is $21.22, and average cost of smelting, $18.13 per ton. Current value of mine is $1,800,000. Capitalization, $10,000,000, in 100,000 shares of $100 each; yield to January 1, 1881, 7,581 tons; 188,481$\frac{66}{100}$ pounds of ore sent to smelter produced 87,967$\frac{54}{100}$ ounces of silver, which sold for $99,489.53, the principal buyer being the Castle Dome Company; $500,000 has been paid in dividends up to date of last dividend, May 31, 1882, which was one dollar and fifty cents per share.

Jack of Clubs Mine (The), owned by McGowan, Reynolds & Co., is located in Chaffee county, Colorado. An incline has been run sixty feet, showing a well-defined vein, and about twelve inches of flesh-colored quartz, assaying over 2,000 ounces. Mill runs have been obtained from picked lots.

Kansas City (The). Owned by O. L. Lightburn, and others. Kansas City mine, the property of Mr. Lightburn, is located on Democrat Mountain, Alma, Col. The mineral has a mill return of 150 to 1,000 ounces per ton. Tunnel, 500 feet in length. This is a strong fissure vein, and the mineral, of which there is a large amount, runs from 150 to 1,000 ounces per ton by mill returns. Eight workmen employed.

Keystone Consolidated Mining Company (The) is chartered under the laws of the State of Wisconsin. The officers are Nath'l McBride, Pres.; C. D. Hooker, Vice-Pres., H. H. Armstead, Sec.; B. F. Newcomb, Treas., and C. F. Brewster, Supt., with an experience of four years. Annual election is held January 11. Transfer and main business office, 155 Washington Street, Chicago, Ill. General office at Madison, Wis. Transfers can be effected at all business hours. The company owns thirteen claims—the Keystone, Governor Tabor, Allegheny City, Mt. Vesuvius, Tabor Mount, B. F. Smith, J. B. McDonald, C. G. McDonald, Consolidated, General Custer, Fleur de lis, Rosebud, and the Keystone Consolidated lodes, located at Red Cliff, Summit county, Col., in the Battle Mountain mining district. The thirteen claims in contact cover an area of seventy-nine and three-quarters acres The ore is a sandy carbonate, average assay of which is $110 per ton. The mine has horizontal contact veins. The shaft is 165 feet deep. The length of the main lode on which the company depends for its supply of ore is 18,000 feet. Average width of vein, twenty-four feet. Number of shafts and tunnels, thirteen. The underground workings consist of inclines, cross-cuts, and tunnels. To April 1, 1882, the sum of $25,000 had been expended in developments which were commenced June 20, 1881 The prospects of the property are reported as A 1, and the amount of ore in sight as $3,000,000. Cost of mining and milling is about $6 per ton. The ore is shipped to Red Cliff and to Leadville, Colorado. The company claims to have a blanket vein which they think will average twenty feet in thickness, and the value of such a vein of sand carbonates covering eighty acres in extent must be considerable. Organized, January 17, 1881; capitalization, $3,000,000, in 300,000 shares of $10 each; non-assessable; yield to April 1, 1882, 200 tons; yield during 1881, 200 tons; no assessments levied; no bonded or other indebtedness, 150,000 shares of stock reserved and now in company's hands, stock quoted $3, April 1, 1882; stock held principally in Illinois; wages paid to all classes of labor per week, $175.

King Bullion Silver Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are Scott A. McKenzie, Pres.; Chas. Benson, Treas.; M. M. Swaab, Sec. The offices are at 117 Market Street, Camden, N. J., and 402 Walnut Street, Philadelphia, Pa. (room 6). The property of the company is located in the Ten Mile district, Summit county, Col., having an extent of ten acres. Capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable. Stock reserved in treasury, 50,000 shares.

King of the Valley Mining Company (The) is incorporated under the laws of the State of New York. The officers are Martin B. Brown, Pres.; Geo. H. Moller, Vice-Pres.; R. H. Rochester, Treas.; Oliver W. West, Sec.; Hon. S. W. Fullerton, Counsel. The Trustees are Gen. L. B. Faulkner, M. B. Brown, G. H. Moller, Hon. R. H. Strahan, R. W. Rochester, Oliver W. West. The offices are at the Equitable Building, (28 and 29, 7th floor,) 120 Broadway, New York city. The company owns one mine located at Silver Cliffs, Custer county, Col., 8.000 feet above sea-level. Extent of claim, 1,500 by 300 feet, or about ten acres. The ore is low grade, free milling chloride of silver and oxide of iron, assaying fifty-three ounces per ton. There are no fissure veins on this formation, the deposit being the result of volcanic action. There are two shafts, forty feet and 163 feet deep respectively. Developments were commenced in July, 1878. The mining plant includes steam-hoisting works, valued at from $5,000 to $6,000, shaft-house, smith's shop, and all conveniences for prospecting the claim. It is estimated that there are in sight at present $2,300,000 worth of free milling ore. The cost of mining and milling is $5 per ton. This mine being only in a partly developed condition, the information regarding it is necessarily of a speculative character. A forty-stamp mill is suggested, built on the latest California style. Mining is suggested by means of open cuts about 200 feet in width. Organized April 20, 1880. Capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable.

Kohinoor Silver Mining Company (The) is organized with a capital of $200,000, in 200,000 shares of $1 each.

Little Silver Mine (The). Owned by Mr. Kearney and others. The Little Silver mine is the property of the above company. The ore is of medium grade and chloride-bearing. Shafts have been sunk—1881. Mr. Kearney, of the Leadville Gold and Silver Milling Company, with a number of other gentlemen, have secured a lease on the Little Silver property. It is thought they would do well in working the silver.

Link Silver Mining Company (The). Officers, Gov. Richard J. Oglesby, Pres.; Judge Hanna, Vice-Pres.; J. B. Grant, Sec.; Wm. Tingley S. Wood, Gen'l Man. Principal office, Leadville, Col. The mining property of this company is located in Lake county, Col. Capitalization, $2,500,000; shares, 250,000; par value, $10.

La Consolidated Silver Mining Company. Agent, Charles A. Porter, 201 Walnut Place, Philadelphia, Pa. The company's property is located in Batopolis district, Mexico. The capital is divided into 500,000 shares; basis non-assessable.

La Plata Mining and Smelting Company (The) is chartered under the laws of the State of New York. The officers are Nathaniel Wetherill, Pres; Theodore Berdell, Vice-Pres.; A. Landon, Sec.; M. G. Smith, Mang Mr. F. W. Day is Supt. The offices are at rooms 12 and 13, No. 58 Broadway. New York. The company owns one mine, the Ora La Plata, located at Leadville, Lake county, Col., the property having an extent of twenty-seven acres. The ore is silver and lead, assaying $30 per ton. There is a tunnel 840 feet in, and shaft 155 feet down. The company have six furnaces in blast, with capacity for smelting 150 tons per day. Main works consist of ore houses, and outlaying buildings, and have a frontage 2.650 feet, and occupy thirty-two acres. The resources of the mine are sufficient to admit of continuous shipments for some time. Current value of the mine is given as $1,600,000; sixty men are employed. Organized, June 13, 1879; capital, $2,000,000, in 200,000 shares of $10 each; non-assessable. Yield during 1881, $2,320.183; thirty-three dividends have been paid to July, 1882; total amount of same, $550,000. Date of latest dividend, June 1, 1882; amount per share, ten cents. Stock is quoted at $9, (July, 1882).1

La Providence Mining Company. The officers are A. L. Snowdon, Pres.; Thos. Cochran, Vice-Pres.; M. H. Hoffman, Sec. Directors, Henry Lewis, D. Haddock, Jr., Rich. Wood (all of Philadelphia), Dr. J. Morrell, of Johnstown, Pa., and Jules A. Rice, of Parral, Mex. The company's mines are located at El Oro, State of Durango, Mex. In the Murculago, there is a six-foot vein of smelting ore; paying-streak runs thirty-two ounces of silver, sorted ore going up to fifty-one ounces per ton. Estimated amount of ore in sight, 5,555 tons, valued at $222,200. The old workings are partly under water, and the estimated cost of reopening and developing the same is $100,000.

Lawrence Silver Mining Company. The officers are John S. Jenness, Pres.; Jacob Stern, Vice-Pres.; W. E. Brown, Sec. Directors, W. D. Swazey, John S. Jenness, Hiram B. Williams, W. Oscar Arnold, Jacob Stern, Manley G. Trask, and Geo. W. Sweetser. The company's property is located at Hampden, Maine. The company was organized in the year 1880, with a capitalization of $500,000; par value per share, $5; yield (net) during 1881, $39,955.87; yield (gross tons) during 1881, $193,989.12; stock reserved in the treasury, 20,000 shares; wages paid to all classes of labor during 1881, $336,043.39.

Leadville Consolidated Mining Company (The) is chartered under the laws of the State of New York. The officers are L. M. Lawson, Pres.; T. W. Shannon, Vice-Pres.; A. Ebert, Sec. and Treas. Trustees, L. B. Elkins, J. B. Chaffee, L. M. Lawson, Y. W. Shannon, R. C. Shannon, H. B. Bacon, P. A. Heyeman. Mr. J. W. Plummer, Superintendent. The offices are at 115 Broadway, New York. The property of the company is located in the California district, Lake county, Col. The ore is silver and lead of high grade. The total length of the lode on which the company depends for its supply of ore is 1,500 feet. Length of north or main level is 600 feet, south incline 200 feet, and combination 235 feet down; all three levels are worked by one engine. Current value of mine is given at $260,000. Organized, 1880; capitalization, $4,000,000, in 400,000 shares of $10 each; non-assessable. The total output for the first half of 1881 was 164,700 tons, taking eleven per cent. of this, the actual lead yield would be 18,100 tons. The total amount of dividends paid to June 15 is $210,000; last dividend, June 15, 1882, ten cents per share; stock quoted June 17, 1882, sixty-five cents per share.

Leadville and Gunnison Mining Company (The). 1881, Mr. O. S. Strothers, Superintendent; Mr. E. Lewis, Financial Agent. The Seguin mine is located on Rock Hill back of the Dome mine, Leadville, Colorado. Very fine ore, composed of carbonates of lead. Depth of shaft, 425 feet, 1881. Fine prospects for a productive and prosperous future. At 375 feet the shaft struck a large body of carbonates of lead, from which shipments have been made with considerable regularity for some time.

Lee Basin Mining Company (The). The officers are Edward D. Cope, Pres.; Charles E. Johnson, Treas.; Geo. L. Smedley, Sec. Mining Engineer, Robert Bunson. Head office, Leadville, Lake county, Col. Transfer office, Exchange Building, Philadelphia, Pa. The company's property is located at Fryer Hill, Lake county, Col. Report says the right shaft has encountered quite a body of fine-grained carbonate ore similar in appearance to that usually found overlying the richer deposits in the Robert E. Lee mine. Late developments in this shaft are very favorable; a depth of 325 feet has been attained. Capitalization, $5,000,000; par value per share, $10; basis, non-assessable.

Victor Mining Company (The) is chartered under the laws of the State of New Jersey. Officers by last election, President, J. L. Sprogle; Secretary and Treasurer, Joseph L. Fryer. Directors, J. L. Sprogle, Jos. L. Fryer, George Y. Magee, A. M. Peel, M. Cullis, J. J. Wilbinham, John L. Smith. Head office, 5 Boston Block, and 310 Chestnut Street, Philadelphia, Pa. The location of the mines belonging to this company are in Texas Creek, Col. Galena ore, containing antimonial silver, assaying 860 ounces of silver to the ton, 1881. They own twelve claims. Capitalization, 200,000 shares of $5 each = $1,000,000; non-assessable; 175,000 shares issued; 25,000 reserved.

Leeds Silver Mining Company (The) owns mining property at Silver Reef, Utah. The length of the main lode on which the company depends for its supply of ore is 3,000 feet. The company is organized on an unassessable basis. Capitalization, $6,000,000, in 60,000 shares of $100 each. The mines yielded in 1880, $29,255. Dividends to amount of $78,000 have been paid to October 10, 1878, date of last dividend of fifteen cents per share. Six assessments have been levied; total amount of same, $57,000. Date of first assessment, January 17, 1880; amount of same, ten cents per share. Date of latest assessment, February 23, 1882; amount of same, thirty cents per share. About 5,000 shares of treasury stock are in the market at $2 per share: proceeds of sale are to be devoted to the purchase of additional machinery

Lehigh Valley Mining and Smelting Company. The officers are T. H. Freeland, Pres.; John T. Giviner, Sec. and Treas.; R. E. James, Atty.; W. H. Kinney, Supt. and Mang. The company owns ten claims located at the upper part of O be Joyful Gulch, Col. A tunnel of 500 feet is now being driven.

Little Chief Mining Company (The) is chartered under the laws of the State of New York. Tingley S. Wood, Manager; S. C. Dean, Sec. Principal offices, 22 California Street, San Francisco, Cal. The Little Chief mine, owned by the company, is located on Fryer Hill, Col. At Leadville, ten acres of land are owned by the company. A tour through workings shows numerous fine streaks of ore, silver and lead carbonates. First-class ore gives 200 ounces silver to ton; second-class, fifty to sixty. Lead, from ten to forty-five per cent. Great probabilities of a prosperous and productive future. The ore face on some parts twelve feet high; the richest points being near No. 2 shaft. Property owned by the company, shaft houses, smelter, etc. (value, $45,000), hoisting works. Shaft used; ninety men employed. The Little Chief mining company was organized December 16, 1879. Current value of mine, $130,000. Capitalization, $10,000,000; shares, 200,000; par value, $50; non-assessable; yield net during 1881, $1,103,311; number of dividends paid August 24, seven; total amount, $700,000; number of assessments levied, one; total amount of same, $50,000; amount per share first assessment, $5; date of latest assessment, January 13, 1882; amount per share, $5; quotations, June 15, sixty-five cents; July 14, fifty-one cents. Total profit of mine since discovery, $2,200,000; net profit for 1881, $135,000; surplus on hand, $120,000.

Little Pittsburgh Silver Mining Company (The) is chartered under the laws of the State of New York. The officers are David S. Draper, Vice-Pres.; H. A. Kirkham, Sec. Mr. E. C. Gilman is the Superintendent. The company owns one mine, the Little Pittsburgh, located at Leadville, Col.; extent of claim, thirty acres. The ore is silver and lead of high grade, assaying from $35 to $50 per ton. There are six shafts in the mine. The trend of the ore is to the east, slightly pitching to the north. The vein varies from eighteen inches to three feet in thickness; No. 6 shaft has a depth of 275 feet. The plant includes two Knowles' pumps. There are 125 men employed; the average amount of wages paid per month is $17,540. Work is now progressing rapidly in No. 6 shaft, where the hopes of the management are centred for the present. From this shaft, No. 6 or the new discovery, the company is shipping about thirty tons of ore a day, which runs from $80 to fifty ounces. The output at Jan., 1882, was about 100 tons. Organized, April 25, 1879. Capitalization, $20,000,000, in 200,000 shares of $100 each; non-assessable; net yield during 1880 was $377,428; total amount of dividends paid, $1,350, to March 1, 1880, the date of last dividend of fifty cents per share. On April 22, 1882, the company had a cash surplus of $88,893.60. Total profit of mine since discovery, $2,457,321. Monthly expense account, about $9,000. Weekly output of ore, 150 tons; seventy-five workmen employed.

Little Sue Silver Mining Company. The Directors are H. B. Mason, Pres.; L. W. Hodgkins, Sec. and Treas.; B. O. Cutter, K. H. Sivett, Jas. W. Davis. The company's property is located at Lamoine, Me. The company was organized January, 1880, with a capitalization of $500,000. Par value per share, $1.

Livingstone Silver Mining Company (The) is chartered under the laws of the State of Colorado. The officers are Jas. W. Latta, Pres.; Thos. V. McCurdy, Vice-Pres.; Lewis C. Green, Sec.; Chas. S. Green, Treas. Directors, J. W. Latta, D. H. Kochesberger, E. Irwin Scott, Thos. V. McCurdy, F. S. Christian, P. A. Snell, and C. G. Greene. Prince A. Snell is the Superintendent. Offices at 154 S. Fourth Street, Philadelphia, Pa. The company owns one mine, the Livingstone, located at Alpine, Col. There are four chief veins; the shaft is down 195 feet; from it run two cross-cuts, which are developing a vein, some fifty feet wide, of rich material. Capitalization, $6,000,000, in 600,000 shares of $10 each; non-assessable; 300,000 shares issued; 300,000 shares reserved in treasury.

Lowland Chief Consolidated Silver Mining Company (The). Officers, S. W. Dorsey, Pres.; John Stanton, Vice-Pres.; T. W. Torrey, Sec. and Treas. Gen. office, 115 Broadway, New York. Capitalization, $1,000,000; shares, 200,000; par value, $50.

Lucerne Mining Company (The) is chartered under the laws of the State of New York. The offices are at 60 Broadway, New York. The property is located in Clear Creek and Gilpin counties, Col. The ore is auriferous and argentiferous. Incorporated October 20, 1880. Capitalization, $5,000,000, in 500,000 shares of $10 each; non-assessable.

Luona Mining Company (The). of which C. H. Garstin is Superintendent, has the following officers: A. B. Hough, of Cleveland, O., Pres.; F. Oscar Reuter, of Denver, Sec. The company owns the Luona mine and one-third interest in the Hancock, an adjoining claim, the property being located in Tescolli mountain, near the head of Brush creek, six miles east of Gothic, Col. The ore is a silver glance, carrying native silver in large quantities and smelting freely, and assaying from 90 to 4,000 ounces per ton. Mill runs range from 400 ounces to 800 ounces. The veins have an average width of from four to five feet, with a two-foot pay-streak of ore in each. The ore of the Hancock is of the same character as that of the Luona. One shaft is down forty feet; two tunnels driven, one fifty feet and the other 100 feet. The property in connection with mine consists of ore-house, boarding-house, smith's shop, etc. It is expected that when this district is fully supplied with concentrating facilities, the Luona mine will stand among the first of the Gunnison producers.

Mackey Mining Company (The) has property located in Storey county, Nev. Length of main lode on which the company depends for its supply of ore, 2,400 feet. The company is organized with a capital of $10,000,000, in 100,000 shares of $100 each. No dividends paid; five assessments levied, aggregating $70,000; latest assessment, November 23, 1880.

McClintock Mining Company (The). Wm. Lent, Secretary. Office, 309 Montgomery Street, San Francisco, Cal. The location of these mines are in Bodie district, California. The amount of property, 300 and 1,500 feet. Well-defined ledge of fair grade ore two to three feet wide. Hoisting works are owned by the company. Tunnel is 600 feet in length. Length of levels are 3,000 feet of excavations. Length on which the company depends for its supply of ore, 1,000 feet. $1,500 expended in developing property 1,000 feet in mine. Capitalization, $6,000,000; shares, 65,000; par value, $100. No dividends paid to January 1, 1882. Number of assessments levied, seven; total amount of same, $123,000; date of latest assessment, October, 1880; amount per share, five cents. Stock quoted January 1, 1880, $2.50, highest point reached.

Madre Silver Mining Company (The) has its offices at 61 Broadway, New York (rooms 41 and 42). The officers are J. H. Williams, Pres.; J. B. Barnes, Vice-Pres.; W. M. Tileston, Sec.. The National Park Bank, Treas. The property is located in the Ward district, White Pine county, Nev., right in the great ore channel of the district, and such developments as have been already made expose a deposit of unusual quantity of carbonate ore. The company is a consolidation of the Ready Cash and Jew Peter mines. Capitalization, $1,000,000, in 100,000 shares of $10 each; non-assessable.

Magnet Mining and Milling Company (The). Officers, Charles Tate, Pres.; A. G. Woodward, Vice-Pres.; Edgar H. Peck, Sec. and Treas. Directors, Charles Tate, Edgar H. Peck, O. C. Hainsbrough, and General Manager; Attorneys-at-Law, Ingersoll & V. Crates. Principal offices, Denver, Colorado, Sims' Block; Boulder office, Hainsbrough Block. The mining property owned by this company is located in Colorado. This company was reorganized January 18, 1882.

Marion Mining Company (The) owns the Cyclope mine located on the south side of Shay Horse Gulch. Work has been prosecuted on this property almost incessantly since its first discovery, and, although not always productive, there has been some valuable ore mined. It is now being worked on base with fair results.

Matchless Mine (The), owned by Gov. Tabor, is located on Fryer Hill, Lake county, Col., adjoining the well-known Robert E. Lee. The ore consists of hard and sand carbonates. The principal workings are in shafts Nos. 2 and 3. In branches of the former, the mineral matter, while not showing any chloride, is remarkably rich, and gives returns of from 400 to 600 ounces to the ton. Outside of this streak, which is quite narrow, are also a large amount of iron which runs high, and occasional deposits of hard carbonates that are very rich. The Leonard shaft has been closed down and its machinery and shaft-house taken to No. 3, which is near the line of the R. E. Lee. Connection is here made with the Lee workings, and along the line fine ore is exposed which runs from 200 to 600 ounces of silver to the ton. The ore-body is very strong to the north, and has been worked out but little. Altogether, the developments show immense deposits of high-grade ore that must prove a source of revenue for some time to come. The property has an extent of four and one-half acres. Mr. S. C. Leonard is Manager. Total production from discovery, $500,000.

Mayflower Mine (The), on Anna Mountain, is the property of Messrs. Hansling & Co. The property is located in Gunnison county, Col. The vein is two and a half feet in width, with a pay-streak of twelve inches carrying black sulphurets, brittle silver, and galena. There are two shafts, 102 and seventy-two feet respectively. The vein is exposed at several points on the surface. Four mill-runs gave as follows: first, 197 ounces silver and ½ ounce gold; second, 190 ounces silver and 1¾ ounces gold; third, 184 ounces silver and 2 ounces gold; fourth, 321 ounces silver and 3¼ ounces gold.

Mercantile Mining Company (The). Mr. Adams, Manager. The Silver King mine is owned by the company. Located near Komoko, Silver Cliff, Colorado. The ore consists of solid galena and carbonates of silver. Entrance to mine is by tunnel; shaft, 100 feet. The opinion of the men at work in the shaft is that the ore body discovered is of considerable extent.

Mexican Guadalupe Mining Company (The). Henry G. Fox, Pres.; H. H. Reed, Treas.; A. C. McCurdy, Sec.; E. S. Butcher, Supt. Principal office, 427 Walnut Street, Philadelphia, Pa. The mines belonging to this company are located in Nueva Leon, Mexico. Character of ore is silver, assaying $200 per ton.

Mexican National Exploring and Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are Henry J. Fox, Pres.; W. D. Frismuth, Jr., Treas.; Joseph R. Livezey, Sec. Directors, Henry J. Fox, W. D. Frismuth, Jr., Henry H. Reed, Evan Morris, B. Frishmuth, Jos. R. Livezey; all of Philadelphia, Pa., and Casper S. Butcher, of Candela, Mexico. The General Manager in Mexico, Frederick Russell, Lampazos, Mexico. Financial Agents, Daniel Milmo Bros. & Co., bankers, Lareda, Texas. The offices are at 427 Walnut Street, Philadelphia, Pa., also at Camden, N. J., and at the cities of Lampazos, Candela, Villaldama, and Monterey, in the States of Cohahuila and Nuevo Leon, Republic of Mexico. The company owns the following claims: The San Juan Chico, a silver claim known as the Philadelphia; the Pedro Yman mine, the Boludo Mountain, a copper claim; the Guadalupi silver claim, the Bolsa de Judes silver claim, the Yguana silver mines, the Panuco claims, the Minas Vejos silver claim, the Rasario, and others, making a total of sixteen claims, all located in the States of Nuevo Leon and Cohahuila, in the Republic of Mexico. Each claim contains from four to six pertinencias, each pertinencia being 200 yards square. Several of the claims have from one to four mines each. $20,000 has been expended in developments which were commenced in June, 1881. Two dividends have been paid; one July 1, 1882, $88,000; one August 1, 1882, $66,000; total, $154,000. No assessments levied. No bonded or other indebtedness. 20,000 shares of Mexican Guadalupe company stock reserved in treasury.

Micawber Silver Mining Company (The) is chartered under the laws of the State of Colorado. Officers, O. L. Garver, Pres.; J. W. Mulford, Vice-Pres.; William Dunlap, Treas.; Enon M. Harris, Sec. Directors, A. L. Garver, J. W. Mulford, S. H. Crawford, A. Hazlet, W. P. Hill, J. V. Fullaway, Joseph Pettit, W. H. Wade, Charles G. Weller, R. Robbins, Charles Klein, Wm. Charleton. Principal office, 113 S. Fourth Street, Philadelphia, Pa. The Micawber mine is owned by this company, located in Colorado. The ore is silver. Two shafts about 100 feet each in depth. Capitalization, 175,000 shares; par value, $10; non-assessable.

Miller and Mormon Canyon Mine (The). Owned by Marks & Co. The mines owned by Marks & Co. are located in Huachuca Mountains, Ariz. The ore gives an assay of forty per cent. copper, and from $230 to $250 per ton in silver. Valuable copper leads. The W. C. Davis mine has been sold to California parties for $45,000. Some very rich discoveries, showing very fine ore, on the north side of Mowery Hill.

Miner Boy Miner Company (The). Principal office, 63 Broadway, New York. The location of the mines belonging to this company are located in Colorado. Entrance to the mines is by tunnel, 270 feet in length.

Mineral Creek Mining Company (The). Officers, Charles G. Rodgers, Pres.; Alvin S. Hill, Sec. Principal office, 202 Broadway, rooms 50 and 52, New York. The mining property of this company is located in Arizona. The company has a five-stamp mill. Capitalization, $2,000,000; shares, 200,000; par value, $10.

Monitor Silver Mining Company owns the Galena, Regatta, and Bonanza mines. They are situated between the Robinson Consolidated and the Gray Eagle mines, Col., and their location and promise, it is reported, are among the best undeveloped properties in the Ten Mile district. All the lodes have abundant timber, and the claims have prospect shafts upon them, ranging from forty to 200 feet in depth.

Monitor Consolidated Mining and Milling Company (The). Officers, Thomas M. Patterson, Pres., Denver, Col.; J. Keating, Denver, Col., Sec. and Treas. H. F. Richardson, Crested Butte, Superintendent. The Monitor Chief, Neptune, Reality, Be Joyful, Richardson, Herentez, are the mines' names belonging to the company. The ore is galena, gray copper, and iron pyrites, assaying fifty ounces silver to the ton. The vein of twelve feet, with a spar gangue rock—rock bearing galena.

Montana Copper Company. The property is located in Silver Bow county, Montana. Their principal mine is the Colusa, which averages fifteen to eighteen feet of width of pay, and is developed to the depth of about 300 feet. Recently, samples have been found carrying as high as seventy ounces of silver per ton, and sixty-five per cent. copper. Besides the Colusa, the company owns the Harvey, Green Mountain, Parrott, and four other locations. Capitalization, $200,000. This property produced during 1881, $1,042,640.

Montana Silver Mining Company (The). This company is chartered under the laws of the State of New Jersey. Officers, L. W. Klahr, Pres.; W. L. Barnum, Vice-Pres.; Anson Gorton, Treas.; Amos T. Hall, Sec.; F. E. Morse, Gen. Mang.; George W. Huddleson, Asst. Sec. Directors, W. L. Barnum, W. N. Hibbard, Amos T. Hall, Anson Gorton, F. E. Morse, Major S. M. Whiteside, John R. Hoxie. Principal office, 138 S. Fourth Street, Philadelphia. This company's mining property is located in Arizona. Capitalization, 200,000 shares; par value, $10; non-assessable.

Montezuma Mine (The). Owned by Tabor & Co. The location of the Montezuma mine is in Ashcroft, Pitkin county, Col. The ore consists of rich veins of minerals. Vein forty feet wide, with a large rich pay-streak.

Montezuma Mine and Milling Company (The) is chartered under the laws of the State of New Jersey. Officers, Ephraim Young, Pres.; Joseph E. Tate, Vice-Pres.; Gen. James Stewart, Jr., Sec. Directors, Ephraim Young, Joseph G. Tate, Gen. James Stewart, Joseph E. W. Mathews, Dr. H. Graham Reed, Dr. J. Lehman Eisenbrey, Edward P. Borden, Lewis A. Connell, Allen Middlebrook. Principal office, Camden, New Jersey. Inquiries made at 312 Stock Exchange Place, Philadelphia, Pa., room 15. The names of the mines owned by the company are Montezuma and McClelland, both full claims, located in Arizona. The Montezuma mine is opened by a shaft of fifty feet in depth, along the incline of the ledge. The vein is ten feet in width, between fine, smooth walls. There is a second ledge, but its size and value have not yet been determined. The Silver Girt lode is said to pass through this claim. The ore from the McClelland will assay $60 per ton. There are about fifty tons of this ore on the dump. Shaft on the McClelland, fifty-four feet down, with cross-cut thirteen feet. Capitalization, 300,000 shares; par value, $10; non-assessable. Amount of stock in treasury, 93,000 shares.

Montgomery County Smelting Company (The). These mines are located in Mono county, Cal. Bish & Co. are erecting smelting and other works on the Walnut mine.

Moore Mining and Smelting Company. The company's property is located in California. The company has paid in dividends $72,000; date of latest dividend, January 6, 1882.

Moose Mining Company is chartered under the laws of the State of Colorado. Office, Dudley, Col. The company have a group of mines located at Mount Bross, Park county, Col., chief among which is the Moose mine. The ore has a value of $93.58 per ton. The company owns 160 acres of mineral ground. The main lode is 2,025 feet in length. The Moose mine has been very extensively worked from the north face of the mountain, and has furnished extraordinarily large chambers of ore, one single slope having produced about $150,000. The formation is lime and porphyry, and the mineral lies in deposits and not in veins. The total extent of excavations will probably aggregate five miles, and the product has been considerably over $3,000,000. A smelter erected by the company at Dudley has proved a failure, owing to mismanagement, and has been closed down. Date of organization, 1872. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable. Yield to January 1, 1881, $3,000,000. Total amount of dividends paid, $550,000; date of latest dividend, March 5, 1881, twenty cents per share. Total amount of assessments levied, $4,000. Stock quoted July 1, 1882, twenty cents per share.

Moose Mining Company (The). Officers; Directors, J. Whitaker Wright, Charles L. Hall, J. A. Rosecrans, C. C. Kellogg, Charles I. Thomas, J. L. Loomis, John Q. Savage, L. G. Kent, Wm. McCafferty. Moose mine is located in Alma, Colorado, 1881, shipping from fifteen to twenty tons of ore per month. Fifteen men employed. The Russia mine, located near, has about ten men employed, shipping about ten tons per month. C. W. Bailey has the management of the mine.

Native Silver Mining Company (The) is chartered under the laws of the State of New York. The offices are at 31 Broad Street, and 18 Wall Street, New York. The property of the company is located in the Grand Island mining district, Boulder county, Col. The ore is argentiferous, assaying about 188 ounces to the ton. The mine is well furnished with complete mill and other necessary buildings. Organized, November 15, 1879; capitalization, $1,000,000, in 200,000 shares of $5 each; non-assessable.

Navajo Mining Company (The) has its offices at 310 Pine Street, San Francisco, Cal. J. W. Pew is Secretary. The property of the company is located in Tuscarora, Nev. The ore is high grade, consisting mostly of chloride. Length of main lode, 500 feet on claim. The company was organized with a capital of $10,000,000, in 100,000 shares of $100 each. Yield during 1880, $30,420. Total of dividends, $25,750, paid to March 25, 1881, date of latest dividend of twenty-five cents per share. Thirteen assessments have been levied, aggregating $235,000; latest assessment, 7th March, 1882, twenty cents per share. Stock quoted 14th July, 1882, $4.50. Current value of mine, $270,000.

Nevada Mining and Milling Company (The), of Chicago, has offices at 153 La Salle Street, Chicago, Ill. Mr. W. Orledge is Superintendent. The annual meeting is June 21. The officers are B. W. Goodhue, Pres.; Gen. G. N. Reece, Vice-Pres.; A. Larrabee, Sec.; F. H. Brown, Treas. Directors, B. W. Goodhue, J. K. Moore, Wm. Orledge, Joseph Schweder, R. Nevers, J. H. Roberts, R. W. Dunston. The company has levied five assessments. The last assessment of four cents per share was levied on May 6, 1882.

Newton County Mining and Smelting Company is chartered under the laws of the State of Illinois. The officers are E. W. Strout, Pres.; W. H. Yeaton, Sec.; F. C. Hoyt, Treas. Directors, F. W. Strout, G. A. Purdy, R. I. Henderson, J. M. Purdy, F. C. Hoyt, W. H. Yeaton. Superintendent, F. W. Strout. This company has leased 1,160 acres of land from the St. Louis and San Francisco Railroad, lying in the mineral belt, almost on a direct line between Granby and Joplin, Newton county, Mo. The principal deposits are at a depth of seventy-five feet. The mines have been examined and pronounced equal to those at Joplin. Date of organization, May 8, 1882; capitalization, $500,000; par value per share, $10.

New York and Colorado Mining Company. Location of property, Colorado. Amount of dividends paid to July, 1879, $25,000. The last dividend was paid July, 1879, at the rate of ten cents per share.

Niagara Consolidated Mining and Reducing Company (The) has offices at 356 Superior Street, Cleveland, Ohio. C. E. Stanley is the Secretary. The company is organized with a capital of $1,000,000, in 100,000 shares of $10 each; non-assessable; full paid. Treasury reserve, 66,400 shares, for a working capital.

Northern Belle Mining Company (The). Officers, W. Willis, Secretary. Office, 309 Montgomery Street, San Francisco, Cal. The mining property of this company is located in Nevada.

Northern Belle Silver Mining Company (The) has property in Columbus district, Esmeralda county, Nev. The mine operated is the Northern Belle, the ore of which is high grade, assaying from $100 to $200 per ton. The vein increased in width to about seven feet. The main shaft is down to 1,300 feet. The length of the main lode on which the company depends for its supply of ore is 1,600 feet. Weekly out-put, April, 1882, from four to five hundred tons. Weekly bullion shipment, June 22, 1882, $18,569.68. Current value of mine, $375,000. Capitalization, $5,000,000, in 50,000 shares of $100 each. Yield during 1880, $1,314,367; $2,188,500 paid in dividends to April 15, 1882, the date of latest dividend, which was at the rate of fifty cents per share. The first assessment levied June 5, 1882; amount per share, twenty cents. No indebtedness. Stock in treasury, $87,074. Dividends paid during 1881, $400,000; equal to $8 per share.

North Horn Silver Mining Company (The) is chartered under the laws of the State of New York. The Trustees are Thos. J. Hurley, of Bamburgher, Hurley & Co., Salt Lake City, Utah, and J. T. Hurley & Co., 18 Wall Street, New York city; Chas. L. Wright, shipping merchant, 56 South Street, New York city; Wm. Smedley, Exchange Buildings, Philadelphia, Pa. Offices at 115 Broadway, New York (the offices of the Mutual Trust Company), and at 18 Wall Street, New York (the offices of J. T. Hurley). The company owns six mines or claims, Gt. Republic, Spanish, Wolcott, Rosa, Comstock, and Vanderbilt, located in Fisco, Utah, being an extension of the famous Horn silver, which is reported having a splendid show of ore at a distance of only about 1,500 feet. The workings consist of four tunnels and two shafts, now in mineral. The Republic and Wolcott veins are from 150 to 200 feet wide. In the tunnel of the Spanish there is a fine showing of low-grade galena ore. A rich strike has been made on an uprise from 130-feet level, a six-inch vein being encountered, assaying $260.91 of silver, with a trace of gold. The average of assays taken from a four-foot ledge was $81. Capitalization, $4,000,000, in 400,000 shares of $10 each; non-assessable, full paid; treasury stock, 100,000 shares.

Oak Silver Mining Company (The). These mines are located in Gunnison county, Col. Capitalization, 600,000 shares.

Occidental Mining Company (The) has property located on the Comstock lode, Nevada. Length of main lode on which the company depends for its supply of ore 1,706 feet. Capitalization, $4,000,000, in 40,000 shares of $100 each. Six assessments levied, aggregating $112,500; date of latest assessment, March 9, 1879; cash on hand, March 1, 1882, $7,064.

Occidentine Mine (The). Owned by the Hon. Nelson Halleck and J. W. Happy. The Occidentine mine is the property owned. Located on Mount Lincoln, Col. The character of the ore is porphyry, dike, and lime. Mill run, assays per ton seventy-five to 500 ounces. Three drifts are run. Depth of shaft, eighty feet, 1882. The owners have shown remarkable grit and perseverance in working this property. Some time ago they worked with discouraging results. All mines that have been worked during the past winter have been looking well. They must have now in sight over $5,000 worth of ore.

Old Colony Silver Mining Company (The). The names of mines owned by this company are the Golding Group. Located in Mosquito Gulch, Col.

Oneida Mine (The). Owned by Nabob & Peterson. The company's claims are the Northern Light, Silver Star, Orphan Boy, Paymaster, and Virginia. These mines are located in Caribou district, Idaho Ter., south side of the mountain. Rich tractable ore claims located on the north side of the mountain. Mines are opened by a tunnel driven on the course of the vein.

Ontario Consolidated Mining Company (The) has offices at Denver, Col. The officers are H. A. W. Tabor, Pres.; Dennis Sullivan, Vice-Pres.; Geo. R. Fisher, Treas.; J. T. Wellborn, Sec.; Timothy Foley, Gen. Mang. Directors, W. H. Bush, Chas. H. Hall, Thos. G. Gibson, and J. W. Gaynor. Superintendent, S. S. Austin. The company owns two mines, Ontario and Capitol, located at Breece Hill, Lake county, Col.

Ontario Mining Company (The) is chartered under the laws of the State of California. Officers, J. B. Haggin, Pres.; Jos. Clark, Vice-Pres.; H. B. Parsons, Asst. Sec. Transfer office, 65 Broadway, New York; San Francisco, and 18 Wall Street, New York, are the general offices. The mines owned by the company are the Last Chance, Ontario, and Switzerland, Mintah, Summit county, Col. There are sixty-three acres of property owned by the company. The ore is silver, soft, pliable, and easily mined, it cleaves readily from the walls, is separated from gangue without difficulty. Assays $70 to $80 per ton. Vein fills a strong, well-defined fissure, having a course nearly east and west, the dip being northerly, varying from 79° to vertical. The fissure traverses the belt of quartz, cutting through the layers of the formation. The mine is worked through two vertical shafts, sunk in the hanging wall connecting. The mill is provided with a steam-engine of 250-horse-power, forty stamps, arranged for dry crushing. Two Stetefeldt furnaces, each with a capacity of chloridizing twenty-five to thirty tons of ore daily. From measurement of the stope, the amount of ore in sight between the second and fourth levels in Last Chance ground, and between the fourth and sixth levels in Ontario, Last Chance, we estimate at 33,964 tons, in addition to which there are 2,050 tons in the ore-bins, making in all, 36,014 tons, sufficient to supply well for two years. Current value of mine, $4,325,000, 3,000 feet in mines, 1,800 feet on Comstock lode. Last current value of mine, $5,062,000. The Ontario mine has yielded nearly $2,000,000 per annum since work fairly began for the year 1880. This company was organized on September 16, 1876. Capitalization, $15,000,000; shares, 150,000; par value, $100. It is announced that the sixty-third successive monthly dividend of 50 cents a share aggregates $30,000. Total dividends to date, January, 1881, $3,150,000. Number of dividends to July 15, 1881, total amount, $4,475,000. Date of latest dividend, June 15, 1882. Amount per share, fifty cents.

Ophir Silver Mining Company (The). Officers, C. L. Weller, Pres.; A. K. P. Harmon, Vice-Pres.; C. A. Fish, J. H. Robinson, C. L. McCoy, Sec.; W. H. Patton, Supt. Annual election, December 21. Principal office, 309 Montgomery Street, San Francisco, Cal. The location of the mines belonging to this company is in Virginia district, Comstock lode, Nevada. Depth of shaft, 2,600 feet. Length of the main lode on which the company depends for its supply of ore is 675 feet. Seventy miners and 19 surface men are employed at the Utsh mine. This company was organized December, 1879. Capitalization, $10,000,000; shares, 100,000; par value, $100; number of dividends paid to January 17, 1880, twenty-three; total amount, $1,596,400; date of latest dividend January 17, 1880; amount, $1; number of assessments levied, forty-one; latest assessment, November 5, 1880; amount per share, $1; total amount of same, $3,294,200; yield, net, during 1880, $75,948; cash on hand February 1, 1882, $1,651.09; stock quoted July 1, $8.50; floating indebtedness, April, $40,960.

Original Keystone Silver Mining Company (The). E. E. Lutz, Sec. Principal office, 530 Pine Street, San Francisco, Cal. The location of this mining company's works is in Nevada.

Orion Mining Company (The) is chartered under the laws of the State of Pennsylvania. H. Disston, Pres.; J. H. Asbury, Treas.; B. F. Hart, Sec. General office, 138 S. Fourth Street, Philadelphia. The company has property located in Pima county, Arizona. The property comprises the Warsaw mine, the most extensively developed of any in the district, one of the shafts being down 212 feet, besides an incline of 100 feet, and drifts that will aggregate 400 feet more. The ore on the dump, about 1,400 tons, is principally sulphides and chlorides of silver in character and of good grade. The vein is from three to five feet in width. At a depth of seventy-five feet in another shaft a ledge of five feet in width was struck which proved to be rich ore, giving an average assay of $600 per ton. The ledge proved to be all ore between smooth walls of porphyry and sienite. The ore is a black sulphuret with ruby, native brittle and wire silver, besides chloride and gray copper. The mill of the company has been closed part of the year owing to a scarcity of water. It is claimed that mill runs of $300 to the ton have been had from the ores obtained. The company has a capitalization of $2,000,000; par value per share, $10; basis, non-assessable.

Ontario Mining Company (The). The property belonging to this company is located in Utah. Production for year 1880, 1,439,542 ounces silver.

Oro Blanco Silver Mining Company (The) is chartered under the laws of the State of Iowa. Officers, Ex-Gov. W. M. Stone, Pres.; P. K. Bone, Vice-Pres.; J. D. Gamble, Sec. Knoxville, Iowa. Principal office, Knoxville, Iowa. The mines belonging to this company are located in the Oro Blanco mining district, Arizona. Capitalization, $2,000,000; par value, $20.

Overman Silver Mining Company (The). Officer, George D. Edwards, Secretary. General office, 414 California Street, San Francisco. The mines of this company are located on Comstock lode, Nevada.

Palmetto Mining Company (The) has property located in Hinsdale county, Col. The company owns the Palmetto, Ruby Queen, and Miner's Bank, mines which are all on one vein, measuring 3,123 feet in length. Forty men have been employed at the mines. The developments now show 430 feet of shafting, the main vertical shaft being 230 feet, with about 1,600 feet of drifting. From that part of the work done on the vein there have been sent to the mill 400 tons of ore, yielding $28,000 worth of silver. The ore ran to eighty-six per cent. of the assays.

Paramint Mine (The). Messrs. James Irvin and Benjamin Miller, owners. The Paramint mine, owned by Messrs. Irvin and Miller, is located near Banner, Idaho. Quartz mill struck seventy or eighty feet. Tunnel is in 110 feet, vein two feet wide. Immensely rich in silver.

Peabody Silver Mining Company (The) has its offices at 386 Washington Street, Boston. The officers are J. W. Johnson, Pres.; E. C. Nichols, Vice-Pres.; L. P. Johnson, Sec.; E. R. Walker, Treas. Directors, J. W. Johnson, S. C. Hursh, W. C. Bradley, N. W. Gannet, C. T. Plumpton, A. C. Gass, E. C. Nicholls. The property of the company is located in Columbia Mountain, Colorado. Basis of organization, unassessable; five assessments levied; latest, May 6, 1882, four cents per share.

Pembina Consolidated Mining and Milling Company is chartered under the laws of the State of Colorado. The officers are James W. Latta, Pres.; Lewis C. Greene, Sec. and Treas. Directors, James W. Latta, N. F. Lightner, D. H. Kochesberger, John Ruhl, J. M. Vanderslice, John Taylor, Mahlon Preston, M.D., Robert L. Orr, P. A. Snell, C. G. Green, J. K. Caldwell. Prince A. Snell, Superintendent. Office, 154 S. Fourth Street, Philadelphia, Pa. The mines owned are the Moccasin, the Red Rover, the Pembina, and the Monroe, located in Chaffee county, in the State of Colorado. The company's property includes one concentrating mill kept constantly employed on custom work and ore from their own properties. The Clifton mine is also owned by this company. It has four well-defined veins from four to six feet wide, extending the entire length of the claim. Assays of the different specimens of ore show from twenty to 280 ounces of silver, and one-half ounce to one ounce of gold. Drifts are being made with a view of cutting all the veins and then working them by levels. A tramway is being constructed 1,750 feet long, to carry the ore from the tunnel to the foot of the hill, where there is a good road to haul to any place desired.

Pennsylvania Consolidated Silver Mining Company (The). D. F. Hoag, Manager, one of the owners. Principal office, Oil City. The Excelsior mine is owned by the company, located at Alma, Colorado, 1881. The past summer has been spent in retimbering and improving this property, to put it in shape to commence shipping ore. Ten workmen employed.

Pentagost Mining and Smelting Company (The). Officers; Directors, John L. Hodsdon, G. H. Emerson, W. E. Carleton, Philip Evans, E. C. Smart, F. H. Clerque, and J. W. Leavitt. Date of organization, June 28, 1881; capitalization, 500,000 shares.

Perry and Park Mines. Owned by Messrs J. A. Park, Leighton, and T. Otto. The Perry & Park mines are located in Hassayampa district, ten miles south of Prescott. Extent of claim is 1,500 feet each. Sulphuret and antimonial ore, assays $375.90 per ton, as sold in San Francisco, Cal. Character of mines are fissure, sienite, and granite. Depth of shaft, 175 feet; average width of vein, eighteen inches to twelve feet. Two tunnels and one shaft used. Property deemed very good; valued at about $6,000. Bonded indebtedness, none.

Philadelphia Mining and Milling Company (The) is chartered under the laws of the State of New Jersey. Officers, E. J. Mathews, Pres.; E. F. Green, Sec. Directors, Henry Whelan, J. F. Bailey, J. T. Owen, P. A. B. Widener, Hamilton Disston, H. A. During, and E. J. Mathews. Main office, Camden, N. J.; branch office, north-east corner Third and Chestnut Streets, Philadelphia, Pa. The names of the mines belonging to this company are West Fork No. 1, West Fork No. 2, Satellite, Black Hawk, Yellow Jacket, and Ten Broeck, all located in Alluras county, Idaho. The Black Hawk is the company's chief mine. It was undeveloped in June, 1881, but up to November of that year produced 600 tons of ore yielding 200 ounces of silver to the ton. The company's capitalization is divided into 200,000 shares; non-assessable.

Pizarro Extension Silver Mining Company is chartered under the laws of the State of Colorado. The officers are J. O. Eberhard, Pres.; Seth Smith, Vice-Pres.; Robert Storey, Treas. Directors, J. O. Eberhard, V. G. Edwards, C. P. Johnson, H. W. Peters, D. B. Herbine, Wm. Tweed, Seth Smith, Wm. Cheatley, and Wm. Spotts. The company's mining property consists of one claim, 150 by 1,500 feet, located in Colorado. The shaft is eighty-five feet deep. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable; stock reserved in treasury, 90,000 shares; amount of stock issued, 110,000 shares.

Plata Pedra Mining Company (The). The Plata Pedra mine is owned by this company. Located at Silver Cliff district, Col. A force of men has been put on for the purpose of getting out a mill run of ore. Mill owned by the company.

Plata Verde Mining Company (The) is chartered under the laws of the State of New York. The officers are J. R. Bartlett, Pres.; Geo. E. Cole, Vice-Pres.; Geo. H. Stayner, Treas.; Andrew W. Kent, Sec. Office, 25 Nassau Street, New York. The company's property is located at Silver Cliff, Custer county, Col. The company has a capitalization of $1,000,000; par value per share, $100.

Plymouth Rock Mining Company (The) has offices at 7 Exchange Place, Boston. Officers are Isaac B. Rich, Pres.; Geo. Haskell, Sec.; J. E. Abbott, Treas.; W. H. Newcomb, Gen. Mang. The property of the company is located in Silver City, New Mexico. Prospecting is conducted by means of a diamond drill and complete outfit with which they can reach a depth of 1,000 feet. Capitalization, $2,500,000, in 100,000 shares of $25 each.

Polonia Mining Company. The company's property is located at Silver Cliff, Colorado. Capitalization, $200 000; par value per share, $25; total amount of dividends paid to June 17, 1882, $12,000; date of latest dividend, June 17, 1882, $1.50 per share; production for four months in 1880 was $25,000.

Queen of the West Company (The). The Russler and Pittsburgh mines are owned by this company. Located in Utah, under the negotiations to the old telegraph company.

Randolph Mining Company. Location of property, Tombstone district, Ariz. Twenty-five miners are employed, and about seven tons are being hoisted per day, and developments are under way.

Red Elephant Mining Company is chartered under the laws of the State of New York. Office, 33 Broad Street, New York. The company's mining property includes the White, Boulder Nest, Free America, and Free America Extension Lodes. Located at Red Elephant Mountain, Clear Creek county, Col. The ore gives a silver assay. The company owns engine and shaft houses. Reports says heavy shipments are made daily, varying from eighty to 100 tons per day. High-grade ore is shipped to the reduction works at Golden. The mines have been worked during the year in a very satisfactory manner. A forty-horse-power engine and a sixty-horse-power boiler have been placed at the Schwarz shaft on the White. The shaft has been retimbered and connected with Clery adits. A new fifteen-horse-power engine has been put up at the Free America shaft, and at the Barrett shaft a new large and more convenient ore-house has been built on the site of one destroyed by fire. The Bush Wills shaft on the Boulder Nest has been successfully worked since the early spring, and the Wheeler shaft on the White extension has also yielded good ore. The Free America extension east has been worked extensively for development during the year, a force averaging about thirty men having been employed. A new fifteen-horse-power engine and thirty-horse-power boiler have been placed at the gulch shaft. The mine has been opened systematically, and large reserves of ore are exposed. Capitalization, $5,000,000; par value per share, $10.

Real del Monte Mining Company is chartered under the laws of the State of California. C. V. D. Hubbard is Secretary. Office, 203 Bush Street, San Francisco, Cal. The company's property is located in

Esmeralda county, Nevada. The ore mined carries silver. The main lode is 3,000 feet in length. The company owns hoisting works, etc. Date of incorporation, October 15, 1877. Capitalization, $10,000,000; par value per share, $100. Number of assessments levied, fifteen; total amount of assessments levied, $505,000; date of latest assessment, March 28, 1881.

Richmond Silver Mining Company. The company's mine, the Richmond, is located in Eureka county, Nevada, and has a current value of $3,172,500. Capitalization, $1,350,000; par value per share, $25. Yield during 1881, $409,131.42. Yield (tons) during 1880, 39,634=$1,582,214. Amount of dividends paid to February 9, 1882, $3,907,587; date of latest dividend, February 9, 1882, $2.50 per share. Stock quoted June 17, 1882, $58.75.

Rico Mountain Mining Company (The) owns ten mines, one of which, the Sixty-six lode, adjoins the Puzzle on the east. The others are the Broadway Broker, Ruby Crown, Crystal Crown, Herrick, Lowell, Dyke, Dunn, Triangle, Comet, and Carbonate.

Robert E. Lee Mining Company is chartered under the laws of the State of New York. J. G. Marshall is Manager. The company's mine, viz., the Robert E. Lee, is located at Fryer Hill, Lake county, Col. The company's property covers thirteen acres of land. Developments were commenced in March, 1879, since which time the yield has been continuous. The ore is unusually high grade. At one time, in 1881, there was a mill-test made of the ore that was extracted by thirty men in seventeen hours, which gave $118,500 as the result, which is unparalleled in the history of American mining. An excessive inflow of water necessitated the introduction of new and powerful pumping apparatus, viz., 105 horse-power engine, since which the workings have been conducted in new and unexplored ground. The ore carries dry silver; mill returns, 900 ounces to the ton. The mine is worked by drifts. The company's works are thoroughly equipped with ample machinery and sampling works. The shaft is 269 feet deep. Large ore reserves are developing in this mine. The mine is producing twenty-five tons daily of very high-grade ore, and is shipping eighty to 100 tons high-grade ore per day to the reduction works at Golden. Assays made on the sand have returned from twelve to fourteen ounces in silver. About 150 men are listed on pay-roll. The pay-roll of the Robert E. Lee for month of January, 1882, amounted to $8,600, while the receipts of the mine aggregated about $75,000. Shipments of 1,000 tons of ore were made. Capitalization, $5,000,000; par value per share, $5. Yield (net) to January 1, 1882, $1,867,855.

Robinson Consolidated Mining Company is chartered under the laws of the State of New York. The officers are Hiram A. Johnston, Pres.; W. M. K. Lathrop, Vice-Pres.; James K. Shilleck, Sec.; Geo. J. Gordon, Treas.; J. B. Stevens, Manager. Trustees, H. A. Johnston, T. J. Richmar, E. C. Hine, W. W. Harris, G. E. Hutchinson, G. J. Gordon, Wm. K. Lathrop. Office, 115 Broadway, New York. The company's mines are the Smuggler and Checkmate, located at Leadville, Col. The ore carries silver and lead, iron pyrites associated with blende, and a small portion of galena. Assays ninety ounces per ton. The company's property includes shaft and engine-house. The prospects of the property are very encouraging. New ore body in the main tunnel is opening well and is twelve feet thick. Five dollars and three cents are the estimated cost of mining and milling. The Robinson mine is one of great promise. The ore was first encountered sixty-eight feet from the incline, and consists of white iron pyrites. From the first it was of a fair grade, assaying from twenty to thirty ounces in silver. The most encouraging feature in the ninth level is a seam of galena ore, which may be of great value and importance. The total expenses of the Robinson mine are from $8,000 to $9,000 per month. The current value of the mine is $200,000. Output daily to December, 1881, about 115 tons, averaging $25 per ton. Date of organization, March 5, 1880. Capitalization, $10,000,000; par value per share, $50; basis, non-assessable. Yield during 1881, $353,-558. Number of dividends paid to November 15, 1881, eleven; total amount of dividends paid, $700,000; date of latest dividend, December 15, 1881. Stock quoted June 17, 1882, $1 per share.

Royal Silver Mining Company is chartered under the laws of the State of New Jersey. The officers are E. P. Carpenter, Pres.; J. M. Richmond, Secretary. Directors, E. P. Carpenter, H. B. Fowler, J. M. Richmond, S. Schofield. Offices, 134 South Fourth Street, Philadelphia, Pa., and 33 Market Street, Camden, N. J. The company owns one claim, 300x1,500 feet, located in California district, Lake county, Col. The shaft is forty feet deep and timbered. Capitalization, $1,000,000; par value per share, $5; basis, non-assessable; treasury reserve, 50,000 shares; amount of stock issued, 200,000 shares.

Ruby Chief and Blue Bird Lode (The). Owned by Messrs De Laverne and others. These mines are located near Venango and Blind King Tunnels, Col. Quality and character of ore, solid body of mineral, eighteen inches in width, rich ore. Mill returns 291 ounces to the ton. Character of mines, veins and drifts. Prospects very fair, indeed, regarding the property, 1881. The ore sent to the smelting works has averaged higher than any other mine in the camp. The quantity of ore will run 500 or 600 ounces to the ton. The principal work at present is on the west drift, which has reached a length of 125 feet.

Ruby Silver Mining and Smelting Company (The). These mines are located in Boulder county, Col. Capital stock, $200,000.

Rudesie Mining Company's property is located in the county of Mecklenburg, N. C. The ore mined is suitable for milling and smelting. Repeated visits to the lower level, and a careful examination of the formation of the mine, leads to a confident expectation that several chimneys of shoots of good ore will be found. The company owns a ten-stamp mill.

Russia Silver Mining Company (The) owns the Pague, Russia, Hoosier, and Buckingham mines, on Mount Lincoln, Park county, Col. On the Russia, work has been conducted systematically since it was first opened, principally for development. The ores, galena and gray copper, carrying copper pyrites, brittle silver, and sulphurets, 2,000 tons of which have been sold to the smelters, whilst an equal quantity of ore of a lower grade remains on the dumps. The mine is opened by a main tunnel 620 feet in length, and numerous lateral drifts.

Raymond & Ely Mining Company. The company's property is located in Meadow Valley, Lincoln county, Nevada. There are 5,000 linear feet in the mine. Capitalization, $11,200,000; par value per share, $100; yield during fiscal year, 1879 and 1880, $98,669. Number of dividends paid to September 10, 1873, twenty-three; total amount of dividends paid, $3,075,000; date of latest dividend, September 10, 1873. Number of assessments levied, sixteen; total amount of assessments levied, $955,000; date of latest assessment, August 27, 1880; amount per share, $2.

Smuggler Mountain Mining Company (The). Officers, John Wilson, Pres.; Dr. A. A. Smith, Treas., Col.; John L. Bartow, Vice-Pres.; B. E. Shear, Superintendent. Principal office, Leadville, Col. The location of the mines belonging to this company is on Smuggler Mountain, Aspen, Col. Company organized March 24, 1880; capitalization, $1,000,-000; par value, $10.

Snow-Drift Consolidated Mining Company is chartered under the laws of the State of New York. Offices, 30 Broad Street, rooms 77 and 78, New York, and 57 S. Third Street, Philadelphia, Pa. The company's claims, the Snow-Drift and Daniel Peters, are located in Griffith district, Clear Creek county, Col. Ten shafts have been sunk on the Snow-Drift lode at various points. There is said to be a large ore body in sight. Tunnel is 150 feet in length. Capitalization, $2,500,000; par value per share, $10.

St. Lawrence Mining and Milling Company (The) owns the Brooklyn Girl and the St. Lawrence mines, located in Gunnison county, Col.

San Juan and New York Mining and Smelting Company owns the Aspen, Susquehanna, Mammoth, and Victor mines, located in San Juan county, Col. The Aspen is said to be one of the best developed mines in San Juan county; some 2,000 feet of tramling and drifting having been run on it. The vein, although not very wide, is very regular in character, the pay-streak averaging about one foot in width. One of the chief features of this vein is the presence of a streak of fluor-spar, a mineral only rarely associated with San Juan ores.

Santa Rita Silver Mining Company's Mines, the Expert and the Merrimac, are located in Tyndall district, Peoria county, Arizona. The Expert is an extension of the Laura, and report says, as far as it has been opened, shows rich chloride ore, carrying considerable horn silver. Four hundred pounds of this ore recently gave an average of $332 per ton. Several assays have been made running from $700 to $4,300 per ton. Stock in this company recently sold at an advance of 100 per cent.

San Xavier Mining and Silver Company (The). Officer, F. A. McGee, Secretary. Office, 32 Merchants' Exchange, San Francisco, California. The mining properties owned by this company are located in Arizona.

Segregated Silver Mining Company. Office, 419 California Street, San Francisco, Cal. The company's property is located in Gold Hill district, Nev. Capitalization, $640,000; par value per share, $100; no dividends paid to April, 1882; number of assessments levied, twenty-one; total amount of assessments levied, $289,600; date of latest assessment, February 15, 1882, $1 per share.

Sierra Apache Mining Company (The). The officers are E. D Cope, Pres.; S. L. Smedley, Treas.; G. L. Smedley, Sec. Directors, E. D. Cope, S. Smedley, J. Haines, C. Middleton, J. Wright, P. Garrett, J. W. Wright. D. H. Jackson, M. E., is Supt. Office, Sierra City, New Mexico. Transfer office, Exchange Building, Philadelphia, Pa. The company's claims are the Kohinoor, Surprise, Crescent, and Grace Darling. Located at Lake city, Dona Ana county, New Mex. The property covers an area of ninety acres. Report says the outcrop of ore on the Sierra Apache property is more extensive than on any of the others. It extends east and west across the Kohinoor to the centre of the Crescent 900 feet, and north and south on the Kohinoor and Surprise, at one point 900 feet. On the Kohinoor a more silicious and probably less valuable outcrop extends 300 feet further north along the middle of the claim. On the Crescent irregular outcrops appear at many points over a tract 600 feet in a north and south direction. The above mass of ore has been merely prospected, and no shafts have been sunk to more than twelve feet in depth on it. The probability is that the ore body is larger on the Sierra Apache property than on either of the three others. Assays from the surface of the Kohinoor run to 190 ounces. On the Crescent are found the high-grade ores of the Plata and Grande. At other points on the Crescent, there are rich veins of galena. Capitalization, $5,000,000; par value per share, $25; basis, non-assessable; fully paid.

Sierra Bella Mining Company (The). The officers are W. H. Miller, Pres.; P. C. Garrett, Treas.; J. L. Smedley, Sec. D. H. Jackson, M. E., is Supt. Office, Sierra City, Dona Ana county, New Mex. Transfer office, Exchange Building, Philadelphia, Pa. The company's mining property includes the Columbia, the Emporia No. 2, and the Struby mines. Located at Sierra City, New Mex. The ore body is thirty-five feet deep, and includes portions of extraordinary richness. An average sample taken by the manager from one of the faces is said to have assayed 445 ounces to the ton. An average of fourteen assays of samples taken from the Sierra Bell property averages 601 ounces per ton. This is raised by the rich ores of the Columbia shaft, which is said to be so impregnated with chloride of silver as to be best cut with a saw. Capitalization, $5,000,-000; par value per share, $25; basis, non-assessable; fully paid.

Shawnee Silver Mining Company (The). Officers, George H. Long, Pres.; Mr. Fox, Treas. Principal office, Equitable Building, corner of Milk and Devonshire Streets, Boston. The mines owned by this company are located in Egypt, Southern Ill. Capitalization, $250,000; par value per share, $10; non-assessable; 3,000 shares of treasury stock for sale at $3 per share. Land, buildings, machinery, tools, and mining labor paid for to date.

Sierra Grande Mining Company (The). The officers are B. A. Shoemaker, Pres.; J. C. Sinclair, Treas.; G. A. Smedley, Sec. D. H. Jackson is Mining Engineer. Head office, Sierra City, Dona Ana county, N. M.; transfer office, Exchange Building, Philadelphia, Pa. The company's mining property includes the Sumpter, Lincoln, and Emporia No. 1 claims, located at Sierra City, Dona Ana county, N. M. The Lincoln and Emporia No. 1 claims may be considered together, as they are identical in character. The ore outcrop here is 200, 100, and fifty feet in width. Fifty feet south of the main outcrop a series of shafts have been sunk across the two claims in which the ore was reached at the following depth, passing from east to west, two and one-half feet, sixteen feet surface, eighteen feet. The assay value of the ore is very good. An average sample taken from one side assayed 440 ounces, and an average piece from a hole near the foot of the southern end assayed 750 ounces. It is estimated that the ore-body in the Sierra Grande is of at least as large dimensions as that of the Stanton claim of the Sierra Plata, and of high grade. The company's mill has a capacity of sixty tons per day, and it is running day and night. Enough ore is stacked to keep the mill busy for eight months, exclusive of the large amount of the highest grade of smelting ore, running from $10,000 to $20,000 per ton, housed under guard. Competent engineers state that the works should be trebled, in order to meet the capital output. Capitalization, $5,000,000; par value per share, $25; basis, non-assessable.

Sierra Plata Mining Company (The). The officers are P. C. Garrett, Pres.; H. A. Duhrig, Treas.; G. L. Smedley, Sec. D. H. Jackson is Superintendent. Office, Sierra City, N. M.; transfer office, Exchange Building, Philadelphia, Pa. The company's mines are the Golden Gate, the Crown Point, the Stanton, the Silver Reef, the Eureka, and the Plata mines, located at Sierra City, N. M. The property covers an area of 100 acres. Report says: "The ore of the Stanton is of the highest quality, and that already taken out will average, according to the assays of Mr. Kadish, 200 ounces to the ton. Not a little of it assays over 500 ounces, and it is easy to select specimens which yield 1,000 ounces, and even larger percentages of silver. This body has been opened to a depth of ten feet. Supposing, what is really inadmissibly small, that its depth is only ten feet, there is an ore body measuring 600 feet by 300 feet by ten feet, and averaging 200 ounces per ton." Capitalization, $5,000,000; par value per share, $25. Basis, non-assessable; full paid.

Silver Cliff Mining and Milling Company (The). The location of the mines belonging to this company is at Silver Cliff district, Utah. Sixty tons of ore conveyed to the mill daily averages $50 in silver to the ton. Tramway and mill are owned by the company.

Silver Cord Combination Mining Company is chartered under the laws of the State of Colorado. The officers are J. B. Grant, Pres.; W. W. Weigley, Vice-Pres.; C. H. Gross, Treas.; David Conrade, Sec.; A. J. Volrath, Asst. Sec. Directors, J. B. Grant, D. Conrade, B. Burchard, W. W. Weigley, T. S. Wood, R. C. Broadbent, C. H. Gross, J. C. Bissell, J. H. Hassenblug. The Superintendent is T. S. Wood. Main office, Iron Hill, Leadville, Col. Transfer office, room D, 305 Walnut Street, Philadelphia. The company's mine, the Silver Cord, is located at Iron Hill, Leadville, Col. The company's property, including eight locations, covers sixty acres. The ore is high grade in lead carbonate, assaying $28 to $30 per ton, with considerable gold. The mine possesses a vein of rich auriferous quartz. The company has a hoisting apparatus over No. 3 shaft. Mr. Wood, the Superintendent, reports the prospects of the property good and improving. The earnings are from thirty to thirty-five thousand dollars over expenses, the ore yielding $20 to $30 a ton net over expenses of smelting. The mine has produced some remarkable specimens, it is said, of chlor-bromide of silver (emhelite) in a variety of silicious oxide of iron. The out-put weekly at January, 1882, was 350 tons. Some 225 men are employed. Length of lode on which the company depends for ore supply, 900 feet. It would be difficult to make any estimate of the resources of this mine. Date of organization, July, 1881; capitalization, $5,000,000; par value per share, $10; basis, non-assessable, full paid. Ore shipments 1,200 tons a month, yielding a net product of $30,000. Bonded indebtedness, January 1, 1882, $150,000. Treasury reserve, 50,000 shares; monthly expenses, $22,000; stock quoted January 1, 1882, sixty-five cents.

Silver City Mining Company (The) has property located in the Gold Hill district, Comstock lode, Nev. The ore is fair grade. There is an incline shaft on the ledge 350 feet, with fair grade ore. The mining plant includes hoisting works, costing $5,000, with 700 feet capacity; a ten-stamp mill, costing $30,000. About $40,000 have been expended on developments. The total length of the main lode on which the company depends for its supply of ore is 3,800 feet. Capitalization, $6,310,000, in 63,100 shares of $100 each. Stock not listed; held partly in Boston. Two assessments levied; total amount of same, $6,310. Latest assessment, May 2, 1881; amount of same, ten cents per share.

Silver Cluster Mining Company (The). Location of mines in Summit and Lake counties, Colorado. Capitalization, $2,000,000; shares, 200,000.

Silver Crescent Mining Company (The) is chartered under the laws of the State of Indiana. The officers are Joseph R. Hale, Pres.; J. Redenour, Vice-Pres.; M. Hatfield, Sec.; J. Elliott, Treas. and Resident Manager. The offices are at Indianapolis, Ind. The company owns a group of mines, the Monday being most developed. The ore is very high grade; dry carbonate, seventy per cent. lead of a superior quality. Formation in shale. The shaft is down sixty-five feet, and has a cross-cut ninety-five feet on the vein. Considering amount of work done, the prospects are very flattering. The location is advantageous for successful working of mine.

Silver Dollar Mining Company (The) owns the Silver Dollar and Piper Heidseick mines, located in Gilpin county, Col. A double compartment shaft has been sunk on the Silver Dollar 205 feet deep, and the 150-feet level has been driven 235 feet, at which point it intersects the Piper Heidseick 175 feet from the surface. The ore is rich in silver, and carries about twenty-seven per cent. copper. A strong inflow of water necessitated the introduction of two new engines for pumping, and which also assist in the hoisting, and the mine is now in good working condition. It is well timbered and ventilated, and all the work done is with a view to permanency.

Silver Era Mining Company is chartered under the laws of the State of New York. Office, 3 Broad Street, New York. The company's claims are the Silver Era, the Etna, and the Caledonia, located in Globe district, Pinal county, Arizona. Extent of claims, 1,600 by 1,500 feet. The ore carries silver. Value per ton, $150. Date of organization February 12, 1880. Capitalization $10,000,000; par value per share, $100; basis, non-assessable.

Silver Glance Mining Company (The) is chartered under the laws of the State of Colorado. E. S. Perkins, Pres.; A. H. Woodward, Sec. and Treas. The company's property is located in Graham county, Arizona. The mine carries a two-feet vein that gives assays of $80 to the ton in silver. Capitalization, $5,000,000; par value per share, $10.

Silver Hill Mining Company's (The) property is located in Gold Hill district, Comstock lode, Nevada. There are 4,000 linear feet in mine. Aggregate of workings, 1,500 feet. Capitalization, $10,800,000; par value per share, $100; number of assessments levied, seventeen; total amount of assessments levied, $1,809,000. Date of latest assessment, February 2, 1882. Treasury reserve April 1, 1882, $5,989. Cash on hand April 1, 1882, $5,989.

Silver Key Mining Company is chartered under the laws of Utah Territory. W. J. Wenner, Pres.; Mandus Thomas, Sec. The company's claims are the Tigur, the Silver Key, and the Old Judge, located in Utah. The Tigur is the principal claim. It was located in June, 1879. It is situated on Penyon Hill, just south of Walker and Buckeye mines. Several very prominent mining men and good judges of ore have examined underground workings of the Tigur, and pronounce the ore to be of the same grade and character as the Penyon mine, and are unanimous in their opinion of its being a continuation of the vein of this mine. Date of organization, January, 1882. Capitalization, $2,000,000; par value per share, $10. Basis, non-assessable for three years from date of organization.

Silver King Mining Company is chartered under the laws of the State of New York. Office, 60 Broadway, New York. The company's mine, the Silver King, is located one-third of a mile from Montezuma, Col. The ore is silver minute, ruby silver, and gray copper, and assays from four ounces to 500 ounces to the ton. The mine shows a fine vein of quartz, fourteen inches in width, inclosed in solid walls. This mine is turning out the usual quantity of concentrations and bullion. The company has a furnace; also, lixiviation works and one ten-stamp mill. About seventy tons of ore are reduced every twenty-four hours. The shaft is about 730 feet deep. The principal mining is being done on the 700-feet level. Work is also being done on the Tilden and Mewey Consolidated. On the latter, steam hoisting works are being erected. Current value of the Silver King, $1,000,000. The mine was discovered in 1867, and came into possession of above company in 1880. Date of organization, December, 1880; capitalization, $1,000,000; par value per share, $2; basis, non-assessable; total amount of dividends paid, $50,000; date of latest dividend, August 19, 1881, ten cents per share; stock quoted June 17, $2 per share.

Silver King Mining Company is chartered under the laws of the State of California. The officers are B. W. Barney, Pres.; J. L. Jones, Vice-Pres.; J. M. Barney, Treas. and Gen. Manager; J. Nash, Sec. Date of annual election, January 11. Office, 328 Montgomery Street, San Francisco, Cal. The company's mine, the Silver King, is located in Tombstone district, Arizona. It was discovered in 1874, and is by far the richest mining property of this district—in fact, it is generally regarded as one of the most valuable discoveries of the Pacific slope. The ore is very rich, yielding an average silver assay of $100 to the ton; and some of the ore is said to average $1,000 per ton by assay. The 510-foot level is regarded as the richest, native and antimonial silver and zinc blende being predominant. At the extreme depth reached (730 feet), the ledge is found to be an enormous mass of ore, indicating increasing richness as depth is attained. New workings have been started 200 feet west and below the old ones. A two-compartment vertical shaft has been sunk to a depth of nearly 200 feet, and still sinking; splendidly timbered. The company owns a twenty-stamp mill, three lix roasters. These roasters or furnaces are on a much improved principle, consisting of a revolving cylinder. Two fires are used, each alternately, with a gratifying result, the ore receiving a uniform heat, and the chlorination being effected with a loss of from two to three per cent. only. This furnace is the work of Mr. Ottakar Hoffman. After a permanent run of three and one-half months, not the slightest repairs were required; and two more of similar construction have been built. The mill is situated about five miles from the mine, near Pinal city, as are also all the other accessory works. The battery of stamps (twenty) is kept constantly in operation, and it is claimed that the producing capacity of the mine is sufficient to keep 100 stamps going. Weed and water are abundant; and when these are exhausted, recourse can be had to a reserve of coal lying imbedded in the immediate locality. Extensive improvements have been made in the mine and above ground. The mill is kept running to its full capacity. At the 400-feet level a chamber has been opened over 100 feet in width. Virgin silver everywhere protrudes or lies imbedded in the walls in curls, twists, and flakes, while here and there large pockets of polybasite, which is eight to eighty-five per cent. silver, are uncovered. The prospects of the mine are said to be most favorable. Current value of the mine is $1,650,000. Capitalization, $10,000,000; par value per share, $100; total amount of dividends paid to July 1, 1882, $1,100,000; date of latest dividend, July 1, 1882, twenty-five cents per share; number of assessments levied, four; date of latest assessment, January 10, 1880, ten cents per share; stock quoted June 17, 1882, $16.50. A correspondent of the *Arizona Star* at Casa Grande says (December 31, 1881) the bullion shipment from this mine during 1881 was $1,800,000.

Silver Mountain Mining Company. The officers are H. E. Townsend, Pres., Boston, Mass.; G. S. Firnald, Sec., Portland, Maine; G. A. Bruce, Treas., Somerville, Mass. E. Copley is Superintendent. The company owns four claims—the Zuma, the Anilgo, the Chicomo, and Tacomo—located in Summit county, Colorado. Shaft is 230 feet deep. The Chicomo vein can be traced three miles.

Silver Mining Company (The). Officer, W. F. Dana, Sec. Gen'l office, 60 Broadway, New York. The property belonging to this mining company is located in Montezuma, Summit county, Colorado. Capitalization, $1,000,000; shares, 500,000; par value, $2.

Silver Plume Mine (The). Owned by Wm. H. Bull & Co. This mine is located on Bald Mountain, Dakota. Tunnel over 100 feet. The Trojan mine, higher up the mountain, shows up richer ore and more of it than any other mine.

Silver Plume Mining Company. The officers are S. A. MacKenzie, Pres.; M. M. Swab, Sec.; C. Benson, Treas. Offices, 33 Market Street, and 117 Market Street, Camden, N. J. The company's property is located in Central mining district, Boulder county, Colorado. The ore gives a silver assay of 150 ounces to the ton. The character of the vein is true fissure, four feet in width, with pay-streak two feet in width. The shaft is forty-five feet deep. Capitalization, $3,000,000; par value per share, $10; basis, non-assessable; treasury reserve, 50,000 shares.

Silver Queen Consolidated Mining Company (The). Incorporators, B. F. Fields, Charles Bobb, J. A. Goodwin, O. Sands, H. F. Smith, Marshall D. Lyle, Levi L. Ashbrook. Gen'l office, Gothic City. The location of the mines owned by this company is in Gunnison county, Colorado. Clay and quartz ore. Capitalization, $1,000,000.

Silver Rock Mining Company (The) is chartered under the laws of the State of Colorado. The officers are Geo. O. Magee, Pres.; A. M. Peel, Vice-Pres.; W. J. Radcliffe, Sec. and Treas. Directors, W. J. Radcliffe, Geo. O. Magee, A. M. Peel, J. J. Wilbraham, J. C. Barnitz, H. J. Paterson, and H. T. Smith. The offices are at 310 Chestnut Street, Philadelphia, Pa. The company owns the Texas Ranger, located in Colorado. Capitalization, $1,250,000, in 250,000 shares of $5 each; non-assessable; treasury reserve, 54,000 shares.

Silverton Mining Company. The officers are W. R. Walkley, Pres.; M. C. Ogden, Vice-Pres.; S. H. Wilcox, Treas.; W. E. Warkley, Sec. The Superintendent is Mr. O. P. Posey. The company's property is located in the State of Colorado. In debt, April 1, 1882, to the amount of $27,500.

Silver Wave Mine is owned by Messrs. George W. Lull, Thomas Weeds, and others. The Silver Wave mine is located in Alma, Colorado. Veins opened on the mine for forty feet or more.

Silver Wing Mining Company (The) is a chartered organization. The company owns the Silver Wing mine and ten additional claims, located in the Eurekas district, Animas river, San Juan county, Col. The property is an aggregation and contiguity of thirty to forty large true fissure veins of silver-bearing ore, all of which can be cut by one tunnel located at the base of the mountain, and 1,100 feet in length. The Silver Wing has been developed to the extent of over 400 feet. The ore is of an average grade, with a gangue of quartz and iron pyrites; is an arsenical, argentiferous, gray copper, occurring in small crystals, granulated and compact galena, sulphurets of copper, copper pyrites, and sulphurets of zinc, assaying $300 gold and $500 silver; width of lode, two to twenty feet. The pay-streak is from eighteen to twenty-four inches wide, greenish hard rock, being compact and tough mixture of Labrador and orthoclase feldspar with angite and chlorite, containing, besides, very finely divided lime, and principally, where veins occur, much magnetic and common iron pyrites. It is, in fact, an immense conglomeration or ganglion of veins of silver ore.

Small Hopes Mining Company (The) has property located in Lake county, Col. The company owns the Robert Emmett and other mines, from which, under the direction of Col. Bohn, considerable ore is being taken, fully seventy-five tons per week being shipped, and a force of thirty-five men being employed. A large chute of chloride-bearing ore has been struck about 100 feet from the shaft. The Robert Emmett has been worked incessantly for three years past, and has produced largely. It has an immense deposit of iron ore, some of which carries enough silver to make it profitable to work. On the Forest City, another of the company's mines, work is proceeding under the direction of Col. Bohn, a staff of three men being employed in development, only occasional pockets of good chlorides being encountered.

Solomon Silver Mining Company (The) has its offices at room 37, No. 157 Washington Street, Chicago, Ill. The officers are Adolph Berend, Pres.; Eugene J. Fellowes, Sec. Directors, Adolph Berend, C. O. Born, T. M. Atkinson, Eugene J. Fellowes, and Sylvester Linn. The property is located in San Juan county, Col. Capitalization, $1,000,000, in 50,000 shares of $20 each; non-assessable.

South California Silver Mining Company. The company's property is located in Gold Hill district, Comstock lode, Nevada. There are 1,500 linear feet in the mine. Capitalization, $5,000,000; par value per share, $100. No dividends paid to June, 1882. Number of assessments levied, one; total amount of assessments levied, $10,000; date of latest assessment, February 16, 1877.

South Half-Moon Mining Company (The). Owned by W. S. Ward, T. S. Wood, G. R. Fisher, O. H. Harker, Thomas Lyles. The names of the mines belonging to this company are the Susquehanna, Monarch, Iron Duke, located on Red Mountain, Col. Yielded about fifteen tons of ore, averaging over 100 ounces in silver. A three-foot quartz vein was found at twenty feet in. Tunnel, 100 feet. Two tunnels are being built, driven one about 150 feet above the other. Quartz rose porphyry and white quartz, sienite gangue, or gouge, iron-stained porphyry and white quartz. The ore, black sulphurets, in honey-combed quartz, with some specks of galena, very little copper, and iron pyrites. Fissure veins. The mine is worked day and night. The upper one is about seventy-five feet in length, has produced ore enough to more than cover the expenses of running it; the lower, also on the vein, has not reached pay-ore, 1881. J. T. Needles, Barnes & Co. are working on a tunnel intended to cross-cut several veins belonging to that firm. Developments were commenced in 1880. Yielded about fifteen tons of ore during the year. The South Half-Moon district was prospected by Southwest Missouri miners. Specimen assays ran very high from the start. Developments, however, remained for a long time so insignificant that no energetic parties could be found to push the matter, December, 1880. When Mr. Bauman left the mine last week, the breast of the upper tunnel showed sixteen inches of No. 1 ore, which runs 250 ounces in silver, and only a trace of gold. Occasionally, the white quartz is well sprinkled with sulphurets, making it an ore, but, on the whole, the honeycombed quartz contains the best mineral. In July, 1881, Mr. Bauman examined the district, and induced Messrs. T. S. Wood, and W. S. Ward to try their chances there. On account of the failure of other parties interested in the claim, by direct purchase, to come down with the money for their share of the work, the mine will be idle this winter.

South Horn Silver Mining Company (The). Officers, R. C. McCormick, Pres.; R. G. Morrison, Vice-Pres.; A. V. K. Stafford, Treas.; H. Bradstreat, Sec. Principal office, 115 Broadway, New York city. The location of the mining property belonging to this company is in Frisco, Utah. Capitalization, $2,000,000; shares, 200,000; par value, $10.

Sovereign Silver Mining Company (The) is chartered under the laws of the State of Colorado. The officers are S. L. Smedley, Pres.; E. D. Cope, Vice-Pres.; W. Smedley, Treas.; G. L. Smedley Sec. Robert Bansen is Mining Engineer. Offices, Post-office Building, Fifth and Harrison Avenues, Leadville, Col., and Exchange Building, Third and Walnut, Philadelphia, Pa. The company's property is located at Leadville, Lake county, Col. Capitalization, $5,000,000; par value per share, $10; basis, non-assessable; full paid.

Spar Mine (The). Owned by Messrs. Gillespie & Reed. Mr. Thomas, Mang. The Spar mine is located one mile from Aspen, Col. Fine silver ore; richest mineral yet discovered, 620 ounces to the ton; seventy-five feet incline sunk on the vein; drift, sixty feet; shaft, seventy feet; twenty-five-foot tunnel (1881). Work has been suspended a short time. The efficient efforts of Mr. Thomas have increased the value of the mines fully $40,000. It will soon be worked to its fullest capacity. There is now on this tunnel fifty tons of ore for shipment.

St. Elmo Mine (The). Owned by Colonel Burichinell, of Leadville, Col.; Messrs. Frank Ganson, Charles L. Clare, M. J. Y. Marshall, Captain Jacque. The St. Elmo mine, owned by the above gentlemen, is located in Colorado. Very rich; mineral, silver glance; assayed 500 to 16,000 ounces to the ton. Vein seventeen feet four inches in width, seventy feet deep. Shaft seventy feet deep. Cost $33 per ton for mining and milling; $9 per ton to mill it (1880). It was stated some time ago that $50,000 had been offered and refused for the St. Elmo mine.

Starr Grove Silver Mining Company is chartered under the laws of the State of New York. The officers are W. S. Clark, Pres.; J. R. Bothwell, Secretary. G. W. Bothwell is Superintendent. Office, No. 2 Nassau Street, New York. The company's mining property includes the Henry Logan and Duasang lodes, located at Lewis Mountain, Nev. The character of the ore is silver. Assay value per ton, $65. The mine is a large fissure vein or ledge, some fifty or sixty feet between the walls, with about three feet of clay gangue on the hanging wall, next to which is the pay-streak or pay-ledge, which is five feet thick and of a very uniform grade. From the pay-ledge to the foot of the wall, about forty feet, is the gangue or white quartz, which will carry about ten ounces in silver to the ton, being, of course, practically worthless. The main incline has reached the depth of 180 feet, and is in good ore. The company's property includes ore house, boarding house, engine house, shaft house, blacksmith shop, boiler and engine for condensing air, an air tank, and an air hoister. The company's fifteen-stamp mill, and furnished with three Bruckner roasters, is located at the foot of the mountain on Lewis creek. The mine is some two miles up the creek, on the side of the mountain, about 500 feet higher than the creek. The climate is mild, free from snow all the year. The Henry Logan lode is 1,500 feet in length by 600 feet in width; the Duasang lode, 350 feet in length by 600 feet in width, both located in the Starr and Grove vein. Current value of mine is $100,000. Date of organization, October, 1880. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable. Total amount of dividends paid, $160,000; date of latest dividend, January 12, 1882, ten cents per share.

Sterling Silver Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, Gen. James Stewart, Jr., Pres.; Barclay J. Woodward, Treas.; John S. Worman, Sec. Directors, Gen. James Stewart, Jr.; Barclay J. Woodward, John S. Worman, David W. Davis, Lewis A. Conwell. Principal offices, 110 Market Street, Camden, N. J., and Georgetown, Col. Capitalization, 200,000 shares; par value, $10, non-assessable.

Sterling Silver Company (The) is chartered under the laws of the State of New Jersey. Officers, John Dailey, Pres., Garden Grove, Iowa; A. B. Page, Vice-Pres., Ottumwa, Iowa. Directors, P. F. Breese, Council Bluffs; J. Knolte, Murray, Iowa; J. T. Walker, Great Bend, Kansas; Hon. Joseph Knotts, Council Bluffs; J. B. Knotts, Indianola; Rude Daily, Lucas, Iowa. Date of annual election, September 21. The names of the mines owned by the company are viz., Nogalito, Santiago, Los Muertos, San Juan, and Quebradillas, all located in Hidalgo district, Chihuahua, Mexico. True fissure veins, with a dip of forty-five degrees into the hill. Depth of shaft, 550 feet. The mines were consolidated under the name Quebradillas mines. Situated on the Minas Mueras lode, they are, perhaps, the oldest of North America, and were uniformly the best paying in the world. They yielded as high as $60 per ton to the Mexicans under their rude methods, have been mined for several centuries, and the lode has been worked to depths varying from seventy-five to 1,000 feet. The shaft of the San Juan is about 110 feet deep, at the bottom of which the lower vein is over thirteen and a half feet wide, and in the Santiago, at the depth of 190 feet, the upper vein is twenty-two feet nine inches wide. Milling ore is found on these mines, carrying on an average forty ounces per ton, and smelting ore carrying 100 ounces.

Stormont Silver Mining Company is chartered under the laws of the State of New York. The officers are W. S. Clark, Pres.; J. R. Bothwell, Sec. Office, 2 Nassau Street, New York. The company's mines are the Savage, the Buckeye, Last Chance, Thompson, and McNally, located at Silver Reef, Utah. The character of the ore is argentiferous sandstone, assaying $32 to the ton. The Savage shaft is being lowered another 100 feet on the ledge, from which depth levels will be driven north and south. A uniform output, it is said, of about fifty tons per day, is maintained, which is raised principally through the Savage shaft. The lower workings in the Buckeye, report says, continue in excellent ore. As the fourth south level from the Savage shaft has advanced, the ore has improved very considerably, and shows a strong four-foot vein of characteristic Buckeye ore in the faces. This is considered of more than ordinary importance from the fact that the same kind of ore was encountered above, and in each of which the grade improved with depth. In Last Chance mine $150,000 was received up to 1880. Half a million dollars' worth of silver was taken from a single bed in the Buckeye mine. Prospects are encouraging, ore being abundant. The cost of mining and milling per ton is small, say $5. Output weekly at January, 1882, 300 tons. The company owns a ten-stamp mill. Date of organization, July, 1879. Capitalization, $1,500,000; par value per share, $10; basis, non-assessable. Yield during 1880, $484,110. Total amount of dividends paid, $155,000; date of latest dividend, November 1, 1881, five cents per share. Stock quoted July 1, 1882, fifty cents.

Surprise Silver Mining Company (The) is chartered under the laws of the State of Iowa. The officers are Hon. Geo. T. Wright, Pres.; J. B. Gregg, Red Oak, Iowa. The offices are at Red Oak, Iowa. Mr. Casey is Superintendent. The company owns the Laura, Surprise, and Arnold mines, located in Tyndall district, Pima county, south-eastern Arizona. From the Laura mine the ore is chloride, and contains considerable horn silver. Selected ore assays from $500 to $2,500 per ton. Unassorted ore gave $256 per ton. At a depth of thirty feet the rich ore is about three feet wide, and carries chlorides, platinum, horn silver and native silver. Little progress has as yet been made with developments, the B shaft of the Laura being down eighteen feet and six feet in the vein. This mine, the Laura, is probably the richest mine in south-eastern Arizona. The Superintendent reports taking $3,000 in ore from the mine in one day. Capitalization, $2,000,000, in 100,000 shares of $20 each.

Sylvanite Mining Company (The). The property of the company, the Sylvanite mine, is rather inconveniently located near the top of Elk Mountain, Lake county, Col. Twenty tons of the ore milled 775 ounces per ton. The vein is from two and a half to four feet in width, with a rich pay-streak of from eight inches to two feet, containing considerable ruby and native silver. The developments of the company were commenced in 1879. Total extent of excavations, 1,000 feet. Owing to some difficulty with the stockholders, the mine is now standing idle. Yield (net) to July 1, 1882, $50,000.

Syndicate Mining Company's property is located in Bodie district, Mono county, Cal. The extent of property is 1,200 by 1,500 feet, covered by United States patent. The ore is low grade, free milling, assaying from $20 to $25 per ton. It is estimated that 25,000 tons can be extracted right along, and milled at a profit of $15 per ton. Expenses of running the mine have averaged $11,000 per month. The vein is well-defined, from two to six feet thick, and very hard, requiring powder for breaking it down. The company has one twenty-stamp mill valued at $100,000, with a capacity of forty tons per day, of twenty-four hours Commenced crushing ore, December, 1879. Monthly shipments are from $25,000 to $30,000. Length of adits, 2,500 feet. Date of organization, 1876; capitalization, $10,000,000; par value per share, $100. Yield during 1880, $24,800. No dividends paid to June, 1882. Total amount of assessments levied, $25,000. Stock quoted January 1, 1879, $10; highest point reached.

Tioga Consolidated Mining Company (The). W. H. Lent, Secretary. General office, 309 Montgomery Street, San Francisco, Cal. Trustees, A. J. Ralston, Wm. M. Stewart, R. N. Graves, John F. Boyd, J. M. Quay. Annual election, September 14. The Tioga mine is located in California (Bodie district), the property having an extent of 600 by 862 feet. The ore is quite free of waste, and will probably mill $25 per ton. Ledge varies from four to six feet in thickness. The main shaft is 720 feet down. The length of the main lode on which the company depends for its supply of ore is 1,500 feet. The mine is furnished with a hoisting capacity to sink 1,500 feet (barring water), costing $20,000. It is expected the Standard pumping apparatus will draw the mine, and save the Tioga company the expense of erecting a pumping apparatus. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends have been paid. Fifteen assessments, aggregating $290,000, have been levied. Date of latest assessment, November, 1880; fifteen cents per share. Cash on hand April 10, 1882, $8,055.21. Stock quoted as high as $12. Receipts during the year 1881, $58,224.74; disbursements during the year 1881, $42,218.32. The financial arrangements are said to be good.

Tip-Top Silver Mining Company. Thomas Brown is Superintendent. The company's property is located at Black Canyon, Yavapai county, Ariz., being situated on one of the outlying spurs of the Bradshaw Mountains. The ore is reported to assay $215.34 to the ton. The prospects of the property are favorable. There is said to be a good face of ore on the north drift. The mine has a current value of $250,000. The main lode is 1,500 feet in length. It is developed by a shaft upwards of 600 feet deep, and thoroughly opened by levels, tunnels, drifts, winzes, and showing a pay-streak of from one foot to eighteen inches in width. The ore is high-grade sulphuret and ruby silver assaying about $300 to the ton, and improves as depth is attained. The mine has been a constant producer since its discovery. The output for the calendar year will be little short of $300,000, and the total production will exceed $1,200,000 in value. A ten-stamp-mill and roaster at Agua Fria have reduced the greater portion of the ores produced by this and the neighboring mines. Capitalization, $10,000,000; par value per share, $100; yield during 1881, $238,312, all in silver. Number of dividends paid to November 26, 1881, five; total amount of dividends paid, $100,000; date of latest dividend, November 27, 1881, twenty-five cents per share. Total amount of assessments levied, $170,000; date of latest assessment, March, 1880; amount per share, fifty cents. Stock quoted June 17, 1882, $2.50 per share.

Toltec Silver Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, Watson Twining, Pres.; M. M. Gillan, Vice-Pres.; Edward S. Sears, Sec. and Treas. Directors, Charles

C. Colby, Guy C. Noble. General office, 163 Market Street, Camden, New Jersey. Transfer office, 431 Walnut Street, room 131, Philadelphia, Pa. The Vermont, Canada, and Viga mines are the property of this company, located on Mineral Point, San Juan county, Col. The Canada and Vermont are producing rich ore. Capitalization, 300,000 shares; par value, $3. Amount of stock issued, 90,000 shares; amount in treasury, 60,000 shares.

Tombstone Mill and Mining Company is chartered under the laws of the State of Connecticut and Arizona Territory. The officers are G. Burnham, Pres.; W. J. Cheney, Sec. Directors, G. Burnham, T. Cochran, G. J. Corbin, J. R. Bothwell, W. J. Cheney, B. F. Hart, P. Corbin, C. T. Parry, W. J. Neilson, M. Hullings, W. J. Hulings. Offices, 39 Wall Street, New York; 432 Walnut Street, Philadelphia, Pa., and 309 California Street, San Francisco. Prof. John A. Church is the Treasurer. The property of the company, comprising the following mines, eleven in all, viz.: Tough Nut, Lucky Cuss, Good Enough, Survey, Defence, West Side, Tribute, East Side, Owl's Nest, East Side No. 2, and Owl's Last Hoot, covering an area of about 169 acres, is located in the Tombstone district, Cachise county, Ariz. The company works five perpendicular shafts and two inclines on two of their principal mines. The ores lie in blanket ledges at comparatively moderate depths. The system of levels, drifts, winzes, and cross-cuts is complete in all their properties. This is specially true of the Tough Nut and Good Enough, the principal mines. The main shafts are fitted with steam-hoisting machinery and improved appliances of all kinds. The two mills, twenty and fifteen stamps respectively, are located at Charlestown, on the San Pedro, nine miles from the mines. The production of the fiscal year, 1880-1881, as reported by the *Tombstone Epitaph*, was $1,586,000. The weekly production is about 300 tons of ore. The company owns two stamp-mills, thirty-horse-power engine, buildings, etc. Mills working well, and up to their full capacity. This mining property has an enviable reputation, good climate, tractable formations, and ore, the latter on or near the surface, while water and timber have offered no great obstacles. Cost per ton of mining and milling is about $23.43. Current value of mine, $500,000. The main lode is 4,500 feet in length. Date of organization, 1879-1880. Capitalization, $12,500,000; par value per share, $25; basis, non-assessable. Total yield during 1881, $1,376,047.13, 29,211.66 tons; expenses during the year 1881, $794,170 90. Total amount of dividends paid, $1,250,000; date of latest dividend, April 15, 1882; number of assessments levied, one; amount, $10,000; date of latest assessment, January 9, 1882. Stock quoted June 17, 1882, $1 per share.

Tranquillity Mining Company (The) has property located in the Tombstone district, Cachise county, Arizona. The company owns the Tranquillity mine, which is one of the celebrated mines of the district, although it has not yet been much of a bullion producer. It is opened by two shafts; one, the old, is 300 feet deep; the other, which is new and the main working shaft of the mine, has attained a depth of over 500 feet. The shaft is double compartment, thoroughly timbered to the 500-feet level, and is furnished with the best steam-hoisting machinery. The ore bodies are not remarkably large, but the quality of the ore is superior. Some two hundred tons are now on the dump. The location of the claim is a guarantee of its value, as the north extension of the great ore body of the Contention must pass through it. Drifting, to strike this ledge, is now being done. This ledge, with two already uncovered, will make this mine one of the largest producers. The company is said to be rich, and the management in capable hands. About twenty men are constantly employed.

Tremont Silver Mining Company (The). Date of organization, March 22, 1881. Capitalization, $500,000.

Trinity Mining Company (The) has its offices at 61 (room 42) Broadway, New York. The officers are J. G. Cooper, Pres.; B. A. Oxnard, Vice-Pres.; D. B. Horton, Sec. H. M. Francis, Treas. (cashier of Wells, Fargo & Co.). The property of the company is located at Galena, Nevada. Capitalization, $12,000,000, in 120,000 shares of $100; a limited number of shares on the market.

Tucker Group (The). Owned by Messrs. Tucker and Makin, of Irvin, and W. H. Kirlgsberry, of Leadville, Col. The mining property of this company consists of the Lost Treasure mine, Tucker, Smuggler, White Quartz, and Horse-Shoe lodes, located on Pine Gulch, above Crystal lake, Slate Mountain Range, Ashcroft, Col. Gray copper and galena silver assaying 125 to 200 ounces in silver. The Lost Treasure, with a fifteen-foot shaft, shows gray copper and galena, assaying from 100 to 1,500 in silver. Entrance by tunnel, sixty feet deep. A sixty-foot tunnel has been run on the Smuggler, cutting the vein at a depth of sixty feet, following the vein fifteen feet. A shaft has been sunk ten feet. The vein, which averages two feet in width, assays from forty to 100 ounces, and gains in richness as depth is obtained in the shaft.

United States Gold and Silver Mining Company (The). Mr. J. W. Warren, Manager. The Virginus mine is owned by the company. Second-class ore, assaying per ton seventeen and a half ounces silver and thirty per cent. lead, 1881. The first-class ore of the United States Gold and Silver Mining Company has settled for on a basis of twenty-two and a half silver and forty-six per cent. lead.

Union Consolidated Silver Mining Company (The) holds its annual meeting on May 1. J. M. Buffington, Esq., is Secretary. The offices are at 309 California Street, San Francisco, Cal. The property of the company comprises the Union Consolidated mine, located in the Virginia district, Comstock lode, Nevada. The ore assays $47 per ton from car samples. The depth of the workings is about 2,600 feet; the length of the main lode on which the company depends for its supply of ore is 800 feet. The ore now obtained is chiefly from the 2,500-feet level, where the developments are now being prosecuted with success, the ore there found being of superior quality. The mine is now self-sustaining. The weekly out-put is from 350 to 400 tons. Capitalization, $10,000,000, in 100,000 shares of $100 each. Yield during 1881, $905,924. No dividends yet paid; nineteen assessments, aggregating $1,360,000, have been levied; latest assessment, March 21, 1882, $1 per share. Cash in hand February 1, 1882, $1,380.

Union League Silver Mining Company (The). George W. Dickson, Sec. Office, 90 William Street, New York. The company's property lies 800 feet north-west of Mack Morris mine, Richmond basin, Globe mining district, Arizona. Capitalization, $1,000,000; par value per share, $10. Basis, non-assessable.

Union Mountain Silver Company. The officers are I. May, Pres.; E. Shepard, Vice-Pres.; J. K. Hornish, Sec. and Treas. Directors, I. May, E. Shepard, J. K. Hornish, E. La Fountaine. Carl Anderson is Superintendent. Office, Denver, Col. The company's mining property consists of six claims, located at Union Mountain, consolidated, Ten Mile district, Summit county, Colorado.

Utah Silver Mining Company (The). Officer, A. G. Pratt, Sec. General office, 309 Montgomery Street, San Francisco, Cal. The mines owned by this company are located on Comstock lode, in Nevada. Twenty-four miners and eighteen surface men are employed at the Utah mine.

Vanderbilt Silver Mining Company of Utah. The officers are F. H. Myers, Pres.; E. H. H. Murry, Vice-Pres.; A. Morris, Treas.; L. L. Davis, Sec. The company's claims, the Vanderbilt and Jenny Lind, are located at East Fork, Warm Spring mining district, Alturas county, Idaho. Capitalization, $2,500,000; par value per share, $25.

Venango Silver Mining Company (The). Nathaniel Tooker, Pres.; J. F. Seldomridge, Sec.; Ed. Copley, Superintendent, of twenty-three years' experience. The property of the company comprises five claims, the Venango, South-west Extenison, Tioga, Souri, and Siskiyou, located at Irwin, in Gunnison county, Col. Seventy-five tons of roughly sorted ore assayed 175 ounces per ton. The mine consists of leads of ruby, brittle and native silver, zinc, and galena ore. Developments were commenced in 1881. A tunnel of about 500 feet is now being driven, and a shaft at its termination will afford excellent ventilation. Cross-cuts are being run to cut the veins, and the workings are kept free from water; this work is now close upon completion.

Vermont and Colorado Mining Company (The) is chartered under the laws of the State of Colorado. Directors, Edward H. Goff (of Goff, Hastings & Co.), Boston; Hon. H. A. Tabor (late Governor of Colorado), Denver, Col.; Hon. Alex. McDonald (Pres. Wabash Mining Co.), New York: Chas. E. Folsom (Chas. E. Folsom & Co.), Boston; J. B. Rhodes, Banker and Broker, Boston; Silas Gurney, Tremont House, Boston; Col. A. J. Ware (Supt. B. B. Smelting Works), Breckenridge, Col.; B. F. Stickley (Pres. Mt. Royal Mining Co.), Leadville, Col.; Col. H. M. French, Breckenridge, Col. Pres., G. E. Goff; Sec. and Treas., H. E. Irving; Vice-Pres., Hon. H. A. W. Tabor; Supt., Thomas Gowanlock. The offices are at Denver, Colorado, and at 292 Washington Street, Boston, Mass. The property of the company is located in the Consolidated Mining district, Col., having an extent of 160 acres. Quality of ore very fine, and supply abundant. Capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable forever.

Vizina Consolidated Mining Company (The) has offices at 30 Pine Street, New York. The officers are J. E. Haskell, Vice-Pres.; James Amm, Sec. The company owns the Vizina mine, located in the Tombstone district, Cachise county, Arizona. The mine has been a very considerable producer, but until the past year its development has been by no means systematic. The ores in the shallower workings occur in horizontal or blanket veins; but as depth is gained, they become more vertical and the ore bodies are larger. The developments consist of three shafts, the deepest or main working shaft having attained to a depth of nearly 500 feet. During the month of October, only 300 tons of ore were treated, eighty of which yielded an average of $454 to the ton, and the remainder, $107, making the bullion production for the month, $60,000. The average of the entire output operated to December 31, 1881, aggregating 5,887 tons, is at the rate of $93 to the ton. The main working shaft is furnished with the latest improved hoisting apparatus, all protected by a substantial building. Carpenters' and blacksmiths' shops are also comfortable buildings, conveniently located. Everything about the mine is done in a thorough and permanent manner, which is warranted by the rich developments of mineral. It is proposed to build a mill, the ore having hitherto been operated by the Boston twenty-five-stamp mill, located at Emery, on the San Pedro, the item of transportation of the ore being, as usual, a considerable drawback. For the fifteen months ending December 31, 1881, the production of the Vizina company's property is reported by the *Tombstone Epitaph* of December 4, 1881, to be $526,717 in value. In addition to the Vizina mine, the company also owns the Yreka, Poor X, and other mines, besides some 400 lots in the town of Tombstone, which are rapidly increasing in value. The above would indicate an excellent financial standing of the company, especially considering that it has only been actively at work for fifteen months. The ore assays, on an average of 675 tons, $92.07 per ton. The shaft is down 231 feet. Ore is being got from the lowest workings, and matters are progressing satisfactorily. The mine has paid its expenses from the grass roots, having produced in three months, $211,216, and since its first shipment of bullion, $42,500 from 4,595 tons of ore, an average of $92.50 per ton. There are sixty men employed. The current value of the mine is $230,000; capitalization, $5,000,000, in 200,000 shares of $25 each; total dividends, $140,000, paid to April 1, 1882, the date of latest dividend of ten cents per share; treasury reserve, December 31, $106,000; stock quoted, June 17, $1.15 per share.

Voltaire Silver Mining Company is chartered under the laws of the State of Nevada. The directors are A. H. Frank, H. H. Bend, T. Coffin, R. L. Shepard, J. G. Cohoe. Date of annual election, 3d Tuesday in July. Superintendent, J. G. Cohoe. Number of years' experience of the same, three. Transfer office, Carson City. The company's mine, the Voltaire Silver mine, is located in Ormsby county, Nev. The ore is silver-bearing based with copper. Average from battery, $56. The character of the mine is fissure vein. The company owns a ten-stamp mill, complete with O'Harra roasting furnace. The shaft is 300 feet deep; length of adits, that is levels, 600 feet. The main lode on which the company depends for its supply of ore is 1,000 feet in length. Developments were commenced July 1, 1880, and $40,000 has been expended to April 1, 1882, in developing the property. The stock is not for sale; it is held by a few individuals, who have confidence in the mine and work it on its merits. The mill is running now with good results, but it is too early to report definite figures. Date of organization, July 7, 1880; capitalization, $10,000,000; par value per share, $100; basis, non-assessable. Yield (gross tons) during 1881, 700. No dividends paid or assessments levied as yet; company free from indebtedness; stock held principally in New York; wages paid to all classes of labor per week, $500. This information was furnished by J. G. Cohoe, Superintendent and Secretary of the Voltaire Silver Mining Company.

Western Star Mining Company (The) is chartered under the laws of the State of Pennsylvania. The offices are at 109 S. Front Street, Philadelphia, Pa. The property of the company, comprising the following claims, Crœsus, Exchange, Golconda, Western Star, Rothschilds, and Fortunatus, is located in Montana Gulch, near Diamond City, Montana, and has an extent of ten acres. The veins are true fissure, widening as the shafts descend. A part of the company's claims is patented. A shaft has been sunk on one fifty feet, and another fifty-five feet in ore. Two tunnels are also driven, and considerable money has been expended in general developments. In the opinion of experts, the property contains the mother vein that supplied Montana and Confederate Gulches with their rich placer diggings from which millions have been taken, and the yield still continues. The company has a ten-stamp mill and necessary buildings erected and in operation. The company may be described as a close corporation, the greater portion of the stock being owned by a few mercantile gentlemen of Philadelphia. The mill property and improvements are all paid for, and the company is free of all bonded or other indebtedness. Stock listed on the Philadelphia Stock Exchange. Capitalization, $1,000,000, in 200,000 shares of $50 each.

White & Shiloh Company (The). The property owned by this company is the Trinity mine, located in Galena district, Nev. Veins four feet of argentiferous galena on the 530-feet level of the mine.

White Quail Mining and Smelting Company (The). Mr. H. R. Austin, Pres. of the company. The White Quail mine, owned by the company, is located on Elk Mountain, Kokoma, Col. Best quality for smelting. Company own a mill, 1881. Mr. Austin has returned east much pleased with the result of his examination. He states that the body of carbonates recently developed in the incline has been cross-cut above the point where it was cut by the incline, and shown to be continuous for a distance of 100 feet in this direction. The ore will enable the smelter to draw upon the company's mine for the bulk of its supply. The smelter will be started up as soon as the condition of the roads permits ore hauling, and will henceforth be kept steadily in operation. It is probable that it will also be enlarged and otherwise altered and improved.

Woronoco Mining Company (The) has property located in the Tombstone district, Cachise county, Arizona. The company owns the San Diego mine, which is being developed with considerable energy. The main shaft is down 347 feet. On the 266-foot level, and about ninety feet north from the shaft, a three-foot vein of carbonates was struck, and found to be very rich. Drifting along this ledge about thirty feet shows gradual improvement of the vein, which in places is partially capped by a quartz ledge which shows chloride stains and copper. In the south drift on the same level, and about sixty feet distant from shaft, rich deposits of galena and gray carbonate ores were also struck, which gave an assay of $180 in silver to the ton. The work is being prosecuted by double shifts of men.

Woodstock Consolidated Silver Mining Company (The) is chartered under the laws of the State of Nevada. Directors, E. B. Dickinson, Shelbourne; Frank B. Dole, John J. Hayes, John D. Morton, Monroe T. Quimby, Jonathan R. Gray, Edward F. Hager, Boston, Mass. Principal office, Shelbourne, White Pine county, Nevada. The mining property of this company is located at Shell Creek mining district, Nevada, and will soon commence work on them. White Pine seems to be attracting attention. Capitalization, $1,000,000; par value, $10.

QUICKSILVER.

Great Western Quicksilver Mining Company (The) has property located in Lake county, California. The length of the main lode on which the company depends for its supply of ore is 3,000 feet. Capitalization, $5,000,000, in shares of $100 each; total amount of dividends paid to September 4, 1881, $250,000; date of latest dividend, September 4, 1881; amount per share, twenty-five cents; $35,500 has been levied in assessments; date of latest assessment, August 25, 1873; amount of same, fifteen cents.

Napa Consolidated Quicksilver Mining Company (The) has property located in the Hill district, Napa county, California. Office, 330 Pine Street, San Francisco. The length of the main lode on which the company depend for its supply of ore is 28,500 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each; paid on capital, $69,882.88; twenty-four dividends paid, total $250,000, to May, 1882, date of latest dividend, which was ten cents per share; total assessments levied, $69.88; stock quoted July, 1882, $5.25.

Quicksilver Mining Company (Preferred). The company's property, which covers 8,500 acres, is located in the State of California. Capitalization, $4,300,000; par value per share, $100; total amount of dividends paid to August, 1868, $535,391; date of latest dividend, June, 1882, at the rate of $6 per share; stock quoted June 15, $47.

Reddington Quicksilver Mining Company. The company's property is located in the State of California. Capitalization, $31,500; par value per share, $25; total amount of dividends paid to July, 1878, $1,052,100; date of latest dividend, July, 1878.

UNCLASSIFIED MINES.

WE have collected the following as a basis for future lists; but as the information when obtained failed to give us officially the mineral, we have put them together, rather than run the risk of wrongly classifying the product of some company.

Alpha Mining Company's (The) works are located in Michigan. Total amount of assessments levied, $420,000. Last assessment levied, March, 1882, at the rate of fifty cents per share.

Ancient Mine. W. A. & Joseph K. Clark, owners. Name of mine is the Ancient mine, located at Black Chief lode, Montana. Considerable ore extracted; mill owned by the company. Depth of shaft, forty feet. Tunnel, 200 feet.

Argonaut Mining Company (The). Officer, J. Pentecost, Sec. Principal office, 702 Market Street, Philadelphia. Mines located in Arizona.

Arivaca Mill Company's works are located in Pima county, Arizona. Officers, Hon. H. N. Hibbard, Pres.; T. H. Bryant, Asst. Sec. Office, 108 Washington Street, Chicago, Ill. Amount of property in acres, 160; capitalization, $300,000; par value per share, $10.

Arkansas Valley Smelting Company (The) is chartered under the laws of the State of Missouri. The names of the officers are F. L. Underwood, Pres.; August R. Myer, Vice-Pres.; E. E. Wilson, Sec.; Louis Virdin, Asst. Sec.; Justice Tungk, Treas.; Chas. T. Limburg, Gen. Mang. The mines are located in Colorado. Property owned is Billing's Smelter, Arkansas Valley Smelting Company, formerly Billing's Smelting works. Capitalization, $500,000; shares, 50,000; par value, $10.

Atlas Mining Company (The) is chartered under the laws of the State of California Officers are M. Goldman, Pres.; John Oppenheim, Vice-Pres.; F. M. Blackstone, Treas.; A. F. McGrew, Sec. Main office is 316 Montgomery Street, San Francisco, Cal.; branch office, 140 S. Fourth Street, room 6, Philadelphia, Pa. The mines are located at West Tintic, Utah. Assays per ton from $35 to $65. Capitalization, $100,000; par value, $100; non-assessable; stock listed on the Mining Exchange at San Francisco, Cal., at a cost of $1,000; amount of shares issued, 100,000; reserved in treasury, 10,000.

Atlanta Mining and Milling Company. A. F. McGrew, Secretary. Principal place of business, 420 Montgomery Street, San Francisco, Cal. The mines are located at West Tintic mining district, Juab county, Utah.

Aurora Tunnel and Mining Company. C. V. Hubbard, Secretary. Principal office, 203 Bush Street, San Francisco, Cal.

Azora Mining Company (The) is chartered under the laws of the State of New Jersey. Lewis Barnes, Pres., J. V. Fullaway, Vice-Pres.; Milton T. Bailey, Sec. and Treas. Directors, Lewis Barnes, J. V. Fullaway, Edward A. Carpenter, Milton T. Bailey, Geo. W. Bratton. Transfer office located at 113 S. Fourth Street, Philadelphia, Pa. Names of mines owned by the company are the Azora and Commodore B., located at Central mining district, three-quarters of a mile from Jamestown, Boulder county, Col. J. B. H. Janeway, Superintendent. Capitalization, $750,000; shares, 150,000; par value, $5; non-assessable.

Bakeman Mining Company. The officers are Hannah M. Mayo, Pres.; S. M. Bakeman, Treas.; Alice R. Johnson, Sec. Directors, H. M. Mayo, S. M. Bakeman, A. R. Johnson, Mrs. A. Smith. Agent, Geo. H. Blake. Office of agent, 93 Exchange Street, Portland, Me. The company's works are located at Cape Rosier. They own 300 acres of land, and have a capitalization of $500,000 in shares, with a par value of $5 each.

Ballarat Mining Company's (The) property is located in Lake and Summit counties, Col. They have a capitalization of $2,000,000. This company's incorporators were H. A. W. Tabor, J. W. Chipley, John Law, and J. A. Cooper.

Baltimore Consolidated Mining Company's Works (The) are located in Gold Hill district, Comstock lode, Nevada. There are 1,050 linear feet in the company's claim. This company has a capitalization of $8,400,000, in 84,000 shares, with a par value of $100 each; nineteen assessments were levied up to April 30, 1879; total amount of same being $1,037,600.

Beehive Mining Company's incorporators were Joseph Bardine, G. H. Plumwell, and G. W. Meyers. This company's property is located in Fremont and Pueblo counties, Col. They have a capitalization of $1,000,000.

Belle Mining and Milling Company (The). Mines located in Custer county, Colorado Capitalization, $100,000; shares, 10,000; par value, $10.

Bertrand Mining Company (The). Names of mines owned; Hudson, Geddes, Nos. 2–34, Bertrand, Nos. 1, 2, 3, and 4, Calico, Stockton, Secret Valley, Eliza, and Ostorne. Location of mines, Secret Canyon, Nevada. Capitalization, $10,000,000; par value, $25.

Big Four Mining Company (The). The mines belonging to this company are located in Colorado. Capital stock, $1,200,000.

Bismarck Mine (The). Vaughn & Co. The mining property of this company is located on Hunt's Gulch, between Jackson and Mokelumne river, California.

Black Range Mining Company (The). Incorporators, C. E. Johnson, J. C. Sinclair, J. M. Chadsey, W. H. Chadsey, A. F. Childs, Geo. C. Garrison, W. S. Hoge, Thomas J. Gardner, Edwin S. Holmes, S. L. Stephenson, H. C. Stein, N. Peters, T. Luna. Location of mines, Colorado. Capitalization, $5,000,000.

Black Rock Mining Company (The), California. N. T. Root, Sec., 225 Beale Street, principal office.

Black Warrior Mining Company is chartered under the laws of the State of New York. Office, 24 Cliff Street, New York. J. S. Alexander, Pres. Superintendent, A. A. Alexander. This gentleman has had four years' experience in this line of work. The Black Warrior mine, the property of this company, is located in Peck district, Yavapai county, Arizona. There are 1,500 feet in the company's claim. They own twenty-one acres of land.

Bobtail Tunnel Company's (The) works are located in Gilpin county, Col. The main lode, on which the company depends for its supply of ore, is 2,500 feet in length. Capitalization, $100,000; par value per share, $5; number of dividends paid up to December, 1879, four; total amount of dividends paid up to December, 1879, $72,000; date of latest dividend, December, 1879; amount per share, fifteen cents; total amount of assessments, $52,000; date of latest assessment, July, 1873, at the rate of thirty cents per share.

Bonanza Consolidated Mining Company (The), Eureka district, Nevada. Names of mines owned, Star of the West Nos. 1 and 2, Pride of the West Nos. 1 and 2. Main shaft is down 150 feet, from which point 300 feet drift has been run, encountering the most encouraging prospects.

Bosco Mining Company is chartered under the laws of the State of New York. The officers in 1880 were Gen. Egbert L. Ville, Pres.; E. W. Andrews, Vice-Pres.; Wm. H. Franklin, Treas.; John T. Banker, Sec. Superintendent, H. K. Ville. The company's property is located in Colorado. They own the Bosco, William, Rome, and Elizabeth mines; and developments have been pushed to the extent of determining beyond question the great value of this property.

Boston and Sonora Mining Company (The) is chartered under the laws of the State of Iowa. Officers, H. G. Curtis, Pres.; P. R. Johnson, Vice-Pres.; J. S. Gill, Treas.; W. E. Wood, Sec. Superintendent of the works, E. G. Barker. Office, 31 Milk Street, Boston, Mass. The mine owned is the Mena Grande, located at Alter district, Sonora, Mexico. This property is an extensive one and makes a very rich showing. The company proposes to raise $25,000 additional working capital, that the work of putting the mine upon a productive, dividend-paying basis may be vigorously pushed. Date of commencing developments, February, 1881; date of organization, December, 1880; capitalization, $2,500,000; par value per share, $25; non-assessable.

Boulder Mining and Developing Company. Directors, O. C. Hainsburgh, Chas. Tate, A. Peck, A. G. Peck. Chas. Tate, Pres.; A. G. Woodard, Vice-Pres.; Edgar A. Peck, Treas. and Gen. Manager. Office, Lymes Block, Denver, Col. The company's works are located in Boulder and Gilpin counties, Col. Date of organization, January 18, 1882; capitalization, $500,000; par value per share, $10.

Bristol Mining Company (The), Minneapolis, Minn. Mines owned, Mayflower and Cave. Located at Bristol district, Nevada.

Brothers' Mine (The) is owned by Messrs. B. N. Brajevich and Joseph Sresovich. The Brothers' mine is located in Calavaras district, Arizona. This mine is near the Gold Hill mine, situated in the Mohave Mountains, near Santa Cruz river. Rock is rich, and constantly improving in quality.

Brown & Urton. Property located in Nevada. Stock, 100,000 shares. Total amount of dividends paid up to July, 1881, $8,350; latest dividend, July, 1881, eight and one-half cents per share.

Blue-Bird Mill and Mining Company. Office, No. 10 Market Street, San Francisco, Cal. Location of works, Globe district, Pinal county, Arizona.

Blue Top Mine (The) is owned by Messrs. Williams & Topliff. The location of this mining property is in Arizona.

Brookland Mining Company (The) are the owners of the Brookland mine, which is located at Carbonate Hill, Col. Property owned, ten-inch Cornish pump and engine, etc. Main shaft is 480 feet deep.

Cabinet Mining Company's (The) property is located in Gold

Hill district, Nevada. Total amount of assessments levied, $4,000; latest assessment levied, October 8, 1877.

Cadillac Mining Company (The). The mines belonging to this company are located on Ball Mountain, Col.

Capps Mine (The). Owned by John Wilkes, of Charlotte, N. C. The name of mine, Capps, located five miles north-west of Charlotte, N. C. Amount of property in acres, 125; two veins, 1,200 feet; now developing on the 145-feet level; production large; when last worked, as low as seventy-five feet. Other statistics of little value. Not being worked at present, July 17, 1882. Mr. Wilkes is also proprietor of the Mecklenburg Iron Works. Production large when last worked.

Caledonia Consolidated Company, of Nevada, embraces the Helmes, Baker, Ashburn, and other companies. It is on the same range of gravel as Blue Tent, Quaker Hill, and Little York.

Carboca Mining Company (The). Directors, S. F. Gashwiler, J. W. Roberts, C. A. Burgess, C. F. McDermott, G. W. Grayson. Location of mine, Sonora, Mexico.

Carbonate Mining Company (The). Name of mines owned, Yankee Doodle, located on Carbonate Hill, Col. This mine was recently transferred to the above company for the sum of $300,000.

Carolina Queen Mining Company's (The) properties are located in North Carolina. Capitalization, $200,000, in 100,000 shares of $2 each. Amount paid in dividends January 1, 1882, $2,000. Date of latest dividend, June, 1882; amount per share, one cent. Stock quoted July 14, eighteen cents per share.

Cataract and Wide West H. Mining Company (The). Officer, Wm. B. Lake, Sec. Principal office, 26½ Kearney Street, San Francisco, Cal. Location of mines, Nevada.

Champion Mining Company (The). Officer, J. Crockett, Sec. Office of company, 302 Bush Street, San Francisco, Cal. Mines located in Nevada.

Chippewa Consolidated Mining Company (The). Officers, Directors, John J. Savage, J. Whitaker Wright, Chas. L. Hall, L. G. Kent, J. A. Rosecrans, C. C. Kellogg, Chas. J. Thomas, W. McCafferty, J. L. Loomis. Location of mines, Colorado. Twenty-five men employed.

Clifton Consolidated Mining Company (The). Directors, 1880, Geo. A. Leaverns, A. A. Munger, Jacob Weil, A. L. Weston, J. Henry Weil, J. A. Stanton, Geo. W. Bittenger. Location of mines, Colorado. Capitalization, $600,000; shares, 60,000; par value, $10.

Colorado and New Mexico Company (The). Name of mine owned, Rose of Breckinridge. Located on Mineral Hill, Colorado. Character of the ore, galena. Character of mine, veins. Depth, 500 feet. Tunnel used, 1881. Will begin shipments to Leadville as soon as the railroad reaches Breckenridge.

Columbus Consolidated Mining Company's property is located in Esmeralda county, Nev. The directors are Simon Reinhart, H. M. Levy, F. M. Luce, R. P. Keating, P. I. White. The company has a capitalization of $10,000,000.

Combination Mining Company (The). Location of mines, Black Mountain, Esmeralda county, Nev. Date of first dividend, none. Number of assessments levied, two; total amount of same, $20,000; date of latest assessment, May 18, 1878.

Comprise Mining Company (The), of Philadelphia. Location of mines, on Yankee Hill, Col. Amount of property, five acres. Prospects of property very favorable.

Conquest Mill and Mining Company is chartered under the laws of the State of New York. The officers are Sheridan Shock, Pres.; A. J. Dittenhoefer, V.-Pres.; Wm. A. Darling, Treas.; James B. Morey, Sec.; A. H. Kidney, Financial Agent. Office, 115 Broadway, New York. The company's property is located in Nevada. Capitalization, $1,000,000; par value per share, $5; basis, non-assessable.

Consolidated Yankee and Breece Hill Company (The). Officers, J. A. Rosecrans, Pres.; C. C. Kellogg, Sec. and Treas.; John Meagher, Superintendent. Principal office, 607 Harrison Avenue, Leadville, Col. The mines are located in Colorado, on Yankee and Breece Hills. The mines are worked by drifts. The shaft is 270 feet deep. This property consists of eight promising locations situated on Yankee and Breece Hills. Capitalization, 300,000 shares; par value, $10.

Cornorvan Mine (The). Messrs. Hustin & Cornorvan. Names of mine owned, Cornorvan; location of mine, Cooper Gulch, Alma county, Col. Most valuable mines; assays per ton (mill-run), $108.50; character of the mines, on the vein, about twenty-five feet, and now a vein three feet in width. Date of organization, September, 1881.

Cosmopolitan Mining Company (The). Location of mines, Gold Hill district, Nevada. 1,800 linear feet in mine. Capitalization, $10,000,000; shares, 100,000; par value, $100. Number of dividends to January 1, 1882, none. Number of assessments levied, five; total amount of same, $125,000; date of latest assessment, October 11, 1877.

Curtis Consolidated Mining Company (The). H. P. Stone, Sec. Principal office, No. 419 California Street, San Francisco, Cal. Mines located in Nevada.

Dauntless Mining Company is chartered under the laws of the State of Colorado. The officers are Wm. R. Thompson, Pres.; Geo. W. Turner, Treas.; W. D. Huntly, Sec. Directors, John S. Doughty, Wm. R. Thompson, Geo. W. Turner, Isaac Bennett, Geo. S. Adams, John D. Ruoff, N. H. Anders, H. C. Off. Superintendent, S. S. Campbell. Office, 333 Chestnut Street, Philadelphia. The Dauntless mine, owned by this company, is located in Colorado. Depth of shaft, 100 feet. Length of tunnel, 110 feet. Capitalization, $5,000,000; par value per share, $10; basis, non-assessable. Bonded indebtedness, January 1882, $10,000. Amount of stock reserved in treasury, 2,500 shares.

Devonshire Mining Company. Office of company, Boston, Mass. This company has a capitalization of $1,000,000, in 100,000 shares, with a par value of $10 each.

Diamond State Mining Company. The officers are Henry C. Conrad, Pres.; Joshua Maris, Sec.; J. W. Allen, Supt. Offices, Wilmington, Del. The company's works are located near Breckenridge, Col. They have a capitalization of $1,000,000.

Deville Mining Company's (The) works are located in Esmeralda county, Nevada. The company was organized March 21, 1880. The Directors are R. N. Graves, A. Hayward, W. H. Sheriden, W. Kobl, and J. Epstein. The company has a capitalization of $10,000,000.

Eagle Mining Company's (The) property is located in Saguache county, Col. The company was incorporated in 1880. The incorporators were Geo. B. Nevins, J. C. Loomis, M. E. Kincaid, J. C. Goodwin, and C. L. Gilingham. The company has a capitalization of $150,000.

Eberhardt and Aurora Mining Company's (The) works are located in White Pine county, Nevada. Capitalization, $1,175,000; par value per share, $50; total amount of dividends paid to December, 1877, $174,500; date of latest dividend, December, 1877, seventy-five cents per share.

Eclipse Mining Company (The). Incorporators, S. D. Prescott, A. M. Barnhart, S. G. Stein, Warren Barnhart, G. W. Barnhart. The company own mines located in Chaffee county, Col. Capitalization, $32,000. The capital stock is named at $32,000, with the privilege of increasing it to $500,000 by a two-thirds vote of the stockholders.

El Carmen Mining Company is chartered under the laws of the State of New York. The officers are E. A. Schroeder, Vice-Pres.; Edgar E. Salters, Treas. Office, 125 Broadway, New York, rooms 6, 7, and 8. The company's works are located at Michoacan, Mexico. Date of organization, June, 1877. Capitalization, $6,000,000; par value per share, $20; basis, non-assessable; full paid.

El Dorado South Consolidation Company (The). The mines of this company are located in Philadelphia district, Nye county, Nevada. 2,600 linear feet in mine. Capitalization, $4,000,000; shares, 40,000; par value, $100. No dividends. Thirteen assessments levied, with a total amount of $567,000; the latest assessment, July 27, 1878.

Electro-Magnetic Mining and Developing Company (The). Incorporators, Robert Brown, Edgar A. Peck, Mills H. Smith. The mines are located in Colorado. Capitalization, $1,000,000.

Emmett Mining Company (The). This company's mine is located in Colorado. Capitalization, $5,000,000; shares, 500,000; par value, $10.

Empress Mining Company (The). Name of mines owned, Empress. Location, Gilpin county, Col. Depth of shaft, 475 feet. Prospects of property encouraging.

Enterprise Mining and Developing Company (The) is chartered under the laws of the State of Pennsylvania. Wm. H. Wade, Pres.; Enon M. Harris, Sec. and Treas. Directors, Wm. H. Wade, A. J. String, T. A. D. Forster, M. D.; Wm. Dunlap, E. P. Carpenter. Principal office 113 South Fourth Street, Philadelphia, Pa. Location of mines, Nash county, N. C. Amount of property in acres, 1,000. Capitalization, 320 shares; par value, $2,500; full paid.

Enterprise Mining Company (The). Mines located in Colorado. Stocks quoted, July 13, 1882, sixty-five cents.

Evergreen Lakes and Mineral Springs Company (The). Simon Desmarchais. Principal office, Leadville, Col. Location of mines, Lake county, Col. Capitalization, $100,000; shares, 2,000; par value, $50.

Farland Mine (The) is the property of D. J. Adams, and is located at Clarksburg, Harrison county, W. Va. The mine is now leased by J. T. Farland. It is in the nine-foot seam. Some forty men are employed. Maximum yearly capacity, February 1, 1881, 12,000 tons. The West is the principal market for the ore.

Farwell Consolidated Mining Company. The property is located in Independence district, Pitkin county, Col., and includes the Independence, Nos. 1, 2, 3, and 4, Last Dollar, Last Dime, Legal Tender, Bennington, Choler, Sheba, Friday, Mammoth, Dolly Varden, Galton, Minnie, Mount Hope, and Golden Champion mines. The company purchased a fifteen-stamp mill, which has been running since January, 1881, and have recently built a thirty-stamp mill.

Fairfax Mining Company's (The) works are located in Nevada, Comstock lode. There are 8,000 linear feet in the company's mine. Capitalization, $10,000,000; par value per share, $100. No dividends as yet paid. Number of assessments levied, April 1, 1880, two; total amount of same, $35,000; date of latest assessment, April 1, 1880.

Flora Morrison Mine (The) is located in Tombstone district, Arizona. Shaft is 632 feet deep.

Florida Mining Company's (The) property is located at American Flat, Nevada. There are 1,200 linear feet in the mine. Capitalization, $5,000,000; par value per share, $100. No dividends paid yet. Number of assessments levied, eight; total amount of assessments levied, $225,000; date of latest assessment, February 14, 1877.

Garfield Mining and Milling Company (The). Incorporators, Daniel C. Coffman, James N. Croft, E. P. Martin, Louis K. Heker, Wm. La Shell. The company's property is located in Boulder county, Col. They have a capitalization of $100,000.

Gem Mining Company. The company's works are located in Colorado. They have a ten-stamp mill on their property. The company has expended $10,000 in developments to January 1, 1882. They have 125,000 shares; basis, non-assessable; fully paid; total amount of dividends paid to July, 1882, $7,450; date of latest dividend, July, 1882, which was at the rate of one cent per share.

General Jourdan Mining Company. Directors, W. B. Meeker, Chas. C. Foster, R. Lindsay, W. A. Allen, Harman Schiltz, J. Shepherd. The company's property is located in Colorado. They have a capitalization of $10,000,000.

General Lee Mining Company. Location of mines, White Pine county, Nev. Length of main lode, 1,000 feet. Capitalization, $1,000,000; par value per share, $100; total amount of assessments levied, $307,000.

General Thomas Mining Company's works are located at Columbus, Esmeralda county, Nev. Capitalization, $5,000,000; par value per share, $100; number of assessments levied, six; total amount of assessments levied, $125,000; date of latest assessment, July 20, 1880.

Germania Mining and Smelting Company (The). Location of works, Gunnison county, Col. The company have a capitalization of $325,000; par value per share, $50.

Gertrude Mine (The), owned by E. W. Bush and Henry Friends, of Chicago, and Mr. Houghton, of Boston, is located at the head of the Platte, Alma, Colorado.

Globe Mining Company. Main office, Leadville, Col. Transfer office, 310 Chestnut Street, Philadelphia, Pa.

Globe Consolidated Mining Company's (The) property is located in Storey county, Nev. 1,500 linear feet in the company's mine. Capitalization, $3,800,000; par value per share, $100; number of assessments levied, eleven; total amount of assessments levied, $222,300; date of latest assessment, March 29, 1879.

Gray Eagle Mining Company's (The) works are located in Chester county, Col. Two veins on the company's property have been cut about fifteen feet apart, but tend towards each other; one of which yields ore worth $75 to the ton, and is only about one foot in width.

Grayson Mining Company have their works located in McDowell county, N. C., where they own 240 acres of land. Mr. Kidney is the Superintendent. The ore assays $25 per ton. Stock and bonds held principally in Meridian, Connecticut.

Green Monster and Azurite Company (The). Officers, Judge George Hibben, Pres., Chicago; J. W. Virgin, Vice-Pres., Leadville; James Streeter, Treas., Leadville. Directors, George Hibben, J. W. Virgin, James Streeter, Captain W. H. Kingsbury, R. C. Hutchinson, Leadville; Daniel Harris, Julius Kespohl, Quincy, Ill.; Col. Henry King, Kansas; T. B. Moody, New York. The location of mines is on Lime creek, Colorado. Capitalization, $3,000,000; shares, 300,000; par value, $10.

Grover Mining and Milling Company. Office, 402 Front Street, San Francisco, Cal. The company's property is located in Amador county, near Drytown, Cal.

Golganda Mining Company (The). The mines belonging to this company are located in Lake county, Col.

Good Faith Mining Company. The Directors are John S. Kae, Joseph Clark, William Dutch, G. J. Funk, Charles Warren. The company's property is located in Columbus district, Nev. The company was organized March 3, 1880. They have a capitalization of $10,000,000.

Good Luck Mining and Milling Company (The) has property located in the State of Colorado. The company was organized with a capital of $2,000,000, and has paid up to July, 1881, two dividends, aggregating $7,000; the last dividend was paid in July, 1881.

Goodwin Mining Company's property is located at Baltimore City, Va. The company own two seventy-horse-power boilers, seventy-five-horse-power engine, Howland pulverizer, rock-breaker, two Imlay concentrators, and Bacon hoisting-machine.

Hamburg Mining Company (The) has property located in the Eureka district, Nev. Length of main lode, 2,000 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends paid. Seven assessments levied; amount of same, $305,000; date of latest assessment, September 19, 1879.

Hamilton Mining Company's property is located at Pitkin county, Col. Office, Denver, Col. The company has a capitalization of $2,000,000, in shares with a par value of $10 each.

Hard Money Consolidated Company. The company's works are located at Columbus, Esmeralda county, Nev.

Hazeltine Mining Company's (The) property is located in Colorado. They have quite recently (according to report) uncovered a large body of pay ore in both the east and west 100-foot levels. First quality of ore mined is reported to assay $700 per ton.

Hecla Mining Company's works are located in Idaho. The company is taking out sixty tons of ore per day, and improvements are in progress, and expected to be completed about July 1, 1882, which will give them concentrating capacity for 100 tons per day. The company has a capitalization of $1,500,000. Date of latest dividend, March, 1882, paying one per cent. per month.

Hock Hocking Mine (The), owned by Mr. H. D. Howe, Superintendent, is located at Pennsylvania Gulch, Alma county, Col. It is a new property. The ore is reported as high grade. A force of six men is employed.

Hornet Mining Company (The) has property located at Tuscarora, Nev. The total length of the main lode on which the company depends for its supply of ore is 1,500 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends paid. Three assessments levied, aggregating $30,000; last assessment in January, 1878.

Horseshoe and Sheep Mountain Mining Company. Office, Leadville, Col. The company's property is located in Lake county, Col. Capitalization, $1,000,000; par value per share, $10.

Horseshoe Mining Company is chartered under the laws of the State of New Jersey. The officers are S. S. Hammond, Pres.; C. H. Woodruff, Vice-Pres.; E. M. Harris, Sec.; A. J. String, S. G. Ford. Directors, S. S. Hammond, A. J. String, S. G. Ford, D. K. Joslin, E. P. Carpenter, G. W. Bratton, C. H. Woodruff. Transfer office, 113 South Fourth Street, Philadelphia, Pa. This company owns the Franklin mine, located in Independence mining district, Lake county, Col. Capitalization, $500,000; par value per share, $5; basis, non-assessable.

Hussey Mining Company's (The) property is located at Cornucopia, Elko county, Nev. The main lode is 4,500 feet in length. Capitalization, $10,000,000; par value per share, $100. Number of assessments levied, nine; total amount of assessments levied, $121,000; date of latest assessment, August 25, 1879.

Ida Elmore Mining Company. Location of property, Silver City, Idaho. Capitalization, $200,000; par value per share, $1. Number of dividends paid to February 8, 1877, thirteen; total amount of dividends paid, $60,000; date of latest dividend, February 8, 1877. Number of assessments levied, twenty-two; total amount of assessments levied, $760,000; date of latest assessment, June 26, 1876.

International Vacuum Mining and Dredging Company. The officers are H. A. Cashman, Pres.; B. Hedge, Vice-Pres.; A. C. Whittier, Jessie E. Dewey, Secretary and Treasurer. Superintendent, D. F. Page. Office, 69 Devonshire Street, Boston, Mass. Location of works, Massachusetts. Capitalization, $2,500,000.

Inyoreka Mining Company (The). Officers, Directors, H. T. Graves, F. B. Wilde, J. W. Shaeffer, W. D. Johnson. Location of mines, Inyo county, Cal. Capitalization, $10,000,000.

Inyo Consolidated Mining and Milling Company is chartered under the laws of the State of New York. Office, 58 Broadway, New York. The company's mines are the Little Chief, Wyoming, Eureka, and Independence, located in Inyo county, Cal. Total amount of dividends paid, $45,000; date of latest dividend, April 30, 1882, five cents per share. Stock quoted July 1, 1882, $5.

Iowa Gulch Mining Company is chartered under the laws of the State of California, A. G. Cattell, Pres.; S. Cresswell, Vice-Pres.; W. T. Vanderber, Treas. Directors, J. C. Wyman, Dr. H. Bergen, H. Stanton, J. W. Jennings, Dell Noble. Office, 306 Stock Exchange Place, Philadelphia, Pa. The company's mines, the Scooper and Marietta, are located at Yankee Hill, Col. Their property covers eight acres of land. The character of the ore is hard carbonate; assays about $25 per ton. According to report, the Scooper mine has lately encountered several pockets of fine ore. The company has a capitalization of $5,000,000, in shares at a par value of $10 each. Stock all issued.

Iron Mountain Mining Company (The) has its office at 128 La Salle Street, Chicago, Ill. The officers are W. L. Helfenstein, New York city, Pres.; Stewart Spaulding, of Chicago, Ill., Sec. The property of the company is located in Mexico. Capitalization, $10,000,000, in 100,000 shares of $100 each.

Julia Consolidated Mining Company (The). E. M. Hall, Sec. General office, 327 Pine Street, San Francisco, Cal. The property belonging to this company is located on the Comstock lode, Storey county, Nevada.

Jefferson Mining Company(The). Owns property in Jefferson, Nye county, Nev. The total length of the main lode on which the company depends for its supply of ore is 8,182 feet. Capitalization, $5,000,000, in 50,000 shares of $100 each; $50 is total of dividends paid to 15th of May, 1875, date of latest dividend. $112,000 has been levied on assessments (four). Latest assessment, April 13, 1877.

John A. Logan Mining Company (The), of which Capt. H. D. Baker is Supt., owns the John A. Logan mine, located about two and a half miles below Sedgwick, in the Kerber Creek district, Col. Capt. H. D. Baker is the Supt.

J. & K. G. Mining Company (The). W. W. Lent, Sec. General office, 309 Montgomery Street, San Francisco, Cal. These mines are located in California.

Kirkwood Mining Company (The). The location of this mining property is in Custer county, Col. Capitalization, $5,000; shares, 200; par value, $25.

Knickerbocker Mining Company (The). Owns mining property located at American Flat, Nev. The length of the main lode on which the company depends for its supply of ore is 2,200 feet. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends have been paid; nineteen assessments have been levied; total amount, $511,000; date of latest assessment, 27th of September, 1877.

Kossuth Mining Company (The). Owns property located at Devil's Gate, Lyon county, Nev. The length of main lode on which the company depends for its supply of ore is 2,700 feet. Capitalization, $5,400,000, in 108,000 shares of $50 each. No dividends have been paid; eight assessments, aggregating $437,400, have been levied since August 31, 1877, the date of the first assessment, which was fifteen cents per share.

Lady Bryan Mining Company (The). Office, 203 Bush Street, San Francisco, Cal. These mines are located in Nevada.

Lady Washington Consolidated Mining Company (The). Officer, W. H. Watson. Principal office, 302 Montgomery Street, San Francisco, Cal. The mining property is located in Nevada.

Lake Valley Mining Company (The). The Lake Valley mines owned by this company are located in New Mexico, Col. Very rich ore. Property owned is a quartz mill. Mr. W. L. Davis (1882), of Leadville, who visited the mines recently, reports in the highest terms of the properties. In his opinion, over a million dollars' worth of ore is already developed and waiting treatment.

Lancaster Mining Company (The). Principal office, Leadville, Col. The mines belonging to this company are located in Park and Lake counties, Col. Capitalization $1,000,000; shares, 100,000; par value, $10.

Leopold Mining and Milling Company (The). Principal office, Leadville, Col. The mines belonging to this company's claims are located in Lake county, Col. Capitalization, $500,000; shares, 50,000; par value, $10.

Liberty Hill Consolidated Mining and Water Company (The). Officer, J. W. Pew, Sec. Principal office, 310 Pine Street, San Francisco, Cal. The mines belonging to this company are located in California.

Lime Creek Mining Company. The officers are J. Y. Marshall, Pres.; J. W. Jacques, Vice-Pres.; J. R. Hammond, Sec.; C. C. Parsons, Treas. Directors, J. Y. Marshall, J. W. Jacques, Samuel McMillen, C. C. Parsons, J. K. Hammond, H. T. Sale, and J. P. O'Brien. Office, Leadville, Col. The company own nineteen claims, located at Holy Cross mining district, Pitkin county, Col. Amount of property in acres, 190.

Lincoln Mining Company (The) is chartered under the laws of the State of Colorado. The officers are W. J. Troth, Pres.; Wm. Robb, Vice-Pres.; J. Morton Rigg, Sec. and Treas. Directors, W. J. Troth, J. Morton Rigg, J. I. Wright, M. D., Geo. R. Stansberry. The offices are 430 Walnut Street, Philadelphia, Pa. The company owns five claims, Rev. Samuel Durborow, Mary Daniels, Little Mary Ann, Lincoln, and Wm. Penn, located at or on Long and Derry Hill, Thompson's Gulch, Cal. Mining district, Lake county, Col., and having an area of fifty-one acres. The shaft is down 225 feet. The mining plant and other property connected with the mine includes good buildings and hoisting machinery. Capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable; stock issued, 120,000 shares; stock reserved in treasury, 80,000 shares.

Little Bear Mining and Milling Company (The). Incorporators, B. F. Grafton, H. E. Paine, N. W. Fitzgerald, J. B. Alley, H. B. Denman, Robert G. Ingersoll, C. P. Farrell, Wm. S. Bush, D. W. Middleton. Principal office, Washington, D. C. The mines belonging to this company are located at New Mexico, Col. Capitalization, $5,000,000; shares, 200,000; par value, $25.

Little Diamond Consolidated Mining Company is chartered under the laws of the State of Colorado. The company has a capitalization of $5,000,000. Par value per share, $10.

Little Delaware Mining Company (The). The mining property of this company is located in California Gulch, Col. Shaft used.

Little Keystone Mining Company is chartered under the laws of the State of New York. The officers are Chas. F. Bussing, Pres.; T. E. Harrison, Vice-Pres.; Benjamin Stearns, Sec.; Albert Alsberg, Treas. Offices, 58 Broadway, New York, and 310 Chestnut Street, Philadelphia, Pa. The company's property is located at Carbonate Hill, Leadville, Col. The company has a capitalization of $300,000, in 20,000 shares; par value, $1.50; basis, non-assessable.

London Mining Company (The). Principal place of business, Fairplay. John T. Herrick, Agent. The mining property owned by this company is located in Colorado.

Longfellow Mining Company (The.) Location of works, Clifton, Apache county, Arizona. Report says the property of this company has developed quietly into a colossal enterprise. Over 600 men are engaged at the mines. Several miles of tramway have been built, and a small army of teamsters is engaged in hauling away the bullion and bringing fuel and supplies to the mines. The company is working the mines at a profit.

Loveland Pass Mining and Railroad Tunnel Company is chartered under the laws of the State of Colorado. The officers are W. A. D. Loveland, Pres.; Ex-Governor W. M. Stone, Vice-Pres.; Edward Reed, Treas.; A. D. Clements, Sec.; Frank W. Loveland. Office, Denver, Colorado. The company's property is located in Colorado. Date of organization, July 13, 1881; capitalization, $5,000,000; par value per share, $20. Preferred stock, 62,250 shares; basis, non-assessable.

Lucky Hill Consolidated Mining Company (The) has property in Durango, Mexico. One assessment levied April 25, 1882, at ten cents per share.

Luna Chihuahua Mining Company (The). The mines belonging to this company are located in Chihuahua, Summit county, Colorado. Capitalization, $2,000,000.

Monarch Mine (The). Owned by Hedges & Company. The location of this mining property is near the Susquehanna, South Half-Moon, mining district, on French Mountain, Lake county, Col. The character of the mines consists of veins. Entrance to mine is by tunnel. The company has made no preparations for winter quarters and work.

Machinist Mining Company (The). The mines belonging to this company are located in Nevada. Capitalization, $1,000,000; shares, 100,000; par value, $10; number of dividends, February 1, 1877, amount, $400,000; date of latest dividend, February 1, 1877; per share, $1.

Madonna Mine (The) is situated about one mile south of Chaffee city, Colorado. This mine is owned by a close corporation composed of General W. Tuttle, of Des Moines, Iowa; General Davis, of Chicago; Judge Richards, of Fort Dodge, Iowa; and Messrs. McDonald, Paine, and Pomeroy, of New York city. Two shafts have been sunk; one to a depth of 115 feet, and the other eighty feet; the former of which is reported to have cut a large body of mineral.

Magnolia Mining Company (The). Principal office, Denver, Colorado. The mining property of this company is located in Pitkin county, Col. Capital stock, $1,000,000; shares, 100,000; par value, $10.

Kammoth Consolidated Mining Company. The officers are J. G. Jones, Pres.; H. Davis, Sec. Directors, J. I. Meek, A. P. Tritgin, and John Lunday. This company's property is located in Nevada county, Cal.

Mammoth Mining and Milling Company. The company's mine is located at Breece Hill, Col. The ore is of a porphyritic formation of very promising character. The shaft is 200 feet deep. The company owns steam-hoisting engine, and other machinery.

Mark Twain Mining Company (The). This mining property is located in Summit county, Col. Capitalization, 100 shares.

Marrs Consolidated Mining Company (The). This mining property is located in Dolores county, Col. Capitalization, $600,000; shares, 6,000.

McMillen Mining Company. Location of property, Arizona. The company has a capitalization of $10,000,000; par value per share, $100. Total amount of dividends paid, $90,000: date of latest dividend, June 20, 1881, being paid at the rate of fifteen cents per share.

Massachusetts and New Mexico Consolidated Mining Company (The) was organized at Portland, Maine, on January 6, 1881. The property is located in the Eureka district, New Mexico. There are from sixty to seventy men employed in the mines. Capitalization, $300,000.

McCulloch Mining Company (The). This company was chartered under the laws of the State of Colorado. S. Janney, Pres.; Shreve Ackley, Treas.; Wm. L. Lisom, Sec. Principal office, 306 Stock Exchange Place, Philadelphia, Pa. Capitalization, 200,000 shares; par value, $10; non-assessable. Amount of stock issued, 160,000 shares; reserved in treasury, 40,000 shares.

Meadow Valley Mining Company (The). The location of the property of this mining company is in Ely district, Lincoln county, Nev. Number of dividends paid to June 16, 1873, 17; total amount, $1,260,000; latest dividend, June 16, 1873. Number of assessments levied: total amount of same, $528,000; date of latest assessment, August 1, 1881. Capitalization, $6,000,000; shares, 60,000; par value, $100.

Metallic Mining Company. Office, 309 Montgomery Street, San Francisco, California.

Mexican Union Mining Company (The). Directors, George Story, Victor Fernbach, D. Fay, Frank Tagliabue, U. Mayers. The mines of this company are in Columbus district, Esmeralda county, Nevada. Capitalization, $10,000,000.

Miller Mining Company (The). The mines belonging to this company are located in Nevada. Capitalization, 200,000 shares; par value, $25.

Mineral Hill Mining Company owns the Keystone mine located near Bellevue, Wood river, Idaho. The company has a capitalization of $500,000: par value per share, $5.

Mineral Hill Mining and Smelting Company is chartered under the laws of the State of Colorado. Office, 132 S. Third Street, room 8, Philadelphia, Pa. The company's mines are the Dandy, the Boss, the Little Dandy, the Little Daisy, and the Damascus, located in the State of Colorado. Title unencumbered. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable.

Minerva Mining Company. Office, 506 Walnut Street, Philadelphia. The company's mines are located in Gregory mining district, Gilpin county, Colorado.

Mineral Mountain Mining Company (The) has property located at Mineral Point, Colorado. The length of the main lode on which the company depends for its supply of ore is 750 feet. The stock of the company has been quoted at $11.

Mineral Bed Consolidated Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, J. J. Hitchler, Pres.; Isaac H. Tillyer, Vice-Pres.; Wm. J Turner, Treas. George R. Lynn, B. F. Bivins. Main office, Camden, New Jersey. Branch office, 9 S. Water Street, Philadelphia, Pa. The mines are the Mineral Bed and Esperanza. Shaft on principal mine is 100 feet, contract for an additional 100 feet. Capitalization, 300,000 shares; par value, $10; non-assessable; stock all issued in payment for property.

Mineral Railroad and Mining Company (The). Officers, George B. Roberts, Pres.; Isaac J. Wistar, Vice-Pres. Directors, Isaac J. Wistar, Edmund Smith, Wistar Morris, George B. Roberts, N. Parker Shortridge, A. J. Cassatt, S. Kneass, J. N. DuBarry, John P. Green, Alfred Mordecai, Sec., H. S. P. Haviland, Treas. This mining property is located in Northumberland county, Pennsylvania. Yield during 1881, net profit, $58,076.61; yield (gross tons) during 1881, $439,077.18. Date of latest dividend, numbers two and three (for 1881); amount, $10,000 each; total amount, $20,000. Wages paid to all classes of labor for 1881, $453,262.91. Number of persons employed, 1,259. Five men were killed in one year.

Monitor Belmont Mining Company (The). The location of mines belonging to this company is at Belmont, Nye county, Nevada. 1,400 linear feet in mine. Capitalization, $3,000,000; shares, 30,000; par value, $100. Number of dividends paid to December 5, 1873, three; total amount, $75,000; latest dividend, December 5, 1873. Total amount of assessments levied, $162,500. Date of latest assessment, August 8, 1877.

Monitor Consolidated Company (The). The mines belonging to this company are located in Colorado. Capitalization, $2,000,000.

Morgan Mining Company (The). J. J. Raphael, Sec. Principal office, 533 Kearney Street, San Francisco, Cal. The location of this company's mines is in California.

Mount Sheriden Mining Company (The). This company is chartered under the laws of the State of Colorado. Officers, John S. Doughty, Pres.; George W. Turner, Treas.; W. D. Huntly, Sec. Directors, Charles H. Selser, John S. Doughty, Geo. W. Turner, John M. Schreiner, Wm. R. Thompson, W. M. Adams. Principal office, 310 Chestnut Street, Philadelphia, Pa. The property belonging to this company consists of eight full claims, one patented. Shaft sunk seventy-five feet. Pay mineral struck. Capitalization, 250,000 shares; par value, $10; non-assessable. Amount of stock issued, 250,000 shares. Reserved in treasury, 20,000 shares.

Mount Hope and Independence Consolidated Mining Company (The). Principal office, Leadville, Col. These mines are located in Lake, Pitkin, Gunnison, and Summit counties, Col. Capitalization, $1,000,000; shares, 100,000; par value, $10 each.

Mount Princeton Irish-American Company (The). Principal office, Leadville, Col. The mining property owned by this company is located in Lake county, Col. Capitalization, $3,000,000; shares, 300,000; par value, $10.

Mount Lincoln Consolidated Mining Company (The) is chartered under the laws of the State of Colorado. Officers, H. V. Reed, Pres.; David Conrade, Vice-Pres.; George F. Work, Sec. Directors, J. T. Hampton, Wm. B. Dalton, Samuel Work, Wilmer A. Walter, Samuel Loag, Shreve Ackley, H. V. Reed, David Conrade, George F. Work. Principal office, 300 Stock Exchange Place, Philadelphia, Pa. The names of mines owned by the company are Mount Lincoln, Main mine, Main No. 1 mine, Rogers, Huron, Dublin, and Monster. Capitalization, 600,000 shares; par value, $10; non-assessable; stock issued, 500,000 shares; stock in treasury, 100,000 shares; stock in bonds, 100,000 shares.

Murphy Mining Company (The). The mines owned by this company are the Mary and Pat Murphy, located in Colorado, in the vicinity of St. Elmo. The system of levels run on the Mary Murphy has exposed a body of high-grade ore. A similar work on the Pat Murphy has lately opened a vein, seven feet wide, of the same character of ore as found in the Mary Murphy.

Murphy Mining and Prospecting Company (The). The mines belonging to this company are located in Lake, Gunnison, Pitkin, and Saguache counties, Col. Capitalization, $1,500,000; shares, 150,000; par value, $10.

National Mine and Tunnel Company (The) is chartered under the laws of the State of New Jersey. The officers are Thos. S. Disston, Pres.; V. G. Edwards, Vice-Pres.; John A. Currier, Treas.; Wm. Tweed, Sec. Directors, Thos. S. Disston, V. G. Edwards, J. H. Currier, D. B. Herbine, G. Hangstefer, Wm. Tweed, and T. W. South. Mr. P. A. Snell is Superintendent. The main office is at 117 Market Street, Camden, N. J. The branch office is at 140 S. Third Street, Philadelphia, Pa. The company owns the Norma mine, located in Chaffee county, Col. The tunnel is in seventy-two feet. The main lode, on which the company depends for its supply of ore, is 1,500 feet. Area of property, 1,500 by 300 feet. Capitalization, $2,000,000, in 200,000 shares of $10 each; non-assessable. Half the stock is reserved in treasury.

Natona Water and Mining Company (The). The mines belonging to this company are located in California.

New Discovery Mining and Milling Company. The company's property is located in Jefferson county, Col. They have a capitalization of $500,000.

New Basel Consolidated Mining Company (The). The property is situated in Black Canon, Placer county, California. During the past two years two shafts have been sunk, each about eighty-five feet deep. The shafts are some 300 yards apart, and the rock in each pitches towards the other. The company propose to sink the northern shaft in the bed-rock as soon as possible, and then drift to the channel. They confidently expect to strike what is called the Greek channel. The mine is equipped with a steam engine and hoisting works.

New Mexican Nestor Mining Company (The). Principal office in Denver, Colorado, and New Mexico. The mines are located in Missouri. Capitalization, $1,500,000; shares, 150,000; par value, $10.

New York Mining Company (The) has offices at 8 San Francisco Exchange Building, San Francisco, Cal. Officers, Gustave Frank, Pres.; L. T. Lazure, Vice-Pres.; F. E. Dietz, Sec.; Nevada Bank, Treas. Matt. Canavan, Superintendent. The company owns the Sophia mine, located in Mono county, California, on the Comstock lode, in the Gold Hill district. Capitalization, $10,000,000, in 100,000 shares of $100 each. No dividends have been paid. Twenty-seven assessments have been levied; total amount of same, $965,000; date of latest assessment, January 18, 1882.

New York and Palmetto Mining Company is chartered under the laws of the State of New York. Office, 40 Broadway, room 52, New York. The company has a capitalization of $2,000,000 in shares, with a par value of $100 each.

Niagara Consolidated Mining Company (The) own a fine group of mines in Niagara Gulch, San Juan county, Col., comprising the Cuba, McAlpine, McKenney, Alta, Money Musk, American, Outlook, Junction, Tyrol, Pride of San Juan, Tabor, Cleveland Central Cross, and Boomerang. Over 1 000 feet of development have been made. Prof. T. B. Comstock is Manager.

Northern King Mining and Milling Company (The). Officer, E. A. Holmes, 310 Pine Street, San Francisco, Cal. The mining property of this company is located in Arizona.

North Sulphurets Mining Company (The) is chartered under the laws of the State of New Jersey. Officers are Hamilton Disston, Pres.; Wm. Kohl, Vice-Pres.; H. B. King, Sec.; Jesse W. Neal, Treas. Capitalization, $200,000, in 200,000 shares of $1 each; non-assessable.

North Belle Isle Mining Company (The), of which E. M. Chapin is Superintendent, holds its annual meeting on the 28th of June. The officers are T. B. Dayton, Pres.; T. L. Brown, Vice-Pres.; E. M. Hall, Sec. The property of the company is located in Nevada, Tuscarora district, Elko county. Current value of mine is $20,000. The North Belle Isle sent to the mill considerable ore of good quality extracted from the upraise on the 150-foot level. The vein has been followed on this level over 700 feet, finding ore of good quality, and the vein averaging about ten inches in width. Capitalization, $10,000,000, in 100,000 shares of $100 each. Yield net during 1880, $51,720. Dividends paid to August 19, 1881, two; the total amount, $30,000; latest dividend, August 19, 1881; amount per share, $15; total assessments levied, $25,000; latest assessment, February 5, 1880; amount per share, 15 cents; cash on hand, April 1, 1882, $1,476; stock quoted June 10, $20 per share.

North Star Mine (The). Owned by Fenwick, Rape, Converse, and Lewis. The North Star mine is located in Fresno county, Cal. Assays from $150 to $200 per ton. Three feet in width.

North-Western Mining and Exchange Company (The). The location of these mines is in Elk county, Pa. Property owned by the company consists of five Harrison's machines; 1,300 tons daily; amount will be increased to about 3,000 tons per day.

North Standard Mine (The) is located in California. The company has a capitalization of $10,000,000, and No. 11 dividend of $1 per share has been declared payable July 1, 1882. The total amount of assessments levied is $20,000. The last assessment was levied November, 1881, at the rate of ten cents per share.

Numa Mining Company (The). D. Wilder, Sec. Principal office, 328 San Francisco, Cal. The location of the mines of this company is in Nevada

Ocean Seneca, Mining Company (The). S. J. De Lau, Manager. The location of the mines belonging to this company is in South Evans Gulch, Col. Shafts are used. Low grade of ore.

Oshkosh Consolidated Mining Company (The). Chartered under the laws of the State of Maine. Officers, E. C. Nichols, Pres.; C. T. Plimpton, Treas.; L. P. Johnson, Sec. Directors, E. C. Nichols S. P. Johnson, D. W. K. Knowles, John R. Mason, C. T. Plympton, H. A. Piper, G. W. Way. A. Mullen, Superintendent. The location of the mines owned by the company is in Lawson, Col. Capitalization, $500,000; shares, 100,000; par value, $5.

Oregon Squaw Lake Company (The). This company owns the Palmer Creek and Oregon mines, located in Arizona, Toughnut county. Toughnut, 703 feet; levels, 1,529; cuts, 404. Goodenough, 147 feet; levels, 419; cuts, 45. West Side, 113 feet. Total shaft, 986 feet; levels, 1,938 feet; cuts, 440 feet. Cost of operating mines and mills, per ton, mining, $2.50; to mill, $4.15. Mill has been in operation six months. Bullion produced, $300,000.

Oriental Company (The). J. T. Bradbury, Superintendent. These mines are located in Alleghany, Sierra county, Cal.

Oro Blanco Mining Company. W. O. Gould, Sec. General office, 214 Sansome Street, San Francisco, Cal. The location of these mines is in Arizona.

Osceola Mining Company (The). The Osceola and Peelstick mines are located in Arizona. 1880. They are now working the Peelstick, which has a 115-feet shaft, from which a seventy-five feet cross-cut has been run. The cross-cut has reached a body of ore five feet in width. Same company are commencing a shaft on the Osceola mine.

Providence Consolidated Mining Company (The). The names of mines are Rose and Providence, located near Volcano, Amador county, Cal. Amount of property in acres, 2,010.

Palmetto Extension Mining Company is chartered under the laws of the State of New Jersey. The Directors are Judah Isaacs, Henry Mitchell, David Mitchell, David Loewen. Office, 106 Market Street, Camden, N. J. Transfer office, 23 South Third Street, Philadelphia, Pa. The company's mine, the Lillian, is located in Colorado. Shaft is down fifty feet. Capitalization, $350,000; par value per share, $1; basis, non-assessable. Treasury reserve, 50,000 shares; stock issued, 300,000 shares.

Paris Mining Company (The). Principal offices, 310 Pine Street, San Francisco, Cal. The mines of this company are located in California. The company has a capitalization of $10,000,000.

Penasquito Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, L. D. Filbert, M. D., Pres.; Gen. R. Thayer, Vice-Pres. and General Manager; A. R. Shepherd, Treas.; Joseph J. Martin, Sec. Directors, John A. Bell, L. S. Filbert, M. D., Charles A. Porter, Gen. Russell Thayer, Ex-Gov. Alexander R. Shepherd. Samuel L. Smedley, R. Stewart, M. D., Joseph J. Martin, J. E. Kingsley, L. H. Stevens. Principal office, Camden, New Jersey. Address, care of C. A. Porter, room 6, No. 201 Walnut Place, Philadelphia, Pa. Mines owned by the company are El Sacramento, La Pieto, Veta Plomosa, Todos Santos, La Bonita, La Hermasa, Santo Domingo, Penasquito, Veta Grande, La Libertad, all located at Batopilas, Mexico. Length of tunnel, 169 feet. Capitalization, 200,000 shares; par value, $5; non-assessable. Amount of stock issued, 200,000 shares. Stock issued in payment of company's property.

Penn-Breckenridge Consolidated Mining Company (The) is chartered under the laws of the State of Colorado, Herman Burgin, M. D., Pres.; John M. Taylor, Treas.; Charles B. Miller, Supt. Directors, Herman Burgin, M. D., Charles B. Miller, James Thatcher, Stephen D. Harris, J. Thomas Harrop, John M. Taylor, John J. Ziegler, D. P. Ladd, Thomas M. Longcope. Price W. Janeway, Sec. The property belonging to this company consists of nine full claims, all located in Colorado. Capitalization, 400,000 shares; par value, $10; non-assessable.

Penry Mining Company (The) is chartered under the laws of the State of New Jersey. George W. Camblea, Pres.; E. B. McKeon, Vice-Pres.; Isaac A. Lee, Treas.; H. K. Whitner, M. D., Sec. Directors, F. A. Rosengarten, George W. Cambles, C. B. McKeon. Isaac A. Lee, H. K. Whitner, M. D. Transfer office, 134 South Fourth Street, Philadelphia, Pa. The name of the mine owned by the company is the Crystal Lake lode, located in Colorado, Horse-Shoe, Peru district, Summit county. Capitalization, 400,000 shares; par value. $1; non-assessable. Amount of stock issued, 350,000 shares; reserved in treasury, 50,000 shares.

Pinal Consolidated Mining Company (The). Officer, J. W. Taylor, Sec. General office, 309 Montgomery Street, San Francisco, Cal. The mining property of this company is located in Arizona. Date of latest assessment, April 3, 1882; amount of same, $30.

Pine Forrest Mining Company (The). Leadville, Col., is the general office. The mining property of this company is located in Park, Lake, and Summit counties, Col. Capitalization, $300,000; shares, 30,000; par value, $10.

Pioche Mining Company. Location of works, Pioche, Lincoln county, Nev. There are 1,000 linear feet in the company's mine. Capitalization, $2,000,000; par value per share, $100. Number of dividends paid to August 5, 1872, three; total amount of dividends paid, $60,000; date of latest dividend, August 5, 1872. Number of assessments levied, fourteen; total amount of assessments levied, $260,000; date of latest assessment, October 5, 1876.

Plymouth Mines, Empire, and Baldwin (The). Owned by E. J. Baldwin and others. The above mines are located in Amador county, Cal. There is a sixty-foot ledge of $17 ore—assays $11.25 per ton. The shaft is eighteen feet wide. (1880.) Work on the Baldwin mine is going ahead; located near Nashville; present shaft 300 feet, cross-cutting. The cost of mining and milling per ton is $3.

Pocumtuck Mining Company (The). Incorporators, J. E. Allen, John E. Allen, Joseph Beals, T. C. Hawks, D. A. Hoffman, J. J. Dougherty. The location of the mining property of this company is in Summit county, Col. The company was organized in 1862. Capitalization, $1,000,000.

Preston Tunnel and Mining Company (The). The location of the mines of this company is in Summit county, Col. Capitalization, $1,000,000.

Presque Isle Consolidated Company (The). Incorporators, S. H. Ellis, W. R. Smith, J. R. Rockwell, D. Cook, T. P. Webb, Wellington Downing, E. A. Rockwell. The location of the mines belonging to this company is in Summit county, Col. Capitalization, $1,000,000.

Prospect Mining Company. The company's property is located in Storey county, Nev. There are 1,000 linear feet in mine. Capitalization, $10,000,000; par value per share, $100. Number of assessments levied, eight; total amount of assessments, $290,000; date of latest assessment, April 26, 1881.

Prussian Mining Company. The company's property is located in Jefferson county, Nev. There are 1,000 linear feet in the mine. Assessments have been levied to the amount of $150,000; date of latest assessment, May 12, 1877. No dividends have been paid.

Quebec Mine (The), owned by Mr. P. M. Hilton. This mine is located in Arizona. He has recently (1881) shipped two tons of ore from another of his claims. The Yuba has rewarded him by the handsome return of $478.96 per ton. On this claim he has sunk about ten feet, and has a vein eighteen inches wide.

Quebec Mining Company. The directors are P. Garnean, Pres.; E. Bandet, V.-Pres.; L. N. Carrier, Treas. and Sec. J. A. Chaplean, C. Leondis. Managing Directors, E. T. Paquet, L. Beaubien, O. Gauthier, Cure Lavelle. Office, Quebec, Canada. The company's property is located at Des Plantes, St. Francis, and Boyer rivers. Capitalization, $500,000; par value per share, $5.

Queen Bee Mining Company (The). Incorporators, Hon. H. W. Bookwalter, William H. Slawson, George W. Hinikle. Principal office, Leadville, Col. The location of the mines belonging to this company is at Silver Cliff, Col. Capitalization, $1,000,000; par value, $10.

Queen Mining Company (The). B. F. Smith, Pres.; S. D. Wilder, Sec. and Treas. The company's property is located in Lake county, Col. Capitalization, $1,000,000.

Queen of the Mountain Mining Company (The). Incorporators, B. D. Wallis, Wm. Faxon, J. C. Elms, Benjamin Dore, E. P. Brown, E. F. Pierce. The mines are located near Silverton, Col. Capitalization, $2,000,000.

Red Mountain Mining and Milling Company (The). Officers, Charles C. Parsons, Herbert Gaston, John H. McArdle, Luther M. Weiley, James R. Hammond. Principal office, Leadville, Col.

Record Mining Company is chartered under the laws of the State of Colorado. The officers are R. J. Dodd, Pres.; W. Culbertson, Treas.; A. C. McCurdy, Sec. Directors, F. H. Myers, R. J. Dodd, E. E. Barclay, A. C. McCurdy, W. Culbertson. Main office, Boulder City, Col. Branch and transfer office. Merchants' Exchange Building, room 19, Philadelphia, Pa. The company's property is located at Sugar Loaf Mountain, Boulder county, Col. Capitalization, $1,000,000; par value per share, $10; basis, non-assessable. Treasury reserve, 40,000 shares. Amount of stock issued, 60,000 shares.

Red Deer Consolidated Mining Company is chartered under the laws of the State of New Jersey. The officers are L. A. Conwell, Pres.; G. S. Dow, Vice-Pres.; C. H. Dow, Sec. and Treas.; F Homer, Gen. Mang. Trustees, L. A. Conwell, G. S. Dow, J. C. McNaughton, C. H. Dow, P. M. Penrose. Offices, Federal Street, Camden, N. J., and 140 South Third St., Philadelphia, Pa. Capitalization, $250,000; par value per share, $1; basis, non-assessable.

Red Oak Iowa Company (The). The California and Austerlitz are the mines owned by this company, located in Arizona. The mine is worked chiefly by drifts. Depth of shaft, fifty feet, 1880. The California mine is showing up splendidly. The Austerlitz has two fifty-feet shafts at the bottom of which drifts have been started. Capitalization, $150,000; shares, 15,000.

Regent Mining Company. The directors are M. C. Hillyer, Pres.; C. L. Weller, Vice-Pres.; T. W. Hubbard, Sec.; L. D. Folsom, Joseph Angel. Charles Elliott, Transfer Sec; Geo. B. Hillyer, Supt. The Regent company have 1,500 feet of ground at Silver City, Lyon county, Nev., adjoining the Lower Comstock, and absorb all the leases, etc., from the Royal and Lower Comstock to the Emigrant Prospecting Company. Thus, all these different claims will hereafter disappear, and all the ground will be known as the Regent, (November 26, 1881.)

Richmond Mining and Reduction Company is chartered under the laws of the State of Colorado. The officers are Dean Richmond, Pres.; G. W. E. Griffith, Vice-Pres.; W. Barth, Treas.; C. F. Leimer, Sec. Branch office, 407 Locust Street, Philadelphia, Pa. This company's mining property consists of the Little Eagle, the Tennessee, the Jack Bull, the Legal Tender, and Legal Tender Tunnel mines, located at Sheep's Mountain, Summit county, Col. Date of organization, 1881; capitalization, $5,000,000; par value per share, $10.

Ricco Mining Company (The), of New York. Amos Lane, Superintendent, and J. Coy of the Bon Ton. The location of the property belonging to this company is in Ouray county, Col.

Rico Pioneer Mining Company is chartered under the laws of the State of Colorado. The officers are W. L. Boswell, Pres.; Sparta Fritz, Vice-Pres.; S. H. Alleman, Sec. and Treas. Directors, W. L. Boswell, Sparta Fritz, S. H. Alleman, E. H. Green, E. C. Irvin. Office, 37 South Third Street, Philadelphia, Pa. The company owns the Philadelphia, Marguerite, Kirke M. Keim, and Harcourt mines, located in Colorado. The company has forty-one acres of land. 33,000 shares are reserved in the hands of trustees as working capital. Entire capital stock has been used in payment for property. Capitalization, $1,000,000; par value per share, $10; basis. non-assessable.

Ruby Lode (The). Owned by Judge Pendery and others. The location of the Ruby lode is Iron Hill, Colorado. The character of the ore is similar to the sulphurous ores in the A. Y. & Gilt Edge lodes in California Gulch, 1881, while the mineral in the shaft is of a refractory nature. Shaft, 470 feet deep. Small hoister machinery. Mine located, 1878.

Royal Arch Mining Company. The officers are L. H. Simpson, Jr., Pres.; R. C. Combs, Treas.; E. P. Moore, Sec. Office, 137 Broadway, New York. The company's property is located at the Black Hills, Dakota. Average of ten assays from promiscuous ore, per ton, $47.94; average of four assays from selected ore, $265 per ton. Yield of Portland Mill, adjoining property, $50,000. The company has a capitalization of $1,500,000; par value per share, $5.

Rye Patch Mining Company's property is located in Nevada. The company has a capitalization of $5,000,000 in shares, with a par value of $100 each. Total amount of dividends paid, $67,500. The last dividend was paid December 31, 1877, at the rate of twenty-five cents per share.

St. Paul Sulphuret Consolidated Mining Company (The). Location of mines, Colorado. Capitalization, $2,000,000; shares, 200,000; par value. $10.

Salida Mining and Milling Company (The). Gen'l office at Salida, Colorado. The location of the mines owned by the company is in Chaffee county, Colorado. Capitalization, $100,000; shares, 10,000; par value, $10.

Saltmarsh Mining Company. Location of mines, Sterling Creek, Oregon.

Sappho Mining Company (The). J. L. Emerson, Manager. The mining property of this company is located on Yankee Hill, Colorado.

San Pedro Consolidated Mining and Milling Company is chartered under the laws of the State of New Jersey. The officers are J. Groesbeck, Pres.; C. A. Brady, Vice-Pres.; F. T. Weldon, Sec.; J. Becker, Treas. Directors, J. Groesbeck, C. A. Brady, J. Becker, J. W. Kerlin, F. L. Welden, J. L. Borsh, R. T. Donovan. Transfer office, 148 S. Fourth Street, Philadelphia, Pa. The company's property is located in Saddle Mountain district, Pinal county, Arizona. The shaft is 364 feet deep. Capitalization, $2,000,000; par value per share, $10; basis, non-assessable; number of assessments levied, five; date of latest assessment, May 17, 1882.

Santa Fe Bonanza Mining and Tunnel Company. The officers are S. T. Reed, Pres.; G. Gordon Pasey, Sec.; W. C. Rogers, Treas. C. Wells, General Manager. The company's mining property consists of the Bottom Dollar mine, together with eighteen good claims and one tunnel location. The property is located in Santa Fe county, Las Callas mining district, New Mexico. The shaft is 110 feet deep. At a depth of seventy feet a level has been run a distance of fifty feet, with a face of twenty-five feet. The distance between walls is seven and one-half feet, over five feet being solid galena ore. There are over 600 tons of ore on the dump and in sight.

Santiago Mining Company. The company's property is located at Devil's Gate, Lyon county, Nevada. There are two thousand linear feet in the mine. Capitalization, $11,200,000; par value per share, $100; no dividends paid to April 1, 1882; date of latest assessment, June 11, 1869.

Savage Mining Company (The). Officer, E. B. Holmes, Secretary. Gen'l office, 309 Montgomery Street, San Francisco, California.

Silver Islet Mining Company have their property located at

Thunder Bay, Lake Superior, Mich. Capitalization, $1,000,000: par value per share, $25; basis, non-assessable; number of dividends paid to January 26, 1880, twenty-three; date of latest dividend January 26, 1880.

Senator Mining Company (The). Officer, L. Reynolds, Secretary. Principal office, 309 Montgomery Street, San Francisco, California. The mines belonging to this company are located in Nevada.

Scorpion Mining Company (The). Officer, R. Spinney, Secretary. Gen'l office, 310 Pine Street, San Francisco, California. The mines belonging to this company are located in Nevada.

Shields Mine (The). Mr. C. F. Barber, stockholder of the company. Mr. G. M. Seymour, Manager. The above mine is located in Colorado Gulch, Colorado. The quality and character of the ore is silver, gold, and carbonate quartz. Fissure veins. New incline shaft sunk on the pitch of the vein over 100 feet. Entrance to the mine by tunnel. Property owned, engine and shaft. 1881, the Shields mine is doing effective development work, the fruits of which will soon be apparent, October 22, 1881. Last week the shaft-house and engine were removed from the old to the new shaft, and hereafter much more headway may be expected. Weekly output, seventy tons. Capitalization, $500,000; shares, 5,000; par value, $100.

Snake River Consolidated Mining Company (The). Incorporators, C. R. Fish, L. W. Aldridge, G. Drown, C. E. Clark, L. R. Vredenbery, Jr., Fred. C. L. Buck, Thomas A. Tobs. The location of the mining property owned by this company is in Fremont and Pueblo counties, Colorado. Capitalization, $1,000,000.

Sombretillo Mining Company. Their works are located at Altar, State of Sonora, Mexico. The company has large quantities of mining machinery. Capitalization, $5,000,000; non-assessable; fully paid.

Socorra Mining and Milling Company's property is located in New Mexico. The company has a capitalization of $250,000; par value per share, $100. Amount of dividends paid to July, 1882, $8,375. Date of latest dividend, July, 1882.

South Barcelona Mining Company (The). The company's property is located in Nevada. There are 1,500 linear feet in the mine. Capitalization, $600,000; par value per share, $100. No dividends have been paid, June 30, 1882. Number of assessments levied, five; total amount of assessments levied, $114,000. Date of latest assessment, August 15, 1879.

Southern Belle Mining Company. The officers are H. F. Hawkes, Pres.; D. A. Lighthill, Vice-Pres.; A. W. Mann, Treas. Office, 79 Milk Street, Boston, Mass. The company's property is located in Rowan county, North Carolina. Capitalization, $125,000; par value per share, $1; basis, non-assessable.

South Evans Gulch Mining and Milling Company (The) is chartered under the laws of the State of Colorado. Officers, H. Graham, Pres.; A. Coates, Vice-Pres.; A. Coates, Sec.; Isaac Warner, Treas.; A. Guggenheim. General office, 237 Chestnut Street, Philadelphia, Pa. Little Lille mine is owned by the company. Shaft, eighty-five feet deep. Property owned, necessary machinery and houses. Capitalization, 200,000 shares; par value, $10. Amount of stock issued, 180,000 shares; amount reserved in treasury, 20,000 shares; non-assessable.

South Standard Mining Company (The). Officer, C. A. Sankey, Sec. General office, 331 Montgomery Street, San Francisco, Cal. The mines belonging to this company are located in California.

South Utah Mining Company (The). W. S. Hinkle, Sec. General office, 207 Sansome Street, San Francisco, Cal. The location of the mines belonging to this company is in Nevada.

Seven-Thirty Consolidated Mining Company. J. H. Hosmer, Treas. Offices, 64 and 40 Water Street, Boston, and 115 Broadway, New York. The company has a capitalization of $5,000,000; par value per share, $10. The property of the company is located at Poughkeepsie Gulch, San Juan county, Col. Ore assays per ton, $418 and $15.

Spanish Peaks Mining Company (The) is chartered under the laws of the State of Colorado. Officers, Hon. E. W. Keys, Madison, Wis., Pres.; Dr. C. T. Miller, Sec. The names of the mines owned by the company are Grand Reserve, Aztec, Rising Sun, and Bonanza. Located on West Spanish Peak, Huerfano county, Col. The mines are situated in the close vicinity of some of the best-paying developed mines in the State. The lodes are continuations of veins which have been greatly developed. They are about ten miles from La Veta.

Specie Payment Mining and Milling Company (The). Incorporators, Messrs, M. A. Lathrop and Almon P. Newton. The mining property of this company is located in Gilpin and Clear counties, Col. Rich, good milling ore. Capitalization, 50,000 shares; par value, $10 each; non-assessable.

Squaw Lake Company (The). Officer, Wm. Hippel, Superintendent. The location of the mine belonging to this company is in Oregon.

Standard Mining Company (The) is chartered under the laws of the State of New Jersey. Officers, A. Wasserman, Pres.; H. P. Nutter, Jr., Vice-Pres.; W. J. Radcliffe, Treas.; Thomas J. Stewart, W. J. Radcliffe, Edwin Klautsheck, H. P. Nutter, Jr., C. J. Fireng, J. L. Sprogle, Joseph L. Fryer, George H. Van Dyke. Gen. office, 310 Chestnut Street, Philadelphia, Pa. Company owns the Bellevue mine. Capitalization, 200,000 shares; par value, $5; non-assessable: amount of stock issued, 200,000 shares; amount reserved in treasury, 30,000 shares.

Star of the West Mining Company. The mines belonging to this company are located near Monarch mine, Col. It is claimed the prospects of the Star of the West Mining Company are very good (1881).

Stevens Consolidated Mining Company (The). Directors, Hon. Lewellyn Morse, Pres.; W. B. Hayford, C. F. Bragg, E. B. Nealley, B. B. Thacher, J. J. Stevens, and another. The location of this mining property is in Clifton, Arizona. Date of organization, March, 1881; stock and bonds reserved in treasury, 1881, $25,000; non-assessable.

Sulphuret Mining Company (The) is chartered under the laws of the State of New Jersey. The officers are Hamilton Disston, Pres.; Wm. Kohl, San Francisco, Vice-Pres.; H. B. King, Sec.; Jesse W. Neal, Treas. The offices are at 105 Market Street, Camden, N. J. Capitalization, $5,000,000, in 200,000 shares of $25 each; non-assessable.

Sultan Mining Company is chartered under the laws of the State of New Jersey. Office, 30 Broad Street, New York. The company's property is located in Sugar Loaf district, Boulder county, Col. Capitalization, $1,500,000; par value per share, $5.

Sultan Mining Company (The). Location of mining property owned by the company is in San Juan county, near Silverton, Col. Capitalization, $2,500,000.

Summit Mining Company (The). The mines belonging to this company are located in Ouray county, Col. Capitalization, $1,000,000. Shares, 100,000.

Sweet Home Mine (The). Owner, Mr. Findley Anderson, New York. W. J. Mullen, Manager. This mine is located on Buckskin Gulch, Col. This property will be opened in a systematic manner, so as to be able to place the mine on a paying basis. 1881. With a small outlay the Sweet Home mine can be made one of the best paying mines in Colorado.

Tabor Sheep Mining Company (The). Officers, John F. Tabor, Pres.; Dr. J. M. Newell, Treas.; John J. McGorman, Sec.; J. A. Stanton, Supt. General office, No. 5 Boston Block, Leadville, Col. The mines belonging to this company are located on Sheep Mountain, Ten-mile mining district, Col. Capitalization, 3,000,000 shares: par value, $10.

Telegraph Consolidated Mining Company (The) has property located in the Pioneer district, Pinal county, Arizona. The officers are Ernst A. Des Maretz, Pres.; C. C. Murphy, Vice-Pres.; Lindley F. Leaman, Sec. and Treas. Board of Trustees, Theo. Williams, Vernon Seaman, C. C. Thompson, Hon. A. W. Blair. F. C. Benton, Supt. The transfer of shares can be effected at 198 Broadway, New York, the office of the New York Union Trust Company. Counsel, Remington Vernan. Capitalization, $2,500,000, in 100,000 shares of $25 each.

Telfair Mining Company (The). J. Pentecost, Sec. Principal office, 702 Market Street, San Francisco. The mines belonging to this company are located in Arizona.

Tennessee and Los Cerrillos Mining Company. The company's claims, the Bonanza, No. 3, and a number of other claims, are located in the State of Tennessee, near Nashville. The ore is a fine-grained galena and copper, assaying quite high. The shaft is 300 feet deep, at which depth water was reached; a cross-cut was then run, showing forty-two feet of mineral between walls. There is a fine hoisting-plant of forty-horse-power on the ground.

Thor and Bright Point Mining Company (The). Directors, George W. Deltzler, Wm. C. Pease, P. Franklin, Wm. S. Campbell, Samuel Purdy, J. D. Lomax. The mines belonging to this company are located in Utah. Company organized March 16, 1880; capitalization, $3,000,000.

Trenton Mining Company. This company's property is located at Devil's Gate, Lyon county, Nev. There are 1,200 linear feet in company's mine. Capitalization, $10,000,000; par value per share, $100.

Tranquillity Mining Company is chartered under the laws of the State of New Jersey. The officers are J. W. Neal, Pres.; W. Kohl, Vice-Pres.; Hamilton Disston, Treas.; H. B. Ring, Sec. Office, 105 Market Street, Camden, New Jersey. The company's property is located in Arizona. Capitalization, $5,000,000; par value per share, $25; basis, non-assessable.

Twin Lakes Consolidated Mining and Milling Company (The). Directors, Col. A. J. Sterling, Warren Cutler, Moses L. Bruner, John Steel, F. S. Schrapp. This company owns seven claims, viz.: the Major, Steamboat, Mandana, Little Major, Clarison, Little Daniel, Little Kate, and others, all located in Colorado. Capitalization, $1,000,000; shares, 100,000; par value, $10 each.

U. S. Grant Tunnel Company (The). Trustees, William B. Stone, Edward F. Browne, John Sawyer, R. R. Dremon, C. M. Osburn. Principal office, Denver, Col. The location of these mines is in Colorado Capitalization, $1,500,000; shares, 150,000; par value, $10 each.

Valley Forge Consolidated Mining Company. The officers are H. Booth, Pres.; G. Anderson, Vice-Pres.; J. M. Eddy, Second Vice-Pres.; J. H. Hamilton, Treas.; D. W. Gale, Sec. Office, 108 Washington Street, Chicago, Ill. The company's mining property, the Bed Rock, is located in Big Bug mining district, Arizona. The property covers an area of 240 acres. Capitalization, $1,500,000; par value per share, $10.

Vizina Mining Company (The). The company owns the Vizina, Ureka Poor, and other mines. They are located in Colorado.

Ventura Mining Company (The). The mines belonging to this company are located in Marion county, Cal. The company was organized, March 4, 1880; capitalization, $10,000,000.

Venture Series of Mines (The). Owned by Captain Potter, Superintendent of the British Mining and Milling Company. The Venture Series, consisting of three claims, are located on Adams Hill, Eureka district, Nev.

Wade Mining Company (The). Directors, G. D. Keeney, U. T. Smith, Oliver Merrill, H. T. Fairbanks, W. W. Myers. The location of the mines belonging to this company is in Fresno county, Cal. Date of organization, March 23, 1880. Capitalization, $5,000,000.

Wappello Mining Company (The). The mines belonging to this company are located in Agency City, Iowa. Capitalization, $500,000; shares, 50,000; par value, $10.

Waeomah Mining Company (The). Officer, L. L. Conrad, Pres. The principal office is located at 15 Lexington Street, Baltimore, Md. The mines belonging to this company are located at Kanawha county, W. Va. They own 4,700 acres of land.

Wall Street Mining Company (The). of Washington, Col. Robert Ingersoll one of the incorporators. The location of the property of the Wall Street Mining Company is in Colorado and New Mexico. Capitalization, $2,000,000; par value, $10.

Ward Beecher Mine (The). Owned by Mr. B. Work. Mr. Work owns the following mines, viz.: Ward Beecher, Hidden Treasure, Mammoth, Manhattan, and Big Smoky Mills. Located in White Pine district, Nev. Good milling ore. The Mammoth mine is said to contain, already exposed, a vast amount of thirty and thirty-five ore, which will pay a mill.

Washington and Virginia Mining Company (The) has property at Madison Run, on the Virginia Midland Railway, in Orange county, Va. Stock in treasury, April 1, 1882, $523.

Wells Fargo Mining Company (The) has property located at North Virginia, Nev. The length of the main lode on which the company's supply of ore depends is 1,500 feet. Capitalization, $10,800,000, in 108,000 shares of $100 each. No dividends paid. Fourteen assessments levied; total amount of same, $228,600; date of latest assessment, 26th May, 1880.

Western Mining Company (The) has property located in Arizona. Capitalization, $10,000,000, in 100,000 shares of $100 each; total dividends, $1,475,000 paid to December 22, 1881; date of latest dividend of $1 per share; total assessments levied, 100,000; date of latest assessment, January 28, 1880; amount of same per share, $1.

West Ontario Mining Company (The) has its transfer office at 309 Harmony Street, Philadelphia, Pa. The officers are W. H. Dole, Pres.; Geo. R. Stansberry, Sec. and Treas. The property of the company is located in the Unitah district, Summit county, Utah, and comprises three claims—West Ontario, Engineer, and St. Julian. Capitalization, $200,000, of 200,000 shares of $1 each; non-assessable.

Western Reserve Mining Company (The). Principal office, Jefferson county. The location of the mines belonging to this company is in Colorado. Capitalization, 50,000 shares, divided into shares of $100 each.

Wheeler and Extension Mining Company (The). Incorporators, Derrick F. Hamlink, Charles Fulton, Alvin H. Roudebush. Capitalization, $1,000,000; shares, 200,000; par value, $5 each.

White Cross Mining Company (The). The location of the mining claims of this company is in Storey county, Nev. Capitalization,

$10,000,000: shares, 100,000; par value, $100; no dividends paid; no assessments.

White Gulches Mining Company (The). Principal office, Leadville, Col. The mining property belonging to this company is located in Colorado.

Whitlock Consolidated Mining Company (The). The mines are Margarittia, Golden Fleece, Berrin, Collins, Fortuna, and Goodman, located five miles north of Mariposa, near head of Whitlock creek, California. The mines have recently been surveyed by R. B. Thomas, Deputy to W. S., mineral surveyor, and re-located by Higman Schofield, etc., with a view to further developing said mines, which have lain idle for the past eighteen years.

Wide Awake Mining Company (The). Officer, C. Hildebrandt, Secretary. Principal office, 232 Sutter Street, San Francisco, Cal. The mines of the Wide Awake Company are located in Arizona.

Willis Creek Mining Company (The). Officers, Philip L. Fox, Pres.; Joseph R. T. Coates, Vice-Pres.; Samuel Schofield, Treas.; J. D. Wood, Sec. Directors, Philip L. Fox, C. E., D. J. Wood, Samuel Schofield, Edward P. Carpenter, D. F Evans, R. Evans Peterson, Joseph A. T. Coates, George V. Case, Theodore Burnham. Main office, 420 Library Street, Philadelphia, Pa. Branch office, 117 Market Street, Camden, N. J. The Willis Creek mine is owned by the company, located in Buckingham county, Va., 100 acres. The property of the company, buildings, 25 horse-power engine and boiler, pumps, concentrators, steam hoister, tools, etc., four shafts, viz.: thirty-seven, twenty-five, sixty-three, and fifty-six feet. Drifts or tunnels connecting shafts, three and four. Drifts are all timbered. Capitalization, 60,000 shares; par value, $5; non-assessable. Total capital stock issued for property purchased. 30,000 shares reserved in treasury.

Windsor Mining Company (The). Officers, directors, T. L. Stanley, O. W. Randolph, Horace Webster, John Sprunance, W. E. Norwood. The location of the mining property belonging to this company is in Columbus, Nev. Date of organization, March 22, 1880; capitalization, $10,000,000.

Woodville Mining Company (The) has property located in the Gold Hill district, Comstock Lode, Nev. Length of lode or claim, 700 feet. The officers are T. P. Cavallier, Pres.; H. M. Levy, Vice-Pres.; R. E. Kelly, Sec.; Bank of California, Treas. Capitalization, $12,000,000, in 120,000 shares of $100 each. No dividends paid. Six assessments levied; total, $3,030,000. Last assessment levied, January 23, 1878.

Woodstock Consolidated Mining Company (The) is chartered under the laws of the State of Michigan. Incorporators, Joel H. Smith, Joseph P. Steele, William M. Heazlit. The mines belonging to this company are located in Buckskin district, Park county, Col. Capital stock, $1 000,000.

Ypsilanti Mine (The). Owned by Colonel J. B. Stone. The Ypsilanti mine is located in Hall's Gulch, Park county, Col. Extremely rich ore, wire and leaf-silver; some of the finest specimens of native silver ore exhibited ever seen.

MINING COMPANIES OF MAINE, NEW HAMPSHIRE, AND THE PROVINCES.

THESE we have separated from the others because the Maine mining industry has in a measure been "a thing apart." When it is remembered that two years ago there were 124 companies organized to do business in Maine mining—each company being organized with a nominal capital of from $100,000 to $300,000 (the limit by law is $300,000), and that there are now only seventeen in operation—the reader may well pause for reflection. Upon this subject of Maine mining, Mr. F. L. Bartlett, State Assayer for Maine, writes as follows:

Mining is a comparatively recent business in the State of Maine, scarcely five years having elapsed since its first blow was struck. Out of 102 mining companies incorporated in the State, only seventeen are now in active operation. Of this number, ten are producing considerable quantities of merchantable ore, some are shipping regularly, others irregularly. Of the ores produced, copper ranks first, zinc second, silver third, lead fourth, gold fifth.

Little confidence has been felt in the ultimate success of the mines, consequently capital has been exceedingly difficult to obtain. As a result, progress in development has been intermittent and slow, characterized by extreme caution, and carried on by men possessing little knowledge of the business. Nothing but its very surprising and encouraging results obtained by development could have kept the business alive.

The total amount of money expended in Maine mines for lands, buildings, machinery, labor, and other things connected with its mines, will not exceed $1,200,000. The amount realized for ores and bullion sold thus far is not far from $70,000. The value of ores on hand and unsold is about $120,000. There are four sets of dressing works, and three sets of smelting works in the State. It will be noticed that, compared with its amount of capital invested, the production is already quite respectable. At this time it is safe to say that at least ten mines in the State will eventually become dividend paying. Many exceedingly promising mines have been abandoned for want of capital to work, mines which are worthy of exploitation, and which warrant the output of capital.

The exploitations thus far have developed several large beds of copper ore, at least one true silver-bearing lode of large dimensions, several good silver, lead, and zinc lodes, and one gold lode. Large tracts of land exist in the State which have never been explored at all, indeed, but a comparatively small portion has been explored as yet for minerals, probably not more than one-seventh of the 37,000 square miles of territory included in the State. The cost of mining in this State is small compared with that of the Western States, certainly not more than one-half. Low grade copper ore exists in the greatest abundance, and offers especial inducements to the mine adventurer. Of the future of the Maine mining industry, it may now be said with certainty that the copper and zinc production will be steady and increasing. Silver seems likely to be steady, but small; lead and gold do not promise to amount to anything.

Only one mine in the State has reached a depth of 500 feet, nearly all the others are yet inside of 200 feet in depth. The mines generally are well equipped with modern and effective machinery. All employ steam-power, and in good part use steam-drills. The ore thus far treated has not, contrary to expectations, proved very refractory. On the whole, the industry may be said to be finally established, and in a very satisfactory condition.

PORTLAND. July 11, 1882.

Acton Consolidated Silver Mining and Milling Company. The company's officers are Hon. George Walker, Pres.; John S. Morris, Vice-Pres.; S. Jennings, Treas.; Charles D. Clark. Sec. Directors, G. R. Wescott, J. S. Morris, W. F. Milliken, B. Barnes Jr., Jas. Baily, C. McCarthy, F. Haines, H. Gregory Jr., F. B. Blackett, George Walker, S. Jennings. Office, located at 22 Exchange Place, Portland, Maine. The company's mines are located at Acton, Yorks county, Maine, containing yellow-like Nevada ore, assaying $330 per ton, and shows a true fissure strongly mineralized from wall to wall with argentiferous galena, sulphuret of antimony, copper pyrites, zinc blende, and other elements peculiar to the ore deposits of the local system. The length of the main lode on which the company depends for its supply of ore is 2,000 feet. Property owned consists of frame ore house, water-power, blacksmith shop, etc. The property has been idle nearly two years, owing to the general depression in Maine mining matters, and the difficulty of obtaining sales of treasury stock. The non-assessable principle of organizing companies is a mistake. This system having proved a financial failure, the assessable plan is being generally adopted, and the companies are obtaining funds for development. Capitalization, $1,200,000; par value per share, $5; floating indebtedness, $800,000. Supplies can be procured at merely nominal prices. Laborers at $1.25 per day; wood, delivered at $2 per cord; coal, delivered at $5 per ton; building lumber, $13 per M; shaft lumber, $6 per M; July 1, 1882, not in operation for want of funds.

Ashley Silver Mining Company (The). Officers are J. R. Grose, of Boston, Pres.; T. Dalby, of Boston, Treas.; Wendell Horne, of Sullivan, Sec. Directors, J. R. Grose, T. Dalby, W. Horne, J. W. Tuttle, and J. Farwell, Jr. W. Horne, Superintendent. The company's property is located at Sullivan, Maine. Date of organization, July, 1879; capitalization, $400,000; shares, each, $10; July 1, 1882, not in operation for want of funds.

Blue Hill Copper Mining and Smelting Company is chartered under the laws of the State of Maine. Officers, S. C. Blanchard, Pres.; W. M. Jewett, Treas.; John M. Merrill, Sec. Superintendent, J. H. Moyle. Offices, rooms 14 and 15, Simmons' Building, and 17 State Street, Boston, Mass. This company owns the Blue Hill mine, which is located at Blue Hill, Maine. Sixty men are now employed (July 14, 1882), and the probability is the force will soon be increased. There are over 300 tons of ore roasted, which will keep smelters going for some time. Company have lately purchased new boiler for shaft house. Capitalization, $500,000; par value per share, $5; number of assessments levied, three; date of latest assessment, June, 1882, twenty-five cents per share; stock quoted July, twenty-five cents.

Cherryfield Silver Mining Company. Office, Cherryfield, Me. Mines, Cherryfield Me. Capital, $500,000; 100,000 shares; par value, $5; unassessable. Samuel N. Campbell, Pres.; Wm. Freeman, Treas.; Wm. Freeman, Sec. and Gen'l Manager. Directors, James A. Milliken, Samuel N. Campbell and Wm. Freeman, of Cherryfield; Thomas Dalby and F. H. Williams, of Boston. Wm. A. Leonard, Supt.

Consolidated Hampden Silver Mining Company. The officers are Hon. F. M. Loughton, Pres.; W. H. Strickland, Vice-Pres.; E. C. Hill, Treas.; C. F. Bragg, Sec. Charles H. Dunton is Superintendent. The company's property is located in Hampden, Maine. Capitalization, $1,000,000; par value per share, $5; July 1, 1882, not in operation for want of funds.

Coxheath Mining Company (The.) The location of mines is in Coxheath, near Sydney, Cape Breton. Amount of property in acres, 640. Character of ore, eight to sixteen per cent. copper. Dimensions of working, 1,000 feet. Prospects of property, etc., favorable; labor cheap, coal procurable within five miles, at about $2 per ton. Date of organization at Portland, Me., October 24, 1881. Capitalization, $500,000.

Deer Isle Silver Mining Company (The). the officers of which are A. H. Harris, Pres.; G. F. Gould, Treas. and Sec. Directors, A. H. Harris, N. Y.; Nathan Cleaves and F. C. Crocker, Portland; C. W. Bryant, of Deer Isle, and Geo. D. Greely, of Boston. Mr. S. Z. Dickson is Superintendent. The offices are at 63 Broadway, New York. The mine is located at Deer Isle, Me., and is fitted with a shaft-house and an assay office. The ore is shipped to England. There are at present about sixteen men employed. Capitalization, $500,000, in 100,000 shares of $5 each. Treasury fund of 52,000 shares. Stock quoted May, 1882, twenty cents; stock quoted July, 1882, twenty-four bid, thirty asked.

Douglass Copper Company (The) is chartered under the laws of the State of Maine. The officers are Hon. Liverus Hull, Pres; F. H. Williams, Sec. and Treas. Directors, Hon. Liverus Hull, Stephen Jennings, W. D. Swazey, Hansen Gregory, Jr., Gen. Chas. Hamlin, J. S. Johnson, and John C. Watson. The offices are at Blue Hill, Maine, and at 28 State Street, Boston. Mr. Thompson is the Superintendent. The mines are located at Blue Hill, Maine. The company has 800 tons of ore roasted and waiting for new furnace smelting works. Incline tunnel, 252 feet. Main shaft sinking at rate of eighteen feet per month. About $133,066.87 has been expended on developments. A new opening has recently been made to the west of the shaft, and about forty feet from the surface, and a fine large body of high-grade copper has been encountered. If same continues west to any distance, capacity of mine will be doubled. A concentrating mill is being prepared for work. A cargo of 300 tons of roasted ore shipped to Orford Nickel and Copper Company, at Bergen Point, N. J., and another cargo of 230 tons now loading for same place. There are at present time, June, 1882, about 100 men and boys working in the shaft. Weekly product 1st of July, 1882, $5,216.77. A cargo of desulphurized ore from Acid Works of Boston, for use as flux in smelting Douglass ore. The ore is a mixture of the Milan mines, New Hampshire, and the Orford mine in Canada, and is found to be just what is required for the purpose. Two tons are used to ten of Douglass ore. This company was the result of a reorganization in November, 1881. Capitalization, $500,000, in shares of $5 each; assessable. The latest assessment was made 15th of July, 1882, of fifty cents per share, payable by instalments. Stock quoted July 1882, fifty cents.

Edgemaggin Silver Mining Company (The). Officers, S. Z. Dickson, Pres.; Mr. Libbey, Treas.; John S. Morris, Sec. Directors, S. Z. Dickson, A. H. Harris, F. H. Williams, F. F. Hale, H. W. Sargent, W. H. Miller, Superintendent. Principal office, 7 Exchange Place, Boston, Mass. Location of mines, in Sedgwick, Me. The company was organized October, 1879. Floating indebtedness, none. Capitalization, $500,000; par value, $10. Stock and bonds reserved in treasury, January 1, 1882, $3,000. Stock quoted July 1, 1882, three cents asked. July, 1882, not in operation for want of funds.

Faneuil Hall and Sullivan Mining Company is chartered under the laws of the State of Maine. The officers are Charles H. North, Pres.; F. W. Morrill, Sec.; L. A. Emery, Treas. Directors, C. H. North, M. B. Boynton, Henry Farnum, F. A. Morrill, F. S. Tuttle, and A. A. Hayward. Superintendent, A. A. Hayward. Office, 107 Faneuil Hall Market, Boston, Mass. The company's property adjoins the Waukeag, at West Sullivan, Me. The stock is all owned by seven men, and the business conducted strictly as a private enterprise. About the end of May last, this mine was flooded by the miners cutting into the vein, from which the water came with a gush and a roar, so rapidly as to scarcely give the men time to be drawn safely to the surface. Attempts to free the mine from water have been made, but it has been found that the mine cannot be pumped without the aid of machinery of almost Herculean magnitude, and operations at the mine have been discontinued. The shaft has reached the depth of 160 feet. The company had recently introduced a new air-compressor, and have a fifty-horse-power boiler, and Kendall & Roberts' double hoisting engine. Capitalization, $500,000; par value per share, $5; basis, non-assessable forever. July 1, 1882, not in operation for want of funds.

Glen Ellis Mining Company. The directors are Samuel W. Thompson, Pres.; S. Pitman, V.-Pres.; F. Osgood, Sec.; L. Julian Ricker, Treas. The company's works are located at Pinkham Grant, near the Jackson Line, and Glen Ellis Falls, N. H. The ore is argentiferous. The company was organized at North Conway, N. H., February, 1881.

Globe Mica Mining Company (The) is chartered under the laws of the State of New Hampshire. The officers are Charles A. Taylor, President, and F. H. Raymond, Treasurer. The offices are at 103 Milk Street, Boston. The property of the company is located at Springfield, N. H., and has an area of 123 acres, as yet undeveloped. The company was organized June 4, 1880; capital, $125,000, in 25,000 shares of $5 each.

Gold Mining Association of Canada (The) is chartered under the English Joint Stock Company's Act. The Hon. J. A. Chaplean is local Director, and Mr. A. A. Humphrey, of Quebec, is the Treasurer. The property of the company is located at Riviere de Loup, Bence county, Can. The mine is of both characters, gravel and quartz, latter in fissure veins. Organized in London, England, January, 1881; capitalization, $250,000.

Golden Circle Mining and Milling Company (The), of which the Directors are Geo. Gilman, Pres.; Amos S. King, Sec. and Treas. T. O. Winslow, John M. Mitchell, Chas. S. Bickford, Elias Chase, Foster E. Swift. Superintendent, R. B. King. The offices are at Portland, and the American Mining Bureau, 63 Broadway, New York. The property of the company is located at Steward's Island, Handcock county, Maine. The ore is mainly a rich telluride (sylvanite and foliated tellurium assaying 18.81 to 163.16). The mining plant and surface property comprises good boarding house, assay office and outfit, powder house, smith shop, shaft house, and wharf. Ore extracted during the prospecting work of 1880 and 1881, yielded by simple battery amalgamation over $800 in bullion, and fifty tons of ore remain on the dump. Developments now show free gold the entire depth of shaft. An incline has been driven from the bottom eighty-three feet, at an angle of 25° following dip of ore body. During past month ore has steadily improved in richness, numerous small veins uniting with main vein. The stock is held principally by residents of Portland, Me.

Gouldsboro Silver Mining Company (The), of which the following are the officers, Judge A. P. Wiswell, Pres.; C. C. Burrill, Treas.; J. B. Redman, Sec.; Frank Worcester, Manager. Directors, A. P. Wiswell, C. C. Burrill, Eugene Hale; all of Ellsworth. Mr. W. A. Leonard is the Superintendent. Head and transfer offices at Ellsworth, Me. The property is located at Gouldsboro, Me. There are now about fifteen men employed. The company is organized with a capital of $500,000, in 100,000 shares of $5 each. Stock quoted January 1, 1881, $1; stock held principally in Maine.

Haviland Copper Mining Company. The officers are G. Burnham, Jr., Pres.; R. O. Conant, Treas.; Geo. S. Winn, Sec. Office, 28 Congress Street, Boston, Mass., and 22 Exchange Street, Portland, Maine. The company's property is situated at Lyman, N. H. They have a capitalization of $500,000 in shares, at a par value of $10 per share.

Hall Anderson Gold Mining Company (The) has offices at 43 Exchange Place, New York. The property of the company is located at Fifteen-mile Stream, Nova Scotia, and covers an extent of 600 acres. The ore assays $60 per ton. The property is intersected with auriferous veins, varying in width from four to forty-eight inches. The shafts have a total depth of 210 feet. Length of adits, 200 feet. The plant includes steam pumping and hoisting works in course of erection, ten-stamp gold mill running, water power in abundance. Regular shipments of bullion are being made. Capitalization, $150,000, in 150,000 shares of $1 each. Total amount of dividends paid to July, 1882, $14,500; latest dividend, January, 1882, five cents per share.

Harbor View Gold Mining Company (The), of Nova Scotia, is chartered under the laws of the State of New Hampshire. The officers are, Directors, E. S. Bliss, J. W. Condon, P. E. Bryant, C. H. Huddleston, O. F. Winslow, J. W. Sayer, T. W. Grafton, G. W. Smith, all of Boston, and H. T. Bowman, Bedford, and C. Richardson, of Nashua. E. S. Bliss is the Superintendent. The property of the company is located in Nova Scotia, Canada. The company was organized at Nashua in January, 1881.

Hercules Mining Company (The) has offices at Portland, Me. The officers are E. Dana, Jr., Pres.; J. N. Lord, Treas.; B. Barnes, Jr., Sec. Directors, E. Dana, Jr., J. N. Lord, John M. Peck, J. R. Bodwell, Hanson Gregory, Jr., E. P. Havilland, and H. H. Emmerson, who is also the Supt. The company owns mining property, 1,805 acres in extent. Date of organization, 1882.

Hibbard Antimony Mining Company. The officers are Howard F. Smith and Dr. Bell, of Manitoa. Superintendent, W. J. Smart. The mines owned are the Hibbard, Prince William, and Brunswick. The company's property covers 800 acres of land. The quality of the ore is reported to be A 1, and improving. Assays per ton about fifty per cent. The vein is five feet wide at present depth of 240 feet, and enlarging downwards. Total sinking, 400 feet. Length of adits, that is levels, 800 feet. Property owned, Bradford's jigs, concentrating machinery, and ore-crusher. Boston, Mass., is the principal market for the ore. Eighty men are employed at the works.

Lawrence Antimony Mining Compnay (The) has offices at St. John, Nova Scotia. The officers or originators are Isaac P. Gray, R. C. Nichols, H. S. Loring, Jas. A. L. Whittier, of Boston; David W. Child, of West Newton; Elias Garritt, of Ashland, and Geo. W. Young, of Lowell, Mass. The property of the company is located at fifteen-mile stream, Nova Scotia. Capitalization, $500,000, in 100,000 shares of $5 each.

Mascot Mining Company (The) has offices at Bangor, Maine. The officers being Hon. F. M. Laughton, Pres.; M. S. Gibson, Vice-Pres.; F. H. Williams, Treas.; C. W. Hobbs, Sec. Directors, Hon. F. M. Laughton, M. S. Gibson, T. H. Williams, John S. Jenness, and E. H. Osborne. F. H. Williams & Co., Financial Agents. Superintendent, J. M. Johnson. The company own three mines, the Galena King, Galena Queen, and the Mascot, located near Mascot, Lake Gorham, New Hampshire. The ore is an argentiferous galena and copper, rich in silver. It is susceptible of oxidization, rendering it applicable to the manufacture of white lead. Assay value, $75 per ton. The mine has 800 feet of tunneling. The mining plant and other property includes ore-house, office, smiths' shop, stable, hotel, machinery buildings, thoroughly equipped with all necessary pumping and hoisting apparatus, tools, etc. Forty miners are employed. Developments commenced in August, 1881. Work progressing vigorously. The weekly output at January, 1882, was thirty to forty tons. The cost of reducing ore is $27 per ton. Capitalization, $500,000, in 100,000 shares of $5 each; forever unassessable.

Mammoth Copper Mining Company (The) has its offices at Bangor, Me. The officers are Eugene M. Hersey, Pres.; John R. Mason, Sec.; G. W. Pickering, Treas. and Transfer Agent; W. D. Lewis, Asst. Sec. and Treas. Directors, E. M. Hersey, T. N. Egery, and Sam'l Stevens, all of Bangor; W. Lewis, of Boston; and Chas. Duff, of Blue Hill, who also acts as Superintendent. The property of the company is located at Blue Hill, Me. The quality of the ore may be described as twenty-eight to thirty per cent. metallic copper. Capitalization, $500,000, in 250,000 shares of $2 each. Treasury stock consists of 100,000 shares, July, 1882; stock quoted at five cents per share, July 1, 1882; not in operation for want of funds.

Mascomo Mining Company (The) has property located at Concord, N. H. The officers or Directors of the company are Sylvester Marsh, Geo. E. Jencks, Geo. H. Emery, J. D. Prescott, Jas. R. Hill, of Concord, and Thos. Binns, of Boston. Total extent of property is 210 acres, there being three chief veins on it. The main shaft is down about 100 feet; and prospects at present are said to be brilliant. The company was organized in the beginning of the year, and developments are in progress.

Milton Mining Company. Wm. D. Lewis, Pres.; Geo. E. Harrington, Treas.; Horace T. Starr, Sec. Directors, Wm. D. Lewis, Geo. E. Harrington, C. F. Mackenzie, Wm. J. Mann, Geo. West, Henry R. Gardner, and Geo. F. Ropes. John Shoenhar, Superintendent. Office, 4 Sears' Building, Boston, Mass. Mines, West Sullivan, Me. Capitalization, $1,000,000; shares, 200,000; par value, $5.

National Mining and Investment Company. The officers are M. G. Palmer, Pres.; B. Barnes, Jr., Sec.; M. E. Moore, Treas. Directors, M. G. Palmer, B. Barnes, Jr., M. E. Moore, J. A. Strout, E. D. Eastman. This company owns the Alton Lode mine, located in Yorks county, Me. The character of the ore is low grade. Galena largely mixed with iron and considerable silica, and contains refractory elements. The character of the mine is true fissure. The veins are ten to twelve feet wide at junction. The shaft is over thirty feet deep. The main lode, on which the company depends for its supply of ore, is 2,400 feet in length. Two veins unite on this location; the fact is regarded as a favorable indication; and the property is spoken of in the highest terms by Col. Thyng, a successful and practical engineer. The property should be developed to a depth of 200 or 300 feet, where the ore-body will evidently be found very extensive, and will improve as depth is attained. Date of organization, July 5, 1881; capitalization, $500,000; par value per share, $5; company free from indebtedness, January 1, 1882; treasury reserve, 42,084 shares.

Oriental Mining Company (The) of Newburyport, has its offices at 235 Washington Street, Boston. The officers are Chester Downer, Pres.; and W. H. Harrington, Treas. Directors, Chester Downer, W. H. Harrington, D. Gilbert Dexter, A. Gould, Prof. T. Binns, John G. Pratt, and E. B. Towne. Prof. A. H. Kidney, Supt. The property of the company is located near Newburyport, Mass., and covers an area of thirteen acres. The ore is a rich, argentiferous galena, assaying from $93 to $132. The mine has two shafts, eighty-five and sixty-five feet, respectively. Capitalization, $2,500,000, in 125,000 shares of $2 each.

Pine Tree Mining Company (The). Directors, Gen. John M. Corse, Pres.; Robert E. Cutting, Jr., of New York, Treas.; Col. Charles H. Lewis, Sec.; W. Oscar Arnold. A. A. Messer, Supt. Principal office, 24 Broad Street, New York. The location of the property of the Pine Tree Mining Company is in Sullivan, Maine. Property owned, shaft house, boiler house, office, hoisting frame, reservoir, wharfage. Preparing for rapid development. Capitalization, $500,000; shares, 100,000; par value, $5; non-assessable. July 1, 1882, not in operation for want of funds.

Rosier Consolidated Copper Company. The officers are R. G. Beardslee, Pres.; E. H. Kervey, Vice-Pres.; Ernest Grosbeck, Treas.; J. B. Miller, Sec. Trustees, Col. Lewis Carr, E. Grosbeck, E. H. Kervey, Grant B. Schley, W. S. Poor, E. C. Preiss, C. C. Dodge, G. D. Schofield, and J. H. Drummond. Superintendent, T. Pollard. The company's property is located in Hancock county, Maine, covering fifty acres of land. The ore assays forty per cent. zinc, or about $8 per ton, and yields a copper assay of $12 to $18 per ton. The vein is of good copper ore twelve feet wide. The company's property includes number one shaft-house, engine-house, machine and carpenter shop, dressing-house, two large boilers, seventy-five horse-power horizontal engine, Blake crusher, and Cornish rolls, jigs; number two shaft house, cobbing house, sheds, etc., fifteen horse-power engine for hoisting, office, powder magazine, three good houses and camps for miners. The main lode is 2,700 feet in length. The weekly output at January, 1882, selected ore, 150 tons. New York is the principal market for the ore. 105 men are employed. Capitalization, $2,000,000; par value per share, $10; treasury reserve, 75,000 shares.

San Marcial Mining Company was organized at Portland, Maine, June 28, 1882, with a capitalization of $500,000.

Silver Lake Mining Company (The) is a chartered organization. The owners are (or were in 1880) Wm. Murdoch, Pres.; E. D. Goodrich, Vice-Pres.; D. L. Dodge, Treas.; E. H. Hastings, Sec. The property is located at Madison, New Hampshire. Capitalization, $1,000,000, in shares of $10 each; non-assessable; fully paid.

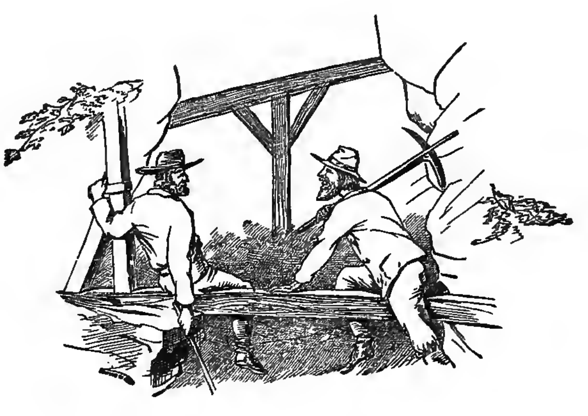
Stewart Copper Mining Company. Office, Bangor, Maine. Mines, Blue Hill, Maine. Capital, $500,000. Shares, 100,000. Par value, $5. Hon. Frederick M. Laughton, Pres.; C. F. Bragg, Sec. and Treas. Directors, Frederick M. Laughton, F. W. Hill, C. F. Bragg, and Thomas White, of Bangor; S. N. Stockwell and G. B. Putnam, of Boston. Daniel Dunn, Superintendent.

Sullivan Mining Company. The Directors are G. B. Brown, Pres.; B. S. Grant, C. F. Farrington, J. G. Russell, Dudley R. Child, E. A. Birchard, Fred. R. Nourse, Treas.; Charles L. Perrin, Sec. Mr. Stephens is Superintendent. Office, 17 Tremont Bank building, Boston, Mass. The company's mine, the Blue Ridge, is located at Sullivan, Maine. The ore is good grade, and character excellent. Assay taken February, 1882, showed $16 gold to the ton. Recent developments have given an ore assaying from $25 to $200 per ton, silver. Character of the mine, true fissure, carrying a well-defined clay seam under hanging wall; continues strong in lower levels; pay-streak preserving a width of from one and a half to four feet. Dip of the vein is changeable. The company's property includes a large Cornish pump, being put in vertical shaft for pumping (water hitherto a source of annoyance), boarding-house, superintendent's and engineer's house, wharf, coal-shed, carpenter shop, and powder-house, all built during the past year (1881), hoisting-engines, and air-compressor, sufficient for present needs. It is estimated that the surplus from the bullion product of the mill will be from $2,000 to $3,000. After paying all expenses of mining and milling, a final dividend of twenty-five cents proposed. All parts of the mines are well timbered, and said to be absolutely safe; and the appliances for raising and handling the ore are simple and of great capacity. Winzes and shaft are 791 feet. Length of adits, 2,400 feet. Capitalization, $500,000. Par value per share, $5. Number of assessments levied, three; twenty-five cents each. Total amount of assessments levied, $74,995.50. Date of latest assessment, July, 1882. Treasury reserve, July 1, 1882, $224,986. Stock quoted, July 1882, $2.

Sunburst Copper and Silver Mining Company (The). Directors, J. W. Davis, Pres.; M. Donelan, Sec.; Dr. S. W. Hodgkins, Major-Gen. Conyers Tower, Esq., James F. Davis, W. W. Clark, H. B. Mason. M. Donelan, Superintendent. Gen. office, Ellsworth, Me. The location of the mining property belonging to this company is located in East Surrey, Me., near Ellsworth. Assay of cobbed ore, 100 pounds, by W. W. Fisk, B. S.; gold, $5.31; silver, $15.41; copper, $67.32; total, $88.04; eleven ounces in gold; assays per ton in gold, $43.96. Depth of shaft, sixty-five feet. Property owned, a pump to raise water 200 feet. Recent test of Sunburst ore for copper gave 150 pounds pure copper per ton of 2,000 pounds. Five men employed; and house for hoisting, equipped with all necessary tools, etc. Propose cutting the work. Buildings erected plain but strong. Facilities for loading and unloading very good. Not troubled with water. Capitalization, 500,000 shares; par value, $1 each; non-assessable; stock and bonds reserved in treasury, 368,500 shares.

Twin Lead Mining and Smelting Company (The). Directors, E. M. Hersey, Pres.; S. Stern, Vice-Pres.; John S. Jenness, Jacob Stern, T. H. Williams, Thomas N. Egery, of Bangor, Charles Duff, of Blue Hill. The latter Superintendent also. Principal office, Bangor, Me. The mines are located on Blue Hill, Me. Capitalization, $500,000; shares, 125,000; par value, $4; date of latest assessment, January, 1882; amount per share, five cents; stock quoted January 1, 1882, five cents; seven cents asked. July 1, 1882, not in operation for want of funds.

Young Hecla Mining and Smelting Company (The) has offices at Bangor, Me. The officers are John S. Jenness, Pres.; Chas. Hamlin, Vice-Pres.; C. B. Wiggin, Sec. and Treas. Directors, John S. Jenness, Chas. Hamlin, W. D. Swazey, F. M. Laughton, Ruel Smith, Horace P. Tobey, Frank H. Williams. The property of the company is located at Blue Hill, Me. The ore is high grade. The ore in the bottom of the shaft continues to improve with increasing depth; and ore is becoming richer and more massive. Capitalization, $500,000, in 100,000 shares of $5 each. Reserve of stock in treasury, 20,000 shares. Stock has been quoted at seventy-one cents, but has depreciated considerably. July 1, 1882, not in operation for want of funds.



PART XII.

EXPLOSIVES—THE USE OF POWDER—THE MANUFACTURE IN THE UNITED STATES—A GROUP OF MINES—INSTRUMENTS OF PRECISION IN ENGINEERING

LAST but not least of all this volume concerning THE MINES, MINERS AND MINING INTERESTS OF THE UNITED STATES is PART XII. In the opening of this part we present some matters to which our publishers desire to draw the reader's attention, matters that pertain to the publisher's, not the compiler's department. The matter of explosives is a very important one and deserves the closest attention. The very interesting account of the Humboldt Mines will be read with profit. The question of engineering instruments of precision is of the highest value, and in the article under that title, the reader will find that information that will pay for perusal.

The PART closes with a fine Index to this volume. This index is in and of itself a reference volume on American Mining. It has been compiled under the compiler's supervision, and is elaborate, thorough and complete. All matters worthy of note will be found therein.

EXPLOSIVES.

THE actual discovery of Gun-powder is lost in obscurity. The Chinese claim to have used it long before it was known in western Europe, where its discovery *was* made by Berthold Schwartz. An explosive powder was known in Europe for use in heavy cannon in the 10th century, but its composition was not accurately defined and its power understood until the 13th century. It was not until three centuries later when Martin Weigel first proposed its application in the Mines of Freiburg in the year 1613, that powder was used in mines as an explosive. In 1630 its use became general in the Hartz and Erzgeberge Mines. Forty years later, or about 1670, it was first used in England at the Ecton Mines, on the borders of Stafford and Derby, where it was employed, not so much to break down the rock under ground, as to split the great blocks of stone that had been brought down by the old method of fire and wedges. Early in the 18th century it was introduced in the Mines of western Cornwall by two men, Bell and Case, who came from the western coast and who had learned the secret from the Germans. Since then the use of gun-powder became almost universal in Mines, and until recently was the only explosive ordinarily employed. It was used in the United States very early in the development of its Mining industry but gave place, quite as promptly as it did in Europe, to the various compounds of Nitro-glycerine, its immediate successor.

The discovery of nitro-glycerine by M. Sobrero in 1847, led almost immediately to a new group of mining explosives of the most wonderful force. The power of powder and, indeed, of all explosives, to rend asunder the substance within, or upon which they are placed, depends on the ignition, the moment they are liberated, of those enclosed gases which are multiplied many times their bulk, as they exist in the constituent parts of the powder. The more instantaneous the ignition of the whole mass, the greater the rending force—hence, the superiority of an explosion by detonation over one by simple ignition. M. Berthold, a French chemist, estimated the relative explosive force of the different kinds of powder, and substances which form the base of other explosive compounds as follows:

Blasting Powder	88
Artillery Powder	137
Powder, with base of Nitrate of Soda	190
Powder, with base of Chlorate of Potash	309
Gun Cotton	402
Gun Cotton, with Chlorate of Potash	680
Nitro-Glycerine	939

M. Berthollet, a French experimenter, endeavored, towards the close of the last century, to increase the force of blasting powder by the use of chlorate of potash as a base, but the destruction of his workmen and part of his family, with the miraculous escape of himself, by an explosion caused by striking his cane on a grain of powder lying on the floor, put a stop to his experiments. Since that time various efforts have been made in the same direction, and compounds have been introduced as being both safe and powerful, but the extreme danger attending the manufacture, carriage and storage of such compounds have thus far prevented chloratic powders from coming into general use. Nitro-glycerine is formed by the chemical action of certain proportions of nitric and sulphuric acids in combination, on glycerine. The latter is a thick syrup-like looking compound, rather sweet to the taste, obtained chiefly from the fatty substance used in the manufacture of candles and soap. When by the action of the acids named it becomes nitro-glycerine, it is an oily liquid, resembling olive oil with a sweet and rather aromatic taste, but almost inodorous. It is poisonous when taken into the human system, whether by the stomach or absorbed through the pores of the skin Its vapors, when liberated by an explosion, cause violent headache and nausea, if inhaled. It explodes spontaneously if exposed to a temperature of 368° F., and at a lower temperature even, if the heat is applied suddenly. In exploding, nitro-glycerine gives out double the amount of heat generated by ordinary gun powder. It has, therefore, been estimated that, if a volume of powder will give 200 volumes of cold gas, expanded by heat say to four times its original volume, or 800—a volume of nitro-glycerine, giving 1,300 volumes of cold gas, will, when expanded by heat, yield 10,400 volumes.

Its explosive power, therefore, is consequently about 13 times greater than that of ordinary gun powder. Practically, it has been found that the use of nitro-glycerine in its unmixed and liquid state was attended with such extreme danger that a substitute combining the nitro-glycerine with a comparatively safe absorbent has been generally adopted in all countries where its manufacture has been carried on.

The advantages of nitro-glycerine-powder over that of ordinary blasting powder are as follows:

1st. The amount of work which can be performed in a given space in a Mine is quite double.

2d. The consumption of steel in the use of the tools employed to drill the holes is about one-half.

3d. The consumption of hammers for the same reasons is also about one-half less.

4th. The consumption of candles in the time taken to drill the holes is about one-half.

5th. The width of drifts or slopes is about one-half and consequently requires a much less quantity of material to be hoisted from the Mines.

6th. The mine timbers required are much shorter.

7th. The ore is broken much finer by the force of the powder and requires less work at the mill.

8th. Progress of the work in the mine is expedited at least forty per cent. and in wet mines the progress of the work is increased fully fifty per cent. if not more.

The amount of high explosives manufactured in the United States, east of the Rocky Mountains, during the year ending July 1st, 1882 was fully 10,000,000 pounds.

The Repauno Chemical Co., whose extensive works are situated at Thompson's Point, New Jersey and main office at 305 Walnut st. Philadelphia, manufactured of this large total during the above year, nearly three and one-half millions of pounds.

This enormous consumption of high explosives is indicative not only of growth in our mining industries but an appreciable progress in the methods and systems of American mining.

The operations of the Repauno Chemical Co., are illustrative of this growth and progress. The company began active operations in June 1880. From June 1881 to June 1882 they doubled their first year's output, and there is every prospect of their doubling the amount of their present business in the year to come, as the sale of high-explosive compounds is increasing with marvelous rapidity. For instance, a half dozen years ago the construction of a railroad required an army of workmen equipped with picks and shovels; today the men with picks have almost disappeared as the work they performed is now accomplished in a great measure by the use of a low grade of high-explosive. If there is an embankment to remove it is blasted out and the dirt is afterward handled with shovels. In this way it is done much more cheaply and rapidly.

Blasting with a low grade of high explosives does not throw the dirt out but seems to disintregate the entire mass and render the removal of it an easy operation. The simplicity with which "Atlas" powder can be used under such circumstances requires nothing better in the workmen than ordinary intelligence, with that, any embankment or rock-work can be removed with comparative ease and without the slightest danger.

One valuable feature to be considered in connection with a high explosive is its safety in transportation.

"Atlas" powder unlike other compounds of a similar class, seems to unite the qualities of strength and safety in a very great degree. Its composition is made up of certain proportions of nitro-glycerine, nitrate of soda, wood pulp and magnesia. The last named ingredient is used to neutralize any free acid which may possibly exist in the nitro-glycerine after washing and which renders compounds of this class quite dangerous.

The nitrate of soda is received by the Repauno Chemical Co. by the cargo from South America, and delivered at their wharf on the Delaware River in its crude form, where it is stored in commodious buildings prepared for that purpose.

In the process of making powder, it is taken to the drying house where it is placed on large iron pans and subjected to a high degree of heat for the purpose of evaporating the moisture which it may contain. It is then conveyed to large pulverizing mills where it is ground nearly as fine as flour. Then certain proportions of nitrate of soda are combined with sulphuric acid, and upon being exposed to great heat in retorts made for that purpose give forth dense fumes which are condensed in specially adapted receivers, and when so condensed the result is the well known article of commerce called nitric acid.

The nitric acid is then sent to the nitro-glycerine house, where it is combined in certain proportions with sulphuric acid and glycerine, and the chemical combination produced is nitro-glycerine.

At another house wood-pulp, which this Company receives in very large quantities, is thoroughly dried, and that with the nitrate of soda and nitro-glycerine is taken to a building where they are mixed together in certain proportions, and the final result is the high explosive known as "Atlas powder." As a measure of safety as before mentioned a certain proportion of magnesia is added. The reason of this admixture of magnesia is found in the fact that nitro-glycerine even after a thorough washing will at times attach to itself small molecules of what is known as weak acid, and the tendency of magnesia is to neutralize this weak acid and thus prevent decomposition, and thereby remove in a measure a not unusual cause of danger.

In this chemical fact, the presence of free acid in nitro-glycerine compounds, will be found, very frequently, the explanation for so many serious and otherwise unaccountable explosions.

It is manufactured of different degrees of strength which are indicated, as mentioned in the following table:

F +	containing	15	per cent.	nitro-glycerine.
E	"	20	"	"
E +	"	25	"	"
D	"	30	"	"
D +	"	35	"	"
C	"	40	"	"
C +	"	45	"	"
B	"	50	"	"
B +	"	60	"	"
A	"	75	"	"

The powder is made into cartridges, either six or eight inches in length, and from ⅞ to 2 inches in diameter, and is packed in either 25, 50 lb. short and 50 lb. long boxes, the last for convenience in handling, containing the powder in 5 and 10 lb. cartoons placed inside of the wooden boxes.

Of these many grades the greatest demand is for the "C" grade, which is used extensively in the mines of Colorado and New Mexico and in heavy rock-work incident to railroad construction. The lowest grade, "F," can be used to the best advantage in dirt blasting and gravel pits. For submarine work and harbor improvements "A" powder is the most suitable. "Atlas" powder and compounds of this class have entirely superseded what is technically known as Dynamite. The former contains nitrate of soda as an absorbent, which gives it an additional explosive force, while in the latter the absorbent is composed of an inert matter, and the force exerted is simply that of the nitro-glycerine. To the ordinary reader it may seem strange to say that soda possesses inherent explosive power, but he may realize that such is the fact, when it is remembered that that chemical enters largely into the composition of ordinary gunpowder. Table sugar also contains a strong explosive force which is nearly as great as that of gunpowder, if confined and exploded by a detonating cap. As we have had occasion to before remark, the extreme care taken in the manufacture of "Atlas" powder by the Repauno Chemical Co., has been so marked and the adherence to the standard adopted by them so absolute, that the railroad companies have granted them special privileges in the way of transportation.

Their compound is so prepared, that it can be transported and stored in almost any climate without danger of premature explosion or deterioration in strength.

Some of the powder which they manufactured when their works were first started, is now stored in one of their magazines, and upon recent examination was found to be in its original state and fully as effective when used in blasting, as when it was first compounded.

Above we have called attention to the important interest so closely allied with the mining industries of this country, as exemplified in the product of the Repauno Chemical Co. There is no doubt that "Atlas" powder is as safe as ordinary blasting powder, and if the holes are placed with judgment, it will do several times the work of ordinary powder. But in a great many mines, almost a new generation of miners will be needed before "Atlas" powder will be able to perform all the work of which it is capable. It has often been found, that men if not watched, will persist in drilling holes just as they did before high explosives were used, and consequently bring no more rock down with a charge than they did with the ordinary system of powder blasting.

This is particularly the case in English mines. To obviate it, the plan has been adopted in many American mines, of appointing one or more intelligent foremen to direct where the holes are to be drilled and to explode them. When the holes are deep enough the drills are removed to another part of the mine for similar work; the drillers being paid per foot for drilling. The foreman then charges the holes and fires the blast. Then the drillers return and remove the débris, and the process is repeated.

In addition, we desire to briefly call the reader's attention to some of the apparatus furnished by the same company, for the proper and successful explosion of their compound. Of the utmost importance to the miner and operator, is the necessity of being provided with the best electrical goods which the market will produce. Unlike ordinary gunpowder, nitro-glycerine compounds can only be exploded by a a detonating cap, fired either by the insertion in it of a piece of safety fuse, or by an electrical current generated by machines constructed for that purpose. This company sells a blasting machine eminently adapted for that purpose. It is light in weight, consequently portable, and certain in its results. For use with this, magneto-battery, as it is called, are platinum fuses, which are constructed with great care and sold in enormous quantities for that purpose.

Many miners still adhere to the old custom of firing by fuse and blasting caps. These goods are also kept in stock by the Repauno Chemical Co. The success attending the use of platinum fuses, and *Magneto* blasting machines is very marked, and their use has rendered the operation of sinking a shaft, tunnelling a hill, and removing obstructions under water an exceedingly simple and safe task.

One great advantage in having a business connection with this company is that its product and accessories can be obtained of responsible agents in all sections of the country. To all of our readers, therefore, in view of the foregoing facts, we can conscientiously and cordially recommend "Atlas" powder for all mining purposes where an explosive of that character is needed.

A MINING PROPERTY.

THE mining property and mines owned and operated by the Humboldt Mining Co., of Engle, Socorro County, New Mexico, are the most prominent in the several localities in which they are situated. They were secured at a period in the history of that territory when choice of localities was to be had. Col. Branson, now President of the Company, and his associates took advantage of the scare that was occasioned by the Apache raid in the summer of 1881, when almost everyone was fleeing from the mining districts, visited the most important points and secured those properties they thought desirable, in the Cuchillo Negro, upper Caballo, lower Caballo, and San Andreas Mountains.

The three first named are located west of the Atchison, Topeka & Santa Fe Railroad in Socorro County and the latter about twenty miles east in latitude 33° on the line dividing Socorro and Dona Ana counties.

What is popularly known as the Black Range, are really the Miembres, the real Black Range or Negreta Mountain being known as the Cuchillo Negro, after a chief of that name, signifying Black Knife. On leaving the railroad at Engle, and facing west, one cannot see the Cuchillo Negro Mountains through the space between the southern end of the San Christobals and the northern end of the Caballos, but the Miembres looms up 40 miles away, black with its covering of evergreens, hence the *misnomer* by the rush of new prospectors in 1881. The company's mines are located as follows: Two on Mount Hancock called, "Gift" and "Garfield," four on Mt. Garfield called "Little Luella," "John G. B.," "Providence," and "Sunny Side," two in Mount Arthur called "Little Hope," and "Reward," and two on the foot hills east of Mt. Garfield called Lookout and Telegraph, at an altitude of about 6,500 feet above sea level. These are all within a few miles of the towns of Grafton, Chloride, Robinson and Fairview.

Shafts have been sunk on all these properties from ten to fifty feet in depth and a tunnel in the "Little Luella" 140 feet that will cross cut when extended all the veins and carbonate deposits in Mount Garfield. The character of the ores in this region are argentiferous galena, lead carbonates carrying silver, goldbearing quartz, and carbonates of copper. A sufficient quantity of fluor spar and limestone is found in combination to make flux for such of these ores as require smelting. Many of them are free milling ores, and can be worked very cheaply, there being abundance of fine timber and water in the immediate vicinity. The ores of this region are mostly high grade.

The developments made are with a view to permanent work in the most economical and productive manner. It is confidently believed by all those capable of forming an opinion that at about two hundred feet the ores in this district will prove to be very rich; assays of $126 to the ton were made of ores taken a few feet from the surface, and it is expected when the tunnel now being driven reaches the same vein that they will be of greatly increased value.

A branch railroad has been twice surveyed, and is about to be built, that will connect this region with the A. T. & S. F. R. R. at Engle.

The Caballo Mountains are east of the Rio Grande, which flows at their base.

In the Upper Caballo near Palomas Gap are located five claims called California, Nevada, Gift, Grammis and Terry.

Shafts have been sunk in all these claims, and the Grammis has been developed by a tunnel of about ninety feet, the entire distance in mineral of varying richness. A great variety of ores are found in these properties, which are only fifteen miles distant from Engle. Veins of good coal have been found within a few miles of this camp. In the Grammis tunnel, gold, silver, copper carbonates, free copper and lead have been found.

In the Lower Caballo the Company own five claims, called "Golden Fleece," "First Extension North," "First Extension South," "Ella," and "Frank W." These claims are all continuous and are located about one mile from the river. The Golden Fleece lode is remarkable for its prominence; it can be clearly traced for miles as a prominent feature in the landscape as it crops from two to thirty feet above the surface, varying in width from four to seven feet. the vein matter is fluor spar and quartz filled through with argentiferous galena. It resembles the celebrated Comstock, and is most favorably located, with plenty of timber and only one mile from the river, with a ranche adjoining that is capable of raising all necessary provisions, and is fifteen miles distant from the A. T. & S. F. R. R. Several shafts have been sunk, the deepest ninety feet, on this vein, which is nearly perpendicular, the mineral increasing in richness as depth is attained. It is the purpose of the Company to drive this shaft to a depth of 300 feet.

The Rio Grande is here about 4,500 feet above sea level, and has an average descent of five feet per mile, rendering easy the construction of irrigating ditches, a pipe line or other water power. These mines are from 200 to 700 feet above the river.

In the San Andreas Mountain 25 miles east of the A. T. & S. F. R. R., six miles from the proposed line of El Paso and White Oaks R. R., soon to be constructed along the eastern slope of this range, the Company secured twelve very desirable claims named Leviathan, Kahler, Cincinnati, Chrysolite, Chloride, Adriatic, Corbit, Hembrillo No. 1, Hembrillo No. 3, Timbuctoo No. 1, Timbuctoo Discovery, Morocco, and four mill sites at Hembrillo, "Cottonwood," Sulphur and Cincinnati Springs, the latter in a secluded gorge near the claim in connection with which it is located, and also within one-half mile of the Kahler mine, which mine has been opened to a depth of 70 feet, and shows large amounts of pay ore. The Adriatic at a depth of only 10 feet assays well in silver, gold and lead. The Chrysolite shows higher grade carbonates and quantities of beautiful Fluor Spar filled with galena but the lead on which the Morocco, Timbuctoo and Hembrillo claims are continuous is evidently the one that is destined to make the greatest return in that locality. It is clearly defined two feet wide at the surface, five feet at 15 feet deep, and steadily increasing in width and richness. A large per centage of lead, fair return of silver, and with every necessary flux, water, timber, and coal not far off makes it a very cheap mineral district to work.

Between these mountains and the Organs on the east, and the San Christobals and Caballos on the west, 5,000 feet above the level of the sea, lies the Jornada del Muerto, or Journey of Death, an apparently barren plain 100 miles from north to south and 40 miles from east to west, which, on examination, proves to have several lakes in it, except in very dry seasons, and many thousands of acres of good pasturage, over which range herds of antelope and other deer, and now the cattle of the enterprising herdsmen. It is much cut up by ravines, and while in some portions large marine deposits are found, on others beds of lava cover the ground.

The A. T. & S. F. R. R. traverses its entire length, and at Engle station, near its centre, is the head-quarters of the Humboldt and other mining companies, only four days' ride from Philadelphia, and one day's drive from any of their mines.

The general development of this country has been very rapid since the advent of the Atchison, Topeka & Santa Fé R. R., which will soon be the direct route from London to Australia, *via* steamer from Guaymas, Mexico, to Sidney, thus avoiding the Suez Canal and "Arabi," and saving several days in the trip.

New Mexico contains more miles of R. R. than any one of the New England States, all built during the past three years, with many hundred more miles projected.

The mineral veins of this territory are much nearer the surface and its mountain ranges not so high as in other mining regions, hence pay ore is much easier reached.

The climate is dry and healthy, warm days and cool nights the seldom varying rule. Work out doors is carried on every day in the year.

No Spanish, Mexican or other land grants mar the titles or embarrass the work of this company as is unfortunately the case in so great a portion of this rich territory.

The policy of the company is to concentrate most of their efforts and expenditures on one of the groups which is most likely to prove speedily remunerative, and as soon as it becomes so, then to push developments on another, and so continue until as many as can be profitably worked under one management are in full production; the surplus property to be partially developed from time to time, and sold for the benefit of the Company treasury.

ENGINEERING AND OTHER INSTRUMENTS OF PRECISION.

THE instrumental work required by engineers, more especially for use in mining interests, where the results of scientific knowledge and skill must be accurate underground, as well as on the surface, is more varied and numerous to-day, than a few years ago. Now, the question of transportation must be considered as well as the question of precise results, and the most perfect and delicate instruments are necessitated; from this necessity has arisen the extraordinary progress made in this country in the production of the various scientific appliances, and we are now in advance of Europe in perfection of instruments of precision. In the early history of Philadelphia are found the names of Godfrey, inventor of the quadrant; Franklin, Fitch, Evans, and other skillful mechanics, engaged in the invention and construction of scientific instruments; Rittenhouse made the first telescope in this country, and in the museums of the American Philosophical Society and Franklin Institute may be seen models of works showing the highest mechanical and mathematical genius, serving as incentives in improvements by the later generations. That worthy successors of those time-honored mechanics continued among us, to add to the scientific wealth and reputation of Philadelphia and this country, by their constructive skill, has an interesting and valuable illustration in the productions of the house of Young and Sons, 43 North Seventh St. This firm is the oldest, largest, and most widely-known manufacturers of the finer kinds of mathematical, astronomical, and civil-engineering instruments in the United States. The business has continued in the same family for three generations, the founder being the late William J. Young, who established the works in 1820, and carried it on for 50 years, when at his death in 1870, the business passed to his son, Alfred Young, the latter being succeeded at his death in March, 1882, by his son, Alfred C. Young, who now conducts it, assisted by valuable skilled mechanics, one of whom has been connected with the house for forty-three years. William J. Young invented the transit instrument in 1831, a long stride in the improvement of engineering appliances, and that it retains to-day its almost identical first form, proves the value of its introduction and the good judgment of the inventor. The English Theodolite, capable of performing the same work, was not in favor with the earlier American engineers, its workings being slow and inconvenient, and its use attended with many discomforts, although many English engineers cling to it to this day. From the theodolite the change was to the magnetic compass, made to read full circle angles, independent of needle; it did close work, and while valuable for speed in preliminary "runs" of railroads and surveying, it was too uncertain for location, the needle producing too much trouble by "playing." The transit made by Mr. Young was graduated to read by vernier to three minutes, it being a favorite idea of the inventor that graduations of three minutes could be easily read to one minute, and be less perplexing to use; the needle was about five inches, the telescope nine inches, of low power; the standards of almost the identical pattern now used by some makers. For whom the first transit was made is not positively known, engineers claiming its use on the State works of Pennsylvania, as also on the Baltimore and Ohio Railroad. About one year ago, one of Mr. Young's transits was sent into his factory for *repairs*, having been *forty years* in service, a greater part of the time in the hands of assistants and in rough wooded country. Messrs. Youngs' *Mining Transits* differ from ordinary ones, principally in being of smaller size for greater portability, in having telescopes admitting more light and completely enclosed, having a greater range of vertical angle, in the vernier and needle being more accessible to read, improved vernier, giving greater accuracy of readings, and its position to one side of the standards very preferable where the engineer is working in confined situations; a GRADENTIER ATTACHMENT measures (where the grade is not too steep) the inclination with *accuracy and speed*, besides distances and differences of level. Messrs. Youngs lately built a GRADUATING ENGINE costing $7,000, and four years were occupied by three of their best workmen in testing and correcting it, that it might be, as intended, a manual of precise scientific mechanism, and enable them to guarantee their astronomical instruments as the finest work of the class produced in this country, and equal to the best European work; instruments with circles as large as forty-four inches can be graduated on their engines. In their line of manufactures Young & Sons admittedly lead the trade in the United States, and with confidence in their superiority, can request the attention of colleges, institutions of learning, civil and mining engineers, and private parties to their facilities and ability to produce perfect work in their specialties. They solicit correspondence and will be pleased to mail their manual and catalogue on application.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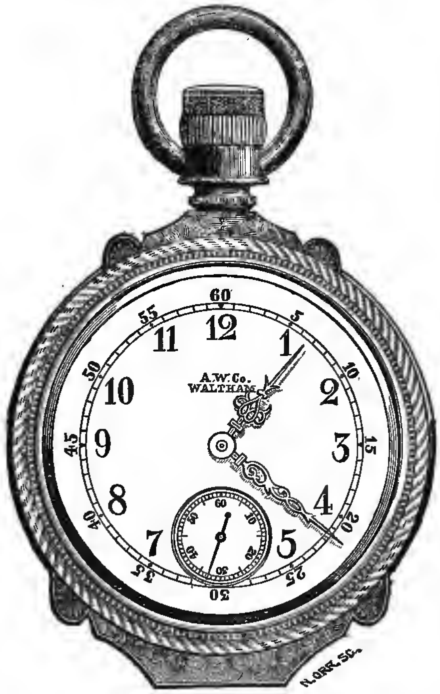
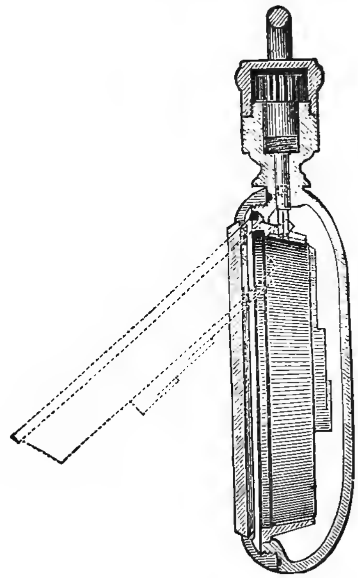
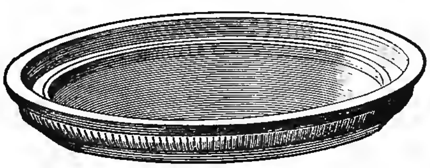


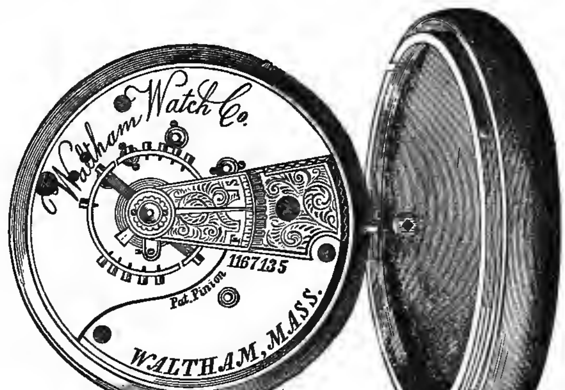


THE continuous construction of the body of this case avoids the opening of the watch in the back, does away with the interior cap, and greatly conduces to the strength of the case.

The movement is hinged to the case in a dust-proof ring of great strength.

The watch winds by the crown which must be screwed back upon the pendant socket, thus guarding the watch against dust at this part





The Bezel into which the crystal is cemented, is attached to the case by screwing it thereon ; the ring of the bezel is formed with an internal screw-thread which meshes with a corresponding thread on the shouldered rim on the face of the case; and as the Bezel is thus tightly screwed down the level-edge of the rim, forms the airtight joint with the shouldered rim of the case, which is thus proof against the entrance of dust.

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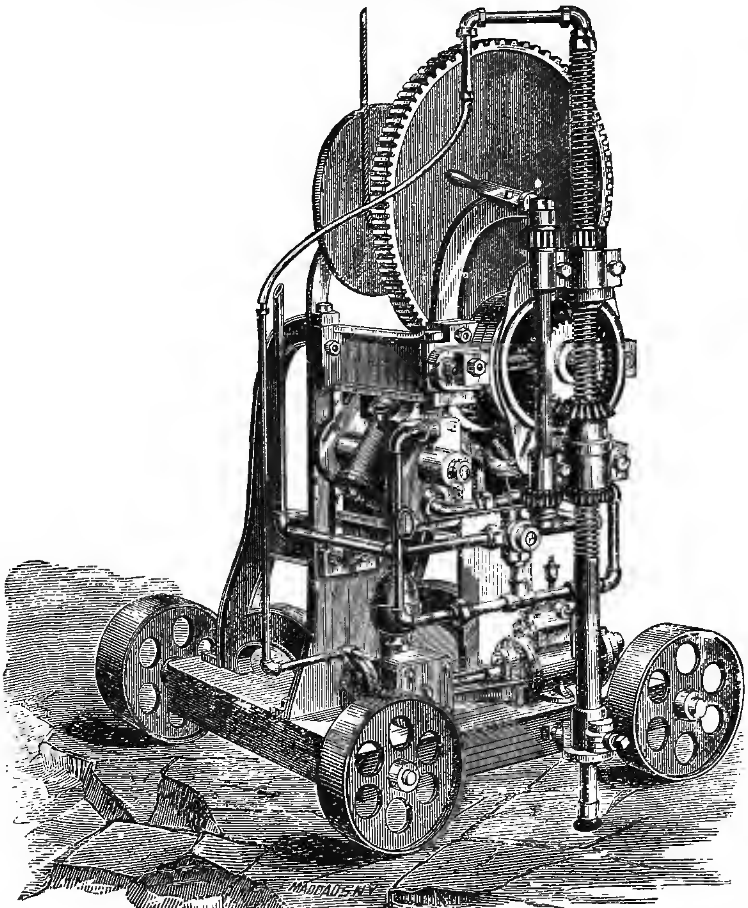

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